Plenary 1: Friedlander Memorial Lecture

Optical Trapping for Aerosol Science and Applications: Advances and Perspectives. CHUJI WANG, *Mississippi State University*

Optical trapping (OT) has evolved significantly over the past few decades, transforming from the early optical tweezers approach—using a single, tightly focused laser beam to levitate dielectric or absorbing micron-sized spheres—into a versatile technique capable of trapping, manipulating, and studying single aerosols without using a substrate. Among recent developments in OT, the Universal Optical Trap (UOT) has demonstrated to be a powerful tool, capable of stably confining single particles of arbitrary chemical and physical properties, including variations in size, morphology, optical absorbance, and material composition, in diverse trapping media such as solutions, gases, and plasmas, under both atmospheric and reduced-pressure conditions. This capability has enabled in-depth investigations of a wide variety of aerosols, including droplets, solid particles, complex organic-inorganic mixtures, chemical and bioaerosols, sea-spray particles, and interplanetary dust particles.

A major breakthrough in optical trapping research has been the integration of an optical trap with advanced laser spectroscopic methods, allowing for near-real-time, in situ, single-particle study. This plenary talk will highlight the latest advances in optical trapping-cavity ringdown spectroscopy, optical trapping-Raman spectroscopy, and optical trapping-elastic light scattering, which have been applied to characterize aerosol physical, chemical, optical, and surface properties and studying aerosol formation and growth, hygroscopicity, phase transitions, photochemical and aging processes, heterogeneous chemical reactions, and surface chemistry. Recent studies using these techniques have revealed time- and structure-dependent fundamental processes occurring in single aerosols levitated in controlled reactive environments.

Building on these capabilities, I will explore the potential for developing single-aerosol spectrometers, a next-generation tool that could provide high-temporal and spatial resolution chemical characterization of individual airborne particles. These instruments would allow time- and space-resolved studies of aerosol surface chemistry and transient processes. While ensemble-based measurements provide bulk properties of aerosols, single-particle studies offer a unique and complementary perspective by capturing intrinsic heterogeneity, transient processes, and microphysical transformations that are often masked in averaged ensemble data. Such tools could bridge single aerosol studies and aerosol ensemble measurements, significantly advancing our understanding and modeling of aerosol behavior in the native atmospheric state (e.g., freely suspended in the atmosphere) and environmental contexts. As optical trapping continues to evolve, especially in combination with other techniques, its applications will extend beyond aerosol science into environmental monitoring and sensing, material synthesis, biomedical research, planetary science, and more, positioning it as a cornerstone technique for single-particle studies across a wide range of disciplines.

Plenary 2: Lundgren-Marple Lecture

Aerosol Transport Phenomena: A Tale of Two Knudsen Numbers. CHRISTOPHER J. HOGAN, *University of Minnesota*

While aerosol research draws on fundamental principles from physics, chemistry, and engineering, there are several unique features in aerosol transport phenomena that make aerosol science a distinct discipline in its own right. This presentation will attempt to overview the development of aerosol science's uniqueness through an understanding of Knudsen numbers. First, I will provide an overview of the momentum transfer, or 'gas-phase,' Knudsen number, which governs the slip correction factor as well as the drag and diffusion of particles. This will include recent developments in modeling the slip correction factor for non-spherical particles, particles traveling at transonic to supersonic speeds, and nanometer-scale clusters where vapor molecules sorb and desorb during migration. Second, I will discuss the diffusive Knudsen number, which governs rates of condensation, coagulation, and particle charging. This discussion will begin with Fuchs's limiting sphere theory and explore how it can be coupled with atomistic simulations to precisely characterize aerosol growth, charging, and heat transfer rates. The presentation will conclude with a discussion of outstanding questions in aerosol transport phenomena and potential pathways for introducing aerosol science to a broader audience.

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Plenary 3: AEESP Lecture

US and Global Aerosol Speciation Monitoring Networks: Successes and Opportunities. ANN M. DILLNER, *University of California, Davis*

Aerosol monitoring networks are foundational to understanding air quality and its impact on people and the planet. The United States boasts two long-term, filter-based aerosol speciation networks: the Interagency Monitoring of PROtected Visual Environments (IMPROVE) network, which has ~150 monitoring sites in pristine locations and launched in 1989, and the Chemical Speciation Network (CSN), which has ~130 urban and suburban sites and started sampling in 2000. More recently, the US began supporting two international particle speciation monitoring networks: the Surface PARTiculate mAtter Network (SPARTAN) and the Multi-Angle Imager for Aerosols (MAIA) satellite mission, which together have ~35 urban sites globally. Finally, in 2024, the Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT) started real-time sampling at twelve US urban and rural sites using high-time-resolution instruments to measure aerosol speciation and particle size distributions.

In this presentation, I will highlight the value of particle speciation monitoring networks, the challenges in maintaining consistency over time, and the opportunities that real-time, high-time-resolution data provides. I will illustrate the value of long-term IMPROVE and CSN data for tracking trends in composition due to regulations and other factors, validating atmospheric models, and providing historical context for field campaigns and major pollution events. I will also discuss efforts by SPARTAN and MAIA to provide speciated aerosol data at international sites where aerosol monitoring is sparse but health impacts are high. Finally, I will describe the opportunities provided by ASCENT's real-time, high-time-resolution monitoring, such as the rapid release of data following the January 2025 Los Angeles wildfires.

Plenary 4

At a Crossroads in the Sky: Tackling Aerosols, Contrails, and a Sustainable Future for Aviation. RICHARD MOORE, *NASA*

If the global aviation sector were a country, it would be one of the top ten carbon dioxide emitters, and yet, models tell us that aircraft CO_2 is not even the biggest aviation climate impact today. Line-shaped contrails and the cirrus clouds that result from them are thought to have a greater radiative forcing than all of the accumulated aviation CO_2 emitted since the Wright Brothers' first flights. Despite this importance, the model representation of contrail-cirrus remains highly uncertain, which is due in part to a lack of observational data at cruise altitudes. In addition, aircraft emissions impact local air quality on the ground near airports. Sustainable aviation fuels (SAF) and advanced lean-burn aircraft engines are promising solutions toward reducing aircraft engine particle emissions that drive these air quality and climate effects. Hydrogen-fueled aircraft also seem, at first glance, to be an attractive option for eliminating the soot particles seeding contrails; although, new particle formation and gas-to-particle conversion of semi-volatile lubrication oil emissions downstream of the gas turbines may compensate for the hard won gains in removing the soot coming from the combustor. Last, there are open questions about how aviation aerosols may interact with natural cirrus clouds and also emerging regulatory interest in optimizing flight trajectories to avoid the ice supersaturated regions of the atmosphere where contrail cirrus form and persist. Developing a coherent engineering and/or policy response requires a clear understanding of these aerosol science and aerosol-cloud interactions processes. This presentation highlights the current state of the science and key research gaps that need to be addressed to ensure a sustainable and robust future for aviation as a critical economic and societal benefit.

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1AC.1

Applying Single Particle Levitation to Explore the Properties of Aqueous Brown Carbon Aerosol. PRAKRITI SINGH, Erin Bowey, James F. Davies, Paula K. Hudson, *University of California, Riverside*

Atmospheric aerosols influence air quality, climate, and cloud formation, with brown carbon (BrC) playing a key role due to its ability to absorb solar radiation at visible wavelengths (<450 nm). While BrC is commonly emitted from biomass burning, it can also form through aqueous-phase reactions of water-soluble organic and nitrogen-containing compounds in cloud droplets.

In this work, we investigate the formation of aqueous BrC by reacting methylglyoxal (MeGX) with glycine in bulk solution; mixtures with 1:1, 1:2, and 2:1 molar ratio were aged over 21 days, showing increasing browning and formation of light-absorbing chromophores. Individual droplets from both fresh and aged solutions were levitated in a linear quadrupole electrodynamic balance (LQ-EDB) to measure hygroscopic growth and phase behavior as a function of relative humidity. Preliminary results show that the 1:2 and 2:1 mixtures exhibit increasing hygroscopic growth with aging, while the 1:1 mixture shows no clear trend. The 1:1 droplet appear to form a viscous phase at low RH and do not effloresce, which may limit water loss at lower RH. Additionally, evaporation measurements revealed that pure MeGX droplets evaporate rapidly, but when mixed with glycine, this volatility is suppressed. Ongoing work aims to determine the threshold composition at which MeGX will show its evaporative behavior within the mixture. Overall, these results show that the properties of BrC can change depending on precursor ratios and aging which could affect how these particles behave in the atmosphere.

1AC.2

Probing the Role of Intermolecular Interactions in the Light Absorption of Biomass Burning Organic Aerosol. Colton Calvert, Holly Anthony, Ahmadraza Chaudhary, Micah Miles, ELIJAH SCHNITZLER, *Oklahoma State University*

Light-absorbing components of biomass burning organic aerosol (BBOA), or brown carbon, influence air quality, visibility, and climate. Here, we explore the hypothesis that organic electron donor and acceptor species among the components of BBOA can participate in intermolecular interactions to form noncovalent complexes, which may contribute to the total light absorption of this material through charge-transfer. The candidate electron donors and acceptors considered here are methoxyphenols and quinones. Methoxyphenols are one of the most abundant classes of compounds emitted from biomass burning, i.e., from the thermal degradation of lignin. Quinones can form from the gas-phase oxidation of aromatic precursors; for example, naphthalene leads to naphthoquinone. The interactions between representative methoxyphenols (e.g., guaiacol, eugenol, vanillin, and others), both individually and in mixtures, and quinones (i.e., benzoquinone and naphthoquinone) were explored in bulk solutions, thin films, and levitated microdroplets. In bulk solutions, evidence for noncovalent complexes included enhanced light absorption that was greater than expected from the sum of the individual species as well as a reversible decrease in the absorption with increasing temperature, consistent with dissociation. In thin films, enhanced light absorption occurred upon uptake of benzoquinone from the gas phase to the condensed phase of pure and mixed methoxyphenols. The light absorption at the center of the thin films increased sigmoidally over the course of 24 h, characteristic of diffusion of benzoquinone through the thin films from the edge, where the benzoquinone exposure occurs. In levitated droplets, enhanced light absorption upon exposure to subliming benzoquinone was similarly observed, but it occurred much more rapidly, as the timescale required for diffusion within the microdroplets is orders of magnitude shorter than that required for diffusion in the thin films. Together, these results provide insights into the potential occurrence and role of organic non-covalent complexes in BBOA.

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1AC.3

Volatility-Resolved In-Situ Chemical and Optical Characterization of Brown Carbon as a Function of Atmospheric Aging Using Advanced Chemical Ionization Mass Spectrometry with Aerosol Evaporation Technique. JIAYUN ZHAO, Mingsheng Fang, Guoyang Lei, Raghu Betha, Garrett McKay, Yue Zhang, *Texas A&M University*

Brown carbon (BrC), primarily attributed to biomass burning, significantly absorbs sunlight and influences climate forcing. However, the chemical composition, volatility distribution, and optical characteristics of BrC remain inadequately quantified during atmospheric aging, making it challenging to model its impact on climate.

In this study, BrC aerosols generated from Spanish moss or firewood (a mixture of oak, maple, cherry, black alder, birch, ash, and beech) were subjected to photochemical aging in a potential aerosol mass oxidative flow reactor (PAM-OFR). A comprehensive suite of online instruments, including the Vocus AIM reactor in I^- mode coupled with a vaporization inlet for aerosols (VIA-AIM), aerosol mass spectrometry (AMS), and an aethalometer (AE43).

The volatility calibration of the VIA was performed using polyethylene glycol standards, establishing a calibration curve spanning over 10^{-10} to 10^{1} μg m^{-3} of effective saturation vapor pressure (C^*). Sensitivity calibration of the Vocus AIM reactor with a liquid calibration system (LCS) and four BrC standards yielded an average response of 6.3 ± 4.5 ncps ppt^{-1}, supporting quantitative, volatility-resolved chemical composition measurements. The Ångström exponent and mass absorption cross-section calculated from AE43 data categorized the BrC samples into moderately absorptive BrC. Detailed optical property measurement suggest that ozone (O_3) exposures caused oxidative bleaching, while hydroxyl radical (OH) exposures darkened BrC, where the volatility and chemical composition of the BrC varied significantly.

This comprehensive online chemical and optical measurement demonstrate that the chemical composition and volatility impact the light absorption properties of BrC, providing molecular-level parameterizations of BrC during atmospheric processing. The results provide comprehensive properties of BrC during its atmospheric aging processes, which helps further constrain the climate properties in climate models.

1AC.4

Concentration-Dependent Photochemical Evolution of Primary Brown Carbon under Irradiation. SITHUMI LIYANAGE, Colton Calvert, Holly Anthony, Elijah Schnitzler, *Oklahoma State University*

Brown carbon (BrC) components of biomass burning organic aerosol (BBOA) influence climate directly, by absorbing and scattering solar radiation, and indirectly, by enhancing cloud formation. The absorption of solar radiation contributes to warming, but the extent of this effect depends on the optical properties of the aerosol, which can vary throughout its atmospheric residence time. Primary BrC undergoes various atmospheric aging processes through irradiation and oxidation that can alter its chemical and optical properties. Overall, this aging generally leads to the whitening of organic aerosols; however, irradiation can also lead to an initial increase in the visible light absorption of BrC species. Here, we address this variability for light-driven processing by examining the evolution of primary BrC optical properties under irradiation while varying the initial concentration of BrC to modulate between these two scenarios. BrC aerosol was generated from eastern red cedar sapwood, and prepared across a range of concentrations from thin films to diluted solutions. Samples were exposed to irradiation, from above, in a solar simulator. Importantly, all samples appeared the same color from above, using sample thicknesses inversely proportional to mass concentration, such that the number of photons absorbed at time zero was the same for all samples. The resulting changes in light absorption were monitored in terms of UV-Vis absorbance at regular intervals. Results indicate that higher concentrations of BrC favor an initial darkening followed by a gradual whitening, while lower concentrations favor a uniform whitening. Changes in physicochemical properties (i.e., viscosity) are explored in terms of reactive uptake of ozone. These results emphasize the significance of concentration in the atmospheric lifetime and optical evolution of BrC, which has consequences for modeling its impact on climate change and visibility.

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1AC.5

Superoxide Burst upon Photochemical Aging of Secondary Organic Aerosols Derived from Biomass Burning Precursors.

LENA GERRITZ, Meredith Schervish, Sergey Nizkorodov, Manabu Shiraiwa, *University of California, Irvine*

Biomass burning is a major source of particulate matter and volatile organic compounds (VOCs) that can be oxidized to form secondary organic aerosols (SOA), contributing to climate, air quality, and public health. The mechanisms of photochemical aging and its effects on particle toxicity are poorly understood. This work offers insight into the radical chemistry occurring during photochemical aging of secondary organic aerosols derived from precursors emitted during biomass burning events (BBSOA). Radicals are detected in-situ over the course of irradiation using electron paramagnetic resonance spectroscopy (EPR) with a spin trapping compound and trapped organic radicals are identified using high resolution mass spectroscopy. The EPR results revealed substantial superoxide (O_2-•) formation, upon irradiation of BBSOA for all selected precursors with yields between 0.05-0.3%. Superoxide radical has important implications for atmospheric oxidation and particle toxicity due to its oxidative potential and its ability to interconvert with other reactive oxygen species (ROS) including hydroxyl radical and hydrogen peroxide. However, the BBSOA from aromatic precursors (phenol, guaiacylacetone, and styrene) exhibited a rapid burst of O_2-• that decayed within 2 minutes, while the monoterpene derived BBSOA (α-pinene, α-terpineol, and β-ocimene) formed O_2-• more gradually, peaking around 5 minutes, and furfural BBSOA peaked around 10 minutes of irradiation. The differences in the formation of O_2-• were further evaluated using a kinetic model that suggested the initial burst observed in aromatic SOA was the result of a direct reaction between photosensitizers and dissolved oxygen, while the more gradual formation observed for the non-aromatic SOA was attributed to the decomposition of peroxides. Organic radicals identified using mass spectrometry were consistent with decomposition of chromophores like carbonyls in non-aromatic BBSOA, while potential photosensitizers were identified in phenol SOA. We also quantified the increase in H_2O_2 after irradiation and found that these photochemical processes are an important source of condensed phase ROS with important implications for particle toxicity and atmospheric aging. Elucidating these mechanisms of superoxide formation during photochemical aging provides crucial insight into the oxidant budget for largescale atmospheric models and health implications of aging.

1AC.6

Significant Photoproduction of Singlet Oxygen from Aqueous Extracts of Biomass-Burning Aerosol.

DANIEL BONOMO, Ryan Sullivan, *Carnegie Mellon University*

Biomass-burning aerosol (BBA) is the gases and particles produced by the incineration of living and dead vegetation. The aqueous aerosol phase can contain a large amount of dissolved organic matter. This chromophoric organic carbon has a dynamic atmospheric lifecycle where more brown carbon is produced as the smoke plume evolves, and then becomes lost, presumably due to oxidation and photo-bleaching. Due to their large quantities of brown carbon, biomass-burning aerosols can generate oxidants through photosensitization, including the reactive oxygen species singlet oxygen ($^1O_2$). By generating $^1O_2$, chromophoric biomass-burning aerosol can contribute to the pool of aerosol-phase reactants, the oxidation of atmospheric contaminants, as well as its own photo-bleaching of brown carbon.

Our research group quantified these contributions by measuring the quantum yield of $^1O_2$ in the dissolved organic matter (DOM) aqueous fraction extracted from authentic biomass-burning aerosol collected from flaming-phase combustion of different fuels. The production of $^1O_2$ by these aqueous extracts during exposure to UVA light was measured by loss of the molecular probe furfuryl alcohol. The steady-state concentration and quantum yield of $^1O_2$ were determined for BBA from different fuels collected during flaming and smoldering combustion.

The results show that aqueous extracts of BBA produce significant amounts of $^1O_2$ during UVA illumination. Quantum yields of $^1O_2$ ranged between 1.2-3.4%, with different $^1O_2$ yields from biomass-burning aerosol of different fuels. Steady-state concentrations of $^1O_2$ were on the order of 10^{-13} M, similar to aquatic dissolved organic matter, a major source of $^1O_2$ in the aquatic environment. $^1O_2$ production was also observed to change during UVA exposure, indicating that photo-induced changes to biomass-burning aerosol can alter its photosensitization properties, and drive its own photo-bleaching. These results suggest that photosensitization of brown carbon from biomass-burning is an important source of aerosol-phase oxidants and contributes to the dynamic lifecycle of brown carbon.

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1AC.7

A Missing Pool of Particle Photooxidants: Photochemistry of Water-Insoluble Chromophores from Wildfire Smoke Particles. LAURA MARIE DAHLER HEINLEIN, Sydney Ma, Murat Onder, Monika Madhiyan, Mingsheng Fang, Jiayun Zhao, Yue Zhang, Kyle Moore, Cort Anastasio, *University of California, Davis*

Wildfire smoke particles are rich in brown carbon (BrC), organic molecules that can absorb light to form photooxidants like triplet excited states (3C*) and singlet molecular oxygen (1O2*). In particles, 3C* can form secondary organic aerosol (SOA) and secondary BrC, alter particle viscosity, and produce secondary oxidants like 1O2* and hydroxyl radical which drive additional multiphase chemical processing. Most measurements of 3C* and 1O2* are limited to BrC filter samples extracted into water, but because only 40% of organic carbon is water soluble, these studies neglect water-insoluble BrC as a potential photooxidant source. In this work, we adapt widely used water-based probe methods for measuring 3C* and 1O2* concentrations to target photooxidant generation from the mostly ignored pool of water-insoluble BrC. We report the first measurements of 3C* and 1O2* concentrations from water-insoluble BrC from wildfire smoke particles. We compare photooxidant generation in aqueous and organic phases by comparing steady-state concentrations, production rates, quantum yields, and rate constants of 3C* and 1O2* with important SOA precursors. We observe rapid decay of phenolic SOA precursors in organic solvents with 3C* and 1O2* photosensitizers. We also find that 1O2* photochemistry is distinct in the organic phase: high O2 concentrations and slow 1O2* deactivation rates suggest 1O2* concentrations may be roughly 10-times higher in an organic phase compared to the aqueous phase. Overall, we demonstrate that current estimates of 3C* and 1O2* concentrations neglect water-insoluble BrC as an important source of photooxidants. Moreover, we challenge the assumption that BrC photochemistry is limited to aqueous aerosols and suggest that BrC photooxidants may drive chemical processing in organic phases in the atmosphere.

1AE.1

Sustainable Aviation Fuels (SAFs): Comparative Characterization of Combustion Emissions using a Novel Aviation Fuel Combustor. ONYINYE A. EZEIFEKA, Yevgen Nazarenko, *University of Cincinnati*

The urgent need to reduce aviation's environmental footprint has accelerated the transition to Sustainable Aviation Fuels (SAFs[YN1]). As this transition is occurring, understanding the complete emissions profile of SAFs and the associated health implications is essential. While extensive research has focused on SAFs' carbon reduction potential and engine performance, the detailed characterization of the organic pollutant emissions with exhaust of aircraft engines burning SAFs and the occupational health implications for aviation workers exposed to these emissions remains largely unexplored. This study examines the organic pollutant composition of SAF emissions from aircraft engines and evaluates potential occupational health risks to aviation workers. This study employs a high-pressure jet fuel combustor that simulates aircraft engine combustion conditions. The combustor enables precise replication of in-engine combustion while overcoming the logistical and safety constraints of full-scale aircraft engine operation. The reference fuels are SAFs that represent diverse chemical production pathways that are currently accepted and available in the market: ATJ-SPK (Alcohol-to-Jet Synthetic Paraffinic Kerosene) and FT-SPK (Fischer-Tropsch Synthetic Paraffinic Kerosene). Exhaust sampling is performed using a spatially averaged 3-prong collector probe and the Series 110B Spot Sampler™ aerosol particle collector. Particle size distribution of nanoparticles and fine particles are measured in real time using a Fast Mobility Particle Sizer (FMPS). The TRACE GC Ultra, Gas Chromatographer-Mass Spectrophotometer (GC-MS) and Beckman Coulter System Gold 126 solvent module High-Performance Liquid Chromatography (HPLC) are used to separate the individual gaseous compounds in the mix of VOCs and non-volatile organic compounds within complex mixtures of air pollutant blends to determine the composition of hazardous pollutants in the bulk fuel used for the field experiments. Through detailed chemical analysis and exposure assessment, this research provides essential insights into the occupational health aspects of the aviation industry’s gradual transition to SAFs, addressing a significant oversight in current aviation sustainability initiatives.

[YN1]Most stakeholders are still not using the term “SAF” in plural, but we should press for the change because these fuels are not a single kind of fuel.

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1AE.2

Elevated Black Carbon Exposure Among Individuals Burning Waste. SALONI VIJAY, Lennox Khonje, Mwaiwathu Laurent Chatha, Elizabeth Tilley, *ETH Zürich*

Globally, about 14% of households have no option but to burn their waste. While open waste burning is a significant source of black carbon (BC) emissions, personal exposure among those involved remains poorly understood. This study presents the first direct assessment of BC exposure from open waste burning. Between November and December 2023, we monitored 46 individuals from 23 households in Blantyre, Malawi, for approximately 20 hours on days when waste was burned. In each household, one waste burner and one non-burner wore MicroAeth MA200 monitors to track personal BC exposure. We calculated average BC concentrations for each participant during the full monitoring period, during burning, and during non-burning times. The median of these averages was then used to characterize exposure levels. We also characterized the waste being burned and recorded stirring frequency to assess their influence on exposure. The median exposure during burning was 12.8 μg/m³ for burners—over four times higher than the 2.9 μg/m³ for non-burners. During the full monitoring period, the median exposure for burners was 5.1 μg/m³, statistically higher than 3.0 μg/m³ for non-burners (Wilcoxon signed-rank test, $p = 0.04$). During non-burning times, there was no significant difference between the two groups ($p = 0.44$). The total exposure of burners during burning increased with the amount of waste burned and how often it was stirred. However, the mean concentrations of BC exposure during burning did not increase with waste quantity, suggesting behavioral adjustments to avoid smoke inhalation. While stirring improves combustion and lowers emissions, our findings show it also increases personal exposure. Overall, the study highlights the high black carbon exposure among waste burners and the associated health risks.

1AE.3

Integration of Community Sensor Network into High Resolution $PM_{2.5}$ Exposure Assessment: A Case Study in Central California. Peizhi Hao, Wenfu Tang, Joost A. de Gouw, XUAN ZHANG, *University of California, Merced*

The Central Valley, home to the largest population of disadvantaged communities in California, has long experienced some of the worst air quality in the United States. However, the sparse distribution of regulatory monitoring stations in the region limits our ability to fully characterize the temporal dynamics and spatial patterns of air pollution. Community-driven initiatives deploying low-cost air quality sensors play a critical role in addressing this gap by identifying pollution sources and hotspots. In this study, we evaluated how integrating a community sensor network improves the accuracy of $PM_{2.5}$ exposure mapping in Fresno County, located in the heart of the Central Valley. We combined data from 214 low-cost sensors with WRF-Chem model simulations using the Enhanced Voronoi Neighbor Averaging (eVNA) method. This data fusion approach produced a higher-resolution spatial distribution of $PM_{2.5}$ concentrations, enabling more precise characterization of pollutant variability and improved exposure assessments. Additionally, we assessed the effect of sensor density on mapping accuracy through repeated random sampling experiments. Our results indicate that increased sensor density significantly enhances the accuracy of $PM_{2.5}$ spatial distribution maps. These findings offer valuable insights for optimizing sensor deployment strategies and support data-driven interventions aimed at protecting public health.

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1AE.4

Establishing Contributions from Agricultural Emissions to India's Ambient $PM_{2.5}$ Exposures. GIRIVENDRA PRATAP YADAV, Neeldip Barman, Lucas Rojas-Mendoza, Zainab Arub, Piyush Bhardwaj, Julian Marshall, Joshua S. Apte, Srinidhi Balasubramanian, Chandra Venkataraman, *Indian Institute of Technology Bombay, Mumbai, India*

India has among the highest ambient $PM_{2.5}$ levels, posing critical risks to public health burden. $PM_{2.5}$ pollution from the agriculture sector, particularly, from crop residue burning in North India has received widespread attention. Yet, agriculture emissions result from many more sources. The impacts of the emitted pollutants from agricultural sources on $PM_{2.5}$ and their regional heterogeneity are unclear. We implemented the PAVITRA tool, that couples a high-resolution (5×5 $km^{2)}$ representative emissions inventory with a recently developed India specific reduced-complexity air quality model (InMAP-PAVITRA) with demonstrated model performance against observations (NMB: 2.55%, RSME: 36.30 $\mu g/m^3$, IOA: 0.69). The contribution from emissions of ammonia (NH_3), primary $PM_{2.5}$, nitrogen oxide (NOx), sulfur dioxide (SO_2) and non-methane volatile organic compounds (NMVOCs) to ambient $PM_{2.5}$, were estimated and sensitivity of $PM_{2.5}$ exposure reduction under four emission-reduction scenarios (100%-25%) was assessed. Agriculture contributed 7 $\mu g/m^3$ (15%) to India's annual $PM_{2.5}$ exposure, with NH_3 alone accounting for ~70% (~5 $\mu g/m^3$). Contribution of NOx, primary $PM_{2.5}$, NMVOCs and SO_2 were smaller (0.95, 0.81, 0.14 and 0.10 $\mu g/m^3$, respectively). Emission-reduction of NH_3, resulted in reduced $PM_{2.5}$ exposures by 5.04-2.51 $\mu g/m^3$, yielding far larger reductions compared to NOx (0.96-0.24 $\mu g/m^3$) and primary $PM_{2.5}$ (0.81-0.20 $\mu g/m^3$). This highlights NH_3, as key target pollutant, emitted from the manure management source in agriculture. Particulate ammonium (6–14 $\mu g/m^3$) that results from NH_3 reactions was concentrated in the Indo-Gangetic Plain (IGP) and Eastern India, with five major clusters exceeding 10 $\mu g/m^3$. In contrast, primary $PM_{2.5}$ concentrations (2-8 $\mu g/m^3$) were more concentrated within northwest IGP. These findings emphasize the need for regional NH_3 mitigation to control agriculture-driven $PM_{2.5}$ pollution in India.

1AE.5

Design and Performance of a Novel Personal Nasal Sampler (PNS) for Measuring Personal Exposure to Biological Aerosols. TAEWON HAN, Gediminas Mainelis, *Rutgers, The State University of New Jersey*

Accurate evaluation of personal exposure to biological aerosols is a significant challenge in bioaerosol science. We developed a personal nasal sampler (PNS) that attaches to a user's nostrils and utilizes their breathing to capture bioaerosols onto a hybrid filter, thus directly measuring actual personal exposure to airborne biological agents. The hybrid filter was designed by overlaying electrospun nanofibers of polyvinylidene fluoride (PVDF or P(VDF-TrFE) polymer onto a pulmonary test filter. This filter design showed an overall collection efficiency of over 90% for particles ranging from 10 nm to 10 µm, while maintaining a pressure drop < 300 Pa, in compliance with NIOSH guidelines. The filter also showed an 80% collection efficiency at a 10 L/min flow rate when tested with the Phi6 virus. The PNS was tested against the Button sampler for the ability to collect NaCl aerosols in the newly constructed walk-in chamber. The PNS samplers were mounted inside the nostrils of a manikin's head and connected to personal pumps, while two Button samplers were placed in a manikin's "breathing zone". Each PNS was operated at 5 L/min. After 1 hour of sampling, the NaCl particles collected by all samplers were eluted into 10 mL of water, and their concentrations were compared. The latest PNS version demonstrated collection efficiency of approximately 79% when the Button samplers were equipped with 0.3 µm pore size filters; however, PNS captured 2- 3 times higher NaCl aerosol mass when the Button samplers were equipped with 1 and 2 µm pore size filters, indicating its superior performance in capturing small particles. Ongoing experiments test the PNS performance with different bacteria, viruses, and mold spores. Overall, the PNS concept demonstrates an effective new tool to estimate actual personal exposures to biological aerosols.

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1AE.6

Advancing Aerosol Exposure Reduction through Integrated UVC Technologies, PPE Innovations, and Fluid Dynamics. TOM DUNBAR, *tomPhyzx.LLC*

Effective reduction of aerosol exposure, particularly in indoor environments, remains critical for infection control and public health. This research outlines an innovative integrated approach combining advanced ultraviolet-C (UVC) technologies, novel personal protective equipment (PPE), and strategic airflow management informed by computational fluid dynamics (CFD). The overarching goal is to substantially reduce aerosol-mediated pathogen transmission in occupied spaces, such as healthcare facilities.

We have developed and tested prototypes utilizing both traditional UVC and far-UVC systems, coupled with real-time occupant awareness via LoRaWAN-enabled Internet-of-Things (IoT) sensors. This approach fosters occupant acceptance by transparently indicating active UVC use and ensuring safety compliance through accessible data visualization. Additionally, our project introduces eyeglass-based PPE explicitly designed for hospital environments, offering frontline workers continuous protection against aerosolized pathogens without obstructing communication, eating, or personal interaction. Unlike conventional masks, this innovative design delivers sanitized air through discreet channels integrated into the glasses, terminating in a transparent silicone nosepiece, significantly enhancing staff-to-patient interactions.

Integral to our research is the application of fluid dynamics to optimize air movement, enhancing pathogen exposure to sanitization technologies while minimizing cross-contamination risks. Collaborations leveraging empirical CFD analyses will validate our innovative airflow management strategies, offering measurable improvements in indoor air quality.

Finally, this work pioneers the theoretical exploration of population inversion in aerosol pathogen inactivation, hypothesizing a nonlinear germicidal response. Planned experimental validation of this theory may redefine UVC efficacy models, significantly impacting guidelines and protocols for air sanitization.

Collectively, our comprehensive approach combining technological innovation, practical PPE solutions, and robust fluid dynamics modeling aims to establish transformative best practices for aerosol exposure mitigation, directly aligning with AAAR's mission to advance aerosol research and its societal applications.

1AE.7

Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in Personal and Cooking Area Air Samples from Rwandan Households and Influencing Factors. CLARA EICHLER, Joseph Pedit, Zachary G. Robbins, Ipsita Das, Karin Yeatts, Pamela Jagger, Sudhanshu Handa, Leena Nylander-French, *University of North Carolina at Chapel Hill*

Polycyclic aromatic hydrocarbons (PAHs) are products of incomplete combustion associated with the burning of biomass fuels, including wood and charcoal commonly used for cooking in low-income countries. PAHs are major contributors to household air pollution and associated with adverse health outcomes. Here, we assessed the concentrations of EPA's 16 priority PAHs in total air (gas/particle phase) samples collected using personal samplers worn by the cooks of 300 households in Gisenyi, Rwanda, in 2015, 2016, 2017, and 2019. In addition, total air was sampled in close proximity to the cooking areas at a subset of 110 households. Particulate matter ($PM_{2.5}$) and carbon monoxide (CO) were measured and information on stove use, fuel types, and the cooking environment was collected. Samples were analyzed by gas chromatography-mass spectrometry (GC-MS). Across all four years of sampling and for both sample types, detection frequencies of the 16 PAHs ranged from 5-100%, with higher detection frequencies for lower molecular weight PAHs. No significant differences ($p>0.05$) between sampling years were observed for the concentrations of the sum of the 16 PAHs, ∑(PAH), for either sample type. However, ∑(PAH) concentrations were significantly lower in personal (median: 1.3 μg/m³, range: 0.061-69 μg/m³) compared to cooking area samples (3.2 μg/m³, 0.57-117 μg/m³). Concentrations were highest for naphthalene, which contributed on average 68% and 62% to ∑(PAH) concentrations in personal and cooking area samples, respectively. ∑(PAH) concentrations correlated moderately well with $PM_{2.5}$ and CO concentrations (Spearman's rho: 0.30-0.68), with stronger correlations for CO than for $PM_{2.5}$. Biomass-burning stoves, including pellet stoves, were associated with significantly higher ∑(PAH) concentrations in both sample types compared to gas/electric stoves (personal: $p=0.0002$; cooking area: $p=0.0009$), emphasizing that a shift towards cleaner cooking technologies could reduce PAH exposures for household cooks.

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1AP.1

Limitations of First-Order Deposition Models for Indoor Aerosol Concentration Decay. LI LI, Himanshi Saini, Jeff Tithof, Christopher J. Hogan, *University of Minnesota*

Traditionally, first-order kinetic models are widely used to interpret indoor aerosol concentration decay and estimate particle deposition rate or loss coefficients. Although these models lead to a straightforward and mathematically simple approach, they rely on assumptions of a well-mixed system and a constant deposition rate, which often fail to represent realistic indoor environments and aerosol chamber experiments. In many real-world measurements, concentration time-evolution curves deviate significantly from the exponential trend predicted by first-order decay models. This is primarily due to complex turbulent flow structures and convective bulk motion driven by the room geometry and ventilation settings. In this study, we introduce a more general approach to model the time-dependent deposition rate by statistically analyzing the cumulative distribution function of particle residence times within an enclosed space. Through this approach we show that the first order decay model is only accurate when the cumulative distribution function is exponentially distributed and initial position-independent, which is not always satisfied in many environments. The approach is applied to a two-dimensional test environment where the turbulent the flow field is resolved by Direct Numerical Simulation, and particle motion is tracked using a Lagrangian approach, covering particle diameters from 10nm to 10µm. We systematically evaluate how convective bulk velocity, Reynolds number, turbulent vortex structures (including their number and configuration), and the extent of the convection influence deposition behavior.

1AP.2

Queuing Theory-based Predictions Ion Mobility Shifts via Vapor Clustering at Arbitrary Field Strength. TOMOYA TAMADATE, Christopher J. Hogan, *Kanazawa University*

Ion mobility spectrometry (IMS) enables the separation of gas-phase ions based on their electrophoretic velocity per unit electric field strength in a bath gas of controlled composition, i.e. based upon their ion mobilities (or mobility diameters). More advanced separation methodologies incorporate high electric field strengths and the introduction of condensable vapor molecules, which selectively cluster with gas-phase ions. In this study, we develop and implement a queuing theory-based framework to predict ion mobilities under arbitrary electric field strengths and in the presence of condensable vapors. The theoretical approach is validated through comparison with molecular dynamics (MD) simulations of doubly charged bradykinin ions in a nitrogen atmosphere (1 atm), with methanol introduced as a condensable vapor. Simulations span a range of electric field strengths extending beyond the zero-field limit (up to 76 kV/cm). The MD results capture typical ion mobility responses to variations in both field strength and vapor pressure. Comparison between the queuing theory model and MD simulations reveals that key statistical parameters, such as vapor arrival time, binding duration, and the number of binding vapor molecules, are well represented by appropriate probability distributions. These findings support the use of the queuing theory approach for mobility prediction, contingent only upon well-defined input parameters.

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1AP.3

What Is the Lower Limit of Epstein's (& Stokes-Cunningham's) Equation for Aerosol Diffusivity? SOTIRIS PRATSINIS, *ETH Zurich, Switzerland*

Epstein's equation[1] for aerosol diffusivity in the free molecule regime has been the standard in nearly all textbooks as it described well micron-sized droplet diffusion at low pressures[2]. However, such experiments are missing the corresponding atomic level interactions between aerosol particles and surrounding gas molecules that are crucial for tiny aerosol (cluster or quantum-dot) transport as well as for diffusion of gas molecules best described by the Chapman-Enskog and Fuller et al. equations[3]. Such interactions lead to multi-body, grazing and orbiting[4] collisions (besides the well-known specular ones) between gas molecules alone that nearly halve[5] the gas mean free path, 66 nm, quoted in all aerosol textbooks. Here diffusion coefficients of tiny (0.4-7 nm in diameter) fullerene[6], zinc, titania and silica[6] nanoparticles in air are obtained by molecular dynamics (MD) wherein both particles and gas molecules are considered in their full atomistic representation (force field and shape). Above 5 nm, these MD-derived diffusivities nicely converge to the Epstein[1] and the widely-used Stokes-Cunningham (E&SC) equations. Below 3 nm these diffusivities are in excellent agreement with the experimentally-based equation for gas diffusivities by Fuller et al[3] but show systematic deviations from the E&SC equations. These deviations become most pronounced as the nanoparticle size approaches that of gas molecules revealing the limit of validity of the E&SC equations and, in particular, the need for accounting for both diffusing species and medium composition, in the spirit of Chapman-Enskog's equation[3].

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1AP.4

Latent-To-Sensible Heat Conversion Kinetics During Nanoparticle Coalescence. ABHILASH OJHA, Tomoya Tamadate, Christopher J. Hogan, *University of Minnesota*

Coagulational growth in aerosols is a multi-step process involving collision followed by coalescence. Previous studies have explored coalescence kinetics using atomistic simulations of nanoclusters, often assuming the process to be completely isothermal or at constant energy. However, during coalescence, new bonds form, which lowers the potential energy and increases the kinetic energy. The evolution of this internal kinetic energy depends not only on the coalescence itself but also on heat transfer to the surrounding gas.

In this work, we develop and validate a model that predicts the evolution of internal kinetic energy in nanoclusters formed by collisions in the presence of a background gas. We show that the dynamics of kinetic energy follow a power-law relationship that links latent heat release to sensible heating and involves a modified thermal accommodation coefficient. We tested the model against atomistic simulations of $1.5text{–}3.0$ nm gold nanocluster coalescence in argon and helium environments. The model shows excellent agreement with the simulations across all tested conditions. Our results reveal that nanocluster temperatures can rise by several hundred Kelvin due to coalescence. However, the rate and extent of kinetic energy changes depend strongly on the surrounding gas. Finally, we use this model to predict how temperature evolves during sintering for different cluster sizes and to estimate the thermal accommodation coefficient in various gas environments.

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1AP.5

Van der Waals and Image Potential Enhanced Coagulation in Unequal-sized Ultrafine Particles. BRANDON BOREN, Deepak Sapkota, Yuechen Qiao, Hui Ouyang, *The University of Texas at Dallas*

Coagulation in ultrafine particles is a fundamental process that impacts particle growth and evolution in atmospheric aerosol systems. Accurate estimation of coagulation rates is essential for predicting particle size distribution and concentration in the atmosphere. Van der Waals (VDW) potential among neutral particles and image potential among neutral-charge pairs are common interactions that can enhance nanoparticle coagulation rates, with the degree of enhancement depending on particle size. However, experimental studies on the coagulation of unequal-sized particles with VDW and/or image potential effects are limited. In this study, two separate differential mobility analyzer (DMA) lines were used to generate monodisperse ultrafine particles from sodium chloride (NaCl), ammonium sulfate ($(NH_4)_2SO_4$), and potassium chloride (KCl) solutions via atomization. One DMA produced smaller particles, while the other generated larger ones. These particles were introduced into a 0.5 m^3 coagulation chamber, and a scanning mobility particle sizer (SMPS) was employed to measure the evolution of particle size distributions in the chamber. Coagulation rates were derived from the decay of smaller particles in the presence of larger ones. To measure VDW-enhanced coagulation rates, larger charged particles were removed before entering the chamber. For image-enhanced coagulation measurements, the charge-to-neutral ratio was adjusted. The measured VDW enhanced coagulation rates closely followed the predictions of the H(KnD) model and exhibited a dependence on the particle size ratio of the coagulating pairs. Assuming equal-size enhancement factors may lead to overestimation of coagulation rates, particularly for sub-10 nm particles. Image potentials were found to enhance coagulation more than VDW forces. Further studies are needed to fully quantify the effect of image potential on coagulation, especially for particles smaller than 10 nm.

1AP.6

Investigating Aerosol Deposition Mechanisms in a Spent Nuclear Fuel (SNF) Dry Storage Cask (DSC) Laboratory-Scale Model Under Variable Environmental Conditions. JAMES HENRY, Ren Garity, Moein Mousavi, Prasad Rangaraju, John Saylor, Nigel Kaye, Andrew Metcalf, *Clemson University*

Spent nuclear fuel (SNF) storage remains a pressing issue in the U.S. due to limited long-term repository options. Dry storage casks (DSCs) are increasingly used at nuclear facilities to store SNF once wet storage pools reach capacity. These casks rely on natural airflow for passive cooling during radioactive decay. However, depending on a given DSC design and environmental exposure, they may be vulnerable to aerosol penetration, which, over long periods of exposure, can lead to stress corrosion cracking in the steel canister that holds the SNF. Understanding aerosol deposition mechanisms under variable environmental conditions is essential to improving DSC designs and reducing this risk of stress corrosion cracking going forward.

Aerosol deposition inside DSCs heavily depends on environmental factors such as temperature, humidity, and particle concentration. These conditions affect which deposition mechanisms dominate and where aerosols accumulate on the interior cask and canister surfaces. Laboratory studies that replicate these conditions can offer practical insights into aerosol behavior and inform better storage system designs.

A 1/6th scale laboratory model of a DSC was developed to investigate these phenomena. The model includes a heated steel cylinder simulating SNF temperatures up to 250° C, enclosed within a concrete overpack and surrounding environmental chamber. Instruments such as humidifiers and polydisperse aerosol generators control the enclosure's relative humidity and particle concentration. Optical particle counters at the cask's inlets and outlets monitor aerosol concentrations, allowing for deposition quantification via mass balance. Aerosol deposition is mapped along the cylinder surface to identify dominant deposition mechanism(s) under specific environmental conditions.

This study provides a controlled approach to understanding aerosol transport and deposition in DSCs, contributing to safer and more resilient nuclear waste storage strategies.

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1AP.7

Integration of a Size-Resolved Aerosol Microphysics Model with CMAQ: Toward Enhanced Representation of Particle Number Concentrations over the U.S. JINGBO MAO, Fangqun Yu, Benjamin Murphy, Jingyu An, Yan Zhang, Gan Luo, Shao Lin, Anna Gannet Hallar, *State University of New York at Albany*

Accurate representation of aerosol size distributions and total number concentrations is critical for evaluating particle impacts on climate, clouds, and public health. An advanced particle microphysics model (APM), which has previously been incorporated into global and regional chemistry transport models (e.g., GEOS-Chem, WRF-Chem), has been successfully coupled into the USEPA's Community Multiscale Air Quality Modeling System (CMAQ). CMAQ is a state-of-the-science air quality model simulating the emission, transport, formation, evolution, and deposition of criteria and toxic air pollutants, and the default version uses the modal approach to treat aerosol processes and properties. The sectional APM model distinguishes secondary and primary particles and keeps track of the amount of secondary species coated on each type of primary particle (black carbon, primary organic carbon, dust, and sea salt). Further, APM is designed to capture key particle properties important for their health and climatic effects. One hundred and sixteen additional APM-related tracers have been included in CMAQ-APM. The chemical mechanisms Carbon-Bond version 6 (CB6), the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMM) version 1 (CRACMM1), and version 2 (CRACMM2) are supported in the CMAQ-APM model. The formation and growth of particles over the United States is studied using an up-to-date version of the H_2SO_4-H_2O-NH_3 ternary ion-mediated nucleation (TIMN) scheme, along with the organics-mediated (OrgT) scheme, both implemented in CMAQ-APM and driven by offline meteorology from the Weather Research and Forecasting (WRF) model. Comparisons of WRF-CMAQ-APM simulated particle size distributions and other particle properties with recent measurements at selected sites (e.g. Southern Great Plains, Bankhead National Forest, and Coast-Urban-Rural Atmospheric Gradient Experiment) in the US will be presented. The simulated spatial distributions of key parameters controlling new particle formation, nucleation rates, and number concentrations over the United States in different seasons will be discussed.

1CE.1 – INVITED

Emerging Urban Emissions: How Buildings, Cleaning and Chemistry Link Indoor and Outdoor Air. DELPHINE K. FARMER, Lauren A. Garofalo, Jienan Li, Morgan Selby, John Clark, Alli Salamone, Rachel Greene, Megan Willis, Emily Franklin, Rose K. Rossell, Adam De Groodt, *Colorado State University*

Each time we breathe, we are exposed to gases and particles in the air. Based on human activity patterns, much of our exposure occurs indoors – but this indoor air includes pollutants of both indoor and outdoor origin. In this presentation, I will highlight how indoor-outdoor interactions and subsequent chemistry can influence aerosol exposure in the context of pollutants including monoterpenes, cooking emissions, building material sources, and other pollutants. For example, ozone of outdoor origin can react with some volatile organic compounds (VOCs) to either create new particles or contribute to secondary organic aerosol formation. Even small changes in isomeric structures can have strong impacts on VOC fate and aerosol impacts. Other anthropogenic chemicals of emerging concern can also be low in concentration, but have substantial health impacts. To investigate processes behind the chemistry of indoor-outdoor interactions, we conducted a series of experiments in an office using both gas- and aerosol-phase mass spectrometry to track chemical perturbations. I will discuss experimental results, and use recent field measurements to place them into the context of urban air pollution.

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1CE.2

Secondary Organic Aerosol Formation from Reactions of Cleaning Liquids and Chlorine Bleach Under Different Lighting Conditions. SOFIE SCHWINK, Ethan Richter, Marina Vance, *University of Colorado Boulder*

Chlorine bleach is a commonly used cleaning product in homes around the world. The use of chlorine bleach leads to emissions of various gas-phase compounds, some of which can oxidize volatile organic compounds (VOCs) and form secondary organic aerosol (SOA) in indoor environments. One common source of VOCs indoors is the use of volatile chemical products (VCPs), like cleaning products and personal care products. When gas-phase emissions from VCPs interact with chlorine bleach in the presence of light, SOA can form. We assessed SOA formation and properties when VOCs emitted from common cleaning products interacted with chlorine bleach under different lighting conditions. For these experiments, chlorine bleach was introduced overnight to a 0.55 m^3 Teflon chamber in dark conditions. After introducing bleach overnight in the dark, a light source was turned on inside the chamber. Lighting types tested included 222 nm germicidal ultraviolet (GUV), 254 nm GUV, fluorescent, compact fluorescent, and incandescent lamps. For some experiments, we used an atomizer to generate ammonium sulfate seed in the chamber. Next, the cleaning liquid was introduced to the chamber by placing a small amount of it into an airtight container with air passing through it. We used a scanning mobility particle sizer to measure aerosol concentrations and size distributions and an aerosol particle mass analyzer to measure the mass of 60 nm, 80 nm, and 100 nm particles, which was used to calculate aerosol effective density. All products tested generated SOA under all lighting conditions. The lighting condition with the highest SOA yield was the 254 nm GUV lamp. Understanding differences in aerosol formation potential and properties from interactions of chlorine bleach with other common consumer products could help inform us about how these products impact indoor air quality.

1CE.3

Building Complexity in Multiphase Bleach Vapor Chemistry from the Bottom Up. DOUGLAS COLLINS, Lauren Stettler, Christina Clarke, Olivia Jaye, Ryan Ziskin, *Bucknell University*

Partitioning and reactive chemical processes at phase interfaces are critically important for scientific understanding indoor environmental quality, including both gas-to-particle and gas-to-building surface processes. The use of chemical disinfection techniques results in the deliberate or incidental release of reactive chemical species throughout indoor spaces in the gas phase and in deposited films on indoor surfaces. Chlorine bleach, for one, is known to release gaseous molecular chlorine (Cl_2) and hypochlorous acid (HOCl) to indoor air along with its surface reactivity upon application. This presentation will describe advancements in our understanding of the chemical consequences of multiphase chemistry involving gaseous HOCl and Cl_2 in laboratory studies. Focus will be placed on their reactivity with mixed organic surface films composed of oxygenated aromatic compounds and unsaturated fatty acids. Prior results in the environmental and biochemical literature have clearly demonstrated the broad oxidative reactivity of HOCl and our own results suggest that multiphase bleach vapor reactions may generate products of toxicological concern. However, the significant chemical complexity of real environmental surface films alters reaction pathways idealized by simplified study systems. Our experiments demonstrate unintuitive outcomes that are supported by the invocation of catalytic processes involving reactive oxygen species. For instance, the formation of certain chlorination and oxidation products of oleic acid under bleach vapor exposure can be modulated by the presence of aromatic species that may be forming reactive intermediates that act as redox mediators, all while the identities of reaction products are unchanged. These findings are complementary to existing and emerging research on the importance of condensed-phase reactive intermediates in driving environmental surface chemistry. At the same time, the chlorine in bleach vapor imparts electronic effects to aromatic species that modulate their reactivity and can also confer consequences for human and ecosystem health.

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1CE.4

Indoor Nanoparticle Emissions and Exposures During Heat-Based Hair Styling Activities. JIANGHUI LIU, Jinglin Jiang, Satya Patra, Xiaosu Ding, Chunxu Huang, Jordan Cross, Brian Magnuson, Nusrat Jung, *Purdue University*

Heat-based hair styling activities, such as straightening, curling, and waving, can emit volatile and semi-volatile chemicals when used with hair care products like creams, lotions, and serums. These emissions can nucleate and condense to form airborne nanoparticles, which may adversely impact human health and indoor air quality. This study investigates airborne nanoparticle formation (6 to 500 nm) as a previously underrecognized source of indoor air pollution during typical hair styling routines. Realistic hair styling activities were conducted in the Purdue zero Energy Design Guidance for Engineers (zEDGE) Test House, with real-time nanoparticle measurements obtained using a high-resolution electrical low-pressure impactor (HR-ELPI+). Our results showed that hair styling at temperatures above 300°F produced nanoparticle concentrations ranging from 10,000 to over 100,000 particles/cm^3, with sub-100 nm particles comprising more than 93% of emissions at temperatures exceeding 360°F. Different heating appliances were found to influence particle size distributions. The primary mechanism for nanoparticle formation was heat-driven vaporization of cyclic siloxanes and other low-volatility constituents in hair care products, followed by nucleation. Oxidation of these compounds and fragrance additives contributed as a secondary pathway. Respiratory tract deposition modeling indicated that more than 10 billion nanoparticles could deposit in the respiratory system during a single hair styling session, with the highest dose occurring in the pulmonary region – even under well-ventilated indoor conditions. These findings highlight heat-based hair styling as a significant indoor source of airborne nanoparticles and draw attention to previously underestimated inhalation exposure risks. This work advances the understanding of the physical and chemical processes underlying emissions from personal care product use and emphasizes the need for mitigation strategies to reduce exposure in residential environments.

1CE.5

Airborne Microplastic Generated by 3D Printing. SUNGYOON JUNG, Peyton Thompson, *University of Florida*

Plastics are everywhere in daily life, with their extensive use in consumer products. Smaller plastics, known as microplastics (ranging in size between 5 mm and 1 μm), can either be intentionally manufactured or formed through the degradation of larger plastics by factors such as UV radiation and mechanical abrasion. Indoor environments generally exhibit higher microplastic concentrations than outdoor settings, due to reduced dispersion. Indoor air quality is crucial, as people spend more than 80% of their time indoors, and poor air quality can directly impact human health and productivity. Owing to their small size, microplastics can penetrate the human body and potentially contribute to respiratory issues.

Recently, 3D printers have become increasingly common, and emerging studies suggest they may serve as a source of microplastic emissions. Here, we present our preliminary data on microplastic release from 3D printing activities in the Makerspace located in the Marston Science Library at the University of Florida. This space contains ten operational 3D printers housed in a black casing, six of which are equipped with a filter. We placed pre-cleaned beakers in various locations, including inside and outside the casing, to collect fallout microplastics for one week. All samples were then transported to the laboratory for concentration and analysis. The physicochemical properties of microplastics were characterized using a stereomicroscope and pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS). Our preliminary results confirmed the presence of microplastics throughout space, indicating potential particle transport across the room. The major polymer type was identified as polymethyl methacrylate (PMMA), one of the common materials for 3D printing. These findings highlight that 3D printers can be a significant source of microplastics in indoor environments and underscore the need to develop treatment strategies to mitigate their release.

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1CE.6

Bridging Indoors and Outdoors: The Impact of Ambient Aerosols on Indoor Air Quality. LUIS MIGUEL FEIJO BARREIRA, Delun Li, Minna Aurela, Laura Salo, Ville Silvonen, Mohamed Elsayed, Teemu Lepistö, Andrea Wagner, Tina Wahle, Roel Schins, Toni Tykkä, Heidi Hellén, Topi Rönkkö, Sanna Saarikoski, Hilkka Timonen, *Finnish Meteorological Institute*

Understanding the relationship between indoor and outdoor air quality is crucial for accurately assessing human exposure to air pollutants. To investigate these interactions, two weeks of simultaneous indoor and outdoor measurements were conducted in an office room at a research facility in Düsseldorf during the spring of 2025. A suite of state-of-the-art instruments, including a soot particle aerosol mass spectrometer (SP-AMS), a proton-transfer reaction mass spectrometer (PTR-MS), and an electrical low-pressure impactor (ELPI+), was used to obtain a detailed characterization of both gas and particle phases. The results showed that outdoor-originating aerosols infiltrated and dominated the indoor environment, even in the presence of mechanical ventilation. Temporal trends in chemical composition revealed that nitrate was the dominant component during the first week, likely due to regional or long-range transport. In the second week, organic aerosols became more prevalent, indicating a shift in source influence or atmospheric processes. Positive Matrix Factorization (PMF) analysis of organic aerosols (OA) identified similar source profiles and mass spectra indoors and outdoors, further confirming the substantial impact of outdoor air on indoor aerosol composition. However, differences in source contributions were observed. Cooking Organic Aerosols (COA), Hydrocarbon-like Organic Aerosols (HOA), and Biomass Burning Organic Aerosols (BBOA) were high outdoors. Indoors, HOA and BBOA were more prevalent. The indoor prevalence of HOA and BBOA, especially during working hours, points to the role of human activities—such as frequent door and window openings—in enhancing air exchange and altering the indoor aerosol profile. Size-resolved particle composition showed both temporal and chemical variability. The results highlight a significant and often underestimated link between outdoor and indoor air pollution, underscoring the importance of accounting for both ambient air quality and occupant behavior when assessing indoor exposure to pollutants.

1IM.1

Detection Efficiency of a Water Condensation Particle Counter Using Electrically Neutral Sulfuric Acid and Sulfuric Acid-Dimethylamine Clusters. Darren Cheng, Joy Kiguru, COTY JEN, *Carnegie Mellon University*

Accurately quantifying atmospheric new particle formation (NPF) rates has pushed the development of condensation particle counters (CPCs) to detect smaller and smaller particles. Currently, CPC detection efficiencies are determined by comparing measured concentrations of size-selected ions with an aerosol electrometer. However, neutrally charged particles represent over 90% of particles formed during new particle formation events and may differ in detection efficiency compared to charged particles. Furthermore, detection efficiency experiments typically use charger ions, ammonium sulfate, sodium chloride, or silver ion particles that each display different detection efficiencies. These compositions differ from particles formed via previously observed atmospheric nucleation of SA and dimethylamine. This study presents a novel method to characterize the detection efficiency of electrically neutral sulfuric acid (SA) vapor and SA-dimethylamine (DMA) particles <1.5 nm in mobility diameter. The detection efficiency was inverted from measured water condensation particle counter (wCPC) concentrations and predicted concentrations of SA-DMA clusters produced by nucleating known concentrations of SA and DMA in a flow reactor. Detection efficiency was determined for a custom, three-stage wCPC. The wCPC was operated at seven different initiator temperatures (98, 91, 81, 71, 61, 51, and 41 °C), while the conditioner, moderator, and optics head were held constant at 1, 1, and 35 °C respectively. These conditioner-to-initiator temperature differences (ΔT) exhibited d50 between 1.8 to 2.6 nm, characterized by traditional ion calibration.

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1IM.2

Improving Accuracy in Mobility-Based Aerosol Sizing by Measuring Bipolar-Charged Particles. JINGKUN JIANG, Jin Wu, *Tsinghua University, China*

Scanning Mobility Particle Sizers (SMPS) are widely used to measure particle number size distribution (PNSD) of nanoparticles. A key component of SMPS is the neutralizer, which generate ions and bring aerosols to steady-state charge fractions. These charge fractions are important parameters when performing data inversion. Conventionally, the charge fractions are calculated using bipolar diffusion theory; for instance, the most widely used approximation formulas are derived from fixed ion properties of radioactive source (Wiedensohler, 1988) and soft X-ray source (Tigges et al., 2015).

However, the real-world charge fractions can differ significantly from those assumed in approximations or models, which could be affected by gas composition, ion source activity and neutralizer design. Our previous studies demonstrated that the concentrations of positively and negatively charged particles provide information about both charge fractions and ion properties. We have also designed and applied bipolar SMPS that can rapidly obtain the PNSD of positively and negatively charged aerosols.

In this research, we analyze the concentrations of positively and negatively charged aerosols conditioned by different neutralizers to evaluate the fluctuations of charge fractions in long-term field measurement. We find the actual charge fractions differ from the previously used approximations. As the neutralizer ages, the deviation becomes more pronounced and harder to predict. The number concentration of aerosols conditioned by neutralizers exhibit size dependencies that differ from the predictions of approximation formulas. Furthermore, by analyzing the data from 14 sites across China, we identified the characteristics of naturally bipolar charged aerosols. We also investigated whether using the summed concentrations of positively and negatively charged particles during inversion provides better results than using unipolar data alone. We suggest that employing bipolar high voltage and modifying the SMPS appropriately are beneficial for reducing bias in results and obtaining more comprehensive information in ambient measurements.

1IM.3

Toxic Metal Aerosols Detection: Enhanced Spark-Induced Breakdown Spectroscopy with Intuitive Software Interface for Community Use. EHSAN GOFTARI, Evan Gittings, Junbeom Jang, Brenda Lopez, Christopher Wallis, Anthony S. Wexler, Hanyang Li, *San Diego State University*

To advance environmental monitoring of toxic air contaminants, we have developed a novel, cost-efficient Spark-Induced Breakdown Spectroscopy (SIBS) instrument engineered for the detection and quantification of airborne particulate metals (Toxic metal Aerosol Real Time Analyzer, TARTA). We have recently optimized TARTA's design (TARTA 2.0) to include a combined electrode holder and ground electrode with increased surface area to improve particle collection efficiency. These enhancements have enabled a more compact, user-friendly instrument with an 8" x 10" footprint, weighing only 6 lbs and powered by a 12 VDC battery, suitable for mobile monitoring. The performance of TARTA 2.0 was validated in a series of laboratory experiments using nebulized elemental standard solutions, demonstrating reliable sensitivity and improved limits of detection (LODs) for a wide range of metals, with LODs ranging from as low as 1.03 ng/m³ for Mn to 26.6 ng/m³ for As.

To improve accessibility for community use, we also developed an intuitive software interface that runs on a Raspberry Pi, removing the need for a laptop or technical training, resulting in a substantial reduction of TARTA's operational costs. The software includes simple menu options, real-time metal concentration display, and a new adaptive monitoring mode. The new adaptive mode automatically adjusts the sampling duration based on ambient particulate matter (PM) levels detected by an integrated Plantower sensor inside TARTA, eliminating the need for users to set sampling times manually and enabling efficient operation in environments with unknown or fluctuating air quality. Our findings highlight the potential of TARTA 2.0 as a practical and accessible tool for community-based monitoring of hazardous air pollutants, supporting efforts to reduce toxic metal exposure and protect public health. Ongoing research will expand the range of detectable pollutants, refine quantification methods, and validate the instrument under diverse environmental conditions.

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1IM.4

Efficiency of Low-Cost Sensors to Detect Dust Particles During Dust Events. KARIN ARDON-DRYER, John Garber, Melodie Martinez-Manahan, Lorena Albuquerque Zanandreis, Raghu Betha, *Department of Geosciences, Texas Tech University*

Dust events are an important and complex constituent of the atmospheric system and one of the main natural contributors to atmospheric Particulate Matter (PM). Dust events are a major concern, as their numbers have increased across the USA in the last decade, and climate models project that trend will continue. Dust events are not often prioritized in air quality mitigation strategies, although they may contain high PM concentrations and even high concentrations of small particles (<0.5 µm). One of the reasons is insufficient measurements that track and examine dust events and their impact on air quality, for example, a low spread of instruments. Can low-cost sensors detect dust particles and enhance our knowledge of dust events and their impact on air quality?

The project investigates the behavior of three low-cost sensor types during the spring of 2025 dust season in Lubbock, a mid-size urban city, located in the Southern High Plains of West Texas. Lubbock is a perfect atmospheric laboratory to examine dust events, as it experiences many dust events each year. The three low-cost units selected for this project were Clarity Node-S unit PurpleAir, and QuantAQ Modulair sensor. The different units were placed in the Aerosol Research Observation Station (AEROS), which also hosts the reference monitor GRIMM EDM-180. Comparison based on PM_1, $PM_{2.5}$, and PM_{10} concentrations was based on all instruments, while comparison of particle size distribution was performed between QuantAQ Modulair and GRIMM EDM-180. The presentation will highlight the similarities and differences between the sensors and their ability and limitations to detect dust particles during dust events.

1IM.5

On the Performance of a Bipolar Multi-Outlet Differential Mobility Analyzer (BiMoDMA). SHIPENG KANG, Tongzhu Yu, Yixin Yang, Huaqiao Gui, Jianguo Liu, Da-Ren Chen, *Virginia Commonwealth University*

A typical DMA with a bipolar particle charger measures particles charged in one polarity. Recent studies however revealed the charge fraction (in one polarity) of particles is subjected to the variation of relative humidity of carrier air. The same studies further observed that the sum of positive and negative charge fractions of particles is much less affected by the relative humidity (Li et al., 2022). To measure particles in both polarities at the same time, a Bipolar Multi-outlet Differential Mobility Analyzer (BiMoDMA) was designed, and its performance was experimentally evaluated in this study.

The plate-to-plate configuration is selected for BiMoDMA. It has one polydisperse particle inlet (located in the middle of spacing defined by two parallel plates) and four pairs of particle sampling outlets (located at both plates). The particle classification zone is defined by the space between two plates. The electric field in the classification zone is established by separately applying positive and negative high voltages on both plates. Once entering the classification zone, particles charged in one polarity are deflected toward the plate in high voltage with the opposite polarity. Four pairs of sampling outlets are used to extract classified particles out from the classification zone.

For the performance evaluation, the BiMoDMA transfer function was evaluated using a Tandem Differential Mobility Analyzer (TDMA) technique under the condition of difference mobility particle sizes, sheath flowrate and sampling schemes. A general method of piecewise transfer function inversion is introduced to retrieve the transfer function of BiMoDMA from the measured TDMA data. Two sampling strategies were studied: (1) equal sampling mode, i.e., the sampling flowrate for each port in a pair is the same as the polydisperse aerosol flowrate; and (2) cycling mode, i.e., the polydisperse aerosol flowrate is the sum of sampling flowrates of two ports in a pair. The detail design of BiMoDMA and results of this evaluation will be presented in this talk.

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1IM.6

Measuring the Detection Efficiency of Neutral Flame-Formed Materials by Two-Component Fluid-Water Condensation Particle Counters (Fluid-WCPCs). Farnaz Khosravi, OWEN S. FUHR, Gregory S. Lewis, Francesco Carbone, *University of Connecticut*

Atmospheric nucleation is a key process in new particle formation, with significant implications for climate, air quality, and human health. While ion-induced nucleation has been extensively studied, neutral aerosols smaller than 10 nm remain poorly characterized. A principal challenge lies in the difficulty of detecting and quantifying these particles experimentally, as they cannot be manipulated by electric fields. Consequently, advanced aerosol diagnostic instruments, such as Condensation Particle Counters (CPCs), are required to accurately determine their number concentration. Although CPCs can detect both neutral and charged particles, their detection efficiency must be carefully evaluated under application-specific conditions. However, the literature has yet to introduce a well-established and reliable procedure for calibrating CPC detection efficiency for uncharged aerosols. This study proposes a new approach to address this gap by quantifying the size-dependent detection efficiency of neutral sub-5 nm flame-formed carbonaceous aerosols using the two-component fluid-water CPCs resulting from coupling a WCPC prototype (model ADI-2021-1, Aerosol Dynamics Inc.) to a saturator inlet operated with either Diethylene Glycol (DEG), n-Butanol (nBA), Isopropanol (IPA), or Ethanol (EtOH). Results demonstrate that the DEG-WCPC, the nBA-WCP, the IPA-WCPC, and the EtOH-WCPC enable the detection of uncharged flame-formed carbonaceous aerosols at least as small as 2.5nm with relatively high sizing resolutions. The comparison with published results quantifying the detection efficiency of the naturally charged fraction of the same flame-formed carbonaceous aerosols highlights that the lack of an electric charge causes a moderate enlargement of the d50% size of aerosols detected with 50% efficiency. The increase in the d50% size is observed to be relatively smaller for the EtOH-WCPC and the DEG-WCPC than for the nBA -WCPC, the IPA-WCP.

1IM.7

Design and Testing of a Water-Based Condensation Particle Counter for a Micro-Gravity Environment. STEVEN SPIELMAN, Gregory S. Lewis, Nathan Kreisberg, Susanne Hering, *Aerosol Dynamics Inc.*

The International Space Station (ISS) provides an environment for a 6-member crew to live and work in low Earth orbit. As a completely sealed volume, maintaining good air quality is vitally important. While gas phase constituents of ISS air are monitored meticulously, NASA has focused on aerosols only recently. This work addresses the monitoring of submicron particles by using water condensational growth. The ISS environment introduces several challenges. First, no liquid reservoirs were permitted for this work and a fully dry system was required for launch acceptance. The working fluid must be gathered from the ambient air during sampling. Second, because the instrument cannot rely on gravity to shed excess water from the wick, the saturation level of the wick must be measured and controlled to prevent flooding. Third, the absence of any gravitational settling means the unit must tolerate 5 to 50 micron particles, which threaten to clog the optics nozzle. A virtual impactor was designed to handle the coarse particle load in a way that requires no disassembly by crew. Results showing the robustness against wick-drying events, along with overall system performance will be shared.

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1UA.1

Trends in New York State Vehicle Fleet Composition: Emission Standards and Engine Technology (2015-2024).

FARIHA RIMU, David Q. Rich, Gavin Lemley, Philip K. Hopke, *University of Rochester School of Medicine and Dentistry*

The United States Environmental Protection Agency (EPA) established regulatory frameworks (i.e., Pre-Tier 2, Tier 2, and Tier 3) to address vehicle emissions. Simultaneously, a technological shift from port fuel injection (PFI) to gasoline direct injection (GDI) engines is being adopted. GDI has greater fuel efficiency but potentially produces more secondary organic aerosol (SOA) under Tier 2 emissions than Tier 3. The aim of this study was to examine vehicle fleet transitions in New York State from 2013-2024, specifically the shift between engine technology (PFI and GDI) and fleet turnover rate across emission tiers. We analyzed registration data from the New York State Department of Motor Vehicles and classified vehicles into Pre-Tier 2, Tier 2, and Tier 3 based on Model Year, Vehicle Identification Number (VIN), and regulatory phase-in schedules. We used manufacturer-reported statistics and VIN to categorize vehicles into Pre-Tier 2 PFI, Tier 2 PFI, Tier 2 GDI, Tier 3 PFI, Tier 3 GDI, Hybrid, and EV. All new vehicles sold after 2007 had to meet Tier 2 standards, but only 51% of the total fleet were Tier 2 vehicles in 2013 suggesting a lag time in fleet-wide penetration. Similarly, penetration of Tier 3 vehicles introduced in 2017 was slower than expected and the annual rate dropped in 2019. By 2024 only 34% of the total fleet consisted of Tier 3 vehicles and <5% were EV or Hybrid. Meanwhile, GDI technology adoption by manufacturers increased rapidly for new vehicles and the percentage of GDI vehicles grew consistently from 5% in 2013 to 37% in 2024. The slow fleet turnover highlights a significant lag between regulatory implementation and actual fleet composition changes. This results in continuing emissions, SOA formation and indicates that air quality benefits from Tier 3 will take longer than anticipated to be fully realized.

1UA.2

Characterization of Emission Factors from Fossil Fuel and Biomass Combustion Sources in Eastern Africa.

THEOBARD HABINEZA, Albert Presto, Allen Robinson, *Carnegie Mellon University*

Anthropogenic emissions in Africa are diverse and evolving due to new emerging sources. Quantifying emission factors (EFs) is essential to reduce uncertainties in regional and global circulation models representing air pollution in this data-scarce region. We conducted tailpipe measurements (81 vehicles) and chamber experiments to quantify EFs for diesel and gasoline trucks, as well as solid biomass energy sources (specifically charcoal). Using a carbon mass balance approach, we quantified EFs by vehicle age (very old, old, new), type (heavy-duty trucks, light-duty trucks, passenger cars and Two wheels motorcycles), Euro category (Euro 1–5), along with charcoal and wood combustion emissions for fine particulate matter ($PM_{2.5}$) mass, SO_2, CO, CO_2, NOx, and black carbon. Very old vehicles (manufactured before 2000) showed 2.97 times higher $PM_{2.5}$ and 1.2-times higher BC emissions than new ones (manufactured after 2015), with heavy-duty vehicles reporting the highest EFs. Light-duty passenger cars exhibited the highest mean CO_2 emissions and lowest CO and NOx emissions. A factor or 2.3 between Euro five and Euro 1 vehicle category. Vehicle maintenance indicators ($CO/CO_2 > 0.005$) showed 47% of vehicles poorly maintained, dominated by older and very old models. Furthermore, 20% of vehicles accounted for ~65% of total CO emissions, while the cleanest 40% contributed <10%. The updated emission factors are compared to global databases (EDGAR v6.1, DACCIWA) and show substantial regional differences. This highlights the need for Africa-specific EFs to improve model-based assessments of air pollution and associated health impacts in the region.

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1UA.3

Characterizing the Spatial and Temporal Variability of Pollution in an Urban Oil Field Using Low-cost Sensors.

CAROLINE FRISCHMON, Venezia Ramirez, Brittney Lu-Jones, Nancy Lam, Richard Parks, Bhavna Shamasunder, Jill Johnston, Michael Hannigan, *University of Colorado Boulder*

The Las Cienegas oilfield in South Los Angeles sits among the most environmentally burdened communities in California. In addition to pollution exposure from oil extraction, residents are also exposed to traffic-related and other typical urban sources of pollution. We set up a dense network of air sensor packages, called HAQ-Pods, in the community to better understand how pollution varies spatially and temporally within this complex environment.

The HAQ-Pods measure multiple pollutants, including $PM_{2.5}$, NO_2, total volatile organic compounds (TVOCs), CO, and CH_4. Measuring and exploring the relationships between these pollutants provides insight into potential emission sources. For example, CO and CH_4 can serve as tracer species for traffic and oil extraction, respectively. We show how correlations with these tracers can reveal likely sources of more broadly emitted pollutants, such as $PM_{2.5}$.

We also use wavelet decomposition to separate each concentration time series into short-lived (<2 h), longer-lived (2-8 h), and regional (>8 h) components. Through this analysis, we found that variance in $PM_{2.5}$ predominantly came from the regional component, indicating $PM_{2.5}$ levels in the community are not driven by the local sources of concern. Other pollutants showed more significant contribution from all three components. We use bivariate polar plotting to visualize how the direction of origin varies across the regional, long-lived, and short-lived contributions of each pollutant. Combining these analytical tools provides a more comprehensive understanding of air quality in a complex urban environment.

1UA.4

Sources of Particulate Matter and Its Precursors in the El Paso Area.

SHIHAO ZHAI, Daniel Sung, Chun-Ying Chao, Kyle Druckman, Kacper Przykaza, Lea El Khoury, David Sullivan, Pawel K. Misztal, Lea Hildebrandt Ruiz, *University of Texas at Austin*

The region of El Paso, Texas, is frequently affected by haze, with particulate matter (PM) concentrations often exceeding established air quality standards, raising concerns about human exposure and public health. Emissions of particulate matter and its precursors have a variety of source categories in the region, including local and long-range transport of industrial emissions, local dust storms, vehicular emissions involving diesel trucks, and biomass burning emissions. Local meteorological conditions and geographical features can lead to higher frequency temperature inversion events and lower air exchange rates, which results in higher pollutant levels. Although recent data show a decline in the frequency of high ozone events, $PM_{2.5}$ levels in the region continue to surpass the daily standard of 35 $\mu g/m^3$. With the recent reduction of the National Ambient Air Quality Standards (NAAQS) for annual average $PM_{2.5}$ down to 9 $\mu g/m^3$, understanding the composition and sources of particulate matter has become crucial in avoiding non-attainment status.

During the field campaigns conducted in January and May 2025, we measured mixing ratios of volatile organic compounds (VOCs) and concentrations of fine particulate matter (<1 micron), using an electric mobile van equipped with a Vocus 2R Proton Transfer Reaction Time-of-Flight Mass Spectrometer (Vocus PTR-TOF-MS) and a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) in the El Paso area. Preliminary findings reveal hotspots for different pollutants from various source types and industries. For example, we observed elevated PM concentration near the US-Mexico border with wind from the western direction, suggesting sources from the nearby Mexican city of Juárez. Traffic emissions, mostly from diesel engines, contributed to sudden spikes in organic aerosol levels near major roads. We will present a comprehensive summary of the observations made and results from positive matrix factorization that provide insights into the sources of primary and secondary gas and particle-phase pollutants in the area.

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1UA.5

A Scalable Framework for Modeling Near-Road Air Pollution Using Representative Road Types and Orientation-Informed Emission Profiles. DEEPSHIKHA OLA, Tahlia Wu, Huyen Le, Jeffrey Bielicki, Andrew A. May, *The Ohio State University*

Traffic emissions are a major contributor of particulate matter (PM), nitrogen oxides (NOx), and carbon monoxide (CO) in urban areas While county-level emission inventories are useful for regional-scale assessments of the impacts of these traffic emissions, they lack the spatial granularity required to evaluate air quality and exposure at the street or neighborhood level. This limitation becomes especially critical within urban microenvironments, where traffic conditions can vary dramatically across locations.

To address this gap, we propose a practical, data-driven framework that constructs a high-resolution emissions dataset using a set of representative roads. Rather than relying on statistical clustering, which yielded limited differentiation, we categorized roads based on two key parameters: average traffic volume and speed. Traffic volume was divided into three categories (low, medium, and high), and speed into five bins (≤25, 26 and ≤35, 36 and ≤45 mph, 46 and ≤55, and >55mph), forming a comprehensive matrix of road types. Using 2023 vehicle activity data from the StreetLight database, project-level emission factors will be estimated through the Motor Vehicle Emission Simulator (MOVES). These emission factors across the representative road types will be integrated with the R-LINE dispersion model to simulate pollutant concentrations across the community level. To enhance transferability, we will further develop a generalized emissions-concentration inventory by incorporating wind direction relative to road orientation across 16 directional bins. The accompanying code will demonstrate how we combine the representative roads and wind directions to quantify traffic emissions in a complete road network in Columbus, OH.

Our work enables the generation of concentration gradient profiles for each road type, allowing estimation of near-road air pollution in different communities using local road network that fall into the same representative categories. This dual approach, combing road classification with directional dispersion, strikes a balance between spatial detail and computational efficiency, offering a robust, scalable tool for community-level air quality modeling and exposure analysis across U.S. cities. By leveraging this data-driven approach, policymakers can better identify neighbourhoods that require stricter regulations and targeted mitigation strategies to improve air quality.

1UA.6

Impact of Suburban Planted Forests on the Dispersion of Carbon-Based Aerosol Plumes from Industrial Sources. BORIS KRASOVITOV, Avi Levy, Itzhak Katra, *Ben-Gurion University of the Negev, Israel*

The carbon-based $PM_{2.5-10}$, typical of industrial emissions, is a major source of air pollution, negatively affecting human health, increasing the risk of worsening respiratory and allergic diseases, and leading to problems such as acid rain and smog. Planted forests in suburban areas can modify the velocity and spatial distribution of aerosol pollutants emitted by industrial sources, affecting the dispersion of plumes. The present study suggests the numerical model of Particle Deposition on a Forest Canopy (PDFC) supplemented by parameterizing the average collection rate based on the CFD model. The turbulent momentum and mass transfer in and above the forest canopy are described by a gradient turbulent transfer model using a modified Blackadar model for turbulent viscosity within the forest canopy. 3D numerical modeling of the particulate flow utilizing discrete phase models based on the Eulerian-Lagrangian technique has been carried out. The vegetation element is considered as a prolate ellipsoid approximating in shape to a leaf of Aleppo pine (Pinus halepensis), the dominant tree species in Northern Negev (Israel). The analyses of the obtained results are performed for different meteorological conditions and atmospheric stability. The performed numerical analysis showed that a significant reduction in PM_{10} concentrations on the leeward side of the forest occurs with unstable stratification due to a combination of effective deposition on the crown and intense atmospheric mixing. With neutral stratification, the effect is moderate, and with stable stratification, the concentration remains high due to weak dispersion. Thus, forest plantations are most effective in reducing air pollutants under daytime convective conditions. The results of this study highlight the importance of forest plantations in controlling air pollution from industrial sources in adjacent urban areas.

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1UA.7

The Influence of Tijuana River Pollution on Coastal and Inland Aerosol Populations. JUSTIN HAMLIN, Jena Herbst, Benjamin Rico, Leila El Masri, Kimberly Prather, *University of California, San Diego*

Mass-based measurements of particulate matter (PM) within the National Ambient Air Quality Standards (NAAQS) often overlook the significance of fine and ultrafine aerosols—particles with diameters less than 1 µm and 100 nm, respectively. New particle formation (NPF), which can considerably influence air quality and human health, may be underrepresented if aerosols do not grow to an appreciable mass. Number-based measurements fill this void and are essential in capturing the influence of fine and ultrafine aerosols. In southern San Diego County, residents have endured noxious odors linked to discharge of raw sewage and industrial waste into the Tijuana River (TJR). A potential yet underrecognized risk is the contribution of TJR emissions to NPF and elevated ultrafine aerosol concentrations.

To investigate this, two monitoring sites were established in Summer 2024: one near a turbulent TJR branch (~4 km inland) and another at the Pacific coast (~1 km north of the TJR mouth). Each site was equipped to measure the particle number size distribution (PNSD) from 12 nm to 20 µm, select criteria gas pollutants, and meteorological conditions. Preliminary results have shown that during high wastewater flow rates, elevated concentrations of ultrafine aerosol were present. A subsequent shift in meteorological conditions and decrease in wastewater flow coincided with a decrease in aerosol concentrations.

This study evaluates the influence of TJR pollution on the PNSD and frequency of NPF events, providing crucial insight into overlooked sources of ultrafine aerosols in coastal environments.

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2AA.1

Impact of Changing Ship Emissions on Water-Soluble Iron in Fine Particulate Matter Between 2009-2018 in Atlantic Canada. RIN TAKAI, Jenny P.S. Wong, *Mount Allison University*

Human exposure to fine particulate matter ($PM_{2.5}$) pollution is linked to acute and chronic cardiovascular, pulmonary diseases, with numerous epidemiological and toxicological studies demonstrating that water-soluble iron (WS-Fe) in $PM_{2.5}$ is an important contributor to these adverse health effects. Although the predominant source of Fe from mineral dust is initially emitted in an insoluble form at the time of emission, Fe solubility measured in ambient $PM_{2.5}$ is greater, indicating the contribution of unknown WS-Fe primary and secondary sources (*i.e.*, atmospheric chemical processing resulting in the iron dissolution). While studies have shown that proton-mediated and ligand-mediated reactions convert insoluble Fe into a soluble form during atmospheric transport in Ontario, the factors controlling WS-Fe in Atlantic Canada (Saint John, New Brunswick and Halifax, Nova Scotia) remain unclear. In addition, since Saint John and Halifax are both known as ports in Atlantic Canada, emissions of sulfur dioxide from large marine vessels can potentially influence WS-Fe production, as sulfur dioxide affects aerosol pH conditions by forming sulfuric acid that affects iron dissolution. Therefore, the impact of implementing the North American Emission Control Area (NAECA) low-sulfur fuel regulations on WS-Fe in Atlantic Canada is explored in this study. Results demonstrate that the implementation of low-sulfur fuel regulations has led to a reduction in WS-Fe: (1) directly, by decreasing primary emissions of WS-Fe from ships, and (2) indirectly, by a potential reduction in sulfur dioxide emission, which influences aerosol pH and consequently, secondary production of WS-Fe through atmospheric processing of iron-containing aerosols.

2AA.2

Determination of Secondary Organic Aerosol Formation from Cyanobacterial Harmful Algal Blooms. SAMANTHA L. BELL, Mia B. Kauffman, Nicolas A. Buchenau, Cara Waters, Haley E. Plaas, Andrew P. Ault, Jason Surratt, *University of North Carolina at Chapel Hill*

Cyanobacterial harmful algal blooms (CHABs), known for their blue-green color, foul taste and odor, and toxicity in freshwater systems, are due to increased water temperature and increased nutrient-dense run off. Living near CHABs can cause adverse respiratory illnesses; yet mostly primary organic aerosol (POA) mechanisms have been examined. Volatile organic compounds (VOCs) are also emitted from CHABs, which contribute to the taste and odor of the water. VOCs emitted during these CHAB events could undergo atmospheric oxidation, and thus, have the potential to form secondary organic aerosol (SOA), a main component to $PM_{2.5}$. Our preliminary work demonstrated that geosmin and 2-methylisoborneol, two abundant VOCs emitted during CHAB events, can be oxidized via hydroxyl radicals (·OH) by hydrogen atom abstraction to yield SOA. The main blue-green photosynthetic pigment of cyanobacteria produces volatile b-ionone and b-cyclocitral when oxidized. b-ionone and b-cyclocitral have a greater potential to undergo daytime oxidation via ·OH due to the presence of pi electrons and more reactive functional groups. Their oxidation mechanisms and transformation products need to be chemically characterized to understand if they can form SOA. A potential aerosol mass-oxidation flow reactor was systematically used to photochemically oxidize both VOCs, and the subsequent SOA particles were collected onto Teflon filters. A scanning electrical mobility sizer (SEMS) measured real-time aerosol size distributions during SOA formation. SOA were extracted and chemically analyzed by using reverse-phase liquid chromatography (RPLC) coupled to cyclic ion mobility spectrometry (cIMS) and interfaced with electrospray ionization high-resolution tandem mass spectrometry (ESI-HR-MS/MS). $PM_{2.5}$ samples were collected along the Chowan River in North Carolina during an active CHAB to determine the presence of lab-measured transformation products.

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2AA.3

From Wave Crest to Wind Drift: Ocean-Atmosphere Microplastics in Three Mexican Coastal Zones. SALVADOR REYNOSO-CRUCES, Harry Alvarez-Ospina, Luis A. Ladino, Roberto Rosal, Carlos Edo, *Universidad Nacional Autónoma de México*

Global plastic production reached 400 Mt in 2022 and could exceed 1 Gt yr^{-1} by 2050, intensifying concern about microplastics (MPs; 1 µm–5 mm). We quantified MPs at the ocean–atmosphere interface of three Mexican coastal sites, i.e., Veracruz (Gulf of Mexico), Manzanillo (Mexican Pacific), and Cozumel (Caribbean Sea), to assess the concentrations, polymer composition, and cross-boundary transfer of MPs. Morning and afternoon aerosols were collected with a high-flow impinger, and seawater profiles (0–10 m) were obtained with a horizontal Van Dorn bottle. MPs were isolated, digested, visually presorted, and confirmed by micro-FTIR. Strict quality-assurance protocols minimized contamination, and size-corrected abundances were derived from random FTIR subsamples.

Nine polymers were identified in 108 airborne and 72 water samples. Polyester dominated (46 %), followed by acrylics and polyethylene. Mean airborne concentrations were 3.9, 3.2, and 2.8 MPs m^{-3} in Veracruz, Manzanillo and Cozumel, respectively, and declined 45 % during afternoon offshore breezes. Seawater contained 17 MPs m^{-3} at the ocean surface; however, only 4 MPs m^{-3} were observed at 9 m depth. Although fibers represented 70 % of airborne MPs, this fraction was lower (60 %) in seawater, indicating preferential aerosolization of these buoyant and elongated particles. Orthogonal partial least squares discriminant analysis (OPLS-DA) revealed overlapping spectral fingerprints between airborne and surface water samples, and statistical coupling with wind vectors showed aerosolization within three hours of sea-spray generation. Artificial non-plastic dyed cellulose particles were 1.4-fold more abundant than MPs in aerosols, underscoring the need for chemical verification.

Our results show that ports are focal points for MPs exchange, modulated by diurnal breezes and polymer buoyancy. These baseline data constrain emerging emission models and highlight the need to integrate atmospheric pathways into Mexican plastic-waste strategies.

2AA.4

Airborne Investigations of Black Carbon Aerosols in Low-level Stratocumulus off the Coast of Southern California. DONGLI WANG, Bradley Ries, Minghao Han, Alexander B. MacDonald, Don Collins, Roya Bahreini, Patrick Chuang, Mason Leandro, Lisa Welp-Smith, Mikael Witte, Sierra Bollinger, Andrew Metcalf, *Clemson University*

Black carbon (BC) aerosols have significant impacts on climate change, including the direct effect on atmospheric absorption and indirect and semidirect effects on clouds. However, aerosol-cloud interactions remain one of the largest uncertainties in estimating atmospheric radiative forcing. To address this uncertainty, comprehensive airborne observations of bulk aerosols and cloud droplet residuals were conducted off the coast of Southern California in June 2023 as part of the Southern California Interactions of Low Cloud and Land Aerosol (SCILLA) campaign. A counter-flow virtual impactor (CVI) was used to sample cloud residuals, while an isokinetic inlet was used to sample both interstitial particles and cloud residuals.

To improve understanding of the role of BC particles as cloud condensation nuclei and to assess impacts of local meteorology on clouds and aerosols, a subset of 7 flights which conducted above, below, and within cloud layer samples were analyzed. Cloud droplet sizes decreased from upwind to downwind of San Clemente Island; the percentage of droplets with diameters larger than 11 µm was approximately 97% upwind but dropped to ~53% and ~15% at two cloud modules downwind. Mass concentrations of BC in cloud droplet residuals and in clear air below clouds increased from upwind to downwind, indicating the effects of pollution gradients and island wake turbulence. BC made up 1.07% to 2.60% of total sub-micron aerosol mass in cloud residuals. The size distributions of BC in cloud residuals were shifted towards larger diameters as compared to the BC size distributions out of cloud in upwind regions, but this shift was less consistent downwind. The vertical evolution of BC indicated efficient aerosol exchanges, including cloud processing and activation. Detailed characterization will help to understand the connection between BC and cloud properties and to evaluate their impact on the marine environment.

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2AA.5

Investigating the Relationship between Oxidative Potential and Absorption Strength of Biomass-Burning Organic Aerosols. YUEZHI (AUGUST) LI, Joseph V. Puthussery, Rajan K. Chakrabarty, *Washington University in St. Louis*

Organic aerosols emitted from biomass-burning events impose profound impacts on Earth's radiative budget and are a major contributor to ambient particulate pollutants. When inhaled, these particles can generate excess reactive oxygen species that cause oxidative stress, leading to respiratory diseases. The capability of aerosols to induce oxidative stress is defined as their oxidative potential (OP).

In this study, we aim to investigate the relationship between OP and absorptivity of biomass-burning aerosols. We generated the aerosols in a combustion chamber by burning three prominent biofuels in North America: white sage, Douglas fir, and cheatgrass. The particles were collected on filters and extracted into water and methanol. An integrated photoacoustic nephelometer, operated at 405, 721, and 1047 nm, measured the ensemble-scale aerosol light absorption. For the soluble organic components, the absorption was measured using an ultraviolet-visible spectrophotometer, and the OP was quantified using in vitro dithiothreitol (DTT) assay. Preliminary results show that the OP of water-soluble components increased with total and water-soluble mass absorption coefficients (MAC) across all wavelengths, with sage aerosols ranked the lowest and grass aerosols the highest. This possibly suggests a correlation between the absorptivity and toxicity of water-soluble biomass-burning aerosols. However, this trend did not hold for methanol extracts. At 405 nm, the methanol-soluble organics from sage were the most absorptive ($MAC_{sage,methanol,405}$ = 0.5 m^2/g) but least toxic. In contrast, the methanol-soluble components from fir and grass were less absorbing with MAC values of 0.2 and 0.4 m^2/g but contributed ~21% and ~33% higher to OP, respectively, compared to sage. More replicates are required to consolidate these results. This study will provide insights into the link between health effects, solubility, and absorptivity of biomass-burning aerosols and could spur new mitigation strategies for the affected populations.

2AA.6

Determination of the Sulfur Mass Balance in Isoprene Epoxydiol-Derived Secondary Organic Aerosols. REBECCA TURNER, Tracy Dombek, N. Cazimir Armstrong, Adam Conway, Barbara Turpin, Zhenfa Zhang, Avram Gold, Andrew P. Ault, Jason Surratt, *University of North Carolina at Chapel Hill*

Isoprene epoxydiols (IEPOX), major atmospheric oxidation products of the abundant biogenic VOC isoprene, contribute extensively to secondary organic aerosol (SOA) formation in Earth's troposphere in low-NOx regions. IEPOX undergoes acid-catalyzed multiphase chemical reactions with anthropogenically derived acidic sulfate aerosol particles, forming a variety of low-volatility and semivolatile SOA products. One class of low-volatility SOA products is organosulfates (OS), which result from inorganic sulfate covalently bonded with IEPOX upon its epoxide-ring opening reactions. However, the mass balance between inorganic sulfate OS has yet to be constrained by laboratory studies under varying aerosol acidity conditions representative of atmospheric aerosols.

In this study, smog chamber experiments were conducted to constrain the mass balance between organic and inorganic sulfur. The SOA formed during these experiments were collected onto filters and subsequently chemically analyzed with ion chromatography (IC) and inductively coupled plasma interfaced to optical emission spectroscopy (ICP-OES) to determine the change in sulfur form before and after reaction with IEPOX. From our initial results, the percentage of inorganic sulfate converted to OS in IEPOX-derived SOA is approximately 47.1 to 50.2%. Methyltetrol sulfates, the most abundant form of OS found in atmospheric aerosols, will be quantified by HILIC/ESI-HR-QTOFMS, allowing for the first determination of the total mass fractions of oligomeric OS.

This work will help atmospheric modelers in their predictions of SOA formation and sulfur mass balance in atmospheric aerosols, which has not been well constrained by models thus far. Ongoing work will include further constraining the effect of initial IEPOX: inorganic sulfate mass ratio at a fixed aerosol acidity on the particulate sulfur mass balance in chamber experiments.

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2AA.7

Investigating Vertical Profiles of Aerosols with ARM's Unmanned Aerial Systems and Tethered Balloon Systems.

FAN MEI, Qi Zhang, Mikhail Pekour, Christopher Niedek, Israel Silber, Damao Zhang, Darielle Dexheimer, Beat Schmid, Jason Tomlinson, Susanne Glienke, Gourihar Kulkarni, Hardeep Mehta, Swarup China, Zezhen Cheng, Nurun Nahar Lata, *Pacific Northwest National Laboratory*

This study presents multiple deployments leveraging a mid-size Unmanned Aerial System (UAS, ArcticShark) and the Tethered Balloon System (TBS), to probe aerosol properties and boundary structures during multiple deployments between 2022 and 2023. Focusing on aerosols, we integrate the spatiotemporal data from in situ measurements and remote-sensing technology to offer valuable comparisons and reveal the consistency and complementarity of these methodologies. Additionally, we obtained unique chemical composition profiles using advanced offline chemical analysis techniques for the aerosol samples collected at the SGP site during March, June, and August 2023. By studying seasonal variations in aerosol properties, we correlated them with the potential influential sources. In addition, the aerosol optical profiles and CCN profiles were derived. This research has significant implications for advancing our knowledge of the vertical gradient of atmospheric aerosols, enhancing air quality monitoring strategies, and informing aerosol transport models.

2AA.8

Global Simulations of Phase State and Equilibration Time Scales of Secondary Organic Aerosols with GEOS-Chem.

REGINA LUU, Meredith Schervish, Nicole June, Samuel O'Donnell, Shantanu Jathar, Jeffrey R. Pierce, Manabu Shiraiwa, *University of California, Irvine*

The phase state of secondary organic aerosols (SOA) can range from liquid through amorphous semisolid to glassy solid, which is important to consider as it influences various multiphase processes including SOA formation and partitioning, multiphase chemistry, and cloud activation. In this study, we simulate the glass transition temperature and viscosity of SOA over the globe using the global chemical transport model, GEOS-Chem. The simulated spatial distributions show that SOA at the surface exist as liquid over equatorial regions and oceans, semisolid in the midlatitude continental regions, and glassy solid over lands with low relative humidity. The predicted SOA viscosities are mostly consistent with the available measurements. In the free troposphere, SOA particles are mostly predicted to be semisolid at 850 hPa and glassy solid at 500 hPa, except over tropical regions including Amazonia, where SOA are predicted to be low viscous. Phase state also exhibits seasonal variation with a higher frequency of semisolid and solid particles in winter compared to warmer seasons. We calculate equilibration time scales of SOA partitioning (τ_{eq}) and effective mass accommodation coefficient (α_{eff}), indicating that τ_{eq} is shorter than the chemical time step of GEOS-Chem of 20 min and α_{eff} is close to unity for most locations at the surface level, supporting the application of equilibrium SOA partitioning. However, τ_{eq} is prolonged and α_{eff} is lowered over drylands and most regions in the upper troposphere, suggesting that kinetically limited growth would need to be considered for these regions in future large-scale model studies. We implement a kinetic partitioning scheme using α_{eff} directly into the GEOS-Chem model to treat dynamic partitioning of SOA to investigate effects of phase state on SOA mass loadings in the atmosphere.

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2AA.9

Advancing the Molecular Understanding of Primary and Aged Residential Biomass Emissions with CHARON-PTR-ToF-MS and EESI-ToF-MS. YAMINA ALLOUCHE, Rachel Gemayel, Sergio Harb, Jérôme Beaumont, Serge Collet, Ali Hnaino, Nicolas Karoski, Vincent Fuvel, Jason Bardou, Adrien Dermigny, Laurent Meunier, Théo Claude, Robin Aujay-Plouzeau, Céline Ferret, Nathalie Bocquet, Andrea Baccarini, Nikunj Dudani, Pabrito Ray, Luka Drinovec, Griša Močnik, Brice Temime-Roussel, Barbara D'Anna, Alexandre Albinet, *INERIS*

Residential wood combustion is a significant source of $PM_{2.5}$ during winter. It also emits large quantities of volatile and semi-volatile organic compounds (VOCs and SVOCs), which undergo atmospheric oxidation, leading to the formation of secondary organic aerosols (SOA) significantly contributing to ambient $PM_{2.5}$ concentrations. Despite the importance of these processes, the mechanisms and SOA formation potential from biomass burning emissions remain poorly understood, particularly in nighttime conditions involving nitrate radicals. Understanding the chemical transformations of these emissions at a molecular level is crucial for assessing their environmental and health impacts. This study focuses on the molecular characterization of primary and aged emissions from a modern wood stove using two advanced online mass spectrometry techniques: CHARON-PTR-ToF-MS and EESI-ToF-MS. Experiments were conducted using a mixture of three hardwood species (beech, oak, and hornbeam) or spruce following the beReal test protocol to simulate real-life wood heating performances. The diluted emissions (20-50 times) were aged at ambient temperature and relevant relative humidity (40-60%) using a potential aerosol mass-oxidation flow reactor (PAM-OFR) under daytime and nighttime conditions with OH (OFR-185) and NO_3 (dark OFR-iN2O5) radicals, respectively. Primary and secondary emissions were characterized simultaneously in real-time using various instruments ((CHARON)-PTR-ToF-MS, CI-ToF-MS, Xact, PTAAM-2, AIR monitor, HR-ToF-AMS, ACSM, AAC, CPMA, SMPS, CPC, AE33, gas analyzers) located before and after the PAM-OFR. These instruments provided detailed information on the chemical composition of both particulate and gaseous phases, as well as particle size distribution, density, number concentration, and light absorption properties. Samples were also collected manually for gravimetric, physical (PM morphology), and chemical analysis. A comparison of the PM chemical fingerprints and molecular descriptions obtained using both CHARON-PTR-ToF-MS and EESI-ToF-MS will be presented and discussed for selected combustion and aging conditions. This work was supported by ADEME (WOODNIGHT project, n° 2262D0034) and the French Ministry of environment.

2AA.10

Sensitivity of Ambient Secondary Organic Aerosol Formation to Perturbations Measured Using Parallel Photochemical Smog Chambers. RASHMI RAJPUT, Shenglun Wu, Benjamin Schulze, Ryan Ward, Qi Zhang, Christopher Cappa, John Seinfeld, Michael Kleeman, *University of California, Davis*

Secondary organic aerosol (SOA) is a major constituent of $PM_{2.5}$, impacting human health, atmospheric visibility, and climate. This study investigates the sensitivity of urban SOA formation to controlled perturbations in volatile organic compounds (VOCs) and nitrogen oxides (NO_x) at atmospherically-relevant concentrations using mobile chamber experiments at two California locations, Pasadena and Sacramento. SOA produced from photooxidation was measured with a high-resolution Aerosol Mass Spectrometer (HR-AMS) in three parallel chambers filled with ambient air: VOC-perturbed, base-case (control), and NO_x-perturbed. Chamber air was aged with UV exposure equivalent to a bright summer day in California for three hours. Compared to the base case, SOA production was suppressed in chambers with 8 ppb of NO_x-addition at both locations, consistent with RO_2 + NO reactions producing more volatile products, including organic nitrates. In Pasadena, 8 ppb of VOC addition increased SOA concentrations by 21% compared to base-case conditions, likely due to enhanced oxidation via RO_2 + HO_2 pathways forming semi-volatile products that absorbed into the existing condensed organic aerosol (OA) matrix. In Sacramento, where initial OA concentrations in the chamber were an order of magnitude lower than Pasadena (because of differences in chamber filling operation), VOC addition reduced SOA production by a factor of two, likely because of reduced condensation owing to reduced OA matrix. Analysis via positive matrix factorization provides further insights into how different OA types evolve with aging and helps explain the sensitivity to VOC/NO_x perturbations. The measured trends imply that minor reductions in NO_x emissions could increase SOA production. Moreover, reduction of primary organic aerosol (POA) could reduce SOA yields, a potential strategy to mitigate the impact of increased VOC emissions from increased temperatures. This underscores the dual importance of considering both gas-phase chemistry and phase partitioning when designing control programs to reduce ambient SOA concentrations.

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2AA.11

Observational Constraints on the Total Contributions of Biomass Burning to Ambient Organic Aerosol. MITCHELL ROGERS, Taekyu Joo, Lijin Zhang, Tori Hass-Mitchell, Benjamin Murphy, Ziheng Zeng, Theobard Habineza, Abhishek Anand, Dexter Resta, Catelynn Soong, Albert Presto, Havala Pye, Drew Gentner, *Yale University*

Biomass burning represents a growing, yet uncertain source of primary and secondary organic aerosol globally. Despite this, source apportionment of organic aerosol mass spectrometry data alone risks underestimating organic aerosol attributable to biomass burning (BBOA). These challenges occur, in part, because oxidative aging diminishes characteristic spectral peaks of BBOA (i.e., m/z 60, 73; levoglucosan fragments), rendering it less distinguishable from other oxygenated organic aerosol with elevated signal at m/z 44 (e.g., organic acids). With tropospheric aerosol lifetimes of several days, biomass burning emissions can travel long distances and originate from a range of combustion sectors (e.g., wildfires, residential wood combustion) and types (e.g., smoldering, flaming). Since potassium is one of the most abundant metals in biomass burning emissions and remains present after transport and oxidative aging, it has utility as a quantitative tracer for biomass burning organic aerosol. The objective of this study is to provide observational constraints on the total contributions of biomass burning to organic aerosol. Specifically, we leverage multiple years of chemically resolved $PM_{2.5}$ measurements from two ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) sites alongside filter measurements to isolate biomass burning potassium from other potassium sources through multiple methods, including both positive matrix factorization of metals data as well as application of derived dust emissions profiles. We then utilize a distribution of biomass burning organic aerosol and potassium emissions ratios derived from literature and recent field measurements to estimate the total contributions of biomass burning to organic aerosol (TBBOA), which presents as an accessible and transferrable method. Additionally, backward air mass trajectories and the Community Multiscale Air Quality modeling system (CMAQ) are used to isolate wildfire and non-wildfire contributions to TBBOA and evaluate their spatiotemporal variations. Lastly, we assess how our top-down quantification of TBBOA compares to model predictions and other source apportionment approaches.

2AA.12

Characterization of the Optical Properties of Nitroaromatic Brown Carbon Aerosols Using Single Particle Techniques. MALSHA AMUGODA, Pedro De Allende, Bilal Shokoor, James F. Davies, *University of California, Riverside*

The scattering and absorption of light by aerosol particles depend on both the real and imaginary part of the complex refractive index (RI). Multifunctional nitroaromatic brown carbon (BrC) chromophores show significant light absorption in the short wave visible range of the solar spectrum. Predicting the contribution of aerosol particles containing BrC to the radiative budget is challenging due to the dependence of the optical properties on the exact chemical composition, with factors such as pH playing an important role.

In this study, we describe a method to retrieve the wavelength-dependent complex RI of aqueous BrC microdroplets levitated in a linear quadrupole electrodynamic balance (LQ-EDB) under controlled relative humidity (RH). A sample BrC droplet is levitated alongside a non-light-absorbing probe droplet and both are illuminated with broadband LED light (425 to 780 nm). Backscattered light is collected consecutively from each droplet and the spectra are processed together to obtain an intensity-calibrated spectrum for the BrC droplet.

We use this method to characterize the optical properties of a series of nitroaromatic chromophores (NAC) and their internal mixtures with inorganic salts. We identify that the optical properties of the NAC also depend on their volatility and hygroscopicity, and we characterize the evolution of optical properties with composition. Furthermore, based on the initial mixing ratio, RH, and volatility, we observe that some samples undergo liquid-liquid phase separation, thereby changing their optical properties. Moreover, increasing the bulk pH to form sodium salts of NAC produces a marked change in the particle properties, including scattering, absorption, volatility, and phase state. Overall, this study aims to connect the optical properties of BrC aerosol with their chemical composition, phase state, and evolution over time.

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2AA.13

Highly Oxidized Molecules Make a Significant Contribution to Enhanced Aromatic-Derived Secondary Organic Aerosol under a Humid Environment. ZHAOMIN YANG, *University of California, Irvine; Shandong University*

Enhanced mass concentrations of aromatic-derived secondary organic aerosol (SOA) are frequently observed during humid-haze events. However, the influencing mechanism of relative humidity (RH) in aromatic-derived SOA formation remains incompletely understood. Here, the RH dependence of SOA formation in the presence of NOx was explored by a series of chamber experiments for toluene (TOL) and 1,3,5-trimethylbenzene (TMB) photooxidation. The yield of TOL SOA and TMB SOA increased by 221% and 52% with increasing RH from ∼8% to ∼70%, respectively. Analytical results from a high-resolution mass spectrometer showed that SOA constituents with high oxygen content (O/C > 0.6) were more abundant in SOA formed in the ∼70% RH experiment. The elevated yields and O/C of SOA could be attributed to the promoted formation and particle-phase diffusivity of highly oxidized molecules. In addition, in comparison with TMB, TOL could produce more unsaturated aldehydes, which are oxidized into carboxylic acids with high O/C, leading to a more sensitive response of TOL SOA formation to the change in RH. Our work provides mechanistic insights into RH roles in aromatic SOA formation and is helpful for a better understanding of humid-haze events.

2AC.1

Enhanced Light Absorption of Levitated Droplets of Methoxyphenols upon Uptake and Complexation of Benzoquinone. AHMADRAZA CHAUDHARY, Micah Miles, Colton Calvert, Elijah Schnitzler, *Oklahoma State University*

Biomass burning is one of the major sources of light absorbing organic aerosol, or brown carbon (BrC), in the atmosphere. These aerosols influence the radiative balance of the atmosphere by absorbing and scattering sunlight, particularly in the visible and near-ultraviolet region, or altering cloud nucleation processes. Previously, we have shown that the light absorption of a representative methoxyphenol from biomass burning, i.e., guaiacol, can be enhanced in bulk solutions and thin films through intermolecular interactions with quinones that act as electron acceptors to form non-covalent complexes. Quinones are known to form in the atmosphere from the gas-phase OH-initiated oxidation of aromatic precursors. Here, we extend this effort to explore the role of intermolecular interactions in the light absorption of methoxyphenols by monitoring the absorbance of acoustically levitated micrometer-scale droplets upon exposure to gas-phase benzoquinone. Droplet size and evaporation are monitored by photography and image analysis. Droplet absorbance is measured using a broadband light-source and miniature grating-based spectrometer coupled to the acoustic levitator. The droplets are exposed to varying mixing ratios of benzoquinone, based on its sublimation vapor pressure, by flowing gas through a sealed chamber that encloses the levitator. Upon uptake of gaseous benzoquinone to the droplets of methoxyphenols, absorbance was found to increase, attributed to complexation. Varying programs of benzoquinone exposure, i.e., decreasing mixing ratio in time, were explored. These results have implications for the impacts of abundant methoxyphenol emissions of biomass burning on air quality, visibility, and climate.

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2AC.2

Linking the Physicochemical Properties of Brown Carbon to the Production of Singlet Oxygen and Organic Triplets Excited States in Atmospheric Aqueous $PM_{2.5}$. THEODORA NAH, Yuting Lyu, Yitao Li, Ruihan Ma, Tianye Zhou, *City University of Hong Kong*

Aqueous photooxidants such as singlet oxygen ($^1O_2$*) and organic triplet excited states (^3C*) are known to drive many chemical processes in atmospheric waters. While it is widely recognized that the photoexcitation of brown carbon (BrC) in atmospheric aqueous aerosols can lead to the photochemical production of $^1O_2$* and ^3C*, the physicochemical properties of BrC that govern the production of these photooxidants remain poorly understood. Here, we combined $^1O_2$* and ^3C* measurements of aqueous $PM_{2.5}$ collected during different seasons and in different parts of Hong Kong, South China with corresponding measurements of the physicochemical properties of the aqueous BrC, and applied various statistical tools and non-negative matrix factorization (NMF) to link the BrC physicochemical properties to $^1O_2$* and ^3C* production. Three fluorescent components, less oxygenated compounds from biomass burning, highly oxygenated compounds, and aromatic derivatives, were identified in aqueous BrC. NMF attributed >85 % of wintertime ^3C* production to biomass-burning BrC, while summer $^1O_2$* production was attributed to aged marine aerosols. Spearman correlations revealed strong associations between $^1O_2$* concentrations and absorption coefficients (e.g., α_{300}), while ^3C* correlated with aromaticity proxies (e.g., $S_{275\text{-}295}$). Multiple linear regression revealed that α_{254} and biological index (BIX) could be used to predict $^1O_2$* (r^2 = 0.95) and ^3C* (r^2 = 0.77) concentrations, respectively, thus indicating that the photochemical production of photooxidants in atmospheric waters could be predicted using measurable BrC physicochemical properties.

2AC.3

Optimizing Aerosol Composition in Hygroscopic Burn-in-Place Flares: Advancing Cloud Seeding and Precipitation Enhancement. SWAFUVA SULAIMAN, Kurt Hibert, James Simmons, Hamed Sadi, Amir Nazem, Suryadev Singh, Andrei Vakhtin, Bruce Boe, Jesse Anderson, Charlie Harper, Raymond Shaw, Will Cantrell, *Michigan Technological University*

Understanding the relative abundance and contribution of each element in hygroscopic burn-in-place flares is essential to evaluate their effectiveness in cloud seeding applications. Scanning Electron Microscopy (SEM) studies, coupled with Energy Dispersive X-ray (EDX) spectroscopy, offer a powerful approach to perform size distribution analysis, chemical characterization of the flares, and quantitative assessment of the elemental composition of cloud seeding flare residues. By correlating the measured weight percentages from spectral analysis with theoretical stoichiometric calculations, it becomes possible to evaluate the incorporation and balance of key hygroscopic elements. Furthermore, EDX chemical mapping provides valuable insights into the spatial and size-dependent distribution of these elements. Such detailed characterization allows for a better understanding of how aerosol hygroscopicity is influenced by their mixing state. This study focuses on flares containing calcium chloride as the primary hygroscopic agent and highlights how effectively the seeding agent contributes to the hygroscopic burning of the flares that act as Cloud Condensation Nuclei (CCN). This study also addresses the contribution to hygroscopicity when the seeding material exists as a mixture of species. These findings help to optimize and quantify the effectiveness of seeding flares in hygroscopic seeding and their ultimate impact on weather modification strategies.

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2AC.5

Chemical Composition of Fire Smoke-Emitted Organics in the Gas and Aerosol Phase During the Recent G-WISE-2 Prescribed Burn Experiments. VIGNESH VASUDEVAN GEETHA, Lee Tiszenkel, Rawad Saleh, Joseph O'Brien, Shanhu Lee, *University of Alabama Huntsville*

Forest fires are emerging and significant air pollutant sources, but it is currently poorly understood how oxygenated organics generated from fires vary with different fuel and burn conditions. Prescribed fires are designed to mitigate the intense wildfires to reduce the widespread fire exposures to the environment and human beings. In this study, we will present the chemical compositions of the oxygenated organics, a major SOA precursor, in the gas and aerosol phase emitted from the burn experiments during the recent G-WISE-2 (Georgia Wildland fire Simulation Experiment) campaign conducted in the forest fire lab in the University of Georgia. Burn experiments to simulate prescribed fire activities were carried out using fuel beds reconstructed from surface fuels resembling forest floors in the Southeastern United States. The fuel beds (fine, woody, and duff) are burned under different conditions of moisture, relative humidity, duff content, and burn conditions (flaming or smoldering) specific within the typical prescription window. Using an online FIGAERO-HrTOF-CIMS (filter inlet for gas and aerosol coupled with high-resolution time-of-flight chemical ionization mass spectrometer) with iodide reagent and offline LC-ESI Orbitrap MS (liquid chromatography-electrospray ionization Orbitrap mass spectrometer), we characterized and quantified the oxygenated organics emitted from the burns under the different controlled conditions. In this presentation, we will discuss the effects of external factors such as fuel bed composition, fuel moisture content, wind speed, and burn intensity on overall oxygenated organic molecule (OOMs) composition and volatility distribution in the fresh and aged aerosols to understand the chemical processes involved in their formation and evolution in the smoke plume.

2AC.6

Impact of Photolysis-driven Aging on Chemical Transformations in Biomass Burning Organic Aerosol (BBOA) Particles. JANIE (YEASEUL) KIM, Willow Hwang, Manjula Canagaratna, Benjamin A. Nault, Anita Avery, Mitchell Alton, Lisa Azzarello, Elise Palombella, Christopher Cappa, Cora Young, Rachel O'Brien, *University of Michigan*

Biomass burning organic aerosol (BBOA) particles can travel long distances and eventually arrive in urban areas where they are often deposited on outdoor surfaces. During transport and after deposition, one of the key aging pathways for these aerosols is photolysis-driven aging under sunlight. Throughout this process, the chemical composition of BBOAs can be altered, potentially changing their behavior and interactions with the surrounding environment. Previous studies suggest that water in humid conditions can act as a plasticizer, enhancing molecular mobility and possibly accelerating chemical reactions.

In this study, we conducted controlled long-term photolysis experiments on fresh BBOA samples under both dry and humid conditions. Additionally, we examined the aging of re-atomized water-soluble fractions of BBOA particles to reflect their potential cloud processing during atmospheric transport. Given their hydrophilic properties and increased water uptake in humid environments, these water-soluble fractions may experience distinct photolytic reaction pathways.

To characterize molecular-level changes, we applied complementary analytical techniques, including high-resolution Electrospray Ionization Orbitrap mass spectrometry (ESI-Orbitrap-MS), Aerosol Mass Spectrometry (AMS), and Size Exclusion Chromatography with UV detection (SEC-UV). These methods allowed detailed assessments of functional group alterations, shifts in molecular weight distributions, changes in carbon oxidation states, and variations in light absorption properties.

This work provides new insights into how relative humidity influences the photolysis-driven aging of fresh and water-soluble BBOA particles. By linking environmental conditions to chemical transformation pathways, this study will improve our understanding of how aged BBOA contributes to air quality and climate change during and after long-range transport.

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2AC.7

Comparing the Reactivity of Aqueous Brown Carbon Precursors in Aqueous Solutions and Levitated Droplets. ERIN BOWEY, Prakriti Singh, James F. Davies, Paula K. Hudson, *University of California, Riverside*

Aqueous phase reactions between aldehydes and small amino acids produce a wide array of products that contribute to the formation of brown carbon (BrC) aerosol. The reaction products and their chemical processing are highly variable and large uncertainties remain, especially with atmospheric aging over time. These reactions have been studied extensively in bulk aqueous solutions representative of cloud droplets, but the rapid liquid-vapor partitioning, enhanced surface adsorption and viscosity effects, and unique phase morphologies presented by droplets play important roles for their chemistry that are not reproducible in a bulk solution of similar composition. Furthermore, the influence of aerosol-phase processing following loss of water is not well understood. In this work, we leverage single particle levitation using a linear quadrupole electrodynamic balance (LQ-EDB) and mass spectrometry using an open port sampling interface (OPSI-MS) to compare the chemistry of glyoxal (GX) or methylglyoxal (MeGX) with glycine (Gly), in both bulk solution and levitated droplets. We compare the optical properties and composition for samples aged over a series of days, with varying initial compositions, with a focus on identifying the similarities and differences between aging in bulk solution versus aging in a droplet. These measurements will provide a more complete understanding of the formation and lifetime of aqueous BrC aerosol necessary to inform on their effects in the environment.

2AC.8

Modeling Secondary Organic Aerosol Formation During Daytime and Nighttime via Multiphase Reactions of Phenolic Compounds. TAMANNA TASNIM, Myoseon Jang, Quang Tran Vuong, *University of Florida*

Wildfires release the vast majority of gaseous pollutants that adversely impact human health and climate. When these fire plumes mix into urban atmospheres abundant in NO_x, ozone formation becomes active, impacting the air quality of the city and background air. Phenols are abundant in wildfire gases, and significantly yield Secondary Organic Aerosol (SOA) mass under the typical urban atmosphere where NO_x can gear an atmospheric oxidation cycle. Hitherto, both gas mechanisms of key phenols of fire smoke and SOA models are either nonexistent or subject to large uncertainties when simulating the impacts of wildfires and urban fires on air quality. In this study, the SOA formation is predicted using the UNIfied Partitioning Aerosol Reaction (UNIPAR) model, which can accurately predict SOA mass and aerosol properties via multiphase reactions of phenolic compounds such as phenol, cresol, and catechol, and methyl-catechol. Phenols can react with OH radicals, O_3, and NO_3 radicals. Explicitly predicted products from phenol oxidations with these three oxidation paths are employed in UNIPAR. Phenol gas mechanisms will include chemistry of RO_2 and HO_2 under different NO_x levels and the mechanisms to form Highly Oxidized Molecule including multi-hydroxybenzene and their multigeneration products. Another unique aspect of phenol chemistry is the formation of persistent phenoxy radicals, which catalytically consumes O_3 via a phenoxy-phenyl peroxide radical cycle integrated with NO_x chemistry. Gas mechanisms will be connected to the oxidation-path-dependent stoichiometric coefficients of lumping species which allow for the simulation of the atmospheric aging of phenols during daytime and nighttime ultimately allowing SOA prediction. The performance of UNIPAR is demonstrated using UF-APHOR chamber data under varying environmental conditions (daytime vs. nighttime, humidity, temperature, and NO_x levels).

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2AC.9

Evaluating Approaches to Simplify Automatically Generated Oxidation Reaction Mechanisms. NAZIFA SAYEED, Jia Jiang, Kelley Barsanti, Gabriel Isaacman-VanWertz, *Virginia Tech*

Oxidation in the atmosphere of a single reactive organic compound can generate thousands or tens of thousands of products. Chemical mechanisms used in atmospheric modeling need to be simplified to avoid slowing down simulations and/or making it difficult to interpret or manage output. This project aims to develop and examine a generalizable method for generating oxidation mechanisms of reactive organic compounds that can be efficiently and reasonably implemented into detailed chemical models without significantly biasing the output products. We developed a Python-based automated pipeline to interface with the SAPRC MechGen mechanism generation tool to simulate the oxidation of volatile organic compounds (VOCs) under various environmental conditions. We use this tool to evaluate different methods for simplifying the reaction chemistry, primarily focusing on approaches internal to MechGen that winnow reactions by yields and an external "step-forward" approach that limits the number of generations and allowable number of reactions of each product. To enable the external approach, the system performs automated generation of reaction pathways, cleans and restructures the data, and simplifies the reaction network by replacing transient radicals that are not typically treated in simple chemical models (i.e., alkyl, alkoxy) with their stable and/or peroxy radical products. Output chemistry is provided in a format designed for integration into the F0AM (Framework for 0-dimensional Atmospheric Modeling) chemical box model. We evaluate differences in the product mixture using several different simplification approaches: full multi-generational oxidation using MechGen, directly applied with different thresholds for yields under which reactions are removed, and "step-forward" chemistry using MechGen for each step with different numbers of generations and products considered. The chemistry of the product mixture of a testbed simulation of alpha-pinene oxidation is examined under each scenario, including distributions of elemental composition, aerosol formation, and gas-phase reactivity, and compared to explicit chemical mechanisms previously validated against experimental data.

2AC.10

Low-Temperature Flow Tube Studies of Secondary Organic Aerosol Formation. MATTHEW GOSS, Frank Keutsch, *Harvard University*

Most laboratory studies of organic aerosol are performed at room temperature, yet much of the atmosphere features lower temperature conditions. For example, secondary organic aerosol (SOA) may form during winter or due to the reactions of lofted reactive VOCs (e.g., from a wildfire event) in the free or upper troposphere. Such conditions affect aerosol formation and properties, for example changing chemical kinetics, aerosol viscosity, and uptake rates. Using a chilled aerosol flow tube, this work examines SOA formation and aging processes across a range of representative temperatures for a series of VOCs relevant to biomass burning emissions, including those typically thought to be too volatile to contribute to aerosol formation. Using chemical ionization mass spectrometry, this work explores trends in both aerosol yield and composition as a function of temperature and evaluates these measurements in the context of SOA modeling methods in chemical transport models.

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2AC.11

Implementation and Assessment of the Automated MOdel REduction (AMORE v2.0) Algorithm on Monoterpenes.
KATHERINE STEVENSON, Forwood Wiser, V. Faye McNeill, *Columbia University*

Full oxidation mechanisms of volatile organic compounds are too computationally costly to be included in large-scale chemical transport and air quality models. The graph theory-based Automated MOdel REduction (AMORE) version 2.0 algorithm simplifies chemical mechanisms, while retaining yield accuracies, to enable their use in 3D models. AMORE employs several graph theory techniques to estimate yields, sort species, group similar species, and ultimately reduce the size and complexity of oxidation mechanisms. Yields of semi-volatile oxidation products that are significant for secondary organic aerosol (SOA) formation are prioritized. Thus far, the reductions of an experimentally-derived isoprene and GECKO-derived camphene oxidation mechanisms have been conducted with AMORE v2.0 and extensively analyzed (Wiser et al., 2025). To further improve algorithm generalizability and automation, AMORE has been implemented for the reduction of an α-pinene oxidation mechanism. To obtain a comprehensive α-pinene oxidation mechanism, Master Chemical Mechanism v3.3.1's α-pinene oxidation mechanism (Jenkin et al., 1997; Saunders et al., 2003) was supplemented with the Peroxy Radical Autoxidation Mechanism (Roldin et al., 2019). This ensured that the formation of highly oxygenated molecules from α-pinene, which are crucial for accurately estimating SOA yields, were incorporated. The α-pinene oxidative mechanism provides a valuable opportunity to assess the accuracy and versatility of AMORE v2.0 due to its increased complexity and presence of many peroxyacyl nitrate strongly connected components (SCCs), or cycles. The performance of the AMORE-derived reduced α-pinene oxidation mechanism and modifications to the AMORE v2.0 algorithm, which prevent undesirable species groupings and SCC removals, are evaluated. To test the algorithm's ability to reduce mechanisms with multiple "root" species, the same analyses were performed with an α-pinene, β-pinene, and limonene oxidative mechanism.

2AC.12

Understanding Key Oxidant and RO_2 Regime Combinations in Indoor Spaces.
ISABEL ALBORES, Hannah Kenagy, Jesse Kroll, *MIT*

Indoor oxidation chemistry differs markedly from that of the outdoors due to lower UV levels, reduced ventilation, and distinct chemical sources. Despite this, many studies of indoor oxidation processes rely on experiments or parameterizations aimed at simulating outdoor ambient air. A key chemical distinction is the initiating oxidant: indoor air chemistry is often initiated by ozone (O_3), though hydroxyl radicals (OH) can also contribute, with key sources including alkene ozonolysis and interventions such as air cleaners or germicidal UV (222 nm) lights. The fate of peroxy radicals (RO_{22} regimes in indoor environments, based on past measurements and modeling. We also use the Framework for 0-Dimensional Atmospheric Modeling (F0AM) to probe the full range of RO_2 fates in indoor environments, informing chamber experiments aimed at simulating indoor conditions. Experiments focused on limonene were performed in a 7.5 m^3 Teflon chamber, using mixtures of O_3, OH precursors, and NO_x to probe relevant oxidant and RO_2 regimes. A chemical ionization mass spectrometer (CIMS) and an aerosol mass spectrometer (AMS) measured gas and particle-phase oxidation products. We examine formation of SOA and other products under these conditions, comparing with those of previous chamber experiments centered on simulating outdoor conditions.

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2AC.13

Dark Ozonolysis of cis-Cycloalkenes (C5-C8): Investigating SOA Formation, Transition Temperatures, and Temperature Cycling Effects in the UCR Atmospheric Chamber. DANIEL GONZALEZ, Sunandan Mahant, Yanyu Zhang, Markus Petters, David R. Cocker III, *University of California, Riverside*

Cis-cycloalkenes provide a structurally constrained and chemically relevant model system for studying secondary organic aerosol (SOA) formation, offering unique opportunities to isolate the effects of molecular ring size and configuration on aerosol properties. Despite their relevance to both biogenic and anthropogenic emissions, the mechanistic drivers of SOA evolution from these compounds remain underexplored.

This study investigates the dark ozonolysis of a homologous series of cis-cycloalkenes (C5-C8) using the UCR Environmental Chamber, focusing on how ring size influences SOA formation, volatility, density, and phase behavior under temperature cycling. Multiday experiments were conducted to capture both the initial particle formation and its subsequent evolution through controlled thermocycling.

A comprehensive suite of instruments was used to characterize particle size, volatility profiles, effective density, and phase transition temperatures. The extended duration of the experiments allowed for assessment of thermal hysteresis in SOA produced from cycloalkene ozonolysis. Two distinct aerosol modes were observed in experiments with initial seed aerosol at temperatures of 5 °C, conversely in experiments with initial temperatures of 35 °C only a unimodal aerosol peak was observed. Additionally, non-equilibrium thermodynamic behavior was observed with respect to thermocycles (5-35-5 °C).

This work provides insight into how molecular structure and thermal history interact to influence SOA formation. The results underscore the need to incorporate precursor-specific behavior and temperature dependent processing into atmospheric models.

2AC.14

Photochemical Aging of Lab-Generated Triclosan Aerosols in the Presence of •OH and Salts. DIANA TRAN, Jonathan Slade, *University of California, San Diego*

Antimicrobial additives, such as Triclosan (5-chloro-2-(2,4-dichloro phenoxy) phenol; TCS), are toxic and accumulate in the environment due to their low solubility and frequent use in everyday household products. TCS may transfer into the aerosol phase at the air-water interface through wave-breaking and bubble-bursting mechanisms in lakes, oceans, and directly from wastewater treatment plants during aeration. Once in the aerosol phase, TCS is prone to photodegradation, producing toxic photoproducts, such as 2,8-dichlorodibenzo-p-dioxin (2,8-DCDD). Although regulated by the FDA, the photo-initiated transformation kinetics of TCS decay and dioxin formation in the aerosol phase, which may differ between bulk solution and surface water, have not been studied. As aerosols are transported in the atmosphere, they are susceptible to chemical aging reactions through interactions with light and oxidants, such as ·OH. This study focuses on the degradation of aerosol-phase TCS by irradiation in the presence of isopropyl nitrite (IPN), forming ·OH and NO_x ($NO+NO_2$), and with or without salts mimicking fresh ($CaCO_3$) and saltwater (NaCl) aerosols. Photochemical aging was conducted in a potential aerosol mass oxidative flow reactor (PAM-OFR) equipped with two 369 nm lamps. TCS and 2,8-DCDD in aerosols were monitored in near real-time with an extractive electrospray ionization high-resolution mass spectrometer (EESI-HRMS). Product analysis was conducted additionally with GC-MS. TCS signal in the presence of IPN showed a greater signal decay, indicating the presence of ·OH may be enhancing the degradation of TCS over time. Effects of varying NO_x, O_3, and temperature in the PAM-OFR on TCS will also be discussed. This work ultimately contributes to a better understanding of TCS's photodegradation kinetics in aerosols, which has implications for public health.

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2AC.15

Production of Dissolved Iron from Atmospheric Processing of Ultrafine and Fine Iron Oxides: Effects of Size and Mineralogy. HEATH D.K. PATTERSON, Sarah C. Garrett, Jenny P.S. Wong, *Mount Allison University*

Iron-containing particles influence oxidative potential and nutrient cycling, with their solubilization through atmospheric processing regulated by mineralogy, particle size, pH, and particle loading. In particular, dissolved iron is an important contributor to aerosol oxidative potential. Natural mineral dust, predominantly in the fine and coarse size ranges (~1–10 µm) and composed of iron oxides and iron-containing clays, has been extensively studied for its ability to produce dissolved iron. However, most of these studies have focused on mineral dust >250 nm. Anthropogenic sources, such as non-exhaust vehicle emissions, industrial activities, and solid biomass burning, also contribute iron oxide particles, including those in the ultrafine (<100 nm) range. Notably, iron oxides contribute to a large mass fraction of ultrafine particles emitted by emergent sources such as non-exhaust emissions. Despite the prevalence of iron-containing ultrafine particles, direct comparisons of iron solubility across different iron oxide minerals and particle sizes, specifically those in the ultrafine range, remain limited.

Here, we developed a semi-automated system using syringe pumps and a flow-through absorbance spectrophotometer to monitor dissolved iron produced during acid dissolution. This system was applied to systematically study iron dissolution from two iron oxides, in both ultrafine (<100 nm) and fine (~1–2 µm) size ranges, under varying pH and particle loading conditions. Results show that iron dissolution was rapid, with dependence on particle size and mineralogy. Mineralogy effects were less significant under the most acidic conditions. By isolating the effects of particle size, mineralogy, loading, and pH conditions, this study provides new insight into the factors regulating the solubility of iron oxide-containing ultrafine particles.

2AC.16

Effect of Mineral Dust Transition Metal Oxides on Photochemistry of Secondary Organic Aerosols. ANTHONY JUE, Sergey Nizkorodov, *University of California, Irvine*

Secondary Organic Aerosol (SOA) makes up a significant fraction of particles in our atmosphere. Volatile organic compounds emitted by biogenic and anthropogenic sources oxidize in the atmosphere through different gas phase reactions and condense into the particle phase, where they can further transform through photochemical processes from solar UV radiation. These processes generate a variety of organic products, resulting in different physical and chemical properties of the resulting aerosol. In addition, organic and aqueous phase compounds can mix with insoluble materials such as mineral dust particles. Mineral dust can contain a variety of transition metal compounds such as metal oxides of iron and titanium, possibly acting as a photocatalytic surface resulting in different chemical transformations during photochemical aging. Soluble iron has been shown to participate in photocatalytic systems such as the Fenton and photo-Fenton cycle, as well as isomerization, oligomerization, and photodegradation reactions. Similarly, titanium dioxide has been shown to be photocatalytic in the UV range, breaking down SOA components. The objective of this study is to determine whether the insoluble mineral dust components such as Fe_2O_3 (hematite), TiO_2 (anatase) and Arizona Test Dust could act as heterogeneous photocatalysts with complex mixtures of lab-generated SOA from α-pinene ozonolysis and naphthalene photooxidation, as well as other single molecules commonly found in SOA. These were modeled in lab solutions with mineral dust slurries photoaged under UV-B light sources and analyzed with UPLC-HRMS to identify the products resulting from these different aging environments. Results have shown that while titanium dioxide behaves as expected in breaking down organic species, hematite does not show the same ability, having little to no effect on the overall product distribution.

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2AC.17

Simulating Prebiotic Earth Environments to Explore the Role of Aerosol Particles in Abiogenesis. STEPHANIE SALAS, Aaron Palmisano, Thomas Preston, Alexander Logozzo, James F. Davies, *University of California, Riverside*

Approximately 4.5 billion years ago, prebiotic Earth had a reducing atmosphere; small amounts of free oxygen and higher amounts of carbon dioxide, ammonia, hydrogen cyanide, and other reactive species. Under intense early solar radiation, unique high-energy environments likely drove otherwise unfavorable chemical transformations. We are investigating the chemistry that could have occurred in aerosol droplets that led to the formation of peptide bonds which ultimately led to more complex biomolecules. Peptide bond formation is not thermodynamically favorable in bulk aqueous solution; however, aerosol droplets provide a unique environment for chemical reactions to occur. A recent collaboration with researchers at McGill University, utilizing aerosol optical tweezers and Raman spectroscopy, has identified the peptide bond formation, of diglycine, by aqueous droplets containing glycine and dicyandiamide (DCD), facilitated by air-water interfaces. It is believed that photochemically excited DCD reacts with glycine, followed by a condensation reaction with glycine which yields diglycine. Our current project aims to investigate this chemistry further by utilizing a linear quadrupole electrodynamic balance (LQ-EDB) to levitate individual particles and Mie resonance spectroscopy to determine the size and refractive index. The particles will be exposed to a blue laser to initiate photochemistry and be ejected individually from the LQ-EDB to an open port sampling interface (OPSI) and aspirated into the electrospray ionization source to be sampled by an Orbitrap Q Exactive mass spectrometer to determine the molecular composition of the levitated particles. By levitating and irradiating single particles with a blue laser, we aim to elucidate the photochemical reaction mechanism and kinetics of peptide bond formation. This approach will provide crucial insights into the role of aerosol chemistry during prebiotic Earth conditions in the emergence of early biomolecules.

2AC.18

Volatility-Resolved Aerosol Chemical Composition using Fast-Switching Chemical Ionization Mass Spectrometry. MANJULA CANAGARATNA, Mitchell Alton, Jenna DeVivo, Mitchell Rogers, Taekyu Joo, Neil Donahue, Andrew Lambe, Drew Gentner, *Aerodyne Research*

Volatility-resolved composition measurements are useful for modeling the partitioning behavior of atmospheric species and are often obtained by coupling a Filter Inlet for Gases and AEROsols (FIGAERO) that volatilizes collected aerosol particles to a chemical ionization mass spectrometer. The selectivity of chemical ionization often limits the range of species that can be characterized by this method. We report on first field and lab measurements from coupling a FIGAERO inlet to a fast-switching bipolar time-of-flight mass spectrometer (BTOF) that cycles through iodide (I-), benzene (C6H6+), protonated acetone dimer ((C3H6O)2H+), and bromide (Br-) reagent ions every 2 seconds. The use of multiple reagent ions allows for simultaneous volatility measurements of a wider range of relevant aerosol species including unsaturated and oxidized organics, organic and inorganic nitrates, sulfates, and reduced nitrogen species.

FIGAERO-BTOF measurements of ambient filters collected during the AEROMMA campaign in New York City are presented. Elemental compositions and thermograms measured across all the reagent ions are discussed. The particle phase composition is also compared with real-time BTOF measurements of gas phase species obtained during the same campaign. Furthermore, laboratory studies are performed to compare iodide and acetone FIGAERO thermograms for a variety of atmospherically relevant ammonium salts and reduced nitrogen species. Iodide and acetone reagent ions provide complementary information about acidic and basic aerosol components, respectively. For example, these intercomparisons indicate that the volatilization of ammonium sulfate proceeds through a stepwise decomposition process in which ammonium sulfate is converted to letovicite (both only yielding ammonia measured by acetone reagent ion) and then finally to ammonium bisulfate which yields both ammonia and sulfuric acid (measured by iodide reagent ion). The laboratory studies shed new light on how physical and chemical processes affect the volatility profiles measured with the FIGAERO.and are used to interpret the thermograms observed from the ambient filters.

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2AC.19

Long Term Trends in $PM_{2.5}$ Particle Components Across New York. OLIVER RATTIGAN, Kevin Civerolo, Amanda Teora, *New York State Department of Environmental Conservation*

The Chemical Speciation Network (CSN) was established in 2000 to monitor spatial and temporal trends in $PM_{2.5}$ particle components. This data is important for tracking the progress of emission controls as well as being useful for health based research. In the Northeastern US the major components of $PM_{2.5}$ particle mass include SO_4 and NH_4 as well as carbonaceous material. NO_3 is important in urban areas particularly during colder months. Over the past two decades large reductions in particle SO_4, NO_3 and NH_4 have been observed across New York. Some reductions in elemental and organic carbon have also been observed. However, indications are that organic carbon maybe increasing in upstate areas particularly in rural locations. The reductions are a result of various emission controls such as the Clean Air Act, Clean Air Act Amendments, NOX State Implementation call, the Clean Air Interstate Rule and Tier 2 light duty vehicle standards, lower sulfur rule as well as improved vehicle technology and cleaner fuels for space heating. Here we examine trends in major $PM_{2.5}$ particle species across New York since the early 2000's. We explore urban-rural contrasts as well as seasonal patterns.

2AC.20

Ambient Air Aerosol Test Facility (AATF): Capabilities and Referee Instrument Measurements from a Recent Test Event for PICARD Program. Vasanthi Sivaprakasam, Paul Johns, Cathy S. Scotto, TOLU ADUROJA, Matthew B. Hart, Ken Grabowski, Jay Eversole, Landon Hernandez, *United States Naval Research Laboratory*

To evaluate performer's technologies for IARPA's Pursuing Intelligent Complex Aerosols for Rapid Detection (PICARD) program, the Ambient Air Test Facility (AATF) at the Naval Research Laboratory is being operated as a test and evaluation facility. The facility draws ambient air from outside the building, with or without HEPA filtration, then introduces generated aerosols of interest. The test section allows sampling and analysis by developmental sensors and various referee sensors to determine aerosol size, concentration, and chemical composition in the presence of realistic backgrounds.

We generate simulant and interferent aerosols representing various classes of chemicals of interest. A range of aerosol generators are used to generate liquid or dry aerosols of interest that becomes well mixed with the carrier air (ambient aerosols or filtered air) in the air tunnel. Multiple referee instruments are used to characterize the resulting aerosols, including a number of commercially available particle sizers. A high-resolution, time-of-flight aerosol mass spectrometer (HR-ToF-AMS) from Aerodyne, Inc., determines inline particle composition. A filter paper collection method followed by gravimetry studies is implemented to validate the total mass loadings.

For a recent test event, a number of chemical aerosols were generated ranging in vapor pressure from 0.15 to 1x10-6 Pa, particle sizes from ~50 nm to 5 µm and concentrations of 50 $\mu g/m^3$ to 2,000 $\mu g/m^3$. Aerosol were generated singly or in combination from wet or dry generations methods. Some of the measurements from the referee instruments will be discussed.

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2AC.21

Ion Concentration Affects the Bubble-Bursting Mechanism for Freshwater Aerosols. GRACE A. YOUNG, Rebecca L. Parham, Carlie Poworoznek, Andrew P. Ault, *University of Michigan*

Lake spray aerosol (LSA) are produced through wave-mediated bubble-bursting in freshwater bodies, which is a similar process to the formation of sea spray aerosols (SSA) from seawater. LSA has the potential to impact community health and climate near bodies of freshwater, though the extent of these impacts remains uncertain. This knowledge gap is partially due to LSA emissions being far less studied than their SSA counterparts, which is problematic due to the drastic differences in the properties of the water (e.g., overall ion concentrations), which change the aerosol emission characteristics. The total salt content of freshwater is ~250× lower than seawater, which impacts the surface tension of the bubbles, affecting their ability to coalesce and subsequently changes the bubbles' densities and radii, and therefore the size distribution of aerosols produced. The goal of this work is to better understand how ion concentration affects the bubble-bursting mechanism and resulting physicochemical properties of LSA. To accomplish this, we used a lake spray aerosol generator (LSA-G) to produce representative particles from the freshwater bubble-bursting mechanism in a controlled laboratory environment. We collected size distributions of bubbles and aerosols produced through image collection and in-situ aerosol sizing. In doing this, we used both field samples from Lake Erie as well as synthetic freshwater. We analyzed the concentration of each salt separately to understand how each salt contributes to coalescence. Using these methods, we are able to better understand how ion concentration may contribute to the bubbles' ability to coalesce. This is important to understand as the bubbles' size affects the transfer of organic species to the aerosol phase, as well as the ratio of film to jet droplets upon bubble bursting. These results will improve our ability to predict aerosolization in freshwater regions through improved understanding of the fundamental aerosol generation mechanisms involved.

2AC.22

Assessing Model Pathogen Localization and Stability in Levitated Simulated Respiratory Droplets Using Quadrupole Electrodynamic Trap Confocal Microscopy. Michael Jacobs, LINDSEY SAENZ, *Texas State University*

The COVID-19 pandemic resulted in an estimated 14.83 million excess deaths globally in 2020-2021, far surpassing official case counts. While SARS-CoV-2 was initially believed to spread primarily through fomites and droplets, airborne transmission via respiratory aerosols is now recognized as the dominant route. This shift has underscored critical gaps in our understanding of viral transmission dynamics, especially for airborne pathogens involved in disease such as influenza and tuberculosis.

Airborne transmission is complex, influenced by multiple interacting factors including pH, viral survivability in suspension, aerosol size, particle concentration, and viral load. These complexities make it difficult to quantify the relative risks associated with different modes of transmission.

This study introduces a novel technique, quadrupole electrodynamic trap confocal microscopy (QET-CM), to directly image the behavior of model pathogens within levitated simulated droplets. The primary objective is to develop a robust methodology for analyzing pathogen dynamics in microenvironments using fluorescent E coli. as a model organism. The simulated droplets are composed of mucin, sodium chloride, and 1,2-didodecanoyl-sn-glycero-3-phosphocholine. By visualizing bacterial distribution across varying relative humidity and droplets compositions, this research aims to establish a foundational framework for studying airborne pathogen behavior using the QET-CM technique.

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2AC.23

Urban-Rural Gradients in Aerosol Liquid Water and pH during the CoURAGE Campaign. AMIR BABAEI-GHAREHBAGH, Jemma Przybocki, Marissa Cuevas, Isaiah Smith, Maria A. Zawadowicz, Akua A. Asa-Awuku, Benjamin A. Nault, Peter F. DeCarlo, Christopher Hennigan, *University of Maryland, Baltimore County*

Aerosol liquid water content (ALWC) and pH are often linked in atmospheric particles due to factors like meteorology and particle composition that influence both parameters. In this study, we characterize urban-rural gradients in ALWC and aerosol pH near Baltimore, MD during the 2025 Coastal-Urban-Rural Atmospheric Gradient Experiment (CoURAGE) field campaign. Simultaneous measurements at paired urban and rural locations show the near-ubiquitous presence of an urban heat island (UHI), with significantly higher temperature and lower relative humidity at the urban site. The average observed differences range between 1-3°C and 8-15% RH, but the differences can exceed 8°C and 25% RH at certain times. The UHI shows distinct seasonal and diurnal cycles that influence pH through effects on particle composition and ALWC. We characterize the resulting differences in semi-volatile species partitioning (NH3-NH4+ and HNO3-NO3-) and discuss the UHI as a key driver of aerosol processes in urban areas.

2AE.1

Does Wildfire Smoke Move Financial Markets? The Impact of Wildfire Smoke Across Cities on Equity Returns and Volatility. KARTHICK MOHAN KUMAR, Jesse Burkhardt, Shantanu Jathar, *Colorado State University*

Wildfire smoke increasingly contributes to poor air quality in the United States (US) and adversely affects public health, visibility, and ecosystems. Previous work has shown that poor air quality is linked to lower stock returns in financial markets. In this study, we examine how smoke fine particulate matter ($PM_{2.5}$) affects the yields and volatility of major indices on US stock exchanges. To do this, we used smoke data from the NOAA Hazard Mapping System (HMS), $PM_{2.5}$ data from the EPA Air Quality System (AQS), and financial data from leading US stock market indices. An independent two-sample t-test was employed to compare yields for stock market indices between smoke and non-smoke days affecting the top 10 US metropolitan statistical areas (MSAs). The analysis covers the fire season months (June through November) from 2010 to 2024. We find that on high-smoke days, New York City (NYC) and some other MSAs (e.g., Chicago) experienced higher returns, contrary to the negative or neutral returns observed in some other MSAs. In contrast, lower volatility was observed on high-smoke days, which might be due to reduced trading activity during smoke days in NYC. We propose the use of machine learning models to find complex, non-linear relationships between the presence of smoke, smoke concentrations, returns, and volatility. Findings from this analysis will reveal how smoke aerosols affect the market behavior, pointing to possible links between environmental conditions and investor responses.

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2AE.2

Introduction of Korea Air Pollutants EXposure (KAPEX) Model for $PM_{2.5}$ and O_3. KIYOUNG LEE, *Seoul National University*

Outdoor air contaminants concentration is often used as a surrogate for population exposure. However, people stay most of their times indoors. The time-activity patterns (TAPs) should be considered in the estimation of personal exposure. The Korea Air Pollutants EXposure (KAPEX) model is being developed to estimate population exposures to $PM_{2.5}$ and O_3. The input data for the model were 1) outdoor air pollution data from 530 ambient air monitoring stations in Korea, 2) detailed TAP surveys of 12,800 subjects, and 3) the microenvironment-to-outdoor (M/O) ratios of $PM_{2.5}$ and O_3 at thirteen microenvironments. The personal exposure can be estimated by the KAPEX model. A field technician simulated a total of 10 TAPs scenarios for each season while carrying portable $PM_{2.5}$ and O_3 monitors. From March 2022 to February 2024, a total of 670 person-days of personal exposure monitoring were conducted across eight seasons. Population-weighted personal exposure was calculated by considering the proportion of people for each TAP scenario. The population-weighted personal exposure to $PM_{2.5}$ in Seoul ranged from 14.7 to 16.7 $\mu g/m^3$ across eight seasons without significant difference. The population-weighted personal exposure to O_3 in Seoul ranged from 3.5 to 10.4 ppb across eight seasons. The O_3 exposures were relatively higher in the spring, with 10.4 ppb in 2022 and 7.6 ppb in 2023. The KAPEX model for $PM_{2.5}$ and O_3 could be used to estimate population exposure, identify determinants for high exposure group, and evaluate the effectiveness of control policies to reduce personal exposure.

2AE.3

Utilizing Low-Cost Clarity Node S Sensors Network to Monitor Local PM Concentrations in Lubbock, TX. KARIN ARDON-DRYER, John Garber, Joshua Shankles, Adam Hernandez, *Department of Geosciences, Texas Tech University*

Measurement of particulate matter (PM) and the establishment of a sensor network are important to ensure improved air quality levels and living conditions. A recent study in Lubbock, TX, suggests that several neighborhoods, especially those near industrial areas, experience increased health problems likely due to elevated PM concentrations from nearby industrial sources. Currently, no sensor network exists to measure local PM concentrations, as only one official $PM_{2.5}$ monitor is situated within city limits. However, the sensor is located at the edge of town, far from residential areas.

This work is part of the Lubbock Environmental Action Plan (LEAP) for Communities project that aims to provide information on air quality across the city. The Clarity Node S sensor was selected for this project. The Clarity Node S is a low-cost sensor that holds a built-in solar panel and SIM card port, which allows the sensors to be operated without a direct power source and Wi-Fi. At first, the 42 sensors were collocated with a reference Grimm EDM-180 for an initial period. The Clarity Node S sensors demonstrated very good correlation with each other, with R2 values above 0.9. The 42 Clarity Node S sensors were calibrated to the EDM-180 and were distributed across the city of Lubbock to create a spatial and temporal network for $PM_{2.5}$ and PM_{10} (particles with a diameter smaller than 2.5 and 10µm, respectively). Once the sensors were deployed, analysis was performed on each sensor to identify if specific neighborhoods experienced higher pollution levels. Such information will be a critical first step to improving the air quality in these specific neighborhoods and provide awareness of the effects of PM on human health. Comparison between the sensors and identification of polluted neighborhoods will be presented.

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2AE.4

Characterization of Aerosol Emissions from Firsthand and Secondhand Vaping. QIAN ZHANG, Maureen Meister, Xiaojia He, Joseph Hess, Mark Wilson, Christa Wright, *UL Research Institutes*

Electronic nicotine delivery systems (ENDS) are promoted as a safe alternative to cigarette smoking and have been gaining popularity especially among young adults and adolescents. ENDS work by heating an e-liquid via a coil and generating aerosols for a user to inhale. These aerosols may contain harmful components that pose health concerns to the users and bystanders. Therefore, it is important to characterize the emissions from ENDS vaping using a reliable method. In this study, we collected paired firsthand and secondhand aerosol emission data with user specific puff topography. Firsthand emissions were generated using an automated multi-channel ENDS aerosol generation system that can be adjusted for puff topography such as puff flow rate, volume, duration and frequency. Secondhand emissions were the exhale breaths from ENDS users after vaping. Emissions were delivered to an exposure chamber with controlled environmental conditions for aerosol characterization. We measured particle concentration and size distribution for 10 nm to 10 µm size range using scanning mobility particle sizers and optical particle sizers. Aerosol characterizations from various pod-type and mod-type devices will be presented. Aerosol size distributions of paired firsthand and secondhand emissions are compared. The retention of aerosols of each size is also calculated. The association between these aerosol characteristics and user specific puff topographic parameters will be discussed. Since ENDS emissions contain a mixture of aerosols of various sizes, paired firsthand and secondhand emission data will help to understand the deposition of aerosols after inhalation, as well as the health impacts for firsthand and secondhand exposures.

2AE.5

An Innovative Geo-AI Model: Improving Indoor PM Prediction for Child-Specific Households in a Highly-Polluted Area. QUANG-OAI LU, Ching-Chang Lee, *National Cheng Kung University*

Indoor air quality (IAQ) is a critical factor in children's health and development. While previous research has primarily focused on IAQ in classrooms, there has been limited attention to developing predictive modeling of PM_1 in child-specific household environments such as bedrooms and living rooms, where children spend much of their time sleeping, learning, and playing. This study addresses that gap by leveraging real-time sensor data and detailed activity patterns to develop a geospatial artificial intelligence framework, integrated with ensemble machine learning (ML) algorithms, for predicting indoor PM_1 levels in highly polluted areas of Taiwan. Additionally, the most influential variables within each model were identified by employing Bayesian Monte Carlo (BaMC) sensitivity analysis. Our findings indicate that PM_1 levels are generally higher in living rooms than in bedrooms. The predictive models for bedrooms achieved adjusted R2 values greater than 0.90, with RMSE reduced to 0.03 compared to the baseline model. For living rooms, model performance also remained strong, with adjusted R2 values above 0.88 and RMSE declined to 0.032. The ensemble model performed well, reaching adjusted R^2 values of over 0.93 for living rooms and 0.95 for bedrooms. BaMC analysis revealed that outdoor $PM_{2.5}$ concentration emerged as the most influential variable, followed by factors including the building characteristics, meteorological factors, and human activities. This study advances the application of ML for PM_1 prediction, providing a strong scientific foundation for strategies of air pollution control aimed at protecting children. It also refines exposure assessments for epidemiological studies and offers evidence-based recommendations for improving indoor air quality in child-specific households within highly polluted regions.

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2AP.2

Relation Between Spatial Age of Air Distribution and Indoor VOC Concentrations in a Classroom Assessed Using CFD.

SUWHAN YEE, Donghyun Rim, *Pennsylvania State University*

Approximately 90 % of human activity occurs indoors, rendering adequate ventilation essential to health and comfort. Ventilation performance is commonly characterized by the age of air, defined as the elapsed time since the supply air last entered the occupied zone. In this study, a steady-state CFD model of a classroom was employed to resolve the three-dimensional age-of-air field and to analyze the relation with volatile organic compounds (VOCs) emitted by occupants and transformed via ozone–terpene chemistry. The simulated age of air distribution is heterogeneous, spanning a few seconds adjacent to the supply diffuser to several hours along perimeter walls. Grid scale analysis confirmed an inverse relationship between the local age of air and VOC concentration. Areas with low age of air displayed a wide range of VOC levels. Locations closest to the emission source recorded the highest concentrations, whereas zones where the supply jet had mixed thoroughly with the indoor air showed much lower values because of dilution. In contrast, regions with high age of air were only weakly affected by the source, and the prolonged residence time encouraged ozone deposition surface reactions that further reduced VOC concentrations. The results demonstrate that spatial variations in age of air, combined with surface deposition processes, play a critical role in modulating indoor VOC accumulation. A detailed map of the local age of air patterns is essential for accurately identifying pollutant hotspots and optimizing ventilation strategies, whereas reliance on room averaged values is insufficient.

2AP.3

High Optical and Temporal Resolution Investigations into Non-Ideal Resuspension Phenomena.

EDWARD NEAL, Lukesh K. Mahato, Richard J. Thomas, Maurice Walker, Jack Vincent, Simon Parker, Virginia Foot, Emily Kruger, Jonathan P. Reid, *University of Bristol*

Particle resuspension is omnipresent in our lives with activities such as cleaning, walking and driving all contributing to resuspended aerosol concentrations. However, this phenomenon is rarely captured in aerosol dispersion simulations as existing resuspension models are constrained by a lack of understanding on the influence of complex governing factors. Particle morphology is one such influence and forms the focus of this study that incorporates a novel approach for fabricating and resuspending particles of reproducible irregular shapes.

Our method, that was previously validated in work by Neal et al. (*Aerosol Sci. and Tech.*, 58(12), 1389–1404, 2024), partners a quadrupole electrodynamic trap (the QuadFab) with a 3D printed wind tunnel. Within the QuadFab, aerosol droplets are suspended and dried under controlled relative humidity (RH) conditions. Varying this RH adapts the morphology of the resulting particles that are then deposited and resuspended in the wind tunnel. Particle detachment is monitored by a camera positioned below the apparatus that acquires images at 100 frames per second (FPS).

The resuspension efficiencies of two morphologies of NaCl particles, framboidal and platelet-like in shape, will be presented. The framboidal particles demonstrated a greater susceptibility for resuspension than the platelets. However, the mechanistic reasons for this difference in resuspension behavior remained elusive with wind tunnel studies alone. To further study these variations in particle detachment, individual resuspension events featuring the two particle morphologies were captured at 64000 FPS with a high frame rate camera. This technique allows for greater optical and temporal resolution analysis of particle orientation, particle-surface contact and particle rotation during resuspension. The latter component provides insight into the contributions of the aerodynamic forces, lift and drag, during resuspension events. Initial observations with the NaCl particles indicated that lift likely provides a greater contribution to their detachment than would be assumed for spherical particles.

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2AP.5

Contact Freezing Experiments and Temperature-Dependent Particle Viscosity Measurements Using a Sub-Freezing-Temperature Dual-Balance Electrodynamic Trap. KYLE MCMILLAN, Dharma Johnson, Upasna B. Rai, Jingchuan Chen, Ryan Davis, Sarah D. Brooks, Margaret Tolbert, *University of Colorado Boulder*

The interaction of clouds with incoming shortwave solar radiation and outgoing longwave terrestrial radiation remains a significant source of uncertainty in current climate models. A major reason for this uncertainty is poorly constrained estimates of the ratio of supercooled liquid water droplets to ice crystals in mixed phase clouds. A more accurate ice nucleation scheme, including a greater understanding of heterogeneous ice nucleation processes is essential in improving these estimates. Additionally, the existence of semi-solid and glassy phase particles and their dependence on temperature and relative humidity further complicate the ability of models to accurately determine both the radiative effects of atmospheric aerosols on climate and the role of the particle phase in atmospheric chemistry. Here, we have developed a dual-balance linear quadrupole electrodynamic trap that has been modified for use at sub-freezing temperatures. Importantly, this apparatus allows us to probe the behavior of the particle phase—including freezing, variations in viscosity, and gel transitions—on freely floating droplets, removing the unwanted influence of external surfaces. Mechanism-specific freezing experiments have been carried out to determine the nucleation temperatures in both immersion and contact nucleation modes. Using silver iodide as the ice nucleating particle, results have shown substantial enhancement in freezing temperatures in both the immersion and contact modes relative to the homogeneous freezing limit. Further, indirect particle viscosity measurements were carried out on 1:1 sorbitol:1,2,6-hexanetriol under dry conditions using the droplet coalescence method. As expected, particle viscosity showed a strong dependence on temperature, with viscosities increasing by over an order of magnitude from -5°C down to -18°C. These experiments not only further establish the use of low-temperature particle and droplet levitation experiments but also demonstrate the importance of such techniques in understanding the particle phase in the atmosphere.

2AP.6

Quantifying Electric Field Effects on Coarse Dust Settling in a Controlled Dust Plume Environment. IAN NORWOOD, Kyle Gorkowski, Claudio Mazzoleni, *Michigan Technological University*

Global climate models underpredict the atmospheric mass of coarse-mode dust particles (diameter >5 µm), accounting for only ~50% of observed concentrations. One potential source of this discrepancy is the omission of electrostatic (Coulomb) forces, which can influence particle settling velocities. Observational and modeling studies suggest that electric fields generated within dust plumes—such as those produced by Saharan dust storms and uplifted into the Saharan Air Layer—can significantly alter the transport and deposition behavior of particles in the coarse-mode.

To investigate these effects under controlled conditions, we use a 1.9-meter-tall humidity-controlled stainless steel cloud chamber, repurposed to generate vertically suspended dust plumes. This setup enables measurement of ion production via triboelectric interactions, particle charge polarity as a function of size and composition, and the electric field strengths resulting from vertical charge separation between particle layers. The experiment also quantifies the rate of ion attachment to particles across fine and coarse size modes, using well characterized mineral dust species such as Arizona Test Dust.

Future work will use these measurements to quantify the development, intensity, and duration of electric fields generated during initial dust transport. The resulting data will inform parameterizations of dust dynamics in large-scale atmospheric models to better constrain coarse particle residence times and distribution.

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2AP.7

Measuring Microparticle Acceleration in Low-pressure Supersonic Nozzles. AUSTIN ANDREWS, Nathan Bellefeuille, Hasan Celebi, Ioannis Pothos, Kaleb Siekmeier, Bernard Olson, Thomas Schwartzentruber, Christopher J. Hogan, *University of Minnesota*

Understanding high-speed particle transport is essential for predicting particle-surface interactions in applications such as damage to thermal projection systems in dusty environments and material synthesis from cold spray depositions. We report velocity measurements of micrometer-sized particles (1.18–7.88 µm diameter) using laser Doppler velocimetry (LDV). The particles are accelerated to speeds approaching 0.9 km/s through a converging-diverging (CD) nozzle and impinge on a substrate placed just beneath the nozzle throat, under low-pressure (3–5 torr), supersonic conditions. We examine how gas type (nitrogen, helium, carbon dioxide, and argon) and particle composition/density (ferrous sulfate, ammonium sulfate) influence particle acceleration. To assess inertial mismatch between particles and gas, we define a dimensionless “velocity lag” parameter. This lag increases steadily with a modified Stokes number tailored for high-speed flows. Measured results are compared to 3D flow simulations and particle trajectory predictions, based on a CT scan of the nozzle and a drag model valid across broad ranges of Mach and Knudsen number. The simulations reproduce key trends in velocity lag, reinforcing the applicability of these drag laws to supersonic, particle-laden flows.

2AP.8

The Effects of Jet Axis Switching and Aerodynamic Focusing on Deposition Patterns in Converging-Diverging Slit Impactors. YENSIL PARK, Tomoya Tamadate, Bernard Olson, Thomas Schwartzentruber, Christopher J. Hogan, *University of Minnesota*

The widths of the deposition patterns of particles accelerated through high-aspect-ratio slit nozzles are influenced by aerodynamic focusing. However, "jet-axis switching", a phenomenon that major and minor axes of the jet flow profile interchange, can also affect the orientation and shape of particle deposits, and in some instances, lead to deposits which are nearly perpendicular in orientation to the nozzle orientation. The combined influences of jet-axis switching and aerodynamic focusing on how particles deposit in slit impactor systems has been incompletely described. In this study, we investigate the deposition behavior of monodisperse particles ranging from 100 nm to 5 µm in diameter in a converging–diverging slit nozzle system under upstream pressure of 252 Torr in air. We vary the downstream pressure (3–50 Torr) and the nozzle-to-substrate distance (90–248× throat width) to characterize how these parameters impact deposition. Depending on particle size and flow conditions, deposits either align with the nozzle geometry, rotate 90°, or become tightly focused and symmetric. Our results show that jet-axis switching is more pronounced for smaller particles, higher downstream pressures, and longer nozzle-to-substrate distances. The degree of switching and the deposit area are both inversely proportional to the particle Stokes number. The degree of switching and the deposit area are both inversely proportional to the particle Stokes number.

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2AP.9

Liquid-Liquid Phase Separation in Secondary Organic Aerosols from Phenolic Compounds and Terpenes: Contrasting Daytime and Nighttime Generation. SEPEHR NIKKHO, Melika Javanmardi, Julia Zaks, Allan K. Bertram, *University of British Columbia*

Secondary organic aerosol (SOA) forms when volatile organic compounds (VOCs) are oxidized in the atmosphere by hydroxyl radicals (OH), ozone (O_3), or nitrate radicals (NO_3). OH dominates as an oxidant during the day, while NO_3 is more important at night. Key VOC sources include vegetation (e.g., α-pinene) and biomass burning (e.g., guaiacol and syringol). While many studies have investigated the phase behavior of SOA formed from OH and O_3 oxidation, there is limited research on the phase behavior of SOA produced by NO_3 oxidation.

We investigated liquid–liquid phase separation (LLPS) of secondary organic aerosol (SOA) using an optical microscope coupled to a flow cell with controlled relative humidity (RH). SOA was generated using NO_3 and OH oxidation of guaiacol, syringol, and α-pinene. For all VOCs oxidized by NO_3, the resulting SOA underwent LLPS at high RH, forming distinct organic-rich and water-rich phases. Similarly, SOA formed from α-pinene and OH also exhibited LLPS at high RH. In contrast, SOA generated from guaiacol and syringol with OH remained as a single phase across the entire RH range tested. These results show that nighttime chemistry (NO_3 oxidation) can produce SOA with two phases at high RH and highlight substantial differences in SOA phase behavior between day and night, with important implications for their cloud-nucleating potential.

2AP.10

Coarse-Grained Models of Nanocluster Interaction Potentials: Application to Metal, Organic, and Carbon Materials. JOSÉ MORÁN, Christopher J. Hogan, *University of Ottawa*

Trajectories and collision frequencies of nanoparticles in gas-phase are highly dependent on their interaction potentials including Coulomb and van der Waals (vdW). The latter can be complex to model and is commonly neglected in numerical simulations based on meso-scale or sectional approaches. Some approaches exist in the literature including the Hamaker's equation (Hamaker, 1937) to predict vdW interactions between spherical particles and its extension to the repulsive short-range potentials (Lazaridis and Drossinos, 1998). However, these models are not accurate for metal, metal-oxides or organic nanomaterials due to multi-body effects and free electrons in the case of metals. This holds true regardless of the method used to calculate the material Hamaker's constant including complex approaches such as the Lifshitz theory. This is shown here based on all-atoms molecular dynamics simulations using LAMMPS (Thompson et al., 2022) to model carbon, silica, and gold nanoclusters. Based on these simulations, we have proposed a new model to coarse-grain the interaction potentials between nanoclusters and validated our model's accuracy to predict a vdW coagulation enhancement of aerosol particles in the diffusive and ballistic regimes. The latter is done by comparison of such enhancement coefficients as a function of the nanocluster size obtained from both all-atoms and coarse-grained simulations. The new equation could be used in future numerical simulations including meso-scale or sectional where a vdW coagulation enhancement is important including the aerosol synthesis of nanomaterials in flames or plasma systems.

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2AP.11

The Optical Properties of Aqueous Carbonate-Containing Aerosol. KELSI RAMOS, Emily Werner, Alison Bain, *Oregon State University*

Stratospheric aerosol injection (SAI), the injection of light-scattering aerosol into the stratosphere, has been proposed as a method of mitigating climate change. To be effective, the injected aerosol must scatter solar radiation back out of the atmosphere. The scattering properties of aerosol particles are described by their size, geometry, and refractive index. Aerosols with a higher real part of the refractive index are more efficient at scattering light. Carbonate salts have been identified as an aerosol of interest for SAI, but the optical properties, including the refractive index, of aqueous carbonate, which will form in the atmosphere, are poorly understood.

Here we have determined the refractive index of aqueous carbonate salt-containing aerosol droplets over a range of relative humidities, using optical trapping and cavity-enhanced Raman spectroscopy. The refractive index data was fit with the oscillator model to determine the effective oscillator parameters for carbonate salts. This model can be used to predict the refractive indices of aqueous aerosol droplets containing one or more solutes. These results can provide insight into the optical properties of aqueous carbonate systems, including aerosol resulting from SAI and mineral dust.

2AP.12

Interactions Between Electrostatic Atomized Water Nanodroplets and Bacterial Membranes. YOHEI ISHIGAMI, Takafumi Seto, Tomoya Tamadate, Toshiaki Sakai, Ryo Igarashi, Yukihiro Masuda, Kagami Aso, Daiki Akashi, Ayako Kitauchi, Satoshi Okumoto, Takahiro Miyatake, Misa Katsuyama, Hiroshi Suda, Yoshiki Kanata, Motomasa Yonezumi, *Panasonic Corporation*

Electrostatic atomized water nanodroplets (EAWNs), generated via an electrospray process in which high voltage is applied to water condensed on a needle cooled by Peltier elements, demonstrate antimicrobial effect. This effect is attributed to the presence of highly reactive species, such as hydroxyl (OH) radicals, within the nanodroplets. This study models the interaction between EAWNs and bacterial cell membranes by integrating exposure experiments with numerical simulations, with the specific objective of providing a framework for simulating EAWNs interactions with microbial membranes. Gram-positive bacteria were selected for modeling due to their structure: a permeable peptidoglycan layer and a phospholipid bilayer membrane. The lipid bilayer was represented using 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine (POPC).

In the experiments, EAWNs were exposed to granular POPC samples dispersed in water within Petri dishes, positioned at 5 cm from the electrospray tip for exposure times ranging from 1 to 4 hours. Subsequent LC/MS analysis revealed time-dependent chemical modifications of POPC, including oxidation, fragmentation, and the formation of aldehydes and carboxylic acids. In the simulation, OH radical penetration and POPC degradation rate was predicted through a one-dimensional bacterial membrane model in COMSOL. The chemical reactions in the 1D simulation incorporated 22 reactive species which reaction rates were determined by the DFT-based electronic state calculations. While the simulation reproduced key degradation steps, discrepancies in intermediate product concentrations were observed compared to experimental results. These differences may stem from assumptions regarding radical concentration and the use of simplified reaction conditions. In the future, further improvements will be necessary by optimizing the concentrations of reactive chemical species and incorporating more realistic bacterial spatial distributions to enhance the accuracy and applicability of the model.

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2AP.13

Characteristics of Airborne Water Cluster Generated by Polymer-Based Evaporation Device. MIKI NAKANO, Yusuke Kuromiya, Tomoya Tamadate, Takafumi Seto, Hiroto Kato, Takayuki Mori, Yoko Adachi, Yuki Tabata, *Kanazawa University*

Airborne Water Cluster (AWC) is a non-equilibrium water cluster composed of several to several thousand water molecules suspended in air. Due to their unique physicochemical properties, AWCs have been utilized in air purification, humidity control, comfort improvement, and physiological activity when applied to hair and skin. However, evaluating the size distribution of AWCs remains challenging because they are in the sub-10 nm range and their properties dynamically vary with changing atmospheric conditions.

In this study, a polymer-based water evaporation device was employed to generate supersaturated water vapor for the formation of AWCs. The device is composed of a corrugated cylindrical flow cell whose walls are made of porous polymer material. The temperature of the device is cyclically controlled for adsorption/desorption of water vapor during cooling/heating. The desorbed vapor is then quenched to room temperature by carrier gas, creating a localized supersaturation region. To characterize the supersaturation profiles, polyethylene glycol (PEG) ions and Ag nanoparticles were introduced as 'probe' particles. Prior to entering the device, a differential mobility analyser (DMA) was used for size selection of both particle types. Changes in the physical properties of the probes, specifically total number concentration and size distribution, were measured with (i) an aerosol electrometer (AE) and (ii) a second DMA coupled with an AE.

For any PEG ions, (i) measurement revealed that the total particle concentration remained constant during vapor generation, confirming that the particles passed through the porous media without extra loss. However, when the two DMAs were both set to the same particle size in (ii), PEG10000 showed a decrease in particle number concentration during vapor generation, implying changes in the size distribution of the probe particles due to interactions with supersaturated vapor. Molecular simulations were also conducted to investigate the initial stage of nucleation under supersaturation.

2BA.1

Title: Characterization of Human-Generated Infectious Aerosol to Improve the Understanding of Disease Transmission and Building-Level Interventions. C.J. WOSLAGER, Vicki Herrera, Ashley R. Ravnholdt, Elizabeth A. Klug, Daniel N. Ackerman, Danielle N. Rivera, Joshua L. Santarpia, *University of Nebraska Medical Center*

Understanding the origins of infectious bioaerosols, within the human respiratory system, is critical to developing effective mitigations for respiratory transmission. Despite research into the sizes of aerosols produced by human respiration and characterizations of human-generated infectious aerosol in the environment, there remains significant uncertainty in the size of particles that present the greatest risk of transmission and, therefore, the most effective mitigation strategies. This study aims to estimate the origin and composition of human-generated respiratory aerosol in asymptomatic individuals and those with respiratory infections by looking at both viral and human respiratory protein content in size-resolved aerosol collections. In addition, we aim to determine the efficacy of building-level interventions (such as HVAC filtration) in removing these aerosols and thus limiting transmission. In this study, we invite subjects to participate in a two-hour aerosol collection session involving normal breathing and optional vocalizations. Concurrently, we collect shallow nasal swabs and saliva samples to compare them with environmental aerosols. To assess mitigation efficacy, we collect air samples through a modified door connected to an HVAC unit operating under three filtration conditions: no filter, MERV 8, and MERV 13. We analyze respiratory proteins (surfactant protein-D, surfactant protein-C, Proline-Rich Protein BstNI Subfamily 2, Aquaporin-5, Mucin-5AC, and Mucin-5B) and viral loads using qPCR to generate cycle threshold values. This work will advance the understanding of bioaerosol origin and composition, improve sampling strategies for future aerosol studies, and identify practical filtration approaches for reducing airborne transmission.

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2BA.2

Determination of pH and Other Physicochemical Properties of Respiratory Aerosols via Fluorescence Probe Spectroscopy.
ANGEL GIBBONS, Victoria Cover, Paul Ohno, *Auburn University*

Understanding the viability of viruses contained in respiratory particles and the connections between this viability and the relative humidity (RH)- and temperature-mediated physicochemical properties of the particles themselves is critical to mitigate respiratory disease transmission. Here, we present the use of fluorescence probe spectroscopy to investigate the pH of submicron model respiratory aerosols. pH-sensitive fluorescent molecules were incorporated into the particles of interest and their ratiometric fluorescent response was used to determine particle pH. The pH of the particles trended towards more acidic pH values than that of bulk solution from which the particles were generated. Furthermore, we demonstrate that volatilization of probe molecules and subsequent condensation into particles of interest is a viable method of aerosol fluorescent labeling. This technique enables the study of real exhaled respiratory particles using fluorescence probe spectroscopy. Finally, we discuss the outlook for fluorescence probe spectroscopy in the field, including its use to investigate viscosity as well as its application to more chemically-complex systems.

2BA.3

Microbiology in Clouds at Whiteface Mountain with Analysis of Air Quality 2024.
SARA LOMBARDO, Archana Tripathy, Sridar V. Chittur, Andrew Hayden, Marcy Kuentzel, Paul Casson, Rudra Patel, Lily Hammond, Scott D. McKim, James Schlemmer, Sara Lance, *University at Albany*

Whiteface Mountain (WFM) in northern NY State is the site of a historic mountaintop atmospheric observatory with an ongoing cloud water chemistry monitoring program that has been operating every summer (June through September) since 1994. Though long-term chemical analysis has been conducted, no analysis on the microbiome has been completed at WFM. Over the years, a new chemical regime has been reported in the cloudwater with missing analytes. Knowing how microbes can interact with chemicals and chemicals interact with microbes will add another lens of analysis to our cloudwater studies.

Starting in 2024, we began microbial analysis of cloudwater filters using 16S DNA sequencing and have been able to start identifying common microbial species found in WFM clouds. Key attention has been paid to filters collected during high times of air pollution as monitored by NYSERDA. This study seeks to highlight microbially studied filters based on chemical composition and air pollution significance to offer insight on the connections that can be made among the three.

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2BA.4

Sargassum Influence on Coastal Bioaerosol Microbiota. NOHHYEON KWAK, Shahar Tsameret, Mahdis Sobhanian, Brittany Mc Intyre, Helena Solo-Gabriele, Jiayu Li, *University of Miami*

The brown algae of the genus, *Sargassum*, float in the open ocean, forming large free-floating mats. Since 2011, unprecedented blooms of pelagic *Sargassum* have created severe socioeconomic and ecological problems, leading to significant tourism losses (estimated at $2.7 billion in Florida in 2018) and potential public health threats. Notably, decaying *Sargassum* can harbor pathogenic bacteria like *Vibrio* and *Pseudomonas*; these microbes, along with largely unknown associated microbial communities, can be released into the air within bioaerosols during decomposition. Characterizing the composition of these bioaerosols is crucial for assessing pathogenic disease transmission risks. In this work, we used molecular-based analysis for bacterial sequencing to identify microbes included in bioaerosols and other environment samples.

We collected samples representing four types of environmental samples – seawater, beach sand, air (bioaerosols), and *Sargassum* from a coastal area. Bioaerosols were collected using a swirling aerosol collector (Biosampler®, SKC Inc.). Microbial community structure and diversity across these sample types were compared using 16S rRNA gene amplicon sequencing, complemented by qPCR to assess bacterial load.

Quantitative PCR (qPCR) analysis indicated that microbial loads (based on 16S rRNA gene copy numbers) were substantially lower in bioaerosol samples compared to the other environmental matrices. In contrast, Sargassum biomass harbored the highest microbial load per unit mass, followed by sand and then seawater samples. However, bioaerosol samples exhibited the highest Operational Taxonomic Units (OTUs) richness (6,415 unique OTUs), with 3.2% of these OTUs also detected in the *Sargassum* samples. High microbial variation was observed across sample types, with 18,200 OTUs, yet only 17 OTUs were universally shared among air, sand, seawater, and *Sargassum*.

For general microbes, the majority of microbes identified in bioaerosols originate from the marine environment (*OM60(NOR5)clade*, *Marinomonas*, and *Alteromonas*), with additional contributions from sand sources (*Nocardioides* and *Lysobacter*). These findings suggest that the rich microbial diversity in bioaerosols is shaped by multiple environmental origins.

Potential pathogenic microbes such as *Vibrio* and *Pseudomonas* were detected in bioaerosol samples. *Vibrio* exhibited high relative abundance in *Sargassum*, suggesting a possible transmission pathway from *Sargassum* to the atmosphere. In contrast, *Pseudomonas* showed higher relative abundance in beach sand, indicating that wind-driven sand erosion may contribute to its presence in bioaerosols.

2BA.5

Investigating the Ice Nucleating Macromolecules in Birch Pollen. CHAMARI MAMPAGE, Miriam Freedman, *The Pennsylvania State University*

Atmospheric ice formation influences the Earth's radiation budget and hydrological cycle through its contribution to cloud formation. Aerosol particles in the atmosphere can affect ice formation by acting as ice nuclei. Pollen grains, one of the major primary biological aerosol particles in the atmosphere, are known to act as ice nuclei and cloud condensation nuclei. Birch is one of the first blooming trees in the spring, and birch pollen is known to be one of the most efficient pollen ice nuclei. In previous studies, it has been suggested that macromolecules like polysaccharides and proteins are responsible for the ice nucleating activity of pollen wash water (a filtered suspension of pollen). In this study, we investigate the ice nucleating macromolecules in birch pollen wash water (BPWW). Agreeing with previous studies, BPWW showed similar freezing properties to an unfiltered pollen suspension (0.1 % wt/wt) with T_{50} values -14 °C and -13 °C, respectively. Scanning electron microscopy and dynamic light scattering analysis confirmed the presence of particles in BPWW with an average diameter of 242 mm. These observations confirm that the ice nucleating components in pollen grains were transferred to BPWW. To investigate the chemical composition of these particles we conduct enzyme digestion and mass spectrometry analysis. Pectin is a polysaccharide that is present in pollen grains. We observed that pectin is an efficient ice nucleating polysaccharide with a T_{50} of -16 °C. BPWW water will be subjected to enzyme digestion using pectinase, followed by mass spectrometry to confirm the presence of pectin. The breakdown of the pectin by the enzyme should decrease the ice nucleating activity of the BPWW. Other known pollen macromolecules will be tested similarly. Identifying the chemical composition of these ice nucleating macromolecules will provide new insight into the contribution of pollen to the atmospheric ice nucleating particles.

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2BA.6

Abundance and Mixing State of Bioaerosols at the BNF Site: Insights from Microscopy and WIBS Analyses. Nurun Nahar Lata, Ashfiqur Rahman, ZEZHEN CHENG, Darielle Dexheimer, Swarup China, *Pacific Northwest National Laboratory*

Primary biological aerosol particles (PBAPs), including pollen, fungal spores, and their fragments, are an important yet understudied component of the atmospheric aerosol population in forested environments. In the southeastern U.S., dense forests contribute a wide array of aerosols both through direct biological emissions and secondary processes involving biogenic volatile organic compounds (BVOCs). While ground-based studies have provided valuable insight into PBAP emissions, there is limited understanding of how these particles are distributed, their abundance and how they interact with other aerosol types during atmospheric transport. Aerosol population emitted from forest environment is essential to assess the transformation, mixing state, and potential roles of PBAPs in atmospheric processes such as cloud interactions and deposition.

To address this gap, we will investigate the distribution and chemical-morphological characteristics of surface aerosols at Bankhead National Forest (BNF) using samples collected with the Size and Time resolved Aerosol Collector (STAC) at DOE-ARM's research facility AMF3. STAC enables size-resolved sampling of ambient particles, facilitating detailed analysis of PBAPs and their association with other aerosol components. We will apply computer-controlled scanning electron microscopy with energy dispersive x-ray spectroscopy (CCSEM/EDX) to examine the morphology and elemental composition of particles, allowing for classification of potential bioaerosols and their mixtures with mineral dust and carbonaceous material. These offline analyses are complemented by in situ measurements from the Wideband Integrated Bioaerosol Sensor (WIBS), which detects PBAPs based on intrinsic fluorescence properties.

This approach allows us to identify and classify PBAPs, evaluate their size-resolved distributions, and investigate potential mixing with other aerosol types such as mineral dust or carbonaceous particles. The study aims to establish a foundational dataset for understanding bioaerosol variability in forested environments and guide future efforts to characterize the composition and behavior of atmospheric bioaerosols.

2BA.8

The Effect of Clinical Environment on the Transport and Antibiotic Resistance of Mycobacteria. Meiyi Zhang, Aayushi Nangia, Jasim Ibrahim, Eduardo Escamilla Rodriguez, Juan Garcia Lunar, Sandun Fernando, MARIA KING, *Texas A&M University*

Despite years of clinical care and research and the increasingly recognized role of the environment in spreading pathogens, there remains a significant lack of understanding of the transmission dynamics of mycobacteria that cause lung disease, their survival in air, and movement within the ventilated environments. The thick, mycolic acid-rich cell wall of mycobacteria and their MMPL5 efflux channels hinder drug penetration. Aerosol transmission exposes bacteria to varying airflow, potentially altering membrane protein behavior and drug susceptibility. Although respiratory isolation is standard in health clinics, the resuspension of aerosolized mycobacteria carried in airflows within ventilation systems may change their behavior. Increasing evidence suggests that environmental stressors may contribute to the development of antibiotic resistance in bacteria by mechanisms that are not well understood. However, the environmental effects on the transmission of aerosolized bacteria with antibiotic resistance also remain understudied. Our study focuses on determining how the aerosolization of pathogens at clinical care centers that often have 6-21 air changes per hour affects the transport of mycobacteria and triggers the development of antibiotic resistance. Aerosolized droplet behavior simulated in a hospital-like setting and airflow-induced pressure changes mapped to the cell membrane dynamics of mycobacteria show effects on antibiotic binding. Molecular dynamics simulations and experimental results demonstrate that ventilation airflow related pressure changes cause the opening and rearrangements of membrane channels enabling the release of antibiotics from the cell.

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2BA.9

Respiratory Aerosol Measurements from Large Cohorts and a Longitudinal Study. JONATHAN P. REID, Bryan R. Bzdek, Nan Zhou, Andrew Shrimpton, Tony Pickering, *University of Bristol*

The amount of exhaled aerosol by respiratory and vocal activities and the concentration of carbon dioxide are often used to assess the risk of indoor transmission of respiratory pathogens by inhalation in the absence of quantitative information on airborne infectious and viable pathogen concentration. Measurements of exhaled aerosols present considerable and unique challenges that must be overcome when measuring exhaled aerosols. For example, the number of particles exhaled is extremely low and cannot be discriminated from the ambient particles in an indoor environment.

We will report on two large campaigns collecting data on respiratory aerosol and respiratory parameters (e.g. minute ventilation, forced vital capacity) from 400 participants and a longitudinal study to investigate how exhaled aerosols from an individual change over time. Distinctively, our studies have quantified the absolute amount of aerosol generated by a range of respiratory and vocal activities, including speech and language therapy, the correlation between particle emission rates and the amount of carbon dioxide exhaled, and the impact of pre-existing lung conditions and infection on emission.

We show that although carbon dioxide is a good measure of indoor ventilation, it is a poor indicator of the amount of aerosol exhaled. Indeed, vocalization can lead to 1-3 orders of magnitude more aerosol than breathing for no change in exhaled carbon dioxide. We will also show that there is no correlation between exhaled aerosol, participant age and body mass index, and that the aerosol number concentrations emitted by those with pre-existing lung conditions and healthy subjects are similar.

From our longitudinal study, we will report measurements of exhaled aerosols over day, week and month timescales. This study is being used to examine the importance of physiological factors in determining exhaled aerosol and to answer the question: are individuals who are high emitters of aerosol particles always high emitters?

2BA.10

Mapping Ecosystem Biodiversity Using Airborne Environmental DNA. SHALLON MUTSA JOZI, Amira Hansch, Nicolas Gustafson, Roger Schürch, Scotty Yang, Gabriel Isaacman-VanWertz, *Virginia Tech*

Insects provide services worth billions of dollars each year, such as pollination, nutrient cycling, and contributing to soil health. Alarmingly, insects are sharply declining, with up to 75% of insect bio-mass lost in the past three decades. Current methods to study these insect declines are labor intensive because they involve manual work (trapping and insect ID) for spatially resolved measurements. We developed simple, portable devices that can sample with limited operator presence to enable temporally and/or spatially resolved measurements. These new portable and programmable samplers enable simultaneous collection of samples across a spatially distributed network, which we demonstrate here as a method to sample airborne DNA. In this presentation we validate their reproducibility and demonstrate their utility for identifying species-specific DNA and quantifying hotspots. We sample onto commercially available filters and extract eDNA using standard DNA assay kits. Primers for general arthropods and specific species are used to provide binary information on presence and absence. Though concentrations of species-specific DNA are typically too low to allow quantification, we co-locate multiple samples and use fraction of positives to estimate source strength. With this approach we can demonstrate mapping of species-specific DNA as well as enable broader biodiversity surveying. In this work we focus on three specific species – honeybees, mealworm beetles, and brown marmorated stink bug – to validate the approach and demonstrate correlations between source strength (number of individuals, activity, etc.) and detection of species-specific DNA.

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2BA.11

3D Chemical Imaging Reveals Surface and Internal Heterogeneity of Airborne Fungal Spores . ZEZHEN CHENG, Yingxiao Zhang, Gregory W. Vandergrift, Ashfiqur Rahman, Xena Mansoura, Valentina Sola, Tasneem Ahmadullah, Nurun Nahar Lata, Erin Bredeweg, Payton Beeler, Laura Fierce, Darielle Dexheimer, Qi Zhang, Alexander Laskin, Jerome Fast, Fan Mei, Scott Baker, Allison Steiner, Swarup China, Zihua Zhu, *Pacific Northwest National Laboratory*

Fungal spores are an important component of primary biological aerosol particles, which play important roles in the Earth system. However, there are still limited observations on airborne fungal spores to understand their physicochemical properties. Even fewer are the model simulations to understand their effects on the Earth system. Here, we utilized experimental observation and WRF-Chem simulation to understand the fungal spores' physicochemical properties and their contribution to atmospheric aerosols. We utilized the state-of-the-art Time-of-flight secondary ion mass spectrometry (ToF-SIMS) coupled with the Ar cluster ion sputtering technique to investigate fungal spores' 3D chemical composition. Samples were collected at the Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) field campaign at the Southern Great Plains (SGP) atmospheric observatory (mega-site, 36.61° N, 97.49° W) on October 14th, 2021. Chemically resolved size distribution shows that more than 25% of coarse particles were biological aerosol particles. ToF-SIMS results reveal that there are two categories of fungal spores. 50% of fungal spores have less Na at the surface, and their cytoplasm is liquid fatty acid (oleic acid and palmitic acid from Triacylglycerol (TAG) fragment signals), which suggests they might be germinating. The fragments from this category of fungal spores might be an important source of airborne fatty acids. Conversely, the rest of the fungal spores have a high Na concentration at the surface, and their cytoplasm is solid or semisolid, suggesting they might be dormant. Moreover, we simulated the fraction of airborne dormant and germination fungal spores at SGP from October 12-15 based on the literature temperature and relative humidity thresholds for surface-deposited fungal spore germination. Results show that there will be consistently higher concentrations of germination fungal spores than dormant ones, which is higher than our observation. This underscores the importance of understanding the environmental conditions for airborne fungal spores to germinate.

2BA.13

Culture and Real-Time Quantitative PCR to Detect Environmental Nontuberculous Mycobacteria in a Clinical Care Center. Meiyi Zhang, Brooke Smith, Rachel Wilsey, Tiana Koch, Elizabeth Dohanich, Pamela McShane, Jennifer Honda, BRANDON LINARES, Maria King, *Texas A&M University*

Nontuberculous mycobacteria (NTM) are opportunistic pathogens widely distributed in natural and human-built environments. Despite their environmental frequency, the airborne presence and distribution of NTM in clinical settings remain poorly understood. In this study, we assessed NTM in air and floor surface samples within a clinical care center using both culture-based and qPCR methods. Air and floor samples were collected across three days from patient rooms, a dictation room, and a hallway using a wetted wall cyclone (WWC), a gelatin filter-based air sampler, and foam swabs. Using the culture-based method, viable NTM were recovered from three floor surface swabs, while all other samples were culture-negative. qPCR analysis revealed frequent NTM detection in air samples, with a higher positivity rate from WWC samples compared to gelatin filters, despite total bacterial count (TBC) being two orders of magnitude higher in gelatin filter samples. The highest frequency of qPCR-tested NTM-positive samples was observed in the clinic hallway, suggesting that airflow dynamics and patient movement influence bacterial redistribution. Floor swabs showed transient NTM detection patterns, likely influenced by environmental deposition and routine cleaning. Despite confirmed Mycobacterium avium complex (MAC) infections among patients, M. avium was not detected in any environmental samples, suggesting species-specific aerosolization differences. Although viable NTM were not recovered from air samples, the high qPCR positivity suggests the potential presence of airborne NTM that may not have been captured by culture due to viability loss or sampling limitations. These findings emphasize the role of air sampling methodologies in capturing NTM and highlight the need to better understand the factors influencing the persistence and distribution of airborne NTM in clinical environments.

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2BA.14

Integrated Electrowetting-on-dielectric and Electrostatic Precipitation for Monitoring Airborne Viruses in Real-world Indoor Environments. SANGSOO CHOI, Seong-Jae Yoo, Amin Piri, Milad Massoudifarid, Sanggwon An, Yong-Jun Kim, Jungho Hwang, *Yonsei university*

The detection of airborne viruses in indoor settings is essential for preventing the spread of infectious diseases. However, their low concentrations in ambient air present a significant challenge for sensitive and reliable detection. In this study, we report an integrated system that combines electrostatic precipitation (ESP) with electrowetting-on-dielectric (EWOD) droplet actuation to achieve efficient virus sampling and enrichment from air into microscale liquid volumes. The ESP component enables high-efficiency particle collection with low pressure drop. Subsequently, the EWOD module actively manipulates and merges droplets to concentrate the collected viruses into a small liquid volume suitable for molecular analysis.

Laboratory tests demonstrated that the system can concentrate airborne viruses by several orders of magnitude within 20 minutes, resulting in significantly improved detection sensitivity using reverse transcription quantitative polymerase chain reaction (RT-qPCR). Field tests conducted in real-world indoor environments, such as classrooms, cafeterias, and corridors, confirmed the system's ability to efficiently collect airborne respiratory viruses, including influenza virus, bocavirus, and coronaviruses, which were subsequently detected by PCR analysis.

This integrated ESP–EWOD platform offers a robust and portable solution for rapid indoor air monitoring. By bridging efficient physical collection and droplet-based concentration, the system addresses both the sensitivity and usability challenges in airborne virus surveillance. These findings underscore the potential of the proposed method for real-time environmental monitoring and public health protection in crowded or high-risk indoor environments.

2BA.15

Integration of Electrostatic Aerosol-to-Hydrosol Sampling With Microfluidic Sample Processing and Fluorescent Nanoprobe-Based Multiplexed Immunoassay for Airborne Virus Detection. MILAD MASSOUDIFARID, Sangsoo Choi, Sojeong Lee, Seungjoo Haam, Jungho Hwang, *Yonsei university*

Bioaerosols that cause respiratory diseases, such as influenza viruses and coronaviruses, are particularly interesting among airborne bioparticles as they significantly and rapidly affect humans and animals. Thus, efficient sampling and targeted detection play an important part in blocking the spread of these pathogens [1]. Among various sampling strategies, electrostatic precipitation (ESP) offers an efficient aerosol-to-hydrosol (ATH) mechanism for capturing airborne viruses into a small volume of liquid media. Amongst various detection methods, Immunoassays enable rapid and target-specific virus detection by leveraging antigen-antibody interactions. Additionally, when enhanced with nanoparticles, they offer simplified, extraction-free workflows with high sensitivity, multiplexing capability, and strong potential for point-of-care deployment [2]. However, bridging the gap between sampling and fast, automated target-based detection remains a challenge.

In this study, we present an integrated platform that combines electrostatic aerosol-to-hydrosol virus sampling with microfluidic sample processing and a fluorescent nanoprobe-based multiplexed immunoassay for the detection of airborne viruses. The system enables rapid and target-specific quantification of viral antigens, such as Influenza A (California/2009), Influenza B (Florida/2006), and HCoV-NL63, by correlating fluorescence intensity with virus concentration in liquid samples. The microfluidic module automates reagent mixing, incubation, and signal readout in a compact, efficient layout, reducing manual handling and assay time. Enhanced with nanomagnet-based separation and fluorescent nanoprobe labeling, the immunoassay achieves high sensitivity without the need for nucleic acid extraction. This platform demonstrates strong potential for portable, multiplexed, and real-time monitoring of viral bioaerosols, offering a field-deployable alternative to conventional molecular diagnostics.

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2BA.16

Modulation of Endotoxin Toxicity by Atmospheric Oxidants and VOC Biomarkers of Its Early Health Effects. HUAYING LIU, Qisong Xing, Chenyu Zhu, Maosheng Yao, *Peking University*

Endotoxin (lipopolysaccharide, LPS), a major biological component of atmospheric particulate matter, induces strong immunogenicity and poses significant health risks. However, the atmospheric chemical transformations of LPS and their modulation of toxicity remain unclear. This study investigated the effects of heterogeneous reactions with atmospheric oxidants (OH radicals and ozone) on LPS. At the same time, volatile organic compounds (VOCs) were identified as early biomarkers of LPS-induced health effects. Oxidized LPS toxicity was evaluated in a rat model, with structural changes analyzed using Fourier transform infrared spectroscopy and high-resolution electrospray ionization mass spectrometry. The OH radicals degraded the key toxic structure, Kdo_2-lipid A, by attacking glycosidic bonds, thereby reducing LPS immunogenicity. Conversely, ozone oxidized hydroxyl groups to carbonyl groups without disrupting Kdo_2-lipid A; this selective oxidation potentially enhances the ability of LPS to induce inflammatory anemia. These distinct oxidative pathways lead to different toxicological outcomes. In *Saccharomyces cerevisiae*, multi-omics, and physiological analyses revealed that LPS exposure induced sequential phases of stress adaptation. During the stress phase, inhibited oxidative phosphorylation triggered growth arrest and cell wall remodeling; acetic acid-D served as an early biomarker of oxidative stress. In the adaptation phase, reprogrammed metabolism generated higher alcohols/aldehydes as secondary metabolite biomarkers, reflecting substrate consumption from the initial stress response. This study clarifies atmospheric oxidant impacts on LPS toxicity and demonstrates VOCs as non-invasive markers of health status.

2BA.17

Simultaneous Detection of Airborne Bacteria and Fungi Using ATP Bioluminescence for Real-Time Monitoring. HYUN SIK KO, Jaeho Oh, Jungho Hwang, *Yonsei University*

Bioaerosols, comprising airborne bacteria and fungi, pose significant health risks and require efficient monitoring across various environments. Conventional culture-based methods for bioaerosol analysis are limited by long processing times and their inability to detect non-culturable microorganisms. In this study, we introduce a novel method for the simultaneous quantification of airborne bacterial and fungal concentrations using ATP bioluminescence. Airborne microorganisms were collected into a liquid medium using a wet cyclone-based system. ATP was then sequentially extracted, first from bacteria and then from fungi, by taking advantage of differences in their cell wall structures and lysis kinetics. The emitted bioluminescence was measured using an integrated optofluidic sensor, allowing for real-time and selective quantification of bacterial and fungal ATP. Laboratory validation showed a strong correlation with conventional culture-based methods while significantly reducing detection time. This approach enables rapid and continuous monitoring of bioaerosols and provides a promising tool for improved air quality management and the prevention of airborne infectious diseases.

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2BA.18

Electrochemical Biosensor for Sensitive Detection of Airborne Bacteria. DONGMIN SHIN, Jungho Hwang, *Yonsei University*

Electrochemical biosensors have emerged as a promising technology for real-time detection of biological targets due to their high sensitivity, low cost, fast response time, and ease of operation. However, traditional biosensors often rely on immobilizing biorecognition elements such as antibodies directly onto the electrode surface. This can lead to poor electron transfer kinetics and reduced sensor performance due to steric hindrance or unstable surface chemistry. To address these limitations, we developed an integrated microfluidic-electrochemical biosensor system that combines efficient bacterial capture with enhanced electrochemical signal processing.

The platform consists of two key components: (1) a herringbone-patterned PDMS microfluidic channel for bacterial capture, and (2) a gold nanowire (AuNWs)-coated PDMS electrode for electrochemical detection. The microfluidic channel is functionalized with antibodies specific to the target bacteria. The embedded herringbone structure induces chaotic advection, enhancing mixing between the bacterial suspension and the antibody-coated surfaces. This not only increases the effective interaction time but also maximizes capture efficiency, which exceeds 90% across a wide range of bacterial concentrations (10^1-10^6 CFU/mL).

Following capture, the bacteria are labeled with horseradish peroxidase-conjugated antibodies, enabling catalytic oxidation of 3,3’,5,5’-tetramethylbenzidine (TMB) substrate. The resulting redox reaction produces electroactive species, which generate a measurable current when a constant potential is applied to the AuNWs-PDMS electrode. The AuNWs improve electrical conductivity and surface area, promoting efficient electron transfer and increasing signal intensity. Detection is completed within 2 minutes, with a demonstrated detection limit as low as approximately 200 CFU.

Overall, the combination of microfluidic enrichment and nanostructured electrodes enables the development of a next-generation biosensor that is fast, reliable, and capable of on-site bacterial detection. The platform’s modular design allows adaptability for different bacterial species by simply modifying the antibody pair, making it suitable for environmental monitoring, food safety, and clinical diagnostics.

2BA.19

A Predictive Model for Indoor Culturable Bioaerosol Concentration Using Optimized Input Structure of Multivariate Time-Series Air Quality Data. DOHEON KIM, Dongmin Shin, Jungho Hwang, *Yonsei University*

Exposure to bioaerosols in indoor environments poses serious public health risks, particularly due to associations with asthma, allergies, and respiratory infections. Traditional culture-based methods for monitoring indoor culturable bioaerosols rely on colony-forming unit (CFU) analysis, which is time-consuming and unsuitable for real-time monitoring. To overcome this limitation, data-driven prediction models have been proposed, but existing approaches predominantly use static, snapshot-based datasets and statistical models, failing to account for the temporal dependencies and lag effects intrinsic to indoor microbial dynamics.

This study presents a novel deep learning (DL)-based framework for predicting indoor culturable bioaerosol concentrations using minute-scale, multivariate time-series data. The proposed method addresses the limitations of previous studies by incorporating mechanistic determinants - such as air exchange, human occupancy, and viability changes - while explicitly modeling time-lag effects. We collected data across six indoor environments, measuring indoor airborne culturable bacterial concentrations and air quality variables (e.g., temperature, CO_2, and PM concentrations) at minute-scale intervals over extended periods.

The proposed framework consists of four key components. First, we selected mechanistically relevant input variables – such as temperature, PM concentrations, indoor-outdoor CO_2 and temperature differences, and PM concentration ratios – and collected corresponding time-series data. Second, to optimize the input data structure, we performed multivariate information compression using principal component analysis (PCA) and identified the optimal time-series input length using multiple machine learning (ML) models. Third, to address data scarcity, we applied and evaluated data augmentation techniques (time-series interpolation and Gaussian noise injection) designed to reflect the high variability and temporal continuity of indoor bioaerosol dynamics observed in this study. Fourth, based on the optimized input structure and augmented dataset, we applied a two-dimensional convolutional neural network (2D CNN) to effectively extract spatio-temporal patterns associated with indoor airborne culturable bacterial dynamics.

Our results demonstrate that the proposed model outperforms traditional statistical and machine learning methods in predicting indoor bacterial concentrations in previous studies. Furthermore, we validated the model on indoor airborne culturable fungal data to assess

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generalizability across microbial types, confirming the framework's adaptability. The ability to capture minute-scale fluctuations and microbial time-lag behavior enables accurate and generalizable prediction of indoor bioaerosol dynamics, providing an effective approach to real-time bioaerosol exposure risk assessment and data-driven indoor environmental bioaerosol monitoring.

To our knowledge, this is the first framework to integrate high-resolution, multivariate time-series environmental data with deep learning for indoor bioaerosol prediction. The approach holds strong potential for scalable deployment of real-time indoor bioaerosol monitoring systems across offices, hospitals, schools, and other sensitive environments, thereby contributing to precision public health and adaptive environmental control.

2BA.20

Airborne Virus Collection Using the BioSampler at Various Sampling Conditions. CHAEWOON JUNG, Wonyoung Jeon, Vidhurathan Soundararajan, Jaesung Jang, *Ulsan National Institute of Science and Technology, Korea*

While the SKC BioSampler has been widely used as a standard microbial air sampler, the effects of sampling flow rates—especially those other than 12.5 L/min at STP—as well as various airborne virus concentrations, sampling periods, and collection liquid volumes have rarely been studied.

In this study, we evaluated the performance of the BioSampler under a range of sampling conditions: flow rates of 4.0, 8.0, 10.0, 12.5, and 13.3 L/min at STP (4.0, 8.1, 11.3, 17.6, and 23.5 L/min at the BioSampler outlet, respectively); sampling periods of 10, 60, and 360 min; three airborne virus concentrations of MS2 bacteriophages (10^8, 10^6, and 10^4 PFU/m^3) and two airborne virus concentrations of influenza A viruses (10^6, 10^5 gene copies/m^3) at the inlet of the BioSampler; collection liquid volumes of 20 and 13 mL.

For viable MS2 viruses, both the concentrations in the collected samples and collection efficiencies increased with the sampling flow rates during 10- and 60-min sampling periods. At the lowest virus concentration—closer to field-level values, viruses could only be detected after 360 min of sampling. Under all sampling conditions, a flow rate of 13.3 L/min at STP was found to be more efficient for collecting airborne viable MS2 viruses than the manufacturer-recommended flow rate of 12.5 L/min.

A similar trend was observed for influenza A viruses. The concentrations of gene copies, as determined by RT-qPCR, and the collection efficiencies increased with the sampling flow rate. Again, 13.3 L/min at STP proved to be more efficient for sampling influenza virus nucleic acids compared to 12.5 L/min. Between the two collection liquid volumes tested, the concentration of gene copies did not differ significantly, but collection efficiencies were lower when using 13 mL compared to 20 mL.

This comprehensive characterization of the BioSampler under various conditions is expected to be valuable for future research on airborne virus sampling.

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2BA.21

Effect of Particle Concentration on Collection Efficiency in the Condensational Growth Tube of VIVAS Air Sampler. AMIR R. SHARAFUDIN, Steven Spielman, Chih-Hsiang Chien, Weixing Hao, Sudheer Salana, Amin Shirkhani, Mohammad Washeem, Yang Wang, Chang-Yu Wu, *University of Miami*

Condensational growth of aerosol particles is widely used in aerosol measurement devices and bioaerosol collection. While it is anticipated that particle concentration plays a crucial role in determining the size of the droplets formed, the effect of number concentration on the collection efficiency of the Viable Virus Aerosol Sampler (VIVAS) was still unknown. The objective of this study was to investigate how variations in aerosol concentration affect aerosol growth dynamics and droplet collection performance in the VIVAS, using Multiphysics modeling in COMSOL software, Simulation results demonstrated that the release of latent heat during droplet growth and the depletion of vapor associated with particle growth reduce vapor saturation within the growth tube, thus reducing the droplet size. As the particle number concentration increased, the resulting droplet sizes decreased. Based on a 4-µm cut-off size, as the VIVAS was operated at an 8 LPM flow rate, four inlet particle concentrations were tested, ranging from 10^3 to 10^6 particles/cm³. The mean diameter of the final particle size decreased from 7.9 µm to 2.75 µm, and the corresponding collection efficiency decreased from 98% to 78%. These findings underscore the significance of thermodynamic and vapor mass-transfer effects in condensational growth tubes. Future work will extend this study by evaluating how temperature gradients and particle residence time influence condensational growth and collection efficiency. Such analyses will enable more precise control over droplet growth and enhance the reliability of bioaerosol sampling across a wide range of environmental conditions.

2BQ.1

Measuring Particulate Matter Emissions from Prescribed Fires. ANNAMARIE GUTH, Marissa Dauner, Sean Benjamin, Evan Coffey, Alexandra Fowler, Spencer Hoel, Chad Hoffman, E. Louise Loudermilk, Peter Hamlington, Michael Hannigan, *University of Colorado Boulder*

The western US has experienced an increase in wildfire activity, contributing to increased periods of poor air quality. Drier and hotter conditions due to climate change are increasing the severity and area burned during wildfires. Wildfires release large quantities of particulate matter (PM). Exposure to PM can have many negative short and long-term health impacts. Prescribed fires are a highly effective way of reducing wildfire risk but come with tradeoffs; for example, prescribed fire still releases PM. This project uses low-cost emissions tools (EPODs) to measure PM at prescribed burns throughout Colorado. EPODs have been used previously in published studies to measure emissions from cookstoves and trash burning. The EPOD uses a Plantower sensor to measure $PM_{2.5}$ and collects PM onto a quartz fiber filter to quantify amounts of elemental carbon and organic carbon, and complete organic speciation. For each burn, we quantify $PM_{2.5}$ emissions factors using the partial capture carbon balance method and modified combustion efficiencies. The placement of each EPOD at prescribed fires is determined by BluSky Playground, an interactive model developed by the USFS to predict ground plume movement and $PM_{2.5}$ concentrations. Terrestrial LiDAR scan (TLS) data was collected for 9 prescribed burns, which can be used to quantify fuel reduction at certain plot locations. We have partnered with several different county and forest service implementers around the state of Colorado. So far throughout this project in partnership with implementers, we have attended 21 prescribed burns, 13 pile burns, and 8 broadcast burns; burn windows for the types of burns are different which also impacts burning conditions. I will present emission factors for carbonaceous components of PM, combustion efficiency, and how $PM_{2.5}$ concentration varies with fuel reduction. I will discuss how these metrics and their variability are impacted by type of prescribed fire, environmental parameters, and landscape.

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2BQ.2

Chemical Speciation of Flaming and Smoldering Combustion from Sagebrush Ecosystem Vegetation. BIANCA MARTINEZ, Chiranjivi Bhattarai, Andrey Khlystov, *Desert Research Institute*

Wild and prescribed fires are prevalent across the western and central United States, where shrubland and grassland vegetation cover over 60% of the landscape, including the wildland-urban interface (WUI). Biomass burning can occur under varying efficiencies, leading to different burning conditions. This study aims to determine the emission factors (EFs) from the burning of sagebrush ecosystem vegetation under flaming and smoldering, as few studies have explored the various chemical species associated with these conditions. Two common fuels from the sagebrush ecosystem, sagebrush (SB) and rabbitbrush (RB), were used. The experiments were conducted at the Desert Research Institute courtyard. Samples were collected for analysis of various chemical classes, including carbonyls, terpenes, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), carbonaceous aerosols, and particulate matter (PM). Carbonaceous aerosols were collected from both fresh and aged biomass burning smoke. The collected samples for carbonyls were extracted and analyzed using high-performance liquid chromatography coupled with a photodiode array detector (HPLC-PDA). For the other classes, the collected samples were extracted and analyzed using gas chromatography coupled with mass spectrometry (GC-MS). Online instruments, such as carbon monoxide and carbon dioxide sensors, were used to calculate the modified combustion efficiency and to obtain carbon-based EFs. The emissions of total carbonyl compounds were higher for SB in both smoldering (2.7±0.3 g/kgC) and flaming (2.5±0.4 g/kgC) conditions. RB showed lower emissions but followed a similar trend. For carbonaceous emissions, RB had higher emission factors compared to SB. Organic carbon concentrations increased after aging for smoldering of SB but not for RB. Regarding VOCs, smoldering conditions resulted in higher emissions, especially for RB (2737±834 g/kgC). SB followed a similar trend but lower (777±1087 g/kgC). For individual VOCs, such as isoprene, smoldering of RB (605±174 g/kgC) produced 1.8 times more emissions than flaming (328±218 g/kgC).

2BQ.3

Volatile Organic Compounds Profile from Laboratory Scale Combustion Emissions of Regionally Relevant Wood Types and Synthetic Building Materials. YIN YEE (CYNTHIA) CHOO, David Kalafut, Marilyn Black, William Goldsmith, Thomas Batchelor, Anand Ranpara, Timothy Nurkiewicz, Mark Wilson, *UL Research Institutes*

Wildland-urban interface (WUI) fires are uniquely complex due to the combustion of both natural biomass and synthetic materials, resulting in emissions with chemical profiles distinct from those of wildfires or structural fires alone. Despite the growing threat, there are still significant knowledge gaps regarding the chemical composition of WUI fire emissions. Although field collection and analysis of emissions from WUI fires is feasible, the unpredictable nature of wildfire events both in timing and location poses significant challenges to obtaining consistent and representative samples. Our research group developed a novel laboratory-scale combustion system to simulate WUI fire conditions under controlled parameters to overcome these challenges. Pellets were fabricated from four regionally representative wood species- red oak, ponderosa pine, loblolly pine, and douglas fir to model wildland biomass. Additional composite pellets were produced by combining each wood type with synthetic building materials commonly present in modern homes, including polystyrene insulation, oriented strand board (OSB), and vinyl flooring. These fuels were combusted in a modified pellet furnace with a programmable feed rate and integrated air sampling ports. A total of 20 different pellets were combusted in the first phase of this project. Emissions were captured on 2,4-dinitrophenylhydrazine (DNPH) cartridges and Tenax TA® sorbent tubes for quantitative analysis of carbonyl compounds and volatile organic compounds (VOCs), respectively. Preliminary results indicate that methyl vinyl ketone, formaldehyde, and acetaldehyde are consistently among the highest-emitting VOCs across all biomass-only combustion scenarios. The inclusion of synthetic materials led to a marked increase in emissions of styrene, a compound absents in pure wood combustion. Our approach allows for controlled generation and chemical characterization of this complex mixture which is useful for exposure modeling and incorporation into in-vivo and in-vitro toxicity assessments.

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2BQ.5

Characterization of Emissions from Burned Residue in Post-wildfire Residential Zones: Analytical Approaches for Assessing the Impact of Wildland-Urban Interface (WUI) Fires. YAN WEN, Vera Samburova, Andrey Khlystov, *Desert Research Institute*

Wildfires are becoming increasingly frequent and severe across the western United States. The January 2025 Los Angeles (LA) fire exemplified this trend, devastating neighborhoods and leaving behind long-term environmental and health concerns. The combustion of household materials, electronics, and plastics releases volatile organic compounds (VOCs) and other toxic substances, such as polycyclic aromatic hydrocarbons (PAHs), which can contaminate soil, water, and air across varying spatial and temporal scales. Additionally, charred and pyrolyzed materials in burned areas continue to release harmful substances post-fire through multiple pathways, posing risks to local ecosystems and public health. In this study, we investigate the environmental and health impacts of wildland-urban interface fires after they have been extinguished. Post-fire samples were collected in burned residential zones in LA, including soil, ash, stones, and insulation materials samples. Chemical characterization of degassing from these samples was conducted to assess the release of harmful substances from various post-fire sources. A non-targeted VOCs screening analysis was performed using gas chromatography-ion mobility-quadruple time-of-flight mass spectrometer (GC-IM-QTOF) to identify key toxins and quantify their concentrations in the post-fire emissions. Coupling this approach with multivariate statistical analysis, we enable a comprehensive understanding of the VOCs and their variations in post-fire samples. These insights facilitate further investigations into pollutant persistence, toxicity, and potential mitigation strategies.

2BQ.6

Exploring Methods of Smoke Generation to Simulate Wildfire Health Impacts. HOVANNESS DINGILIAN, David R. Cocker III, David Lo, Veronica Penuelas, *University of California, Riverside*

Wildfire smoke has been linked to adverse human health effects in the cardiovascular, pulmonary, and, more recently identified, nervous system. Many different components, including black carbon, PAHs, and inorganic ions, make up wildfire smoke, each with a unique contribution to the overall impact. Methods in generating smoke include pyrolysis - smoking through intense heat - and generating smoke through a live burn in a closed system chamber. In this work, we investigate the similarities and differences in chemical composition between the smoke generated by these two methods. This chemical composition analysis includes Cation, Anion, PAH, Metal, and Elemental Carbon Analysis.

These findings show the distinctive features of each type of burn and their corresponding effects on health. These health effects were measured through mouse exposures which are carried out by having the wildfire smoke travel into acrylic chambers that house mice. Health impacts are analyzed through inflammatory response analysis which include comparing the percentage of neutrophils, alveolar macrophages, and other indicators with mice that are exposed to wildfire smoke and those that are not. The methodologies of this study can be applied to other instances of combustion emissions.

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2BQ.7

Oxidation of Eucalyptus Biomass Burning Emissions by Hydroxyl Radical in Cloud Water Mimics and Implications to Secondary Organic Aerosol. VIVIAN CAMPBELL, Haley Royer, Megan McRee, Marc Fiddler, Cade Christensen, Solomon Bililign, Jason Surratt, Barbara Turpin, *University of North Carolina at Chapel Hill*

Biomass Burning (BB) emissions are a substantial source of aerosol, including brown carbon (BrC), a form of light-absorbing organic aerosol that impacts radiative forcing. Previous research has demonstrated that water-soluble organic gases (WSOGs) present in BB emissions can form secondary organic aerosol through cloud processing, yet cloud processing of BB emissions remains poorly understood. Eucalyptus camaldulensis is a prevalent fuel on several continents. Using Eucalyptus camaldulensis from sub-Saharan Africa, we investigated the transformation of WSOGs through cloud water oxidation experiments, focusing on reactions with OH radicals. The combustion of Eucalyptus camaldulensis under smoldering conditions in an indoor smog chamber at NCA&T University generated smoke for the collection of WSOGs via mist chamber samplers (MCS). A MCS blank was collected before two 20-minute sampling periods. Samples and blanks were analyzed using a Total Organic Carbon (TOC) analyzer and aliquots were placed into quartz cuvettes for oxidation in an aqueous chemistry reactor. Both MCS samples and a blank MCS aliquot were exposed to ~10-12 M hydroxyl radicals produced through photolysis of 500 µM H_2O_2 by a 254 nm ultraviolet (UV) lamp. Control experiments included exposing samples to H_2O_2 only and UV only. A time-series of 14 samples removed from the reactor during each experiment was analyzed using ion chromatography to determine the presence of soluble small chain organics. To determine the overall chemical composition and optical properties of samples, we used reverse-phase liquid chromatography interfaced to diode array detection and electrospray ionization high-resolution quadrupole time-of-flight mass spectrometry (RPLC/DAD-ESI-HR-QTOFMS). Results are used to identify WSOGs for further study, with a focus on compounds that are potentially important precursors for secondary organic aerosol formation via cloud processing and to stimulate hypotheses relevant to BrC.

2BQ.8

Oxidation of African Biomass Burning Emissions within Cloud Water Mimics as a Potential Source of Aqueous Secondary Organic Aerosol and Brown Carbon. HALEY ROYER, Vivian Campbell, Cade Christensen, Megan McRee, Marc Fiddler, Solomon Bililign, Barbara Turpin, Jason Surratt, *University of North Carolina at Chapel Hill*

Wildfires, which are increasing globally due to climate change and land use changes, emit water-soluble organic gases (WSOGs) that can partition into cloud water. Reactive species such as the hydroxyl radical (•OH) are common in cloud droplets, creating an opportunity to oxidize WSOGs and alter their chemical and optical properties, including the formation of semi-absorptive brown carbon (BrC). However, few existing studies have explored this mechanism in a controlled laboratory setting with real fuel samples. Studies are especially scant for African fuels, despite African wildfires accounting for nearly half of biomass burning emissions globally. In this study, we monitor changes in cloud-water mimics consisting of •OH and WSOGs from the combustion of common African vegetation to explore how the chemical and optical properties of wildfire emissions change as they are oxidized. Common African biomass burning fuels were first combusted in a smog chamber, during which WSOGs were collected into mist chamber samplers and subsequently analyzed for total organic carbon (TOC) concentrations. We then produced cloud water mimics consisting of diluted mist chamber samples (to mimic TOC concentrations in clouds influenced by wildfire plumes) and hydrogen peroxide. Cloud water mimics were exposed to a 254 nm ultraviolet lamp to generate •OH and facilitate oxidation of WSOGs. Over the course of 3-hour experiments, aliquots were collected at 14 time points and analyzed via ion chromatography (IC) for soluble short-chain organic compounds and reverse-phase liquid chromatography coupled to both diode array detection and to a high-resolution quadrupole time-of-flight mass spectrometer equipped with electrospray ionization (RPLC/DAD-ESI-HR-QTOFMS) for characterization of BrC species and long-chain organics, respectively. Results show the evolution of short-chain and long-chain organics as they form or decay over the course of each experiment. Corresponding optical measurements provide insight into the potential of organics to evolve into semi-absorptive secondary BrC compounds.

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2BQ.9

Effect of pH on the Optical Properties of Brown Carbon (BrC) Aerosols and Climate Change During Aging Process by Hydroxyl Radicals. YANRU HUO, Thomas Preston, *McGill University*

Brown carbon (BrC) emitted from wildfires represents a significant fraction of atmospheric light-absorbing aerosols to impact its radiative forcing and climate. However, the optical properties of BrC during the aging process by ·OH and the effects of pH are still not very clear. To address this gap, six nitrophenols are chosen as model compounds to investigate their ·OH aging mechanism, kinetics, ultraviolet-visible spectrum, and complex refractive index (RI) in the aqueous at different pH values using computational chemistry. Reactivity exhibits a positive correlation with the electron-withdrawing ability of side-chain substituent groups of the aromatic rings. At 298 K, the reaction rate constant for neutral species + ·OH reactions is in the range of 6.17×10^{4}–8.04×10^{9} M^{-1} s^{-1}, while that for deprotonated species + ·OH reactions is 1.21×10^{10}–5.91×10^{10} M^{-1} s^{-1}. Deprotonated species are more reactive than neutral species. Neutral and weakly alkaline conditions favor the aqueous phase aging of BrC. Aging predominantly yields more light-absorbing polyhydroxy compounds and quinones, whereas the formation of less light-absorbing ring-opening products is limited under the ·OH-initiated aging pathway alone. Aging products of nitrophenol BrC formed during the daytime exhibit resistance to photobleaching. Owing to their high complex RI and strong light absorption, these products significantly absorb solar energy, leading to localized atmospheric heating and potentially enhancing the greenhouse effect.

2BQ.10

Transformation of Polycyclic Aromatic Hydrocarbons (PAHs) Present on Firefighter's Personal Protective Equipment (PPE) During Ozone-Based Decontamination. ALEXANDRE ALBINET, Ahmad El Masri, Faustina Fuvel, Ophélie Simonin, Jean-Marc Lo Guidice, Samuel Trupin, Valérie Martial, Guillaume Garçon, Anne Platel, *INERIS*

Firefighters are routinely exposed to hazardous combustion products, either through direct inhalation of smoke during firefighting activities or indirectly via residues deposited on their personal protective equipment (PPE). The effective decontamination of PPE is therefore a critical occupational health concern. Recently, ozone chambers have been introduced as an alternative decontamination approach to conventional laundering methods. It is well established in atmospheric chemistry that the ozonolysis of typical combustion-derived compounds, such as polycyclic aromatic hydrocarbons (PAHs), can lead to the formation of potentially more toxic species as oxygenated and nitrated PAH derivatives (oxy- and nitro-PAHs). However, little is known about the transformation of PAHs bound to PPE or soot during ozone treatment. This study aims to characterize and compare the chemical profiles of PAHs, and their derivatives present in combustion residues on firefighting jackets, before and after ozonolysis. Five jackets used during fire training exercises involving wood pallet combustion, along with one new jacket (used as a reference), were tested. Sections (100 cm^2) were cut from the jacket sleeves both pre- and post-ozone treatment for chemical analysis. Ozonolysis was performed according to the manufacturer's specifications (4-hour treatment at 60°C), with ozone concentrations monitored inside the chamber throughout the process. Samples were extracted using pressurized liquid extraction (PLE) with toluene (120°C, 140 bar). Analytical determination of 22 PAHs, 32 oxy-PAHs, and 33 nitro-PAHs was carried out using UPLC-fluorescence detection and GC-MS. The concentrations of PAHs and their transformation products were compared before and after ozonolysis. The experimental data were assessed against theoretical predictions based on second-order degradation rate constants available in the literature for heterogeneous ozonolysis of PAHs (e.g., gas/particle systems involving soot or graphite particles). Results obtained showed almost no degradation of PAHs together with a significant formation of nitro- and oxy-PAHs from the oxidation of the gaseous PAHs released by the jackets questioning the pertinence of ozone chambers for firefighters' PPE decontamination. This study is part of the OZONO-TOX project (ANSES grant n° 2023/EST/040).

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2BQ.11

Formation of Reactive Oxygen Species by Plastic Burning Particulate Matter Formed Under Pyrolysis Conditions.

BRIANNA LAUPER-COOK, Manabu Shiraiwa, *University of California, Irvine*

Plastic burning as a means for waste treatment causes substantial generation of particulate matter (PM) and microplastics into the atmosphere. The chemical composition and health effects of these combustion products are not well understood. Reactive oxygen species (ROS) can cause oxidative stress upon inhalation and deposition of the PM into the lungs. A previous study has shown that plastic burning PM generated by flaming combustion produces ROS in the aqueous phase; however, there has been no work looking into the ROS generated by plastic burning with pyrolysis. We characterized the chemical composition of plastic burning PM generated through controlled pyrolysis of various plastics, such as EPFRs and microplastics through the use of Raman spectroscopy. Here we conducted measurements of ROS ($^{\cdot}OH$, $O_2^{\cdot-}/HO_2^{\cdot}$, organic radicals, H_2O_2), reactive chlorine species (RCS - $HOCl/OCl^-$), and oxidative potential ($^{\cdot}OH$ assay) in aqueous extracts of plastic burning PM and compared with those generated by flaming plastic burning (under oxygenated conditions). It has already been seen that during plastic burning, less ROS is produced under pyrolysis conditions than through flaming, and in turn a lesser potential for oxidative stress. Microplastics and RCS have also been detected in the samples generated through pyrolysis. These results will allow for greater understanding of ROS/RCS multiphase chemistry by plastic burning PM and a potential alternative to current methods of plastic waste treatment.

2CA.1

Generation of Light-Absorbing Carbonaceous Aerosol from Thermal Degradation of Plastics and Whitening through Atmospheric Aging.

ASMA SOOFI, Katrina Betz, Jace Barton, Elijah Schnitzler, *Oklahoma State University*

Plastic incineration is a growing source of carbonaceous aerosol, which can impact air quality, visibility, and the radiative balance of the atmosphere, through scattering and absorbing radiation and altering cloud formation. Previously, we have shown that light-absorbing carbonaceous aerosol generated from the heated nozzle of a 3D printer can undergo whitening upon exposure to simulated sunlight and gas-phase ozone, with implications on role of this aerosol in the atmosphere. Here, we extend this effort to explore the formation and fate of carbonaceous aerosol from plastic pollution by generating carbonaceous aerosol from thermal degradation of plastic, i.e., polyethylene terephthalate glycol (PETG) and acrylonitrile butadiene styrene (ABS), in a tube furnace and monitoring changes in the color and absorbance of filter-collected samples upon aging processes in the laboratory. Carbonaceous aerosol was generated at furnace temperatures between 300 and 500oC, in 50-degree increments, from both colorless and colorful PETG. At low furnace temperatures, colorless and blue PETG both gave colorless carbonaceous aerosol, while red PETG gave red aerosol. At 450oC, all bulk PETG gave light-absorbing organic aerosol, or brown carbon (BrC). At 500oC, bulk PETG began to give black carbon (BC), from flaming combustion. Filter-collected nanoparticles were exposed to light from a Xe lamp in a solar simulator for up to four days. The absorbance of the samples at visible wavelengths was monitored in 24-hour intervals, indicating significant changes in light absorption with aging. Additionally, composition of the aerosol was monitored using attenuated total reflectance (ATR) Fourier-transform infrared spectroscopy before and after aging and compared to the bulk materials. These results help further the community's growing understanding of the formation and fate of carbonaceous aerosol from plastic pollution.

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2CA.2

Photochemical Aging of Dark Brown Carbon Aerosols Using a PAM-OFR. SHU-WEN YOU, Taveen S. Kapoor, Prabhav Upadhyay, Rajan K. Chakrabarty, *Washington University in St. Louis*

Dark brown carbon (d-BrC) aerosols exhibit significant light absorption across the ultraviolet (UV), visible, and near-infrared (IR) spectra, rivaling that of black carbon. D-BrC has been shown to account for 10% of both the number and mass fractions of wildfire smoke during the 2019 FIREX-AQ. The intrinsic light absorption of a material is represented by the imaginary part (*k*) of the complex refractive index (RI, $m = n + ik$). Several factors—including the complex chemical nature, analytical techniques, and atmospheric transport—contribute to considerable uncertainties in the *k* of d-BrC. However, a knowledge gap remains regarding the magnitude and timescale of photobleaching for d-BrC. To systematically investigate the impact of photochemical aging on d-BrC's optical properties over time, we plan to produce d-BrC in the laboratory using a recently developed method that involves aerosolization of dry distilled wood tar followed by heat-shock treatment, and photochemically aging it in a potential aerosol mass oxidation flow reactor (PAM-OFR, Aerodyne). The d-BrC aerosols will be exposed to various hydroxyl radical (OH) exposure levels to simulate 0, 1, 2, 5, and 7 days of equivalent aging. Four integrated photoacoustic nephelometers (IPN) will be operated to monitor the absorption and scattering coefficients of d-BrC across the UV, visible, and IR spectrum. Along with the number size distribution, which is measured by a scanning mobility particle sizer (SMPS, TSI), we will invert the effective RI using PyMieScatt to evaluate the effect of photochemical aging on the changes in d-BrC's RI. This study will significantly benefit the community by providing the evolution of absorptivity for current climate models during photochemical aging, thereby more accurately estimating its radiative forcing effect.

2CA.3

Chemical Diversity of Tar Balls in Wildfire-Influenced Aerosol: A Single-Particle Analysis of the 2017 Pacific Northwest Fires. AMNA IJAZ, Kaitlyn J. Suski, Zezhen Cheng, Yuzhi Chen, Gourihar Kulkarni, Sijia Liu, Tania Gautam, ManishKumar Shrivastava, Jerome Fast, John Shilling, Swarup China, Alla Zelenyuk, *Pacific Northwest National Laboratory*

The Pacific Northwestern US and Southwest Canada experienced extensive wildfires from mid-August through September 2017, offering a unique opportunity to study wildfire-influenced aerosol. Using complementary techniques, including a miniature single particle mass spectrometer, miniSPLAT, and a high-resolution aerosol mass spectrometer, HR-ToF AMS, we conducted a comprehensive investigation into the chemical composition and physical properties of sub-micron aerosol, focusing particularly on tar balls. We demonstrate that the wildfire-influenced plumes sampled here featured PM_1 loadings of ~60 $\mu g/m^3$, with aerosol being mainly carbonaceous and spherical, consistent with their microscopic images. This aerosol presented diameters ranging from 100 to 400 nm and densities between 1.35 and 1.45 g/cm^3. Despite the predominantly organic and aged nature of aerosol, as revealed by the HR-ToF AMS, miniSPLAT identified eight distinct particle types with varying internal compositions of elemental carbon, potassium-related species, oxygenated organics, and polyaromatic hydrocarbons (PAHs). Notably, PAH-containing particle types were associated with larger sizes, i.e., $d_{va} > 300$ nm, and were prevalent on the most polluted days. These particles were remarkably stable, retaining approximately 90% of their volume after 24 hours under both dry and humid conditions, indicating low volatility and high viscosity. The persistence of PAHs within these highly viscous particles suggests potentially extended atmospheric lifetimes and environmental impacts. Our findings provide insights into the complex physicochemical nature of wildfire-influenced aerosol and reveal that tar balls exhibit significant particle-to-particle chemical diversity that may influence their impact on radiation and clouds, as well as environmental fate.

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2CA.4

X-Ray Detector Window Importance in the Characterization of Black Carbon Nanoparticles. WILLIAM NICOLAS BACCA NOVOA, Cristina Cordoba, Cesar Diaz Pomar, Cristian Arango, *Universidad Distrital Francisco José de Caldas*

Black Carbon Nanoparticles (BCNs) in the atmosphere are hazardous pollutants that cause severe consequences to human health and the environment. Epidemiological studies directly link chronic exposure to BCNs with respiratory diseases and cardiovascular morbidity, contributing to reduced life expectancy in polluted regions [1]. BCNs are also effective at absorbing solar radiation heating the surrounding air, and reducing albedo accelerating ice melting.

BCNs are especially prevalent in developing nations like Colombia, where urban transit systems remain heavily dependent on diesel-powered vehicles. While local governments have introduced mitigation strategies—such as Bogotá's electric bus fleet and stricter emissions standards—critical gaps persist [2]. Notably, there remains a characterization deficit in BCN monitoring (e.g., size-resolved abundance, mixing state), hindering the development of targeted policies to reduce their health and climate impacts during the transition to cleaner energy and transportation systems.

Methods for collecting black carbon nanoparticles (BCNs) from the atmosphere based on simple teflon and quartz filters are widely available and cost efficient, however they may constrain the kind of studies that one is able to perform. Typical studies of BCNs deposited on there substrates commonly employ Raman spectroscopy (RS) and scanning electron microscopy (SEM). In SEM-based analyses, the oxygen-to-carbon (O/C) ratio is frequently characterized as a proxy for particle oxidation state, often measured via energy-dispersive Xray spectroscopy (EDS). While both techniques are widely available as standard tools for material characterization, we identified a critical gap in the literature: the lack of systematic studies evaluating how the detector window material (beryllium, polymer-based) in SEM-EDS systems affects the accuracy of O/C ratio quantification for BCNs. This parameter is particularly crucial for low-Z element (C, O) detection, where window absorption properties may introduce significant measurement biases. We provide correction factors for each window and compare the results with newer windowless detectors using BCNs collected on quartz from various areas of Bogota-Colombia.

References:
[1] WHO (2021). Global Air Quality Guidelines.
[2] IDEAM (2022). National Air Quality Report.

2CA.5

High-Time-Resolution Measurements of Total and Black Carbon and the Determination of Primary and Secondary Organic Carbon at the ASCENT South DeKalb (Atlanta, GA) Measurement Site. MARTIN RIGLER, Matic Ivančič, Irena Ježek Brecelj, Gašper Lavrič, Bálint Alföldy, Ruizhe Liu, Sohyeon Jeon, Longkun He, Pengfei Liu, Nga Lee Ng, Asta Gregorič, *Aerosol d.o.o.*

In recent years, carbonaceous aerosols (CA) have been recognized as a significant contributor to the concentration of particles smaller than 2.5 µm (i.e., $PM_{2.5}$), impacting public health and Earth's radiative balance. To measure CA in real-time, we used the Carbonaceous Aerosol Speciation System (CASS, Aerosol Magee Scientific), comprised of two instruments, a Total Carbon Analyzer TCA08 (Rigler et al., 2020) in tandem with an Aethalometer AE33 (Drinovec et al., 2015) or recently developed AE36s. The instruments allow us to perform measurements of total carbon (TC) and black carbon (BC) concentration, where the difference provides highly-time-resolved organic carbon (OC) data.

The measurement campaign, conducted from April to September 2025, took place at the South DeKalb (SDK) site—an urban location situated in a mixed commercial-residential area approximately 15 km east of downtown Atlanta, GA, near the intersection of two major highways. This site is part of the newly established Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT), a comprehensive, high-time-resolution, long-term monitoring initiative. We integrated high-time-resolution total carbon measurements (30-minute) into a comprehensive set of online instruments, including an Aerosol Chemical Speciation Monitor (ACSM) for non-refractory aerosols, Xact for trace metals, an Aethalometer for black and brown carbon, and a Scanning Mobility Particle Sizer (SMPS) for aerosol number size distribution and concentration. An advanced TC–BC method, incorporating an upgraded black carbon tracer model, was applied to the dataset to differentiate between primary and secondary organic carbon (OC).

The BC (EC) tracer model (Ivančič et al., 2022) is frequently used to distinguish between primary OC (POC) and secondary OC (SOC). The main assumption of this method is that the BC (EC) and POC are emitted from the same source and should be well correlated, while the correlation between the BC and SOC should be low due to different formation paths. The traditional BC tracer model has one free parameter (OC/BC)prim, which is expected to be site (source) and season-dependent. To avoid using the predefined values of (OC/BC)prim, the parameter can be determined from the data itself using the minimum R-squared (MRS) method (Wu and Yu, 2016). Briefly, the hypothetical SOC is firstly calculated for a wide range of hypothetical (OC/BC)prim ratios. Then, the R-squared between hypothetical SOC and BC is calculated for every hypothetical (OC/BC)prim ratio, and the optimal (OC/BC)prim ratio is chosen where the MRS criterion function has a minimum.

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2CA.6

Black Carbon (BC) Measurements in Addis Ababa: Reconciling Aethalometer BC with Filter Based BC and FTIR-EC Measurements. AHMAD JALIL, Sina Hasheminassab, Kyan Shlipak, Tesfaye Mamo, Araya Asfaw, Hossein Kazemian, Ann M. Dillner, *UNBC, UC Davis*

Black carbon (BC) is the second-strongest climate forcer after CO_2 and a ubiquitous component of $PM_{2.5}$ with significant health impacts. Accurate BC measurement is critical for understanding air-quality and climate effects, yet discrepancies between optical and thermal methods hinder reliable assessment in dust-rich environments such as Ethiopia.

We evaluated adjusted BC concentrations from an MA350 aethalometer (median-K correction applied) against established reference techniques using 109 matched filter days from Addis Ababa, Ethiopia (mean FTIR-EC = 4.6 ± 2.1 μg m^{-3}). Aethalometer BC was compared with Fourier-Transform Infrared (FTIR) elemental carbon (EC) and Hybrid Integrating Plate & Sphere (HIPS) optical absorption.

Fundamental comparison of optical absorption measurements shows moderate agreement between the aethalometer and HIPS methods, and both optical approaches track FTIR-EC trends well after calibration.

Seasonal dependence in the mass-absorption cross-section (MAC) is evident, with higher values in the dry season than in the wet season; ongoing work is quantifying these differences. Initial indications suggest that elevated iron concentrations in Addis Ababa do not dominate BC optical absorption, though further analysis is in progress.

These findings highlight that universal MAC values and default instrument corrections fail to represent local aerosol properties in Addis Ababa. Site-specific, seasonally adjusted MAC values therefore provide more realistic BC estimates and better alignment with reference methods.

2CA.7

Backscattering by Soot Fractal Aggregates: A Model for Lidar Applications. ROMAIN CEOLATO, Jerome Yon, Matthew Berg, *ONERA*

Aerosol lidar remote sensing relies on the interpretation of backscattered light to retrieve particle properties of interest.

This study presents a novel analytical backscattering model for soot or black carbon aerosols, based on the Rayleigh-Debye-Gans for Fractal Aggregates (RDG-FA) approximation. This model is used to derive simple expressions for common lidar-relevant parameters are derived using this model, including differential backscattering cross-section, lidar ratio (LR), mass-backscattering coefficients (MBC), backscattering color ratio (CR), and Ångström exponent (BAE). The behavior of these lidar parameters is investigated as a function of wavelength, size, and aging.

Key findings include a general decrease in LR, along with a clear dependence of CR and BAE on aerosol size as black carbon aggregates grow, for both freshly emitted and aged soot. These findings have highlighted the ability to model the variations of these parameters throughout the life cycle of black carbon, capturing the evolution from chain-like freshly emitted particles to more spherical aged particles.

Furthermore, this study demonstrates the potential of the RDG-FA backscatter model to calculate key lidar parameters and improve the retrieval of soot aerosol products.

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2CC.1

Potential Factors and Impacts of Long-Range Saharan Dust Transport on PM Concentrations in Central Europe.
VLADIMÍRA VOLNÁ, Daniel Hladký, Marie Glofáková, Adéla Šmejkalová Holubová, Jáchym Brzezina, Adriana Šindelářová, Eva Houbová, Hana Škáchová, *Czech Hydrometeorological Institute*

The poster presents the assessment of the massive transport of aerosol from the Sahara desert in the period between March and April 2024 in the Czech Republic. The transport of Saharan dust across Europe is not unusual. However, such high concentrations of PM_{10} have never before been measured in Central Europe in this context, causing smog alerts throughout the Czech Republic. This unusual episode was caused by a combination of several important factors. There was a massive and relatively constant increase in dust plumes from the North African desert region, combined with strong downslope winds behind mountain barriers in Central Europe. Prolonged very good dispersion conditions with a prevailing southwesterly direction of dry air masses at higher speeds also played a significant role. The combination of these factors also allowed dust plumes to pass through to low altitudes to the earth's surface over temperature inversions or even contributed to the breakdown of inversions.

The assessment provides as a basis for raising public awareness and for State Authorities and the Ministry of the Environment of the Czech Republic. The assessment analyses are used to adjust legislation and rules for issuing warnings, smog alerts and regulations in the Czech Republic. New rules should therefore also take into account the influence of natural sources. Until now, only anthropogenic sources, especially industrial ones, have been taken into account in smog conditions.

2CC.3

Investigating Alkylamine Content in Size-Resolved Aerosol Collected over the Yellow Sea During Fatima 2023.
CONNOR OVERTON, Leyla Salehpoor, Rachel Chang, Gianina Giacosa, Harindra J. Fernando, Ed Creegan, Kyung-Il Chang, Seok Lee, Trevor VandenBoer, *York University*

Aerosol can promote droplet formation by acting as nucleation sites for fog and cloud droplets. High aerosol concentrations might promote denser, longer lasting clouds and fog, should they be able to activate at a given temperature. The processes governing fog formation in the marine boundary layer have proven difficult to predict, resulting in persistent navigation safety issues. Condensation of water to form cloud or fog droplets also influences gas partitioning and aerosol mass distribution. The chemistry of these systems and their role in droplet microphysics can shed light on their interactions. This study analyzes reduced nitrogen (N) species in size-resolved aerosols to better understand how the phase distribution of these trace species may change during fog. Nitrogen bases can neutralize acids in the air, forming molecular clusters which then nucleate atmospheric aerosols. They may also thermodynamically or reactively partition to existing aerosol, facilitating growth and chemical transformation. They have high spatial variability due to their short atmospheric lifetimes in the gas phase and are primarily emitted from anthropogenic and biogenic sources. In this study, marine aerosol samples were collected during the 2023 Yellow Sea Fatima campaign using a Micro Orifice Uniform Deposit Impactor (MOUDI) in which aerosols were collected in size-bins ranging from 0.18-18 µm. The Yellow Sea is one of the foggiest regions on Earth due to strong tidal mixing and the distribution of low salinity water. Between 20 June to 9 July 2023, ship-based sampling and analysis instruments were deployed on board the R/V Onnuri. This MOUDI was deployed continuously, and quantitative analysis of major ions and reduced nitrogen was performed subsequently using an ion chromatograph.

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2CC.5

Contrasting Above and Below Cloud Aerosol Composition and Properties from ArcticShark Uncrewed Aerial System at the Bankhead National Forest Site. SIJIA LIU, Zezhen Cheng, Nurun Nahar Lata, Gregory W. Vandergrift, Xena Mansoura, Valentina Sola, Alla Zelenyuk, Celia Faiola, Sergey Nizkorodov, Fan Mei, Damao Zhang, Zihua Zhu, Swarup China, *Pacific Northwest National Laboratory*

Atmospheric aerosols significantly impact Earth's climate by influencing solar radiation, cloud formation, and precipitation processes. However, substantial uncertainties persist due to limited observations of aerosol vertical profiles, where complex sources and transformations occur. To address these gaps, we conducted flight campaigns using the ArcticShark uncrewed aerial system (UAS) at the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Bankhead National Forest (BNF) site during August 2024. During the four-day exploratory flights, ArcticShark collected aerosol particles at multiple layers between 2,000 and 9,500 ft, recording detailed measurements of aerosol number concentrations and size distributions, ambient parameters (temperature, relative humidity, pressure, and other meteorological conditions), and cloud location.

Using multi-modal offline analytical platform at the Environmental Molecular Sciences Laboratory (EMSL), we characterized vertical variations in aerosol size distributions and chemical composition above and below cloud layers. We employed nanospray desorption electrospray ionization high-resolution mass spectrometry (nano-DESI-HRMS) to acquire molecular-level composition, tracking sulfate-containing species and biomass-burning markers at different altitudes. Vertical profiling was further analyzed by computer-controlled scanning electron microscopy (CCSESEM) coupled with energy-dispersive X-ray (EDX) spectrometer for particle morphology and elemental composition, and by scanning transmission X-ray microscopy (STXM) to assess Organics, inorganics, and elemental carbon within individual particles. Our preliminary data reveal distinct microphysical and chemical patterns in samples collected above cloud layers compared to those sampled farther aloft. Nano-DESI-HRMS indicates a depletion of sulfate-rich compounds in near-cloud aerosols, suggesting that in-cloud hydrolysis. These combined observations will elucidate aerosol-cloud interactions and shed light on vertical aerosol profiling, which eventually benefits regional and global modeling.

2CC.6

Elucidating the Complexity of Mass-Based Hygroscopicity and Photochemical Transformation of Himalayan Aerosols as Revealed by Piezoelectric Technique. SHAILINA SRIVASTAVA, Aishwarya Singh, Tariq Ahmed, Amar Krishna Gopinath, Bin Bai, Christi Jose, Rizana Salim, Subrat Sharma, R. Ravikrishna, Pengfei Liu, Sachin S. Gunthe, *Indian Institute of Technology Madras, India*

Atmospheric aerosols are key players in Earth's climate system, originating from both direct emissions and secondary formation through chemical reactions of gaseous precursors. Their climatic effects include directly scattering or absorbing solar radiation and indirect effects by acting as cloud condensation nuclei (CCN) or ice nuclei (IN), thereby perturbing cloud formation and precipitation. To better understand the role aerosol play in cloud and precipitation formation is crucial for reducing the climate uncertainty. One such critical aspect is to assess their hygroscopicity in sub-saturated region as knowing RH dependent history of aerosol particles is critical for improved understanding of water uptake, phase states, viscosity, and radiative impact of atmospheric aerosols. Additionally, investigating the seldom-studied transformation process of photodegradation is vital for gaining insights into the atmospheric evolution and lifespan of aerosol particles. Aerosol samples ($PM_{2.5}$ and PM_{10}) were collected from Ladakh, a climatically and geographically unique high-altitude cold desert plateau (~3400 m a.s.l.) located in the Indian Himalayan ranges. $PM_{2.5}$ particles were transferred as a thin film on QCM (Quartz Crystal Microbalance) sensors and subjected to RH variations (1–90%) to evaluate hygroscopic growth. Key parameters including, mass-based hygroscopic growth factor (gf_m), hygroscopicity parameter (κ_m), deliquescence relative humidity (DRH), and UV-induced mass loss, were analyzed. The κ_m values ranged from 0.04 to 0.06, with DRH between 65–78%, indicating a mixture of organic and inorganic species. The relatively low κ_m and high DRH values suggest the dominance of water-insoluble organics with limited hygroscopic potential. Photodegradation under UV exposure resulted in an average mass loss of 9.16%, implying the presence of low-volatility oxygenated organics. Complementary comprehensive chemical characterization included ion chromatography for water-soluble ions, ICP-MS for elemental profiling, OC/EC analysis, and scanning electron microscopy imaging. Further detailed findings will be presented.

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2CC.7

Atmospheric Particle Fluxes in the High Arctic Across Three Surface Types. THERESA MATHES, Heather Guy, John Prytherch, Julia Kojoj, Ian Brooks, Sonja Murto, Paul Zieger, Birgit Wehner, Michael Tjernström, Andreas Held, *Technische Universität, Berlin, Germany*

The Arctic is warming much faster than the global average, and aerosols, clouds, and sea ice play key roles in its climate system. To assess how atmospheric particles affect cloud formation, it is essential to identify their sources and sinks in the High Arctic.

This study presents turbulent particle flux measurements to quantify the vertical aerosol exchange between open water, sea ice, and the atmosphere. Measurements were performed during the ARTofMELT cruise aboard the Swedish icebreaker Oden in the marginal ice zone of Fram Strait from 9 May to 12 June 2023. Data were collected both on board and at ice stations, capturing conditions before and during the seasonal melt.

Two systems were used: an eddy covariance setup combining a mixed condensation particle counter (MCPC 1720, Brechtel, USA) with a sonic anemometer on the ship's foremast, and a gradient system measuring aerosol concentration, wind speed, and temperature at multiple heights. A sensor board mounted on a linear actuator was equipped with a distance sensor, wind and temperature sensors, and an aerosol inlet connected to a condensation particle counter (CPC 3007, TSI, USA).

Data were categorized by surface condition: wide leads, narrow leads, and closed ice. Over wide leads, net particle emission fluxes dominated, indicating that open water is typically a net particle source. Narrow leads showed both emission and deposition. Closed ice acted as a net particle sink. These measurements add quantitative data and support previous research showing that different surface types have characteristic effects on the turbulent particle exchange between the atmosphere and the central Arctic Ocean.

2CC.8

The U.S. DOE ARM User Facility Establishes a New Site for Studies of Land-Aerosol-Cloud Interactions in the Southeastern U.S. CHONGAI KUANG, Scott Giangrande, Shawn Serbin, *Brookhaven National Laboratory*

The U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility has established a new site in the Bankhead National Forest (BNF) in northern Alabama that will gather data on how clouds, the land surface, and aerosols interact at a hierarchy of scales important to understanding and simulating the Earth system. Starting its operations in October 2024, the BNF site provides a multi-year opportunity for scientists to unravel complex land-atmosphere interactions. A suite of ground-based sensors, elevated tower-based instrumentation, and aerial facilities will enable scientists to investigate those interactions from within the canopy to the clouds. The Southeastern United States was recommended by the DOE ARM and its collaborators in the broader community as an important region to address their common scientific questions given the region's abundant surface-forced convective clouds and mesoscale convective systems that pose ongoing challenges in Earth system models. The region is also home to significant terrain complexity and land-use heterogeneity that will unleash new understanding of anthropogenic and biogenic aerosol processes, boundary-layer aerosol-cloud interactions, and the interactions between the terrestrial ecosystem and coupled aerosol-cloud-radiation processes. Importantly, the BNF site breaks new ground for improving ARM's capabilities for interactive land-atmosphere studies. A facility overview will be presented highlighting several state-of-the-art tower facilities, campaign-driven aerial assets, targeted intensive operational periods, and distributed profiling and surveillance sites found within the forest canopy and spread across the larger domain around BNF. Initial BNF datasets will also be presented, providing the community with important baseline, quality-controlled, continuous observations of aerosol, cloud, thermodynamic and radiative properties.

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2CE.1

Beyond the Open Crop Residue Burn: Comprehensive Assessment of Fine Aerosol Emissions and Health Burden from Indian Agriculture. ROSHAN KUMAR SINGH, Seema Prajapati, Indra Mohan Nigam, Tarun Gupta, Ran Zhao, *University of Alberta*

India is the second-largest producer of crop residues globally, and crop residue burning, especially over the Indo-Gangetic Plain (IGP), is a well-known contributor to severe air pollution episodes. While significant attention has been given to understanding the physiochemical characteristics, health effects, and mitigation of emissions from residue burning, other agricultural practices also contribute substantially to aerosol emissions. Activities such as tillage, planting, fertilizer application, harvesting, and grain handling are overlooked sources of fine aerosol ($PM_{2.5}$). For instance, tillage may release fine soil particles particularly in the alluvium-rich IGP region and verity of bioaerosols. Fertilizer use results in significant NH_3 volatilization, contributing to secondary inorganic aerosol formation, while harvesting can re-emit adsorbed pollutants from plant surfaces. This study, for the first time, presents a comprehensive inventory of $PM_{2.5}$ emissions from six key agricultural activities: tillage, planting, fertilizer application, harvesting, crop residue burning, and grain handling. We estimate a total emission of 1.1 Tg $PM_{2.5}$ in 2021 from agriculture in India, spanning food grains, oilseeds, vegetables, cash crops, and spices. Notably, this accounts for approximately 16% of India's total $PM_{2.5}$ emissions that year. Using an indirect health impact assessment approach, $PM_{2.5}$ emissions attribute approximately 4 million Disability-Adjusted Life Years and 0.13 million deaths to these emissions in 2021. Projections suggest this burden may rise to 1.6 Tg by 2051 without intervention. The findings not only fill a key gap in emission inventories but also equip atmospheric modelers with more accurate data to enhance air quality simulations. For policymakers, this study provides clear evidence to guide regulatory reforms, clean technology interventions, and rural outreach programs. As India advances toward its 2047 goal of becoming a developed nation, sustainable agriculture must be central to the country's environmental and health strategy.

2CE.2

Detailed Characterization of Fine Aerosols from Crop Residue Burning of Major Indian Crops: Implications for Atmospheric Chemistry and Climate. ROSHAN KUMAR SINGH, Indra Mohan Nigam, Rowshon Afroz, Shakiba Talebian, Seema Prajapati, Kerry Chen, Antonio Mirante, Jason S. Olfert, Tarun Gupta, Ran Zhao, *Indian Institute of Technology Kanpur*

Crop residue burning is a major seasonal source of air pollution in India, particularly over the Indo-Gangetic Plain, where agricultural intensity is high. While India cultivates a wide range of crops, over 90% of surplus residue subjected to open burning comes from wheat, rice, corn, millets, and sugarcane. Despite decades of research, a detailed physicochemical characterization of aerosols emitted from these Indian specific crop residues under controlled conditions remains limited. This study aims to fill that gap through a comprehensive laboratory analysis of fine particulate matter ($PM_{2.5}$) emissions from the combustion of these five key residues. $PM_{2.5}$ was measured gravimetrically using a dual-filter setup (quartz and Teflon) to capture both particulate and semi-volatile components. Emission factors of $PM_{2.5}$ ranged from 6.8 to 16.4 g/kg, depending on crop type. Particle number concentrations were monitored using a scanning electrical mobility spectrometer, while chemical composition was assessed via analysis of elemental carbon, organic carbon, water-soluble organic carbon, water-soluble nitrogen, inorganic ions, and trace metals. Optical properties of carbonaceous aerosols were evaluated for both polar and non-polar fractions, shedding light on their light absorption and scattering behaviour. These insights are crucial for understanding the direct radiative forcing effects of such emissions and their role in short-lived climate forcers like brown carbon. Furthermore, this study contributes to improving emission inventories and advancing atmospheric chemistry models by offering detailed speciation data and aerosol characterization. Ultimately, this research enhances our understanding of crop-specific aerosol properties, informs climate impact assessments, and provides a critical dataset for policymakers working toward emission mitigation and sustainable agricultural practices in India and other developing nations.

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2CE.5

Multiphase O_3 and OH Oxidation of Benzotriazole Ultraviolet Stabilizers UV328. YAO YAN HUANG, Jonathan Abbatt, Xinke Wang, Amila De Silva, Cassandra Brinovcar, Linna Xie, *University of Toronto*

Benzotriazole ultraviolet stabilizers (BZT-UVs) are a class of chemicals used to prevent the degradation of materials from ultraviolet (UV) radiation that are added to various consumer and industrial products such as paints, polymers and food packaging, and textiles. They are highly recalcitrant with a growing concern as an environmental contaminant, being observed in water bodies, sediment, and in airborne dust and aerosols. Their reactivity and degradation pathways in the environment are still largely unknown. 2-(benzotriazol-2-yl)-4,6-bis(2-methylbutan-2-yl)phenol (UV-328) has been added to the Stockholm Convention on Persistent Organic Pollutants, but its reactivity and degradation pathways in the environment are still largely unknown. Its presence in airborne dust, aerosols, and consumer products suggests a potential for exposure and transformations in everyday environments. The first multiphase experiments of 2-(benzotriazol-2-yl)-4,6-bis(2-methylbutan-2-yl)phenol (UV-328) with gas phase oxidants (·OH, O_3) were conducted in a flow tube. Transformation productions were identified using liquid chromatography – orbitrap high resolution mass spectrometry (LC-ESI-HRMS). 6 unique ·OH oxidation products with 5 different molecular formulae were identified of up to +2 oxygen atom species to the parent. Major products included benzotriazole (BT) and hydroxylated benzene ring species. Reactions with O_3 at 250 ppb for 3 days produced only benzotriazole. Further experiments with 7 ppm ozone for up to 24h showed long-term products may contain ring-opened carboxylic acid and aldehyde groups up to +4 oxygen atom species from the parent. Reaction pathways were proposed for UV-328 with ·OH and O_3. Analysis of a traffic cone plastic sample identified UV-328 and two OH radical transformation products, suggesting that OH chemistry may be more important than O_3 chemistry in a real-world environment. This study also identifies benzotriazole ($C_6H_5N_3$) as atmospheric transformation product for BZT-UVs as a class. The potential transformation products can be used for future screening in aerosols and dust, and for toxicological studies.

2CE.6

Molecular Characterization and Quantification of Oxidized Volatile Methyl Siloxanes in Laboratory Generated and Ambient Aerosols. JEEWANI MEEPAGE, Josie Welker, Saeideh Mohammadi, Hanalei Lewine, Charles Stanier, Eleanor Browne, Elizabeth Stone, *University of Iowa*

Decamethylcyclopentasiloxane (D_5), a common ingredient in personal care products, is emitted to the atmosphere where it undergoes oxidation to form 1-hydroxynonamethylcyclopentasiloxane (monosiloxanol, D_4TOH) and other products. To date, the abundance of D_5 oxidation products and their contribution to ambient aerosol formation remains poorly understood. To address this, a novel liquid chromatography–tandem mass spectrometry method was developed and validated for the sensitive detection and quantification of oxidized D_5 in gas and particle phases. Laboratory oxidation experiments in a smog chamber confirmed that D_4TOH is the dominant oxidation product, primarily residing in the gas phase under urban plume conditions (~1 day of atmospheric aging). Oxidation flow reactor experiments were conducted extending OH exposures beyond four days, allowing investigation of more oxidized products formed from D_5. Field measurements conducted in New York City during the summer of 2022 identified D_4TOH and the disiloxanol as the most abundant forms of oxidized D5 in atmospheric aerosols. Moreover, the lower positive artifacts and larger particle phase fractions of disiloxanol compared to D_4TOH indicates that it is a more suitable molecular marker to track D_5-derived secondary organic aerosols (SOA) in ambient aerosols. By comparing the fraction of D_4TOH to total organic carbon in field and laboratory studies, the contribution of oxidized D_5 to organic carbon was estimated to be <0.05%, indicating that D_5 is a very minor contributor to SOA in NYC during summertime. This work presents a new analytical method for quantifying oxidized molecular tracers in the atmosphere, enabling improved source attribution of SOA and advancing understanding of the atmospheric fate of D_5. Further, the applied methodology enables bottom-up estimates of D_5-derived SOA, providing new insights into the atmospheric fate of this compound.

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2CE.7

Integrated Experimental and Modeling Investigation of Volatile Methyl Siloxane Oxidation and Secondary Organic Aerosol Formation. SAEIDEH MOHAMMADI, *University of Iowa*

Volatile methyl siloxanes (VMS), commonly found in personal care products (PCPs), are persistent environmental contaminants that undergo atmospheric oxidation, primarily with OH, forming a mixture of secondary products, some of which have been found in atmospheric secondary organic aerosols (SOA). The fate of decamethylcyclopentasiloxane (D5), a prominent VMS, is of scientific and ecological interest due to its propensity for long-range atmospheric transport to pristine locations. However, lack of knowledge of the product distribution and aerosol yield resulting from OH oxidation of D5 makes comprehensive knowledge of fate and transport impossible. This study integrates experimental and modeling approaches to better constrain D5 oxidation and extends the results to long-range (global) environmental fate and transport by incorporating D5 and its gas and aerosol oxidation products into the global Multi-Scale Infrastructure for Chemistry Modeling (MUSICA-v0).

An oxidation flow reactor (OFR) was employed to systematically vary OH exposure (5×10^{11} to 1×10^{13} molecules·s·cm^{-3}). Since fate of the RO_2 radical generated from initial OH attack of the parent compounds varies significantly across the global modeling domain, SOA yields and molecular product distributions were also studied as a function of the RO_2 radical loss pathways (primarily $RO_2 + HO_2$ and $RO_2 + OH$ reactions). Particle and gas-phase samples were analyzed using high-resolution liquid chromatography-mass spectrometry (LC-HRMS), revealing distinct series of oxidized VMS products, including siloxanols and silanediols, which contribute to low-volatility SOA. Results demonstrated that higher OH exposure favored fragmentation pathways, reducing aerosol yields, while reactions with HO_2 supported the formation of low-volatility products. A kinetic box model was developed to parameterize these processes, providing critical insights for scaling experimental results to atmospheric conditions.

The Multi-Scale Infrastructure for Chemistry Modeling (MUSICA-v0) framework was updated to incorporate oxidation products of D5. Simulations were conducted for July 2022, evaluating aerosol formation potential and spatial distributions at regional and global scales. Model predictions were compared against field measurements in urban New York City (NYC) during a one-month campaign, demonstrating the ability to capture observed trends in aerosol formation and identifying discrepancies linked to gas-particle partitioning mechanisms. Experimentally constrained molar yields were mapped across volatility bins, revealing significant contributions to low-volatility SOA under typical urban conditions.

This work bridges laboratory experiments and atmospheric modeling, providing insights into the fate of D5 and its role in SOA formation. Future directions include refining kinetic frameworks to account for multigenerational oxidation products, validating partitioning simulations under diverse environmental conditions, and extending the approach to investigate the biogeochemical implications of VMS-derived SOA on a global scale.

2CE.8

Individual Effects and Interactions Between Ultrafine Particles and Extreme Temperatures on Hospital Admissions of High Burden Diseases. Quan Qi, Yukang Xue, Najm Madani, RANDY TANGANG, Fangqun Yu, Arshad Arjunan Nair, Xiaobo Romeiko, Gan Luo, Isa Brackett, Chris Thorncroft, Shao Lin, *University at Albany, State University of New York*

Background

Health effects of ultrafine particles (UFPs) and their interactions with temperature are less studied. We investigated the risks of UFPs concentrations and extreme temperatures on hospitalizations for high-burden diseases (HBDs) in New York State (NYS).

Methods

This case-crossover study included hospitalizations for HBDs that contain ischemic heart diseases, diabetes, stroke, kidney diseases, and depression using NYS Hospital Discharge Data (2013–2018). Daily pollutants and temperature data were obtained from a chemical transport model validated by multiple prior studies. UFP changes were measured using interquartile range increase, and extreme heat and cold were defined as temperatures >= 90th% and <=10th% respectively by month and location. Conditional logistic regression was applied controlling for criteria pollutants, relative humidity, and time-varying variables.

Results

Among 1,308,518 cases, significant risk ratios (RR) were observed for UFPs (RRs ranged: 1.009–1.012) and extreme heat (RRs ranged: 1.024–1.028) on overall HBDs, but extreme cold had protective effects on HBDs. The adverse effect of UFPs had significant interactions with extreme cold and was higher in winter and fall. UFPs affected all HBD subtypes except kidney diseases, and extreme heat increased the risks of ischemic heart disease and kidney disease. There were disparities across demographics in exposures-HBDs associations although they were not statistically significant. Elevated UFP concentrations were associated with four clinical indicators (hospital stays, charges etc.).

Conclusion

We observe positive associations between elevated UFP concentrations or extreme heat and HBD hospitalizations, but negative associations with extreme cold. The UFPs' risks were higher in children and during cold seasons.

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2CE.9

Realistic VOC Emissions and SOA Potential of Asphalt Pavement. HUAWEI LI, Kyah Gracia, Yanyu Zhang, Daniel Gonzalez, John Williams, Hovanness Dingilian, Thomas Eckel, David R. Cocker III, *University of California, Riverside*

Asphalt surfaces have been proposed as significant urban sources of volatile organic compounds (VOCs) and intermediate-volatility organic compounds (iVOCs), yet their true atmospheric impact remains poorly constrained. In this study, we primarily employed an oxidation flow reactor (OFR) to simulate the atmospheric aging of emissions from compacted fresh PG-64-22 asphalt pucks under controlled laboratory conditions. Secondary organic aerosol (SOA) formation was monitored in real time using particle-phase instrumentation. In parallel, VOCs and iVOCs were collected on sorbent tubes for subsequent thermal desorption and analysis by flame ionization detection and mass spectrometry.

Our results show that while emissions are strongly temperature-dependent, both SOA mass yields and total VOC release rates are significantly lower than previously reported. At 60°C, we estimate that total asphalt-related SOA emissions across Los Angeles County contribute only ~0.131 kg/day, which is less than 0.0016% of total SOA reported in the 2022 AQMP. In contrast to prior work (e.g., Khare et al., 2020), which assumed complete binder accessibility and estimated a 0.1% binder mass loss, our data suggest a worst-case lifetime loss of only ~0.0025%. When applying a more realistic exponential decay model, the projected lifetime loss is ~0.00014%, which is over 700 times lower than earlier estimates. These discrepancies are due to earlier assumptions of full binder accessibility. This work emphasizes the importance of incorporating physically realistic, time-dependent emission behavior into urban VOC inventories and offers a refined understanding of asphalt's contribution to atmospheric chemistry.

2CE.10

Indoor and outdoor profiles of atmospheric microplastics within an urban environment in Brazil. ADMIR CRESO TARGINO, Gustavo Akutagawa, Anggraini Widyastuti, Jheng-Jie Jiang, *Federal University of Technology - UTFPR*

Microplastic (MP) pollution, stemming from the widespread use and mismanagement of plastics, represents a critical environmental challenge globally, particularly in high-plastic-producing, low-recycling nations. In Brazil —a major plastic producer— studies on atmospheric MP remain limited. To address this regional scientific gap, we quantified and characterised MPs in indoor and outdoor air samples, examining temporal variations across weekdays and weekends/holidays. Total suspended particulate matter was collected over five weeks using active samplers, and subsequent analyses involved optical microscopy for size, shape and colour classification, followed by μ-FTIR for polymer identification.

Airborne MPs were ubiquitous, with higher indoor concentrations (mean: 2.17 ± 0.94 MP/m³) compared to outdoor concentrations (1.24 ± 0.56 MP/m³), potentially linked to human activity patterns. Overall, fragments and fibres were the most common MP shapes, with fibres being predominant in indoor samples (55%), followed by fragments (38%). In outdoor samples, fragments were the most prevalent (53%), followed by fibres (37%). Indoor MP concentrations also seem to be correlated with human activity, peaking on weekdays. Size distribution revealed that 100–300 μm MPs were most frequent indoors, and 25–50 μm outdoors. Polymer analysis revealed cellulose as the most prevalent material (overall mean 74%), particularly indoors. Whilst polyvinyl chloride (PVC) was the most prevalent petrochemical polymer overall (30%), the indoor and outdoor distributions differed. Polyamide (PA) dominated indoors, whereas PVC prevailed outdoors, with polystyrene (PS) and polyethylene (PE) also detected. The prevalence of different polymers in indoor versus outdoor air suggests that their origins and contributing sources vary. We will also explore how atmospheric conditions influence MP abundance. This research provides crucial baseline data on airborne MPs in a Brazilian urban setting, highlighting the significance of indoor sources and transport and contributing relevant insights to the global understanding of atmospheric MP pollution risks and implications.

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2CM.1

Development of a Theoretical Framework for Particle Charging and Transport in Two-Stage ESPs and Unipolar Ionizers. HASAN AL TARIFY, Austin Andrews, Christopher J. Hogan, *University of Minnesota*

Electrostatic precipitators (ESPs) are aerosol control technologies that remove airborne particles by charging and capturing them through electrostatic forces. ESPs are commonly categorized into single-stage and two-stage configurations and have been widely investigated to assess their performance, especially in complex designs. While high-fidelity simulations can accurately model these systems by resolving the coupled multiphysics phenomena, including fluid flow, electric fields, ion transport, and particle charging, they are often computationally expensive, and are rarely used in the design of commercial ESPs. This study aims to develop a simplified model that captures the essential features of ESP operation without relying entirely on full-scale simulations. Specifically, we model the charging mechanisms by developing simplified approximations for the charging rate (nt product), assuming ballistic particle motion. This charging rate is then used to estimate the number of charges acquired by particles and then to predict collection efficiency with an analytical trajectory model. The predicted efficiency is compared with results obtained from full trajectory simulations. Our findings suggest that the nt product can be effectively estimated using an analytical expression for ion number density within the charging region, eliminating the need to solve for complete particle trajectories. Future work will focus on comparing the predicted charge fraction from ballistic motion against full trajectory results across a range of particle sizes and operating conditions to validate the model's applicability further.

2CM.2

Evidence of pH Change in Impinger-Collected Aerosols Resulting from Non-thermal Plasma Exposure. HUNTER RICHARDS, Zhenyu Ma, Herek L. Clack, *University of Michigan*

Non-thermal plasma (NTP) is a partially ionized state of matter characterized by the presence of high-energy, non-equilibrium electrons and the formation of reactive species that they promote (Mumtaz et al. 2023). NTP has been explored for its effectiveness in air pollution control, environmental remediation, and bacterial deactivation (Li et al., 2024). The treatment of flowing air with NTP has also shown inactivation of airborne viruses (Xia et al., 2019; Ma et al., 2024).

In this study, aerosols are seeded into a flow of air supplied to an NTP reactor, from which are collected pre- and post-NTP-treated aerosol samples into liquid impingers. The NTP reactor is a packed-bed dielectric barrier discharge (DBD) device. Air and aerosol flows through the NTP reactor are maintained using an induced draft fan (Fantech FGC-4), which has an air flow rate of 200 liters per minute and discharges into a lab exhaust ventilation duct. Aerosols are generated from a handheld nebulizer (Mesh Nebulizer Model YM-3R9) with an aerosolization rate of approximately 0.3 mL per minute for 30 minutes. A digital wave function generator (BK Precision, Model 4052) outputs sinusoidal waveform with a frequency of 300 Hz and a voltage of 20 V, which is connected to a high voltage amplifier (Trek Model-610E) to amplify the 20 V AC signal to a 20 kV signal supplied to the NTP reactor. A digital oscilloscope (BK Precision Model-2190D) is connected to the circuit and determines the plasma status and its power consumption. Additionally, an ozone sensor (EcoSensors A-21ZX) samples the outlet to monitor the generated ozone concentration. Aerosol samples from the inlet and outlet flows of the NTP reactor were extracted at 5 L/min and captured in twin impingers using a vacuum pump.

In preliminary experiments, one case with the aerosolization of Phosphate Buffered Saline (PBS) and one case with only ambient air over a course of 30 minutes both with and without NTP generation were analyzed. In each experiment, 40 mL of DI water in the inlet and outlet impingers captured aerosols through bubbling, with pH tested before and after. Through preliminary experiments results show that without any NTP generated, liquid samples collected from the inlet and outlet impingers showed no significant difference in pH. However, when NTP was generated, the solution containing aerosol samples collected from the outlet after exposure to NTP was more acidic, with more than twice the hydrogen ion ([H+]) concentration compared to the inlet samples.

As potential applications of NTP are explored, characterizing the resulting chemistry and effect on pH in air applications will be an important consideration. Current studies have explored

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multiple possible mechanisms for virus inactivation when NTP is applied (Assadi et al. 2022). Additionally, recent work has explored the effect of aerosol pH on virus inactivation in the case of respiratory viruses (Luo et al. 2022). However, the potential impact that pH change induced by NTP application on bioaerosols has not been considered. Through this study, it is possible to better understand aerosol chemistry within NTP technologies based on environmental conditions, NTP settings, and the aerosols of interest.

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2CO.1

Characterization of Emissions from Residential and Commercial Heating Appliances Under Transient Operating Conditions. Stephen Galvin, CHETHANI ATHUKORALA, Rebecca Trojanowski, Thomas Butcher, *Brookhaven National Laboratory*

Accurate emission inventories are essential tools for estimating air pollutant emissions from residential and commercial heating systems, directly influencing the reliability of air quality modeling and public health interventions. However, the emission factors (EFs) currently utilized by the U.S. Environmental Protection Agency’s National Emissions Inventory (NEI) are based almost exclusively on steady-state tests of outdated appliances burning traditional fuels, and therefore fail to capture the complex dynamics of modern appliances, especially under realistic transient operational scenarios such as ignition, shutdown, and cyclic load changes—and exclude any data on emerging fuels or modern combustion technologies. These limitations lead to inventories that do not reflect real-world emission patterns and highlight the urgent need to update EFs to reflect today’s heating equipment and the growing adoption of alternative fuels.

This study systematically characterizes emissions from representative residential (27–41 kW) and commercial (220–454 kW) heating appliances operating on conventional fuels (natural gas, No. 2 oil) and alternative fuels (biodiesel, renewable diesel, hydrogen blends) under realistic transient conditions, including cyclic loads, ignition, and shutdown events. Emissions of methane, carbon dioxide, nitrogen oxides, volatile organic compounds, hazardous air pollutants, and both filterable and condensable particulate matter were quantified using continuous and integrated measurement techniques.

Results demonstrate that transient operating conditions substantially alter emissions profiles compared to steady-state assumptions. Notably, filterable PM emissions increased for No. 2 oil during transient operation, while condensable PM decreased, reflecting the benefits of reduced sulfur content. Methane emissions during ignition and shutdown in residential natural gas appliances were found to be approximately 3.5 times higher than current NEI factors, indicating significant underestimation of emission impacts. These updated and more precise EFs represent vital improvements for accurately modeling air quality impacts, enhancing the effectiveness of policy decisions, and ensuring robust public health strategies.

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2CO.2

Reduction in nvPM Emissions of a Long-Range Business Jet Operating on Sustainable Aviation Fuel During Ground-Test Measurements. SERGIO DOMINGUEZ-MEDINA, Jennifer Klettlinger, Denise Ahrens, Edward Winstead, Bruce Anderson, Palmer Booth, Nicole Didyk-Wells, Richard Moore, *NASA Glenn Research Center*

While the benefits of sustainable aviation fuel (SAF) in large commercial aircraft start to be accounted for in ground tests and flight campaigns, there is limited quantifiable information available of the impact of SAF in the business aviation industry. The possible differences in engine technology, cruising altitudes and mission profiles, among others, justify the need for emissions measurements in the smaller, but growing sector of business aviation. Ground tests provide comprehensive data at controlled engine settings and complement in-flight aerosol measurements. Here we present non-volatile particulate matter (nvPM) emissions data measured 20 meters downstream from a Gulfstream G700 aircraft, powered by two Rolls-Royce Pearl 700 engines. We show a substantial reduction in the emission indices for nvPM mass and number while operating on 100% HEFA from World Energy and a 30/70 HEFA/Jet-A Blend, when compared to 100% Jet-A. This reduction is dependent on the engine setting, but significant almost across the entire range of N1% fan speeds tested. Trends of the emission indices are also shown for different fuel components, such as hydrogen content, total aromatics and sulfur impurities. The fuel impact on nvPM emissions is well within the expected range from other (larger) engine test campaigns. The data presented here complements aerosol measurements performed in commercial aircraft, emphasizing how SAF fuels can also provide significant reductions in nvPM emissions in the business aviation industry.

2CO.3

Speciation & Quantification of Air Toxics From Tier II and Tier III Ocean-Going Vessels. KYAH GRACIA, Ryan W. Drover, Thomas Eckel, J. Wayne Miller, David R. Cocker III, *University of California, Riverside*

This body of work proposes a study of potential community impacts from the shipping industry. In particular, the contribution of hazardous air pollutants (HAPs) and other toxics from large ocean-going vessels (OGVs). In this study, samples were taken from tier II and tier III technology class vessels with category 3 engines. The study serves to quantify the chemical composition and concentration of air toxics from these two technology classes as well as the two regulatory fuel blends used in transport. The two fuels contain different sulfur content values. A full spectrum of samples was collected at different loading points based off the ISO 8178 testing cycle and the two fuel types used. Samples were collected from two main engines, the auxiliary engines as well as a boiler for each vessel. The work shown will give a full chemical analysis of the HAPs and other toxics emitted by both technology classes, including a range along the California coast from the port of Oakland to the port of Long Beach to show the potential risk and health impact to local portside communities. A full spectrum of species from the engine stack emissions will be shown from aldehydes and ketones, polycyclic aromatic hydrocarbons, some inorganics, and more.

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2CO.4

Gas-Phase Organic Compound Emissions Associated with a Malfunctioning Distributed Natural Gas Combustion Source in New York City. ADAM THOMAS, Paul Moon, Mia Tran, Mitchell Rogers, Jo Machesky, Minguk Seo, Taekyu Joo, Conner Daube, Mitchell Alton, Manjula Canagaratna, Jordan Krechmer, Andrew Lambe, Roisin Commane, Joseph Roscioli, Drew Gentner, *Yale University*

The adoption of distributed energy generation (DEG) systems powered with natural gas has increased, particularly in urban areas, as a means of meeting peak energy demand. These systems are distinguished from centralized power plants with smaller generation units at or near the points at which they are consumed, and they represent poorly-understood localized sources of gas-phase organic compounds (i.e., volatile organic compounds; VOCs), trace gases, and greenhouse gases in urban areas. Here, we use real-time mass spectrometry and spectroscopy data collected during the intensive NYC-METS (New York City metropolitan Measurements of Emissions and TransformationS) ground campaigns during summer 2022 and 2023, as part of the larger AGES+ collaborative project, and compare those results to long-term monitoring of carbon dioxide (CO_2), carbon monoxide (CO), and methane (CH_4) at the site. Using high-time resolution data (e.g., 1 Hz) we examine the source profiles of emissions from a malfunctioning DEG unit in Upper Manhattan. The performance of the unit is shown to worsen over the course of the two campaigns, evidenced by a decline in modified combustion efficiency and increased pollutant concentrations, including CO and CH_4 spikes in excess of 25 ppm and 15 ppm, respectively. In addition to these, significant quantities of VOCs including ethane, formaldehyde, benzene, and phenol, among others, are shown to originate from the malfunctioning unit, including formaldehyde spikes of 100+ ppb. The range of emitted compounds observed can affect human health through both primary and secondary air pollution (i.e. ozone, secondary organic aerosol), as well as climate change. This work contributes to the development of source profiles for malfunctioning distributed natural gas combustion units of varying performance for future studies, and underscores the importance of maintenance and compliance for achieving energy, climate, and health goals in urban areas.

2DA.1

An Analytical Framework for Characterizing Pollutant Source and Sink Mechanisms from Time-Resolved Indoor Air Quality Data. SAEED FARHOODI, Insung Kang, Kaveeta Jagota, Nancy Karpen, Zane Z. Elfessi, Israel Rubinstein, Mohammad Heidarinejad, Brent Stephens, *Illinois Institute of Technology*

The growing availability and accuracy of lower-cost consumer- and commercial-grade air quality sensors have greatly increased the spatial and temporal scales at which indoor exposure measurements can be conducted. Increasing amounts of data also necessitates advances in analysis approaches to provide deeper mechanistic insights beyond concentration measurements alone. Therefore, we developed an analytical framework to characterize indoor pollutant source and sink mechanisms from time-resolved indoor air quality data, based on mass balance principles and open-source signal processing approaches. We applied this framework to data collected from an ongoing randomized, single-blind, parallel-group trial of portable air cleaners (PACs) in the homes of US military veterans with chronic obstructive pulmonary disease (COPD) residing in Chicago, Illinois. The field collected dataset includes concurrent time-resolved measurements of indoor particulate matter (PM) concentrations via low-cost monitors and PAC operational patterns via plug load data loggers. The framework includes algorithms for identifying indoor PM peak and background level to automatically detect and characterize the presence and magnitude of PM sources and emission events, estimate PM concentration at background levels in the absence of indoor sources, and quantify decay or loss events under different PAC operation modes (e.g., off, low, medium, and high fan speed settings). Results reveal that while the indoor PM source in the active group was 166% higher than the sham group, the $PM_{2.5}$ concentrations at background levels were 19-47% lower in the active group compared to the sham group at the same PAC fan speed settings. The $PM_{2.5}$ loss rates in the active group increased by ~15%, ~70%, and ~130% in the low, medium, and high fan speed settings, respectively, compared to the baseline (air cleaner off). These findings underscore the utility of the proposed framework in revealing the true benefits of PACs, benefits that would otherwise be obscured without this analytical approach.

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2HR.1

Effect of Volatilization of E-liquid on Electronic Cigarette Aerosol Composition. NATHAN EDDINGSAAS, Chamodhi Ravihansi Polgampola Ralalage, Edward Hensel, Risa Robinson, *Rochester Institute of Technology*

Electronic cigarettes generate aerosol by vaporizing the e-liquid (mainly propylene glycol (PG), glycerol (GL), and nicotine (Nic)). Deposition location and efficiency within the respiratory tract will differ if a compound is in the gas phase or particle phase. This work determined the composition of the aerosol a user is exposed to and how it varies from the e-liquid and what causes the change in composition. Experiments were designed to study multiple possible mechanisms using a lab synthesized e-liquid with a known composition. E-liquid and its resultant aerosol were analyzed for designed experiments by gas chromatography-flame ionization detector (GC-FID). Results from these experiments suggest that the change in composition results from the condensation phase of aerosol formation with more volatile components such as propylene glycol, present at a reduced fraction in the aerosol only in experiments where the condensation step was isolated. In addition, the inclusion of organic acid into the e-liquid (termed salted e-liquid by manufacturers) influences nicotine concentration in the resulting aerosol. The change in composition of aerosol vs e-liquid across several commercial products varying in amount and type of added acid were also evaluated.

2HR.2

DIY Filters for Tuberculosis Surveillance and Infection Control. DAVID KORMOS, Jeffrey Siegel, Sarah Haines, Nehul Agarwal, *University of Toronto*

Tuberculosis (TB) remains the leading infectious killer globally, with drug-resistant TB (Rr-TB) causing significant mortality. Despite substantial efforts, the incidence of Rr-TB has not decreased since 2020. Global migration exacerbates TB transmission, posing challenges for continuity of care and increasing resistance. The TB Antimicrobial Stewardship Program (TASP) aims to address these issues through improved diagnostic and treatment strategies, aligning with the Team Europe Initiative to enhance health technology access in Africa. This presentation focuses on two key areas: designing and evaluating low-cost, regionally adaptable portable air cleaners (PACs) to reduce healthcare facility (HCF) circulation of airborne pathogens and advancing quantitative filter forensics (QFF) for antimicrobial resistance (AMR) surveillance in bioaerosols. Here, we report on the process for and evaluation of discrete choice experiments (DCE) to determine end-user preferences, ensuring PAC designs meet the needs of staff and patients in three hospitals in Mozambique, South Africa, and Nigeria. Highlighted issues included electric power reliability, noise, placement within TB wards, and aesthetic considerations. For surveillance and monitoring, methods to estimate room-scale AMR priority pathogen density and diversity trends using QFF depend on low-cost and flexible methods for dust extraction from the filters, sample storage, and DNA extraction from the dust. Experiments evaluating dust extraction methods suggest that swabbing can replace vacuuming, although variation in the presence of bacteria as well as qPCR inhibitors can require the use of multiple swabs per filter. Extraction of mycobacterium tuberculosis DNA from dust follows similar procedures as other QFF studies for other bacterial targets with additional attention needed during clean-up steps. Expected outcomes include demonstrating the effectiveness of low-cost PACs in reducing airborne pathogens in HCFs, establishing robust AMR surveillance methods, and providing scalable, sustainable solutions for high-burden settings that align with global health strategies.

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2HR.3

Size-Resolved Characterization of Secondhand Vaping Aerosols: Implications for Indoor Exposure and Toxicity.

LINHUI TIAN, Wonsik Woo, Ying-Hsuan Lin, *University of California, Riverside*

The growing use of electronic cigarettes (e-cigs) and increasing reports of vaping-related lung illnesses have raised significant concerns about their broader public health impacts, particularly regarding indoor air quality and passive exposure. According to survey data from 2025, 6.5% of adults aged 18 and over were current e-cigarette users; the percentage of adults who used e-cigarettes increased from 4.5% in 2019 to 6.5% in 2023. Vaping transforms e-liquids, typically composed of propylene glycol (PG), vegetable glycerin (VG), nicotine, and various flavorings, into inhalable aerosols with various particle sizes. These particles exhibit different respiratory deposition behaviors; smaller particles can penetrate deeper into the lungs and are associated with greater health risks.

In this study, we compared fresh and aged e-cig emissions relevant to primary and secondhand vaping aerosols and found that the latter contained significantly higher levels of highly oxygenated compounds. Volatility Basis Set (VBS) estimations indicated that these oxidized products possess lower volatility and a stronger tendency to contribute to new particle formation, thereby exacerbating indoor air pollution. Additionally, we investigated how e-liquid formulation influences aerosol size distribution using online measurement techniques and a MOUDI sampler in controlled chamber experiments with commercial flavored liquids. MOUDI results revealed that highly oxygenated compounds were more enriched in the lower stages (i.e., smaller particle sizes), suggesting a greater potential for deep lung deposition. Cell viability determined by the XTT cell proliferation assay further confirmed that fine particles exhibit higher cytotoxicity toward exposed cells.

These findings underscore the need to consider both vaping aerosols' physical and chemical properties in exposure assessments and regulatory frameworks. The elevated reactivity and toxicity of secondhand emissions reinforce the urgency of protecting both users and non-users in indoor environments.

2HR.4

Geekbar Brand Electronic Cigarette Aerosol Emissions Characterization.

EDWARD HENSEL, Gloria Mbaka, Logan Kelly, Nathan Eddingsaas, Risa Robinson, *Rochester Institute of Technology*

Methods:
Two variants (Pulse and Pulse X) of Geekbar brand rechargeable disposable adjustable flow ecigs, were purchased from retail vendors in Rochester. The Pulse variants were filled with “Strawberry Mango” while the Pulse X variants were filled with “Blackberry Blueberry” flavored eliquid. A Design of Experiments (DOE) consisted of 24 puffing profiles to span the operating range of the devices. Twelve “Activation Flow Rate” profiles systematically varied the puff flow rate while holding puff duration fixed at 3.5 secs. Twelve “Activation Duration” profiles varied the puff duration while holding puff flow rate fixed at 75 ml/s. Each variant was tested with the user-adjustable valve set in the “high flow” and “low flow” position.

Results:
The Geekbar Pulse and Pulse X ecigs exhibited aerosol generating operating envelopes spanning 1 to 8 secs of puff duration and 10 to 160 ml/s puff flow rate. With a fixed puff duration of 3.5 seconds, the Geekbar Pulse and Pulse X emitted a mean yield (or dose) of Total Particular Matter per puff, YTPM, ranging between 12 to 16 mg/puff (Pulse, mid-flow setting) and 16 to 26 mg/puff (Pulse, high-flow setting) 12 to 20 mg/puff (Pulse X, mid-flow setting) and 20 to 30 mg/puff (Pulse X, high-flow setting) across the operating envelope. With a fixed puff flow rate of 75 mL/second, long duration puffs were yielded over 50 mg/puff (Pulse, High flow setting) and 80 mg/puff (Pulse X, High flow setting). The ecig emitted aerosol mass concentration, CTPM, ranged from 0.01 to 0.27 mg/mL.

Conclusions:
The Geekbar Pulse and PulseX ecigs were fully characterized in a controlled laboratory setting. Data will inform how users may vape the Geekbar Pulse/PulseX and the user’s exposure to harmful or potentially harmful constituents as a result of their puffing behavior.

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2HR.5

The Lure of the 'Healthier Smoke': Physical, Chemical, and Toxicological Characterization of Emissions from Herbal and Tobacco Cigarettes. ALOK KUMAR THAKUR, P. S. Ganesh Subramanian, Vishal Verma, Sameer Patel, *Indian Institute of Technology Gandhinagar*

Cigarette smoking continues to be a pervasive global health challenge, with well-documented acute and chronic health effects. Approximately 1.1 billion people around the world smoke tobacco in various forms, including traditional cigarettes, cigars, hookahs, pipes, and bidis. In response to growing health concerns, alternative products such as e-cigarettes and herbal (non-tobacco) cigarettes have gained popularity, often marketed as less harmful options or even health-enhancing substitutes. While the emission profiles and toxicological impacts of e-cigarettes have been widely investigated, the scientific evaluation of herbal cigarettes, particularly those claiming reduced or beneficial health impacts, remains limited.

This study presents a multi-dimensional assessment of firsthand smoke emissions from both conventional tobacco cigarettes and commercially available herbal cigarette products. Herbal variants, which substitute tobacco with herbs and spices such as mint, basil, and clove, are commonly promoted as nicotine-free alternatives for smoking cessation or wellness enhancement.

We employed a Scanning Mobility Particle Sizer and an Optical Particle Sizer to quantify the size distribution of emitted particles in the 10 nm to 10 µm range. Comprehensive chemical analyses were performed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and an EC/OC analyzer to determine the concentrations of trace metals and carbonaceous species. To assess the oxidative potential, a proxy for biological reactivity and toxicity, we conducted two established assays - the hydroxyl radical generation assay in surrogate lung fluid (OH-SLF) and the dithiothreitol (DTT) assay.

Correlative analyses among particle characteristics, chemical composition, and oxidative potential offer new insights into the comparative health risks posed by tobacco and herbal cigarette emissions. This work provides insights to assess the validity of "healthier smoke" claims.

2HR.6

Investigation of Drug Delivery Rate of Three Different Nebulizers Using a Lung Simulator. Taewon Han, Michael Falvo, Daniel P. Wilhite, GEDIMINAS MAINELIS, *Rutgers, The State University of New Jersey*

Pulmonary function laboratories are increasingly adopting dose rather than concentration for reporting methacholine challenge test results. One of the key parameters of nebulizers used in such tests is their drug delivery rate (mg/min). This project analyzed the delivery rate of three popular medical nebulizers: AeroEclipse® II BAN®, Hudson RCI® MicroMist®, and Vyaire Misty Max 10™.

Each nebulizer was connected to a pulmonary function testing filter, and different breathing patterns, including tidal volume, breathing rate, lung compliance, and lung resistance, were simulated using a lung simulator (Michigan Instruments, MI). The aerosol delivery rate was determined by measuring the mass of methacholine (Provocholine®) captured on the filter. The delivery rate depended on the nebulizer model, operation time, initial drug concentration, and initial liquid volume. When AeroEclipse® II BAN® aerosolized 16 mg/ml of Provocholine® from 3 mL of initial solution, the delivery rate decreased from 7.1 mg/min to 5.5 mg/min as the delivery time increased from 20 seconds to 2 minutes. For the same drug concentration of 16 mg/min and a 2-minute operation time with an initial 3 mL drug solution, the MicroMist® and Misty Max™ nebulizers demonstrated delivery rates of 3.1 ± 0.3 and 2.87 ± 0.3 mg/min, respectively, which were lower than the AeroEclipse® II BAN®'s 5.5 ± 0.5 mg/min. This delivery rate by AeroEclipse II® BAN® is about 2x higher than advertised by its manufacturer. Also, the tidal volume was positively correlated with the delivery rate.

Thus, selecting a nebulizer can significantly affect the delivered drug dose, which is determined by the product of delivery rate and delivery time. with implications for methacholine challenge tests and resulting asthma diagnoses.

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2HR.7

Oxidative Potential and Lung-Deposition of Size-Resolved Aerosols Emitted from Common Indoor Sources. P. S. GANESH SUBRAMANIAN, Saman Haratian, Mohammad Heidarinejad, Brent Stephens, Vishal Verma, *University of Illinois Urbana-Champaign*

Oxidative potential (OP) quantifies the ability of particulate matter (PM) to induce oxidative stress in humans and is used as a surrogate of PM toxicity. Although people spend most of their time indoors, the lung-deposited OP exposure from PM emitted indoors is still unknown. In this study, we collected size-resolved PM emitted from common household sources [incense (patchouli), incense (frankincense), cigarettes, toasters, ultrasonic humidifiers running on tap water, and unscented candles in the presence of a wind-draft] in a clean-controlled-environmental-chamber. Our goal is to evaluate the size-resolved emission rates, mass-normalized OP (OP^m) using dithiothreitol (DTT) assay, and chemical composition of PM from these sources. Lung-deposited exposures were calculated by integrating the size-resolved data with the multiple-path particle dosimetry (MPPD) model and compared with total respirable exposures (i.e., fine PM; $PM_{2.5}$) for both mass and OP of the PM emitted from indoor sources.

Preliminary results revealed that submicron particles (<1 μm) constituted over 95% of the total PM mass emitted from incense (both fragrances), cigarettes, and toasters. Notably, OP^m increased with decreasing particle size for the emissions from the few sources characterized thus far (i.e. both fragrances of incense), aligning with previous findings on ambient PM. Exploratory exposure assessment revealed that only 18.3%, 11%, 16.6%, and 20.9% of the $PM_{2.5}$ emitted from incense (patchouli), incense (frankincense), cigarette, and toaster emissions, respectively got deposited in the pulmonary regions. Similarly, lung-deposited OP was also a very low fraction of total emitted $PM_{2.5}$-OP [i.e. 20.8% and 13.3% of the $PM_{2.5}$-OP for incense (patchouli) and incense (frankincense) emissions, respectively]. Notably, ultrafine PM (UFP; D_p<0.25 μm) constituted around 59±20% of the emitted PM mass but constituted a larger fraction of lung-deposited PM (80±16%) and OP (77±19%), due to higher intrinsic OP of UFP. These preliminary results reveal that respirable exposures conducted using bulk $PM_{2.5}$-OP overestimate lung-deposited dose of potentially toxic PM and emphasize the need for size-resolved measurements to reliably estimate PM-induced health-effects.

2HR.8

Albumin Adductome Profiling Uncovers $PM_{2.5}$ Interference in β-Amyloid Peripheral Clearance: Connecting Ambient Particles to β-Amyloid Accumulation in Alzheimer's Disease. YALING ZENG, Xin Yang, *Southern University of Science and Technology*

Exposure to fine particulate matter ($PM_{2.5}$) has been epidemiologically associated with increased risk of Alzheimer's disease (AD). However, the underlying molecular mechanisms linking $PM_{2.5}$ exposure to AD onset remain poorly understood. In particular, how $PM_{2.5}$ affects peripheral β-amyloid (Aβ) clearance—a critical step in the "peripheral sink" hypothesis—has not been clarified.

We hypothesized that soluble organic molecules (SOM) in $PM_{2.5}$ form adducts with human serum albumin (HSA), interfering with its ability to bind and clear Aβ. Year-round urban $PM_{2.5}$ samples were collected, and nontarget analysis was performed using UPLC-Orbitrap MS/MS to characterize SOM composition. Aβ was immobilized on CM5 chips, and HSA (with or without SOM modification) was injected through a Biacore 8K+ SPR system to monitor real-time interaction. Pure HSA bound Aβ with a distinct response unit (RU), while SOM-modified HSA showed reduced RU, indicating impaired Aβ binding.

Machine learning was employed to deconvolute the contribution of individual SOM species. Of the 11,848 identified SOM molecules, 7,796 contributed significantly to the observed disturbance. The most impactful molecular classes followed the order: CHN > CHO > CHON > CH > CHONS > CHOS > CHNS > CHS. Non-covalent HSA-SOM adducts were profiled using Biacore T200, showing a seasonal accumulation trend peaking in winter. Molecular docking (Maestro, Schrödinger 2021-3) and Protein-Ligand Interaction Profiler (PLIP) analysis revealed that many SOMs preferentially occupy residues 494–515 on HSA—the known Aβ binding site.

Our findings demonstrate that $PM_{2.5}$-derived SOMs can competitively bind to critical Aβ-binding regions on HSA, disrupting peripheral Aβ clearance. This provides novel mechanistic insight into how air pollution may contribute to AD progression by targeting the peripheral sink pathway.

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2HR.9

Development of a High-Throughput multipattern Aerosol Deposition Device for Respiratory Toxicity and Health-Risk Assessment (mARTHA). Amin Shirkhani, SUDHEER SALANA, Arantzazu Eiguren-Fernandez, Mohammad Washeem, Stavros Amanatidis, Gregory S. Lewis, Nathan Kreisberg, Chang-Yu Wu, *University of Miami*

The increasing use of engineered nano-materials (ENMs) raises concerns regarding their potential respiratory toxicity. However, *in vitro* assessments are often limited by inconsistencies in aerosol exposure methods, dosimetry, and physiological relevance. Conventional exposure systems provide uniform particle deposition, whereas *in vivo* deposition is inherently heterogeneous across lung regions. To address this, we developed a high-throughput multipattern Aerosol deposition device for Respiratory Toxicity and Health-risk Assessment (mARTHA). mARTHA employs laminar-flow, water-based condensation technology to efficiently grow and deposit nanoparticles as small as 5 nm while maintaining physiological conditions (37°C, ≥95% humidity). Unlike existing systems (e.g., Vitrocell, Cultex, CellTox), mARTHA achieves superior nanoparticle deposition efficiency and enables simultaneous exposure of up to 12 air-liquid interface (ALI) cell cultures. A key innovation is its ability to generate both uniform and non-uniform deposition patterns using three distinct nozzle configurations (3-jet, 7-jet and pie-shaped). The system demonstrates >95% collection efficiency for aerosolized sodium fluorescein (Uranine) nanoparticle with number concentrations ranging from 2,000–200,000 #/cm³. Deposition validation revealed consistent particle dose distribution across nozzle types, with a low coefficient of variation (CoV <15%) across wells. In laboratory test to evaluate toxicological properties of e-liquid, A549 cells at ALI exposure resulted in significant differences in trans-epithelial electrical resistance (TEER), underscoring the impact of deposition patterns on epithelial barrier integrity. Overall, mARTHA is a first-of-its-kind platform that provides a physiologically relevant *in vitro* model for aerosol toxicity studies, bridging the gap between controlled *in vitro* exposures and complex *in vivo* deposition dynamics.

2HR.10

Experimental Simulations of Thirdhand Smoke from Electronic Cigarettes. KAITLYN HUNTER, Stephanie Jacoby, Nahin Ferdousi-Rokib, Akua A. Asa-Awuku, *University of Maryland, College Park*

Thirdhand smoke refers to residual tobacco smoke pollutants that remain on indoor surfaces and re-emit into the air over time, posing potential health risks even after active smoking has ceased. While thirdhand smoke has been studied for conventional cigarettes, there is currently little data on its formation from electronic cigarettes, despite their widespread use and perception as a safer alternative. In this work, we analyze thirdhand smoke within a plexiglass chamber box designed to represent a typical indoor environment. Within our small-room model, we simulate electronic cigarette use and employ a condensation particle counter (CPC) to measure particle concentration over time as it returns to background levels. Experiments examined the influence of rug pile (low, medium, high) on particle retention to identify statistically significant factors. The results indicate that particle concentrations as a function of time consistently exhibit a double exponential decay with time. The initial decay was attributed to airborne particle deposition to the available surfaces, while the secondary decay is attributed to particle removal from indoor surfaces such as walls and carpeting. The double decay was separated into two phases, each fit with an exponential model and linearized to determine particle decay constants. We use these constants, along with the calculated residence time of the e-cigarette smoke, to characterize smoke particle behavior over time in different indoor environments. These findings highlight the potential for prolonged exposure to e-cigarette emissions through re-emission from indoor surfaces, with implications for indoor air quality and human health.

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2IA.1

Low-Cost PM Sensor for Indoor Air Quality Monitoring: Improving Reliability and Accessibility of In-Situ Microenvironment-Based Calibration. JALIL MOKHTARIAN MOBARAKEH, C. Victoria McCrary, Sara Jones, Perry Hystad, Molly Kile, Parichehr Salimifard, *Oregon State University*

Monitoring and controlling indoor air quality (IAQ) is crucial for preventing health issues caused by exposure to particulate matter (PM). While low-cost sensors (LCS) have made PM measurement for IAQ monitoring more accessible, they require regular calibration and maintenance to ensure accuracy. This has hindered the integration of LCS into IAQ monitoring programs and the use of LCS data to measure PM concentration trends. While there are various methods for laboratory calibration of LCS, on-site calibration of LCS remains under-evaluated. In this study, we conducted co-location tests in five microenvironments within a school building using LCS (PurpleAir [PA]), reference (TSI Optical Particle Sizer [OPS]), and mid-range (IC Sentinel [ICS]) sensors. A linear regression model with PM concentration, absolute humidity (AH), and temperature as variables was developed for calibration. The average Pearson correlation (R^2) between LCS and the reference in each individual microenvironment was <0.50 with a large coefficient of variation (CV>30%), indicating the considerable differences between microenvironments. The overall calibration using collected data from all five microenvironments resulted in R^2 >0.90, showing the improvement of the model generalization using a wider range of data. ANOVA analysis indicated that PM concentration, AH, and temperature significantly affect the calibration model's predictions, with PM concentration having the highest impact, followed by AH, and then temperature (p-value<0.01). These results underscore the need for regular on-site microenvironment-based calibration to provide an appropriate range for predictors. Lack of access to a reference sensor impedes such measures. However, our results indicate acceptable proximity between ICS and OPS data; the average R^2 between ICS and OPS in each individual microenvironment calibration was >0.70, and the R^2 of overall calibration using all microenvironments' data was >0.90. This suggests possible application of mid-cost sensors to reduce reliance on more expensive sensors for LCS calibration.

2IA.4

Investigating the Effectiveness of a Ventilation Intervention on Air Quality in a Commercial Kitchen. YINGXI LU, Riley Benko, Tyler Cargill, Zhiyao Li, Jay R. Turner, Jenna Ditto, *Washington University in St. Louis*

Emissions of gas- and particle-phase organic compounds from commercial kitchens can significantly impact indoor air quality. These emissions present a major source of occupational exposure for kitchen staff and other building occupants. In this study, the gas-phase volatile organic compound (VOC) concentrations were measured using a proton transfer reaction mass spectrometer (PTR-MS) in a campus building with a ground-floor commercial kitchen and office space on the second floor. Measurements were taken before and after a ventilation upgrade aimed at improving the efficiency of the kitchen's range and reducing fugitive cooking emissions, which had been affecting air quality and causing discomfort for building staff. Particulate matter mass concentrations ($PM_{2.5}$) and carbon dioxide (CO_2) mixing ratios were also sampled with low-cost sensor devices on both floors of the building. Inhalation exposure to VOC was estimated by calculating an average daily dose (ADD) for building occupants. All the quantified VOCs did not exceed the Environmental Protection Agency (EPA) set chemical-dependent ADD thresholds. However, some quantified VOCs that possess strong odors exceeded their odor thresholds, such as acrolein, isoprene, acetic acid, propionic acid, and butyric acid. Positive matrix factorization (PMF) is applied to the gas-phase data to support non-targeted chemical analyses and investigate complex mixture VOC behavior. Identified PMF factors include emissions from cooking, cleaning, occupancy, and background species (e.g., outdoor infiltration). $PM_{2.5}$ mass concentrations and CO_2 mixing ratios correlate with the cooking emissions and occupancy temporal patterns. Together with measurements of $PM_{2.5}$ and gas-phase mixing ratios for CO_2 and a wide range of VOCs, the air quality impacts of the ventilation intervention in the campus kitchen are evaluated.

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2IA.5

Partitioning of Reactive Oxygen Species Among Indoor Surfaces. Zhenduo Yao, GLENN MORRISON, *UNC-Chapel Hill*

The presence of peroxides, ozonides and other reactive oxygen species (ROS) has been observed on indoor surfaces. Initiated by ozone and possibly other oxidants, ROS has been shown to form on surfaces coated with skin lipids and cooking oils. Models predict that some of the ROS formed have physico-chemical properties that allow them to partition from indoor surfaces to aerosols. This process can thereby lead to inhalation exposure of indoor-generated ROS, and the possibility of deposition deep in the respiratory system. In this research, we explored the potential for ROS formed on indoor surfaces to partition via gas-phase transport to a separate condensed phase. A simulated surface lipid mixture (SLM), comprising squalene, fatty acids, triglycerides, and cholesterol was applied to a glass slide and was exposed to ozone in a reactor at ozone concentrations ranging from 100 to 350 and times from 2-16 h. After exposure, a second glass plate coated with dioctyl sebacate (DOS) was positioned 1mm above the SLM coating in a custom frame for several hours. ROS formed on the SLM coating at a molar yield (ROS formed/ozone deposited) of 0.5. ROS that partitioned to the DOS film was not strongly associated with ROS on the SLM. We observed an inverse relationship between partitioned ROS (in the DOS film) and the ozone concentration during the SLM exposure, for the same exposure time. For all conditions, we observed a positive relationship between partitioned ROS and the ratio of ozone deposited to ozone concentration. This suggests that ozone itself forms ROS that is less likely to partition, while other processes, perhaps autoxidation, form ROS that is more likely to partition.

2IA.6

Evaluating Plate-Based dPCR Methods for Indoor Bioaerosol Analysis. Patricia Watanabe, Nehul Agarwal, Sumaiya Hassan, David Kormos, SARAH HAINES, *University of Toronto*

We spend 90% of our time indoors where we are exposed by abiotic and biotic aerosols, some of which may be a concern for human health. Accurate and reliable quantification of indoor microbial communities (e.g., fungi and bacteria) is critical to characterizing the indoor microbiome. Quantitative polymerase chain reaction (qPCR) has been historically used for detecting and quantifying bioaerosol DNA/RNA in indoor environments. Newer third-generation digital PCR (dPCR) technologies take this further offering absolute quantification, increased precision, and improved reproducibility through partitioning of samples into thousands of parallel PCR reactions. Despite widespread application in both water quality and indoor viral research, the effectiveness of these newer dPCR methods for indoor microbiome assessments remains largely unexplored. This study evaluates the use of nanoplate-based dPCR systems for quantifying fungal and bacterial bioaerosols from diverse indoor sampling methods, including vacuum-collected dust, indoor air cleaner filters, and surface swabs. *Penicillium rubens,* a common indoor fungal species*,* serves as the standard model organism to compare across qPCR, digital droplet PCR (ddPCR), and newer plate-based dPCR platforms. Preliminary findings indicate differences between results from the newer dPCR protocols and established qPCR protocols, suggesting possible inhibition or saturation effects impacting accuracy in the plate-based dPCR systems. Continued research will refine the dPCR methodologies for effective quantification of indoor bioaerosols taken from a variety of sources to advance or ability to accurately assess indoor air microbial exposures.

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2IA.7

Assessment of Indoor Air Quality in Schools: Variability, Determinants, and Mitigation Strategies. AZHAR SIDDIQUE, M. Rami Alfarra, Feras Mestariheh, Maryam Yousuf Al-Shamlan, Tamer Nada, *Hamad Bin Khalifa University, Doha, Qatar*

Vehicular emissions significantly contribute to air pollution in school environments. This study investigates the impact of vehicular emissions on indoor and outdoor air quality in an educational setting in Qatar, focusing on fine particulate matter ($PM_{2.5}$) and black carbon (BC). The study analyzed diurnal variations, indoor-outdoor concentration ratios, and the effectiveness of HVAC systems in mitigating pollutant infiltration. Results indicate that outdoor $PM_{2.5}$ and BC levels were elevated during school drop-off and pick-up times, with mean outdoor $PM_{2.5}$ concentrations peaking during school days compared to weekends. Black carbon levels followed a similar trend, with weekdays attributed mainly to vehicular emissions. Despite effective filtration, indoor $PM_{2.5}$ and BC concentrations were influenced by outdoor sources. Correlation analyses indicated fine particulate matter exhibited a stronger indoor-outdoor relationship than coarser particles. Additionally, an air quality awareness campaign was implemented to assess shifts in students' knowledge, attitudes, and behaviours regarding air pollution. Post-intervention surveys revealed a significant improvement in students' understanding of pollution sources and a moderate increase in engagement with mitigation actions, such as reducing vehicle idling and checking air quality indices. Schools can create healthier learning environments for students and staff by integrating air quality management strategies with policy-driven vehicle emission reductions. This study emphasizes the need to adopt multi-tiered interventions, including implementing no-idling zones, enhancements in HVAC filtration efficiency, and educational initiatives to promote behavioural change.

2IM.1

Visualization and Characterization of Aged Organic-Inorganic Aerosols with Vapor-Phase Transmission Electron Microscopy. MARTIN AHN, Yuhang Wang, Liza-Anastasia DiCecco, Jennifer Gray, Amy Chen, Akua A. Asa-Awuku, Taylor J. Woehl, *University of Maryland, College Park*

Using hermetically sealed microfluidic chambers, vapor-phase transmission electron microscopy (VPTEM) offers a novel method for in-situ single particle observation of aging of organic-inorganic aerosol particles. This previously established method can be further expanded by performing spatial, elemental and crystallographic characterization on these particles using TEM techniques such as diffraction pattern (DP), high-resolution TEM (HRTEM), energy dispersive spectroscopy (EDS), and electron tomography. For visualization, we utilized a MEMS-based in situ TEM sample cell, where relative humidity (RH) control was achieved by mixing humidified and dry air streams at various volumetric flow rate ratios. The dry mixed particles were impinged on silicon nitride sample chips and assembled into the in situ TEM sample cell and observed under controlled RH using in situ scanning TEM (STEM). Here we apply VPTEM on a phthalic acid (PTA)/sodium chloride (NaCl) system to observe aging of single organic acid/inorganic salt aerosol particles and characterize the effects of aging. Organic-inorganic aerosol mixtures exhibit non-ideal mixing behaviors and internal morphologies resulting in complex water-uptake and drying mechanisms. Results show non-prompt and step-like dissolution mechanisms of PTA/NaCl particles when exposed to relatively constant RH (~60%). This RH-independent, transient dissolution may be the result of increasing pH in the aerosol droplet due to chloride depletion. This hypothesis is tested and quantified via crystallographic and elemental analysis of the particles before and after aging using traditional TEM techniques. This work aids in demonstrating the potential of VPTEM as a novel method for multiphase aerosol and droplet studies.

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2IM.2

Development and Evaluation of a High-Volume Virtual Impactor with a Circumferential Slit Nozzle. SUSMITA ISLAM, Qingqing Fu, Li Li, Bernard Olson, Christopher J. Hogan, *University of Minnesota*

One important application of virtual impactors is to increase the concentration of bioaerosols during sampling, as the analysis of biological agents requires sampled pathogen concentrations above the limit of detection for the assay utilized. To this end, virtual impactors designed for high aerosol flow rates and with submicrometer cut-off sizes are desirable for concentrating particles as part of bioaerosol sampling schemes, to collect large volumes of aerosol in small liquid volumes or small substrate areas.

In this study, we designed a high-volume virtual impactor with a circumferential slit nozzle, targeting a cut-off size of 0.65 µm when sampling an aerosol flow rate of 720 LPM with a minor flow of 72 LPM. Performance evaluations were conducted in an ASHRAE Standard 52.2-2017 wind tunnel using polydisperse oleic acid particles generated by an atomizer. Experimental results indicate that the 50% cut-off point of the impactor agrees well with numerical predictions. However, the particle collection efficiency curve is less sharp compared to that of conventional virtual impactors with round nozzles. To better understand particle losses and trajectories within the designed virtual impactor, we performed computational fluid dynamics (CFD) simulations coupled with particle trajectory analysis. The effects of manufacturing tolerances—such as varied width in acceleration nozzle and misalignment between the acceleration nozzle and receiving tube—will be discussed.

2IM.3

Characterization of Size-Resolved Charge Distributions for Tribologically Charged Particles by Differential Mobility Analysis Coupled to Optical Particle Spectrometry. RAHAF A. BAHAJRY, Christopher J. Hogan, *University of Minnesota*

Understanding how toner particles acquire charge through triboelectric contact is critical in controlling particle transport and deposition in applications such as electrophotographic printing. While size-resolved charge distribution measurements are needed to understand particle charging, techniques enabling such measurements are often limited. We have developed an aerosol-based system combining inertial impaction, a differential mobility analyzer (DMA), and an optical particle spectrometer (OPS) to characterize the size-resolved charge distributions of toner particles from 0.3 to 10 µm, charged via contact with larger carrier microparticles (developer). Data are further used to calculate surface potential, charge-to-mass ratio, and charge per unit surface area. The influence of environmental humidity and carrier surface coatings including acrylic, silicone, and silicone+charge control agent is systematically evaluated, showing that carrier composition can flip the majority polarity for toner particles. This aerosol-based measurement approach facilitates multidimensional size-charge distribution measurements and doing so enables optimization of triboelectric charging processes in toner systems and other electrostatically driven applications.

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2IM.4

Understanding the Long-term Performance and the Reject Counts for the Alphasense OPC-N3. TRISTALEE MANGIN, Kamaljeet Kaur, Nancy Daher, Kerry Kelly, *University of Utah*

As climate change leads to more arid landscapes, interest in windblown dust and particulate matter 10 microns in diameter and smaller (PM_{10}) is growing. The drying of the Great Salt Lake (GSL) is a prime example of how water consumption and increasing aridity have led to historically low lake levels and increasing PM_{10} levels. Unlike $PM_{2.5}$, PM_{10} particles settle quickly, making it difficult to obtain representative PM_{10} concentration measurements; yet, regulatory measurements for PM_{10} are generally sparser than for $PM_{2.5}$. To address this gap, we deployed a network of low-cost air quality devices using Alphasense OPC-N3 to measure PM_{10} in communities near the GSL. In February 2024, we began co-locating three sensors, each containing an OPC-N3, with a Thermo Scientific Model 5030 SHARP w/ VSCC beta attenuation monitor at a Division of Air Quality monitoring station. This study evaluates how relative humidity (RH) affects OPC-N3 performance in a region and strategies for developing effective correction models (including multiple linear regression (MLR), k-Kohler fit, and machine learning approaches). Finally, we discuss how to interpret the reject count parameters provided by the OPC-N3 and how environmental factors (like RH and wind speed) affect these parameters. Preliminary findings show that an MLR model with concentration and RH parameters resulted in correlation, R2, of 0.73, 0.65, and 0.20, Spring, Summer, and Winter, respectively. The k-Kohler model fitting yielded similar R2 values for Summer and Spring (0.80, 0.66) but performed better for Winter (0.57). During Winter, the higher RH complicates the OPC corrections for both models. If we set a threshold on RH at <80%, both the MLR and k-Kohler models resulted in Winter R2 values of 0.67 and 0.66. The machine learning models are still in development, and the analysis of the reject count parameters is still ongoing.

2IM.5

Improving Low-Cost Optical PM Sensor Accuracy in Humid Conditions via Aerosol Liquid Water Estimation Using U.S. EPA CSN Data. YUHANG GUO, Alexandra Catena, Janie Schwab, Nga Lee Ng, Amanda Teora, Oliver Rattigan, Violet Harder, Yasi Hassanzadeh, James Schwab, Jie Zhang, *Atmospheric Sciences Research Center, University at Albany*

High ambient relative humidity (RH) poses a substantial challenge to the accuracy of low-cost optical sensors used for measuring fine particulate matter ($PM_{2.5}$) concentration. In this study, we use integrated data from the Chemical Speciation Network (CSN) to evaluate two key correction processes for an optical $PM_{2.5}$ measurement system comprising a nephelometer and an optical particle counter: (1) optical calibration grounded in Mie theory to account for variations in sensor performance driven by aerosol size distribution, refractive index, and hygroscopic growth, and (2) determination of aerosol liquid water (ALW) to estimate dry-equivalent $PM_{2.5}$ mass concentrations under high RH conditions. The corrected $PM_{2.5}$ data exhibits strong agreement with EPA reference measurements, affirming the robustness of the proposed correction framework. Furthermore, the quantification of ALW offers valuable insights for advancing aqueous-phase aerosol chemistry and secondary aerosol formation studies. For regions without co-located CSN data, we provide practical guidance for applying these correction methods using surrogate information. Overall, the methodologies developed in this work are expected to significantly enhance the accuracy and applicability of low-cost optical $PM_{2.5}$ sensors in humid environments.

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2IM.6

Systematic Integration of Laboratory Insights Into Chemical Mechanisms Development for SOA Formation. JIA JIANG, Lesly Franco Deloya, Erik Helstrom, Havala Pye, T. Nash Skipper, Rebecca Schwantes, Jesse Kroll, *Massachusetts Institute of Technology*

Secondary organic aerosol (SOA) formation from the oxidation of volatile organic compounds (VOCs) involves complex, multigenerational chemistry that remains only partially represented in current atmospheric models. While laboratory studies have significantly advanced the detection and quantification of key gas and particle phase intermediates, incorporating these insights into chemical mechanisms remains challenging due to the complexity of the chemistry, the dynamic nature of oxidation processes, and the large volume of data. To address this gap, we introduce the Chemical Assessment for Mechanism Evaluation and Optimization (CAMEO) framework, a unified framework that integrates laboratory data with mechanistic modeling outputs into a centralized database with interactive visualization tools. This framework enables transparent, systematic comparisons between experimental observations and model predictions. We demonstrate its capabilities through application to α-pinene oxidation, a major biogenic source of SOA. Two representative chemical mechanisms are assessed: an explicit mechanism generated using the SAPRC Mechanism Generation System (MechGen) and a lumped mechanism from the Community Regional Atmospheric Chemistry Multiphase Mechanism Version 2 (CRACMM2). By automating species mapping, product grouping, and alignment between observed and modeled outputs, CAMEO enables the examination of α-pinene SOA formation pathways and highlights key mechanistic discrepancies. Its streamlined measurement-model comparisons and scalable, modular design support continuous dataset integration and consistent mechanism development across experimental studies.

2IM.7

VOCentinel - a Novel Solution for Automated Real-time Monitoring of Atmospheric VOCs. MARKUS MUELLER, Martin Graus, Tobias Reinecke, Klaus Winkler, Todd Rogers, Andreas Herburger, Jens Herbig, *IONICON Analytik GmbH., Innsbruck, Austria*

Volatile Organic Compounds (VOCs), emitted by both biogenic and anthropogenic sources, play a crucial role in atmospheric processes like SOA formation and significantly affect air quality. Despite their importance, routine monitoring of VOCs poses challenges due to limitations in time-resolution, labor intensity, long-term stability, and compound-specific identification capabilities. Proton-transfer-reaction mass-spectrometry (PTR-MS) is widely used for detecting VOCs with high time-resolution and stability. However, as a soft chemical ionization method, it primarily identifies chemical compositions rather than specific compounds. Acquiring additional chemical information through alternative ionization methods remains labor-intensive, making it impractical for long-term VOC monitoring.

Here, we introduce an innovative solution to streamline these time-consuming tasks with the push of a button for key atmospheric VOCs. This new VOC monitor “VOCentinel” leverages Selective-Reagent-Ion (SRI) PTR-MS combined with Automatic Measurement and Evaluation (AME), integrating recent technological advancements in PTR-MS, such as fast switching of reagent ions, extended volatility range (EVR) surface treatment, active humidity control, and automatic pattern matching, alongside IONICON's extensive experience in robust industrial monitoring. Essentially, five ionization modes sequentially ionize specific atmospheric VOCs within one minute, and the resulting mass spectra are immediately analyzed for chemical composition using a pattern matching algorithm. Automatic quality control ensures optimal instrument performance.

We will present a comprehensive characterization of the VOCentinel, emphasizing its long-term stability, and share initial results from VOC measurements in Innsbruck, Austria. Using isoprene as an example - an important biogenically emitted VOC often subject to chemical interferences in PTR-MS measurements - we demonstrate the system’s ability to automatically measure, evaluate, and correctly quantify compounds with isobaric and/or isomeric interferences.

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2IM.8

Characterization of a Novel Laminar-Flow Oxidation Reactor for Simulating Atmospheric Multiple-Day Oxidation. TOBIAS REINECKE, Markus Leiminger, Andreas Klinger, Todd Rogers, Martin Graus, Markus Mueller, *IONICON Analytik GmbH., Innsbruck, Austria*

Rapid photochemical oxidation in small volume reactors is a useful tool to mimic atmospheric processes of days within minutes. The new automatable Laminar-flow Oxidation Reactor (ILOx) consists of a 110 cm long Quartz glass tube with a total internal volume of 8 l that is irradiated by 480 W UVA LEDs. Based on the total reactor flow, typical residence times range from 2 to 16 min. Oxidants can be introduced through multiple customizable inlet ports. To achieve laminar flow conditions, sample injection is CFD optimized to suppress any formation of injection jets. The outlet of the ILOx Reactor allows for sampling both particles and VOCs simultaneously, with VOC core-sampling to reduce wall interactions and potential formation of artifacts. All wetted materials are optimized for purest experiments.

To experimentally confirm the oxidation potential of the reactor, air containing ~2 ppbV of toluene is sampled through ILOx and VOCs were monitored by FUSION PTR-TOF. Just 2 minutes after starting the UVA irradiation, 50% of toluene is oxidized, while atmospheric lifetimes are in the range of 2 days. In addition known toluene oxidation products like methyl glyoxal, cresols or dihydroxymethyl benzene are increasing. MCM 3.3.1 simulations of this experiment result in average OH concentrations of $3x10^8$ cm^{-3}, which equals to an OH exposure OH_{exp} of 10^{11} $cm^{-3}s$.

To characterize particle transmission, polydisperse ammonium sulfate particles were injected into the ILOx. The particle distribution at the inlet and outlet of the ILOx was measured by an SMPS system (SMPS+C, Grimm Aerosol Technik, Germany) to assess potential particle losses. Even with maximum UVA irradiation, no significant change in the particle distribution and intensity of ammonium sulfate aerosol is measurable, proving highly efficient particle transmission of the system.

We will present a comprehensive characterization of the ILOx reactor, highlighting benefits and limitations.

2IM.9

Development and Optimization of a Low-Detection Limit Array-Type Beta Attenuation Monitor. I-CHEN CHANG, Qi-Xiang Li, Chih-Wei Lin, Sheng-Hsiu Huang, Chih-Chieh Chen, *National Taiwan University*

Purpose:
The Beta Attenuation Monitor (BAM) is widely used for real-time ambient $PM_{2.5}$ monitoring. However, its typical detection limit (4 – 4.8 μg/m³) is close to the WHO guideline of 5 μg/m³, limiting its effectiveness in low-concentration environments and health-related assessments. This study aims to develop a home-made array-type sampling BAM with an improved detection limit by enhancing sampling efficiency, reducing particle loss, and increasing beta signal strength through design optimization.

Method:
The system integrates a 1-to-4 split-flow sampling tube and a redesigned filter holder. Within a controlled particle generation system, the particle penetration efficiency and size distribution uniformity across the four sampling branches were evaluated. The filter holder was modified to optimize beta particle transmission. Signal attenuation was converted to mass concentration using the Lambert-Beer law, and data smoothing was applied through a moving average method. Key performance metrics—counts per second (CPS), response time, signal-to-noise ratio (S/N), and detection limit—were assessed and compared with those of a commercial BAM.

Result:
The split-flow sampling system achieved approximately 98% penetration efficiency for particles smaller than 3.625 μm, with inter-branch size distribution variation below 9.8%. The redesigned filter holder increased beta signal strength by 10%. A four-unit BAM array effectively reduced data fluctuation, response time, and detection limit under an S/N ratio of 10.

Conclusion:
The array-type BAM successfully reduced the detection limit from 10 μg/m³ to 3 μg/m³ while maintaining uniform sampling and particle integrity. This system offers improved speed and sensitivity, enhancing its utility for accurate and responsive $PM_{2.5}$ monitoring.

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2IM.10

$PM_{2.5}$ Morphology and Speciation Analysis of BAM Tape During Wildfire Smoke Events. Kelly Cheng, ZHONG-MIN WANG, Jeff Wagner, Kazukiyo Kumagai, *California Department of Public Health*

The beta attenuation monitor (BAM) is now a widely used Federal Equivalent Method to continuously measure particulate matter (PM) concentrations at regulatory stations to meet federal and state monitoring requirements. Characterization of the particles collected on these glass fiber filters would provide meaningful particle morphology and chemical speciation of air pollution exposures.

This study describes the development of a sample extraction process and analytical method to analyze element profiles for $PM_{2.5}$ collected on BAM tape. The key aspect for this method development is the minimization of the background interferences in BAM filters. BAM filter tape samples collected during California wildfire smoke events in fall 2023 were used to develop the sample preparation method, and those samples were further characterized by ICP-MS and SEM-EDX to yield their particle morphology and chemical composition information. The analyses indicated that the blank-corrected BAM filters had enriched concentrations of chromium, manganese, and copper during the wildfire smoke events.

The development of this method can potentially extend the capabilities of BAM PM regulatory monitors to further particle morphology and chemical speciation analysis of outdoor air exposures.

2IM.12

Impact of Flow Rate on the Dilution Factor of Capillary Dilution Systems. Lars Hillemann, Daniel Göhler, SCOTT HYDE, Tyler Beck, Stephan Grosse, Jan Müller, *Particle Instruments LLC*

Dilution systems are widely used to adjust the concentration of aerosols, either during the generation or quantification of aerosols. Dilution systems with internal mixing gas preparation are often used for this purpose(Fuchs, 1965; Göhler, 2020). They are based on the passive passage of a defined total flowrate of the aerosol to be diluted. This flow is divided into two partial flows. A small partial volume flow flows through a capillary, whereby its particle concentration remains constant, if losses within the capillary can be neglected. The majority of the total flow passes through a bypass consisting of a valve and an absolute filter for particle separation and then mixes again with the capillary flow. The valve adjusts the ratio of the two volume flows and thus the dilution ratio of the system.

The volume flowrate through the capillary depends on its pressure drop. The volume flow through the bypass is determined by the pressure drop of the filter and the valve, whereby the increase in the pressure drop of the filter due to filter loading is compensated by adjusting the valve so that the pressure drop across both branches and thus the dilution ratio remain constant.

Due to the pressure drop of the components and the dynamic range of the pressure sensor each type of dilution system is configured to a fixed total volume flow rate and dilution ratio. The individual calibration according to VDI 3491-6: 2023 defines the setpoint of the bypass valve to obtain the desired dilution ratio. The pressure drop at this setpoint is connected to an OK flag, indicated by a green status LED.

The total volume flowrate through the dilution system is determined in practical use by the measuring device downstream. If this flow deviates from the setpoint, the pressure drop of the dilution system changes and therefore also the OK flag is disabled. If the pressure drop of the capillary and the bypass would depend in the same way on the flow rate, the dilution ratio would not change. Unfortunately, this is not the case, so the ratio between both flows changes, which results in a divergent dilution ratio. This mode of operation assumes that the setpoint of the valve is fixed(“not trimmed”), which is particularly relevant to quantify the sensitivity coefficients for the error propagation due to the uncertainty of the total flow rate.

Additionally, it is interesting for practical applications, how the dilution ratio changes, if the user corrects the valve to keep the OK flag valid, even during the total flow changes (“trimmed” mode of operation).

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2IM.13

How to Deduce an Overall Particle Size Distribution from Scanning Electron Microscopic Images of Multiple Magnifications. Daniel Göhler, Petra Fiala, Benno Wessely, Lars Hillemann, SCOTT HYDE, Tyler Beck, Michael Stintz, Frank Babick, *Dresden Technical University*

Much effort was spent in the past on operating procedures to characterize particles of disperse systems on the basis of static image analyses by electron microscopy(EM). Sample preparation (Fiala et al. 2017), image evaluation (Buhr et al. 2009) and the extraction of size distribution data were intensively discussed(Lin et al. 2018). But there are still limitations especially for the evaluation of broad-distributed particle systems as typically for e.g. environmental or occupational aerosols. The characterization of broad-distributed particle systems requires in the case of EM multiple magnifications to resolve all particles(Lin et al. 2018). But due to the lack of a suitable method for the evaluation of size distribution data over images with different magnifications, EM images are often used only for a qualitative size assessment.

In the area of aerosol science, it is common practice to use scaled particle size distributions(i.e., non-normalized or specific-weighted particle size distributions) to 1) extend the analytical size range by merging measurement data of different aerosol-analytical instruments (Tritscher et al. 2015) or to 2) investigate effects of specific measures on processes on the basis of one instrument. The idea of using scaled particle size distribution was applied in this work to merge size distribution data from EM images of different magnifications.

To prove the concept, an artificial polydisperse aerosol containing sodium chloride particles(x mean, geo=68.6nm, ln=1.8, c0=$1x10^6$ cm^{-3}) was generated by means of a field calibration aerosol generation system(FCS249, Topas GmbH, Germany) and simultaneously characterized by differential mobility analyses(DMA,TSI3938L72, TSI Inc., Shoreview, USA). Particles were sampled for 10 min after unipolar charging at -3kV on a carbon filmed cupper grid within an electrostatic precipitator(Dixkens & Fissan 1998). Images of deposited particles on the grid were taken at twelve positions for 3 different magnifications (5000, 15000, 30000) each by scanning electron microscopy (SEM, Gemini SEM 300, Zeiss GmbH, Jena, Germany) and evaluated with commercial image analysis software(Image Pro Plus 7.0, Media Cybernetics, Rockville, US).

Over all images, $3.3x10^4$ single particles were identified. The size distribution data for each magnification were scaled by the respective surface-specific number of observed particles. Merged size distribution data are promising.

2IM.14

Novel Balloon-Borne Devices for Experimental Investigation of Stratospheric Aerosols. STEPHANIE EILTS, Lauren Wheeler, Philip Miller, Andrew Glen, Patrick Burton, Bryan Weaver, Nathan Wolff, Jessica Tran, Jake Zenker, Andres Sanchez, Erika Roesler, Daniel Bowman, Raymond Friddle, *Sandia National Laboratories*

Stratospheric aerosols influence chemical pathways, have radiative properties, and have microphysical interactions with high altitude clouds. Two new and distinct stratospheric research platforms are pursued to develop a controlled method to investigate stratospheric aerosol properties. They are called BLYSS (Balloon-LaboratorY for Stratospheric Sampling) and STEVE (Sample Transport Exposure Vessel). The BLYSS chamber will allow for in situ measurements and atmospheric aging studies of stratospheric aerosol within a controlled and sealed sampling volume. In laboratory tests, we demonstrate that the BLYSS chamber can collect a 55-gallon volume of ambient air at standard temperature and pressure with a gravitational inflation approach. On a balloon-borne field experiment, two BLYSS chambers successfully collected ambient air in both the upper troposphere and lower stratosphere at 7.5 and 13 km respectively. The STEVE chamber is designed to take isolated samples on Scanning Electron Microscope (SEM) stubs up to the stratosphere on a balloon flight, expose the samples to stratospheric conditions, and then take the isolated samples back down to ground level for chemical analysis in the lab. STEVE has been tested in the laboratory using an aerosol exposure chamber to show proof of concept functionality by exposing TiO_2 to varying relative humidity levels during device sampling. STEVE will be sent on a stratospheric balloon flight for further validation. These results indicate that flying such a chamber for aerosol investigations on light-weight balloons is possible and may open future opportunities for understanding aerosol behavior at stratospheric elevations.

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2IM.15

A Low-cost In-Situ Instrument for Organic Aerosol Speciation Using Thermal Desorption. Yaping Zhang, Xin Yang, XIAOFEI WANG, *Fudan University*

Automated aerosol thermal desorption (TD)-GCMS systems are common but pricey. It usually needs a long rigid line that complicates installation and weakens sensitivity to large molecules. We introduce a ~$3 k, fully automated unit that replaces that line with a 10 cm needle sealed by double septa between the CTD (sample Collection and Thermal Desorption cell) and GC inlet. Moving the needle tip handles sampling, desorption, and injection, so no GC hardware mods are needed. The short “soft” link boosts transfer efficiency, cuts maintenance, and sharpens detection limits, delivering two-hour, molecular-level aerosol data for real-time monitoring.

2IM.16

Enhanced Ion Delivery from a Surface-Discharge Microplasma Aerosol Charger Using Tangential Airflow. RYO SHIBUI, Tomoya Tamadate, Toshiaki Sakai, Takafumi Seto, *Kanazawa University*

Aerosol particle charging is a crucial pretreatment step for processes such as classification, deposition, and measurement. Uniform and efficient ion generation is particularly important for achieving high charging efficiency with submicron and nanometer-sized particles.

We propose a novel aerosol charging method using a surface-discharge microplasma aerosol charger (SMAC), which provides a uniform ion source. Unlike conventional corona-discharge ionizers, SMAC does not require a sheath flow for discharge stabilization or ion transport. The device features a three-layer structure comprising a discharge electrode, dielectric barrier, and grounded electrode. In this configuration, plasma is generated primarily near the dielectric surface facing the grounded electrode, resulting in a preferential direction of discharge toward the back side. This geometry limit the amount of ions released into the charging space.

To overcome this limitation, we introduced a tangential airflow along the device surface to actively detach ions from the plasma region and enhance their transport. Ion concentration was evaluated by monitoring the surface potential change of a charge plate monitor (CPM), and theoretical fitting of the ion deposition rate was used to estimate ambient ion concentrations under different airflow conditions. Experimental results demonstrated that introducing airflow significantly increased the rate of potential change on the CPM, indicating improved ion delivery. Theoretical analysis estimated that ion concentration without airflow was approximately 3.0×10^{12} m^{-3}, while with airflow, the concentration nearly doubled. These findings confirm the effectiveness of airflow in controlling ion output.

Future work will focus on optimizing airflow configurations and device design to further enhance performance. The proposed method offers a promising approach not only for improving aerosol manipulation precision but also for electrostatic neutralization in various product manufacturing processes.

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2IM.17

Development of a Low-Cost Optical Trap for Studying Phase Transitions of Single Suspended Aqueous Inorganic Microdroplets. ALI ALOTBI, Evan Dalton, Cara Waters, Ryan Davis, Andrew P. Ault, *University of Michigan*

The phase state of atmospheric aerosol particles influences their climate-relevant optical properties, size, and chemical processes; therefore, phase transitions of atmospheric aerosol particles is an important process to understand for improving climate models. Optical trapping is a technique that uses radiation pressure from a focused laser beam to levitate and spatially confine single aerosol particles without surface interactions, enabling in-situ characterization of the evolving phase state of single suspended aerosol particles. However, the barrier to entry into optical trapping research can be both experimentally and financially challenging. Custom-built optical traps are often expensive and intricate, often using parts machined to specification, and the practical details of these designs are not widely available. Here, we present a low-cost aerosol optical trap constructed from readily available commercial components, improving the financial accessibility of the technique and reducing the expertise required to construct an aerosol optical trap. We use the low-cost optical trap to study phase transitions of atmospherically relevant aqueous inorganic aerosol droplets produced from a microdroplet generator. The size, shape, and phase of trapped particles were characterized with far-field and bright-field images, and the relative humidity of the trapping chamber was reduced until efflorescence (crystallization) of the trapped microdroplets occurred. A low-cost optical trap capable of monitoring single-particle phase transitions holds potential to inspire more rapid innovation in single-particle atmospheric analytical chemistry.

2IM.18

Bipolar Charging of Sub-20 nm Particles: High-Accuracy Measurements of Particle Charge Fractions and Ion Mobility Distributions. FABIAN SCHMIDT-OTT, Robert T. Nishida, Jason S. Olfert, George Biskos, Juha Kangasluoma, *University of Helsinki, The Cyprus Institute*

Sizing ultrafine aerosol particles is commonly carried out by electrical techniques, e.g., using a Differential Mobility Analyzer (DMA), which require particles to reach a steady-state charge distribution prior to measurement. The steady-state charge distribution is typically achieved using bipolar diffusion chargers, where the resulting particle charge fractions largely depend on the charger ion properties.

In this study, we present unique measurements where we determine simultaneously both the charge fraction of sub-20 nm particles which have undergone bipolar diffusion charging, together with precise measurements of the electrical mobility distribution of the ions in the charger. To do so we developed and used a novel setup that eliminates the need of a tandem DMA configuration, thereby minimizing particle losses.

Using the resulting dataset, we investigated the effect of ion composition on charge fraction by introducing various trace gases to the carrier gas (dry air), among which ethanol vapor, water vapor and volatile methyl siloxanes (the latter were introduced solely through the use of silicone conductive tubing, which is commonly employed in aerosol measurements) in order to affect the composition and the mobility of the ions. Changes in mean ion electrical mobility (from -18% for positive ions to +30% for negative ions) resulted in shifts of the positive (f_{+1}) and negative (f_{-1}) particle charge fractions of up to -36 % and +76%, respectively. Notably, the use of silicone conductive tubing alone led to shifts of f_{+1} = -20% and f_{-1} = +25%.

Our measurements are within 10% agreement with a numerical model applying Hoppel & Frick charging theory when incorporating experimentally determined mean ion properties across the cases investigated here. Also, they have a discrepancy of around 30% for both polarities between the measured charge fractions and those predicted by Wiedensohler's approximation that is often used to invert the electrical mobility measurements.

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2IM.19

Comparative Analysis of Low-Cost Particulate Matter Sensors in the Indoor Environment. SALVATORE MILLETICH, Kirsten Koehler, *Johns Hopkins University*

Background: Accurate assessment of indoor air quality is critical for evaluating exposure to airborne pollutants. As low-cost sensors continue to emerge on the market, there is a need to evaluate performance against older established monitors and reference devices.

Objective: To evaluate the performance of new low-cost PM sensors and monitors (Sensirion SEN66-T, BOSCH BMV080, and PurpleAir Pixel) in comparison with commonly used monitors (PurpleAir Classic II, PurpleAir Zen, Awair Element, and QuantAQ Modulair-X) and a reference device (TSI DustTrak DRX 3533 with gravimetric correction).

Methods: Sensors were co-located over four consecutive days in the central room of the main floor of an occupied row home in Baltimore, Maryland. DustTrak PM measurements were corrected using a gravimetric factor derived from an internal filter. Sensor performance was evaluated at minute-level resolution using U.S. EPA performance targets, including linearity (R^2), inter-sensor variability (coefficient of variation, CV), bias (regression slope and intercept), and error (RMSE) across all particle size bins.

Results: The only sensor to reach every available EPA performance metric was the PurpleAir Classic II for $PM_{2.5}$. All sensors exhibited a strong linear relationship with the reference device (R^2>0.70). The BMV080 was within EPA metrics (R^2, regression slope and intercept, and RMSE) for PM_{10}, however exhibited high inter-sensor variability (CV>30%). For $PM_{2.5}$ the BMV080 approached EPA metrics, but exhibited elevated positive bias (slope >1.35) and similarly high variability. The SENS66-T and Pixel exhibited high correlation with the reference device but failed to meet one or more criteria for each size bin.

Conclusion: While newer, low-cost PM sensors show promise for indoor monitoring, not all of them outperform existing sensors. The BOSCH BMV080 achieved near compliance for PM_{10} and $PM_{2.5}$, but exhibited high inter-sensor variability. These findings underscore the need for continued validation and calibration of low-cost sensors, particularly in indoor settings.

2IM.20

High Pressure Bipolar Electrospray, Towards Simple nanoparticle Sources. LUIS-JAVIER PEREZ-LORENZO, Christian Luebbert, *Yale University*

Bipolar electrosprays are a strong tool for generation of sub 10nm aerosols. The most important features of this type particle generation are: a) Chemically defined particles. b) Huge reduction of losses in convective transport from reduction of the net space charge and the particle mobility at the same time. c) Wide range of charge states accesible. d) Great variability in accessible material.

In general, even single electrosprays are considered complex in practical operation and the bipolar variant may be expected even more complex. We present a bipolar electrospray particle source in which the bipolar spray is performed at elevated pressure (2.5bar, 3.5lpm@aTp) with water as only solvent in both sprays. Operating both sprays in the cone jet mode is surprisingly simply under the elevated pressure conditions. The individual spray stability is hardly affected by the operation of the other spray. Charge reduced and even charge inverted electrospray products are generated in either polarity and transferred to ambient pressure via a critical orifice for analysis utilizing a Differential Mobility Analyzer. Capabilities of the device are exemplary shown for: Charge state adjustment: Protein and polymer samples (BSA, Lysozyme) from aqueous ammonium acetate solutions are produced at various charge states from either positive negative or both emitters. Polarity dependence of the product: PEG molecules are practically not emitted from drops of the negative spray but practically completely emitted from positive drops during solvent evaporation. The clustering state can therefore be changed by simply swapping polarities. Chemical cleanliness: Based on measurements for cluster ions that can be resolved down to the number ion pairs we demonstrate that the generated particles are chemically clean down to molecular level.

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2IM.21

Widefield Fluorescence-Detected Photothermal Infrared Spectroscopy for Characterizing Aerosol Particles. RANDI LIBIN-STRAUB, Abbygail Ayala, Eoghan Dillon, Rebecca L. Parham, Andrew P. Ault, *University of Michigan*

Determining the composition and morphology of aerosol particles, particularly those with a diameter less than 2.5 µm, is essential for understanding their impacts on the climate and human health. Decades of vibrational spectroscopic atmospheric studies have focused on the characteristics of bulk particle samples; these studies lack the nuanced information which single-particle analysis provides, making the development of these techniques vital to furthering our understanding of aerosol particles. This has been challenging because single-particle analysis has been limited by the diffraction limit of light, particularly in the case of infrared (IR) spectroscopy, and by the autofluorescence of atmospheric particles which overwhelms the comparatively weak signal of Raman microspectroscopy.

Recently, widefield fluorescence detected photothermal infrared (FL-PTIR) spectroscopy has been introduced; this method harnesses fluorescence, including autofluorescence, to significantly increase the throughput of IR spectral collection while improving size resolution to extend into the sub-micron regime. When a particle absorbs an IR frequency from a tunable laser, the particle's fluorescent emission decreases due to localized heating. This change can be used to create hyperspectral IR images. Importantly, this technique enables characterization of particles that cannot be studied via Raman microspectroscopy due to autofluorescence interference.

Here, the capability of widefield FL-PTIR spectroscopy to identify atmospherically-relevant aerosol particles was evaluated for the first time. Spectra were collected from a series of atmospheric proxy standards, including fluorescent polymer microspheres and particles containing fluorescent species representative of those found in atmospheric particles (e.g., sea spray aerosol, pollen, etc.). These results establish a baseline for understanding the capabilities of this newly-available experimental method and its ability to distinguish between particle types.

2NP.1

Determining Gas Temperature and Electron Density in Spark Discharge: Insights Into Nanoparticle Nucleation and Growth in the Gas Phase. QINGQING FU, Ji Yung Ahn, Griffin Trayner, Tasnim Akbar Faruquee, Yiwei Zhu, Marien Simeni Simeni, Christopher J. Hogan, *University of Minnesota*

Non-equilibrium gas-phase synthesis processes, such as spark discharge and non-thermal plasma synthesis, enable the production of nanoparticles with high purity and a variety of material compositions. Their continuous operation presents promising potential for scaling up from the laboratory to industrial scale. However, synthesizing nanoparticles in a controlled manner via gas-phase methods can be challenging without trial-and-error experimentation, as the mechanisms of particle nucleation and growth in the gas phase are not yet fully understood.

In this study, towards improved understanding of non-equilibrium gas phase synthesis processes we designed a spark discharge generator to produce iron nanoparticles. The effects of process parameters, including applied power (2.5–10 mA), gas flow rate (1–5 slpm), and electrode distance (1–5 mm), on particle properties were systematically investigated. The resulting particle primary size, morphology, and size distribution were characterized using transmission electron microscopy (TEM) and a scanning mobility particle sizer (SMPS), respectively. In addition, optical diagnostics, including optical emission spectroscopy (OES) and coherent anti-Stokes Raman spectroscopy (CARS), were applied to determine time- and spatially resolved gas temperature and electron density. These experimental results will be used as inputs and validation parameters for numerical simulations, contributing to a deeper understanding of particle nucleation and growth mechanisms.

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2NP.2

Crumpled Graphene Oxide (CGO)-Based Drug Delivery System. YIMING XI, Shalinee Kavadiya, Daniel Bilbao, Russo Marco, Pratim Biswas, *University of Miami*

Various methodologies continue to be developed for the treatment of cancer, with emphasis on improved specificity and targeted delivery to tumor cells. A crumpled graphene oxide (CGO)-based drug delivery system (DDS) for cancer treatment was synthesized via an aerosol approach to achieve enhanced drug loading capacity with an anti-cancer drug doxorubicin (DOX). The proposed system with reduced particle size and preserved surface modifiability for active tumor targeting was compared to current graphene oxide (GO)-based systems. The particle size, the drug loading capacity, the drug release profile, and the in vivo toxicity of the synthesized DDS nanoparticles were evaluated in the study.

The synthesis method for the CGO was a one-step aerosolized approach using a Furnace Aerosol Reactor (FuAR). The sheet, two-dimensional (2D) graphene oxide (GO) was aerosolized into droplets and passed through a heated tube furnace to evaporate the solvents. During the solvent evaporation, the sheet 2D GO was crumpled into three-dimensional (3D) structures, CGO, due to the capillary force compression [1]. From the study, the synthesized CGO had a surface area of 79.091, that was 8.6 times larger than the sheet graphene oxide 9.178, because the crumpling had minimized pi-pi interaction-induced stacking of GO. The crumpled graphene oxide exhibited similar drug loading capacity (0.52 ± 0.01 mg / mg) compared to GO (0.57 ± 0.07 mg /mg) and less drug released (11.23%) compared to GO (13.12%). In-vivo studies on mice indicated that the CGO demonstrated less toxicity (60 mg/kg) on mice than GO (7.5 mg/kg). The poster will further demonstrate additional data which will further provide improved understanding of the one-step aerosol-based synthesis for nanomaterials with applications in healthcare.

Key Words: Aerosol Synthesis; Crumpling; Drug Delivery; Graphene Oxide.

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2NP.3

One-Step Synthesis of Nanostructured Spinel-Type High Entropy Oxide (HEO) Materials by the Flat Premixed Droplet-Seeded Flame (FPDSF) Method. Owen S. Fuhr, Serdar Yildirim, TYLER PARK, Xiao-Dong Zhou, Francesco Carbone, *University of Connecticut*

High Entropy Oxides (HEOs) have emerged as promising materials in catalytic and energy storage applications due to their structural stability and compositional flexibility. In this study, nanostructured spinel-type HEO materials composed of Fe, Cr or Cu, Mn, Co, and Ni have been synthesized using the Flat Premixed Droplet-Seeded Flame (FPDSF) method, which enables rapid, scalable, and highly controllable synthesis and thermophoretic deposition of compositionally complex metal oxide nanoparticles. Thermophoretically deposited HEO films are analyzed using Transmission and Scanning Electron Microscopy (TEM and SEM) and X-ray Diffraction (XRD). Microscopy analyses reveal polycrystalline nanoparticle aggregates spanning multiple length scales, and XRD identifies clear diffraction peaks consistent with a single-phase spinel magnetite (Fe_3O_4) structure, confirming the successful incorporation of multiple transition metals into a homogeneous oxide lattice. Size Distribution Functions (SDFs), measured from 0.75 nm to 50 nm using dilution sampling followed by High-Resolution Differential Mobility Analysis (HR-DMA), reveal a particle mode centered around 1 nm to be predominant in number at a Height Above the Burner (HAB) of 30 mm. Preliminary electrocatalytic tests FPDSF-synthesized HEO nanoparticles have yielded promising results. Additionally, HR-DMA results are being cross-validated with TEM analyses performed on samples collected directly on TEM grids over ~50 ms sampling intervals using a double-acting pneumatic actuator. This study demonstrates the potential of the FPDSF method as a cost-effective, rapid, and scalable synthesis route for producing nanosized high-entropy oxides with precise compositional control and promising catalytic performances.

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2NP.4

Stable, High-Performance, and CO_2 Tolerant High-Temperature Water Gas Shift (HT-WGS) Catalysts Using Multiple Promoters. MOHD ASHHAR KHAN, Mark Swihart, *University at Buffalo - SUNY*

The water gas shift reaction converts carbon monoxide and steam (CO and H_2O) to carbon dioxide and hydrogen (CO_2 and H_2). In combination with CO_2 capture, it is an important component in the production of "blue" hydrogen. One route to simultaneous H_2 production and H_2/CO_2 separation is to use a catalytic membrane reactor (CMR). Ferrochrome catalysts are prominent commercial HT-WGS catalysts, however these traditional catalysts suffer from CO_2 inhibition which negatively affects catalyst activity in WGS reaction under CO_2-rich conditions, potentially making them less effective in membrane reactors. To address this gap, we designed and prepared novel multicomponent high performing and ultrastable CO_2-tolerant nano-catalysts using a unique flame-based aerosol process for catalyst synthesis. Our goal was to find a set of promoters that together exhibit synergistic effects thus weakening CO_2 adsorption to reduce inhibition without affecting activity. Our unique process for producing high-entropy metal oxides (HEMO) opens up a vast composition space for producing these catalysts with multiple promotors. We conducted kinetic studies on these HEMO catalysts to quantify CO_2 and H_2O inhibition, along with activation energies. This study allowed us to synthesize catalysts that enable higher CO conversion, higher H_2 production, and high resistance to CO_2 inhibition and coking.

2RA.3

Optimizing Indoor Pollutant Exposure, Energy Consumption, and Thermal Comfort Using Deep Reinforcement Learning Agent. NISHCHAYA KUMAR MISHRA, Nipun Batra, Sameer Patel, *Indian Institute of Technology Gandhinagar, India*

With individuals spending nearly 90% of their time indoors, maintaining well-controlled indoor environments is critical for minimizing pollutant exposure and ensuring thermal comfort. However, achieving optimal indoor air quality often involves trade-offs between energy consumption and thermal comfort, presenting a complex multi-objective optimization challenge. Multiple data-driven machine learning and fully physics-driven algorithms have been proposed to predict indoor air quality and operate heating, ventilation, and air conditioning systems. However, their real-world integration is limited in dynamic control processes such as indoor environment control owing to modelling, computational, and learning challenges.

Reinforcement learning (RL), with its capacity for autonomous adaptation through continuous interaction with the environment, presents a promising alternative. Unlike static models, RL agents can dynamically learn control strategies with fewer prior assumptions, offering broader deployment potential. Previous studies have applied RL to optimize pollutants, energy, and thermal comfort. However, the control actions in most studies are limited to ventilation.

This work developed an RL agent to control ventilation and set temperature of the air conditioning unit to optimize exposure, energy, and thermal comfort in a house. The study evaluates the reliability of a reinforcement learning (RL) agent for indoor environmental control under varying pollutant emission scenarios by evaluating its performance against a physics-based dynamic optimization strategy. Simultaneously, the transferability of the trained RL agent is investigated across multiple residential buildings subjected to diverse ambient conditions. The results highlight the potential of RL agents as scalable and adaptable solutions for maintaining healthy indoor environments while reducing environmental impacts.

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2RA.4

A Comparative Evaluation of Regeneration in Electret Filters. HUI-JING LI, Ying-Chi Lin, Wei-Hung Chen, Sheng-Hsiu Huang, Chih-Wei Lin, Chih-Chieh Chen, *National Taiwan University*

Global market data show rising demand for filters from 2018 to 2023. During COVID-19, mask use led to 1.6 million tons of daily waste by the end of 2022. To reduce resource use and waste, extending filter life and enhancing regenerability are essential. However, conventional corona electret filters suffer from charge decay due to environmental factors. Water electret technology has offered high filtration efficiency and potential for washability and reuse. This study investigates the filtration characteristics and regeneration of corona and water electret filters under identical structural conditions.

This study uses a constant output atomizer and SMPS to assess the collection efficiency of various filters for submicron particles at different face velocities. Filter thickness was measured using a laser displacement sensor, and packing density was estimated from volume, weight, and material density, validated by the liquid displacement method. Fiber diameter was determined from SEM images and air resistance. Isopropanol (IPA) soaking was applied to evaluate charge density and stability, and filtration data were analyzed using single fiber filtration theory. The regeneration test was conducted by soaking the uncharged filter in water solutions to observe its recharging performance.

Preliminary results show that water electret filters achieve >98% efficiency for the most penetrating particle size (MPPS, 45–55 nm), outperforming corona electret filters at 80% under identical filter structure. The charge density of the water electret filter is more than five times that of the corona electret filter. After IPA treatment, MPPS shifts to around 220 nm, and efficiencies drop to 18% (corona) and 23% (water). They were similar to those of uncharged filter (18% and 21%), making it difficult to observe differences in charge stability between them. By altering surface tension, soaking in water–IPA solution enabled electrostatic charging of uncharged filters, resulting in filtration efficiency of 80%.

2RA.5

Using Size-Resolved PM Measurements to Determine Fine and Ultrafine Particle Infiltration and Filtration Patterns in Older Educational Buildings. JIANING BAO, Nigel Kaye, Ehsan Mousavi, Christopher Post, Andrew Metcalf, *Clemson University*

Older educational buildings often lack centralized mechanical ventilation and rely on decentralized HVAC systems, such as fan-coil units. This configuration may increase occupant vulnerability to poor indoor air quality (IAQ) due to limited ventilation and filtration capabilities. Fine and ultrafine particles, although contributing little to overall particulate matter (PM) mass, are the most abundant by number in both indoor and outdoor environments. Their small size allows deep penetration and deposition within the respiratory tract, posing significant health concerns.

This study evaluates the effectiveness of an older classroom equipped with fan-coil units as its ventilation system in mitigating occupant exposure to fine and ultrafine particles. Specifically, we examine the size-resolved PM infiltration and filtration characteristics of the indoor environment. Particle number concentrations across various size ranges are measured indoors and outdoors using a Scanning Electrical Mobility Spectrometer (SEMS). To quantify indoor particle dynamics, controlled particle releases are conducted while the classroom is unoccupied. Additionally, CO_2 decay tests are performed to determine the room's air exchange rates. An aerosol size-resolved box model based on the mass balance approach is used to analyze particle losses across size bins. The model incorporates air exchange, particle deposition, filtration, and penetration processes to derive size-resolved infiltration factors and identify shifts in PM size distributions resulting from HVAC operation changes or the addition of mitigation devices, such as HEPA filters and Corsi-Rosenthal box fans. Furthermore, the model simulates real-world pollution scenarios, including wildfire smoke infiltration and indoor particle generation from occupant activities, to assess indoor exposure risks and evaluate potential mitigation strategies. Results from this study provide practical insights into how building design, operational adjustments, and targeted interventions can effectively manage occupant exposure to fine and ultrafine particles in older educational buildings.

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2RA.6

Experimental Evaluation of Additively Manufactured High-Efficiency Cyclones for Condensed Aerosol Removal. Rafael Venancio Durand, Roberto Guido, Stefano Zago, PAOLO TRONVILLE, *Politecnico di Torino*

This study presents the design, fabrication, and experimental evaluation of two compact high-efficiency reverse-flow cyclones—Stairmand HE and Swift HE—developed for removing condensed aerosols generated during slow pyrolysis at low volumetric flow rates (3–10 m^3/h). The cyclones were designed using classical design criteria and fabricated via Selective Laser Sintering (SLS) of polyamide PA2200, enabling the precise reproduction of small-scale geometries suitable for integration into a prototype that demonstrates the potential of FumeCatch technology.

Experiments were conducted in a controlled laboratory environment using DEHS aerosol and a TSI OPS 3330 optical particle counter to measure fractional collection efficiency. At the same time, pressure drop was monitored with a differential manometer. At 6 m^3/h, the Stairmand HE exhibited close agreement with the Iozia–Leith model, with minor deviations observed in the submicron range. The Swift HE cyclone exceeded theoretical expectations, achieving a cut-off diameter close to 1 µm.

Increasing the flow rate shifted the efficiency curves toward smaller diameters, confirming the anticipated influence of inlet velocity. However, improved collection performance was accompanied by higher pressure drops, with increasing deviation from theoretical predictions at elevated flow rates.

These findings demonstrate the viability of using additively manufactured cyclones for efficient separation of condensed aerosols in compact systems, while underscoring the trade-offs between collection efficiency and aerodynamic resistance in low-flow applications.

This study was carried out within the MICS (Made in Italy – Circular and Sustainable) Extended Partnership and received funding from Next-GenerationEU (Italian PNRR – M4 C2, Invest 1.3 – D.D. 1551.11-10-2022, PE00000004).

2RA.7

Spatiotemporal Size Distribution of Secondhand Cigarette Smoke in an Indoor Environment: A Manikin-Based Study. JUDITH ARTHUR, Joseph Nyakundi, Michael Yermakov, Jun Wang, Sripriya Nannu Shankar, *University of Cincinnati*

Secondhand smoke contains over 7000 chemicals, many of which are carcinogens. There are no safe levels, and even acute exposures can have adverse health impacts. Despite these adverse effects, there remains a knowledge gap in the duration for which SHS remains airborne after an individual has smoked and how interventions like masking practices and increased air change rates influence exposure in an indoor environment. To address these gaps, we used a smoke generator (EVT, Data Sciences International, USA) to mimic the puff profile of a smoker, as recommended by ISO (35 mL puff volume, 2 s puff duration, 60 s puff frequency). At varying distances (1, 3, and 6 ft) from the smoke source (traditional and electronic cigarettes), aerosol concentrations were recorded using the Electrical Low-Pressure Impactor in a controlled indoor chamber. Results revealed elevated aerosol concentrations over time for both cigarette types. Specifically, the median concentrations of traditional cigarettes increased from background levels (~558, 524, and 412 µg/m^3) to 31,056, 7,278, and 2,711 µg/m^3 during active burning at 1, 3, and 6 ft, respectively. Similar trends were observed in e-cigarettes, but only at reduced intensities. Linear mixed-effects modeling revealed that traditional cigarettes produced 22.35-fold higher aerosol concentrations than e-cigarettes ($\beta = 22.35$, $p < .001$) with persistently elevated levels during active burning ($\beta = 11.17$, $p < .001$) and post-burning ($\beta = 10.73$, $p < .001$). Elevated concentrations during post-burning emphasize the persistence of SHS long after smoking has ceased, thus contributing to sustained exposure risks among individuals. The effect of distance at 3 ft ($\beta = 1.49$, $p = .108$) and 6 ft ($\beta = 1.39$, $p = .186$) was not significant, likely due to the formation of secondary compounds. We further investigated the effect of masking and increased air change on reducing the smoke concentrations. N95 and respirators with gas filters outperformed the surgical masks when used independently. With increased air change rate (6.75 air change per hour), a median exposure reduction exceeding 90% and 70% was observed for e-cigarettes and traditional cigarettes, respectively, highlighting the benefits of combined engineering and personal protection controls. These results provide valuable insights in minimizing exposure risks, particularly for vulnerable occupational groups, such as home healthcare workers who have limited control over their environment or personal protection choices.

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2RA.8

Environmental Detection of Airborne Methicillin-Resistant Staphylococcus Aureus (MRSA) in Healthcare Environments and Laboratory Testing of MRSA Inactivation. Xinyi Niu, Perminder Kaur, Judith Arthur, Joseph Nyakundi, Jagjit Yadav, Elizabeth Mckinley, Vivek Narendran, Missy Nurre, Arantzazu Eiguren-Fernandez, Chang-Yu Wu, SRIPRIYA NANNU SHANKAR, *University of Cincinnati*

Methicillin-resistant Staphylococcus aureus (MRSA), known to transmit predominantly through direct contact, is recognized as a serious public health threat by the CDC. We investigated the presence of airborne MRSA in the Neonatal Intensive Care Unit (NICU) and the Women's health service Operating Room (OR) of a medical center, using both active (BioCascade impactor and gelatin filter) and passive air sampling methods. Identification of MRSA was performed via plate culturing, broth enrichment, and PCR. Of the samples collected (NICU:61 active and 78 passive samples; OR:20 samples from active sampling), we observed amplicon bands for 16S rRNA genes for at least 20 samples, which proved the presence of bacteria. Thirteen samples were positive for mecA gene, but below lukS gene's detection limit, thus making the presence of MRSA inconclusive. Five enriched samples from the NICU were positive for femA, nuc, mecA and lukS genes, confirming the presence of MRSA. Furthermore, size-resolved collection using the BioCascade revealed the presence of airborne MRSA across a broad size range (<0.5 µm to >10 µm), suggesting the potential for airborne transmission.

Subsequently, we tested the effectiveness of UV-C irradiation, a wearable air purifier (AP), and a commercial disinfectant in inactivating methicillin susceptible S. aureus (MSSA) and MRSA, in the laboratory. Over 90% reduction in viable MSSA was recorded at 10-20 min, while they were completely inactivated after 30 min of exposure to the disinfectant. For MRSA, >90% inactivation was recorded only for 20-30 min. When using the AP, higher CFU were recorded for 5-10 min exposures, while at least 80% reduction was recorded for longer periods. UV-C irradiation was the most effective, resulting in the lack of viable MSSA and MRSA in most of the samples. These findings highlight UV-C as a promising intervention and underscore the need for further infection control strategies for airborne MRSA.

2RM.1

Assessing Black Carbon and Iron Oxide Aerosols: A Comparative Study Between Urban and Rural Environments in the Southeastern U.S. SHREYA SURI, Lifei Yin, Bin Bai, Yuhan Yang, Dongli Wang, Andrew Metcalf, Nathan Chellman, James Sherman, Pengfei Liu, *Georgia Institute of Technology*

Black carbon (BC) and iron oxide (FeOx) aerosols represent important contributors to shortwave atmospheric heating and have been associated with adverse human health outcomes. Accurate measurement of BC and FeOx is crucial for understanding their roles in climate forcing and air quality. However, observational data—particularly for anthropogenic FeOx—remain limited. In this study, we use a modified single-particle soot photometer to measure atmospheric concentrations of refractory BC (rBC) and FeOx particles in urban (Atlanta, GA) and rural (Boone, NC) environments in the Southeastern U.S. We identify likely emission sources and estimate light absorption properties to assess the relative contributions of rBC and FeOx to atmospheric heating. Our findings indicate that rBC and FeOx concentrations and absorption are substantially higher in the urban environment, reflecting significant anthropogenic contributions to pollutant emissions. Assuming external mixing, we estimate that FeOx contributes 1.3% of total absorption by rBC at the urban site and approximately 0.6% at the rural site. These results highlight the spatial variability in primary aerosol species and the importance of localized assessments to better understand their impacts on air quality and climate.

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2RM.2

A Seasonal Investigation of Ambient Air Quality in the Mississippi Delta. AMELIA SMITH, Samuel Smith, Abigail Barnett, Katarina Lindskog, Ryan Chartier, Tracy Dombek, Courtney Roper, *RTI International*

The Mississippi Delta region includes 18 counties in West Mississippi (MS), USA. Primarily a rural, agricultural region, community members face health disparities, including increased rates of chronic illness, disproportionate hospitalizations from asthma, and overburdened healthcare facilities. Health initiatives work to combat these issues, yet environmental risk factors remain understudied, specifically, poor air quality. Community air sensors and surveys provide a means to investigate potential links between the environment and human health. The goal of this project was to measure air quality using real-time sensors in areas currently unmonitored by traditional air quality networks to reveal hotspots and patterns that could impact and degrade air quality, as well as assess environmental health literacy in the Mississippi Delta region. Surveys addressing environmental exposure concerns were distributed and used to support both outreach programming and pollutant characterization. Field sampling utilizing real-time $PM_{2.5}$ monitoring (PurpleAir Inc.), was initiated at three Mississippi locations; two in the Mississippi Delta, including the Greenville and Shellmound and one in Oxford, a comparison site in North MS. $PM_{2.5}$ sampling (SKC IMPACT, SKC, and Micro Personal Exposure Monitors (mPEM), (RTI International) and passive sampling of NO_x and NH_3 (Ogawa & Co., USA) were also deployed in Shellmound, MS. Air quality data measured using the mPEM and PurpleAir Zen sensor revealed a pattern of sustained, elevated $PM_{2.5}$ concentrations indicative of a local hotspot that is degrading air quality in the Delta. These findings underscore the need for more comprehensive monitoring to understand the associated health impacts of air quality in the MS Delta. Characterization of $PM_{2.5}$ composition, source identification and mapping, as well as comparison between sampling sites will provide critical information to understand the health risks associated with air quality in rural locations. This information can in turn be used to educate and promote environmental health literacy within rural communities.

2RM.3

Aerosol Acidity Size-Dependence in a Remote Marine Environment. KAYLEIGH REILLY, Tiantian Zhu, Cara Waters, Clare Murphy, Andreas Schmitt, Ruhi Humphries, Christina S. McCluskey, Kerri Pratt, Andrew P. Ault, *University of Michigan*

Aerosol acidity plays a crucial role in the formation of secondary aerosols and their physicochemical properties as a result of pH-dependent processes. However, aerosol pH has proven difficult to accurately measure or predict in the ambient atmosphere due to their complex composition, partitioning of semi-volatile gases, and the non-conservative nature of the H+ ion. Thermodynamic models and gas-aerosol partitioning studies have provided important acidity insights, but do not account well for potential pH size-dependence due to assumptions about mixing state and thermodynamic equilibrium. Thus, field-deployable acidity measurement techniques are critically important to understand aerosol acidity in the ambient atmosphere. Herein, we collected direct size- and time-resolved colorimetric pH spot measurements to explore the size-dependence of aerosol acidity under different atmospheric conditions. With this method, aerosols are directly impacted onto pH paper and an imaging processing script then calculates the pH by relating the average blue-green pixel intensity of the spot to a calibration curve, using a previously published method. Aerosol pH data was collected over the course of two months at kennaook Cape Grim (KCG) Research Station during the CAPE-k campaign and COAST-k research cruise. KCG is located on the coast of western Tasmania and experiences a unique marine environment that frequently experiences pristine air masses from the Southern Ocean. Over the course of this measuring period, acidic aerosols were measured for submicron particles during all air mass histories, while more neutral pH values were observed in the coarse mode. The transition size to more acidic aerosols varied, shifting to larger sizes when the aerosol composition was dominated by sea spray. This detailed and unique data set of direct atmospheric environmental pH measurements enables a greater understanding of the factors that determine aerosol pH, which will improve our ability to predict secondary aerosol formation and its impacts on climate.

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2RM.4

Advancing Airborne PFAS Characterization Near Industrial Sources Through Integrated Targeted and Non-targeted Offline Mass Spectrometry Analysis. YOONSUB KIM, Yufan Hu, Michael Davern, Sahir Gagan, Margot Francini, Miska Olin, Xiangxinyue Meng, Sining Niu, Alana Dodero, Sarah D. Brooks, Yue Zhang, Jason Surratt, Barbara Turpin, *University of North Carolina at Chapel Hill*

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants associated with potential human health risks. Although elevated PFAS concentrations in air have been observed near fluoropolymer manufacturing facilities, prior monitoring efforts have largely focused on targeted analyses, limiting the detection of emerging or unknown compounds. This study was conducted as part of the 2025 Real-time Air Measurements of PFAS (RAMP) campaign in Fayetteville, NC, USA to address these limitations. Two types of low-volume samplers, quartz fiber filters (QFFs) and polyurethane foam (PUF)-XAD2-PUF cartridges, were deployed for four weeks at two stationary sites <2 km from a fluoropolymer manufacturing facility and on a mobile laboratory. The filters and cartridges sampled continuously without replacement during the sampling period. In each location, $PM_{2.5}$ samples were collected using a stack of six QFFs to capture total (gas- and particle-phase) ionic PFAS, considering that ionic PFAS can be substantially adsorbed onto QFFs. In contrast, PUF-XAD2-PUF cartridges collected gas-phase neutral PFAS. Additionally, high-volume air samplers collected six-day PM_{10} samples on QFFs over an eight-week period, resulting in nine samples for each stationary site. Samples will be analyzed using targeted reverse-phase liquid chromatography interfaced to electrospray ionization coupled to high-resolution quadrupole time-of-flight mass spectrometry (RPLC/ESI-HR-QToF-MS), and by gas chromatography interfaced to electron ionization coupled to mass spectrometry (GC/MS) to quantify 25 ionic and 9 neutral PFAS, respectively, using authentic standards. Non-targeted analysis will be explored using ion mobility spectrometry coupled to a high-resolution quadrupole time-of-flight mass spectrometer (IMS-HR-QToF-MS). This integrated analytical approach enables both the quantification of established PFAS and the identification of previously unmonitored PFAS in ambient air. This study could contribute to a more comprehensive understanding of the local atmospheric PFAS burden and support efforts to protect environmental and public health through enhanced monitoring strategies and future PFAS exposure assessments.

2RM.5

Assessment of Wildfire Impact on Secondary Organic Aerosol Formation Using CMAQ-UNIPAR. GANGHAN KIM, Myoseon Jang, Tamanna Tasnim, *University of Florida*

Wildfires in the United States caused significant impacts on ecosystems, climate, and human health. Massive wildfires release a large amount of hydrocarbons (HCs) into the atmospheric environment and increase concentrations of background ozone and secondary organic aerosol (SOA). The composition of HCs in wildfires varies due to the tree species in different regions and the burning temperature. In general, wildfire smoke includes terpenes, non-aromatic oxygenated HCs, non-oxygenated aromatics, and phenolic compounds. Unlike conventional urban pollutants, wildfires uniquely contain phenolic compounds, such as phenol, catechol, cresol, methyl-catechol, guaiacols, and syringols. The fraction of phenolic compounds of wildfires is generally less than that of wood-burning in fuel consumption. Phenolic compounds are highly reactive, making them essential in wildfire atmospheric chemistry. Furthermore, they can effectively yield SOA due to the production of highly oxygenated products throughout the day and night through reactions with OH radicals, ozone, and nitrate radicals. In this study, SOA formation is simulated using the Community Multiscale Air Quality Modeling System (CMAQ) coupled with the Unified Partitioning Aerosol-phase Reaction (UNIPAR) model on a regional scale. The UNIPAR model is equipped with SOA parameters for aromatics, alkanes, naphthalene, terpenes, isoprene, sesquiterpene, and phenolic compounds to predict SOA formation during wildfires. SOA parameters of phenolic compounds originate from phenol, cresol, catechol, and methyl-catechol for three major oxidation pathways (OH radical, ozone, and nitrate radicals) to simulate day and night SOA formation. CMAQ-UNIPAR simulations were performed for wildfire cases in 2018 and 2019, specifically in the regions covering the states of Washington, Oregon, California, Idaho, and Montana of the United States.

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2RM.6

High-resolution Mass Spectrometric Analysis of Ultrafine Marine Aerosol Composition During the Eastern Pacific Cloud Aerosol Precipitation Experiments (EPCAPE). TERESA PALACIOS DIAZ, Kristen Cramer, Anna Kapp, James Smith, *University of California, Irvine*

Marine aerosols contribute significantly to the Earth's radiative budget and studies suggest that the organic sea surface microlayer contributes to the formation of mostly organic ultrafine (sub-100 nm) marine particles. However, the compounds responsible for this process are still poorly understood. Given the importance of marine aerosols to cloud formation and the Earth's climate, measurements are needed of ultrafine particle composition and possible connections to climatically important properties such as hygroscopicity. We report measurements of ultrafine particle composition at Mt. Soledad near La Jolla, on the southern California coast. This area is susceptible to heavily polluted winds from Los Angeles, as well as clean winds from the Pacific Ocean. This combination becomes a good area for examining both remote and urban influences on marine particle composition. Filter samples at Mt. Soledad were collected downstream of a 3-stage MOUDI impactor during the Eastern Pacific Cloud Aerosol Precipitation Experiments (EPCAPE) field campaign for two months (14 April 2023 to 15 June 2023) and were analyzed offline by an ultrahigh-performance liquid chromatographer (UHPLC) combined with an Orbitrap high-resolution mass spectrometer (HRMS). Metabolomics-based analysis of organic aerosols (untargeted analysis) was performed to determine patterns of compounds collected. While the emphasis of this work is on characterizing the composition of ultrafine marine particles, these measurements can be connected to climatically important processes and the results are directly applicable to the formation of larger particles and ultimately the climate and air quality in this important region in southern California.

2RM.7

Observations of Particle Growth and Composition in the Mojave Desert. KRISTEN CRAMER, Sanjeevi Nagalingam, Alex Guenther, James Smith, *University of California, Irvine*

The California deserts have been identified as vulnerable ecosystems due to their heightened susceptibility to the impacts of climate change. Models suggest the region will experience larger increases in annual temperature and more extreme weather patterns, and climatic effects on season precipitation will be most impactful as water is a limiting variable in arid climates and thus can have cascading effects. Previous field work in the western Sonoran Desert found that, during the frequent summertime particle events, particles grow to the size of climatically-relevant cloud condensation nuclei, but little is known about the composition and dominant growth mechanisms of aerosols in the California deserts. To address the need for a more comprehensive understanding of particle composition and growth in the California deserts, we conducted a field campaign at the Burns Piñon Ridge Reserve in the Mojave Desert in July 2024. We collected ultrafine particles on filter samples to analyze composition via high resolution mass spectrometry, and took measurements of ambient meteorology, ozone, gas-phase samples of biogenic volatile organic compounds (BVOCs), and particle size distributions. Analysis of size distributions showed particle growth events occurred on 35% of days through the month of July with an average growth rate of 7.2 ± 0.94 nm/hr. Ozone and meteorological data suggest that the transport of ozone from the California coast may play an important role in the desert atmosphere. Preliminary analysis of particle composition suggests that sulfates and highly oxidized extremely-low volatility organic compounds contribute significantly to particle composition and play a role in the growth mechanisms occurring in the Mojave Desert. These findings further our understanding of aerosol composition in the California deserts and can lead to a greater understanding of the mechanisms of growth and formation in remote and rural environments, particularly those impacted by transport for urban regions.

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2RM.8

Influence of Temperature Variations on $PM_{2.5}$, Secondary Organic Aerosol (SOA), and SOA Precursor Loading in Urban and Rural Baltimore Region. NAHIN FERDOUSI-ROKIB, Ayreanna Pettijohn, Omara Rosenfeld, Daniel C. Blomdahl, Keelie N. Steiner, Amira Yassine, Maria A. Zawadowicz, Akua A. Asa-Awuku, Christopher Hennigan, Benjamin A. Nault, Peter F. DeCarlo, *Johns Hopkins University*

Secondary organic aerosols (SOA) significantly contribute to the composition of fine atmospheric particulate matter ($PM_{2.5}$) in both urban and rural environments. SOA formation is dictated by the presence and chemical reactions of volatile organic compounds (VOCs), such as isoprene. Temperature can impact both the emission of precursors and the chemical mechanisms of SOA formation and may result in evolving composition profiles with temperature variations. Regions such as Baltimore experience broad diel temperature variations during the spring-summer seasonal transition. However, the effects of dynamic temperature fluctuations on SOA formation are not well understood. Long-term chemical field measurements of VOC and PM composition allow for observational constraints of the impact of temperature on $PM_{2.5}$ and SOA concentrations to be explored. In this work, we have obtained real-time compositional and concentration measurements in the field using Aerosol Chemical Speciation Monitors (ACSM), Vocus ELF PTR-ToFMS, and a PTR/GC instrument (ecTOF). Measurements were obtained at both the DOE Urban Integrated Field Laboratory (UIFL) urban site in Baltimore and the DOE ARM Coast-Urban-Rural Atmospheric Gradient Experiment (CoURAGE) rural site in Mt. Airy to better discern temperature effects in both environments. The results of this work are relevant to understanding $PM_{2.5}$ and SOA chemistry in a rapidly warming climate with more frequent temperature fluctuations.

2SA.2

Machine Learning-Based Prediction of ICP-MS Results Using XRF Data. HYEJIN SHIN, Taeyeon Kim, Seung-Muk Yi, Kwon Ho Jeon, Kyungmi Lee, Hyeog Ki Chae, *Seoul National University, Seoul, Korea*

X-ray fluorescence (XRF) and inductively coupled plasma mass spectrometry (ICP-MS) are widely used techniques for trace element analysis. While XRF offers rapid, non-destructive analysis with minimal sample preparation, ICP-MS provides higher sensitivity and lower detection limits. Due to their complementary characteristics, the two methods are selectively applied depending on analytical objectives and sample matrices. This study investigates the feasibility of predicting ICP-MS results using XRF data through machine learning techniques. By identifying patterns between XRF and ICP-MS data, predictive models to estimate ICP-MS values from XRF measurements could be developed.

In situations where ICP-MS measurements are limited or unreliable—such as for arsenic (As), which may suffer from sample preparation artifacts—XRF data can serve as an alternative for indirect estimation. For example, As and lead (Pb), which are frequently co-emitted from sources like coal combustion, often exhibit strong correlations. Given that Pb is reliably detected by XRF, it can act as a surrogate predictor for As, along with other XRF-accessible elements.

To evaluate the validity of the machine learning-based reconstruction, Positive Matrix Factorization (PMF) was applied to both the original ICP-MS dataset and the reconstructed dataset generated from XRF-based predictions. Source profiles and contributions derived from each dataset were compared to determine the consistency and reliability of the reconstructed values.

Additionally, previous studies using dithiothreitol (DTT) assays to assess oxidative potential of particulate matter reported inconsistent sets of DTT-correlated elements depending on the analytical method (XRF vs. ICP-MS). In this study, we further examine the correlation between DTT activity and the machine learning-predicted ICP-MS values to assess whether the reconstructed data can recover physiochemically relevant associations with oxidative toxicity.

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2SA.3

Comparison of Carbon Analysis Protocols in $PM_{2.5}$ Source Apportionment. SUNGHWAN SHIM, Seung-Muk Yi, Kwon Ho Jeon, Taeyeon Kim, Minsu Kang, Sujung Han, Hyejin Shin, Jinwoo Choi, Jaewook Hwang, Yein Kim, *Seoul National University, Seoul, Korea*

Thermal-optical methods are widely used to quantify carbonaceous species in $PM_{2.5}$, which serve as marker species for source apportionment, particularly for mobile sources such as gasoline and diesel vehicles. Two commonly applied protocols of carbon analysis are Thermal-Optical Transmittance (TOT) and Thermal-Optical Reflectance (TOR) methods, both of which provide quantitative information on organic carbon (OC) and elemental carbon (EC) fractions. Both TOT and TOR methods analyze carbon fractions by gradually heating filter sample, first in an inert atmosphere (100% He) to volatilize organic carbon, then in an oxidizing atmosphere (2% O_2 + 98% He) to combust elemental carbon. The key difference is that TOT monitors the decrease in laser light transmitted through the filter, whereas TOR tracks changes in light reflected from its surface. These optical differences result in discrepancies in how carbon fractions are classified: TOT (OC1-OC5, POC, EC1-EC6), and TOR (OC1-OC4, EC1-EC3). Such differences can affect how carbon marker species are interpreted in receptor models like Dispersion-Normalized Positive Matrix Factorization (DN-PMF). In this study, we conducted a direct comparison of DN-PMF results using input data from both TOT and TOR to assess how analytical protocols influence $PM_{2.5}$ source apportionment. A total of 450 $PM_{2.5}$ samples were collected on the rooftop of Seoul National University's building over 23-hour periods from September 2020 to August 2025. Mass concentrations were measured by microbalance. Trace elements (20 species) were analyzed using Energy-Dispersive X-ray Fluorescence (ED-XRF), and ionic species (6 species) were quantified through ion chromatography. The comparison highlights how protocol-specific differences in carbon fractionation affect the estimation of mobile source contributions. These findings may help guide analytical method selection in future source apportionment studies.

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2SA.4

Machine Learning Approaches for Replacing Missing Values in $PM_{2.5}$ constituents. SUJUNG HAN, Taeyeon Kim, Seung-Muk Yi, *Seoul National University, Seoul, Korea*

$PM_{2.5}$ has been identified as a Group 1 carcinogen by the International Agency for Research on Cancer. It causes significant health risks due to its ability to penetrate deep into the respiratory system. Accurate analysis of $PM_{2.5}$ mass concentrations and chemical constituents is critical for effective policy development and health impact assessments. However, measurements of $PM_{2.5}$ constituents often encounter missing data due to equipment failure or maintenance issues, which can compromise data reliability. This study aimed to impute missing values in $PM_{2.5}$ mass concentrations and their chemical constituents. A total of 387 samples were collected on the rooftop of the Graduate School of Public Health at Seoul National University, Seoul, Republic of Korea, for 23-hour intervals between September 2020 and January 2025. Trace elements, including Al, Ca, Cr, Cu, and Br, were analyzed using Energy Dispersive X-ray Fluorescence on Teflon filters. Carbonaceous components (OC, EC) were measured with an OC/EC analyzer on Quartz filters, while ionic species (NO_3^-, SO_4^{2-}, Cl^-, NH_4^+, Na^+, K^+) were analyzed using Ion Chromatography on PTFE filters. To fill out the missing data, three representative imputation methods were used: Random Forest Regression, SoftImpute, and K-Nearest Neighbor (KNN) imputation. Overall, Random Forest showed strong performance due to its flexibility in complex relationships, while SoftImpute and KNN also produced reasonable results depending on data structure and multivariate patterns. The analysis showed that no single method consistently outperformed the others, emphasizing the importance of selecting or combining approaches tailored to the characteristics of each dataset. This study highlights that appropriate imputation supports more accurate statistical analyses and strengthens the scientific foundation for air quality management and health risk assessments.

Acknowledgment

This research was supported by the Particulate Matter Management Specialized Graduate Program through the Korea Environmental Industry & Technology Institute (KEITI), funded by the Ministry of Environment (MOE).

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2SA.5

New Particle Formation from Biosolid Processing Plants.
SANGHEE HAN, Lintong Cai, Markus Petters, *University of California, Riverside*

Emissions from wastewater treatment plants have been widely reported, including bioaerosols, greenhouse gases, siloxanes, nitrous oxide, and other gaseous pollutants. Additionally, sewage sludge composting sites have been reported to release volatile organic compounds (VOCs), bioaerosols, and gaseous pollutants. VOCs with high secondary organic aerosol (SOA) yields—such as benzene—along with nitrogen oxides and ozone, have been identified as key emissions from these facilities in numerous studies. These findings have raised concerns about nanoparticle formation in the vicinity of wastewater treatment operations. Here we show results from mobile atmospheric aerosol measurements that detected high concentrations of ultrafine particles (3–20 nm in diameter) downwind of a composting site exceeding 200,000 cm^{-3}, along with elevated CO_2 levels downwind of the plume. Emission factors ranged from 4.4×10^{14} to 3.7×10^{15} kg^{-1} CO_2. Transmission electron microscopy analysis shows that particles composed primarily of carbon, with some sulfur, nitrogen, and phosphorus. Agglomerated morphology suggests either solid or highly viscous phase states. This suggests new particle formation resulting from emissions associated with the facility.

2UA.1

Temporal Variability of Black Carbon in Jakarta and Bandung, Indonesia.
Muhayatun Santoso, Asta Gregorič, Martin Rigler, PHILIP K. HOPKE, *National Innovation and Research Agency (BRIN), Indonesia*

Prior work based on 24-hour integrated filters had shown the presence of high concentrations of black carbon (BC) in the ambient $PM_{2.5}$ in Indonesia. To better characterize the temporal variability and identify potential major sources of the light absorbing carbon in Indonesia, AE33 aethalometers were operated in Jakarta, the capital and largest city, and Bandung, a smaller city in central Java for almost 2 years. Indonesia has a variety of BC sources including high volumes of traffic and biomass burning that have contributed to air quality issues. Thus, the resulting multiple wavelength BC data were analyzed in a variety of ways to provide diel, monthly, and seasonal variation patterns. The data provide apportionment of the BC mass to fossil fuel and biomass burning sources. Combining the data with wind speed and direction data, likely major source locations were identified.

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2UA.3

Integrated Energy and Air Quality Assessment of Clean Energy Initiatives in the New York State. RICHARD MAHUZE, Bo Yuan, K. Max Zhang, *Cornell University*

The increasing frequency and intensity of extreme weather events, combined with the urgent need to transition to low-carbon energy systems, pose significant challenges for energy infrastructure planning. In New York State—where ambitious renewable energy targets and emission reduction commitments are in place—building resilience to both gradual climate shifts and sudden, severe weather events is essential. To aid in this transition, power system planners need high-resolution data to accurately project future energy demand and renewable resource variability. This research presents an integrated modeling framework that combines renewable energy resources, power systems, and air quality dynamics. The framework leverages a suite of analytical tools, including geographical information systems (GIS), optimal power flow (OPF), numerical weather simulation (WRF), and air quality chemical transport modeling (CMAQ). All components are synchronized within a unified weather regime, offering a holistic view of the system and capturing the interdependencies among these components. The entire framework is developed in Python, with all tools publicly accessible on GitHub. The framework is evaluated against various meteorological and air quality observational datasets. Future scenarios indicate significant reductions in winter $PM_{2.5}$ and summer ozone levels from 2018 to 2030. However, substantial demand growth in the building and transportation sectors, driven by aggressive electrification policies, could partially offset emissions reductions achieved by phasing out thermal power generation.

2UA.5

Mapping Air Pollution Concentrations in Greater Boston Using Hyperlocal Mobile Sensing and Machine Learning. ABIR SAHA, Mars Keesey, Yang Zhang, Shang Liu, *Northeastern University*

Although many regions in the United States have met the National Ambient Air Quality Standards (NAAQS), the assessment of attainment is based on sparsely located air quality networks. Localized pollution still exists and varies spatially, especially experienced by disadvantaged communities. The growing body of low-cost sensor deployments has greatly improved our understanding of the spatial patterns of air pollution, but they suffer from measurement uncertainties and still lack coverage at the neighborhood level. To overcome this limitation, we have built a mobile laboratory equipped with advanced real-time instruments that are capable of accurately measuring gas- and particulate-phase air pollutants (i.e., O_3, NO, NO_2, NOx, SO_2, CO, benzene, toluene, ethylbenzene, xylene, PM_1, $PM_{2.5}$, PM_{10}, PM composition, and size distribution) and greenhouse gases (CO_2, CH_4). We will conduct an intensive, 30-day mobile measurement field campaign in Greater Boston, Massachusetts, in the summer of 2025, focusing on two neighborhoods: Brookline, an affluent neighborhood, and Chelsea, a low-income neighborhood. Geospatial analysis will be performed to identify air pollution hotspots, and comparable analysis will be conducted between the two communities. Positive Matrix Factorization (PMF) will be applied to the mass spectrum measured by the High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) for spatially resolved source apportionment. Expected PMF components include hydrocarbon-like organic aerosol, secondary organic aerosol, cooking organic aerosol, and others. By combining hyperlocal chemically resolved concentration measurements and source apportionment with real-time street view imagery, traffic density, and Google point of interest data, we will develop machine learning-based high-resolution land use regression models. These models will aid in predicting air pollution concentrations in these neighborhoods when measurement data is not available. The integration of chemical speciation, mobile sensing, and machine learning represents an emerging framework to tackle air pollution at street scales.

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2UA.6

Relative Importance of Primary Organic Aerosol Source Types across Spatiotemporal Scales in New York City. LIJIN ZHANG, Mitchell Rogers, Taekyu Joo, Tori Hass-Mitchell, Catelynn Soong, Havala Pye, Benjamin Murphy, Drew Gentner, *Yale University*

Advanced aerosol measurements have been collected since summer 2022 as part of the ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) at the NYSDEC (New York State Department of Environmental Conservation) site in Queens, NYC, where the average $PM_{2.5}$ concentrations are around 8 μg m^{-3} in recent years. The instruments employed include an Xact that measures trace metals, an Aethalometer measuring black and brown carbon, a Scanning Mobility Particle Sizer (SMPS) measuring aerosol size distribution, as well as an Aerosol Chemical Speciation Monitor (ACSM) that measures non-refractory aerosols, whose source types are examined using positive matrix factorization (PMF). Observations show the predominance of organic aerosols (OA) during summer months and increases in inorganic aerosol fractions during winter months. While OA is comprised of primary and secondary organic aerosol (POA, SOA), we examine the magnitude and dynamics of major POA source types, including cooking-related OA (COA), and hydrocarbon-like OA (HOA), across daily, weekly, and seasonal time scales, while considering variations in meteorology and transport. We compare the findings to model results, such as those from the Community Multiscale Air Quality (CMAQ). We also examine the relative influences of local, regional, and long-distance sources using meteorological data, modelling, and the network of NYSDEC sites measuring $PM_{2.5}$ mass concentrations in the region. The source contributions of POA factors are interpreted along with gas-phase criteria pollutants, such as carbon monoxide (CO) and nitrogen oxides (NO_x), then compared to emissions inventories, while considering spatiotemporal variations in emissions, which serves to advance the understanding of their roles in ambient $PM_{2.5}$ in the New York Metropolitan Area.

2UA.7

Urban Railroad Yards: An Underappreciated Source of Urban Black Carbon Particles. PHILIP K. HOPKE, Marjan Savadkoohi, Kamsi Oparaugo, *Clarkson University and University of Rochester*

Railroads in the United States remain a major transport provider for goods. For most of the country, railroad engines are diesel and often relatively old. Emissions then occur both along the tracks outside and withing of urban areas, but within urban areas, there are often railroad yards where cars are moved from one train to another or to sidings so they can be loaded or unloaded. The switching of individual cars from one group to another is done with switcher engines who frequently start and stop under load and release substantial particulate emissions. A preliminary study around the yard in Rochester, NY had shown substantial concentrations of BC measured with an AethLabs MA201 on the upwind side of the yard where there were black deposits on windowsills. In particular, higher concentrations were often observed between 20:00 and midnight, presumably when cars were being actively moved from one train to another or to a loading dock. Thus, a 1-year study was undertaken using 2 AethLab MA201s with one upwind and one downwind of the yard. The detailed analyses of the resulting data will be presented.

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2UA.8

Aerosol Chemical Composition at an Urban Core Location in Nairobi, Kenya. ABHISHEK ANAND, Godwin Opinde, Tedy Mustisya Mwendwa, Theobard Habineza, Albert Presto, Peter F. DeCarlo, Benjamin A. Nault, Daniel Westervelt, Leah Williams, *Columbia University*

The recent successful proliferation of low-cost sensors has made tremendous strides in obtaining useful air pollution data across the African continent, especially for $PM_{2.5}$. The initial results from sensor networks have generated a number of new scientific questions and unknowns regarding atmospheric chemistry and air quality in Africa. Actionable air quality data on PM composition is still needed for identifying emission sources to guide policymaking. We present here results showing comprehensive concentrations of $PM_{2.5}$, black carbon, and non-refractory aerosol chemical components (organics, sulfate, nitrate, ammonia, chloride) at the Kenyatta University-Columbia University air quality laboratory, located in the Nairobi Central Business District at Kenyatta University City Center campus. Total $PM_{2.5}$ is measured with a reference grade Thermo Fischer TEOM 1400a and a series of air sensors, black carbon with a Magee Scientific AE-33 aethalometer, and aerosol composition with a Time-of-Flight Aerodyne Aerosol Chemical Speciation Monitor (ToF-ACSM). This data can provide novel insights into diel profiles of $PM_{2.5}$, PM composition, and quantitative source apportionment. Preliminary results show high levels of $PM_{2.5}$ (~30 μg m^{-3}), constituting more than half with organic aerosol. Morning and evening rush-hour peaks can reach up to 70 μg m^{-3} on average over the course of the dry season. An ACSM measurement campaign between May-June 2025 shows an average organics, sulfate, nitrate, ammonia, chloride concentrations of 7.1 μg m^{-3}, 0.92 μg m^{-3}, 0.42 μg m^{-3}, 0.35 μg m^{-3}, and 0.21 μg m^{-3}. BC concentrations at the site follow a similar pattern as $PM_{2.5}$ with spikes up to 60–75 μg m^{-3} with an average of ~15 μg m^{-3}. We also observe high levels of BC to $PM_{2.5}$ ratio at the site which indicates that much of the pollution is sourced from local traffic including personal vehicles, matatus, and trucks. This collaborative effort stands to be among one of the first studies to measure PM composition in Nairobi. In addition to source apportionment, these data can also be beneficial for public health, policy evaluation, and mitigation strategies.

2UA.9

An Integrated Global Assessment of Particle Number Concentrations: Spatiotemporal Variations, Source Contributions, Severe Air Pollution Episodes, Spatial Homogeneity, and the Pandemic Effects (2000-2024). MEHDI AMOUEI TORKMAHALLEH, Ali Darvishi Omrani, Marziyeh Kashani, Milad Malekitabrizi, Farzaneh Jafarigol, Faezeh Darvish Omran, Hamed Sharifi, Mahsa Alishiri, Enoch Adotey, Philip K. Hopke, Lidia Morawska, Luca Ferrero, Martine Collaud Coen, Markku Kulmala, Tareq Hussein, Motahareh Naseri, Hilkka Timonen, Ville Vakkari, Armin Sorooshian, Tuukka Petäjä, Stergios Vratolis, Gulden Ormanova, Jarkko Niemi, Luca Stabile, et al., *University of Illinois at Chicago*

Ultrafine particles pose a recognized threat to human health. As urbanization accelerates and road traffic expands, population exposure to ultrafine particles is expected to rise, heightening concerns about their potential health impacts. This study provides a broader perspective of the spatiotemporal variations of particle number concentrations and particle number size distributions globally based on datasets from 149 monitoring stations from 41 countries, including urban background, traffic, rural, coastal, mountainous and polar stations. Spatiotemporal analyses reveal significantly higher values at urban background and traffic sites in South America and southern European cities compared to other regions. Despite moderate PNC fluctuations (20–27%), the results indicate that PNC can serve as a spatially homogeneous factor for epidemiological studies, as it exhibits dispersion patterns similar to $PM_{2.5}$ when sufficiently distant from highways. Source apportionment revealed that the primary contributors to the global PNC are new particle formation from road traffic, primary and delayed primary emissions from road traffic. The global analysis of particle number size distribution identifies traffic emissions—particularly nucleation of hot gases—as the primary particle number concentration source. This study attributes vehicular exhaust nucleation to primary emissions rather than secondary formation. Traffic remains the dominant urban background particle source, with secondary photo-nucleation contributing 11–23% of total PNC. Trend analysis shows significant PNC declines at urban background and traffic stations, though nucleation mode particles remain challenging to regulate. Long-term air quality policies have reduced pollution frequency and magnitude, particularly at North American and European sites. However, $PM_{2.5}$-focused regulations did not directly lower PNC in some regions, emphasizing the need for targeted policies. Diverse patterns in PNC were observed as a consequence of the lockdown-related reduction of emissions that were context-specific.

Keywords: Global particle number concentration, primary and secondary emission sources, COVID-19 impacts, severe air pollution events, nucleation mode particles

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3AC.1

New Perspectives on Decades of SOA Formation Studies: A Comprehensive Laboratory Data Review from UCR. YANYU ZHANG, David R. Cocker III, *University of California, Riverside*

From the early 2000s through 2025, researchers at Atmospheric Processes Laboratory (APL), University of California, Riverside, have conducted approximately 6000 experiments using their 100+ m^3 environmental chambers, contributing extensively to the understanding of atmospheric processes for both anthropogenic and biogenic compounds. This study presents a comprehensive review of the over two decades of chamber-based research at APL, with a particular focus on the formation and evolution of secondary products including ozone and secondary organic aerosols (SOA), along with broader insights into aerosol physical and chemical properties. We examine several critical elements: (1) SOA yield — reevaluating the dataset with respect to current scientific understandings involving atmospheric reactivity (e.g., beta) and SOA formation; (2) particle wall loss — investigating the effect of particle wall loss on SOA formation, utilizing a new environmental chamber with a dramatic reduction in wall loss by an order of magnitude, to assess the impact of commonly applied correction methods, with additional considerations discussed as part of the broader analysis. Overall, this study will generate a long-term dataset that provides critical benchmarks for validating atmospheric models.

3AC.2

The Critical Role of Synthetic Chemistry in Identifying Isoprene-Oxidation Products Beta-HPALD in Isoprene-Derived Secondary Organic Aerosol. REBECCA L. RICE, Zhenfa Zhang, Avram Gold, *University of North Carolina at Chapel Hill*

Isoprene, the largest biogenic volatile organic compound emitted into the atmosphere, undergoes a cascade of atmospheric oxidations initiated by rapid reaction with hydroxyl radical to form secondary organic aerosol (SOA). Despite intensive studies, the routes of formation are incompletely resolved, particularly the characterization of early generation gas phase oxidation products. Synthetic organic chemistry is integral in providing comprehensive elucidation of SOA formation pathways by enabling confirmation and direct investigation of reactive gas-phase intermediates by using authentic standards. Importantly, first-generation isoprene gas-phase oxidation products formed under low-NO_x conditions impact aerosol composition and physicochemical properties. The initial detectable transient in isoprene oxidation is a manifold of hydroxyperoxyl radicals which branches between the well-studied bimolecular reaction with HO_2 and understudied H-shift pathways. $C_5H_8O_3$, species, the earliest closed-shell products of the H-shift branch, have been categorized as δ- and ß-hydroperoxyaldehydes (δ- and β-HPALDs) and may account for as much for 12% of isoprene oxidation products. We have reported that the major products, δ-HPALDs, are cyclic peroxyhemiacetals which can be further oxidized to low-volatility products and form SOA. We now report synthesis of the second, and minor class of H-shift products, 3,4-ß-HPALD and 2,1-ß-HPALD. Characterization methods include proton NMR, UV spectroscopy, and hydrophilic liquid interaction liquid chromatography coupled to an electrospray ionization HR-ToF-MS. The ß-HPALDs do not cyclize or retain the photolabile conjugated carbonyl chromophore but do have the carbonyl functionality with a UV-vis absorbance tail into the ambient UV range. Targeted chamber studies reveal the influence of their structure on oxidation and acid-catalyzed particle-phase reactions. Synthetic chemistry is a powerful tool for rectifying the divergent atmospheric observations and incompletely understood molecular-level processes, by authentic products for modeling isoprene-derived SOA and enhancing our understanding of SOA impacts on climate and air quality.

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3AC.3

Particle-Phase Peroxides Form Carboxylic Acids in Pinene Secondary Organic Aerosol. CHRISTOPHER KENSETH, Jing Chen, Olivia Hakan, Donterrio Moore, Matthieu Riva, Michael Kamrath, Yuzhi Chen, John Shilling, Henrik Kjaergaard, Joel A. Thornton, *University of Washington*

Carboxylic acids are major components of atmospheric secondary organic aerosol (SOA), which plays a pivotal role in climate, air quality, and health. Their production is currently understood to occur predominantly through gas-phase chemistry. However, despite extensive study, the identities and thus the formation mechanisms of carboxylic acids in SOA remain largely unvalidated. In this work, we identify the most abundant carboxylic acids in SOA from ozonolysis of α-pinene and β-pinene—substantial global SOA sources—through independent synthesis of authentic standards. Based on targeted laboratory experiments featuring isotopically labeled compounds, tailored precursors, and isomer-resolved mass spectrometry, together with quantum chemical calculations of multigenerational peroxy and alkoxy radical chemistry, we show that these acids are formed in the particle phase through the decomposition of acylperoxyhemiacetals. These findings, together with past work on the formation of dimer esters in SOA, demonstrate that the particle-phase production of acylperoxyhemiacetals, and their subsequent conversion to carboxylic acids and dimer esters via Baeyer-Villiger decomposition and nucleophilic addition of alcohols, represents a key process in SOA formation.

3AC.4

Composition of Aerosols Formed by OH, Cl, or Ozone-initiated Oxidation of Limonene. ANITA AVERY, Mitchell Alton, Manjula Canagaratna, Andrew Lambe, *Aerodyne Research, Inc.*

Reactions of volatile organic compounds (VOCs) with various radicals generate oxygenated VOCS (OVOCs) and secondary organic aerosol (SOA) species. However, the variability and availability of these oxidants changes drastically within the atmospheric lifetime of many VOCs, so that a different oxidant will dominate the initial reaction and resulting products. Here we use limonene as a ubiquitous VOC to compare oxidation by chlorine radicals (Cl), hydroxyl radicals (OH), and ozone (O_3), using an oxidation flow reactor (OFR). The yield and chemical composition of OVOCs/SOA generated from these reactions were characterized with several online measurements, including an aerosol mass spectrometer (AMS), an extractive electrospray chemical ionization mass spectrometer (EESI-CIMS), and a scanning mobility particle sizer (SMPS). We observe that in addition to Cl being highly efficient at oxidizing organic molecules, it also promotes the formation of condensable vapors compared to OH and O_3 - maximum SOA yields were highest with limonene/Cl, followed by OH and O_3. Resulting aerosols were small, with a mode number size distribution generally below 50 nm. Low-volatility limonene oxidation products such as $C_{10}H_{18}O_5$ were detected by the EESI to provide such molecular characterization of products to compliment the bulk organic aerosol measured by the AMS. Cl oxidation produces large molecular weight ions with small mass defects, indicating Cl addition to the limonene backbone is a contributor to the total aerosol mass. OH and O_3 oxidation produce smaller molecular weight compounds, but with different characteristic ions that can be used in future work to differentiate between oxidation pathways.

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3AC.5

Dependence of Reactive Oxygen Species Formation on Oxidation State of Biogenic Secondary Organic Aerosols.

Kasey Edwards, LENA GERRITZ, Meredith Schervish, Manjula Canagaratna, Anita Avery, Mitchell Alton, Lisa Wingen, Jackson Ryan, Celia Faiola, Andrew Lambe, Sergey Nizkorodov, Manabu Shiraiwa, *University of California, Irvine*

Reactive oxygen species (ROS) play a central role in chemical aging of organic aerosols and adverse aerosol health effects upon respiratory deposition. Previous research has shown that biogenic secondary organic aerosols (SOA) form ROS, including hydroxyl radicals and superoxide, via reactions of reactive compounds including organic hydroperoxides and alcohols in the aqueous phase. However, the influence of oxidative aging and SOA oxidation state on ROS yield has not been systematically investigated. In this study, we quantify ROS yields in d-limonene SOA and β-caryophyllene SOA generated via ·OH and ·Cl oxidation in an oxidation flow reactor at equivalent atmospheric aging times ranging from 4 h to 22 days. We quantify radical formation using electron paramagnetic resonance (EPR) spectroscopy combined with a spin-trapping technique and characterized the molecular composition of the SOA samples with high-resolution mass spectrometry. We observe maximum radical formation at oxygen-to-carbon ratio (O/C) of ~0.5. Thereafter, we observe a >90% decrease in radical yield as the O/C increases to 1.2 for both d-limonene SOA and β-caryophyllene SOA. Similarly, the radical yield in d-limonene and β-caryophyllene SOA is reduced by >80% after on-filter photoirradiation. Peroxide yields are found to decrease with increasing O/C values and irradiation, suggesting that the aging-induced fragmentation and/or photolysis of hydroperoxides contribute to a decrease of radical formation in aged SOA.

3AC.6

Rethinking the Sources of Secondary Organic Aerosol: The Case of Sesquiterpenes and β-Caryophyllene.

ANGELIKI MATRALI, Christina N. Vasilakopoulou, Stella Eftychia Manavi, Petro Uruci, Damianos Pavlidis, Elena Voutsina, Spyros N. Pandis, *University of Patras, Greece*

Studies of the reactions of β-caryophyllene (a prominent sesquiterpene) with ozone have indicated that it is a good secondary organic aerosol (SOA) precursor. Significant SOA is also formed when β-caryophyllene reacts with OH and NO_3 radicals, reactions generally slower than its ozonolysis. Most chemical transport models either include only the first-generation reactions of sesquiterpenes in SOA formation or completely disregard them due to sesquiterpenes' relatively low (compared to monoterpenes) emissions. Experiments, conducted in the FORTH Atmospheric Simulation Chamber (FORTH-ASC), quantified the role of chemical aging of the ozonolysis products of β-caryophyllene as they continue reacting with OH in the atmosphere. Instrumentation included a high-resolution Aerosol Mass Spectrometer, a high-resolution PTR-MS with the CHARON addon (monitoring OA composition), and additional GC-MS analysis of organic vapors.

Multigeneration reactions increased dramatically the SOA formed by ozonolysis. Increases of up to a factor of 2.5 were measured. The later generation SOA was more oxidized than the ozonolysis SOA with O:C reaching 0.6. The oxidant to precursor concentration ratio affected the composition and yields of the aging products. The evolution of several ozonolysis products was quantified during the experiments. In many cases, ozonolysis-produced species like β-caryophyllon aldehyde and β-caryophyllinic acid were consumed during the OH chemical aging.

Results of the experiments were used to derive a parameterization of the sesquiterpene SOA aging based on the 1-D Volatility Basis Set, which was then added to the PMCAMx chemical transport model and used to simulate SOA production over Europe during a typical summer month. The predicted OA and SOA levels were compared to measurements from the SPRUCE-2022 field campaign and the ACTRIS network. The results suggest that accounting for the sesquiterpene chemical aging can help bridge the gap between modeled and observed SOA levels. Ignoring multigeneration reactions leads to significant underestimation of sesquiterpene SOA.

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3AP.1

Observation and Real-Time Monitoring of Soot Superaggregates with Small Angle Light Scattering. RAIYA EBINI, Justin Maughan, Kurt Ehlers, Prakash Gautam, Hans Moosmüller, Christopher M. Sorensen, *American Ecotech*

Superaggregates (SAs) are formed during late-stage aggregation near the gel point of an aggregating system [1], where Diffusion Limited Cluster-cluster Aggregation leads an overall structure with a fractal dimension $D_f \approx 2.6$ and a short-range structure with $D_f \approx 1.8$ [2]. This yields hybrid slopes in the fractal power law regime as seen in log-log plots of scattered intensity vs. wavevector [3]. SAs were first observed in diffusion flames [4] and are commonly emitted by heavily sooting and inverted flames [5, 6], pool fires [7], and forest fires [8], as result of cluster dense aggregation at cluster-cluster mean separation comparable to the mean cluster size.

Here, we observed SAs using small angle light scattering when burning toluene in a simple wick lamp. SAs are commonly generated in combustion processes and may also be important in the atmosphere where they could be monitored in real time with small angle light scattering methods.

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3AP.2

The Color of Aerosols: In Situ Imaging with Color Digital Holography. MATTHEW BERG, *Kansas State University*

Light-scattering techniques are commonly used to characterize micron and submicron particulate matter, such as aerosols, in a rapid and contact-free way. A typical objective is to infer the size and shape of particles from their light-scattering patterns. While this approach can be useful for simple shapes, difficulties arise for large irregularly shaped particles. An alternative, well-suited for large particles, is digital holography. A particle is illuminated by a beam and the interference pattern produced by unscattered and scattered light is recorded by a sensor. The pattern is the hologram, and from it, an image of the particle can be rendered computationally. Using red, green, and blue lasers along with a color sensor enables color holograms of particles, from which color images can then be generated. We have applied the method to an aerosol of mineral dust particles and can categorize different minerals according to the colors observed at the single particle level. The method shows promise as a means to encode aerosol-particle material information into a digital hologram, which could advance our aerosol characterization capabilities.

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3AP.3

Infrared Spectral Modeling for Detection of Aerosols using the Complex Refractive Indices. Jessica Salcido, Schuyler Lockwood, Tracy Baker, Alla Zelenyuk, Tanya Myers, TIMOTHY JOHNSON, *Pacific Northwest National Laboratory*

Detection of aerosolized chemicals using traditional spectroscopic methods and (absorption) reference libraries is challenging because such methods do not take into account the particles' ability to scatter and refract light. Due to an infinite number of aerosol sizes, shapes and compositions, constructing a database of such laboratory-measured scattering/absorption reference spectra is not feasible. As an alternative approach, the measured n(λ)/k(λ) optical vectors, i.e. the complex refractive indices, can be used in combination with particle absorption / Mie scattering theory and the Beer-Lambert law to generate a series of synthetic infrared transmission / scattered light spectra. These synthetic spectra manifest the unique aerosol spectral signatures, for either scattering or transmission measurements: Relative to simple "slab" transmission measurements, the aerosol spectra peak display significant spectral peak shifts and peak profile changes depending on the n/k values, the aerosols particle size(s) and particle shape(s). The modeled spectra are validated vs. laboratory transmission spectra of liquid and solid aerosols.

3AP.4

High-Resolution Measurements of Mineral Dust Light Absorption. TOMMASO ISOLABELLA, Clarissa Baldo, Marco Brunoldi, Mathieu Cazaunau, Claudia Di Biago, Paola Formenti, Federico Mazzei, Edouard Pangui, Franco Parodi, Paolo Prati, Bénédicte Picquet-Varrault, Virginia Vernocchi, Dario Massabò, *University of Genoa*

Desert dust aerosols play a critical role in Earth's climate system by modulating the radiative balance through absorption and scattering of radiation. Accurately characterizing the optical properties of these aerosols is essential for improving climate models and remote sensing applications.

We present new high-resolution absorption measurements of desert dust obtained using the Broadband Light Analyzer of Complex Aerosol (BLAnCA), a novel instrument designed to provide continuous, broadband spectral absorption data with unprecedented resolution.

BLAnCA employs an innovative optical design that combines a broadband light source with a high-sensitivity spectrometer, enabling spectral absorption measurements from the ultraviolet across the visible to near-infrared (UV-NIR) range.

In this study, we analyzed samples of mineral dust collected from multiple arid regions and conducted controlled laboratory experiments to measure their spectrally-resolved absorption coefficients.

The desert dust samples were generated in the laboratory starting from dust specimens collected in several deserts around the world. The samples were then analyzed with BLAnCA to measure optical absorption, as well as with X-ray diffraction for the mineralogical composition.

We observed distinct absorption characteristics among dust samples from different geographical sources, suggesting that local mineralogical differences play a crucial role in their optical behavior. In particular, while all mineral dust aerosol samples share the same generic optical features, their fine structure is markedly different. The slope and the location of the inflection points in the absorption coefficient plots are different across the samples, and can be determined with BLAnCA's high resolution and linked to the aerosol mineralogical composition and size distribution.

This work highlights BLAnCA's capabilities as a powerful tool to distinguish fine structures in the optical absorption of aerosol, which can then be linked to its composition in order to perform source identification and apportionment based solely on optical data.

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3AP.5

The Impact of Particle Size and Volatile Organics on the Light Absorption of Wildfire-like Brown Carbon Emissions from Wood Combustion. Constantinos Moularas, Irini Tsiodra, Nikolaos Mihalopoulos, Philip Demokritou, GEORGIOS A. KELESIDIS, *Delft University of Technology*

Here, the light absorption of brown carbon (BrC) emitted by wood combustion is elucidated using a recently developed thermal decomposition platform coupled with a suite of real-time aerosol instrumentation and time-integrated sampling systems. The BrC particle size distribution, morphology and optical properties are closely controlled by increasing the combusted wood mass from 50 to 600 mg, finding excellent agreement with those measured for “real world” wildfire particulate matter (PM) emissions. Size-fractionation of such wildfire-like BrC reveals that the $PM_{0.1\text{-}2.5}$ fraction contains high molecular weight, carcinogenic polycyclic aromatic hydrocarbons (PAHs) and absorbs up to five times more light compared to the $PM_{0.1}$ fraction. Thus, increasing the combusted wood mass from 50 to 600 mg increases the $PM_{0.1\text{-}2.5}$ concentration by a factor of about eight and enhances the overall BrC mass absorption cross-section, *MAC*, up to a factor of two. Condensation of volatile organic carbon (VOC) on BrC reduces its *MAC* up to 40 %. Still, the particle size seems to largely determine the BrC light absorption, as large VOC-rich particles absorb more light compared to small VOC-lean ones. The size-resolved BrC *MAC* measured here can be interfaced with climate models to estimate the climate impact of wildfire PM emissions.

3AP.6

Modeled and Observed Relationships Between Mass Absorption Cross Section (MAC) and Absorption Ångström Exponent (AAE). Marjan Savadkoohi, Aki Virkkula, Marco Pandolfi, Andrés Alastuey, PHILIP K. HOPKE, *Institute of Environmental Assessment and Water Research*

1. Introduction
Optical properties (MAC, SSA, and AAE) of BC particles coated with a light-scattering shell were calculated for unimodal size distributions (GMD range 50-500 nm, GSD 1.4, 1.6, 1.8, 2.0) for core volume fractions fc = 0.01 – 100% at the seven Aethalometer wavelengths. We present main results of those simulations and some comparisons with field measurement data.

2. Simulations
A significant correlation was observed between MAC and the AAE difference ΔAAE=AAE (470/950)-AAE (370/470). In a surface plot, they have their maxima and minima roughly at the same fc vs GMD "coordinates". The scatter plots of MAC vs ΔAAE show that they have approximately linear relationships.

3. Measurement data, MAC vs ΔAAE
The simulated relationships were compared with analogous relationships found from three European measurement sites, Barcelona, Athens, and Kosetice. April-July probably had significant biogenic oxidized organics forming a particle scattering coating. The vast majority of ΔAAE > 0, agreeing with the assumption that light scattering material coats the particles. December-February is a period when light-absorbing carbon (BC and BrC) particles emitted from heating are present. This source explains the large fraction of ΔAAE < 0 in the MAC vs ΔAAE scatter plots. In this period, there were no sharp increases in MAC values at ΔAAE > 0, likely due to coating of BC cores with light-absorbing material. In the simulations, the MAC peak was due to coating with non-absorbing material.

4. Conclusions
Comparison of the Mie-modeled MAC vs ΔAAE with the observations suggests that particles can be treated as particles when processing filter-based absorption photometer data, not just as uniform layers like paint on the filter. The observed MAC vs ΔAAE relationships may prove to be useful in developing accurate BC and BrC measurement methods, especially for Aethalometer data reprocessing. More laboratory experiments and model development are needed.

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3CE.1

Global and Regional Simulations of EPFR Concentrations From Biomass Burning and Anthropogenic Sources Using GEOS-Chem and Their Contribution to ROS Production in the Lung Lining Fluid. MEREDITH SCHERVISH, Pascale Lakey, Regina Luu, Manabu Shiraiwa, *University of California, Irvine*

Environmentally persistent free radicals (EPFRs) in PM have received growing attention for their potential toxicity as they are redox active to form reactive oxygen species (ROS). EPFRs are formed from incomplete combustion, including biomass burning and vehicle exhaust. Their long atmospheric lifetime implies that, in addition to local sources, long-range transport may impact local concentrations of EPFRs. Measurements of EPFRs in PM have been conducted across the globe with concentrations ranging from 10^{16}-10^{20} spins/g of PM and have been shown to vary with different emissions sources as well as meteorological conditions. In this work, we estimate EPFR concentrations across the globe using regional and global simulations of black carbon from GEOS-Chem. We utilize tight correlations between emission markers of biomass burning and vehicles and EPFR content in particulate matter. We reproduce measurements of EPFRs around the globe reasonably well and find that anthropogenic sources consistently contribute more to total EPFR concentrations in the investigated regions. Equivalent cigarettes smoked based on simulated EPFR concentrations reach up to 3.5 per day in the most polluted areas in China, while major cities in the US and Europe reach up to 0.75 per day. EPFR, iron, copper, and $PM_{2.5}$ concentrations are then used as inputs to the KM-SUB-ELF model to predict the production rates of ROS in the epithelial lining fluid (ELF). We find that the OH radical production from EPFR is similar in magnitude to the production from biogenic SOA suggesting that anthropogenic EPFRs contribute significantly to the health effects of PM.

3CE.2

Characterization of $PM_{2.5}$-Bound Carcinogenic PAHs and Their Emission Sources on the Western Coast of India. JAMSON MASIH, Lorraine Tellis, Sachin Gupta, *Chemistry Department, Wilson College*

Particulate matter ($PM_{2.5}$) and polycyclic aromatic hydrocarbons (PAHs) are critical components of air pollution due to their persistence in the atmosphere and harmful effects on human health. $PM_{2.5}$ can penetrate deep into the lungs, facilitating the transport of toxic compounds such as PAHs. These organic pollutants are mainly produced by incomplete combustion of fossil fuels and biomass and are known for their carcinogenic, mutagenic, and teratogenic properties. Monitoring their concentration and identifying emission sources is essential for risk assessment and pollution control. This study presents a comparative investigation of $PM_{2.5}$-bound PAHs in Mumbai, a densely populated urban center on the western coast of India. The study spans two periods 2018-2019 and 2022-2023. While the earlier study focused on six priority carcinogenic PAHs, the recent phase expanded the scope to include 22 PAHs, capturing both low and high molecular weight compounds. $PM_{2.5}$ concentrations during the study ranged from 66.29 to 182.15 μg/m³, exceeding safe exposure limits. The cumulative concentration of the 22 PAHs in the recent study was 48.36 ng/m³. Major contributors included fluoranthene (5.47 ng/m³), benzo(b)fluoranthene (4.26 ng/m³), indeno(1,2,3-cd)pyrene (3.14 ng/m³), and chrysene (2.71 ng/m³). Source apportionment using diagnostic ratios and principal component analysis indicated that vehicular emissions-particularly from gasoline and diesel combustion—remain the dominant source over both periods. BaP-equivalent toxicities showed that despite the broader PAH profile, a few key compounds contributed disproportionately to overall carcinogenicity. The expansion in PAH analysis from 6 to 22 compounds has allowed a more comprehensive understanding of air toxicology and trends in pollutant sources. The results highlight the ongoing need for stringent vehicular emission control and continuous PAH monitoring in urban coastal regions.

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3CE.3

Application of Aerosol Techniques to Measure Nanoscale Particles Leached from Plastic Infant Feeding Products. STEPHANIE JACOBY, Chun-Ning Mao, James Radney, Akua A. Asa-Awuku, *University of Maryland*

Microplastics (MPs; plastic particles 5 mm - 1 µm) and nanoplastics (NPs; < 1 µm) are emerging pollutants increasingly detected in diverse environments including the atmosphere, aquatic ecosystems, and the human body, posing significant environmental and health risks. Food-contact materials, including plastic infant feeding bottles, have been identified as sources of MPs and NPs, which leach during typical use conditions such as heating. While many studies have investigated MPs release, significant knowledge gaps remain for NPs due to analytical challenges. Traditional spectroscopic and mass-based methods are unable to measure sub-µm particles due to insufficient spatial resolution and mass concentrations below the detection limit. In contrast, aerosol-based techniques effectively measure the size distribution and number density of sub-µm particles, presenting an alternate method to measure NPs via atomization of material leached from macroplastics. Here we present aerosol-based measurements of the size distribution and water-uptake of nanoparticles released from polypropylene baby bottles and polyethylene bottle liners, using a single mobility particle sizer (SMPS) and continuous-flow streamwise thermal-gradient cloud condensation nuclei counter (CCNC). CCNC measurements are used to estimate hygroscopicity, which quantifies the propensity of a particle to absorb water. Importantly, hygroscopicity is strongly influenced by molecular size and can be used to estimate molecular weight of NPs using Flory-Huggins Köhler theory. This approach enables rapid characterization of leached NPs as oligomer or polymer, addressing a challenge in NP research. Oligomers and polymers have the same elemental composition but different chemical and physical properties, affecting their environmental fate and toxicity. By bridging atmospheric aerosol science with materials science, this work provides insight into metrology and techniques for measuring NPs. This approach can be broadly applied to other plastics, supporting a more holistic understanding of consumer products as sources of NPs.

3CE.4

Aerosol Mass Spectrometry Analysis of Common Nanoplastic Particles. LIN KONG, Michael A.R. Tawadrous, Alex K.Y. Lee, Man Nin Chan, Arthur W. H. Chan, *University of Toronto*

Nanoplastics (NPs) are increasingly recognized as emerging atmospheric contaminants. However, real-time quantification remains challenging due to the current lack of suitable online analytical techniques. While aerosol mass spectrometry (AMS) has demonstrated potential in detecting plastic aerosols, its application to NPs is limited by the absence of polymer-specific relative ionization efficiency (RIE) values and representative calibration standards. To address these limitations, we chemically synthesized atmospherically relevant NPs derived from five common polymer types, polypropylene (PP), low-density polyethylene (LDPE), polystyrene (PS), polyethylene terephthalate (PET), and polyvinyl chloride (PVC), via a top-down emulsified nanoprecipitation approach. This method yielded colloidally stable NPs (30–200 nm) that replicate key physicochemical features of ambient plastics, making them suitable surrogates for analytical development. They retained their polymeric structures, and their chemical integrity was confirmed by pyrolysis gas chromatography-mass spectrometry through identification of characteristic monomeric and oligomeric fragments. High-resolution mass spectra were obtained and the RIE for each polymer was quantified relative to ammonium nitrate. Significant variability in RIE values across different polymers underscores the necessity of polymer-specific calibration for accurate mass quantification. This study presents the first systematic AMS response dataset for atmospherically relevant NPs and establishes a quantitative framework for their identification and source apportionment in ambient aerosols. The use of validated surrogates for real-world NPs enhances the reliability and atmospheric relevance of AMS-based detection, supporting real-time quantification and improved integration into atmospheric transport and exposure models for plastic-derived aerosols.

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3CE.5

Remote Sensing of Microplastic Aerosols Using GRASP Open Spheroid Modeling. CAMILLE TEDDER, Alexandria Johnson, Gouri Prabhakar, Olga Kalashnikova, *Purdue University*

Environmental pollution by plastics has long been a reason for concern but recently atmospheric microplastics (AMPs) have emerged as a significant area of interest due to their widespread presence in even the most remote regions of the planet. With the increasing number of AMPs comes the need to detect these particles, differentiate them from natural aerosols like dust, and understand their spatial and temporal heterogeneity to help inform environmental, health, and safety policies and studies. Here we work towards an understanding of AMP optical properties to determine their detectability through remote sensing.

Using the GRASP Open Spheroid-package, we have modeled and compared the scattering and polarization properties of three commonly identified AMPs – polyvinyl chloride, polyester, and polystyrene – and four dusts from distinct regions – Beijing, Seoul, Tunisia, and Libya – over a range of wavelengths. Using randomly oriented, polydisperse spheroids provides a more realistic approximation of the optical properties. Additionally, our wavelengths of interest correspond to those used by the Multi-Angle Imager for Aerosols (MAIA), a joint NASA and the Italian Space Agency mission aimed at collecting data on atmospheric aerosol pollutants with a focus on urban areas. In this talk I will discuss how the complex refractive indices of these materials show distinct differences between the absorption of AMPs and dust particles which leads to predicted differences in the amount of forward (0° - 15°) and mid-angle (90° - 120°) scattered light and the degree of linear polarization at mid-angles between AMPs and dusts. While preliminary, this work indicates that remote detection of these particles at optical and near-IR wavelengths may be possible and further studies, including those focused on instrument sensitivity, are needed.

3CE.6

Characterizing the Atmospheric Oxidation and Cloud Condensation Nuclei Activity of the Polystyrene Nanoplastic Particles. SAHIR GAGAN, Alana Dodero, Miska Olin, Ruizhe Liu, Zezhen Cheng, Sining Niu, Janie (Yeaseul) Kim, Andrew Lambe, Yuzhi Chen, Swarup China, Yue Zhang, *Texas A&M University*

Nanoplastic particles (NPPs) are emerging anthropogenic pollutants identified from urban to remote areas. Characterizing the lifetime, fate, and cloud-forming potential of atmospheric NPPs improves understanding of their environmental processes and climate impacts. This study provides the first quantified heterogeneous reaction rate and lifetimes of polystyrene (PS) NPPs against common atmospheric oxidants. The atomized PS NPPs were introduced to a Potential Aerosol Mass (PAM) oxidation flow reactor with ·OH exposure of 0 to 1.5 x 10^{12} molecule cm^{-3} s, equivalent to atmospheric exposure from 0 to 18 days, assuming ambient ·OH concentration of 1 x 10^{6} cm^{-3}. The decay of the PS mass concentration was quantified by monitoring tracer ions, $C_6H_6^+$ (m/z 78) and $C_8H_8^+$ (m/z 104), using a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS). The pseudo-first-order rate constant of PS particles reacting with ·OH, k_{OH}, was determined to be (3.2 x 0.7) x 10^{-13} cm^3 $molecule^{-1}$ s^{-1}, equivalent to a half-lifetime of a few hours to ~80 days in the atmosphere, depending on particle sizes and hydroxyl radical concentrations. The hygroscopicity of 100 nm PS NPPs at different ·OH exposure levels was quantified using a cloud condensation nuclei counter (CCNC), showing a two-fold increase of hygroscopicity parameter upon 27 days of atmospheric photo-oxidation.

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3HR.1

Simultaneous Puff and Puff Associated Respiration Topography in the Natural Environment for Juul Ecig. RISA ROBINSON, Shehan Jayasekera, Edward Hensel, *Rochester Institute of Technology*

Background: Modeling particle deposition in the lung of inhaled tobacco product users requires knowledge of the aerosol particle concentration, particle size and flow conditions of the aerosol. Methods for measuring concentration and particle size of aerosols are well established. However, methods for measuring puff topography and puff associated respiration (PAR) topography, particularly in the natural environment are lacking. Tobacco product users inhale in two part pattern- puffing followed by deep inhalation of the puff mixed with clean air. Without an accurate account of the complex flow pattern the aerosol experiences while traveling through the in the respiratory tract, accurate particle deposition modeling is not possible.

Method: Participants were asked to use a Juul monitor with Juul Virginia Tobacco eliquid having either 3% or 5% nicotine content, whichever matched their usual nicotine level. Participants were monitored for 24 hours in their natural environment. The wPUM Juul topography monitor was used to capture the time, flow rate and duration of every puff taken. Simultaneously, a sensorized wearable garment was used to measure chest motion which was associated with each participants inhalation volume.

Results: We recruited 72 regular ecig users from the Rochester, NY area. Of these, n=64 participants completed the study and n=55 completed the data quality check for puff topography and 39 passed the quality check for puff and PAR topography. Results are reported for the resulting n=39 participants.

Mean (STD) puff associated inhalation volume was 104 (785). Mean (STD) puff topography parameters were 30 (7) mL/s flow rate, 3.5 (1) sec duration, and 104 (6) puff volume.

Conclusions: This study demonstrated successful simultaneous capture of puff and puff associated respiration in the natural environment. Data should be used as in put to lung deposition models to accurately determine the deposition efficiency.

3HR.2

Effects of Power and E-Liquid Constituents on Secondhand Electronic Cigarette Emissions. SARAH FRESQUEZ, Gabriela Gabriela, Emma Piner, Talia Chavis, Sinan Sousan, *Department of Public Health, East Carolina University*

Electronic cigarette (ECIG) aerosol emissions contain $PM_{2.5}$ particles with diameters of 2.5 micrometers or less that can pose significant health risks upon inhalation. Users can increase aerosol emissions, or “clouds,” by adjusting the power output of their devices. Additionally, they can tailor the vaping experience by modifying e-liquid characteristics such as flavor, nicotine type (freebase or salt), nicotine concentration, and the ratio of propylene glycol (PG) to vegetable glycerin (VG). Measuring particulate matter (PM) mass concentrations using “gold standard” air monitoring techniques involves expensive and time-consuming processes. These include calculating time-weighted averages from discrete filter samples, which are used to develop filter correction factors for commercially available real-time monitors. These correction factors are essential to address the overestimations and underestimations of PM concentrations commonly observed in real-time data. This study investigates how varying ECIG device power settings and e-liquid features affect $PM_{2.5}$ filter correction factors, mass concentrations, and aerosol size distributions. Experiments were conducted in a controlled laboratory chamber during 30-minute sessions. Two sets of conditions were tested: the first involved four e-liquid flavors at five different wattage settings, and the second compared freebase and salt nicotine e-liquids across the same wattages. Filter correction factors ranged from 9.08 to 15.25 for the combined Scanning Mobility Particle Spectrometer and Aerodynamic Particle Sizer monitors, and from 0.36 to 0.53 for the personal DataRam (pDR-1500). These values revealed both over- and underestimations in real-time $PM_{2.5}$ measurements. Mass concentrations reached up to 60,000 $\mu g/m^3$, and particle sizes ranged from 0.10 to 2.52 µm. The elevated $PM_{2.5}$ levels in secondhand ECIG emissions suggest an even greater risk for firsthand users. These findings emphasize the importance of accurate monitoring and regulation of ECIG aerosol emissions to protect public health.

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3HR.3

Formation of Tobacco-Specific Nitrosamines from the Atmospheric Aging of Nicotine. WONSIK WOO, Linhui Tian, Ying-Hsuan Lin, *University of California, Riverside*

Secondhand vaping aerosols are a source of environmental nicotine, which can undergo changes in its chemical composition due to aging by atmospheric oxidants and gas-particle partitioning. In places with the greatest amount of nicotine emissions, there tends to also be an abundance of ground-level atmospheric oxidants such as O_3 and NOx due to high anthropogenic activity and pollution in urban areas. Having NOx as potential nitrosating agents brings forward the possibility for nicotine to undergo chemical transformation in the atmosphere and form tobacco-specific nitrosamines (TSNAs). This study aims to simulate the atmospheric aging process of nicotine-containing vaping emissions and monitor the formation of TSNAs during this process using mass spectrometry, and assess the genotoxic potential of these aged aerosols via in vitro exposures. Our observations indicated that fresh vaping emissions contained minimal amounts of NNN (N'-nitrosonornicotine) and NNK (4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone) in the particle phase. In contrast, O_3-mediated and NOx-mediated aging induced significant generation of both TSNAs. NO_2 showed the greatest ability to produce NNN during the 3-hour aging process, while NNK is the predominant TSNA produced during O_3-mediated aging. BEAS-2B cells will be exposed to both fresh and aged e-cigarette aerosols to determine if the aging process has significant effects on their genotoxicity. Altered expressions of the DNA repair enzymes, MGMT and AAG, will be monitored with qPCR, and the abundance of nuclear DNA damage will be determined with the qPCR-based, LORD-Q assay for the quantification of lesion frequency. This work suggests that the atmospheric oxidation and aging of nicotine produce known carcinogens, highlighting a significant area of concern. The expected results will provide scientific evidence that will aid in bringing awareness to this topic in the hope that future work will be performed to study the chemical and toxicological complexity of aged secondhand tobacco products.

3HR.4

Development and Application of a Novel Aerosol Respiratory Deposition Method to Assess Health Risks of Metals in E-Cigarette Aerosol. WEI-CHUNG SU, Jinho Lee, *University of Texas Health Science Center at Houston*

This study improved the performance of the Mobile Aerosol Lung Deposition Apparatus (MALDA) and utilized it to investigate the respiratory deposited mass of e-cigarette aerosol. The enhanced MALDA broadens its applicability in aerosol respiratory deposition studies by covering a wider particle size range, from nanometers to micrometers, making it ideal for various aerosol exposure research. By integrating MALDA with the Micro-Orifice Uniform Deposit Impactor (MOUDI), the resulting MALDA-MOUDI tandem system enables an effective estimation of the size-dependent deposited mass of inhaled aerosol in major airway regions, providing crucial data for assessing health risks caused by aerosol exposure. To study e-cigarette aerosol respiratory deposition using the MALDA-MOUDI tandem system, a series of laboratory experiments were conducted to obtain the deposited mass of e-cigarette aerosol in human airways. Three different types of e-cigarettes (JUUL, disposable, and IQOS) were used to generate test e-cigarette aerosol. Respiratory deposition experiments were carried out under both active (mainstream) and passive (secondhand) vaping conditions. Metal-induced health risks were systematically evaluated based on the measured respiratory deposited mass according to presumed active and passive vaping scenarios. The acquired results indicated that non-cancer and cancer risks associated with metals released from the tested e-cigarettes fell within acceptable levels for both active and passive vaping. The MALDA-MOUDI approach developed in this study can be applied to other environmental and occupational aerosol exposure research to assess health risks associated with toxic substances present in the aerosol particles.

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3HR.5

A Comprehensive Approach for Detecting and Locating Black Carbon in Human Placentae. DENISE IVEY, Amanda Sanko, Barbara Tisdale, Philip Katzman, Thomas O'Connor, Kaye Thomas, Tanzy Love, Rogelio Perez-D'Gregorio, Carolyn Salafia, Ronald Wood, Atsuo Chiu, Richard Miller, Philip K. Hopke, *University of Rochester School of Medicine and Dentistry*

Molecular passage across the placenta generally serves developmental purposes, but some also can induce harm. Particulate matter affects the pregnancy through the maternal circulation to the placenta. Black Carbon (BC) particles produced by fuel combustion contributes to global air pollution and climate change. Their health impacts likely extend beyond respiratory complications. Thus, studying BC translocation into human tissues provides insights into the mechanisms of observed adverse outcomes. The human placenta is a useful tissue since it provides further understanding of placental transport mechanisms, impacts on the organ and embryo/fetus, and for developing prevention strategies. Having well measured tissue dose metrics provides an epidemiological tool to relate exposures to a variety of health outcomes in the woman, fetus, and resulting child. A microscopy methodology for quantifying BC particles in human placental histology slides utilizing multiphoton microscopy has been developed. A two-photon Olympus FVMPE-RS microscope with an 810 nm laser excitation and four bandpass emission channels with fixed voltage and distinct bandpass filters: 370-410, 425-465, 575-630, and 645-685 nm was used to examine 5 µm thick tissue slides of formalin-fixed placental material. Small (≤300 nm diameter) objects that emitted light observed in all 4 channels were deemed BC. 3-D models were used to ensure that the spots were not above the sample. Artifacts due to formalin precipitation and tissue staining were excluded by using unstained tissue and the multichannel criterion. Using 25 placentae with 4 blocks examined for each placenta and 15 fields per block, the BC counts per field were estimated with a precision of ±0.2. BC densities ranged from 2.9 ± 3.1 x 103 to 2.5 ± 1.4 x 104 mm-3, with a standard error of 2.7 ± 1.4 x103 mm-3. Concentrations declined from maternal blood to fetal tissue to fetal blood. Environmental tissue doses are being measured.

3HR.6

A High-throughput Lung Air-blood Barrier Assay for Aerosol Toxicity Evaluation. SEONGBIN JO, Liang-Hsin Chen, Shuichi Takayama, Nga Lee Ng, *Georgia Institute of Technology*

The development of new approach methodologies (NAMs) for inhalation toxicity testing is critical to address the ethical concerns and species-specific limitations associated with in vivo studies. However, current in vitro models often lack the physiological complexity or throughput necessary for comprehensive toxicity evaluation. To address this gap, we developed a high-throughput air-blood barrier array (ABBA) model incorporating lung epithelial (NCI-H441) and endothelial (HUVEC) cells under an air-liquid interface (ALI) condition to assess aerosol-induced lung injury and inflammation. To further enhance physiological relevance, human macrophage cells (differentiated THP-1 cells) were incorporated into the system to model the cytokine secretion as immune responses following destruction in barrier integrity. We demonstrated the capability of this novel platform through investigating the toxicity of secondary organic aerosols (SOA) derived from naphthalene and α-pinene, two representative precursors of anthropogenic and biogenic emissions. These SOA were generated under controlled atmospheric chamber conditions and have been intensively characterized for their cellular toxicity using murine macrophage models in 96-well formats in our previous studies. Building upon this foundation, the ABBA model was applied to evaluate how these SOA perturb the air-blood barrier integrity and induce inflammatory responses at the epithelial-endothelial interface in dose-response manners.

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3IM.1

Bridging the Gap Between Single-Particle Measurements and Aerosol Models With SPIN-Sim. KYUHAENG LEE, Maria A. Zawadowicz, Xiaoli Shen, Daniel Cziczo, Arthur J. Sedlacek, Matthew West, Nicole Riemer, *University of Illinois at Urbana-Champaign*

Aerosol mixing state, the distribution of chemical species across individual aerosol particles, is crucial for quantifying aerosol optical, chemical, and microphysical properties. For example, a particle's absorptivity depends on whether light-absorbing components such as black carbon are externally or internally mixed with other species. Accurately representing this compositional complexity in aerosol models is essential, but direct comparisons between particle-resolved simulations and composition-resolved measurements (e.g., single-particle mass spectrometer) remain challenging. While particle-resolved Monte Carlo aerosol models such as PartMC track the mass of individual species per particle, single-particle mass spectrometers report ion signals as a function of mass-to-charge ratios. These signals do not scale linearly with species mass, making it challenging to infer per-particle composition directly. To bridge this gap, we introduce SPIN-sim (Single Particle Instrument Simulator), a framework that converts mass spectrometer measurements into model-comparable outputs. Using Non-negative Matrix Factorization (NMF), SPIN-sim decomposes measured mass spectra to estimate the fractional contribution of individual species within mixed particles. Tests on synthetic mixtures demonstrate that SPIN-sim can reconstruct species fractions with errors below 5% for most particles. Ongoing work focuses on extending this approach to laboratory data, including calibration for instrument-specific response. By enabling a quantitative mapping between single-particle measurements and particle-resolved model outputs, SPIN-sim provides a new pathway for validating mixing state representation in aerosol models and advancing model-measurement integration in aerosol science.

3IM.2

Online Water-to-Air Ammonia and Amine Flux Measurement System using Chemical Ionization Mass Spectrometry. CHRISTINE TROLLER, Coty Jen, *Carnegie Mellon University*

Ammonia (NH_3) and alkylamines play critical roles in atmospheric aerosol chemistry, influencing cloud formation, Earth's radiative balance, and air quality. Despite significant contributions from water-based sources, associated emissions of ammonia and alkylamines remain poorly characterized, especially in freshwater environments. Here, we present a novel flux measurement system (FMS) coupled with a hydronium chemical ionization mass spectrometer (CIMS) for real-time quantification of ammonia and alkylamine (i.e., methylamine, dimethylamine, and trimethylamine) fluxes from water samples up to 16 liters in volume. The FMS CIMS system overcomes challenges associated with the high polarity of these compounds, allowing for online gas-phase measurements with minimal sampling loss. We validate the system using model solutions under varying operational conditions and characterize the fluid dynamics within the FMS. Flux experiments were conducted using aqueous solutions with total liquid concentrations of ammonia and alkylamines ranging from 10^{-5} to 10^{-9} M, carrier gas varying from 2.9 to 29 cm min^{-1}, and model solution volumes of 8 and 16 liters, to assess how these parameters influenced flux. We compare measured fluxes to theoretical fluxes predicted by Henry's Law, which best represents the conditions inside the FMS. The FMS was also used to evaluate ammonia and amine contamination in reverse osmosis water. Our findings demonstrate that the FMS CIMS can reliably capture water-to-air fluxes of ammonia and alkylamines, filling a crucial gap in understanding aquatic contributions to atmospheric nitrogen chemistry. This system provides a useful new tool for investigating gaseous fluxes in aquatic systems, with important implications for atmospheric modeling and environmental health assessments.

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3IM.3

Re-Analysis of Long-Term Aerosol Mass Spectrometer Data: Homogenizing 13 Years of Measurements. JULIETTE BROCHET, Hasna Chebaicheb, Yunjiang Zhang, Laura Cadeo, Valerie Gros, Philip Croteau, Olivier Favez, Jean-Eudes Petit, *LSCE*

Since the early 2010s, the implementation of Aerosol Chemical Speciation Monitors (ACSM, Ng et al., 2011) has provided valuable information on the nature and temporal variability of non-refractory submicron aerosols worldwide. This led to the emergence of a growing number of long-term datasets, introducing new challenges in data treatment strategies. Indeed, such datasets often result from the juxtaposition of separate data processing periods, associated with the evolution of quality assurance/control guidelines and measurement procedures, which may lead to heterogeneous subsets and prevent a robust and relevant analysis of long-term features. Here, we present a re-analysis of the longest ACSM datasets worldwide from the SIRTA facility, located in the Paris region.

We will present and discuss the developed strategy towards homogeneous data processing, also considering the challenges related to long-term measurements. We highlight first the utmost importance of re-evaluating (relative) ion efficiency calibration values, as they directly impact concentrations, and discuss how to take their variability into account. Further data processing steps (m/z calibration, airbeam correction, ion transmission) will be discussed. Additionally, we present a long-term evaluation of the composition-dependent collection efficiency (CDCE) and discuss the interest and relevance of updating the parametrisation originally proposed by Middlebrook et al. (2011) regarding improved mass closure.

The impacts of this re-analysis are presented through a Mann-Kendall trend test (Collaud Coen et al., 2020), where results (both statistical significance and slope) are directly linked to the homogeneity of the dataset.

3IM.4

Bipolar FUSION PTR-TOF Mass Spectrometer: Advantages of Multiple Reagent Ions to Characterize Oxidation and Secondary Organic Aerosol Formation. TOBIAS REINECKE, Markus Leiminger, Andreas Klinger, Todd Rogers, Martin Graus, Markus Mueller, *IONICON Analytik GmbH., Innsbruck, Austria*

Proton-transfer-reaction mass-spectrometry (PTR-MS) is a well-established technique for the characterization of secondary organic aerosols and its precursors. More advanced instruments like the FUSION PTR-TOF feature positive selective reagent ions like H_3O^+ for quantitative measurements of the widest range of organic compounds or NH_4^+ for soft adduct ionization enabling the detection of highly oxidized compounds. Complemented by NO^+ and O_2^+ ionization modes, this instrument covers the detection of the vast majority of organic and inorganic compounds. However, measurements of certain inorganic compounds including small inorganic acids and organic acids are still challenging. Recently, the FUSION PTR-TOF was upgraded with bipolar electronics, enabling operation in negative ion mode using negative reagent ions like CO_3^- which provides enhanced selectivity for acids and volatile inorganic compounds, including SO_2, HNO_3, H_2SO_4, and halogen compounds.

Based on a limonene oxidation study in the IONICON laminar flow oxidation reactor (ILOx) the complementary ionization modes of the Bipolar FUSION PTR-TOF are studied. Limonene and its volatile oxidation products were monitored in real-time while quickly cycling through the ionization modes. H_3O^+ provides quantitative data, NH_4^+ allows for fragmentation free ionization of oxidized organics and CO_3^- proves to be highly selective to the formed acids, effectively capturing products like limononic acid with virtually no fragmentation.

Additionally, the particle phase was measured with a CHARON particle inlet, providing a detailed picture of the generated particulate SOA on a chemical composition level. Besides quantitative measurements using H_3O^+, soft NH_4^+ adduct ionization enables detection of compounds up to the trimer section with volume mixing ratios of only single digit ppqV, corresponding to mass concentrations < 20 pg/m^3.

For the presentation, we will show data from sequentially ionizing with H_3O^+, NH_4^+, O_2^+, and CO_3^- primary reagent ion modes for both chamber and ambient measurements, highlighting the benefits and limitations of complementary ionization modes.

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3IM.5

Exploring Ionization Mechanisms and Accelerated Chemical Reactivity with Droplet Assisted Ionization-Mass Spectrometry. BRYAN R. BZDEK, Joshua Harrison, Edward Neal, Jim Walker, *University of Bristol*

Aerosol droplets are unique microcompartments containing microscopic amounts of material and exhibiting surprising reactivity relative to macroscopic systems. Many approaches for online molecular analysis of aerosols and droplets require a separate ionization stage (e.g. extractive electrospray, chemical ionization) before introducing the sample to the mass spectrometer (MS). A separate ionization stage can have drawbacks, as the ionization step can extend over relatively long times (seconds), potentially reducing sensitivity by spreading signal intensity over time or introducing artifacts (e.g. undesirable reactions) that complicate measurement interpretation. Droplet assisted ionization (DAI) is a novel inlet ionization approach that overcomes these drawbacks. In DAI, particles are grown hygroscopically to micron-sized liquid droplets immediately before being sampled into the MS inlet. Within the inlet, rapid (micro- to millisecond timescale) aerodynamic or thermal droplet breakup generates charge that ionizes the analyte molecules within the droplet. In this presentation, the role of the solvent matrix in controlling ionization in DAI will be described. Ion yields are highly correlated with particle phase and relative humidity (which controls droplet water content). These effects are easily controlled by standardizing the relative humidity around the aerosol plume immediately before sampling into the MS. The DAI ionization efficiency for plumes of submicron aerosol will be compared against complementary measurements made on individual levitated droplets in an electrodynamic balance, enabling a comprehensive understanding of the ionization mechanism across multiple orders-of-magnitude in droplet size and water content. Experiments on biomolecules suggest that molecular structure is preserved upon MS analysis due to the charge-limited nature of ionization. Lastly, an esterification reaction observed to occur orders-of-magnitude faster in aerosol than in macroscopic solution is studied using DAI, elucidating the underlying mechanism for reaction acceleration. Combined, these results demonstrate the unique capabilities of this novel approach to aerosol chemical analysis.

3IM.6

Rapid In-Situ Detection of Aerosolized Chemicals of Interest by Single Particle Mass Spectrometry. SCHUYLER LOCKWOOD, Alla Zelenyuk, *Pacific Northwest National Laboratory*

The PNNL single particle mass spectrometer, miniSPLAT, is currently employed as a “ground truth” instrument for detection of chemical species in aerosols as part of the testing and evaluation efforts for IARPA’s PICARD program. The goal of the program is to develop fieldable sensors that can detect and rapidly identify aerosol particles of interest in challenging environments. In this work, miniSPLAT was used to acquire single particle mass spectra of laboratory generated aerosols that represent model systems for different target materials, including chemical warfare agents, pharmaceutical based agents, such as fentanyl analogs, toxic industrial materials, environmental pollutants, explosives, and radioactive materials.

In most cases, target materials were introduced in the presence of background aerosol particles or “clutter”, resulting in the rapid increase in particle number concentrations above the background level, along with the appearance of particles with different shapes, sizes, and mass spectra compared to those of the background aerosol.

Custom single particle analysis software was used to classify particles with different mass spectra into different classes, making it possible to detect and identify particles composed of the target material within a couple of minutes, in both clean air and varied ambient background environments. Additionally, we discuss the observed particle-to-particle variations in mass spectral fragmentation patterns, which are inherent to the laser ablation ionization process.

We will demonstrate the utility of custom software to easily identify particles of interest based on single particle mass spectra with high abundance of the target parent ion peak and compare these mass spectra to those obtained by other ionization methods such as electron impact ionization of volatilized aerosols.

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3UA.1

Spatial Heterogeneity in Urban Heat and $PM_{2.5}$ Co-variation: A Multi-site Sensor Study in Pittsburgh. TZUCHI LIN, Albert Presto, *Carnegie Mellon University*

Although urban heat islands (UHIs) and urban pollution islands (UPIs) often spatially coincide, their underlying drivers can vary substantially across urban subregions and may also influence each other. This study explores spatial heterogeneity in the co-variation of $PM_{2.5}$ and meteorological factors using multi-year, multi-site data from a network of low-cost sensors (RAMPs) deployed across Pittsburgh. The sensor data are supplemented by $PM_{2.5}$ composition and size distribution data from a central monitoring site. Focusing on temperature and relative humidity as key atmospheric drivers, we examine how $PM_{2.5}$ and gas-phase pollutants such as CO and NO_2, which serve as proxies for emission activity and background accumulation, vary under different diurnal and seasonal conditions. Rather than assuming uniform responses to meteorology, we apply machine learning models to characterize spatial variability and use explainable techniques to assess the relative contribution and interaction of drivers under varying conditions. This helps clarify whether $PM_{2.5}$ increases are more strongly influenced by thermodynamic partitioning, precursor accumulation, or local emission patterns. Despite similar meteorological settings, subregional differences in $PM_{2.5}$ behavior are evident, highlighting the interplay between emissions, atmospheric dynamics, and urban form. These findings emphasize the need for spatially resolved approaches to understand UHI and UPI interactions and to inform targeted mitigation strategies.

3UA.2

Evaluating Fine-Scale Air Quality Heterogeneity Using a Low-Cost Multi-pollutant Sensor Network in Twin Cities, Minnesota. Varuni Abhayaratne, WEIXING HAO, Anjana Yatawara, Philip K. Hopke, Jiayu Li, Yang Wang, *University of Miami*

There is growing interest and effort in deploying low-cost air quality sensors to understand fine-scale spatiotemporal heterogeneity of ambient air pollutants in urban areas. The Assessing Urban Air Quality project conducted by the Minnesota Pollution Control Agency deployed 45 low-cost air quality monitors (AQMesh, Environmental Instruments Ltd.) in a Minneapolis-St. Paul metropolitan area network. Hourly averaged pollutant concentrations or mixing ratios for CO, O_3, NO_2, NO, and SO_2 and particulate matter (PM) (PM_1, $PM_{2.5}$, and PM_{10}) were obtained. The network data from June 2019 to June 2021 were analyzed for temporal air quality variations related to traffic patterns and atmospheric chemistry. Compared to the PM concentrations, gaseous pollutant (CO, NO_2, O_3, and SO_2) mixing ratios among the different sites showed higher correlations (with pairwise Pearson r2 values above 0.6). However, pairwise coefficients of divergence (COD) show higher spatial heterogeneity for O_3 and NO_2, with COD values above 0.2. The conditional bivariate probability function coupling the sensor and wind data can partly explain the fine-scale heterogeneity. There was little to no correlation between pollutant concentration/mixing ratio and census-based income or site groups in different redlining areas. This study demonstrates the capability of a multi-year, dense network of low-cost sensors to provide high-resolution spatiotemporal data with desirable performance.

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3UA.3

Spatiotemporal Variation in Ambient Particulate Metal Concentrations from Heavy Firework Activity in the Los Angeles Area Associated with the Independence Day Holiday: Initial Analysis of Filter Samples and ASCENT Data. DANIEL B. CURTIS, Zeinab Khalil, Tyler Deflin, Haroula D. Baliaka, Ryan Ward, John Seinfeld, Richard Flagan, Bradley Ries, Yumeng Cui, Roya Bahreini, Eleanor Bentley, Lelia Hawkins, Nga Lee Ng, Ann M. Dillner, Armistead G. Russell, *California State University, Fullerton*

The July 4 Independence Day holiday is one of the worst air quality days of the year in the greater Los Angeles region due to extreme, albeit short-lived, particulate emissions from public and private use of fireworks, potentially impacting public health. Fireworks aerosol particles are especially concerning because they are known to contain certain heavy metals used as colorants or oxidants. To better understand the spatiotemporal variation in metal concentrations, ambient particulate samples were collected in the time period around July 4, 2024 at Fullerton and Downey, California. Filter samples were collected using portable samplers (AST UPAS v2+) and subsequently digested and analyzed in the laboratory using ICP-Optical Emission Spectroscopy (Agilent 4800). Metal concentrations (Xact EDXRF, SailBri Cooper, Inc.) from the ASCENT (the Atmospheric Science and Chemistry mEasurement NeTwork) sites located in Pico Rivera, Rubidoux, and Joshua Tree National Park were also analyzed. There was generally good agreement in metal concentrations from the filter samples and ASCENT data. Large increases in ambient concentrations were observed for known fireworks tracers, such as barium, strontium, aluminum, and copper for both the filter and ASCENT measurements. Additionally, increases in concentrations of potentially harmful metals such as chromium, lead, and arsenic were small but measurable. The filter samples indicated relatively high concentrations of zinc and calcium, while the ASCENT site at Pico Rivera did not. Potential reasons for discrepancies, such as freeway emissions, will be discussed. Preliminary analysis of the ASCENT data from the three sites indicates that the particle plume from the Los Angeles Basin may have been transported to the Rubidoux and Joshua Tree National Park sites, located approximately 80 km and 180 km east of downtown Los Angeles, respectively.

3UA.4

Elevated Aerosol and VOC Concentrations in Imperial Beach, California, Associated with Sewage Discharges to the Tijuana River and Ocean. LEA EL KHOURY, Shihao Zhai, Katarina Konon, Daniel Sung, Chou-Hsien Lin, Evelyn Deveraux, Kimberly Prather, Pawel K. Misztal, Lea Hildebrandt Ruiz, *University of Texas at Austin*

Imperial Beach, California, a coastal city near the U.S.-Mexico border, is frequently impacted by sewage discharges from the Tijuana River. Residents have reported respiratory and other health problems that appear to be associated with this pollution; yet, airborne emissions and air quality impacts are poorly characterized. Here we present our work from an ambient measurement campaign conducted in September 2024 in Imperial Beach (IB), California. Volatile organic compounds (VOCs) and non-refractory particulate matter (NR-PM) were measured using an electric mobile van equipped with a Vocus 2R Proton-Transfer-Reaction Time-of-Flight Mass Spectrometer (Vocus PTR-TOF-MS) and High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS). Stationary and mobile measurements were conducted during different times of the day. We observed episodic high aerosol concentrations with a maximum NR-PM_1 (particulate matter with a diameter ≤1 μm) concentration of 100 μg m^{-3}. During the highest concentration period, the organic aerosol composed 90% of NR-PM_1, and the wind direction was from the south, downwind of the Tijuana River (TR). PM has several sources in this area, including sea spray aerosol, cross-border sewage pollution, vehicle and other urban emissions, and we use positive matrix factorization to separate these sources. Consistently, VOC magnitudes and compositions differed between various odorous plumes downwind of the TR and IB hotspots which are comprehensively analyzed in terms of aerosol precursors, odor activity, and toxicity. Overall, our results highlight that airborne pollutants originating from sewage discharge substantially impact air quality in Imperial Beach.

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3UA.5

Episodic Air Pollution and Environmental Pressures from Industrialization in Qaragandy City, Central Kazakhstan.

GULDEN ORMANOVA, Philip K. Hopke, Fatma Ozturk, Alexey Alexeyev, Yertay Otarov, Nurxat Nuraje, Gulzat Demeuova, *Renewable Energy Lab, National Lab Astana, Nazarbayev Univ.*

Since attaining independence following the post-Soviet era, Kazakhstan has experienced fast industrialization, making it one of the most polluted countries with high concentrations of air pollutants.

Qaragandy, a major industrial hub in Central Kazakhstan, is located adjacent to one of the world's largest coal basins, producing approximately 33–35 million tons annually. In addition to coal mining, the region hosts large-scale operations for the extraction of copper and polymetallic ores, heavy engineering industries, and Kazakhstan's largest steelmaking enterprise in nearby Temirtau. In 2024, atmospheric monitoring in Qaragandy was conducted using three automated stations that tracked $PM_{2.5}$, PM_{10}, SO_2, CO, NO, NO_2, H_2S, and HCHO. A total of 585 thousand tons of pollutants were emitted from 332 stationary sources, with additional contributions from coal-fired stoves, autonomous boilers, motor vehicles, the burning of coal in private households during the cold season and long-term combustion systems. The city experienced 106 days of stagnant weather and accumulation of pollutants, with episodes forming over several days. Episodic observations revealed cases of severe pollution, in particular, observations at station No. 8 confirmed cases of critical pollution during the heating season (especially in December and January), indicating 8 cases of high pollution for PM_{10} (10.4–14.2 MPC) and 190 cases for $PM_{2.5}$ (10.0–26.6 MPC), registered as episodes of extremely high pollution.

Currently, the air quality in Kazakhstan's cities does not meet World Health Organization (WHO) guidelines, since the recommendations of WHO and Kazakhstan on air quality differ, Kazakhstan utilizes antiquated one-time Maximum Permissible Concentration (MPC), which has a detrimental effect on the health of the population.

This study emphasizes the critical need for scientifically grounded air quality research, increased monitoring infrastructure, and transparent reporting. Addressing these gaps is essential for developing effective mitigation strategies that safeguard the environment and public health in Kazakhstan's industrial heartland.

3UA.6

Urban Aerosol Properties Measured in Southeast Asian During the 2024 NASA ASIA-AQ Flight Campaign.

SAYANTEE ROY, Francesca Gallo, Carolyn Jordan, Edward Winstead, Elizabeth Wiggins, Michael Shook, Raphael Maerkl, Guy Symonds, Dongwook Kim, Seonsik Yun, Douglas A. Day, Pedro Campuzano-Jost, Jose-Luis Jimenez, Luke Ziemba, Richard Moore, *NASA Langley Research Center*

NASA conducted the Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) flight campaign in early 2024, leveraging a multi-perspective approach that integrates aircraft, satellite, and ground-based data. It covered four countries, Philippines, South Korea, Thailand, and Taiwan. The NASA DC-8 aircraft was deployed to make in-situ measurements of a wide suite of gas and particle parameters close to the pollution emissions in these locations. Our group, the Langley Aerosol Research Group (LARGE), provided real-time measurements of aerosol microphysical and optical properties, and meteorological parameters. In this work, we focus on a comparative analysis of aerosol microphysical and optical properties over three different megacities – Manila, Seoul and Bangkok. These cities represent diverse environmental conditions, influenced by different emission sources, boundary layer dynamics, and topography. Particle number size distributions and optical properties were examined to identify the contributions of scattering and absorbing aerosols and to infer dominant source types. By analyzing vertical and horizontal profiles of aerosols alongside meteorological data, we assess the influence of local processes and regional transport on urban air quality. Key discussions will underscore substantial spatial variability in aerosols properties, contribution of absorbing and scattering aerosols, role of boundary layer dynamics, and evidence of regional pollution transport within the ASIA-AQ domain.

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4JS.1

Caroline Frischmon, Ph.D. Candidate in Mechanical Engineering, seeking postdoctoral research position.

CAROLINE FRISCHMON, *University of Colorado Boulder*

I am a Ph.D. candidate at the University of Colorado Boulder seeking a postdoctoral research position to begin in spring/fall of 2026. As a graduate researcher in the Hannigan Air Quality Lab, I have developed expertise in the following areas related to air monitoring using multi-pollutant, low-cost sensors:

Source apportionment: Measuring multiple pollutants, including PM, VOCs, methane, NOx, and CO, makes it possible to conduct source apportionment analysis with low-cost sensor data. I leverage the known relationships between these pollutants and relevant emissions sources to parse out the likely contributors. I also use bivariate polar plotting and wavelet decomposition to explore the spatial and temporal trends of the likely emissions sources.

Sensor calibration: Low-cost sensor calibration is challenging, especially over long-term use. To improve the accuracy and reliability of sensors in a multi-year deployment, I performed a two-step colocation approach that better addresses sensor drift. I also implemented a framework for evaluating the performance of machine learning calibration models and explored data weighting approaches to improve sensor prediction of peak concentrations.

Community-based participatory research: In my Mississippi-based research, I worked closely with impacted community members to design and deploy an air monitoring network, interpret data collaboratively, and use results to support community advocacy. Our community partner has seen increased involvement in their organization following our study, highlighting the benefits of community participation in research activities.

An ideal position would enable me to continue collaborating with impacted communities to advance new applications of low-cost sensing, while also expanding my expertise into complementary research areas such as exposure assessment, indoor air quality, and community-scale modeling.

4JS.2

Tristalee Mangin, Project Manager and PhD Candidate at the University of Utah Chemical Engineering Department, Looking for Post-Doctoral or National Laboratory Position.

TRISTALEE MANGIN, *University of Utah*

I am seeking a postdoctoral or national laboratory position, available fall of 2025. I am looking to enhance my skills in modeling and simulations, remote sensing, and the overlap of these tools with measurements from sensor networks. I am especially interested in developing my ability to write funding proposals, having successfully secured $8,645 in research funding through the University of Utah during my Ph.D, along with smaller travel grants.

My research has focused on air quality, environmental sensing, and data science. I managed a network of 100+ low-cost air quality sensors deployed across Utah (schools, childcare centers, residential), including a team of two staff and four students. I also led a study on how pollution events (e.g., wildfire smoke, inversions, dust storms) affect indoor particulate matter concentrations in commercial buildings. The study found that wildfire smoke infiltration was three times greater in buildings with HVAC systems using air-side economizers than those without.

Additionally, I designed and deployed a novel system to mitigate discretionary idling that provided dynamic feedback about idling status and a persuasive message to drivers on large outdoor displays. The system integrates audio and video feeds into a machine-learning algorithm to detect vehicle idling status and a network of low-cost sensors to measure air quality impacts. Installed at a hospital drop-off zone, the system reduced CO_2 emissions by 30% compared to static signage.

I also have strong teaching experience. I served as a TA for the process control course (90+ students), where I transitioned support sessions online during the COVID-19 pandemic. Throughout my PhD, I have mentored 12 students in undergraduate research and two high school students in summer programs. Before graduate school, I served in the U.S. Navy, teaching four courses and leading two divisions at the Nuclear Power School, graduating 200+ students into advanced training.

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4JS.3

Sudheer Salana, Postdoc at the University of Miami, Seeking Positions in R&D Institutions, and Faculty Jobs. SUDHEER SALANA, *University of Miami*

I am Dr. Sudheer Salana, and I am currently a postdoc, working with Prof. Chang-Yu Wu at University of Miami (UM). I have a PhD in Environmental Engineering from the University of Illinois Urbana-Champaign (UIUC) where I worked with Dr. Vishal Verma. The overarching goal of my research is to devise holistic approaches to assess the health impacts of particulate matter (PM). In my current role at UM, I investigate the transmission of bioaerosols, development of novel instruments for aerosol capture and toxicity analysis, and the assessment of toxicity of microbes found in indoor air such as fungal spores. My research employs a multidisciplinary approach, combining novel bioaerosol sampling techniques, microbiological analysis, and lung cell-based toxicological methods. During my Ph.D. at UIUC, I worked on evaluating various metrics, such as total PM mass, lung cell-based toxicity, and oxidative potential (OP) measurements, that could be used to quantify the health effects of PM. Additionally, through a combination of lung cell-based and cell-free toxicity measurements, I investigated how our current approach to evaluating PM toxicity may be improved. I also have teaching experience which includes Teaching Assistantship (TA) for different undergrad and graduate-level courses. I was ranked as an excellent teacher for one of these courses at UIUC. Besides being a TA, I have also mentored and trained several undergraduate and graduate students during my Ph.D. and postdoc.

I am looking for a position in R&D positions related to bioaerosols, aerosol health effects, in developing new tools and measurement techniques or faculty positions in environmental engineering and public health departments. My anticipated availability will be December 2025 and I am looking forward to explore new geographic locations.

4JS.4

Uzzal K. Dash, Postdoc at The Ohio State University, Seeking Postdoctoral/Research Scientist/Engineer Position in the Field of Atmospheric Chemistry/Modeling. UZZAL KUMAR DASH, *Ohio State Unviersity*

My research mainly focuses on atmospheric modeling, chemical data assimilation, and machine learning techniques. I am currently a postdoctoral scholar at The Ohio State University, where I develop machine learning-based models to predict the mass absorption cross-section (MAC) of black carbon.

From 2023 to 2024, I worked as a postdoctoral associate with Prof. Dylan Millet at the University Minnesota. My work focused on a NASA-funded project that involved assimilating satellite observations of reactive Ozone precursors to update Volatile Organic compound (VOC) emissions and to advance the model forecast. I employed GEOS-Chem model to develop a parameterized relationship between Isoprene/HCHO/NO_2 column concentrations and Isoprene emissions.

During my Ph.D., I built an ensemble-based chemical data assimilation system for the CMAQ model, applying algorithms like the ensemble Kalman filter to assimilate $PM_{2.5}$ observations and improve aerosol predictions over East Asia. I also have a strong foundation in statistical modeling and geospatial analysis, applying methods such as Ordinary Kriging to estimate particulate matter distributions over urban regions.

With nine years of experience, I bring strong expertise in atmospheric chemistry, 3D atmospheric modeling, data assimilation, scientific programming (Python, R, Fortran, C++, Shell), and machine learning. Building on this experience, I am eager to contribute to collaborative research that advances the predictive capability of atmospheric models. I am currently seeking postdoctoral/ research scientist/specialist position—across academic/non-academic/government institutions—where I can contribute to high-impact atmospheric research. I will be available beginning January 2026.

Geographic Preference: Anywhere in U.S.
Start Date: January 2026
Contact: uzzal.buet07@gmail.com

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4JS.5

Mohammad Washeem, Ph.D. Candidate in Environmental Engineering – Seeking Research Roles in Aerosol Science and Public Health. MOHAMMAD WASHEEM, Chang-Yu Wu, *University of Miami*

I am a Ph.D. candidate in Environmental Engineering at the University of Miami, planning to graduate in Spring 2026, with research expertise in aerosol science, toxicology, and bioaerosol exposure assessment. I have contributed to several NIH and NIOSH-funded projects combining experimental and computational methods to address airborne virus transmission, sampler performance, and health impacts of inhaled contaminants. My work has included evaluation of the biological collection efficiency of the BioSpot-VIVAS for viable virus sampling and development of machine learning models to optimize collection efficiency across varying environmental conditions. I've led occupational exposure studies using personal and stationary samplers (e.g., NIOSH BC-251 and BioSpot-VIVAS) to assess airborne viral risk in clinical environments via PCR and culture analysis. Additionally, I've participated in toxicological evaluations of aerosolized air fresheners and fungi on A549 lung cells, analyzing endpoints such as cell viability, ROS/RNS generation, metabolic activity, and cell migration. I'm currently engaged in an interdisciplinary study deploying the BioCascade in occupational settings and identifying pathogens through metagenomics and Nanopore sequencing. My technical skillset includes aerosol instrumentation (SMPS, APS, Spider-Magic, BioCascade, filters, and Collison and SLAG Nebulizers), molecular biology techniques (RT-qPCR, DNA/RNA sequencing, and metagenomics), and bioinformatics tools (ChimeraX, AlphaFold, Biopython, BLAST, HMMER, and Github). I am also proficient in Python, R, and SQL. As Lab Manager of the Aerosol and Particulate Research Lab at the University of Miami, I lead SOP development, safety compliance (OSHA HAZWOPER certified), and field coordination. My goal is to apply this multidisciplinary background in research-focused roles across academia, industry, or government, especially those integrating aerosol exposure and environmental health risks. I am open to positions across the U.S. and internationally starting Summer 2026, and eager to contribute to teams working on translational solutions in air pollution control, disease surveillance, and public health protection.

4JS.6

Alok Kumar Thakur, Ph.d. Candidate in Earth and Environmental Engineering, Seeking a Postdoctoral/Research Associate/Scientist Position. ALOK KUMAR THAKUR, *Indian Institute of Technology Gandhinagar*

I am Alok Kumar Thakur, a final-year PhD student at the Energy, Environmental, and Exposure Lab at the Indian Institute of Technology, Gandhinagar, India. Over my PhD journey, I have worked in the research area of aerosols, indoor air quality, working and deployability of low-cost monitors, physics-informed deep learning, mitigation devices, computational fluid dynamics for indoor environments, and chemical assay-based toxicity. To explain each in brief, I understood aerosol science in detail while working on my first chapter, where I estimated the size-resolved scattering intensity of aerosols while trying to assess the performance of low-cost monitors. As our lab was new, we also developed in-house multi-pollutant monitors, which we deployed in multiple indoor settings to briefly characterize indoor air pollution by looking at the source and fate of pollutants. Later, we used physics-informed deep learning to predict Spatio-temporal concentrations. We also used OpenFOAM to do CFD for the indoor environments. Lastly, we devised a passive mitigation device to reduce exposure from fine particles. Apart from the thesis, I also worked on the toxicity of PM using chemical-based assays, which I got trained for two months at UIUC, USA. I have three peer-reviewed published research papers, with four more papers currently under review and preparation.

I will submit my thesis around September'2025. I am seeking postdoctoral, research associate, and scientist positions in the US and Europe to extend my research and explore new research domains. I would be interested in the research area of CFD of indoor spaces, online and offline aerosol characterization and modeling, deployment of low-cost monitors, toxicity of PM and bioaerosols, and building automation. These areas are not in order of preference, and I would love to explore any of these areas if given the right opportunity. I do not have any geographical preferences.

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4JS.7

Nishchaya Kumar Mishra, PhD Candidate in Civil Engineering Seeking a Postdoctoral/Research Associate/Scientist Position.
NISHCHAYA KUMAR MISHRA, *Indian Institute of Technology Gandhinagar*

I am Nishchaya Kumar Mishra, a PhD candidate in Civil Engineering at the Indian Institute of Technology Gandhinagar (IITGN). My research lies at the intersection of sustainability, energy efficiency, and occupant health in buildings. Given that buildings consume a large share of global resources and that we spend nearly 90% of our time indoors, ensuring energy-efficient indoor comfort and pollutant control is critical.

At IITGN, I explore the trade-offs between energy consumption, thermal comfort, and indoor pollutant exposure. My first project involved developing a physics-based dynamic optimization model to understand these interdependencies. However, such models require detailed information on house geometry, pollutant deposition, and models for heating, ventilation, and air conditioning systems, thereby limiting real-world applications. To address these challenges, I am integrating reinforcement learning (RL) for dynamic and optimal control of indoor environments. The developed agent is deployed in an office to evaluate its performance under real-world ambient conditions and emissions. I am also investigating the uncertainties associated with the prediction of control actions in the RL agent, along with its potential to be transferred to different homes under varying ambient and pollutant emission scenarios. Currently, I have 3 peer-reviewed publications and 4 at various stages of publication.

In addition to my PhD work, I have explored urban morphology using satellite data and machine learning to study heterogeneity in building heights and footprints. This research contributed to shadow analysis at road intersections, providing valuable insights for urban planning and heat stress mitigation.

I expect to graduate in January/February 2026 and seek postdoctoral, research associate/scientist, or national lab opportunities in the USA or Europe. I would like to collaborate at the intersection of adaptive control, uncertainty quantification, and aerosol science, and I am open to exploring emerging areas in aerosol generation, dynamics, and modelling.

4JS.8

Yixiang Wang, Postdoctoral Research Associate, Seeking Faculty or Research Scientist Position in Air Pollution and Environmental Health.
YIXIANG WANG, *College of Health, Lehigh University*

My name is Yixiang Wang. I earned my Ph.D. in Environmental Engineering from the University of Illinois Urbana-Champaign in 2021. My research bridges atmospheric chemistry and public health, focusing on the cytotoxicity, composition, and sources of outdoor and indoor $PM_{2.5}$, and on identifying effective interventions to reduce exposure-related health risks.

My earlier work employed oxidative potential (OP), a redox-based toxicity indicator, to apportion health risks to specific sources and components of ambient $PM_{2.5}$. These findings support using oxidative potential as a meaningful indicator for assessing the health risks of ambient $PM_{2.5}$. Notably, my research revealed that rural $PM_{2.5}$, often driven by agricultural emissions, can be as toxic as urban $PM_{2.5}$—highlighting the importance of re-evaluating risk assumptions based solely on particle mass or location.

Currently, I am a Postdoctoral Research Associate at Lehigh University, working with Professor Linchen He on three research projects related to indoor $PM_{2.5}$:

Portable Air Purifier Study (Completed): This project evaluated the effectiveness of portable air purifiers in reducing indoor $PM_{2.5}$ toxicity. By quantifying toxic component contributions and applying source apportionment, we demonstrated that purifiers mitigate risks through mechanisms such as particle filtration and suppression of indoor chemistry. This study was published in ACS ES&T Air.

Indoor $PM_{2.5}$ Modeling: I developed a mass balance model to distinguish the contributions of indoor emissions and outdoor infiltration to indoor $PM_{2.5}$ levels. The model also estimates the chemical profiles of indoor-generated $PM_{2.5}$, supporting efforts to identify and manage indoor emission sources.

Urine Metabolomics Analysis: I am developing an LC-MS method to analyze urinary metabolic biomarkers from a cohort study, aiming to uncover biological mechanisms linking indoor air exposure to health outcomes.

I have authored 19 peer-reviewed publications, including 7 as first author. I am seeking faculty or research scientist positions in North America, Europe, or East Asia. (https://scholar.google.com/citations?user=LvxirmYAAAAJ&hl=en)

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4JS.9

Pradeep Kumar, PhD Candidate in Environmental Health, Seeking Postdoctoral Position in Bioaerosols and Air Quality Research. PRADEEP KUMAR, *South Dakota State University*

As a PhD candidate in Environmental Health at South Dakota State University, my current research focuses on the characterization and source apportionment of airborne particulate matter and bioaerosols in swine production facilities. I employ advanced molecular techniques including Oxford Nanopore-based 16S rRNA and shotgun metagenomic sequencing to profile the microbial composition of $PM_{2.5}$ and PM_{10}. This work provides novel insights into the diversity of airborne pathogens and antibiotic resistance genes (ARGs) in agricultural environments, supporting the development of targeted mitigation strategies.

In a parallel study, I utilize particle size distribution (PSD) data and EPA's Positive Matrix Factorization (PMF) model to identify key PM sources within swine barns and associated environments. This integrative approach bridges physical aerosol characteristics with microbial source tracking, enhancing our understanding of occupational exposure risks.

Previously, I worked as a research fellow at Satyawati College, University of Delhi (2018–2022), where I conducted microbiological and molecular characterization of airborne pathogens from diverse microenvironments. My work explored the impacts of bioaerosols on respiratory and cardiovascular health, and I have presented my findings at various national and international conferences. Additionally, I have co-authored 15 peer-reviewed publications in reputable journals such as Journal of Hazardous Materials, PLoS ONE, and Science of the Total Environment.

I am seeking postdoctoral opportunities in the areas of bioaerosol science, air quality, and microbial exposure assessment. I am available to begin a position in summer 2026 and open to relocating within the U.S. or internationally. My long-term goal is to contribute to interdisciplinary research that informs public health interventions and sustainable livestock management practices.

4JS.11

Katherine (Katie) Kolozsvari, Graduate Student at University of Michigan, Seeking a PostDoc Position. KATHERINE KOLOZSVARI, *University of Michigan*

The viscosity of atmospheric aerosol particles is a key physical property which allows us to predict particle behaviors in the atmosphere including aging, chemistry, and mass uptake. However, viscosity measurements for submicron particles are extremely challenging due to analytical limitations at these extreme sizes. My dissertation work mainly investigates the use of an atomic force microscopy (AFM) based technique to directly determine the melting temperature of aerosol, which can then be converted to viscosity. I have used this to investigate isoprene-derived secondary organic aerosol (SOA), α-pinene-derived SOA, and biomass burning aerosol as well as the effects of factors such as relative humidity and aging on these measurements. My interests include single-particle analytical techniques with a focus on microscopy as well as learning methods to compliment these techniques. I am also passionate about thoughtful data visualization and effective science communication.

I am a Materials/Analytical Chemistry PhD student at the University of Michigan in Prof. Andrew Ault's lab. My instrumentation experience includes work with microscopy and spectroscopy (AFM, Raman spectroscopy, photothermal infrared spectroscopy). My laboratory experience includes both continuous flow and batch mode chamber experiments as well as experience working in a clean room. I have extensive experience in troubleshooting and fixing a wide range of instrumentation (AFM, aerosol chemical speciation monitor, aerosol mass spectrometer, scanning mobility particle sizers), and I am comfortable problem-solving both experimental setups as well as instrumentation and equipment. I anticipate a defense in May 2026 and I am seeking an academic PostDoc position, and I am flexible in terms of location. I can be reached at kkoloz@umich.edu.

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4JS.12

Nohhyeon Kwak, Ph.D. Student in Mechanical Engineering, Seeking a Postdoctoral, Research Associate, Scientist, or National Lab Position in the U.S. Starting Fall 2026.

NOHHYEON KWAK, *University of Miami*

I am Nohhyeon Kwak, and I am actively seeking a **postdoctoral, research associate, scientist, or national laboratory position in the U.S**., beginning in **Fall 2026**, where I can apply my interdisciplinary expertise to advance impactful research.

As a Ph.D. student in Mechanical Engineering at the University of Miami, my work focuses on aerosol science, with a particular emphasis on the comprehensive characterization of airborne particles, including their physical, chemical, and biological properties.

My doctoral research explores the biological characteristics of bioaerosols, utilizing 16S rRNA gene amplicon sequencing to identify bacterial communities, trace their environmental origins, and assess their potential health impacts. This includes evaluating the performance of various bioaerosol samplers and investigating emissions from decaying *Sargassum*, which revealed the aerosolization of marine microbes and potential pathogens. I have also examined how environmental factors, such as location and meteorological conditions like rainfall, influence the composition, concentration, and size-dependent dynamics of bioaerosols.

This specialization builds on a strong foundation in the physical and chemical analysis of particulate matter developed during my master's research. I investigated the morphology of airborne fine particles using transmission electron microscopy (TEM), classifying individual particles—including sea spray, organic-rich, sulfur-rich, dust, metals, and fly ash—based on their distinct morphological and elemental features. Additionally, I conducted simultaneous $PM_{2.5}$ chemical composition measurements in Beijing, China, and Gwangju, South Korea, during winter haze periods to trace particle sources, assess aging processes, and understand the effects of long-range atmospheric transport.

Collectively, my academic training has equipped me with a robust skill set spanning physical (**morphology, size distribution**), chemical (**elemental analysis, source apportionment**), and biological (**DNA-based microbial identification**) aerosol characterization. I excel at integrating these dimensions to investigate aerosol sources, transformation, transport, and impact, and I am eager to contribute this interdisciplinary expertise to a collaborative, research-driven environment.

4JS.13

Jianing Bao, Ph.D. Candidate in Environmental Engineering, Seeking Industry or Consulting Position near Atlanta, GA.

JIANING BAO, *Clemson University*

I am a Ph.D. candidate in Environmental Engineering at Clemson University, expecting to graduate in August 2026. My research focuses on indoor air quality (IAQ), particularly in older educational buildings with outdated ventilation systems. I use low-cost sensors and a size-resolved box model to quantify particle and CO_2 dynamics, assess ventilation and filtration performance, and evaluate the effectiveness of mitigation strategies such as portable HEPA filters and Corsi-Rosenthal boxes under real-world scenarios. Previously, I collaborated on an atmospheric modeling project at Johns Hopkins University to estimate global emissions of sulfuryl fluoride using a simplified box model framework. This experience helped build my skills in data analysis, environmental modeling, and the communication of technical findings. My technical strengths include environmental data processing in MATLAB and R, modeling indoor pollutant transport, and communicating complex results to both technical and non-technical audiences. I am passionate about applying research to real-world challenges in environmental health, exposure reduction, and sustainable building operations.

I am seeking full-time employment in the Atlanta, GA area. I am specifically interested in roles in industry or consulting that focus on air quality, environmental monitoring, or building science. I hope to contribute to organizations working at the intersection of science, public health, and practical solutions for cleaner indoor and outdoor environments.

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4JS.14

P. S. Ganesh Subramanian, Ph.D. Candidate, University of Illinois at Urbana-Champaign, Seeking Postdoctoral Positions in Aerosol Measurements/Health Effects/ Epidemiology. P. S. GANESH SUBRAMANIAN, *University of Illinois Urbana-Champaign*

I am a fifth-year Ph.D. Candidate in Prof. Verma's Illinois lab for Aerosol Research at the University of Illinois, Urbana-Champaign. The overarching aim of my research is to enhance our understanding of the health-effects of indoor PM.

My Ph.D. research primarily involved experiments in controlled-chamber environments and real-world environments. I was instrumental in setting up chamber-based indoor measurement protocols in our lab to quantify the emission rates, chemical composition, and toxicological properties of PM originating indoors. Key research outcomes from my work include: a.) demonstration of human-generated aerosols primarily originating from non-respiratory sources such as skin-shedding/clothing, b.) development of OP emission inventory for indoor PM sources which revealed that using certain sources for just 1-hour in a one-bedroom apartment could result in as much PM/OP exposure as is typical from inhaling ambient $PM_{2.5}$ in the US over an entire day, and c.) highlighting the significant role that residential PM exposure could play on human health and its dependence on both residential and source-use characteristics. I am proficient in using several aerosol measurement instruments, analytical instruments, and semi-automated instrument development.

I have also had the opportunity to teach guest lectures for courses and serve as a TA for an undergraduate laboratory course in which I was chosen as an excellent instructor by the students. I have mentored junior undergraduate and graduate student peers in our lab and been actively involved in science-communication and community outreach activities.

Collectively, my Ph.D. work has resulted in two first-authored and six co-authored publications, with two each currently under review and in preparation. I have been fortunate to have received recognition such as the ASHRAE Grant-In-Aid Award (GIA), A&WMA Scholarship Award, and Mavis Future Faculty Fellowship.

I anticipate graduating between Dec 2025-May 2026 (flexible) and am looking for postdoctoral or R&D positions in aerosol measurement, toxicology, health-effects, and epidemiology in the US.

4JS.15

Yaling Zeng + Research Assistant Professor + Health Effects of Aerosols. YALING ZENG, *Southern University of Science and Technology*

I am a Research Assistant Professor at Southern University of Science and Technology (SUSTech), specializing in environmental toxicology with a focus on protein adductomics and neurotoxicological mechanisms of airborne particulate matter ($PM_{2.5}$). My research leverages high-resolution mass spectrometry (Orbitrap, FT-ICR) to identify protein-bound pollutants, providing molecular insights into how $PM_{2.5}$ constituents translocate across the blood-brain barrier and potentially disrupt neurophysiological pathways.

Recent projects explore the role of $PM_{2.5}$-bound organics in modulating amyloid protein aggregation, linking chronic exposure to neurodegenerative outcomes such as Alzheimer's disease. These studies have revealed specific chemical markers of $PM_{2.5}$ exposure that correlate with inflammatory and oxidative stress responses, contributing to biomarker development for early diagnosis and mechanistic understanding.

I am seeking a research position where I can further develop my expertise in molecular toxicology and biomarker identification while contributing to interdisciplinary projects focused on air pollution, neurodegeneration, and environmental health. My technical skills include advanced HRMS-based untargeted analysis, protein interaction studies, and computational toxicology, complemented by extensive experience in project leadership and graduate mentorship.

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4JS.16

Archana Tripathy, Ph.D. Candidate in Atmospheric Science – Seeking Postdoc or Research Scientist Role in Atmospheric Chemistry. ARCHANA TRIPATHY, *University at Albany*

I'm a Ph.D. candidate at the University at Albany, SUNY, studying Cloud-Aerosol Chemistry. My research focuses on multi-phase chemistry at Whiteface Mountain, a remote, high-elevation site in the Adirondacks.

I've looked at how organic acids contribute to cloud water acidity, ion balance, and dissolved organic carbon, and how wildfire smoke and biogenic emissions influence their levels. I also examine black carbon and CO data to identify pollution from energy production versus background levels. Recently, I've been studying the link between excess ammonium and organic acids in both cloud and aerosol phases, and how temperature and ozone on clear-air days impact SOA chemistry.

In the field, I've worked with GCVI, SMPS, AMS, and PILS, and I use a range of lab-based analytical tools, including EC-OC analyzer, ion chromatography, GC-MS, and TOC analyzer. I'm proficient in IGOR Pro and Python for data analysis and visualization.

I'm expecting to finish my Ph.D. by the end of 2025 and am looking for postdoc or research scientist roles in academia, government, or industry. I'm open geographically, but especially interested in opportunities in the States.

My background combines strong fieldwork, analytical chemistry, and statistical analysis of large datasets. I'm excited to bring this expertise to teams working on atmospheric composition, air quality, and climate.

4JS.17

Chemical Engineering PhD Candidate Seeking Research Scientist Roles. CHRISTINE TROLLER, *Carnegie Mellon University*

I am a Chemical Engineering Ph.D. candidate at Carnegie Mellon University with a research focus in atmospheric chemistry, particularly the emissions of biogenic volatile organic compounds (BVOCs) from freshwater and marine systems. My work combines lab and field measurements, high-resolution chemical ionization mass spectrometry, and multivariate analysis to investigate gas fluxes from harmful algal blooms and aquatic ecosystems and their impacts on air quality and climate.

I am broadly interested in research-driven roles that bridge environmental science, atmospheric chemistry, and data analytics. I'm especially excited by opportunities that involve interdisciplinary collaboration, environmental monitoring, and the translation of complex data into actionable insights for policy, public health, or environmental management. While I would enjoy continuing work related to atmospheric and environmental science, I am also open to a wide range of research and development opportunities in industry related to chemical engineering.

I anticipate completing my Ph.D. in spring or summer 2026 and am open to postdoctoral positions or research scientist roles in academia, government, or industry. I have a strong preference for staying in the Northeastern U.S., although I am open to considering any position offered in the US.

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4JS.18

Dongli Wang, Ph.D Candidate Seeking Postdoctoral or Industry Positions. DONGLI WANG, *Clemson University*

My research focuses on atmospheric aerosols, particularly black carbon (BC) aerosol and its interactions with clouds. My master's work involved the removal of gas-phase elemental mercury from smelting flue gas by synthesizing and modifying sorbent materials and liquid solutions. During the early stage of my PhD, I studied the influence of BC aerosols from prescribed fires on regional air quality and participated in a wildland fire simulation experiment, focusing on the characteristics of BC aerosols from various fuel sources and fire conditions. My current dissertation research is investigating BC aerosol-cloud interactions using airborne observations from the SCILLA field campaign off the coast of Southern California. We characterized BC aerosol concentrations, size distributions, and mixing state above, below, and within cloud layers and evaluated the impacts of local meteorology on clouds and aerosols. This study aims to improve understanding of the role of BC as cloud condensation nuclei and the influence of BC on cloud microphysical properties under different meteorological conditions.

I expect to graduate in December 2025. I'm looking for full-time positions that align with my background in air pollution and climate-related field or laboratory studies. During my PhD, I worked on detailed instrument maintenance, including optics cleaning, laser alignment, and calibration, developing a foundation in hands-on measurement techniques. I have experience in data analysis using MATLAB, Python, and Igor Pro, including work with large-scale observation datasets, time-series processing, size distribution, and mixing state characterization. I'm also proficient in using GIS tools. I'm interested in roles involving data analysis in both academia and industry. I'm open to postdoctoral and industry research positions and am flexible geographically.

4JS.19

Aerosol Scientist. WAJIH UR REHMAN, *COMSATS University Islamabad*

I have a PhD in Aerosol Technology with several years of experience with measurement and instrumentation. I have used continuous monitoring instruments as well as filter based instruments including DMA, CPC, QAMS, Aethalometer, OC-EC Analyzer, nanoscan SMPS, nanoSampler and IC. I have expertise in source apportionment using PMF and CMB. I have used various softwares including Igor, Origin and MatLab. I have used field based work and laboratory studies for ambient measurement.

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4JS.20

Sining Niu, Ph.D, Student, Industry/Government/Postdoc Positions. SINING NIU, *Texas A&M University*

I am a Ph.D. student at the Texas A&M University with experience in charactering the physicochemical properties of organic aerosols. Throughout my Ph.D. journey, I have gained extensive experience in both laboratory and field studies, focusing on the properties and impacts of organic aerosols from various sources.

My main research projects include:
· Laboratory study on charactering the chemical properties of nanoplastic particles: Designed and conducted the experiments with Aerosol Mass Spectrometer to detect the airborne PS NPPs. The concentration of ambient PS NPPs was quantified with Aerosol Mass Spectrometer coupled with Multi-linear Engine-2, and the human exposure was derived.
· Laboratory chamber study on organic sulfate and SOA formation: Designed and conducted the experiments in an environmental chamber with Aerosol Mass Spectrometer, mini-SPLAT (Single Particle Mass Spectrometer), Nanospray Desorption Electrospray Ionization Mass Spectrometer, and connect to their potential of acting as cloud condensation and ice nucleation nucleus with Cloud Condensation Nuclei Counter and Continuous Flow Diffusion Chamber measurements.
· Field study on urban aerosols and volatile organic compounds: Actively involved in the instrumentation maintenance, driving the mobile laboratory, developing the campaign strategy. Processed the data and collaborated with the group from University of British Columbia for the spatial distribution of cashmeran in Houston. Processed spatiotemporal pollutant data (Python/SQL), integrating results into large-scale chemical models.

I am proficient in operating and conducting daily maintenance of advanced mass spectrometry instruments such as HR-ToF-AMS and VIA-Vocus CIMS. Additionally, I have experience with data analysis techniques and software including Python, Matlab, Igor Pro, and machine learning, which allow me to interpret complex datasets effectively.

I anticipate graduating around spring 2026 and am seeking positions in industry, government, and national labs within the U.S., with no geographical preference. My goal is to apply my expertise in aerosol chemistry to address real-world environmental issues and contribute to advancements in improving air quality and public health.

4JS.22

Lena Gerritz, PhD Candidate in Atmospheric Chemistry Seeking Post-Doctoral or Government Research Position. LENA GERRITZ, *University of California, Irvine*

Atmospheric chemistry doctoral candidate at the University of California, Irvine investigating radical formation and compositional changes during photochemical aging of aerosols using laboratory experiments and kinetic modelling.

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4JS.23

Sofie Schwink, Environmental Engineering PhD Candidate, Postdoctoral Researcher/Research Scientist. SOFIE SCHWINK, *University of Colorado Boulder*

My main research interest is investigating how aerosol formation potential and properties change under a variety of atmospheric conditions. I earned my bachelor's degree in bioengineering at the University of Illinois Urbana-Champaign, where I studied potential uses for nanomaterials in medical imaging. In my graduate research at the University of Colorado Boulder, I've measured changes in properties of primary smoke particles, smoke secondary organic aerosol (SOA), and SOA formed from volatile chemical products (VCPs) in chamber and real-world experiments. I led an 8-week field campaign investigating indoor SOA formation and properties from consumer products and smoke in a real home, overseeing ~25 scientists from six labs. I published work investigating how properties of biomass-burning smoke particles change following exposure to relative humidity and oxidative aging by ozone. I studied the SOA formation potential of VCPs typically used indoors, including perfumes, deodorants, and cleaning liquids. I investigated SOA formed via reactions with ozone and via reactions with chlorine bleach under different lighting conditions, which has implications for indoor chemistry. Aerosol properties I have investigated include size distributions from 1 nm–20 µm, effective density, and light absorption, and I have collaborated with other researchers to measure aerosol chemical composition using gas chromatography–mass spectrometry.

I will defend my PhD this spring and am searching for a job with a start date around June–July 2026. I am open to working as a postdoctoral researcher or for a public or private research agency. I have an interest in instrumentation and have practical experience with and have taken coursework on instrument management and repair. I prefer to work in the Colorado Front Range or remotely.

4JS.24

Evan Dalton, Ph.D., Postdoctoral Scholar, Looking for Career Opportunities for Analytical Chemists in the Midwest. EVAN DALTON, *University of Michigan*

I am a postdoctoral scholar in Dr. Andrew Ault's Laboratory at University of Michigan in Ann Arbor, MI. The focus of my current research is analytical method development for the direct measurement of ambient aerosol acidity. This method was recently deployed in New York City, NY, and I am currently analyzing the full field campaign for publication. I am also focused on characterizing the chemical heterogeneity of particle populations (i.e. the external mixing state of an aerosol) in ambient samples, and the development of miniaturized impactors for aerosol microfluidics applications.

I received my Ph.D. in Analytical Chemistry from Indiana University in Bloomington, IN, where I researched nitrate photochemistry and heterogeneous chemistry in Dr. Jonathan Raff's laboratory. Through careful laboratory experimentation, I characterized 5 new aqueous nitrate photochemical mechanisms with common environmental matrix components (aliphatic organic matter, chromophoric compounds, and halides). This was achieved with specialized instrumentation, including chemical ionization mass spectrometry (CIMS), Fourier transform infrared spectroscopy (FTIR), flow injection chemiluminescence analysis (FIA), UV-Vis Spectroscopy, NOx chemiluminescence analysis, in addition to targeted assays, flow tube techniques and kinetic modeling.

I am keenly interested in understanding natural chemical mechanisms that impact air and water quality. My career goal is to build a research group that investigates heterogeneous aerosol chemistry. There is an immense need for more chemical mechanism research conducted in the atmospheric condensed phase, and I intend to help fill that need. My earliest availability for employment would be January 2026. I am interested in job opportunities within the Midwest, especially within a 4-hour drive from either St. Louis, MO or Indianapolis, IN. While I am most interested in careers in government or academia, I am generally open to other options if they fit my expertise, interests, and geographical preferences.

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4JS.26

Sithumi M. Liyanage, Ph.D. Candidate in Atmospheric Chemistry – Seeking Research Scientist or Postdoctoral Role in Atmospheric Chemistry. SITHUMI LIYANAGE, *Oklahoma State University*

I am a Ph.D. candidate in atmospheric chemistry at Oklahoma State University, with a research focus on the physicochemical properties and transformations of atmospheric aerosols, particularly brown carbon (BrC). I completed my bachelor's degree in environmental science, where I worked on measuring trace gases and modeling urban air quality. I have experience in field sampling and laboratory analyses, including IC, AAS, GC, and AES. In my doctoral work, I investigated multiphase processing of the water-soluble and insoluble phases of biomass burning organic aerosol, physicochemical properties of secondary organic aerosol from aqueous OH-initiated photo-oxidation of catechol, and the effects of these materials on air quality and climate. Through coated-wall flow-tube experiments, I have measured reactive uptake of ozone onto thin films and contributed to understanding the fate of atmospheric aerosols. Currently, my research is focused on the photochemical evolution of primary BrC and its dependence on concentration, using spectroscopic techniques. I am also exploring the pH-dependent behavior of phenolic compounds relevant to their partitioning and absorptivity, using a combination of experiments and quantum chemistry calculations. Furthermore, for my candidacy, I have generated a proposal on the influence of relative humidity on pollen rupture, the resulting particle size distributions, and the impacts on cloud condensation nuclei and respiratory health. I am seeking opportunities as a postdoctoral researcher or scientist in academia, national laboratories, or industry settings that focus on atmospheric chemistry, climate-relevant aerosol processes, or environmental exposure science. I am particularly interested in interdisciplinary research at the intersection of air quality, climate, and human health. I will be available to begin a new position starting in August 2026, and I am open to relocation within the United States and internationally. I am highly motivated to contribute to research teams working on environmental challenges with strong societal impacts.

4JS.27

Minghao Han, Ph.D. Candidate, Seeking Postdoctoral, Research Scientist, or Aerosol Instrumentation Development Roles in Atmospheric Chemistry & Aerosol Science. MINGHAO HAN, *University of California, Riverside*

I am a final-year Ph.D. candidate in Chemical and Environmental[DC1.1] Engineering at the University of California, Riverside, specializing in atmospheric chemistry, aerosol science, and aerosol instrumentation development. My research integrates advanced hardware design with fundamental science to address the sources, transformation, and impacts of urban air pollution.

A central focus of my work is oxidation flow reactor (OFR) technology. I built a custom OFR system with precise control of temperature, relative humidity, ozone concentration, and UV intensity, engineered to provide a narrow residence time distribution (RTD) for particles and gases. I have deployed this system in both laboratory and field settings, including on the Twin Otter research aircraft for the SCILLA airborne campaign, enabling in situ secondary aerosol formation measurements. This OFR system also supports laboratory studies quantifying SOA formation from tire (using a custom-designed temperature-controlled enclosure), brake, and vehicle exhaust emissions. These projects have developed my skills in hardware prototyping, sensor integration, electronic control, and field deployment of advanced aerosol instrumentation.

My collaborative work spans the California Statewide Mobile Monitoring Initiative, a CARB-funded project that delivers community-scale mobile air quality mapping; the Drone-Based Ship Emissions Project, which integrates on-board and drone-based measurements of hazardous pollutants from marine vessels; and an investigation into the secondary formation of ethylene oxide. These experiences have provided me with a unique skill set at the intersection of atmospheric science, advanced measurement technology, and instrument engineering.

I anticipate completing my Ph.D. in June 2026 and am seeking postdoctoral, research scientist, or aerosol instrumentation development roles beginning in summer 2026. I am open to positions in academia, government, or industry—including companies focused on aerosol measurement and generation technology—primarily in North America, but I am open to global opportunities.

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4JS.28

Rebecca Parham, Graduate Student at University of Michigan, Looking for Federal or Industrial Position in Midwestern or Southern U.S. REBECCA L. PARHAM, *University of Michigan*

Plastic particles between 1–5000 µm in size, called microplastics (MPs), are known to be widespread in the atmosphere, but their overall health burden on the general population is undetermined. Challenges in detecting the MP particles most likely to cause lung damage or disease (i.e., particles < 10 µm in size) contribute significantly towards this issue. My dissertation work has focused on accurately identifying and quantifying atmospheric MPs by investigating analytical methods. In particular, my research topics are 1) validating a recently automated spectroscopic method that can simultaneously acquire infrared (IR) and Raman spectra for particles < 10 µm; 2) determining the efficiency and robustness of a statistical method that labels an unknown particle using both the IR and Raman spectra collected; and 3) quantifying the likelihood of MPs generated from freshwater sources to enter the aerosol phase as well as characterizing their physicochemical properties. The results of this work support a collaboration tasked with mapping the deposition of atmospheric MPs across Michigan.

I am an Analytical Chemistry Ph.D. student at the University of Michigan advised by Professor Andrew Ault. I have experience with many spectroscopic techniques (optical photothermal infrared spectroscopy, Raman spectroscopy, and scanning electron microscopy with energy-dispersive X-ray spectroscopy). Moreover, I have designed, implemented, and troubleshooted a variety of experimental workflows to generate and characterize aerosols in laboratory and field settings. I have worked extensively with researchers across a wide range of disciplines to create methods for sample collection, spectral collection, particle characterization, and data analysis. I am interested in continuing to bridge analytical method development with environmental chemistry once I complete my doctoral program (anticipated defense is July 2026). I am interested in government or industrial positions, and I would like to stay in Michigan but am open to relocating to the midwestern or southern U.S.

4JS.29

Advancing Respiratory Protection and Exposure Assessment Through Applied Aerosol Science. XINYI NIU, *University of Cincinnati*

I am a postdoctoral researcher with a Ph.D. in Environmental and Industrial Hygiene from University of Cincinnati, a program with long tradition of aerosol research dated back to the 70s. My research expertises span aerosol science, respiratory protection, and exposure assessment, bridging laboratory-based experimentation with applied field research to advance worker health and indoor air quality.

My research encompasses the development, evaluation, and deployment of novel sensor technologies for real-time monitoring of respirator performance. This system features an intuitive user interface and an innovative customized algorithm that overcomes limitations of traditional optical particle sensors, thereby promoting more effective use of respiratory protective equipment. I have also contributed to the development and evaluation of next-generation self-decontaminating respirator filters that that simultaneously improve breathability and aerosol filtration efficiency. These innovations hold promise for creating a ‘universally fitting’ device suitable for broad public use.

In addition, I have conducted bioaerosol exposure surveillance in healthcare environments, modifying conventional sampling equipment to enhance microbial collection efficiency and viability. Other projects include evaluating particle emissions during industrial processes such as laser cutting and assessing indoor air quality during common particle-generating cleaning activities.

I am currently seeking a teaching-track faculty position, associate researcher appointment, or relevant positions in industry. I am interested in opportunities that support the advancement of aerosol technologies and exposure assessment tools to improve environmental and public health.

I am available to begin a new position and am open to opportunities across the United States, Canada, and Europe. I am interested in institutions or organizations with strong programs in aerosol science, industrial hygiene, or environmental and public health. My long-term goal is to translate scientific research into practical, evidence-based solutions that address real-world health challenges.

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4JS.30

Laura Heinlein, PhD Candidate at the University of California, Davis Seeking Postdoc/Government Positions. LAURA MARIE DAHLER HEINLEIN, *University of California, Davis*

I am a fourth year PhD candidate in Dr. Cort Anastasio's group at the University of California, Davis studying atmospheric chemistry. My dissertation focuses on multiphase brown carbon photooxidant formation in biomass burning particles and their impacts on PM composition.

In my first chapter, I quantified brown carbon (BrC) photooxidants in PM from winter pollution in Fairbanks, Alaska from the ALPACA campaign. I performed illumination experiments on filter extracts to measure three photooxidants and then built kinetic models predicting photooxidant concentrations in particles. To explore their implications, I then built a secondary sulfate formation model with numerous formation pathways, including photooxidants, finding that a surprising 76% of daytime secondary sulfate was formed by photochemistry.

In my second chapter, I incorporated photooxidant production and phenolic SOA formation into the Platform for Atmospheric Chemistry and Transport in One Dimension (PACT-1D), a MATLAB-based model. I integrated 564 additional processes into PACT-1D, many of which are constrained by ALPACA field measurements. The results show that wintertime phenolic SOA formation in Fairbanks is dominated by particle photooxidants, producing on average 2 µg m-3 at solar noon during pollution events, and explaining up to 35% of measured daytime oxidized organic aerosol.

In my third chapter, I target the limitations in current photooxidant measurement techniques. Current methods only consider photooxidants from water-soluble BrC, yet the majority of BrC is water-insoluble. To address this, I am developing a method to target methanol-soluble BrC photooxidants, pairing illumination experiments, LC-MS, and computations in Gaussian to elucidate differences in photooxidant production in different solvation environments.

I expect to graduate in September 2026, after which I am looking for a postdoc or a government agency position. I am particularly interested in emerging contaminants, kinetic modeling, field work, and working towards solving air quality and climate related issues.

4JS.31

Esther Olonimoyo, Ph.D. Candidate, University of Maryland College Park, Postdoctoral/Industry Positions. ESTHER OLONIMOYO, *University of Maryland*

I am a fifth-year doctoral candidate at the University of Maryland, College Park, conducting research in the Environmental Aerosol Research Lab under the guidance of Dr. Akua Asa-Awuku. In general, my research expertise is in aerosol chemistry and the impacts of pollutants on soil, water, and air environments.

Technical Qualifications:
In my Ph.D. research, I employ chemistry analytical techniques and meteorological modeling tools to bridge the gap between real-time atmospheric measurements and climate model predictions. Specifically, the chapters of my research thesis discuss HPLC-PDA method development and optimization for organic acids quantification, field sampling and measurements, and controlled biomass burning laboratory studies. My undergraduate research experience included field experiments to determine the impacts of wastewater from a power plant on the soil and water environments. I also have studied the impacts of COVID-19 facemasks on incinerated solid wastes.

Unique Skillsets:
Technical: High-Performance Liquid Chromatography – Photodiode Array Detector (HPLC-PDA), Liquid Chromatography Tandem Mass Spectrometer (LC-MS/MS), Gas Chromatography-Flame Ionization Detector (GC-FID)

Others: Data analysis, Research, Written and Spoken Communication, Project Management

Employment Interests:
I am excited to continue my passion for aerosol and environmental research. I am open to several topics but have a keen interest in biomass burning, African Air quality, and subsequent impacts on international research and policy. I am open to postdoctoral and research scientist positions at institutions (non-academic, government, or industrial). I am also interested in Environmental consulting roles. By leveraging my technical expertise and training, I hope to offer practical solutions to global environmental sustainability issues.

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4JS.32

Kiran Reddy Pitta, Ph.D. Candidate, Seeking Postdoctoral, Research Scientist, or Industry Positions. KIRAN REDDY PITTA, *The Pennsylvania State University*

I am a Ph.D. candidate in the Department of Chemistry at The Pennsylvania State University, specializing in Atmospheric Chemistry. My research investigates the phase behavior and chemical composition of submicron and supermicron atmospheric aerosol particles under various humidity and temperature conditions, which plays a role in cloud formation and atmospheric heterogenous chemistry.

My work explores the influence of organic-organic and organic-inorganic interactions on the phase transitions of model aerosol systems composed of non-polar amino acids (e.g., valine, leucine, isoleucine), oxidized organics (2-methylglutaric acid and 1,2,6-hexanetriol), and a range of inorganic salts at both supermicron and submicron scale. This project is part of a larger collaborative effort to investigate the connections between morphology and hygroscopicity for these systems. I also use advanced microscopy techniques along with spectroscopy tools (e.g., Raman, FTIR, UV-Vis, TEM, Fluorimeter, SMPS) to probe particle morphology and composition. I also investigated the kinetics of brown carbon formation using characterization techniques like NMR, UV-vis and Raman spectroscopy. I have worked closely with lab mates to use cryo-TEM to develop parameterizations for separation relative humidity (SRH) in submicron aerosols, accounting for composition, particle size, and equilibration time. These studies highlight how factors like solubility, surface activity, and nitrogen-containing functional groups influence LLPS and cloud condensation activity.

In addition to lab-based research, I am proficient in Python, MATLAB, Igor Pro and ImageJ for image and data analysis and have mentored undergraduate researchers and led science outreach initiatives. My interdisciplinary training bridges physical chemistry, and instrumentation for environmental applications. I anticipate completing my Ph.D. by Summer 2026 and am seeking postdoctoral or scientist roles in atmospheric science, air quality, or climate-related research. I am geographically flexible and open to opportunities in academia, national laboratories, and all areas of industry.

4JS.33

Cara Waters, Graduate Student at University of Michigan, Seeking Postdoctoral Position. CARA WATERS, *University of Michigan*

Aerosol acidity is a critical variable that influences the formation of particulate matter in the atmosphere. It influences many important secondary processes, such as reactive uptake of certain LVOCs, continued liquid phase accretion reaction kinetics, and sulfate oxidation. My dissertation research has explored secondary organic aerosol (SOA) pH through a series of laboratory studies using a broad range of analytical instrumentation. My projects involve (1) developing a new colorimetric aerosol pH measurement technique for extending aerosol pH measurement to the ultra-acidic regime, (2) measuring differences between bulk solution pH and generated aerosol pH, (3) exploring the evolution of aerosol pH over the course of organic uptake during SOA formation, (4) characterizing intraparticle acidity gradients in phase-separated SOA, and (5) determining the pH dependence of formation mechanism of organosulfates. This work will advance our understanding of aerosol pH for improved atmospheric modelling.

I am a physical/analytical chemistry PhD student at the University of Michigan in Prof Andrew Ault's group. I have experience with microspectroscopy techniques (Raman, O-PTIR), mass spectrometry techniques (liquid chromatography coupled with electrospray ionization high resolution mass spectrometry, matrix-assisted laser desorption ionization mass spectrometry), and aerosol sizing instrumentation (SMPS, APS, OPS). My laboratory experience includes running continuous flow atmospheric chamber experiments utilizing an oxidation flow reactor. I anticipate defending in July 2026, and I am looking for an academic postdoctoral position where I will have the opportunity to continue laboratory investigations of fascinating chemical phenomena. I can be reached at carawrs@umich.edu.

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4JS.34

Komal Jaswal, Ph.D. Candidate, Seeking Postdoctoral, Research Scientist, or Industry Positions. KOMAL JASWAL, *The Pennsylvania State University*

I am a Ph.D. candidate in the Department of Chemistry at The Pennsylvania State University, specializing in Atmospheric Chemistry. My research focuses on advancing measurement techniques for the physical and chemical properties of aerosol particles with special emphasis on acidity, morphology, and phase state, which influence cloud formation, radiative forcing, and heterogeneous chemistry.

I developed a novel approach using carbon quantum dots (CDs) as *in situ* fluorophores for direct measurement of pH of individual aerosol particles and their phases in the highly acidic range (pH 1.5 – pH 3.5). This work involved the use of various spectroscopic and microscopic techniques for CDs characterization (fluorescence spectroscopy, UV-Visible spectroscopy, FTIR, TEM, XPS, DLS, and Raman spectroscopy) and aerosol pH measurement (optical and fluorescence microscopy). I applied this method to measure the pH of model continental aerosol particles to study the influence of pK_a of organic compounds on the particle acidity. These model aerosol particles were synthesized in two distinct systems: one consisting solely of organic compounds with varying pK_a values and another combining these organic compounds with different inorganic compounds. In a separate study, I investigated the effect of oxidation state and aromaticity of organic compounds on the size-dependent morphology of submicron aerosol particles in organic/inorganic binary systems using cryo-TEM. Separately, I studied how inorganic ions influence phase transitions in organic-rich supermicron aerosol particles using optical microscopy.

My research has provided an interdisciplinary background in analytical and physical chemistry, with a focus on nanomaterials and atmospheric chemistry. I am proficient in Igor Pro, ImageJ, MATLAB, and Python for data and image analysis. I expect to complete my Ph.D. by summer 2026 and am actively seeking postdoctoral or research scientist opportunities in academia, national laboratories, or industries. I am geographically flexible and eager to contribute to impactful research in atmospheric science.

4JS.35

Ajmal Rasheeda Satheesh, Ph.D Student Seeking Industry or Postdoctoral Positions. AJMAL RASHEEDA SATHEESH, *North Carolina State University*

I am a PhD student in Atmospheric Science at North Carolina State University, working under the supervision of Dr. Nicholas Meskhidze, expecting to graduate in June 2026. My research addresses critical atmospheric processes, including novel approaches to aerosol flux derivation, new particle formation, and improving dust deposition parameterizations for climate models. I am currently researching improving dust deposition parameterizations in CESM2 using CALIPSO satellite data. For which I have to handle large amounts of satellite datasets and visualize them in 3D.

I excel at processing complex, large scale spatiotemporal and timeseries datasets, and have a proven track record in scientific communication, as I have presented at multiple international conferences and have published a first author paper with another one close to submission which is on investigating new particle formation in the remote marine boundary layer using airborne observations from the ACE-ENA field campaign in the island of Azores, in Eastern North Atlantic. The study aims to close the gaps in understanding the underlying mechanisms regarding NPF.

I am proficient in data science, analytics, and visualization using MATLAB and Python with experience in handling large scale datasets like NetCDF, HDF, and Zarr files. I am also experienced in handling atmospheric models like Geos-Chem and CESM2 with the ability to set up model runs in a Linux environment using shell scripting.

I'm interested in roles involving data science and analytics in both academia and industry. I'm open to postdoctoral and industry research positions and am flexible geographically.

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4JS.36

Sahir Gagan, Ph.D, Student, Industry/Government/Postdoc Positions. SAHIR GAGAN, *Texas A&M University*

I am a Ph.D. candidate in Atmospheric Sciences at Texas A&M University with expertise in characterizing the chemical evolution of emerging atmospheric contaminants to assess their climate and health impacts. My research integrates laboratory experiments, advanced mass spectrometry, and field campaigns to understand the physicochemical properties, transformations, and ambient variability of pollutants.

Key research highlights:

i. Characterized Polystyrene Nanoplastic Particle (PS NPP) atmospheric Oxidation against hydroxyl radical (·OH) using HR-Tof-AMS. Further, a Condensation Particle Counter and a Cloud Condensation Nuclei Counter were used to assess the CCN activity of oxidized PS NPP.

ii. Developed and optimized a novel method to characterize and quantify PFAS compounds with high high-resolution chemical ionization mass spectrometer (HR-CIMS) using positive reagent ions. The developed method can detect previously unreported classes of per- and polyfluoroalkyl substances (PFAS) compounds, such as perfluoro olefins and perfluoro vinyl ethers, in ppt levels. The developed method was further used in field measurements to quantify PFAS emissions.

iii. Led field measurement campaign, which included instrument maintenance, developing the campaign strategy, and driving the mobile laboratory. The Vocus 2R CIMS with positive reagent ion was used to investigate the distribution and emission of PFAS compounds near the point source in Fayetteville, North Carolina, in collaboration with the University of North Carolina, Chapel Hill.

iv. Apart from the above-mentioned objectives, I am trained and proficient in the synthesis of biogenic volatile organic compounds (BVOCs) derived oxidation products such as Isoprene epoxydiol (IEPOX), 2-methyltetrol (2-MT), and 2-methyltetrol organosulfate (2MTOS).

My technical skills include operating and conducting daily maintenance of advanced mass spectrometry instruments such as HR-ToF-AMS and Vocus CIMS. Additionally, I have experience with data analysis techniques and software, including Python and Igor Pro, which allow me to interpret complex datasets effectively. I am also proficient in the organic synthesis of BVOC-derived oxidation products.

I anticipate graduating around spring 2026 and am seeking positions in industry, government, and national labs within the U.S., with no geographical preference. My goal is to apply my expertise in aerosol chemistry to address real-world environmental issues and contribute to advancements in improving air quality and public health.

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5AC.1

Exploring Solvation and Aggregation Effects in Microdroplets Using Time-Resolved Fluorescence. MIN-HSIEN (TONY) KAO, Conlan Broderick, Jim Walker, Thomas A. A. Oliver, Andrew J. Orr-Ewing, Bryan R. Bzdek, *University of Bristol*

Surface effects can significantly change chemical behavior. To investigate such changes at the molecular scale, we developed a linear-quadrupole droplet trap coupled with time-correlated single photon counting (TCSPC) to measure fluorescence emission lifetimes in microdroplets with diameters of ~40 µm or smaller. This setup provides time resolution of fluorescence decay ranging from 100 ps to 100 ns and was tested by using coumarin 480, a common laser dye known for its sensitivity to solvation environments. Coumarin derivatives have been widely employed to study solvation dynamics in bulk solvents and micellar systems.

We measured the fluorescence lifetimes of coumarin 480 in a 9:1 (v:v) water/acetone mixture both in cuvettes and in trapped droplets. In bulk solution, the fluorescence lifetime was ~6.1 ns and remained consistent across concentrations from 2 µM to 25 µM. In contrast, the emission decay in microdroplets exhibited a bi-exponential profile, with time constants varying between ~2 ns and ~11 ns depending on concentration, as did the associated amplitude weights. In addition to the fluorescence lifetime, the fluorescence emission spectra in cuvettes and droplets were measured. The observed Stokes shifts differed between the cuvette and droplet environments, suggesting a change in solvation environment at the microscale.

We attribute these differences to environmental heterogeneity: while the bulk solution is homogeneous, acetone rapidly evaporates from droplets upon generation, leaving behind water droplets supersaturated with coumarin 480. This leads to dye aggregation and surface accumulation, creating confined interfacial environments that alter fluorescence behavior. These results demonstrate the capability of our setup to probe photochemical processes in microdroplets and aerosols, providing insight into surface-induced effects at the microscale.

5AC.2

Salting Effects Alter the Gas-Aqueous Partitioning and SOA Potential of Formic and Acetic Acid. AMIR BABAEI-GHAREHBAGH, Rose Taylor, Vikram Pratap, Annmarie Carlton, Christopher Hennigan, *University of Maryland, Baltimore County*

Formic acid (FA) and acetic acid (AA) are abundant atmospheric carboxylic acids that play important roles in wet deposition acidity and secondary organic aerosol (SOA) formation. Despite their significance, observations of FA and AA gas-particle partitioning differ substantially from thermodynamic predictions, contributing to uncertainties in SOA burden estimates. In this study, we systematically investigate the effects of sodium chloride (NaCl) and ammonium sulfate ($(NH_4)_2SO_4$) on the partitioning behavior of FA and AA using two independent experimental approaches: dual parallel mist chambers and a shared headspace method. Our results reveal a consistent salting-out effect for both compounds in NaCl solutions, with Setschenow constants indicating increased volatilization with rising salt concentrations. In contrast, $(NH_4)_2SO_4$ was found to have minimal impact on FA and AA partitioning at concentrations up to 2 mol kg-1. Additionally, pH-dependent experiments confirmed that partitioning behavior is strongly modulated by acid dissociation equilibria, especially when the solution pH nears the pKa of the acids. These findings demonstrate that both ionic strength and pH influence gas-aqueous partitioning of small organic acids; - implications for ambient SOA formation and the potential to reconcile observations with thermodynamic predictions will be discussed.

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5AC.3

Time-resolved Photochemistry of Pyruvic Acid. CONLAN BRODERICK, Min-Hsien (Tony) Kao, Bryan R. Bzdek, Andrew J. Orr-Ewing, *University of Bristol*

Pyruvic acid (PA), the simplest α-keto acid and a key oxidation product of isoprene, plays a significant role in the formation of secondary organic aerosols (SOAs)—a major component of fine particulate matter — with implications for both air quality and climate. As a semi-volatile compound, PA partitions between the gas and condensed phases and exhibits environment-dependent photochemistry. In complex aerosol matrices, which can include supersaturated solute states, understanding the solvent-dependent photodynamics of PA is essential for accurately assessing its atmospheric behavior.

This study investigates the excited-state dynamics of PA in bulk water and acetonitrile solutions using two ultrafast spectroscopy techniques: time-correlated single photon counting (TCSPC) and transient electronic absorption spectroscopy (TEAS). TCSPC measurements reveal longer fluorescence lifetimes in acetonitrile (7.5 ns) than in water (4 ns), indicating solvent-mediated differences in the relaxation dynamics. TEAS spectra, obtained for PA in water/acetonitrile following 345 nm excitation (a near-UV wavelength chosen to be relevant to atmospheric conditions) show evolving excited-state absorption (ESA) features, with kinetic analysis identifying three time constants: 400 ps, 7.5 ns, and 110 ns. Notably, signatures of a transient species (tentatively, T_2 state population) appear in acetonitrile TEAS measurements but are absent in water.

The bulk-phase results highlight the critical influence of solvent environment on the excited-state behavior of PA and suggest implications for its reactivity and lifetime in atmospheric condensed aerosol phases. Ongoing work is extending these studies to 30-micron aqueous droplets using TCSPC, aiming to better replicate the microenvironments of atmospheric aerosols and explore the air–water interfacial chemistry. These droplet-phase experiments will give new insights into how confinement and surface effects modulate the photochemical pathways of PA, offering a valuable complement to the bulk solution measurements.

5AC.4

Water Surfaces and Multiphase Chemistry in/on Droplets: Towards a Molecular View of Atmospheric Chemistry at the Air-Aqueous Solution Interface. ALEXANDRA DEAL, Franky Bernal, Andreas Siebert, Alexander Prophet, Mauricio Lopez Luna, Monika Blum, Richard Saykally, Kevin R. Wilson, *Lawrence Berkeley National Laboratory*

Recent evidence for novel chemistry and enhanced reaction rates on water surfaces has implications for environmental and atmospheric chemistry. However, the fundamental causes for these observations are still under investigation, and direct assessment of potential drivers, including increased concentrations, pH effects, and competitive adsorption, is challenging. Levitated microdroplets are used to study the pH-dependent ozonation of thiosulfate, a surprisingly surface-active doubly charged anion, and the associated MS analysis provides a high level of kinetic detail. Kinetic modeling of the microdroplet reaction kinetics demonstrates that the droplet interface significantly mediates sulfate production, which could impact droplet growth, cloud condensation, and radiative forcing. Sulfate can be produced by two different pathways at pH 5, one with a contribution from the interface of >70% and the other occurring predominantly in the bulk (>98%). Additionally, the overall reaction rate decreases with increasing pH, suggesting competitive adsorption between OH^- and the anion of interest, which has significant implications for understanding the overall ‘acidity’ and ‘basicity’ of the water surface. This is further investigated using surface-specific techniques including deep UV second harmonic generation (DUV-SHG) and ambient pressure X-ray photoelectron spectroscopy (APXPS) The findings from these works demonstrate the importance of using multiple techniques to obtain a molecular view of air–water interfaces and the utility of fundamental studies in piecing together a thorough understanding of atmospheric chemistry involving water surfaces.

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5AC.5

Aqueous Processing of Volatile Organoselenium-derived Secondary Aerosols Results in Reactive Oxygenated Species Production. MICHAEL LUM, Ying Zhou, Erin Bowey, Lillian Tran, Linhui Tian, Wonsik Woo, Dimitri Niks, Aiden Pianalto, Yiwen Zhu, Yujie Men, Don Collins, Roya Bahreini, Ying-Hsuan Lin, *University of California, Riverside*

Dimethyl selenide (DMSe) and dimethyl sulfide (DMS) are major organoselenium and organosulfur species that are released from phytoplankton in marine environments and undergo atmospheric oxidation to form secondary aerosols (SA). Prior studies indicate that DMSe-derived secondary aerosols exhibit elevated oxidative potential. However, the role of Se and the underlying processes responsible for reactive oxygen species (ROS) production along with the impact on aqueous environmental systems remain unclear. In this study, we used electron paramagnetic resonance spectroscopy (EPR) to detect, quantify, and contrast ROS produced by DMSe- and DMS-derived secondary aerosols in aqueous solutions and X-ray photoelectron spectroscopy (XPS) to confirm oxidation state changes for Se elements before and after dissolution. DMSe-derived aerosols and DMS-derived aerosols produced 9.0 ± 2.1 nmol ·OH/μg SA and 0.29 ± 0.11 nmol ·OH/μg SA, respectively. The average 33-fold difference in ·OH produced by each system implies different dominating mechanism of formation. The sulfur-containing system will form ·OH through peroxide decomposition, while the selenium-containing system is capable of producing ·OH through Fenton-like chemistry in addition to potential peroxide decomposition. Se was observed to cycle between oxidation states Se(0), Se(IV), and Se(VI) when exposed to water, catalyzing the production of ·OH. Selenate (SeO_4^{2-}), selenite (SeO_3^{2-}), selenium dioxide (SeO_2), and methane seleninic acid (CH_4O_2Se) were confirmed to be redox-active compounds within DMSe-derived secondary aerosols driving the production of ·OH radicals. This study highlights the redox cycling of atmospheric particulate Se species in the production of ·OH radicals in aqueous environments, which has important implications for atmospheric aqueous chemistry and biogeochemical cycling.

5AC.6

Probing Reaction Pathways of RO_2 Radicals in the Atmospheric Aqueous Phase. LEXY LEMAR, Seamus Frey, Yaowei Li, Frank Keutsch, Jesse Kroll, *MIT*

Organic peroxy radicals (RO_2) are key intermediates in most oxidation processes, and their branching has a governing influence on product distributions, including secondary organic aerosol (SOA) formation. RO_2 chemistry has received considerable study in the gas phase, but significantly less in aqueous environments (e.g., deliquesced aerosols, cloud droplets), and represents a major uncertainty in our understanding of atmospheric aqueous-phase oxidation, including the formation of aqueous SOA. In this study, we probe how the reaction pathways of RO_2 radicals differ between the gas and aqueous phases. The reactions of these intermediates are not well constrained in the atmospheric aqueous phase and likely differ significantly from that in the gas phase due to locally high concentrations, solvent effects, and competition with reactions unique to the aqueous phase, such as oligomerization or hydrolysis. We assess the impact of these differences by direct comparison of the product distributions through gas-phase experiments, carried out in an environmental chamber, and aqueous experiments, carried out both in the bulk phase (by oxidation within an aqueous reactor) and in the aqueous particulate phase (by oxidation within deliquesced particles in the environmental chamber). In both types of aqueous experiments, we modulate the chemical environment by varying the concentrations of water-soluble organic species and OH precursors (H_2O_2, HONO, and NO_2^-) and initiate oxidation chemistry using UV lights. A number of analytical instruments, including an aerosol mass spectrometer, a chemical ionization mass spectrometer, and a scanning mobility particle sizer, are used to provide real-time concentrations of both gas- and aerosol-phase products. Direct comparison of the evolution of various products across phases (gas phase vs. bulk aqueous phase vs. aqueous particulate phase), provides new insight into the mechanisms and branching ratios governing oxidation product formation in the atmospheric aqueous phase, improving our understanding of aqueous-phase RO_2 chemistry and hence the aqueous generation of SOA and gas-phase products.

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5AC.7

Using a Particle-Resolved Model to Design Cloud Chamber Experiments for IEPOX-SOA Formation. MANISHKUMAR SHRIVASTAVA, Jie Zhang, Steven Krueger, John Shilling, Alla Zelenyuk, Yuzhi Chen, Richard Flagan, Mikhail Ovchinnikov, Raymond Shaw, Will Cantrell, Tania Gautam, Gourihar Kulkarni, Mikhail Pekour, *Pacific Northwest National Laboratory*

Isoprene is the largest non-methane organic gas emitted by vegetation globally. Over the past decade, extensive laboratory and modeling studies have provided important insights into the formation of isoprene epoxydiol secondary organic aerosol (IEPOX-SOA). However, most laboratory measurements have been limited to flow tubes or environmental chambers focused on aerosol chemistry, while direct measurements of in-cloud chemical formation of IEPOX-SOA remain rare and have not yet been conducted in laboratory cloud chambers.

In this study, we use our detailed particle-resolved 1D EMPM-Chem model to design experiments in the Michigan Tech cloud chamber aimed at maximizing IEPOX-SOA formation. The model resolves turbulence down to ~1 mm (Kolmogorov scales) and performs cloud chemistry calculations on every droplet and haze particle. It tracks each particle's history as it undergoes repeated cycles of activation and evaporation.

Simulations show that in weakly forced conditions in the atmosphere (like a small updraft velocity in a shallow cumulus cloud parcel)—producing smaller, longer-lived cloud droplets—are favorable for IEPOX-SOA formation via cloud chemistry, as larger droplets are lost more quickly due to gravitational settling. Within the laboratory cloud chamber, forcing can be reduced by lowering the temperature difference between the bottom and top plates that lowers the mean supersaturation and its variability, enhancing droplet lifetimes and in-cloud reaction times. Maintaining acidic conditions in cloud droplets also accelerates IEPOX-SOA formation and favors production of non-volatile products like organosulfates and methyltetrol oligomers over semi-volatile methyltetrols, which can be lost during sampling.

We use these modeling insights to guide actual IEPOX-SOA experiments in the cloud chamber. This talk will present key lessons learned about cloud chemical kinetics of IEPOX-SOA and demonstrate how state-of-the-science modeling tools can be used to design more effective laboratory experiments that improve our understanding of real atmospheric processes.

5AP.1

The Role of Interfacial Processes in Accelerated Reaction Kinetics in Aqueous Microdroplets. Shu Yang, Meng Li, Justin Wang, Vicki Grassian, Satish Kumar, CARI DUTCHER, *University of Minnesota*

Aqueous microdroplets have been shown to exhibit enhanced chemical reactivity compared to bulk solutions, although the mechanisms for these enhancements are not completely understood. Here we combine experimental measurements and kinetic modeling to show the strong coupling of interfacial reactions and gas/droplet partitioning in the condensation reaction of pyruvic acid (PA) to yield zymonic acid (ZA) in acidic aqueous microdroplets. Using a newly developed diffusion-adsorption-reaction-evaporation model, we simulate the intricate kinetics where reactant diffuses and adsorbs to the surface of a microdroplet, where it can remain, react, desorb, or evaporate, while product formed at the surface desorbs and diffuses into the bulk. Tensiometry measurements are utilized to parameterize the adsorption kinetics in the Langmuir adsorption model. The model quantitatively predicts compositional changes during the condensation reaction, and provides insights into how microdroplet reactivity is controlled by coupled interfacial reactions and the gas-phase partitioning of PA and water. Moreover, the model can be generalized to systems where the interplay of reaction, adsorption, diffusion, and evaporation processes varies with droplet size, from nanometer to millimeter scales, or with different initial reactant concentrations, leading to diverse kinetic behaviors. Notably, we observe an intriguing competition between evaporation and reaction rates that determines the optimal droplet size. While smaller droplets exhibit faster reaction rates due to the dominance of surface reactions, they also experience higher PA evaporation rates, leading to more PA being consumed via evaporation rather than reaction. These findings offer insights into the complexity of microdroplet reaction kinetics, with interfacial processes playing a central role, and provide a universal mechanism for understanding reaction kinetics in aqueous nano- and microdroplets.

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5AP.2

Surface and Interfacial Tensions Affect Size-dependent Phase Separation in Droplets. ANDREAS ZUEND, Ryan Schmedding, *McGill University*

Ultrafine aerosol particles are sensitive to the chemical composition and physical properties of surfaces and interior interfaces. For these particles, the thermodynamic equilibrium state depends on size, composition, and temperature with a tight coupling of bulk and surface properties. Liquid–liquid phase separation (LLPS) has impacts on size-dependent particle hygroscopicity, heterogeneous reactions, and phase viscosities. In turn, the presence of LLPS introduces additional interfacial tension contributions to a particle's overall Gibbs energy. Numerous laboratory experiments had characterized the onset relative humidity of LLPS in larger aerosol particles and macroscopic bulk systems. However, in sufficiently small particles, the interfacial tension between two liquid phases constitutes an energetic barrier that may prevent the formation of an additional liquid phase. Determining this small-size limit is a key question, one that is difficult to explore experimentally. Moreover, in models the small-size limit hinges on the method used to estimate interfacial tensions and on proper accounting for feedbacks on the air–liquid surface tension of an aqueous aerosol. We will introduce a predictive equilibrium droplet model based on the Aerosol Inorganic–Organic Mixtures Functional groups Activity Coefficients (AIOMFAC) model. This model enables size-dependent computations of surface and interfacial tension effects on bulk–surface partitioning within phase-separated and single-phase particles. We evaluate a selection of methods for computing interfacial tension in multicomponent aerosol. We found that Antonov's rule often provides good agreement with observed liquid–liquid interfacial tensions in the case of highly immiscible mixtures, while a different method is more adequate for partially miscible systems. Among the options studied, we show that two interfacial tension approaches substantially lower the onset relative humidity of LLPS as particle diameter decreases in the ultrafine regime. Our methods can also be adopted to model interfacial tension effects in dynamic, time-resolved simulations.

5AP.3

Describing the Surface Tension of Aerosol Droplets Containing Mixtures of Organic Solutes. ALISON BAIN, *Oregon State University*

The partitioning of surface-active molecules and surface tension of aerosol droplets play a role in their hygroscopic growth and the eventual formation of cloud droplets. Recent experimental work and modeling efforts have shown that, due to the high surface-area-to-volume ratio inherent to aerosol droplets, macroscopic surface tension measurements alone are insufficient to predict the surface tension in aerosol droplets. The small volume, and thus a finite reservoir of surfactant molecules, in addition to the relative increase in surface sites, can lead to bulk surfactant concentration depletion in droplets. This depletion means that at equilibrium, the fraction of surface sites occupied by surfactant molecules in a droplet may be lower than a macroscopic solution of the same total composition, resulting in the droplet having a higher surface tension than the macroscopic solution.

Aerosol droplets have high chemical complexity, and field measurements collecting aerosol samples find many surface-active molecules. Thus, it is necessary to understand surfactant partitioning and surface tension lowering in droplets containing two or more surface-active species. Here, I will describe surface tension measurements of picolitre volume droplets containing two strong surfactants and an organic cosolute. Three mixed surfactant partitioning schemes are used to make predictions of aerosol surface tension and compared to the experimental observations. Finally, we test an effective Langmuir isotherm and a surrogate surfactant approach to predict the surface tension of accumulation mode aerosol, where the individual properties of organics in a mixture are unknown.

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5AP.4

Influence of Surfactants on Morphology and Phase State of Internally Mixed Atmospheric Aerosol Particles. REENA JAGLAN, Miriam Freedman, *The Pennsylvania State University*

Liquid-liquid phase separation (LLPS) and the mixing state of atmospheric aerosols influence particle morphology, phase behavior, and physicochemical properties, thereby modulating their role in critical environmental processes such as cloud formation, radiative forcing and climate dynamics. However, while surfactants are common in aerosol particles, the influence of surfactants on aerosol physical and chemical properties remains uncertain, introducing significant challenges in understanding aerosol behavior and its broader environmental impacts. Herein, we investigate the effects of various hydrocarbon surfactants on the phase transitions and morphology of model secondary organic aerosol (SOA) particles. To form these aerosol particles, surfactants were mixed with model SOA compounds (2-methylglutaric acid or 1,2,6-hexanetriol) and ammonium sulfate to produce supermicron droplets for study with optical microscopy. Optical microscopy showed a range of morphologies, including core-shell, partially engulfed-like structures, depending on surfactant type, concentration and relative humidity (RH). At higher concentration of surfactants, an anionic surfactant exhibits partially engulfed-like structures, while neutral surfactants favor a core-shell morphology. Cationic surfactants displayed varied morphology based on the organic SOA compound. These morphological transitions are primarily controlled by interfacial energy, with spreading coefficients responding to differences between surface/interfacial tension between the air, aqueous, organic, and inorganic phases. Furthermore, in aerosol particles containing neutral surfactants, we observed a primary LLPS transition forming an organic-rich outer shell and a mixed organic-inorganic phase core, followed by a secondary LLPS transition at lower RH, redistributing ammonium sulfate to the core. Also at the submicron scale, transmission electron microscopy (TEM) images of surfactant-containing aerosol particles agree at sufficiently larger sizes with our results for supermicron droplets, enhancing our understanding of surfactant effects on aerosol particles morphology. Our findings provide a detailed understanding of how different types of surfactants drive phase transitions and morphological evolution in internally mixed aerosols, offering key insights into their role in atmospheric processes and aerosol-climate interactions.

5AP.5

Single-Droplet Techniques for Analysis of Evaporation Kinetics and Particle Morphology in Spray Dryers. Barnaby Miles, Lukesh K. Mahato, Rachael E.H. Miles, Emmanuelle Costard, Jewe Schröder, Arend Dubbelboer, JONATHAN P. REID, *University of Bristol*

Investigation into the impact of droplet drying kinetics on the morphology of the resultant dried particle is crucial for understanding the spray drying process. Understanding the impact of the drying conditions on the resultant powder properties can help increase the spray dryer efficiency and product quality (Eijkelboom et al. 2024). Experiments in spray dryers have struggled to monitor the drying of the individual droplets directly, whereas single droplet drying (SDD) experiments have been shown to be successful in relating the drying behaviour of single droplets to the resultant particle morphology (Miles et al. 2024). However, SDD techniques struggle to represent the droplet size and temperature profile differences seen in spray dryers (Eijkelboom et al. 2023), so more work is needed to demonstrate if they are relevant for helping increase our understanding of the drying process in spray dryers.

Here, we present novel investigations into the drying kinetics of a range of fat free, dairy-based powders, the impact of their drying behaviour on the final particle morphology and comparative generation of particles in an SDD technique against a small-scale Büchi B290 spray dryer.

An electrodynamic balance was used to characterise the evaporation behaviour of the skimmed milk powders which, coupled with the SADKAT model (Robinson and Hardy (2022)) and the diffusion model reported by Siemons et al. 2019, allowed us to predict the SDD conditions that would reproduce the drying conditions experienced by droplets in a Büchi spray dryer. Using a falling droplet column we then collected samples of particles that had been generated under equivalent drying conditions to those in a Büchi spray dryer (Miles et al. 2025). SEM analysis of the particles showed we had successfully generated comparable morphologies in the SDD and spray dryer samples.

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5AP.6

Chemical Composition Dependent Morphology of Model Bioaerosols Generated in Aerovirological Studies. DEEPAK SAPKOTA, Yuhui Guo, Zhenpeng Qin, Hui Ouyang, *The University of Texas at Dallas*

Virus-laden particles are bioaerosols generated through respiratory activities or aerosol generators in aerovirological experiments. Bioaerosol morphology, which encompasses characteristics such as shape, phase state, and chemical homogeneity, is a critical property for the mechanistic understanding of virus transmission in indoor environments. Currently, aerovirological experiments often utilize different aerosolization media, each with distinct physical properties and chemical compositions. We hypothesize that these varying compositions result in different morphologies, which in turn might contribute to inconsistencies in study outcomes. In this study, Scanning Electron Microscopy (SEM) and Energy-Dispersive X-ray Spectroscopy (EDX) imaging were used to examine the morphology and chemical composition distribution of model bioaerosols equilibrated at a controlled relative humidity (RH) of 30%. Our results show that bioaerosol morphology is strongly influenced by chemical composition. In two-component systems with a 1:1 organic-to-inorganic mass ratio, aerosols containing NaCl with mucin or bovine serum albumin (BSA) appeared well-mixed, whereas NaCl with glucose or dipalmitoylphosphatidylcholine (DPPC) exhibited phase separation, with the inorganic salt crystallized and forming a clear boundary from the organic contents. Among cell culture media, Dulbecco's Modified Eagle Medium (DMEM), with or without fetal bovine serum (FBS) and penicillin, formed core-shell phase-separated structures, whereas Eagle's Minimum Essential Medium (EMEM) displayed a well-mixed distribution. Artificial saliva prepared following Woo's formulation showed homogeneous chemical distribution. In contrast, Artificial Saliva (AS) and Artificial Lung Fluid (ALF), purchased and used without modifications from Pickering Laboratories, both exhibited phase-separated morphologies, with AS forming a core-shell structure. Interestingly, even at 30% RH, several organic-rich bioaerosols, such as NaCl with glucose, DMEM formulations, and AS from Pickering Lab exhibited semi-solid states. If virions are localized with organics, the spatial distribution of these organics may influence their microenvironmental conditions and survival mechanisms. Therefore, when possible, bioaerosol morphology should be reported in laboratory-based aerovirology studies to improve reproducibility and understanding of transmission dynamics.

5AP.7

Evaporation Kinetics and Dried Agglomerate Particles Morphology of Aqueous Aerosol Droplet Containing Nanoparticles. LUKESH K. MAHATO, Panagiotis Georgiou, Barnaby Miles, Sorrel K. Haughton, Rachael E.H. Miles, Steven P. Armes, Jonathan P. Reid, *University of Bristol*

Understanding the agglomeration of nanoparticles through evaporation-induced assembly is a key process, highly desirable for manufacturers in powder technology, such as those in pharmaceuticals, food products, cosmetics, and fine chemicals. Controlling the dried agglomerate particles can also facilitate understanding of the dried particles' optical and mechanical properties. Typically, morphology is influenced by the drying conditions and the diffusional properties of nanoparticles. In this study, we evaporate aerosol droplets of monodisperse size containing monodisperse, bi-disperse, tri-disperse or polydisperse copolymer nanoparticles of total concentration 2% v/v, at a relative humidity between 0 and 45% and a temperature of 21ºC. We obtained the dried particle using the falling droplet column (FDC) technique. Additionally, we use the electrodynamic balance (EDB) to measure the evaporation rate of the drying colloidal aqueous aerosol droplet. To prepare the sterically stabilized deblock copolymer nanoparticles of desired sizes (30 to 228 nm), we used the polymerization-induced self-assembly (PISA) technique. We observe that as the evaporation rate (K) increases, the degree of buckling increases (i.e. the shape transitions from spherical to donut shapes), consistent with changes in the commonly used Peclet number (Pe) for explaining the dried particle morphology. Moreover, the degree of buckling of dried particles increases with an increase in the nanoparticle initial diffusional coefficient (D) while keeping K constant. D increases as the nanoparticle's size decreases. We estimate the average diffusion coefficient (D_{avg}) using the weighted harmonic mean diameter of nanoparticles for bi-disperse, tri-disperse, or polydisperse nanoparticles. The harmonic mean diameter varies by varying the relative concentration of smaller to larger nanoparticles. Interestingly, we observed similar morphology of dried particles for a given average diffusional coefficient for monodisperse, bi-disperse, tri-disperse or polydisperse nanoparticles for a given K. Further, we varied the dried particle morphology from spherical to buckled by varying the D_{avg} for a given K.

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5CE.1

Gas and Aerosol Phase PFAS Measured with Iodide HR-ToF-CIMS in Houston. Zachary Watson, Lee Tiszenkel, Vignesh Vasudevan Geetha, SHANHU LEE, *The University of Alabama in Huntsville*

Per- and polyfluoroalkyl substances (PFAS) are a class of toxic synthetic compounds produced from industrial plants and manufacturing processes, and due their low chemical reactivities, they are referred to as “forever chemicals”. PFAS compounds have been detected typically using offline analytical techniques such as liquid chromatography mass spectrometry, but in-situ measurements of atmospheric PFAS are very limited. Here, we have measured PFAS compounds simultaneously in the gas and aerosol phase an iodide high-resolution time-of-flight chemical ionization mass spectrometer (HR-ToF-CIMS) attached to a Filter Inlet for Gases and AEROsols (FIGAERO) at the urban center of Houston, Texas in October, 2022. Our measurements identified several PFAS compounds including perfluorooctanoic acid (PFOA), hexafluoropropylene oxide dimer acid (HFPO-DA, GenX), perfluoropentanonic acid (PFPeA), and trifluoroacetic acid (TFA), both in the gas and aerosol phase. In this presentation, we will discuss the calibration, volatilities, gas-to-particle conversion, and potential associations of these PFAS compounds to other pollutant trace gases at the urban site. This is study represents one of the very few studies that measured PFAS at the urban residential areas at real time, thus will have important implications in understanding the effects of PFAS on urban air quality and public health.

5CE.2

Heterogeneous Reaction of Perfluorinated Carboxylic Acids (PFCAs) with Aerosol Proxies: Implications for Aerosol-Mediated Long-Range Transport. TREVOR VANDENBOER, Nasrin Dashti, Elizabeth Gaona-Colmán, Jeremy Wentzell, John Liggio, Cora Young, *York University*

Perfluorinated carboxylic acids (PFCAs) are the notorious persistent environmental degradation end products of the oxidation of many poly- and perfluoroalkyl substances (PFASs). PFAS are highly used substances due to their stability and surfactant properties leading to industrial applications such as textiles manufacture, cookware, and firefighting foams.

These substances are ubiquitously distributed in the environment, even in remote locations such as the Arctic as they are detected and increasing in deposition in ice core records. In the atmosphere, short chain PFCAs can be emitted directly into the environment or be formed from reactions of precursors (e.g. fluorotelomers, hydrofluorocarbons) with atmospheric oxidants (e.g. hydroxyl radicals). Despite the well-known atmospheric formation of short chain fluorinated acids, there is still a gap of knowledge regarding their transport to remote locations, where aerosols could contribute to this transport, as suggested by ice core analysis. In this study we present the uptake of gas phase PFCAs onto aerosol proxies, including carbonate salts as proxies of crustal mineral dust. The experiments were performed in a flow tube reactor at 296 K and atmospheric pressure with zero air as carrier gas coupled to a chemical ionization mass spectrometer (CIMS) as detection system, using acetate as the reagent ion. Controlled amounts of gas phase perfluoropropionic acid (PFPrA) were obtained from the acid displacement reaction of HCl(g) over a salt bed of sodium perfluoropropionate. To our knowledge, this work is the first determination of the reactive uptake coefficients of gas phase PFCAs onto aerosol proxies. Reactive uptake coefficients will be presented and the implications for PFAS long-range transport will be discussed.

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5CE.3

Condensed-phase Hydrolysis of Per- and Polyfluoroalkyl Substances (PFAS). EMMA D'AMBRO, Benjamin Murphy, Ivan Piletic, Havala Pye, Jesse Bash, *US Environmental Protection Agency*

Per- and polyfluoroalkyl substances (PFAS) are a class of thousands of industrially-produced compounds that have been released into the environment for decades. They are often long-lived, resulting in their distribution throughout the globe in all environmental media, and earning them the nickname “forever chemicals”. Despite their nickname, several atmospheric chemical transformations have been documented, and as our understanding of the present and historical atmospheric emissions of PFAS grows, so too does our understanding of important atmospheric chemical pathways. One such pathway is the hydrolysis of acyl fluoride-containing compounds into carboxylic acid-containing compounds. The hydrolysis of acyl fluorides to carboxylic acids is rapid in bulk condensed water, and the resulting carboxylic acids exhibit higher solubility in atmospheric particles resulting in decreased atmospheric lifetimes due to enhanced deposition. This process is relevant for one compound of particular regulatory and public interest: HFPO-DA (GenX). We apply the Community Multiscale Air Quality (CMAQ) model version 5.4 to a case study in Eastern North Carolina to model the PFAS emissions, transport, and chemical transformations at fine scale (1 km) from the Chemours Inc. Fayetteville-Works facility. We implement condensed-phase hydrolysis of hexafluoropropylene dimer acyl fluoride (HFPO-DAF) to hexafluoropropylene dimer acid (HFPO-DA) in aerosol and cloud liquid water. We evaluate the model’s deposition predictions with deposition measurements in North Carolina and discuss the impact of this chemical transformation on results.

Disclaimer: The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

5CE.4

Real-Time Detection of Particle-Phase Per- and Polyfluoroalkyl Substances (PFASs) Using Aerosol Mass Spectrometry. XIANGXINYUE MENG, Sahir Gagan, Barbara Turpin, Jason Surratt, Yue Zhang, *Texas A&M University*

Per- and polyfluoroalkyl substances (PFASs), known for their resistance to degradation, are environmental pollutants with significant adverse health effects. Their widespread occurrence in rivers, soils, landfills, consumer products, drinking water sources, as well as indoor and outdoor air near fluorochemical manufacturing facilities, has raised significant environmental concerns. Furthermore, previous studies have demonstrated the presence of PFASs in inhalable fine particulate matter, highlighting the need to assess their abundance, distribution and potential health risks in atmospheric aerosols using more advanced analytical techniques. Current analytical methods for quantifying particle-phase PFASs predominantly rely on offline sampling techniques, while real-time, in situ monitoring technologies remain underdeveloped. In this study, a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) was employed to establish an online approach for identification and quantification of PFASs-containing particles from laboratory-generated aerosols. Four standard species, perfluoro-n-butanoic acid (PFBA), perfluoro-n-octanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and hexafluoropropylene oxide-dimer acid (GenX) were quantified with the AMS. Consistent fragmentations were observed and the ionization efficiencies of these standards were derived. A series of fragment ions are identified as the major tracer ions for PFASs-containing particles, including CF, CF_2, CF_3, and C_2F_5, suggesting these fluorocarbon ions may be useful for identifying particle-phase PFASs in real-time. A field study conducted near a fluorochemical manufacturing facility in North Carolina was used to validate the laboratory techniques. The derived tracer ions from PFASs and the capability to quantify particle-phase PFASs species can substantially enhance our understanding of the sources, transport, fate, and health impacts of PFASs-containing aerosols, further providing mitigation of these emerging environmental concerns.

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5CE.5

Effects of an Ether Group on the Mechanism, Products, and Nitrate and Secondary Organic Aerosol Yields for the Reaction of Dioctyl Ether with OH/NOx. Anna Ziola, John Orlando, PAUL ZIEMANN, *University of Colorado Boulder*

Ethers are a particularly interesting class of VOC whose atmospheric chemistry is still not fully understood. They are common components of volatile chemical products, reformulated "cleaner" gasoline, solvents used by industry, and agricultural products, and have been shown to react much faster with OH radicals and have lower organic nitrate and SOA yields than the corresponding alkanes. For example, in a study of C_5 and C_6 ethers it was shown that an ether group reduced the organic nitrate yields by ~50% compared to the corresponding alkane, while others have shown that the SOA yields from C_5–C_{10} glycol ethers (which typically contained two ether and one hydroxyl groups) were <1%. In the light of these results, we have conducted an environmental chamber study of the effect of an ether group and a long alkyl chain on the branching ratios between organic nitrate and alkoxy radical formation, the reaction products and mechanism, and SOA yield using dioctyl ether [$CH_3(CH_2)_7O(CH_2)_7CH_3$] (DOE) as a model compound. The presence of an ether group and symmetric structure greatly simplifies the reaction products and mechanism compared to glycol ethers, which have multiple ether and hydroxyl groups, each of which impacts H abstraction by OH radicals, organic nitrate and alkoxy radical formation, and alkoxy radical decomposition and isomerization throughout the molecule. This complexity makes it difficult to interpret product measurements and determine the impact of an ether group. In addition, the two C_8 alkyl chains in DOE allow alkoxy radicals to isomerize faster away from the ether group than with short alkyl chains, thus potentially competing with decomposition since isomerization across the ether group is slower by a factor of ~30 due to ring strain. All these factors make for an easier comparison to the reactions of large alkanes, which we have studied in detail.

5CE.6

Variable-Depth Surface Composition Measurements of Micro- and Nano-Plastics Using Matrix Assisted Laser Desorption Ionization (MALDI) Mass Spectrometry. SAMANTHA KRUSE, Andre Benally, Mohammad Shohel, Steven Storch, Jake Zenker, Andres Sanchez, Jess Kustas, Ryan Davis, *Sandia National Laboratories*

Micro- and nano-plastics (MNPs) are an emerging environmental contaminant that can persist in the atmosphere for days to weeks due to their increasingly small sizes. Aerosolized MNPs have been identified in samples across the globe, with higher concentrations near large cities and industrial sources, and lower concentrations as far remote as the arctic. MNPs are known to adsorb pollutants while in the environment, which can exacerbate their impacts on the environment and public health. As MNP concentration in the atmosphere increases, it becomes critical to better understand the unique surface chemistry of MNPs. To approach this problem, we are developing a technique to analyze the surface composition of MNP using soft ionization mass spectrometry. In this approach, aerosolized MNP are coated with an organic matrix using a custom-built saturator/condenser apparatus and collected on a substrate for analysis with matrix-assisted laser desorption ionization mass spectrometry (MALDI). We demonstrate the application of this approach with polystyrene latex (PSL) spheres. The coated PSL spheres were collected by a micro-orifice uniform deposition impactor (MOUDI), and their matrix coating thickness was determined in real time by an aerodynamic particle sizer (APS). Post-collection, the samples were measured using atomic force microscopy (AFM), scanning electron microscopy (SEM), and MALDI to determine their surface morphology and composition. The depth of the measurement into the surface of the PSL spheres were determined by the ratio of matrix and polystyrene signal. The influence of different variables including matrix type, coating thickness, and PSL sphere diameter will be discussed.

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5CE.7

Mobile Metals Measurements Using a New Microwave-Induced Plasma Time-of-Flight Mass Spectrometer examining Roadways and Industrial Sites. EDWARD FORTNER, Alexander Gundlach-Graham, Martin Tanner, Conner Daube, Jay G. Slowik, André S. H. Prévôt, John Jayne, Douglas Worsnop, *Aerodyne Research, Inc.*

Metals in atmospheric particles have for many years been a focus of concern related to human health. Metals also have distinct chemical fingerprints which can be utilized as chemical tracers for emissions tracking. Mobile platforms enable the measurement of microenvironments at a neighborhood level and provide the flexibility to optimize measurement locations for different wind directions. The utilization of this measurement strategy requires rapid measurements of metals. Existing metals measurement techniques are not suitable for mobile applications, which require quantitative data on timescales of ~1 min or better. X-ray fluorescence-based systems have insufficient time resolution, laser ablation/ionization mass spectrometers lack quantification, and inductively coupled plasma (ICP)-based mass spectrometers are impractical due to their reliance on an Ar-based plasma.

The microwave-induced plasma time-of-flight mass spectrometer (mipTOF), recently developed by Tofwerk AG (Schild et al., 2018), provides the time resolution, quantification and field adaptability necessary for mobile metals measurements. Unlike conventional ICP-based systems, the mipTOF uses a microwave-assisted (MICAP) plasma source sustained with N_2 that maintains performance and stability during direct sampling of ambient air. The mipToF was run at 1 second time resolution and calibrations were performed daily by nebulizing a mixture of suspended 92 nm silver nanoparticles in a dissolved multi-element standard.

The mipToF was operated for 5 days on board the Aerodyne Mobile Laboratory 23 -27 March 2025. A number of roadside sources were evaluated including tunnel traffic, industrial sources such as galvanizing and electroplating facilities were sampled along with general aviation aircraft emissions. The different metals signature of these sources can be used for relative source attributions. An Aerodyne soot particle aerosol mass spectrometer (SP-AMS) also sampled alongside the mipToF for the first two days of the campaign and metals measurement comparisons are presented.

Schild, M., et al. (2018) Anal. Chem. 90, 13443-13450.

5ES.1

PTR-TOF: Real Time Analysis of Volatile and Condensed Organics on a Molecular Composition Level. MARKUS MUELLER, Todd Rogers, Tobias Reinecke, *IONICON Analytik GmbH., Innsbruck, Austria*

IONICON is the leading producer of real-time trace gas analyzers based on Proton Transfer Reaction – Mass Spectrometry (PTR-MS). Our extremely sensitive PTR-TOF systems allow for quantitative detection of concentrations of < 1 pptv of volatile organic compounds and, with our genuine CHARON particle inlet, < 100 pg m^{-3} of condensed organics on a molecular composition level without sample pre-treatment.

Our instruments are used in atmospheric and environmental research, indoor air analysis, engine emissions testing, food & flavor science, illicit substances detection, medical breath analysis and many more. Air quality monitoring networks and mobile laboratories benefit from our dedicated, robust trace VOC analyzers for mobile and field deployment. For this Application Showcase we will give a short introduction to PTR-MS including basic operation principles and application examples in aerosol research.

With our PTR-TOF 4000 instrument we take the slogan of this session ‘Scientists doing Experiments drinking Coffee’ almost literally by performing a real-time measurement of coffee headspace. Similar to organic aerosol, coffee headspace is a very complex sample with a plethora of chemical information. The interpretation of such complex mass spectra is not trivial but with the new IONICON Data Analyzer (IDA) the audience is guided through all the needed data-analysis steps to get from raw data to quantitative time-series for compounds of interest.

Both experienced instrument developers and application scientists will be present during this showcase to engage with the audience, discuss experiences from measurement campaigns and answer all questions.

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5ES.2

Designing a Successful Community-Engaged Particulate Matter Sampling Campaign with the Ultrasonic Personal Air Sampler. JESSICA TRYNER, Gabe Neymark, Luis Hernandez Ramirez, Mollie Phillips, Xiaoying Li, Daniel Dean, Grant Erlandson, Bonnie Young, Sherry WeMott, Nayamin Martinez, Sheryl Magzamen, *Access Sensor Technologies*

Environmental issues in communities that are disproportionately burdened by air pollution are often best understood by the residents of those communities. When studying environmental exposures in these communities, collaboration between aerosol scientists, epidemiologists, community organizations, and residents is critical. To investigate air pollution from local agricultural operations, rural residents of California's Central Valley collected PM_{10}, $PM_{2.5}$, and organophosphate pesticide samples outside their homes using Access Sensor Technologies' Ultrasonic Personal Air Sampler (UPAS) during two campaigns that took place May–July and August–September 2024. Whereas only 1/21 samples attempted during the first campaign were successful, 20/36 samples attempted during the second campaign were successful. All 16 of the unsuccessful samples from the second campaign failed due to issues outside of residents' control (for example, high outdoor temperatures). Feedback received from residents during these sampling campaigns helped researchers from Access Sensor Technologies and Colorado State University learn how to prepare air samplers, sample media, standard operating procedures, data log forms, and in-person training activities to better support residents' efforts and maximize the number of samples collected successfully. This presentation and hands-on instrument demonstration will focus on these lessons learned while also covering the range of sampling settings available on the UPAS, how to select the appropriate settings based on sampling goals, and general considerations for sampling outdoors with the UPAS.

5ES.3

The TSI Portable Water CPC: OmniCount 3002. JUSTIN S. KOCZAK, Daniel R. Troolin, Andrea J. Tiwari, Noah Bock, Aaron Avenido, *TSI Incorporated*

In this Instrument Showcase, TSI will provide an overview of the new Model 3002 OmniCount™ Portable Water-based Condensation Particle Counter (PWCPC). The showcase presentation will cover the features, specifications, and theory of operation of the instrument, as well as sample data taken from real-world use cases. The presentation will culminate in an interactive demonstration with the audience.

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5HR.1

Salivary Metabolomics and Air Pollution Exposure in Toddlers: Black Carbon and $PM_{2.5}$ are Associated with Pathways Related to Inflammatory Regulation. ROBY GREENWALD, Yu Jung Lin, Bisan Hammid, Nadia Alhadidi, Patrick Chepaitis, Donghai Liang, *Georgia State University*

The Air Pollution Exposure in Child Care Settings (APECCS) study measures air pollution exposure in healthy children ages 3-4 years and explores biological mechanisms of response using salivary metabolomics. We coordinated exposure assessment activities at child care centers in Atlanta, Georgia, and we measured air pollutant levels indoors and outdoors at the centers, the homes of participating families, and in ambulatory settings using small backpacks accompanying the children in transport environments. Air pollutant measurements included $PM_{2.5}$, black carbon (BC), nitrogen dioxide (NO_2), ozone (O_3), particle number concentration (PNC), and elemental speciation of metals present in $PM_{2.5}$. Health outcome assessment included a metabolome-wide association study (MWAS) of saliva samples collected weekly. Untargeted metabolomics analysis measured the intensity of ~16000 metabolomic features using both C18 and HILIC column for separation. We assessed the association of exposure with feature intensity using linear mixed-effects models and the lme4 package for R. We sequentially ran models for all features in the database using the weekly exposure of each measured pollutant as the dependent variable and the change in feature intensity over the corresponding time period as the predictor while controlling for ambient temperature, sex, and race. We additionally included a random effect for subject. After adjusting resulting p-values for multiple comparisons, we performed pathway analysis using the mummichog network analysis tool for metabolomics. Numerous statistically-significant associations were observed for all pollutant metrics and various metabolomic pathways. Notably, exposure to $PM_{2.5}$ was strongly associated with multiple pathways related to inflammatory regulation. Exposure to BC was also strongly associated with inflammatory regulation and additionally to pathways identified as indicators of asthma pathogenesis. Analysis of this extensive dataset is ongoing, and it is likely that additional noteworthy observations will be reported at the time of presentation.

5HR.2

Modeling the Formation of Reactive Oxygen Species in SOA Using Explicitly Predicted Organic Products and Its Comparison with Chemical Assay Data. ANTHONY CHUNG, Myoseon Jang, *University of Florida*

Exposure to secondary organic aerosol (SOA) can harm human health by the production of reactive oxygen species (ROS) that triggers respiratory cell death and damages lung functions. Despite the adverse impacts of SOA on public health, accurately predicting SOA composition and mechanisms of toxicity remains uncertain. This study will predict SOA toxicity by using an innovative UNIfied Particle Aerosol Reaction extended to Toxicity (UNIPAR-TOX) model. UNIPAR-TOX is a cutting-edge model that elucidates the comprehensive multiphase chemistry of precursor hydrocarbons. The model encompasses the formation of SOA through the multiphase partitioning of lumping species that originate from explicitly predicted products and processes their in-particle chemistry to form low volatile products. Lumping species in UNIPAR-TOX embodies physicochemical parameters of oxygenated products that can encode their oxidation potential productivity. Thus, the UNIPAR-TOX model enables the estimation of ROS with predicted concentrations of lumping species in SOA. This model dynamically captures SOA mass, product distributions, and ROS associated with oxidative potential with changing NO_x levels and the atmospheric aging of organic products under different oxidation paths with major atmospheric oxidants (OH radical, ozone, and nitrate radicals). A toxicity database, built from chamber-generated SOA and measurements of acellular assay data (i.e., dithiothreitol (DTT) and 4-nitrophenylboronic acid (NPBA)), will facilitate the evaluation of UNIPAR-TOX's ability to predict oxidative potential and bring quantitative insights into the mechanistic role SOAs play in adverse respiratory health. The enhanced UNIPAR-TOX algorithm will allow for the creation of a next-generation SOA model to better predict the impacts of environmental variables on air quality and cardiorespiratory health under diverse meteorological conditions.

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5HR.3

Reduced Organic Nitrogen Dominates Atmospheric Organic Particle Toxicity. YALING ZENG, Xin Yang, *Southern University of Science and Technology*

Despite decades of efforts to control air pollution, the global disease burden attributable to atmospheric particles remains alarmingly high. Atmospheric particles contain thousands of organic molecules, yet most remain chemically unidentified and toxicologically uncharacterized. This fundamental knowledge gap challenges the conventional view that particle mass concentration and a few known toxicants are the primary drivers of air pollution health risks. Here, we performed a comprehensive molecular and toxicological investigation of atmospheric particles from urban environments, integrating non-target analysis of high-resolution mass spectrometry, protein adductomics-based internal exposure assessment, and multi-endpoint toxicity prediction. We reveal that reduced organic nitrogen (RON) compounds, despite their low diversity, dominate the multi-organ toxicity of atmospheric particles, surpassing traditionally emphasized oxygenated organics. RON compounds show strong binding affinity to human serum albumin, enabling their transport and distribution to peripheral organs. This mechanism facilitates systemic toxicity, inducing respiratory, neurological, hepatic, renal, and hematological damage. Our findings uncover a previously overlooked mechanism of particulate toxicity and call for a paradigm shift in air quality management, highlighting the urgent need to regulate organic nitrogen emissions to mitigate global public health risks.

5HR.4

Assessing the Toxicological Interactions Between Two Biotic and Abiotic Components of Indoor Aerosols: Mold and Air Fresheners. SUDHEER SALANA, Avraham Moshe Friedman, Jess Austin, Luis Angel Nino Barreat, Mohammad Washeem, Chang-Yu Wu, *University of Miami*

Biotic and abiotic components of indoor aerosols have been studied separately, assuming their health impacts are independent. However, recent epidemiological studies suggest this may not be the case, highlighting the need for a systematic evaluation of their interactions to assess the overall health impacts of indoor aerosols. In this study, we assessed the toxicological relationship between a commonly found indoor mold species called Aspergillus fumigatus, and air fresheners, which are a prominent source of abiotic pollutants in indoor air. We first evaluated the cytotoxicity induced in A549 cells individually by Aspergillus fumigatus and aqueous solutions of two popular air freshener brands (Brands A and B). Next, we investigated whether adding a non-toxic concentration of mold to the air freshener solutions enhances their cytotoxicity. Finally, we examined the effect of air freshener solutions on mold viability and its role in inducing oxidative stress and inflammation in A549 cells. Preliminary results show that Air freshener A was 40 times more cytotoxic than Air Freshener B. Mixing non-cytotoxic concentrations of mold (3×10^5 spores/mL) resulted in a statistically significant enhancement in the LC_{50} (concentration of the air freshener which causes a 50% reduction in cell viability) value of both air fresheners. Further, we also observed a concentration-dependent impact of the air freshener solutions on the viability of mold. Interestingly, similar to cytotoxicity, the mold-air freshener mixtures showed significantly higher oxidative stress (>20%) and higher secretion of inflammatory cytokine IL-8 compared to the sum of responses when mold and air fresheners were exposed individually to the A549 cells. However, such variation in response was not observed in the case of inflammatory cytokine TNF-α. Overall, our study demonstrates the toxicological interactions between biotic and abiotic components of indoor air, highlighting the need for further research on these interactions among other household products and bioaerosols.

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5HR.5

Chemical and Oxidative Properties of Indoor PM: Discerning the Influence of Residential Characteristics. P. S. GANESH SUBRAMANIAN, Alice Oloo, Vinh Vo, Brenda Koester, Vishal Verma, Sheena E. Martenies, *University of Illinois Urbana-Champaign*

Oxidative potential (OP) is an emerging metric, that quantifies the ability of particulate matter (PM) to induce oxidative stress in humans and cause adverse health outcomes. Although people spend the largest proportion of their time in residential environments, our understanding of exposure to PM constituents and its OP in this critical environment is limited. In this study, we collected PM samples from 22 homes in the Champaign-Urbana region (CUR), Illinois, and characterized their chemical composition and OP [using dithiothreitol (DTT) assay]. Residential characteristics were also obtained using questionnaires from each participant. The median concentrations of PM (PMC), water-soluble organic carbon (WSOC), and metals across the residential environments were 12.94, 1.34, and 0.32 μg/m^3, respectively. The median OP_v (volume-normalized OP) of residential PM was 185.90 pmol/(min.m^3), which is comparable with values reported for ambient $PM_{2.5}$ in CUR. Exploratory exposure assessment revealed significantly higher OP exposure in residential environments (> 7×) compared to ambient, due to a larger proportion of time spent indoors. Chemical constituents such as WSOC, and redox-active metals such as Cu and Mn were mainly driving OP_v, aligning with past findings on ambient $PM_{2.5}$. Univariate analysis revealed an increase in PMC and OP_v with increasing window-opening frequency or decreasing floor area, indicating the effect of building characteristics on PM characteristics. The median PMC and OP_v of residences using gas stoves were 72% and 42% higher than those using electric stoves, respectively. Similarly, scented candle usage also resulted in a 71% and 34% increase in the median PMC and OP_v, respectively, signifying the importance of indoor-source characteristics in determining residential exposure to toxic PM. Collectively, these findings reveal that residential characteristics play a significant role in determining PM and OP_v exposure indoors and emphasize the need for studies with larger cohort sizes to reliably estimate residential exposures as a function of building and source characteristics.

5HR.6

Seasonal Variation and Source Contribution to $PM_{2.5}$ Oxidative Potential and Environmentally Persistent Free Radicals in Atlanta, GA at the ASCENT Site. MINHAN PARK, Ma. Cristine Faye Denna, Kasey Edwards, Ruizhe Liu, Sohyeon Jeon, Seongbin Jo, Anna Kaehr, Nga Lee Ng, Manabu Shiraiwa, Pengfei Liu, Rodney J. Weber, *Georgia Institute of Technology*

Atmospheric fine particulate matter ($PM_{2.5}$) is a global concern due to its impact on the environment and human health. Numerous toxicological and epidemiological studies have reported that $PM_{2.5}$ is strongly associated with adverse human health effects, but variability in sources and physical and chemical properties can affect the associations. Reactive oxygen species (ROS) are an important factor in $PM_{2.5}$ toxicity, causing oxidative stress and inflammation. Oxidative potential (OP), the capacity of PM to generate ROS, is widely used to assess $PM_{2.5}$ health-relevant properties. However, as individual assays vary in sensitivity to specific chemical components, the use of multiple assays is necessary for comprehensive analysis of the overall OP of fine particles. This study aims to characterize seasonal variation in $PM_{2.5}$ chemical composition and OP using the dithiothreitol (DTT) assay for water-soluble (WS) and all (total) $PM_{2.5}$ and the hydroxyl radical (OH) production assay in synthetic lung fluid, and environmentally persistent free radicals (EPFR) concentrations. Ambient $PM_{2.5}$ samples were collected in Atlanta, GA from December 2023 to November 2024 at the ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) site at South DeKalb, providing a suite of $PM_{2.5}$ chemical speciation data. Volume-normalized water soluble and total- DTT (WS-DTT_v and total-DTT_v) showed higher values in winter, influenced by combustion-related components. In summer, WS-DTT_v notably increased its contribution from 60% to 86% of total-DTT_v, indicating enhanced photooxidation effects. Total-DTT_v and WS-DTT_v were correlated ($r>0.5$, $p<0.05$) with BC, NO_3^-, organics, and K. Total-DTT_v was also correlated with Fe, Zn, Cu, CO, and SO_2. The OH production assay was correlated with BC, NO_3^-, Fe, SO_2, and NO_x. $EPFR_v$ was correlated with BC, NO_3^-, Zn, SO_2, CO, and NO_x. All OPs and EPFR were correlate with BC ($r= 0.6$-0.8, $p<0.05$) and NO_3^- ($r= 0.5$-0.7, $p<0.05$). A multiple regression using sources identified by PMF analysis on Aerosol Chemical Speciation Monitors (ACSM) and real-time metal data was conducted to determine source contribution to OP and EPFR. The results showed that WS-DTT_v and total-DTT_v were associated with biomass burning organic aerosols (BBOA, 11%-24%), more oxidized oxygenated OA (MO-OOA, 40%-56%), and less oxidized OOA (LO-OOA, 24%-34%). Total-DTT_v was also associated with hydrocarbon-like OA (HOA, 11%). The OH production assay was mainly associated with isoprene OA or secondary sulfate aerosols (IsopOA/S, 60%) and dust from brake/road dust from traffic emissions (40%). $EPFR_v$ was associated with MO-OOA (53%) and dust (47%). Combustion/traffic-related sources were commonly associated with all assays, suggesting that these sources were an important factor for $PM_{2.5}$ OP and EPFR at the ASCENT Atlanta site. More results will be discussed in this presentation.

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5HR.7

Superoxide Release from Macrophages upon Exposure to Secondary Organic Aerosols, Biomass Burning, Plastic Combustion, and Brake Wear Particles. Kasey Edwards, Ting Fang, Rizana Salim, Caitlyn Cruz, Sukriti Kapur, Sachin S. Gunthe, James Smith, Sergey Nizkorodov, MANABU SHIRAIWA, *University of California, Irvine*

Oxidative stress induced by reactive oxygen species (ROS) is a key process for adverse health effects upon respiratory deposition of particulate matter (PM). Alveolar macrophages can release large amounts of superoxide upon phagocytosis of PM through a process called the respiratory burst. The release of cellular ROS should depend on both PM composition and dose, but the dose-response relationship for various types of PM remains unclear. Here, we quantify cellular superoxide generation by macrophage cells exposed to secondary organic aerosols (SOA) derived from $^{\cdot}$OH oxidation of limonene, toluene, and naphthalene, as well as primary organic aerosols (POA) from biomass burning, brake wear, and pyrolysis of five different types of plastics. We quantified cellular superoxide production over the span of four hours after initial exposure of cells to PM suspensions by applying a chemiluminescence assay combined with electron paramagnetic resonance spectroscopy. We additionally identified the activation threshold, or the dose in which cellular superoxide production was altered compared to unexposed cells. Limonene SOA was found to induce the largest amount of superoxide release but had the largest activation threshold of 500 µg mL-1. Naphthalene SOA, toluene SOA, and biomass burning aerosol showed minor enhancement of superoxide production but had lower activation thresholds from 0.1-1 µg mL-1. Plastic burning PM showed a varied response depending on the type of plastic, with polyethylene terephthalate (PET) and high-density polyethylene (HDPE) having the highest observed superoxide production. The activation threshold for plastic combustion PM was found most often to be between 10-100 µg mL-1. Brake wear PM, on the other hand, led to suppression of cellular superoxide release beyond a dose of 5 µg mL-1. Determining the activation threshold and resulting cellular superoxide production of different types of PM provide critical insights for their relative inflammatory responses.

5IM.1

What Ten Years of Evaluating "Low-Cost" Particulate Matter Sensors Can Tell Us About Coarse Fraction and Humidity Biases. NAMRATA SHANMUKH PANJI, Noel Ruiz, Xiaobi M. Kuang, Victor Rocha Jr., Brandon Feenstra, Wilton Mui, *South Coast Air Quality Management District*

The Air Quality Sensor Performance Evaluation Center (AQ-SPEC) program at South Coast Air Quality Management District (South Coast AQMD) has evaluated the performance of over 175 "low-cost" particulate matter (PM) sensor units (comprised of over 55 sensor models) that measure both $PM_{2.5}$ and PM_{10}. While significant progress has been achieved in the affordability and accessibility of PM sensors, uncertainty remains regarding their ability to accurately detect and quantify coarse particles ($PM_c = PM_{10} – PM_{2.5}$). Using a decade of AQ-SPEC field evaluation data, we explore the relationship between $PM_{2.5}$, PM_{10}, and PM_c readings from sensors co-located with reference monitors to identify trends, limitations, and potential mischaracterizations to understand whether sensors are able to accurately detect and quantify the coarse fraction of PM or if such readings are predominantly influenced by the fine fraction. We will explore the influence of the fine fraction on PM_{10} and PM_c measurements along with humidity effects, which can influence particle growth and PM sensor response, further complicating the interpretation of PM measurements. These insights will help clarify the current capabilities and limitations of PM_{10} sensors, inform sensor developers about critical areas for improvement, and illustrate the value of select performance metrics for end-users seeking to measure PM_{10} using sensors.

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5IM.2

Assessing the Accuracy and Reliability of a New Ambient Ultrafine Particle Monitor for Quantifying Total Particle Number Concentration at Three ASCENT Sites. DAVID HAGAN, Can Barut, Sohyeon Jeon, Ruizhe Liu, Nga Lee Ng, Haroula D. Baliaka, Vine Blankenship, Ryan Ward, Purushottam Kumar, John Seinfeld, Richard Flagan, Mitchell Rogers, Lijin Zhang, Tori Hass-Mitchell, Taekyu Joo, Drew Gentner, *QuantAQ, Inc.*

Air sensors and air sensor networks have become widely used for measuring criteria air pollutants such as $PM_{2.5}$, CO, NO_2, and O_3. The use of air monitoring networks has been instrumental in beginning to understand and quantify the impacts of source-specific air pollutants in previously unmonitored or insufficiently monitored communities. Although not currently regulated in the United States, ultrafine particles (UFPs) are a major concern for human health and are not currently measured regularly by monitoring agencies, partly due to the cost and complexity of making such measurements. Recently, a lower-cost, lower-power water-based condensation particle counter (CPC) was developed by Aerosol Dynamics (Berkeley, CA) that has the opportunity to make these measurements more accessible and improve our understanding of UFPs and their impact on human health. In this work, we compare initial co-location results for QuantAQ's implementation of this CPC at three ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) sites: Atlanta, Pico Rivera, and Queens College (NY), wherein results collected by the QuantAQ MODULAIR-UFP are compared to a standard TSI water-based CPC.

5IM.3

Calibration of Low-Cost Particulate Matter ($PM_{2.5}$) Sensors under West Africa Weather: A Year-Long Evaluation Integrating K-Kohler Hygroscopic Correction and Machine Learning. JAMES NIMO, Yusif Ibrahim-Anyass, Mathias A. Borketey, Nancy Owusuaa, Nathaniel Obeng Anim, Emmanuel Banahene Asante, Selina Amoah, Esi Nerquaye-Tetteh, Victoria Owusu-Tawiah, Michael R. Giordano, Daniel Westervelt, Md. Aynul Bari, Raphael E. Arku, Allison Felix Hughes, *University at Albany, State University of New York*

With scarce regulatory monitors, air quality management in West Africa increasingly relies on low-cost $PM_{2.5}$ sensors (LCS). Yet, their accuracy is frequently compromised by regional meteorological extremes, notably high humidity, temperature, and transported dust during the dry Harmattan season. This study addresses the critical need for robust LCS calibration under these challenging weather conditions. We conducted a year-long (2024-2025) field evaluation of nine distinct commercially available LCS at the University of Ghana's Air Sensor Evaluation and Training Facility (Afri-SET) in Accra, Ghana. We systematically investigated the influence of applying Köhler theory-based hygroscopic growth correction factors in the assessment of sensor performance across low (20-60%) and high (60-99%) relative humidity in both wet and dry seasons. Subsequently, four machine learning algorithms, Multiple Linear Regression (MLR), XGBoost, Random Forest (RF), and LightGBM (LGB), were developed and compared to derive sensor-specific calibration models. We also examined long-term sensor drift among the evaluated LCS brands and developed practical guidance for end-users on effective re-calibration strategies in West African contexts. Preliminary results indicate that the integrated approach, combining hygroscopic pre-correction with advanced machine learning models, particularly LGB, substantially improves LCS data accuracy. For example, the LGB model demonstrated strong performance across various sensors, achieving coefficients of determination (R^2) as high as 0.987, with corresponding Root Mean Square Errors (RMSE) as low as 5.56 and Mean Absolute Errors (MAE) as low as 3.36$\mu g/m^3$ under overall seasonal conditions. These ensemble methods, including Random Forest and XGBoost, consistently outperformed Multiple Linear Regression, underscoring the benefits of this integrated calibration strategy for enhancing data reliability, particularly under challenging and varied humidity conditions. These findings demonstrate a viable pathway for optimizing LCS data reliability in West Africa, crucial for enhancing air quality assessments and supporting evidence-based environmental policy.

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5IM.4

Characterization of a Novel, Mid-Cost Device for Ambient Monitoring of Ultrafine Particles. UNA TRIVANOVIC, Osnan Maragoto Rodriguez, Kevin Auderset, Florian Huewe, Konstantina Vasilatou, *Federal Institute of Metrology METAS*

Ultrafine particle (UFP) number concentration is not routinely monitored at air quality monitoring stations despite the potentially significant health impacts relative to larger particles. This is in part due to the relatively high cost and complexity of such measurements compared to mass-based measurements of particulate matter below 2.5 µm ($PM_{2.5}$). Euro7 regulations for light- and heavy-duty vehicles require measurement of solid particle (sPN) and total particle number concentration (tPN) down to 10 nm. The effectiveness of Euro7 regulations and UFP health effects can only be assessed through ambient monitoring of these quantities. Here, a novel, mid-cost device for monitoring UFPs down to 10 nm is characterized in order to help bridge the gap between ambient air quality and tailpipe emissions.

The AirPN10 uses a diffusion charger (DC), already approved for measuring PN in diesel exhaust, to reliably measure ambient particles with geometric mean mobility diameters (GMD_{mob}) in the range of 10 – 200 nm. Particles either go directly to the detector (tPN) or pass through a high temperature zone to remove volatiles (sPN). The AirPN10 was characterized with polydisperse miniCAST soot with GMD_{mob} of 10, 15, 23, 50, 80, 120 and 200 nm. The two-stage DC sensor provides an estimate of the GMDmob with excellent agreement to that measured by a scanning mobility particle spectrometer (SMPS; TSI 3752, 3082 and 3085). The sPN and tPN concentrations were compared to a traceable reference condensation particle counter (CPC; TSI 3752). Acceptable counting efficiencies (CE) were considered to be the greater of ± 25% or 1500 cm^{-3}. For GMDmob = (15 – 120) nm, the CE was almost entirely within the acceptance bands. At GMD_{mob} = 10 and 200 nm, CE was slightly lower at approximately 0.5 and 0.7, respectively. The AirPN10 also performed well at a range of ambient pressures, temperatures and humidities.

5IM.5

Enabling Real-Time, Low-Cost Measurement of Hazardous Air Pollutants: A Multidimensional Approach. TALHA JUBAIR, James Hurley, Anum Khan, Namrata Shanmukh Panji, Amanda Gao, Jesse Kroll, Gabriel Isaacman-VanWertz, *Virginia Tech*

Hazardous air pollutants (HAPs) such as benzene, toluene, and acrolein pose significant health risks even at low concentrations. However, conventional measurement methods are often expensive, stationary, and lack the temporal and spatial resolution needed for effective air toxics surveillance in communities. To address this gap, we are developing a compact, low-cost system designed to measure HAPs in real time with compound-level resolution. This approach consists of short length of gas chromatography column used as an inlet for commercially available low-cost sensors. Compounds are coarsely separated by the column, the identified through the relative responses of low-cost detectors—including photoionization and metal oxide sensors—to capture the chemical signatures of the compounds as they elute from the columns. We pair this hardware with machine learning algorithms trained to interpret the sensor signals and estimate concentrations of specific HAPs. In this presentation we evaluate the system using known gas mixtures and compared against conventional reference instruments to quantify its accuracy, sensitivity, and reliability. Preliminary lab results show that the system can separate and detect key air toxics in under a minute, with clear potential for identifying and quantifying compounds in real-world conditions. In particular, we demonstrate detection limits for some detectors of down to tens of ppb and chromatographic peak widths of only a few seconds, enabling baseline resolution of compounds within a carbon number of each other (e.g., benzene and toluene). However, this sensitivity and resolution are achieved with different detectors, highlighting the engineering challenges of the low flows and high specificity needed for the goals of this project. In this work we will therefore examine solutions to these engineering challenges and present opportunities for validation through field deployment.

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5IM.6

Fundamental Understanding of Low-Cost Sensor Response. SREEKESH KOOKKAL, Suresh Dhaniyala, *Clarkson University*

Air quality monitoring is critical for understanding the health and environmental impacts of airborne particulate matter (PM). Recently, Low-cost sensors (LCS), such as the Plantower PMS5003, Sensirion SPS30, and Alphasense OPC-N3, offer an inexpensive and scalable option for wide-scale deployment. These sensors employ optical scattering methods to derive PM_1, $PM_{2.5}$, and PM_{10} concentrations in real time. The performance of these sensors is often characterized by co-location with ambient sensors. This allows for correlation and correction but not a fundamental understanding of the performance of these sensors. In this study, we present a systematic evaluation of these three commercially available LCS against reference instruments (APS and WPS) with a broad range of test aerosol including ammonium sulfate, dust, and smoke. Our experiments show that the reported number and mass concentrations have a strong dependence on test particle properties. We derive size-dependent collection efficiencies and compare the performance of the devices against expected theoretical performance of these sensors. This study will help predict and interpret sensor data under different ambient conditions and improve accuracy in reported measurements.

5IM.7

Automated Measurement of Particle-Phase Organic Compounds Using Chip-Scale Gas Chromatography. VIKAS GOEL, Nipun Thamatam, Nathan Kreisberg, Zinoy Manappadan, Jyothi Chintalapalli, Suman Dewanjee, John Michalek, Chien Nguyen, Masoud Agah, Gabriel Isaacman-VanWertz, *Virginia Tech*

The atmosphere is a complex mixture of hundreds to thousands of chemical compounds, which are either directly emitted from sources or formed through atmospheric processes. Accurate detection and quantification of these compounds are critical for understanding their impacts on climate and human health. Field-deployable gas chromatography (GC) systems have significantly advanced our ability to perform near-real-time, chemically resolved measurements of gases and particles in ambient environments. However, most existing systems rely on conventional GC components that are bulky and challenging to transport. Although recent advancements have improved the portability of instruments measuring volatile gases, a truly portable system for detailed characterization of particle-phase organic compounds remains unavailable. To address this gap, we have developed a miniaturized instrument for near real-time detection of particle-phase organics. Particles are impacted into a metal temperature-controlled cell coupled with chip-scale (i.e., Microelectromechanical Systems or MEMS) components including an adsorbent trap, gas chromatography column, and photoionization detector (PID). MEMS modules are connected without adhesives using a novel Fluidic and Electrical Modular Interfacing (FEMI) architecture. The entire system, including valves, heaters, fans, pump, and mass flow controllers is controlled by an Electronic Control Unit (ECU), enabling fully automated operation. Injections of hydrocarbon standards at the same concentration produced highly consistent results with minimal standard deviation and a highly linear response (R^2=0.95). The system has also been demonstrated for the collection and quantitative analysis of laboratory-generated aerosol particles through comparison to samples collected in parallel for analysis on a separate GC system. In this work we will describe the instrument, present validation, and evaluation data, and demonstrate its application to real-world ambient aerosols.

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5UA.1

Gas-Particle Distribution of D5 Oxidation Products in New York City During Summertime. JOSIE WELKER, Jeewani Meepage, Charles Stanier, Elizabeth Stone, *University of Iowa*

Personal care products can release decamethylcyclopentasiloxane (D_5) to the atmosphere, where it oxidizes to form 1-hydroxynonamethylcyclopentasiloxane (D_4TOH). This oxidation product subsequently can partition to the particle-phase to form secondary organic aerosol (SOA). The gas-particle distribution of D_4TOH has been studied in the laboratory but has yet to be established in ambient air. This study examines the gas-particle distribution of D_4TOH and related oxidation products in New York City during the summertime of 2022 using medium volume air samplers, solvent extraction, and gas and liquid chromatography mass spectrometry methods. Positive sampling artifacts constituted the majority of D_4TOH observed on quartz fiber filters (54-100%, averaging 86%, n=12), indicating the high potential for particle-phase D_4TOH to be over-estimated. After artifact correction, D_4TOH was observed in fine particles in 5 of the 12 sampling periods, with its particle-phase fraction averaging 12%. Because D_4TOH is predominantly in the gas phase, it makes a minor contribution to D_5-derived SOA during summertime. Further oxidation products of D_5, including di-, tri-, and tetra-siloxanols are predominantly in the particle-phase (>77%, n=4) during summertime and have relatively small positive artifacts. These poly-siloxanols provide evidence of D_5-derived SOA in the urban aerosols and are more suitable tracers for D_5-derived SOA than D_4TOH because of their higher particle-phase fraction.

5UA.2

Secondary Aerosol Formation under Variable Relative Humidity and OH Exposure: Field Observations Using an Oxidation Flow Reactor in Bakersfield, California. YING ZHOU, Alexander B. MacDonald, Xuanlin Du, Roya Bahreini, Don Collins, *University of California, Riverside*

Secondary aerosol (SA) contributes significantly to ambient $PM_{2.5}$, yet its formation and aging mechanisms remain poorly understood, particularly via aqueous phase chemistry. This study used an oxidation flow reactor (OFR) and a mini aerosol mass spectrometer (mAMS) to investigate SA formation from filtered ambient air under varying OH exposure (OH_{exp}) and relative humidity (RH) in Bakersfield, California. The OH_{exp} ranged from 3.7×10^{10} to 8.9×10^{10} molec cm^{-3} s, equivalent to 0.29–0.69 days photochemical aging for a low OH_{exp} condition, and 5.0–6.9 days for a high OH_{exp} condition. RH was stepped between 40%, 85%, and 100% to create environments in the reactor with dry seed aerosol, aqueous seed aerosol, and cloud droplets, respectively. Relative to the study-average ambient secondary organic aerosol (SOA) concentration of 5.59 ± 4.56 μg m^{-3}, we observed significant SOA production in the OFR, with average increases of 4.60 ± 3.71, 7.15 ± 4.76, 7.29 ± 7.86, 16.20 ± 10.60, 6.90 ± 5.05, and 22.59 ± 9.65 μg m^{-3} across six conditions of dry seed aerosol at low and high OH_{exp}, aqueous seed aerosol at low and high OH_{exp}, and cloud droplets at low and high OH_{exp}, respectively. The SOA enhancement for each RH level was greater under the high OH_{exp} condition, accompanied by a decrease in f_{43} and an increase in f_{44}. These effects were most pronounced in the presence of aqueous seed aerosol and cloud droplets, underscoring the role of oxidative aging and aqueous phase processes in SOA formation. A persistent diurnal pattern in SOA formation was observed, especially for the high OH_{exp} condition, with peaks in the early morning and late afternoon. These findings offer critical insight for improving chemical transport models and developing region-specific $PM_{2.5}$ mitigation strategies, especially in agriculturally influenced and meteorologically complex regions like California's Central Valley.

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5UA.3

Can Acid-Base Aerosol Nucleation Be Applied to All Urban Settings in the World? Lee Tiszenkel, James Flynn, Alana Dodero, SHANHU LEE, *University of Alabama Huntsville*

Aerosol nucleation is an extremely complex atmospheric process that produces new particles directly from gas phase species, impacting air quality, human health, and climate. The current understanding of urban aerosol nucleation is mostly based on the measurements made in Chinese megacities that suggested that sulfuric acid and dimethylamine contribute to urban nucleation, without organics. An important question is whether this acid-base nucleation process can be applied to all urban sites in the world, regardless of vastly different urban vegetations and different emissions of urban VOCs (e.g., emerging VCPs). Here, we conducted comprehensive measurements of nucleation precursors at the urban center in Houston, the 4th most populated and highly polluted urban site in the United States. Our observations and box model simulations show that sulfuric acid, base, and low-volatility OOMs contribute to urban aerosol nucleation in Houston. The chemical composition analyses of OOMs and box model simulations show that under the typical urban Houston conditions, low-volatility OOMs form from autoxidation of VOCs, as well as multigenerational OH oxidation of aromatic compounds; autoxidation and dimerization reactions are not suppressed by NOx. Our findings thus contrast with previous urban studies made in Chinese megacities, where OOMs are too volatile to contribute to urban aerosol nucleation, demonstrating distinctively different roles of organics in urban aerosol nucleation due to different chemical compositions of OOMs. With increasing emissions of emerging air pollutants in the United States and Europe, this multicomponent nucleation process will be crucial for mitigating air pollution in the evolving urban climate.

5UA.4

Aerosol Chemical Composition Within the Paris Region, France: What Can We Learn from 13 Years of Continuous Online Measurements? JEAN-EUDES PETIT, Juliette Brochet, Yunjiang Zhang, Hasna Chebaicheb, Olivier Favez, *LSCE*

The SIRTA observatory is a multi-instrumented observatory located around 20km South-West of Paris. Since 2011, continuous aerosol mass spectrometer (ACSM) measurements have been carried out, gathering essential knowledge of submicron aerosol chemical composition, its pluri-annual trends and behaviours which can be linked to mitigation policies as well as changing meteorological conditions.

Here, we present the long-term features of one of the longest ACSM time series worldwide. We will especially highlight :

- A phenomenology analysis of haze episodes. We will discuss their temporal evolution, their seasonal features, and the influence of climatological variability.
- First insights of a very long-term Organic Aerosols source apportionment, discussing the changes of the fractions of OA linked to its oxidation properties, and also how long-term measurements and trajectory analysis can help to provide additional information.
- The changes induced by COVID-19-related lockdowns, put in the context of long-term trends. We will discuss the efforts needed in order to further mitigate pollution sources within the Paris region.

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5UA.5

$PM_{2.5}$ Composition, Sources, Chemistry and Volatility over Manila: Insights from the ASIA-AQ Campaign. GUY SYMONDS, Pedro Campuzano-Jost, Dongwook Kim, Douglas A. Day, Seonsik Yun, Eric Apel, Rebecca Hornbrook, Alan Hills, Daun Jeong, Taehyoung Lee, Taehyun Park, Jihee Ban, Armin Wisthaler, Felix Piel, Tobias Reinecke, Wojciech Wojnowski, Richard Moore, Luke Ziemba, Michael Shook, ASIA-AQ Science Team, Maria Cambaliza, Melliza Cruz, James Simpas, James Crawford, Jose-Luis Jimenez, *University of Colorado Boulder*

Urban air pollution is one of the leading causes of mortality worldwide. Both ozone and particulate matter (PM) are formed by complex chemical processes and are often still poorly understood. There is limited data for many parts of Southeast (SE) Asia, one of the most populous regions on Earth. Importantly, most of the available measurements have been ground-based. Aircraft studies can provide a different context on sources, dynamics, and vertical distribution of pollutants. In early 2024 during the NASA-led ASIA-AQ mission, we collected data onboard the NASA DC-8 on a wide range of pollutants with the objective of elucidating the local and regional sources of PM in several Asian megacities. This work focuses on greater Manila in the Philippines. Data was collected both during days of strong transport from the Asian continent and days dominated by local pollution, providing contrasting conditions to study. Manila stands out from most other Asian megacities by its larger organic PM fraction. Substantial concentrations of nitrate were measured in the morning above Manila. To better understand the sources of the large organic aerosol (OA) concentrations, different approaches were taken to identify primary and secondary contributions (POA and SOA). Using Positive Matrix Factorization (PMF), the overall contribution of Biomass Burning OA (BBOA) appears small, and thus does not explain the high OA fraction of total PM (although trash burning is a known localized source still under investigation). An appreciable share of Isoprene Epoxydiols-derived SOA (IEPOX-SOA) was observed outside Manila, including in fresh volcanic outflow, which is consistent with high isoprene emissions, acidity impacts, and strong NO_x gradients. We show that "intensive" urban SOA formation rates (i.e., per unit ΔCO and photochemical age) in Manila are similar to the median of previous studies of Western megacities, e.g., Los Angeles.

5UA.6

A Coupled Condensational-Growth Colorimetric Approach for Direct Field Measurements of Ambient Aerosol Acidity. EVAN DALTON, Yao Xiao, Cara Waters, Emily Costa, Drew Gentner, Andrew P. Ault, *University of Michigan*

The acidity, or pH, of atmospheric aerosols is a key variable that affects the eventual health and climate impacts of an aerosol. Aerosols are typically highly acidic (pH = 0 – 5), although it is difficult to measure aerosol acidity due to the low water content and high ionic strength of most atmospheric particles, and the non-conservative nature of the H^+ ion. As such, aerosol pH is commonly inferred from thermodynamic models, which utilize condensed-phase and gas-phase compositions to derive the aerosol pH. This derivation requires intensive analyses with expensive instrumentation, which has limited the number of reliable aerosol pH determinations during atmospheric field campaigns. Recent advances in direct aerosol pH measurements have the potential to improve our understanding of aerosol acidity but have not yet been broadly applied to the ambient atmosphere. Herein, we present measurements of ambient aerosol pH for particulate matter less than 1 micron in diameter (PM_1) in the New York City (NYC) metropolitan area. This method, deployed during a field campaign for the first time, directly measures PM_1 pH with colorimetric indicators (thymol blue, pK_a = 1.7; methyl orange, pK_a = 3.5) following particle growth within a condensational growth tube to ensure sufficient particulate water content to saturate the pH indicator paper. We can derive the pH of the original ambient aerosol by accounting for the well-defined particle volume changes in the growth tube, and knowledge of the original PM_1 size distribution and sulfate mass concentration. PM_1 was quite acidic during NYC-METS (New York City metropolitan Measurements of Emissions and TransformationS), with pH < 2 in both NYC and at a coastal site near New Haven, CT. We will discuss method optimization, field measurements, and comparison of this pH measurement to thermodynamic models. Measurements of aerosol pH such as these will enable improved model predictions of secondary aerosol formation, a key contributor to atmospheric PM concentrations across urban regions globally.

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5UA.7

Tracking Variations in Heatwave-Induced Aerosol Concentration and Chemical Composition Following Emission Reductions in NYC's Downwind Region. JIE ZHANG, Tianyu Zhu, Qi Zhang, Nga Lee Ng, Alexandra Catena, Janie Schwab, Jorge E. Gonzalez-Cruz, Shan Zhou, Jianzhong Xu, Julia Stuart, Amanda Teora, Dirk Felton, James Schwab, *Atmospheric Sciences Research Center, University at Albany*

While emission reductions from energy market shifts and regulatory controls have lowered primary fine particulate matter ($PM_{2.5}$) concentrations over the past decade, heatwaves can amplify $PM_{2.5}$ and potentially reverse these gains, a phenomenon not fully tracked. This study examines the heatwave-induced aerosol variations using aerosol chemical component measurements (2011, 2018, and 2023) and routine $PM_{2.5}$ mass concentrations in New York City's downwind region. Results indicate that, under current emission reductions, heatwave $PM_{2.5}$ concentrations decreased by 41% (daytime), 30% (nighttime), and 26% (rush hour), significantly greater than nonheatwave reductions (~20%), highlighting enhanced $PM_{2.5}$ mitigation effects during heatwaves. Particle sulfate, ammonium, and locally formed secondary organic aerosol (SOA) were the dominant contributors to heatwave aerosol reductions, closely tracking precursor emission changes. Additionally, sulfate and local SOA showed similar reduction rates (~0.2 μg m–3 per year), while regional SOA remained independent of volatile organic compound (VOC) emission reductions, suggesting a more complex formation process. Further reductions in local SOA concentrations are expected with ongoing emission controls, although continuous monitoring remains crucial. These findings will also offer valuable insights and serve as a reference for similar research in other regions.

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6AC.1

Direct Measurement of the Acidity of Model Marine Aerosol Particles Using Carbon Quantum Dots. VICTORIA ADEKUNLE, Komal Jaswal, Miriam Freedman, *The Pennsylvania State University*

pH is a central component of aqueous and multiphase aerosol chemistry in the atmosphere and has significant implications for heterogeneous chemistry, climate, and human health. Atmospheric aerosol particles are known to be acidic, and the composition of aerosol particles contributes to their pH. Sea spray aerosol particles (SSAs) have the most significant atmospheric emission by mass, and nascent sea spray aerosol particles have been shown to be acidic. Therefore, understanding the influence of the composition of SSA and relating it to aerosol acidity is essential, mainly due to the impact of aerosol acidity on heterogeneous chemistry. In this study, we develop an in situ fluorescence-based technique for directly measuring aerosol pH based on carbon quantum dots (CQDs) by incorporating a pH-sensitive CQD probe and a pH-insensitive CQD internal standard into laboratory-generated aerosol particles and carrying out ratiometric fluorescence microscopy. We measure the pH of aerosol particles containing sodium chloride, medium-chain saturated fatty acids, and various marine-relevant organic compounds with different pKa values as models for SSAs to assess the factors influencing their acidity. Our droplet pH results range from approximately 2.0 to 3.7, showing a general decrease in droplet pH with increasing concentrations and decreasing pKa values of organic acids present in our model SSAs, as confirmed by pH paper measurements. Notably, although the model SSAs primarily consist of saturated fatty acids, we observe a pH decrease of up to 1 unit with just a 6% increase in dicarboxylic acid concentrations. Our findings demonstrate the potential of using CQDs for in situ measurements of particle physicochemical properties and suggest that the pKa and composition of organic acids may significantly influence the acidity of SSAs. Understanding the origins of the acidity of sea spray aerosol particles will aid in developing parameterizations for acidity to aid in modeling their heterogeneous atmospheric chemistry.

6AC.2

Expanding Aerosol Acidity Measurements to the Water-Limited Regime and Complex Chemical Systems: A Coupled Condensational Growth and Colorimetric Approach. CARA WATERS, Mia B. Kauffman, Evan Dalton, Zhenfa Zhang, Avram Gold, Jason Surratt, Andrew P. Ault, *University of Michigan*

Aerosol acidity is a critical variable that influences the formation of particulate matter in the atmosphere. Particle pH affects the rate of heterogeneous reactive uptake of carbonyl- and epoxide-containing species, aqueous-phase accretion reaction rates, dissolution of transition metal ions, and sulfate oxidation pathways. However, directly measuring aerosol pH is analytically challenging due to the low liquid water content and high ionic strength of aerosol particles. The colorimetric method for bulk aerosol pH determination is low-cost and easily field-deployable, but pH measurements cannot be obtained for highly acidic particles (pH < 0) or particles with low liquid water content that do not saturate the pH indicator paper. We have developed a new approach that extends aerosol pH measurements into the water-limited regime, using a condensational growth tube to induce water uptake onto submicron aerosol prior to impaction onto pH paper. Aerosol pH prior to condensational growth is calculated based on the volume of water accumulated over the growth tube and the shift in relevant acid-base equilibria. Herein, we use this water uptake colorimetric method to explore a range of different conjugate acid-base pairs and measure aerosol pH for particles of increasing chemical complexity, including chamber-generated SOA. Aerosols are generated from bulk solutions at a moderate relative humidity (60%), simulating the conditions of “wet”-seeded chamber experiments and a common atmospheric RH value. Aerosol pH can be more acidic than the original solution by up to 3 pH units, with this difference being highly dependent on the initial pH and conjugate acid-base pair of the bulk solution. These results highlight the importance of accurate aerosol acidity measurements to understand the relationship between aerosol pH and secondary aerosol mass formation, both in complex laboratory studies and ambient locations where aerosol pH remains highly uncertain.

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6AC.3

Direct Determination of Aerosol Acidity in Model Continental Aerosol Particles. KOMAL JASWAL, Victoria Adekunle, Miriam Freedman, *The Pennsylvania State University*

The acidity of aerosol particles can have a significant impact on atmospheric visibility, climate, heterogeneous chemistry, and human health. Continental aerosol particles have been predicted by thermodynamic models to be highly acidic based on their composition. The small size of aerosol particles makes pH measurement challenging. Here, we present a novel approach using carbon quantum dots (CQDs) as *in situ* fluorophores to directly measure the acidity of individual droplets and droplet phases in the range of pH 1.5 – pH 3.5. The method used pH-sensitive CQDs and pH-insensitive CQDs (internal standard) which were incorporated into models for continental aerosol particles. Model continental aerosol particles were synthesized in terms of two distinct systems: one consisting solely of organic compounds with varying pK_a values, and another comprising mixtures of these organic compounds with different inorganic compounds. Fluorescence microscopy was used to construct a calibration curve using the ratioed fluorescence intensities of droplets of standard solutions to develop an assay of fluorescence emission intensities as a function of pH. The calibration curve was used to determine the pH of model continental aerosol particles in the highly acidic range and compared with bulk pH measurements. The droplet pH values of the aerosol particles showed a good agreement with the bulk pH values, demonstrating the efficacy of this direct approach for evaluating the acidity of aerosol particles. Moreover, the effect of the pK_a of the organic compounds on the droplet pH was investigated, and it was observed that with an increase in the pK_a, there is a smaller increase in the pH of aerosol particles. Our method demonstrates the capability of CQDs for real-time and direct measurement of the acidity of aerosol particles, which holds a significant potential to parametrize acidity in models and refine predictions of aerosol properties such as heterogeneous chemistry.

6AC.4

Understanding Surface pKa of Molecules in Macroscale Solution and Microdroplets: A partitioning perspective. Rebika Tamang, Jacob Twichell, Madelyn Johnston, MICHAEL JACOBS, *Texas State University*

Numerous classes of reactions (from condensation to redox to biomolecular) have been reported to occur several orders of magnitude faster (up to 10^{11}!) in microdroplets than equivalent reactions in macroscale solutions. These results have broad implications from understanding chemistry in the atmosphere to suggesting new methods to run reactions more sustainably. Most studies largely ascribe the observed accelerated chemistry in microdroplets to the increased importance of interfacial chemistry and the unique properties of the air-water interface. For example, several studies invoke the “superacidity” of the air-water interface to explain accelerated chemistry in microdroplets. The ability of surface water to either accept or donate protons has been rigorously debated, with some results suggesting the surface is proton-rich, but others suggesting it is hydroxide ion-rich. Studies have presented a ‘surface pKa’ for molecules that can be shifted by several units relative to their bulk pKa values. For example, alkyl acids can have a surface pKa > 7, indicating a proton-rich interface. However, molecular origins of shifted surface pKa values remain unclear. Do they report on the acidity of surface water, or do they report on the different surface affinities of protonated/deprotonated species? Furthermore, it also remains unclear how different surface pKa values can alter the composition and acidity of microdroplets to promote chemical reactions.

We use a quadrupole electrodynamic trap (QET) to study the physicochemical properties of levitated microdroplets and explore how these unique physicochemical properties influence the partitioning of molecules to the air-water interface. In this talk, we will present recent experimental results aimed at understanding how the acidity of surface water influences molecular partitioning to the air-water interface. Using careful macroscale surface tension measurements, we demonstrate the shifts in the apparent ‘surface pKa’ of alkyl acids and amines can largely be explained using a simple competitive adsorption model that separately describes the surface partitioning of protonated and deprotonated molecules. We use our partitioning model to describe how changing surface pKa values can alter the pH of microdroplets. We compare our model results to preliminary surface tension measurements of microdroplets containing alkyl acids. Ultimately, we are working to develop a fundamental understanding of how confinement and differences in partitioning behavior may alter the chemical composition of microdroplets to promote and accelerate a wide array of chemical reactions.

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6AC.5

Measurements of Surrogate Respiratory Sessile Droplet pH and Implications for Exhaled Respiratory Aerosol and Airborne Disease Transmission. Jianghan Tian, Beiping Luo, Aidan Rafferty, Allen E. Haddrell, Ulrich Krieger, JONATHAN P. REID, *University of Bristol*

The respiratory aerosol pH has been proposed as a major driver for the infectivity loss of SARS-CoV-2 viruses and influenza A virus in exhaled aerosols, thus affecting the airborne transmission of respiratory diseases. A pH of 9-11 within aerosol droplets was considered driving the loss of SARS-CoV-2 infectivity (Haddrell *et al.*, 2023). Sodium bicarbonate acts as a principal buffer in biological systems, regulating blood pH and balancing the CO_2 content in the gas and liquid phases. Upon exhalation, changes in gas phase conditions affect the aerosol composition and pH. Despite several studies utilising Raman spectroscopy to quantify atmospherically relevant aerosol pH, there is limited understanding of the kinetics of CO_2 partitioning and pH variability within respiratory fluid-relevant droplets.

The aim of this study is to explore the HCO_3^-/CO_3^{2-} equilibrium in surrogate respiratory fluid sessile droplets (40 µL) to elucidate the pH evolution of exhaled respiratory aerosol, yielding crucial insights for understanding the aerosol processes that are central to airborne disease transmission. In situ direct measurements are made using Raman spectroscopy, which is applied to study the kinetics of CO_2 evaporation from sodium chloride-sodium bicarbonate microlitre sessile droplets with and without the enzyme carbonic anhydrase (CA), respectively. In particular, we explore the impact of gas flow rate, droplet volume, gas phase CO_2 concentration, and enzymatic catalyst concentration on the CO_2 evaporation kinetics. The experimental results are used to benchmark the Respiratory Aerosol Model (ResAM), which simulates respiratory picolitre droplet thermodynamics and pH evolution (Luo *et al*., 2023).

Our measurements show that the CO_2 evaporates slowly in sessile droplets of volume of 40 µL, taking ~200 minutes for the droplet to reach pH 9 from an initial level 7.6. The effect of changing droplet size and gas flow rate to the pH change is within the experimental error. However, the gas phase CO_2 level controls the final pH profoundly. The ResAM simulates the pH evolution profile and is highly comparable to the experimental measurements. When scaled to respiratory aerosol droplet sizes of 0.004 and 65 pL, the pH occurs over ~27 min. The simulated pH evolution profiles of picolitre droplets show size independence. Simulations for both sessile droplet and respiratory aerosol show that the presence of CA can significantly increase the rate of pH increase, and the gas phase CO_2 level is also important for determining the final droplet pH.

This study represents the first direct *in situ* investigations into the pH dynamics of an aqueous sodium chloride-sodium bicarbonate droplet and CO_2 evaporation kinetics using Raman spectroscopy. The composition of human respiratory fluid is dynamic, reflecting the true nature and physicochemical properties of exhaled aerosols is challenging. However, this study highlighted the timescale differences for the pH increase in microlitre sessile droplet and aerosol droplets of respirable size, that are responsible for fomite and airborne transmission, respectively. This information is crucial for understanding the aerobiological pathway for virus transmission and providing evidence to inform indoor airborne control strategies.

6AC.6

Influence of Inorganic Ions on the Phase Behavior of Organic Rich Aerosol Particles. KIRAN REDDY PITTA, Komal Jaswal, Sylvain Foisy, Miriam Freedman, *The Pennsylvania State University*

Phase transitions in atmospheric aerosols influence heterogeneous chemistry, hygroscopicity, and cloud formation. Aerosol particles often contain both organic and inorganic compounds, with organic matter making up 20–90% of the total mass, though only ~10% has been characterized. In contrast, inorganic composition is better understood, with major ions including Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, NO_3^-, NH_4^+ and SO_4^{2-}. Research on the phase transitions of organic/inorganic aerosol particles has primarily focused on $(NH_4)_2SO_4$, which is a dominant component of the total inorganic mass of continental aerosol. This focus creates gaps in understanding the influence of other prevalent inorganic ions on phase transition. In this study, 2-methylglutaric acid and 1,2,6-hexanetriol, proxies for oxidized organic compounds, were mixed with different salts to investigate the phase transition properties of model droplets using an optical microscope. Experiments were conducted with 20 different salts, and separation relative humidity (SRH), efflorescence relative humidity (ERH), and deliquescence relative humidity (DRH) were compared. Anions followed the Hofmeister series, where strongly salting-out species had higher SRH, whereas cations showed an opposite pattern, with weaker salting-out ions exhibiting higher SRH. Relatively strong hydrating ions exhibited higher values of SRH, ERH, and DRH. In addition, systems with organic compounds and mixed inorganic compounds ($(NH_4)_2SO_4/NH_4NO_3$, $(NH_4)_2SO_4/NH_4Cl$, and NH_4Cl/NH_4NO_3) were also studied. SRH values were compared as the relative concentrations of the salts varied, revealing a suppression in SRH with increasing concentrations of salts containing relatively weakly hydrating ions. Parameterizations of phase transition relative humidity were examined as a function of salt concentration in mixtures containing weakly and strongly hydrating ions. These studies are important in understanding the impact of organic-inorganic interactions on the phase transition properties of aerosol particles, which is important for predicting the role of aerosol particles for climate and air quality.

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6AC.7

Unveiling the Mixing Behavior of Secondary Organic Aerosols from Isoprene and Trimethyl Benzene. YUZHI CHEN, Rahul Zaveri, Alla Zelenyuk, Claire E. Moffett, Gregory W. Vandergrift, Swarup China, John Shilling, *Pacific Northwest National Laboratory*

Secondary organic aerosol (SOA) contributes a large fraction of atmospheric aerosol, significantly impacting climate, air quality, and human health. SOA formation is traditionally described by semivolatile partitioning theory, which typically assumes that different SOA types form a well-mixed condensed phase on a short time scale. However, this assumption has been challenged by several recent studies showing that a well-mixed phase is not always formed, even between fresh and aged SOA of the same type. The oxygen-to-carbon ratio (O:C) has been widely used to characterize the oxidation state of SOA and can be linked to various SOA properties, including phase separation. Here, we investigate the ability of O:C to predict whether equilibrium partitioning and ideal mixing are achieved between two different types of SOA. We conduct two types of chamber experiments: (1) co-condensation experiments, where isoprene and isotopically labeled trimethyl benzene (TMB) were oxidized simultaneously to form SOA; and (2) sequential condensation experiments, where isoprene SOA was formed in the presence of pre-existing TMB SOA, and vice versa. We find that in both scenarios, an equilibrium partitioning model significantly overpredicted the SOA mass yield, indicating isoprene SOA and TMB SOA did not form a well-mixed phase within the experiment time scale of 4-5 hours, despite their similar O:C. To further elucidate the mixing state of the binary SOA mixture, we employed miniSPLAT, a single particle spectrometer, for depth-profiling, enabling us to analyze the morphological distribution of TMB and isoprene SOA within aerosol particles. Utilizing isotopically labeled TMB allows us to distinctly differentiate between isoprene SOA and TMB SOA and thus unravel the extent of mixing or phase separation. Complementary offline analysis of the SOA filter samples using nanospray desorption electrospray ionization mass spectrometry (nanoDESI-MS) provides molecular-level insights into the SOA mixture composition.

6AC.8

Controlling the Morphology of Microparticles Formed by Evaporation of Aerosol Droplets Containing Polymer Nanoparticles. SORREL K. HAUGHTON, Panagiotis Georgiou, Lukesh K. Mahato, Steven P. Armes, Jonathan P. Reid, *University of Bristol*

Final morphology of spray-dried microparticles is an important factor in determining the particle's chemical and physical properties, which in turn is important for applications such as spray-dried pharmaceuticals, cosmetics and food products. The morphology of the dried particle governs its surface area and density, which in turn affects the suitability for application; for example, low density particles are useful for inhaled drug formulations. It has previously been shown that the drying kinetics and the composition of the feed solution of the evaporating droplets affects the dried particle's morphology. Here, aqueous, nanoparticle-laden droplets, prepared via polymerization-induced self-assembly, are used to investigate the effect of polymer glass transition temperature on the dried particle morphology. Four aqueous samples of the monodisperse nanoparticles were tested, with hydrodynamic diameters of 72.8 to 86.2 nm and glass transition temperatures of -30.4 to 93.3 °C, to allow a comprehensive investigation of the effect of glass transition temperature on the evaporation kinetics and dried particle morphology of the aerosol droplets (28 – 36 μm radii). To study levitated single droplets, a comparative kinetics electrodynamic balance was used to record the evaporation profiles of the droplets at relative humidities (RH) of 0 to 55%. A falling droplet column paired with scanning electron microscopy was used to dry and collect the droplets under the same external conditions and visualize how the evaporation kinetics and glass transition temperature of the nanoparticles impacted their final morphology. Decreasing the RH led to an increased evaporation rate and increased buckling in the final nanoparticles. At dilute concentrations the nanoparticles' properties had no impact on the evaporation kinetics, but decreasing the glass transition temperature of the nanoparticles did lead to softer dried microparticles which exhibited a greater degree of buckling. These results signify a move towards increased control over a microparticle's final morphology.

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6BQ.1

Emerging Pollutant Emissions from the Combustion of Built Materials. Hongru Shen, Bradley H. Isenor, Carolyn Liu-Kang, Mohamad H. Al-Jabiri, Rowshon Afroz, Amanda Hanashiro Moraes, Shakiba Talebian, Oscar Olfert, Ginny Marshall, Alex K.Y. Lee, Samar Moussa, Sumi Wren, Jeremy Wentzell, Amy Leithead, Jason S. Olfert, Ran Zhao, John Liggio, ARTHUR W. H. CHAN, Jonathan Abbatt, *University of Toronto*

Wildland-Urban Interface (WUI) fires are wildfires that spread into areas settled by humans, and their frequency and intensity have increased in recent years due to the rising number of wildfires and rapid urban expansion. These fires cause large-scale destruction of infrastructure and vehicles, degraded local and regional air quality, and significant health risks to emergency responders and surrounding communities. Unlike wildfires, which primarily burn natural materials, WUI fires can also involve a diverse range of built materials, including plastics, building insulation, and household furnishings. The combustion of these materials releases a more complex mixture of hazardous pollutants, many of which remain poorly understood in terms of their chemical composition and health impacts. During a fire lab campaign in the summer of 2024, the Biomass Burning in Canada (BBCan) project collected and burned common built materials, including polyester curtains, polyvinyl chloride (PVC) pipes, polystyrene (PS) insulation, and polyurethane (PU) foam. A suite of state-of-the-art online mass spectrometers, including a Soot Particle Aerosol Mass Spectrometer (SP-AMS), a Vocus Proton-Transfer-Reaction Time-of-Flight Mass Spectrometer (PTR-ToF-MS), and an iodide Chemical Ionization Mass Spectrometer (I-CIMS), was employed to investigate the resulting airborne emissions. We identified and quantified the emissions of nanoplastic particles (NPPs), halogenated compounds, toxic gases, and other emerging pollutants. Emissions of NPPs were observed from PET burns, characterized by *m/z* 121, *m/z* 149, and *m/z* 166 in SP-AMS. In both PVC and PS burns, bromine-containing submicron particles were observed, likely to originate from additives present in building materials. Enhanced emissions of HCl were observed in PVC burns, with an estimated emission factor of 354-477 g kg-1. For PU burns, elevated emissions of HONO, HCN, and HCNO were detected, with estimated emission factors of 1.1±0.8 g kg^{-1}, 0.61±0.02 g kg^{-1}, and 0.064±0.001 g kg^{-1}, respectively. This study aims to advance the understanding of chemical composition, physical properties, and emission factors of WUI fire pollutants, providing data support for their climate and health impact assessment.

6BQ.2

Aerosol Emission Factors for Structural Fuels in Wildland-Urban-Interface Fires. KEVIN RIDGWAY, Anna Helfrich, Lily Cast, Amy P. Sullivan, Aika Davis, Ryan Falkenstein-Smith, Thomas Cleary, Rodney Bryant, Mathew Bundy, Christian L'Orange, Shantanu Jathar, *Colorado State University*

With nearly 50 million houses in the United States located at the wildland-urban interface (WUI) and wildfire frequency and activity on the rise, there is a growing concern that wildfire-related structure fires might be an important source of air pollutants in WUI regions, with implications for air quality and public health. However, aerosol emissions from structure fires are poorly understood and what we do understand remains fragmented and incomplete. The Burning Homes And Structural Materials (BHASMA) campaign studied emissions from a variety of structural fuels under different combustion modes (pyrolysis and flaming) and fire scales (0.5-250 kW) in an effort to quantify fuel-specific emission factors. Around 100 experiments were conducted with over 17 different fuels, including: lumber (e.g. southern yellow pine), engineered wood products (e.g., oriented strand board), insulation (e.g. polyurethane foam), textiles (e.g. polyester carpet), conduit (polyvinyl chloride), siding (e.g. cement fiberboard). Additionally, fuel mixtures representative of residential structures were combusted to compare mixed-fuel emission factors with individual fuels. Differences in emission factors are evident between fuel type and combustion efficiency, often ranging 1-2 orders of magnitude for bulk pollutants: $PM_{2.5}$ and organic aerosol (OA). Considering non-lumber materials as a 30% fraction by mass for a structure increases the net emissions by a factor of two for $PM_{2.5}$, three for OA and nearly five for elemental carbon (EC, soot). Ongoing work is focused on identifying fuel-specific signature species based on a detailed analysis of ions, saccharides, and elemental species (e.g. ammonium, levoglucosan, zinc, chromium, iron – for biomass v. non-biomass fuel identification) and comparing species-resolved emission factors with literature data. Our work will contribute to a more detailed understanding of pollutant exposure for first-responders, evacuees, and down-wind communities affected by WUI fires.

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6BQ.3

Characterization of Speciated Aerosol Emissions from Combustion of Furnished Structures. MICHAEL MILAZZO, Nathan Kreisberg, Robert Weber, Wuquan Cui, Bryce Bathras, Siyan Wang, Faraz Hedayati, Michael Gollner, Allen Goldstein, *University of California, Berkeley*

The number of structures destroyed in fires has risen in recent decades due to the increasing severity of wildland fires and expanding development at the Wildland-Urban Interface (WUI). Although previous research has characterized smoke emissions from individual anthropogenic fuels, limited data exist on emissions from fully furnished, burning structures. We measured emissions from a series of structure-to-structure fire spread experiments using full-scale Accessory Dwelling Units (ADUs). These ADUs were constructed according to the California Building Code and furnished with typical household contents, including appliances, bathroom fixtures, a couch, television, and clothing.

Emissions were measured and collected using a custom sampling package aboard a drone that followed the smoke plume in real time. Online continuous measurements of CO and CO_2 enabled calculation of the modified combustion efficiency (MCE). Time-integrated samples of particulate matter were collected to quantify $PM_{2.5}$ mass, organic carbon (OC), elemental carbon (EC), speciated elemental composition via inductively coupled plasma mass spectrometry (ICP-MS), and organic aerosol speciation via thermal desorption two-dimensional gas chromatography with high-resolution time-of-flight mass spectrometry (TD-GCxGC-HToF-MS).

We report CO_2-based emission factors for speciated $PM_{2.5}$ from the combustion of multiple ADUs. We contextualize the observations by MCE, building materials, and notable fire events. Elemental analysis revealed high emission factors for potassium and sulfur, which have been observed in studies of biomass burning emissions. Strong correlations among certain metals suggest they are emitted together from specific household materials or combustion events.

These findings will contribute valuable data to emissions inventories of WUI fires and will improve air quality predictions during these events. Furthermore, they will support improved regulatory modeling of health and economic impacts associated with WUI fires, and could inform choices of building material in future policy.

6BQ.4

Flying Through Fire: Drone-Based Emissions Measurements From Structure and Prescribed Fires. ABIGAIL MABEN, Karthick Mohan Kumar, Emilio Molina Rueda, John Flynn, Misa Soto, Clara McMullin, Gabriel Isaacman-VanWertz, Christopher Robertson, Jack Gottschalk, Jessica Tryner, Tami Bond, John Volckens, Christian L'Orange, Shantanu Jathar, *Colorado State University*

Prescribed burning and controlled training burns have emerged as key wildfire mitigation and preparedness strategies, aiming to reduce fuel loads, enhance firefighter readiness, and lower the risk of catastrophic wildfires. However, little is known about the emission rates and chemical composition of air pollutants produced during these burns. In this work, we present the development and deployment of a multirotor drone equipped with sensor and sampling devices to measure key atmospheric species. Time-resolved measurements are obtained using low- to lower-cost instruments (CO_2 via photoacoustic spectroscopy, CO and NO_x via metal oxide sensors, $PM_{2.5}$ via light scattering, and black carbon (BC) via a micro aethalometer). Particles are also collected on Teflon and quartz filters for offline analysis to quantify mass concentrations of $PM_{2.5}$, soot (BC and elemental carbon), organic aerosol (OA), inorganic ions, water-soluble organic carbon (WSOC), and trace metals. Organic vapors are sampled on thermal desorption tubes and analyzed for C_2–C_{12} compounds, including alkanes, alkenes, aromatics, isoprene, terpenes, phenols, methoxy phenols, and heterocyclic species. We have measured emissions from 4 laboratory pyrolysis burns, four structural burns at a fire training center in Loveland, CO, as well as two prescribed pile burns conducted in Red Feather Lakes, CO. Measured $PM_{2.5}$ and BC concentrations were compared with reference measurements. Emission factors were consistent with published values. Additional analyses will include evaluation of OA, EC, speciation profiles of VOCs, and comparisons with existing emission profiles from wildfires and laboratory burns. These results will shed light on the role of prescribed burns in shaping air quality and highlight the utility of drone-based platforms for capturing emission data in prescribed fire environments.

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6BQ.5

Chemical Composition and Photolytic Aging of Urban Material Burning Smoke. SERGEY NIZKORODOV, Matt Zaragoza, Luis Ruiz Armenta, Noam Levi, Katherine Hopstock, Manabu Shiraiwa, Abigail Smith, Qiaorong Xie, Alexander Laskin, Gregory W. Vandergrift, Swarup China, Zezhen Cheng, Shantanu Jathar, Zoë Golay, Evan Chartrand, Allan K. Bertram, *University of California, Irvine*

Wildfire events increasingly occur at the wildland-urban interface, burning not only biomass but also a wide range of urban materials. This presentation will focus on the chemical composition and important physical properties of particulate matter from pyrolysis and smoldering of common urban materials. Specifically, we measure mass absorption coefficients by spectrophotometry, perform untargeted analysis of samples by ultrahigh resolution mass spectrometry, measure particle viscosity by poke-flow and fluorescence recovery after photobleaching methods, measure distribution of effective saturation vapor pressures by thermal desorption mass spectrometry methods, and study the effect of UV-aging on all of these properties. We observe that exposure of OA to solar radiation tends to increase particle viscosity, change solubility and reduce the volatilities of particulate compounds. At the same time, the absorption coefficient can either be reduced (photobleaching) or increased (photoenhancement), reflecting complex aging mechanisms driven by condensed phase photochemical reactions in OA.

6BQ.6

Impact of Flame Retardants on the Physical and Chemical Properties of Residential Combustion Aerosol from Furniture Foams. Riley Weatherholt, Bailey Bowers, Amila De Silva, Heather Stapleton, Carrie McDonough, RYAN SULLIVAN, *Carnegie Mellon University*

To meet flammability standards initially introduced in the 1970s, furniture manufacturers often add mixtures of chemical flame retardants to furniture foams. Flame retardants, including brominated organics and chlorinated organophosphates, are known to exhibit a wide range of toxic effects, but little is known about the effects these flame retardants have on the chemical and physical properties of the resulting emissions when residential fires occur. Since flame retardants work by making combustion less efficient, we hypothesize that foams treated with flame retardants will yield higher mass concentrations of combustion aerosol as well as gas and particle phase emission of potentially toxic byproducts resulting from transformations of the flame retardants. We combusted foams with and without flame retardants in a steel chamber, collected the emissions on quartz filters and polyurethane gas samplers, characterized the aerosol concentration and size distributions with a scanning mobility particle sizer (SMPS), and evaluated the elemental to organic carbon ratio (EC/OC) of the aerosol collected on filters. The foams included authentic commercial foams as well as a manufacturer's sample with and without Firemaster 600, a common mixture of chlorinated organophosphate esters and brominated flame retardants. We analyzed filter extracts with gas chromatography-mass spectrometry (GC-MS) and ultra-high performance liquid chromatography mass spectrometry (UPLC-QTOF-MS), and compared the contents of the emissions to extracts from the intact foams. We found that combustion of flame retardant laden foams releases intact flame retardant molecules, such as tris(2-chloroisopropyl)phosphate (TDCIPP) and 2-ethylhexyl 2,3,4,5-tetrabromobenzoate. While it is generally thought that organophosphate flame retardants stay within or on the surface of the foam, polymerizing to create a char layer that suppresses combustion, we observe that up to 4% of the FR mass in the foam is released during combustion. We observed drastically different mixtures of flame retardants between commercial products, indicating that chemically complex mixtures of halogenated flame retardants are likely released during residential fires. Furthermore, halogenated transformation products of flame retardants were also measured. Our work suggests that the emission of intact flame retardants and halogenated byproducts would drive human exposure to harmful gas and aerosol emissions such as during and following urban fires.

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6BQ.7

Optical Properties of Aerosols Generated from a Simulated Structural Burn. GEOFFREY SMITH, Ryan Poland, John Allen, Muhammad Abdurrahman, Michael Caraway, Thomas Carroll, Mike Lesiak, Mac A. Callaham, Joseph O'Brien, Andrew Metcalf, Pengfei Liu, Rawad Saleh, *University of Georgia*

We present results from simulated structural burns conducted as part of the second **G**eorgia **WI**ldland fire **S**imulation **E**xperiment (G-WISE 2) conducted in Athens, GA in April/May 2025. In these experiments, a fuel bed consisting of carpet, plastic, plywood and insulation was combusted, and optical properties of the emitted aerosols were measured using a home-built 4-wavelength photoacoustic spectrometer (MultiPAS-IV: 406/532/663/783 nm) along with a single-particle soot photometer (SP2). We measured absorption coefficients, mass absorption coefficients (MACs), absorption Angstrom exponents (AAEs) and single-scattering albedos (SSAs), for both thermodenuded (100 °C and 300 °C) and unthermodenuded particles allowing us to relate the optical properties to aerosol volatility fractions. Compared to aerosols from simulated wildland fires, we find that the aerosols emitted from structural burns contained much less volatile material and a much smaller contribution from brown carbon. Values of the optical properties generally resemble those of black carbon particles and do not change upon thermodenuding up to a temperature of 300 °C. However, we did find that the AAE values were consistently below 1, indicating that the particles may not consist exclusively of black carbon.

6BQ.8

Environmentally Persistent Free Radicals, Reactive Oxygen Species, and Oxidative Potential of Fine Particulate Matter Generated From Burning Natural Fuels and Building Materials. BRADLEY H. ISENOR, Hongru Shen, Lena Gerritz, Brianna Lauper-Cook, Amanda Hanashiro Moraes, Ginny Marshall, Manabu Shiraiwa, Jason S. Olfert, Ran Zhao, Jonathan Abbatt, Arthur W. H. Chan, *University of Toronto*

Wildfires are expected to become more prevalent with climate change and as a consequence, their contribution to global fine particulate matter ($PM_{2.5}$) emissions and adverse health outcomes is expected to rise. The $PM_{2.5}$ emitted from wildfires is highly complex as its composition can vary based on an assortment of burning conditions, such as the types of biomass burned, moisture level, and combustion type. This complexity has made understanding the harm associated with wildfire $PM_{2.5}$ challenging at a chemical level. With increasing frequency of fires at the wildland-urban interface (WUI), it is important to not only assess the potential health implications of burning natural fuels when considering the health impacts of wildfire $PM_{2.5}$, but also those arising from the burning of building materials, whose health effects are even less understood. Here we investigate the potential health impacts of $PM_{2.5}$ generated from the burning of nine natural fuels and four plastic building materials through the lens of oxidative potential (OP) using the dithiothreitol assay. Additionally, electron paramagnetic resonance spectroscopy is used to measure environmentally persistent free radicals (EPFR) and reactive oxygen species (ROS). Several replicates of each fuel type were burned during the Biomass Burning Canada fire lab campaign in the summer of 2024 and were accompanied by a comprehensive suite of online and offline measurements to connect aerosol composition with EPFR, ROS, and OP measurements. Given the obvious differences in the chemical composition of fuel-types burned, $PM_{2.5}$ from natural fuels and building materials is expected to have considerably different compositions and thus different OP and radical profiles, even within the two classes. In this presentation, an analysis of EPFR, ROS, and OP for all fuels burned will be presented with an emphasis on building fuels and how they compare to natural fuels. Results from this work will improve understanding of the potential harm of wildfires under different burning conditions and those that reach the WUI.

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6CC.1

Aerosol Fluxes and Boundary-Layer Coupling in New Particle Formation: Case Studies from the ARM ArcticShark Measurements. RUOYU ZHANG, Fan Mei, Damao Zhang, Yang Wang, *University of Miami*

New particle formation (NPF) significantly influences air quality and climate by affecting cloud condensation nuclei (CCN) production. Comprehensive NPF observations have largely been restricted to surface measurements, predominantly reflecting conditions within the lower mixed layer of the planetary boundary layer (PBL). However, emerging research indicates that NPF events may originate at various altitudes above the surface and are potentially linked to PBL dynamics. In this study, we analyzed upper-PBL aerosol measurements obtained by the DOE ARM uncrewed aerial vehicle ArcticShark at the Southern Great Plains (SGP) observatory. We examined the vertical profile of aerosol properties and developed criteria for flight-based aerosol flux measurements, which we integrated with PBL and ground-based aerosol observations to evaluate specific NPF case studies.

From the flight-based aerosol flux analysis, we found that during NPF periods, turbulence at medium frequency (timescales of 10–15 s) significantly influenced particle fluxes, and instrumentation response frequencies of at least 0.5 Hz were necessary to avoid substantial flux underestimation. Furthermore, a minimum flight-leg duration of approximately 1,000 s was recommended to accurately capture representative aerosol fluxes when averaging over extended periods. In case study analyses, over half of the observed NPF events originated from higher altitudes. Notably, on May 24, we documented a sustained aerosol particle flux event lasting about 10 minutes, characterized by downward bursts exceeding 1,500 cm^{-3} s^{-1} originating from the upper PBL. These fluxes were approximately 100–200 times higher than baseline aerosol fluxes recorded during stable atmospheric conditions, indicating significant turbulence-driven downward transport of nanoparticles. These quantitative findings underscore the critical role of boundary-layer evolution and upper-air aerosol dynamics in shaping the vertical distribution and propagation of NPF events.

6CC.2

ASIA-AQ Flight Campaign Reveals Impacts of Transboundary Aerosol Transport in Southeast Asia. FRANCESCA GALLO, Gangwoong Lee, Meehye Lee, Taehyoung Lee, Carolyn Jordan, Sayantee Roy, Michael Shook, Elizabeth Wiggins, Edward Winstead, Luke Ziemba, Richard Moore, *NASA Langley*

The recent NASA Airborne and Satellite Investigation of Air Quality (ASIA-AQ) flight campaign combined multiple observing platforms (aircrafts, satellites, and surface sensor network) to study the atmospheric composition of four metropolitan areas across Southeast Asia including Philippines, South Korea, Taiwan, and Thailand. The two-month effort spanned February-March, 2024, and targeted wintertime peaks in pollution levels to advance the understanding of air quality over Asia and inform satellite observations and model predictions. Multiple science flights were conducted using the NASA DC-8 to provide comprehensive in situ data of atmospheric aerosol properties, chemical constituents, and meteorological parameters. In this study, we integrate observational datasets of aerosol properties collected during ASIA-AQ to capture the occurrence of transboundary aerosol transport and assess their impact on particle microphysics, formation mechanisms, and boundary layer processes over the Yellow Sea region. Competing influences of transboundary-transported aerosol versus regional aerosol emissions are also evaluated to provide key constrains necessary for understanding dominant emission sources and contributions on air quality in Southeast Asia.

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6CC.3

Aircraft Observations of Ice Nucleating Particles in the Arctic and Sub-Arctic Boundary Layer and Free Troposphere.

RUSSELL PERKINS, Ryan Patnaude, Camille Mavis, Kevin Barry, Kerri Pratt, Vanessa Selimovic, Andrew Holen, Logan Forshee, Paul DeMott, Sonia Kreidenweis, Paquita Zuidema, Bart Geerts, Greg McFarquhar, Sebastian Schmidt, *Colorado State University*

Ice Nucleating Particles (INPs) are responsible for primary cloud glaciation temperatures between 0 and -38 °C, and act as a prerequisite for the onset of secondary ice production processes. Mixed-phase clouds fall into this temperature range and are common in the spring and autumn transition seasons in the Arctic, and during wintertime cold-air outbreak (CAO) events, where cold airmasses over the Arctic ice flow southward over North Atlantic open water. Two recent campaigns, across three deployments, have targeted these cloud types with an extensive suite of instrumentation, but we will focus on INP measurements here. The Cold-Air outbreak Experiment in the Sub-Arctic Region (CAESAR) occurred in Feb-April of 2024, targeting CAO events over the Norwegian Sea and Greenland Sea. Several strong and weak CAO events were captured, including events with evidence of long-range transported terrestrial aerosol from Europe, Asia, and Africa. Evidence of elevated INP concentrations were found over the marginal ice zone, potentially related to increased biological production. The Arctic Radiation-Cloud-Aerosol-Surface-Interaction eXperiment (ARCSIX) had two deployments, one in May-June and another in July-August of 2024, targeting different sea ice and cloud systems in the Lincoln Sea and surrounding areas. This presentation will discuss preliminary findings from both campaigns, using a combination of online and offline INP measurements, and aerosol physical and chemical composition. There will be a special focus on the characteristics and concentrations of local arctic INP sources, long-range transported mineral INP sources, and the roles of INPs sourced from above and below clouds.

6CC.4

Seasonal Variability, Sources, and Parameterization of Ice-Nucleating Particles in the Rocky Mountain Region During SAIL.

RUICHEN ZHOU, Russell Perkins, Drew Juergensen, Kelton Ayars, Oren Dutton, Paul DeMott, Sonia Kreidenweis, *Colorado State University*

The Surface Atmosphere Integrated Field Laboratory (SAIL) campaign was conducted in the Upper Colorado River Basin, a critical watershed supplying water to the western United States. Investigating atmospheric ice-nucleating particles (INPs) in this mountainous region is crucial for improving precipitation prediction in this area and reducing uncertainties in aerosol-cloud interactions in global climate models. Here, we present results from nearly two years of INP observations during SAIL. Clear seasonal variations were observed for INPs active at all temperatures, with concentrations lowest in winter, increasing in spring, peaking in summer, and decreasing in autumn. Aerosol source apportionment analysis found that dust in the coarse mode was strongly correlated with INPs, suggesting its dominant role. Further sample treatments with heating and H_2O_2 separated INPs into fractions of biological and heat-labile, other organic, and inorganic types. Other organic INPs were correlated with inorganic INPs with a ratio near 10, suggesting similar origins, and the abundant organic INPs indicate that soil dust is the main contributor to INPs in this region. Biological INP contributions were identified mostly during warm seasons, with limited contribution in winter. An unexpected correlation was found between biological and heat-labile INPs and other organic INPs at −15 ℃. This potentially provides an indirect approach for estimating biological INPs in this area. A parameterization method was developed based on the surface active site density for the two-year samples. This mainly represents the INP particles originating from soil dust and may be applicable to other remote continental areas where soil dust dominates INP populations.

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6CC.5

The Role of Aerosol Properties in Determining Deep Convection Cloud Properties. SARAH D. BROOKS, Seth Thompson, Bo Chen, Taylor Peña, Brianna Matthews, Anita Rapp, Christopher Nowotarski, Ziying Lei, Milind Sharma, *Texas A&M University*

Accurately characterizing the vertical distribution of aerosols and their cloud-forming properties is crucial for understanding aerosol-cloud interactions and their potential impact on deep convection. During the DOE TRACER campaign, we combined mobile laboratory van, micropulse lidar and radiosonde measurements to observe the surface concentration, vertical distribution and cloud-forming properties of aerosols. Aerosols may influence deep convective clouds by serving either warm could condensation nuclei (CCN)or ice nucleating particles (INPs). Airmass samples in Galveston, TX were surprisingly polluted with brief periods of ship emissions containing extremely high aerosol concentrations, at times exceeding 34,000 cm-3. These ship emission periods contained smaller, less hygroscopic particles than the background air, resulting in a 69% decline in the CCN activated fraction at 1% supersaturation. In comparison, continental airmass northwest of Houston contained an average aerosol concentration of 5200 cm-3, with low to moderate CCN activity. INPs may affect various cloud properties related to the formation, lifetime, and precipitation of deep convective clouds. Within the INP population in Greater Houston, supermicron particles were largely responsible for ice nucleation above -20°C, while submicron particles dominated below -20°C, as expected. The warmest nucleation temperatures coincided with the presence of potassium-rich feldspar, determined by Raman spectroscopy. This characterization of Greater Houston's aerosol population can provide insight for weather and climate models.

6CC.6

Aerosol Particle Measurements and Cloud Properties During the Southern Ocean Clouds (SOC) Campaign in November and December 2024. LEAH WILLIAMS, James Allan, Michael Flynn, David Beddows, James Brean, Simone Louw, Irina Gorodetskaya, Timothy Onasch, Stephen Jones, Mark Tarn, Imogen Wadlow, Nina Kinney, Manuel Dall'Osto, Amélie Kirchgaessner, Thomas Lachlan-Cope, *Aerodyne Research, Inc.*

We deployed an Aerosol Mass Spectrometer (AMS) on the British Antarctic Survey Research Vessel Sir David Attenborough (SDA) during November and December 2024 as part of the Southern Ocean Clouds (SOC) campaign. The AMS measures sub 1 micron aerosol particle chemical composition and size distributions, using thermal vaporization and electron impact ionization, followed by time-of-flight mass spectrometry.

The cruise track covered a broad area (50 S to 67 S and 70 W to 25 W) and encountered a variety of atmospheric environments, including seasonal sea ice zones, open ocean, and areas near islands with penguin colonies and volcanoes. Different ratios of organics, sulphate, methane sulphonic acid (MSA) and ammonium were observed and associated with distinct aerosol size distributions. The results will be discussed in the context of different air mass sources, varying gas-phase concentrations of aerosol precursors and real-time cloud property measurements.

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6CC.7

Quantifying Timescales for Below-Cloud Removal of Particles by Precipitation. CHRISTOS STAMATIS, Chenyang Bi, Gabriel Isaacman-VanWertz, *Virginia Tech*

Wet deposition is an important removal mechanism for aerosols that affects their atmospheric lifetimes. Studies involving global circulation models suggest that wet deposition is the dominant mechanism for particle removal in the atmosphere. Unfortunately, there are few direct observational constraints on the wet deposition of particles and their timescales of removal, leading to significant uncertainty regarding the impact of precipitation on aerosols. In this work we will present observationally constrained estimates of below-cloud wet deposition timescales for particles. Precipitation size distribution data from globally distributed sites in the Department of Energy Atmospheric Radiation Measurement (ARM) network provided highly detailed measurements of precipitation characteristics, collocated with measurements of particle size distributions. Direct observations of changes in particle size distributions during precipitation events are used to calculate size-dependent below-cloud scavenging coefficients. Using data from Lamont, Oklahoma (2017-2023), Manacapuru, Brazil (2014-2015), southern great plains (2016-2024), Gunnison, Colorado (2021-2023), eastern north Atlantic (2022-2024), and Cordoba, Argentina (2018-2019) removal rates are examined as a function of size, rain intensity and geography. Below-cloud scavenging shows weak dependence on geographical location and particle size, but is strongly influenced by rainfall rate (with little observable impact at rates below ~1 mm/hr). During precipitation events, particles are scavenged at an average rate of 10-100 hours, and can be parameterized as a function of particle size and rainfall rate. Accounting for rainfall rate and frequency across sites the overall below-cloud removal is 8-42 days, which is comparable to particle dry deposition. With global models suggesting wet deposition dominating particle removal our results indicate that in-cloud scavenging must be dominating below-cloud removal and therefore wet deposition in models must be evaluated in this new context.

6CC.8

Long-Term Trends in Aerosol Optical Properties and Biomass Burning Influence at the Southern Great Plains. MANISHA MEHRA, Yang Wang, Sujan Shrestha, Arthur J. Sedlacek, Yan Feng, Janek Uin, *University of Miami*

Direct aerosol radiative forcing estimates depend on key aerosol optical properties (AOPs), including the scattering coefficient (σsp), absorption coefficient (σap), and single scattering albedo (ωo). Despite their importance for constraining radiative impacts and source contributions, long-term observations of these properties remain limited. Building on an earlier study at the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) site (Sheridan et al., 2001), this study analyzes multi-year AOP trends from January 2018 to December 2024. The median σsp at 550 nm was 15.4 Mm^{-1}, less than half the value reported in 1996–2000, potentially reflecting reductions in particulate matter emissions due to implementation of cleaner technologies over recent decades. The median σap was ~1.2 Mm^{-1}, highest during late spring and autumn, consistent with earlier reported seasonal patterns. The median ωo decreased from 0.95 (1996 to 2000) to 0.92 (2018 and 2024), with further decrease to ~0.87 in late spring and autumn, indicating increased aerosol absorption during these seasons. This seasonal decrease in ωo, along with elevated σap, indicates the influence of regional or local biomass burning (BB) emissions. The median aerosol absorption exponent (AAE) was 0.98, suggesting dominant fossil fuel combustion sources, while elevated AAE values (1.1–1.4) in spring and autumn point to contributions from BB-derived brown carbon. Together, these results highlight both persistent seasonal features and evolving AOPs over two decades at SGP, reinforcing the potential utility of AOPs as indicators of BB influence. Previous studies have demonstrated the effectiveness of AOPs for real-time BB characterization, even under polluted conditions influenced by dilute BB plumes. Therefore, this study further investigates the efficiency of AOPs for BB characterization at SGP. The detailed results of the frequency and seasonality of BB influence at SGP will be presented at the conference.

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6CE.1 – INVITED

Tire, Road or Both - Examining the Sources of Ultrafines at the Tire-Road Interface. Siriel Saladin, Josh Hassim, Molly J. Haugen, David O'Loughlin, Chiara Giorio, ADAM M. BOIES, *University of Cambridge*

Tire–road interactions generate airborne and settled nanoparticles that contribute to urban particulate pollution and can enter waterways. However, the mechanisms, sources, and chemical signatures of tire-derived nanoparticles remain poorly characterized. Here, we simulate tire wear using a rotating-drum abrasion system at Karlsruhe Institute of Technology under tracer-gas–controlled drive cycles and collect the resulting nanoparticles for detailed analysis.

We quantified particle-number emission indices during standardized cycles and applied complementary online (size-resolved chemical ionization) and offline (ICP-MS, high-resolution mass spectrometry) methods to characterize particle composition. Drive-cycle trials showed that roughly 70 % of emitted nanoparticles are semi-volatile species, likely formed by thermal vaporization of tire polymer binders at the contact interface. ICP-MS confirmed the presence of tire-specific trace elements (e.g., Zn, S, Mg) in the ultrafine fraction, although distinguishing tire versus pavement contributions remains challenging.

To improve source apportionment, we developed sampling protocols capable of collecting tens of micrograms of nanoparticles for elemental and molecular analyses and are evaluating stable-carbon isotope ratios to differentiate elastomer-derived carbon from asphalt and concrete substrates. Complementary Soxhlet extraction of cryomilled tire material with polar solvents revealed a 10–15 % mass loss of oligomeric and cyclic hydrocarbon binders. Thermal aging of air-dried tire particulates in a tube furnace (20–250 °C) produced substantially fewer nanoparticles than untreated samples, implicating volatilized binders as primary emission precursors. Ongoing tests across diverse roadway materials aim to quantify pavement-specific effects on nanoparticle chemistry and establish robust emission factors.

These findings advance our mechanistic understanding of tire wear nanoparticle formation and composition, laying the groundwork for improved source-apportionment studies and targeted mitigation strategies for non-exhaust traffic emissions.

6CE.2

Secondary Organic Aerosol Formation from Gaseous Tire Emissions: Laboratory Characterization and Real-World Implications. MINGHAO HAN, Don Collins, *University of California, Riverside*

Reductions in tailpipe emissions have increased the relative significance of non-exhaust sources, particularly tire wear, as contributors to urban particulate pollution. However, secondary organic aerosol (SOA) formation potential from gaseous tire emissions remains poorly characterized. To address this, we constructed an experimental system combining a temperature-controlled tire enclosure, an oxidation flow reactor (OFR), and a scanning mobility particle sizer (SMPS) to quantify SOA production from tire emissions. We evaluated SOA formation from over 120 tires covering diverse brands, manufacturing years, and usage histories, at temperatures from 20–90°C to replicate realistic driving conditions. Emissions consistently increased dramatically with temperature, with SOA production at 90°C nearly three orders of magnitude greater than at 20°C. Significant variability among tire brands and production years highlights the influence of tire composition and manufacturing methods on emissions. In addition, we conducted long-term emission yield experiments by heating new tires continuously for extended periods of time and intermittently measuring SOA until emission rates significantly decreased. This procedure allowed us to directly quantify total SOA yield relative to tire mass loss, providing insights into long-term emission potential. To link laboratory results to real-world conditions, we gathered tire temperature data from over 1,000 vehicles and built a comprehensive inventory of more than 3,000 tires across the Los Angeles air basin, documenting detailed brand, model, and manufacturing year information. Integrating these real-world data with laboratory-derived SOA emission factors supports robust bottom-up regional SOA emission estimates. Further, Electron Paramagnetic Resonance (EPR) spectroscopy measurements quantified radical production and oxidative potential of tire-derived SOA, enhancing our understanding of potential health impacts. Our integrated approach advances understanding of the magnitude, variability, and environmental health implications of tire-emission SOA, emphasizing its significance for urban air quality management and potential regulatory frameworks.

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6CE.3

Probing the Molecular Composition of Organic Particulate Matter from Automotive Braking and Identification of Brake Tracers in Near-Roadway Ambient Environments. BERENICE ROJAS, Adam Thomas, Lisa Wingen, Madeline Cooke, Véronique Perraud, Samuel La Salle, Sanjeevi Nagalingam, Barbara Finlayson-Pitts, James Smith, *University of California, Irvine*

Understanding vehicle emissions is crucial for mitigating poor air quality. The national trend towards vehicle electrification has reduced tailpipe emissions, leaving non-tailpipe emissions (e.g., brake and tire wear) as the remaining sources of vehicular emissions. Most modern passenger vehicles use ceramic or semi-metallic brake pads with phenolic resins as binder agents. These resins thermally degrade under high temperatures, potentially releasing organic compounds and particles into the environment. Although braking is a recognized source of particulate matter (PM), the exact contributions from different brake pad components and in particular, the role of phenolic resin decomposition in particle formation remain unclear. To address this, we conducted laboratory experiments on the controlled thermal degradation of commercial phenolic resin samples and compared our results with actual braking experiments using a custom-built brake dynamometer with ceramic and semi-metallic brake pads. Particles generated in both experiments were collected on filters and analyzed using liquid chromatography coupled with high-resolution Orbitrap mass spectrometry. This analysis revealed a range of organic compounds emitted during both the heating of phenolic resins and emissions of particles during braking simulations, including prominent nitrogen-containing (CHN) and nitrogen-oxygen containing (CHON) compounds. To evaluate the contribution of organic PM from braking to ambient air quality, we also conducted two field campaigns at two near-road freeway sites in Southern California. Ambient organic PM was collected using a Sequential Spot Sampler, allowing time resolved monitoring. Measurements of the PM collected from both field sites showed the presence of organic compounds that matched key constituents from our laboratory studies. Temporal trends in these species matched daily traffic patterns and local wind directions, confirming that they likely originate from roadway sources. This study highlights the environmental relevance of brake wear emissions, especially in communities near major freeways.

6CE.4

Chemical Characterization of Tire Wear Particles: Size-Resolved Composition and Source Signatures in Near-Road PM Samples. XING WANG, Yushan Su, Colman Wong, Michael A.R. Tawadrous, Chelsea Rochman, Bonnie Hamilton, Alex K.Y. Lee, Greg J. Evans, Arthur W. H. Chan, *University of Toronto*

Tire wear particles (TWPs) have become an increasingly important source of traffic-related particulate matter due to the declining emissions from internal combustion engine vehicles. However, their chemical composition and contribution to near-road air pollution remain poorly characterized. This study employs offline pyrolysis gas chromatography mass spectrometry technique to investigate polymeric composition and tire-derived additives in both lab-generated tire particles and size-selected particulate matter samples collected near a highway. Distinct tire chemical-to-rubber ratios are observed for new, worn, and ambient TWPs. New tire tread particles exhibit higher antioxidant ratios, whereas worn tread particles show elevated pyrene levels. Field samples display an increased chemical-to-rubber ratios with decreasing particle size, highlighting mechanistic differences in fine and coarse TWP generation. Additionally, the natural-to-synthetic rubber ratios in ambient particles were higher on weekdays than weekends across all size fractions, consistent with increased truck traffic volume and higher natural rubber content in truck tires. While TSP and PM_{10} ratios fell below model predictions, $PM_{2.5}$ ratios exceeded theoretical values, suggesting different emission processes for fine and coarse TWPs. Our findings provide insights into the size-resolved chemical and polymeric profiles of TWPs, enabling more accurate source apportionment and assessment of their environmental and health impacts.

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6CE.5

Secondary Organic Aerosol from Anthropogenic Terpenes and Terpenoids and Contributions to Air Quality in United States Cities. Masoud Akbarzadeh, Huiying Luo, Abraham Dearden, Havala Pye, Lauren A. Garofalo, Delphine K. Farmer, Tucker Melles, Cort Zang, Megan Willis, Matthew Coggon, Carsten Warneke, Damien Ketcherside, Lu Hu, Nga Lee Ng, James Hurley, Gabriel Isaacman-VanWertz, Benjamin Murphy, SHANTANU JATHAR, *Colorado State University*

Volatile chemical product (VCP) use results in volatile organic compound (VOC) emissions that contribute to the formation of ozone (O_3) and secondary organic aerosol (SOA) and negatively affect urban air quality. Personal care products and cleaning agents are formulated with fragrant hydrocarbon terpenes (e.g., limonene) and oxygenated terpenes (e.g., linalool), which once released, participate in photochemical reactions to form O_3 and SOA. In this work, we combine environmental chamber data and box and chemical transport models to study how VCP terpenes contribute to SOA formation and the urban organic aerosol (OA) burden in United States (US) cities. Consistent with earlier work, our chamber and modeling data suggested that while cyclic terpenes like limonene and α-pinene are efficient SOA precursors (mass yields >20%) , most acyclic (e.g., linalool) and oxygenated (e.g., α-terpineol) terpenes have a much weaker potential (mass yields <5%) to form SOA. Simulations were performed with the Community Multiscale Air Quality (CMAQ) model over the contiguous US for the summer of 2023 and these indicated that terpenes contributed up to 20% of the SOA from all VCP VOCs in urban areas. We also found that VCP and mobile sources were both responsible for similar contributions to urban OA in the top 20 metropolitan statistical areas in the US and, together, they accounted for ~1 μg m^{-3} of OA and up to 25% of the total OA in those urban areas. Our work highlights the influence of anthropogenic terpenes on urban air quality and advocates for revisiting VCP formulations where fragrant terpenes could be removed or substituted to reduce anthropogenic contributions to urban $PM_{2.5}$.

6CE.6

High-Resolution Spatial and Temporal Characterization of Particulate Matter in Kigali Using Mobile Sampling. THEOBARD HABINEZA, Albert Presto, Allen Robinson, *Carnegie Mellon University*

Air pollution poses a significant threat to public health, the environment, and the climate, with impacts varying across neighborhoods due to localized point and mobile sources. Integrating mobile sampling with long-term stationary monitoring enables a multidimensional understanding of pollutant dynamics, essential for identifying localized emissions, temporal patterns, exposure disparities and environmental injustice. His study combined mobile and stationary monitoring of particulate matter mass ($PM_{2.5}$ and PM_{10}) and black carbon (BC) in Kigali, Rwanda, to identify pollution hotspots, overlaps between activities and pollution levels, and to achieve higher temporal and spatial resolution of PM and BC concentrations and composition. Three stationary BC monitoring sites (urban background, near-road, and urban) and mobile sampling across five neighborhood types (urban residential, urban traditional, traffic-dominated, commercial, and mixed) were conducted. As was expected, urban background recorded lower average BC concentration (2.2 μg/m³) making a 40% and 60% of the mean BC concentrations in urban roadside and urban site respectively. The diurnal patterns in BC all had peaks associated with the morning and afternoon rush hours. This morning peak was most intense at the near road site (6.8 μg/m³) where it was 2.2 times higher than the peak at the urban background and 1.6 times higher than at the urban site. Mobile sampling showed that traffic-dominated neighborhoods recorded the highest BC concentrations (median 12 μg/m³). The BC/$PM_{2.5}$ ratio in high traffic neighborhoods was 18%. This is 4 times higher than in the urban residential neighborhood indicating contributions from idling vehicles and cooking activities. Traditional neighborhoods recorded higher PM levels (PM_{10} = 136 μg/m³, $PM_{2.5}$ = 69 μg/m³) attributable to emissions from unpaved roads and charcoal-based cooking and lower in the urban residential area ($PM_{2.5}$ 52 ug/m³, PM_{10} = 80 ug/m³), Commercial areas exhibited numerous hot spots associated with micro-industries, schools, and incinerators. Findings underscore the need for targeted mitigation strategies, transitions to cleaner energy, and urban planning that separates residential, commercial, and industrial activities.

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6CE.7

Urban VOCs: Novel Chiral Measurements of Monoterpenes and AVOCs in Los Angeles. JACKSON RYAN, Thaomy Vo, William Berelson, Celia Faiola, *University of California, Irvine*

Volatile Organic Compounds (VOCs) are a ubiquitous and reactive component of the atmosphere. In the urban atmosphere, VOCs can react to form secondary pollutants such as secondary organic aerosols (SOA) leading to negative health impacts. The urban atmosphere is a complex mix of biogenic- and anthropogenically-sourced VOCs where the major VOC emission sources have been shifting following decades of strong regulation. Volatile Consumer Products (VCPs) are one important class of AVOCs derived in part from use of personal care products and cleaning products that typically contain and emit terpenoids. Terpenoids are also the major class of BVOC emissions from urban vegetation. Thus, creating a major challenge for VOC source apportionment, emission inventory development, and effective regulation. Previous work has shown that separation of monoterpenes by their enantiomers can be useful in separating living plant and anthropogenic monoterpenes. Building on that work, we collected ambient VOC samples in Los Angeles using a novel, automated adsorbent cartridge sampler. The samples were analyzed via offline TD-GC/MS technique equipped with a chiral column. Preliminary results suggest that the (+)-limonene, a mostly anthropogenic monoterpene, dominates the ambient air while a-pinene may fluctuate between favoring the (+)/(-) enantiomer throughout the day suggesting a possible variation in sources diurnally. Additional terpenoids, BTEX, and certain VCP tracers (siloxanes and PCBTF) were also measured along with meteorological information to better understand temporal trends of urban air quality chemistry and VOC sources in Los Angeles.

6IM.1

Comparison Sulfuric Acid Measurements at the DOE SGP Field Site by a Transverse and Parallel Flow Chemical Ionization Inlet Coupled With a Time-Of-Flight Mass Spectrometer. JOY KIGURU, Dominic Casalnuovo, Christine Troller, Jenna DeVivo, Nirvan Bhattacharyya, Coty Jen, *Carnegie Mellon University*

Gaseous sulfuric acid (H_2SO_4) is the key precursor for atmospheric new particle formation, a process that ultimately influences cloud properties and the Earth's radiative balance. Accurate quantification of gaseous sulfuric acid in ambient conditions is therefore important for improving our understanding of aerosol-climate interactions. Chemical ionization mass spectrometers (CIMS) are traditionally used for real-time measurements of sulfuric acid due to their relatively low detection limits (about 1×10^{-5} molecules cm^{-3} for sulfuric acid) and high temporal resolution. However, challenges remain in ensuring consistency across CIMS, particularly in field campaign settings where variations in measurement techniques can lead to differences in reported concentrations. This study presents a comparison of sulfuric acid measured by two different atmospheric pressure nitrate chemical ionization inlets coupled to near identical time-of-flight chemical ionization mass spectrometers. One inlet chemically ionizes sulfuric acid with nitrate ions in parallel flow with the sampled gas, while the other mixes nitrate with the sampled gas in a perpendicular manner. The two instruments were deployed at the U.S. Department of Energy Southern Great Plains (SGP) site during summer 2024. Although the two instruments used distinct inlet designs, sampling tubes, and flow rates, they reported relatively consistent concentrations of sulfuric acid throughout the month-long campaign. This agreement is notable given the expected variability due to sampling efficiency and loss processes. We explore this consistency by accounting for inlet transmission efficiency based on flow and geometry, highlighting that geometric and volumetric effects likely dominate H_2SO_4 losses in such systems. These findings demonstrate that, despite operational differences, API-TOF CIMS instruments can yield comparable results, supporting their reliability as a tool for trace gas quantification in the field.

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6IM.2

Continuous Chemical Characterization and Variability of Ultrafine Particulate Matter (PM0.1) at one Urban and one Background Site. GEORGIA A. ARGYROPOULOU, Christina N. Vasilakopoulou, Kalliopi Florou, Christos Kaltsonoudis, Angeliki Matrali, Andreas Aktypis, Maria Georgopoulou, Katerina Seitanidi, Christina Christopoulou, Panagiotis Kalkavouras, Nikolaos Mihalopoulos, Spyros N. Pandis, *Institute of Chemical Engineering Sciences, Greece*

Ultrafine particles (diameter less than 100 nm) can translocate to sensitive organs and are primary suspects of adverse health effects. Measuring their chemical composition continuously and accurately is particularly challenging because of their typically low mass concentration ($PM_{0.1}$). The past few $PM_{0.1}$ chemical composition studies have relied on cascade impactors, which offer low temporal resolution, require substantial labor, and are prone to interference from larger particles with much higher mass.

The Aerodynamic Aerosol Classifier (AAC, Cambustion) has the capability to function as a low pass separator with selectable cut-off. We used the AAC to separate $PM_{0.1}$ from larger particles, followed by instruments that provide continuous composition measurements. An SP2-XR (Droplet Measurement Technologies) for black carbon, Xact 625i (SailBri Cooper, Inc.) for multi-metal measurements, and a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HToF-AMS, Aerodyne Research Inc.) for organic aerosol and particle density.

This continuous $PM_{0.1}$ characterization system was deployed at two sites in Greece: a continental background and an urban background site, at different seasons. The first campaign (September 2024; summer season) took place on Poros Island, 50 km downwind of Athens, ideal for studying secondary $PM_{0.1}$ formation and long-range transport, since it had minimal local emissions. Sulfate dominated (30-40%) $PM_{0.1}$, while organic aerosol also constituted a significant fraction. Black carbon (BC) contributed approximately 5%. Key elements detected by the Xact in the $PM_{0.1}$ included Zn, Pb, Ca, Fe, Cl, and Br.

The second field campaign (January-February 2025) was in central Athens, focusing on local anthropogenic impacts during winter. $PM_{0.1}$ was mainly organic (~70%), with sulfates and nitrate contributing around 10% each. BC averaged 10-15%, and prominent elements included K, Zn, and Ag.

The temporal variations in concentration and composition at both locations were analyzed and will be discussed in detail.

6IM.3

Performance Evaluation of an Optical Particle Counter in Mexico City. ANIL NAMDEO, Elizabeth Vega, A. Mezza, Ann Wellens, *Northumbria University and Particles Plus Inc.*

This study reports on an optical particle counter (OPC) performance evaluation against a reference Beta Attenuation Mass (BAM) monitor.

Particles Plus outdoor ambient air monitor, Series 10000, is an OPC designed for outdoor particulate monitoring. Series 10000 adopts concurrent measurement of multiple, user-selectable PM sizes from 0.3um to 25 µm. It has a closed-loop humidity control for incoming airstream (to provide more accurate particulate sizing) and a closed-loop condensation control within the enclosure.

BAM used for this study is a Thermo Electron Corporation, model FH 62 C-14 Series Particle Monitor, with a source model WA-1186. In BAM, airflow is introduced through a pump that deposits particles on a filter for specific periods.

Both BAM and EM10000 were co-located at Instituto de Ciencias de la Atmósfera, where there is a monitoring site called Ciencias de la Atmósfera, which belongs to the Secretariat of the Environment of Mexico City. The data from co-located BAM (hourly) and OPC (every minute) were collected and compared at hourly intervals to determine OPC's performance against the reference BAM monitor.

The performance evaluation was based on $PM_{2.5}$ concentrations from May 2022 to July 2023. The comparison between the OPC (10000) and BAM for hourly average $PM_{2.5}$ concentrations yielded a correlation coefficient of $R^2 = 0.96$, indicating a very strong linear relationship between the two devices. The OPC successfully captured the same diurnal patterns as the BAM. This demonstrates the OPC's strong validity in tracking particulate matter trends. RMSE of 2.7 µg m^{-3} and Bias of −1.8 µg m^{-3} indicate very tight agreement with the reference BAM monitor, reinforcing the OPC's accuracy.

Overall, it can be concluded that the Particles Plus OPC's performance against a reference BAM monitors was consistent and satisfactory over one year period.

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6IM.4

Optimizing PurpleAir $PM_{2.5}$ Data in a South Asian Megacity: One-Year Machine Learning Calibration and Correction Factor Development in Dhaka, Bangladesh. JAMES NIMO, Md. Aynul Bari, Lauren Riviere, Kaylia Morgan, Abhijeet Sarkar, Chowdhury Arafat Hossain, Sanjeev Delwar, Abdus Salam, Provat Saha, *University at Albany, State University of New York*

Low-cost PurpleAir $PM_{2.5}$ sensors offer a scalable solution for air quality monitoring in South Asian megacities like Dhaka, Bangladesh, but necessitate robust local calibration. This study presents a year-long field evaluation of four PurpleAir sensors, focusing on optimizing data accuracy using machine learning (ML) models. Under National Science Foundation (NSF) International Research Experiences for Students (IRES) program, PurpleAir monitors were co-located alongside a reference-grade instrument at a continuous air quality monitoring station (CAMS) in Dhaka hosted by the Department of Environment. PurpleAir's native estimated $PM_{2.5}$ data algorithms (ATM and CF-1) were assessed, and various ML calibration models (including Multiple Linear Regression, XGBoost, Random Forest, and LightGBM) were developed for both data streams. The study also evaluated long-term sensor drift among the four PurpleAir units to develop practical guidance for effective re-calibration strategies within the South Asian context. The extended monitoring period facilitated a thorough investigation of seasonal performance variations and the impact of relative humidity (RH), analyzed across three bins (20-40%, 40-60%, and 60-100%). The performance of these locally tuned ML models was compared against established external calibration equations. Results indicate that while raw PurpleAir outputs show considerable error, particularly under high RH and specific seasonal conditions, the developed ML models significantly improve data accuracy. Notably, the Dhaka-specific models demonstrated better performance over widely used external calibration approaches, highlighting the necessity of localized strategies that account for unique regional atmospheric characteristics and seasonal dynamics. This research provides critical insights and practical methodologies for optimizing low-cost sensor deployment and data quality in humid, resource-constrained environments, ultimately supporting more accurate air quality assessment and informed decision-making in South Asian countries.

6IM.5

Performance Analysis of Nested Inlet for Sampling Stratospheric Aerosol (NISSA) on a NASA WB-57 High Altitude Aircraft during SABRE 2025 Test Flights. NAGARAJAN RADHAKRISHNAN, Charles Brock, Suresh Dhaniyala, *Clarkson university*

The interaction of stratospheric aerosol particles with solar radiation critically determines Earth's temperature and climate. Stratospheric particles are often a result of gas-phase nucleation, but increasingly, primary emissions from rocket activities are observed. The characteristics of these particles and their evolution with time is critical to modeling long-term climate change. Accurate characterization of stratospheric aerosol properties requires aircraft-based measurements with research-grade instruments. High-speed aircraft-based sampling at high altitudes presents persistent challenges due to the combination of flow compressibility and turbulence in the inlet flow. Our limited ability to numerically model flow under these extreme conditions limits our ability to use computational fluid dynamics (CFD) for aircraft sampling studies. Recently, we developed a Nested Inlet for Sampling Stratospheric Aerosol (NISSA) for accurate aerosol sampling over a broad size range of 10 nm to 10 µm.

NISSA features a nested two-stage inlet design to mitigate turbulence effects and enhance isokinetic sampling across a range of flight conditions. NISSA was deployed on NASA's WB-57 aircraft and flown during the SABRE 2025 test campaign. The seven high-altitude research flights allowed in-situ flow characterization using a miniature hot-wire anemometer for turbulence quantification, while absolute and differential taps/pressure sensors at several locations in the inlet allowed for flow validation. A DPOPS instrument sampled from the inlet, and the aerosol size distribution and concentration measurements with this instrument was compared against a balloon experiment conducted in the same air mass. In this presentation, we will report details of the inlet design and our results of performance characteristics obtained from the field campaign.

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6IM.6

Evaluating Low-Cost Instrumentation for Ultrafine Particle Number Monitoring in Urban and Suburban Environments.
AARON COLLINS, Rob Caldow, *OpenAeros LLC*

Ultrafine particles (UFPs, dp <100 nm) are primarily produced through combustion processes and are prevalent in urban and suburban environments, especially near roadways, biomass combustion sites, and aviation hubs. Although UFPs contribute minimally to overall particle mass, they constitute the majority of particle number and are strongly associated with adverse health outcomes, including cardiovascular, pulmonary, and neurological effects. However, widespread regulatory monitoring of UFP number concentration remains limited due to the high cost and complexity of conventional condensation particle counters (CPCs).

This study evaluates the performance of relatively low-cost instrumentation for measuring UFPs in real-world urban and suburban settings. A low-cost instrument package, comprising an OpenAeros OpenCPC™ for total number concentration and another OpenCPC with a catalytic stripper for solid number concentration enables direct comparison between total and combustion-derived solid particle counts. Additionally, total number concentrations from optical particle counters (PMS5003, Piera IPS7100, Alphasense OPC-N3) are compared against the CPCs to assess correlation and suitability for cost-effective UFP monitoring.

The findings highlight both the strengths and limitations of low-cost optical sensors and lower-cost CPCs for number-based monitoring. By harnessing affordable, open-source instrumentation, this research aims to advance UFP monitoring methodologies and promote broader adoption of number concentration measurements across research, regulatory, and community applications.

6IM.7

Integrating Low-Cost Sensors with the New York State Mesonet for Continuous, Dense $PM_{2.5}$ Monitoring in New York City.
ELLIE HOJEILY, Jason Covert, Scott Miller, Kit Moore, Md. Aynul Bari, Cheng-Hsuan Lu, Janie Schwab, *Atmospheric Sciences Research Center, University at Albany*

A low-cost air quality sensor package to measure particulate matter ($PM_{2.5}$), ozone (O_3), carbon monoxide (CO), nitric oxide (NO), and nitrogen dioxide (NO_2) was designed and integrated with 38 New York State Mesonet (NYSM) sites in the New York City Metropolitan Area. A new calibration approach, the Network Calibration Algorithm (NCA), was developed, whereby a single low-cost sensor package (the “keystone” package) was co-located alongside regulatory-grade instruments at the New York State Department of Environmental Conservation Queens College monitoring site for 16 months. For each pollutant, hourly data from the keystone package and reference instruments were used to train a single calibration model that was subsequently applied to all packages at field sites across the network. The calibration model for the $PM_{2.5}$ sensor (Plantower PMS5003) was a hybrid approach that combined multiple linear regression with machine learning. The $PM_{2.5}$ model was evaluated using data from 41 sensor packages (over 25000 hours) and showed high correlation with the reference monitor (R^2>0.88) and low error (RMSE = 2 $\mu g m^{-3}$). Hourly $PM_{2.5}$ data from the 38 NYSM sites from May 2023 through August 2024 are used to characterize temporal pollutant patterns at daily, weekly, and seasonal time scales, to contrast pollutants in urban and rural environments, and to evaluate spatial correlations across the network. This study illustrates that the data from the low-cost sensor augmented Mesonet sites, along with the existing FRM/FEM monitors, can be used to identify and understand emission sources and improve our understanding of urban air pollution.

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6IM.8

OPERA: A New Platform for Next Generation Aerosol Sensing. SURESH DHANIYALA, Ajay Sonar, Sreekesh Kookkal, Brandon Beattie, Claire Fortenberry, *Clarkson University*

Optical scattering-based aerosol sensing has traditionally had focused aerosol beams intersect a narrow collimated laser beam, with the resultant scattered light collected from a wide range of angles and redirected to a sensitive photomultiplier tube. With this design, analysis of the scattered signals can provide accurate size distribution measurements over a broad size range but these instruments can be expensive, large, and difficult to operate. We have been developing a new OPto-Electrical Real-time Aerosol (OPERA) Sensor, in which an unfocused aerosol flow is passed through a highly focused aerosol beam, and the scattered light is collected on one or more photodiodes located very close to the scatter region, with no collection optics used. This design is similar in principle to that of low-cost optical sensors. While this design results in signals that are complicated to invert for size distribution measurements, the simplicity of the design allows for low-cost aerosol sensing with broad range of applications. In this talk, I will briefly review the theoretical basis for the OPERA (TelosAir Corp), the use of AI/ML for characterizing instrument transfer function, and discuss the first deployment of the system for monitoring air quality on the International Space Station (ISS).

6RA.1 – INVITED

Uncovering Real-World Implementation of HEPA Portable Air Cleaners in Schools: A Bayesian Latent Class Approach to Improve Exposure Assessment. NASIM ILDIRI, Kevin Josey, Nathaniel Ramirez, Anna Segur, Julia Poje, Bowen Du, Jeffrey Siegel, Thomas Jaenisch, Mark Hernandez, *University of Colorado at Boulder*

In real-world settings, air quality interventions are not always implemented or maintained as intended, especially when scaled across many sites. These deviations can compromise exposure classification and bias health outcome evaluations. Portable air cleaners (PACs) are increasingly deployed in schools to reduce airborne exposure risks, but their operation is often inconsistent. To address this, we aim to assess the fidelity of PAC implementation and develop a method to infer usage status using sensor-based indoor air quality (IAQ) data. As part of a state-wide trial, over 10,000 PACs were deployed to K–12 schools in 2023, with each intervention classroom assigned two units. Structured observations were conducted in 512 classrooms across 27 Denver Public Schools to assess real-world PAC usage and adherence to study protocols. We are developing a Bayesian Latent Class Analysis (LCA) model to classify classrooms based on CO_2-derived air exchange rates, $PM_{2.5}$ concentrations, and other relevant IAQ indicators. This unsupervised model aims to infer likely “PAC active” versus “PAC inactive” status without relying on deployment records. Site visits revealed a critical implementation gap: more than a year after large-scale PAC deployment, only 29% of classrooms issued PACs consistently operated them; approximately one-third of teachers left them unplugged or inactive, despite being encouraged and educated to operate them. This misalignment between protocol and practice challenges the validity of any subsequent IAQ–health analyses. Preliminary LCA modeling is underway and shows potential to distinguish clusters of classrooms with IAQ patterns indicative of active filtration versus limited or absent intervention effects. Our approach offers a scalable way to identify actual exposure when protocol adherence is uncertain. This methodology is applicable to studies where sensors or behavioral data supplements incomplete implementation records. Improving exposure classification enhances the credibility of health effect estimates and the effectiveness of policy decisions based on them.

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6RA.2

Performance of Portable Air Cleaners During a Randomized Crossover Trial in Three Multi-Unit Residential Buildings.

ALEXANDER MENDELL, Seungjae Lee, Jeffrey Siegel, *University of Toronto*

Portable air cleaners (PACs) can be used to reduce indoor concentrations of fine particulate matter ($PM_{2.5}$). Reducing $PM_{2.5}$ concentrations in the home, where most exposure occurs, can potentially improve health outcomes. This study evaluated PACs in 60 apartments in three neighbouring multi-unit buildings in downtown Toronto, Canada using a three-arm randomized crossover design. Participants' homes were monitored for a total period of three weeks, during which they experienced three experimental conditions: Placebo (noise generated without filtration), Constant (PAC always operating), and Auto (PAC operating when concentrations were measured above 10 $\mu g \cdot m^{-3}$). $PM_{2.5}$ concentrations were continuously monitored, as was PAC operation. Weekly surveys were used to estimate how frequently participants engaged in activities that could affect $PM_{2.5}$ measurements. Mean concentrations during the Placebo arm ranged from 2 to 527 $\mu g \cdot m^{-3}$. Mean concentrations were reduced in 56 homes during the Constant arm, with absolute reductions between –10 and 251 $\mu g \cdot m^{-3}$ and relative reductions between –64% and 98%. During the Auto arm, mean concentrations were reduced in 50 homes accompanied by a substantial reduction in PAC runtimes relative to the Constant arm. After adjusting for measured factors and unmeasured differences between homes, the average reduction in mean concentration was found to be 66% (95% CI: 59% – 72%) during the Constant arm and 40% (95% CI: 27% – 50%) during the Auto arm. Much of the variation in weekly concentrations was attributable to behaviours evaluated by the surveys (e.g., smoking, cleaning, and balcony door opening), which also contributed to the large difference in concentrations between homes. This variation is reflected in the wide range of absolute and relative reductions measured across the study population. Interventions targeting air pollutant concentrations should measure and adjust for behaviours and other environmental factors when analyzing and reporting their results.

6RA.3

Not All Boxes Are Equal: Investigation of Parameters Affecting Removal of $PM_{2.5}$ Particles by Corsi-Rosenthal Box.

ANTONIO BARATTA, Taewon Han, Gediminas Mainelis, *Rutgers, The State University of New Jersey*

Poor indoor air quality is an urgent and often underestimated public health challenge, especially in buildings where ventilation and air circulation are lacking, and infiltration of poor outdoor air is likely. The Corsi-Rosenthal (C-R) Box has gained widespread popularity as an affordable, do-it-yourself air cleaner designed to address these gaps in indoor air quality. Despite its rapid adoption, limited studies have evaluated how different operational variables affect the C-R Box's efficiency. This study measured the Clean Air Delivery Rate (CADR) of C-R Boxes as a function of filter rating, its electret enhancement, location of measurement devices, and air mixing when challenged with sodium chloride (NaCl) or Arizona Road Dust (ARD) particles in a 3,024 ft^3 (~86 m^3) chamber. CADR focused on the removal of $PM_{2.5}$ mass concentration. Results show that a C-R Box with four MERV-13 filters achieved CADR values of 358.56 ± 10.58 cubic feet per minute (cfm) at the maximum box fan speed, outperforming MERV-8 filters (209.93 ± 9.30 cfm) by 71% despite only a 41% increase in filter cost. MERV-13 filters with electret designation did not improve CADR compared to plain MERV-13 filters. When challenged with ARD particles, the C-R box achieved a CADR of 416.60 ± 8.31 cfm, compared to 358.56 ± 10.58 cfm with NaCl particles. We also observed that having the measurement device at 65 inches from the C-R Box increased the observed CADR by 8% compared to a 140-inch distance. Adding additional mixing fans helped improve the CADR in the chamber's corners. For best results, C-R Boxes should use the highest MERV filters and fan speed and be placed close to the pollution source or area. Our systematic evaluation of the C-R Box's performance will assist in optimizing its construction and deployment, thus improving its effectiveness for mitigating particulate pollution indoors.

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6RA.4

Improving Classroom Air Quality in Schools: Field Study of Air Filtration, Ventilation, Monitoring, and Implications for Energy Performance. TANYA SHIRMAN, Sissi Liu, *VP of Materials*

Reducing aerosol exposure in school environments is essential for protecting student health and supporting cognitive development. In schools where students spend long hours indoors, exposure to particulate matter (PM) and volatile organic compounds (VOCs) has been linked to cognitive impairment, increased disease transmission, and higher absenteeism. This field study evaluated air quality control intervention methods via HVAC ventilation versus distributed, localized air filtration. It also assessed monitoring strategies for improving indoor air quality (IAQ) in occupied middle school classrooms. Environmental quality sensors for continuous data collection were deployed to monitor PM and VOC levels alongside reference-grade particle measurement instruments under real-world conditions.

A distributed, localized, and low-maintenance air filtration system was installed and tested for its ability to reduce aerosol concentrations in comparison with the standard HVAC ventilation-based air quality maintenance strategy.

Our results underscore the limitations of the current, dominant IAQ intervention approach that rely primarily on outdoor air ventilation—a strategy that is both energy intensive and potentially detrimental during wildfire events or in areas with poor ambient air quality. The tested air filtration system provided consistent reductions in indoor aerosol levels with minimal energy use. Additionally, we identified key challenges in interpreting environmental sensor data and highlight the need for practical solutions for calibration and analysis to improve deployment in school settings.

This study demonstrates that integrating targeted filtration-based interventions with improved sensor analytics offers a sustainable, scalable pathway to reduce aerosol exposure and protect occupant health in educational environments.

6RA.5

Improving Classroom Indoor Air Quality with DIY Corsi-Rosenthal Boxes. Misti Zamora, Sharmin Akter, Marina Creed, Jessica Hollenbach, Angela Jiang, Noah Kosh, Britney Russell, Alexis West, Martin Wolek, KRISTINA WAGSTROM, *University of Connecticut*

Poor classroom ventilation creates an environment where particles can accumulate, leading to reduced indoor air quality (IAQ), heightened risks of infectious disease transmission, and exacerbating asthma symptoms. Children are particularly vulnerable to the health consequences of poor classroom ventilation due to a combination of physiological factors, such as developing respiratory and immune systems and higher breathing rates, and the significant amount of time they spend in school environments. Therefore, practical and effective air purification strategies are crucial for mitigating these risks in classrooms. Corsi-Rosenthal boxes (C-R boxes), low-cost DIY purifiers using box fans and MERV-13 filters, represent a practical and accessible intervention. This study, conducted by the UConn Indoor Air Quality Initiative, assessed C-R box effectiveness and practicality in two occupied classrooms without mechanical ventilation. We measured PM_1, $PM_{2.5}$, and PM_{10} mass and number concentrations with the C-R boxes on and off. They achieved an average particle reduction of 60% for both mass and number concentrations. Spatially resolved measurements showed consistent particle reduction throughout classrooms, which is key to ensuring all students are benefiting from the filter. These results demonstrate that C-R boxes can substantially and rapidly improve classroom IAQ by reducing particle exposures. We will also discuss additional tests of the effectiveness of C-R boxes built by different teams and with common “mistakes”. This accessible, DIY intervention, offers a highly effective strategy to lower children's airborne particle exposure in schools, potentially mitigating respiratory health risks and improving public health in school environments.

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6RA.6

Long-Term Size Dependent Filtration Efficiency Test (ASHRAE 52.2) and Clean Air Delivery Rate Test (CADR) of 5" MERV 16 Air Filters Used in DIY Air Cleaners Operated in K-12 Schools.

DEVABHAKTUNI SRIKRISHNA, Christopher Barnes, *PatientKnowhow.com*

Do-it-yourself (DIY) air cleaners can be a temporary, low-cost, ventilation strategy to help meet Centers for Disease Control and Prevention (CDC) and California Department of Public Health (CDPH) recommendations of ≥5 air changes per hour (ACH) in buildings, which can help reduce airborne contaminants to improve indoor air quality. However, the long-term performance of DIY air cleaners remains unclear. Furthermore, there is no guidance on when to replace filters used in DIY air cleaners. In this study, we report the long-term filtration performance of two DIY air cleaners constructed with a 20” box fan and a 5" MERV 16 filter deployed in an elementary school in California from February 2022 to Dec 2023. An additional three DIY air cleaners constructed in the same manner were deployed in a middle school in the same locale from August 2023 to Dec 2023. The DIY air cleaners were operated daily during school hours as reported by the teachers. It is also important to note that a wildfire smoke event was recorded for one week while the DIY air cleaners were deployed. At the end of the study, the size-dependent filtration efficiencies, for particles between 0.3 to 10 µm in diameter, were evaluated per an initial ASHRAE 52.2 test for each filter. The filtration efficiencies of the filters deployed in the elementary school degraded to <50% for particles in the 0.3 – 0.4 µm size range, which includes the most penetrating particle size (0.3 µm), over the 16-month period. Filtration efficiencies were retained (>85%), in the same size range, for filters deployed in the middle school over the four-month period. Additionally, each filter was incorporated into a SAFE DIY air cleaner, consisting of a 20” box fan paired with a fan shroud and safety screen. The clean air delivery rate (CADR) for particles between 0.3–2.685 µm was evaluated for each assembled unit using decay curves from aerosolized sodium chloride (NaCl) particles with and without the units operating on low fan speed. Filters from the elementary school (16-months of use) yielded CADRs between 109–145 cubic feet per minute (cfm), whereas filters from the middle school (4 months of use) yielded CADRs ranging from 190–213 cfm. Overall, this study found the size-dependent filtration efficiency and CADR varied for the MERV 16 filters used to build the DIY air cleaners deployed in the schools. The three filters deployed in the middle school retained filtration efficiencies equivalent to MERV 15 or higher, while the two filters deployed in the elementary school degraded to MERV 12 or lower. We suspect the filtration performance varied due to changing ambient particulate concentrations (i.e., wildfire smoke event), and the operating time. More research could help inform filter replacement intervals to maintain 5 ACH in the participating classrooms in this study.

Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

6RA.7

An Integral Approach to Quantifying the Clean Air Delivery Rate (CADR) of Indoor Air Cleaning Devices.

SAMAN HARATIAN, P. S. Ganesh Subramanian, Vishal Verma, Mohammad Heidarinejad, Brent Stephens, Max Sherman, *Illinois Institute of Technology*

Evaluations of indoor air cleaner performance commonly involve pulse injection and decay tests conducted in a controlled chamber with and without an air cleaning device operating. Analysis of concentration decay data to generate an estimate of the clean air delivery rate (CADR), also called the equivalent clean air (ECA) flow rate, most commonly involves comparing first-order loss rate constants between the two test conditions and multiplying the difference by the volume of the room. Although the first-order exponential decay assumption may be held for some types of pollutants and tests, sometimes pollutant decay tests exhibit behavior that is not consistent with first-order kinetics, which results in error, biases, and/or high uncertainty in estimates of CADR. This is particularly evident in many bioaerosol decay tests. To address these issues, we introduce a novel integral approach to quantify loss rates and CADR from time-resolved contaminant concentration data resulting from pulse injection and decay tests of air cleaning devices, which does not rely on conventional first-order assumptions. We explore the utility of the developed approach using several examples from literature and investigate the magnitudes of uncertainty associated with both the integral technique and traditional first-order approaches. We find that the integral approach can replicate first-order kinetics (when applicable) and can also be used to estimate CADR for other decay forms, such as 2-stage decay or when there is no specific model form. The integral method is particularly sensitive to measurement uncertainty and requires some assumptions to approximate the area under the decay curve, especially when time-steps are large. Both estimation approaches reveal the importance of incorporating robust measures of uncertainty in estimating EAC to guide selection and specification of air cleaning technologies.

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7AC.1

$PM_{2.5}$ Composition at the Houston-Liberty ASCENT Site.

ANANDI WILLIAMS, Subin Yoon, Eugenia Velasco-Cunningham, Sergio Alvarez, Robert Griffin, James Flynn, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Nga Lee Ng, Fangzhou Guo, *University of Houston*

Houston, TX, as a large industrial city on the Gulf of Mexico, has a diverse medley of air pollution sources under photochemistry-favored atmospheric conditions. The ASCENT (Atmospheric Science and Chemistry Measurement Network) Houston site (Liberty, TX) is in a suburban area about 45 miles away from the city center and about 30 miles from the Houston Ship Channel, one of the busiest seaports in the world. This site hosts a range of aerosol measurements, including a TOF-ACSM, SMPS, Xact, and Aethalometer, which provide a wholistic picture of the aerosol size and composition. This presentation focuses on the $PM_{2.5}$ chemical composition measured at the Houston-Liberty site in 2024 and 2025, especially on the influence of long-range marine emissions alongside local anthropogenic emissions. $PM_{2.5}$ mass was just over 9 $\mu g/m^3$ on average and was composed mostly of organic (66%) and sulfate aerosol (14%), with smaller contributions from ammonium, nitrate, chloride, black carbon, and trace metals. The organic aerosol (OA) had a variety of sources, including biomass burning events and urban emissions, with a significant secondary organic aerosol background (>70% of OA). Marine emissions primarily drove the sulfate aerosol mass as well as the most oxidized OA. The highest recorded $PM_{2.5}$ mass during our measurements was a biomass burning event, as revealed by a combination of Xact, aethalometer source apportionment, and ACSM tracer ion analysis.

7AC.2

Characteristics of Size - Resolved Organic Aerosols Using Offline Aerosol Mass Spectrometry: NYC-METS, Part of the 2023 AEROMMA Campaign.

XU HE, Corin Tyler, Yao Xiao, Emily Costa, Delaney Schulteiss, Kayleigh Reilly, Ruizhe Liu, Athena Xu, Nga Lee Ng, Drew Gentner, Andrew P. Ault, Rachel O'Brien, *University of Michigan*

Urban areas often suffer from high ozone and PM events, both of which can have detrimental effects on human health. New York City has periods of high particulate matter (PM) concentrations each summer, much of which is formed through secondary processes. There is a wide range of biogenic and anthropogenic sources, including volatile chemical products (VCPs), that contribute to volatile organic compound (VOC) emissions. Their contribution to the formation of secondary organic aerosols (SOA) in urban environments is not well characterized. To improve our understanding of the changes in the composition and size distribution of urban organic aerosols (OA), aerosol particles were collected at a ground site in Manhattan during the summer of 2023 as part of the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) campaign. The chemical composition and concentration of the aerosols as a function of particle size were analyzed using offline high-resolution time of flight aerosol mass spectrometry (HR-ToF-AMS) and with liquid chromatography (LC)-Orbitrap mass spectrometry. Combining organic family fragment group information obtained from HR-TOF-AMS with the molecular distribution from LC-Orbitrap enabled a detailed characterization of organic aerosol composition across the full-size distribution (56 nm to 5.6 um). Comparison of aerosol composition and organic mass loading under different weather conditions is used to examine the influence of sources on SOA formation. 12 and 24-hour size resolved samples are compared to online data sets collected during the campaign. Both qualitative and quantitative comparison provide insights into characteristics OA mass that are retained during offline analysis. Overall, these results investigating chemical composition, concentration, and urban aerosol size distribution will improve our understanding of OA composition and possible sources within megacities as VOC emissions changes.

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7AC.3

Abundance and Gas-Particle Partitioning of Inorganic Bromine in the Remote Atmosphere. DONGWOOK KIM, Pedro Campuzano-Jost, Benjamin A. Nault, Jason Schroder, Douglas A. Day, Michael Cubison, Jack Dibb, Patrick Veres, J. Andrew Neuman, Jin Liao, Greg Huey, Yuk Chun Chan, Lyatt Jaegle, Alan Fried, Thomas Ryerson, Andrew Weinheimer, Glenn Diskin, Eric Apel, Rebecca Hornbrook, Alan Hills, Donald Blake, Rainer M. Volkamer, Jose-Luis Jimenez, *CIRES & University of Colorado Boulder*

Halogens play important roles in the ozone chemistry in both the stratosphere and troposphere. Bromine can also affect the deposition rate of mercury from the atmosphere. In the particulate phase, halogens can react directly with ozone and could serve as reservoirs for gas-phase reactive halogen species. However, quantitative measurements of particulate halogens on a global scale over remote areas are rare, especially in the upper troposphere and the lower stratosphere. Here we report particulate bromine measurements with the customized University of Colorado Aerodyne high-resolution aerosol mass spectrometer (CU-HR-AMS) together with gas-phase inorganic bromine from multiple aircraft campaigns, including the NASA ATom and ARCTAS missions. We also discuss 1) the AMS response to particulate halogens and details of the quantification method, 2) the total inorganic bromine gas budget estimated by a box model, 3) potential sources of bromine in the free troposphere and polar regions and their implications for ozone chemistry, and 4) the evaluation of bromine from the current GEOS-Chem model. Preliminary results suggest that 1) most particle-phase bromine in the remote atmosphere is likely in bromide form. 2) Particle phase fraction can reach up to ~50 % in the upper free troposphere. 3) Biomass burning and anthropogenic emissions could be important sources of atmospheric bromine. 4) GEOS-Chem needs a better representation of particulate bromine. These results will provide valuable constraints on the bromine budget and chemistry in chemical transport models.

7AC.4

Molecular-Level Understanding of New Particle Formation Processes Under the Conditions Relevant to Mixed Forests in the Southeastern United States. LEE TISZENKEL, Vignesh Vasudevan Geetha, Astrid Pedersen, Jonas Elm, Shanhu Lee, *The University of Alabama in Huntsville*

New particle formation (NPF) is a highly complex process where gas-phase precursors undergo and subsequently grow. Currently, biogenic NPF remains poorly understood under the conditions in the mixed forests in the southeastern United States, when influenced by the transported pollutant plumes. Here, we present results from laboratory experiments of biogenic NPF, using comprehensive chemical precursor measurements, coupled with quantum chemical calculations, to better understand the NPF processes at the molecular level. Experiments were conducted in a dual flow tube nucleation and growth reactor (TANGENT, described by Tiszenkel et al., ACP, 2019). Nucleation precursors (sulfuric acid, ammonia, amines, and oxygenated organics) were measured with three different chemical ionization mass spectrometers. Additionally, the chemical compositions and molecular structures of oxygenated organics in newly formed particles were detected with ultra-high-performance liquid chromatography-electrospray ionization Orbitrap mass spectrometer (UPLC/(-)ESI-Orbitrap) MS/MS analysis. Our results provide new insights into the NPF processes in the mixed forests with the long-range transported sulfur plumes: (1) In the mixed monoterpene and isoprene system, particle formation is either enhanced or suppressed by isoprene depending on isoprene as well as HO_2 concentrations (Tiszenkel et al., GRL 2025). (2) Particle phase formation of dimers occurs via accretion or decomposition reactions within the particle phase, independently from gas-to-particle conversion, to affect the growth and shrinkage of newly formed biogenic particles (Vasudevan-Geetha et al., ACP 2025). (3) Gas-phase OOS can form in the mixed biogenic and anthropogenic system, and OOS can act as an effective nucleation precursor by enhancing aerosol nucleation independently from OOM and sulfuric acid (Manuscript under preparation).

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7AC.5

The Detection Efficiency of Sulfuric Acid Using a Nitrate-CIMS: Impacts of Base Molecules. JUN ZHENG, *Nanjing University of Information Science and Technology*

Nitrate anion (NO_3^-) based chemical ionization mass spectrometry (i.e., NO_3-CIMS) has been extensively employed in atmospheric sulfuric acid (SA, H_2SO_4) measurements. The ion chemistry is highly sensitive and selective because H_2SO_4 is one of the select few molecules in the atmosphere that is stronger than nitric acid in gas-phase acidity (GA = 1295 kJ/mol for H_2SO_4 and 1380 kJ/mol for HNO_3). Therefore, the SA - NO_3^- reaction is considered collision-limited given the relatively significant Gibbs free energy change during the ionization process. However, these estimations were based on the thermodynamic parameters of pure H_2SO_4 molecules. Under typical ambient conditions, H_2SO_4 is believed to be present in clusters associated with other ligands, such as water, ammonia, and other basic gases. Thermodynamic calculations indicated that a significant portion of H_2SO_4 is in the form of SA-amine clusters within amine-rich environments, particularly during nucleation processes. The fact that SA-amine clusters were scarcely detected during nucleation processes by a NO_3-CIMS was due to the evaporation of ligands from the SA-amine clusters caused by the large reaction enthalpy released from the nitrate ionization process. Here, using a water cluster-CIMS and proton-transfer-reaction (PTR) based ion chemistry, we demonstrated that SA-amine clusters were indeed present during nucleation processes. The detection efficiency of SA by a NO_3-CIMS would increase when trace amounts of amines (such as methylamine, dimethylamine, and trimethylamine) were present due to the formation of SA-amine clusters. These findings indicated that ambient SA concentrations detected by a NO_3-CIMS were very likely underestimated because the NO_3-CIMS was calibrated under an amine-free condition. The underlying causes and implications of these findings were also further investigated.

7AC.6

Characterizing the Stability and Composition of Size Resolved MSA-Amine Aerosol Nanoclusters from 1 – 2.5 nm. COLLEEN MILLER, Paulus Bauer, Véronique Perraud, Barbara Finlayson-Pitts, James Smith, *University of California, Irvine*

New particle formation (NPF) is an important process in which new aerosols are generated and grow through various processes. There are many questions surrounding the exact mechanisms involved in the nucleation and growth of the smallest clusters (1 nm) to yield particles capable of influencing climate through direct and indirect effects. One mechanism of current interest is acid-base driven chemistry, in which acid and base molecules interact through intermolecular forces and/or proton transfer to stabilize the growing cluster. While sulfuric acid is recognized as the main contributing acid to this process, methanesulfonic acid is also a major nucleating species in the air, and is rising in importance as anthropogenic sources of H_2SO_4 are decreasing globally. In this work, we generated methanesulfonic acid – amine aerosol nanoclusters using a bipolar electrospray. The formed nanoclusters were subsequently mobility-selected with a half-mini differential mobility analyzer and analyzed using a Faraday cup electrometer (used for obtaining size distributions), a time-of-flight mass spectrometer (for cluster composition), and an Orbitrap mass spectrometer (for cluster composition and stability). Results from these experiments showed an overall neutral cluster composition (equal amounts of acid and base molecules) over all sizes for all systems except putrescine (PUT), which is a diamine. It was found that the MSA-PUT nanoclusters grow by addition of a 2-acid:1base cluster or a 1acid:1base cluster, thus giving rise to the presence of both neutral and acidic nanoclusters. Additional cluster stability analysis from collision-induced dissociation experiments revealed a linear correlation between the collision energy at which the survival yield of the parent cluster is 50% (CE50) and cluster size. Through these studies we directly observed the chemistry of particle nucleation and growth in its earliest stage (1-2.5 nm), furthering our understanding of aerosol growth mechanisms and informing our understanding of atmospheric NPF mechanisms.

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7BQ.2

Indoor Building Materials as Reservoirs for Prolonged Wildfire Sourced VOC Exposure. RACHEL HURLEY, Shichao Liu, Anita Avery, Manjula Canagaratna, Chenyang Bi, *Worcester Polytechnic Institute*

Wildfire smoke can severely damage indoor materials by infiltrating indoors and absorbing on surfaces. Volatile organic compounds (VOCs) may re-emit from smoke-contaminated building materials and persist for weeks to months indoors, posing long-term exposure risks. However, the intensity and duration of indoor exposure, governed by re-emission rate and timescale, respectively, remain poorly understood. The objective of this work is to better understand the human exposure to VOCs re-emitted from smoke-contaminated building materials. Six materials—drywall, painted drywall, granite, hickory flooring, carpet, and aluminum—were soaked in burned pine needle lab-generated smoke for 40 minutes with particles removed with an in-line HEPA filter. VOC re-emission from smoke-contaminated materials were monitored in a rapid emission chamber using a Vocus Chemical Ionization Time-of-Flight Mass Spectrometer (Vocus CI-ToF-MS) with NH4+ as the reagent ion. Micro-computed tomography quantified material porosity. A mechanistic model will be developed to link key emission parameters to re-emission rate and timescale.

We found that re-emission rates and timescales are governed by the material's porosity and are associated with the physiochemical properties of the VOCs, such as volatility and solubility. There are significant impacts of material type on the maximum re-emission concentration with acetaldehyde and furfural being the most abundant compounds across all materials. Drywall (bare and painted) exhibited re-emission levels up to three orders of magnitude higher than impervious aluminum, emphasizing the importance of pore space in VOC transport. Interestingly, painted drywall retained fewer VOCs and showed faster re-emission compared to bare drywall, likely due to the paint layer's low porosity acting as a barrier. However, for some polar compounds, the maximum re-emission for wood and painted drywall were higher than pure drywall. The VOC decay profiles in chamber tests provide critical emission parameters to fit a mechanistic models predicting re-emission and human exposure after wildfire smoke infiltrates indoors.

7BQ.3

Impact of Wildfire Smoke on the Performance of Air Purifiers. DONGRYUL PARK, Shibo Wang, Qisheng Ou, Kiwon Seo, Hyungho Park, David Y. H. Pui, *LG Electronics*

Wildfire smoke is a critical environmental health hazard that significantly deteriorates indoor air quality (IAQ) by increasing concentrations of fine particulate matter ($PM_{2.5}$). Prolonged exposure to elevated $PM_{2.5}$ levels—even in residences located several miles from burn areas—has been linked to adverse respiratory and cardiovascular outcomes. In response, ASHRAE Guideline 44-2024 recommends the use of mechanical ventilation with high-efficiency filtration and portable air purifiers to protect occupants during wildfire events. This study investigates the impact of wildfire smoke on the degradation of air purifier performance and filter longevity. A laboratory-scale smoke generation and loading system was developed to simulate wildfire conditions. Using this setup, the Clean Air Delivery Rate (CADR) was evaluated and the Cumulative Clean Mass (CCM) was calculated to serve as indicators of purifier performance over time. Two types of filters—electret melt-blown and nanofiber—were tested under repeated smoke loading. Simultaneously, pressure drop across the filters was monitored to assess airflow resistance and clogging characteristics.

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7BQ.4

Wildfire and Prescribed Burn Smoke Preparedness and Indoor Air Quality in Schools: Long-Term Air Quality Monitoring in Schools. PARICHEHR SALIMIFARD, Jalil Mokhtarian Mobarakeh, C. Victoria McCrary, Sara Jones, Perry Hystad, Molly Kile, *Oregon State University*

Exposure to wildfire smoke fine particulate matter ($PM_{2.5}$) is a public health concern. Children are particularly vulnerable to $PM_{2.5}$ because their respiratory systems are developing, and they have a higher breathing rate relative to body size. Building readiness to maintain healthy indoor air quality (IAQ) during smoke events is important in early care and education (ECE) settings where children spend extended periods of time. This community-engaged project, supported by the U.S. EPA's Wildfire Smoke Preparedness in Community Buildings Grant Program, is implementing and evaluating scalable IAQ interventions in Oregon's ECE settings. Interventions included deploying portable air cleaners in classrooms and common areas, conducting real-time indoor and outdoor air quality monitoring using low-cost $PM_{2.5}$ sensors, and developing customized smoke response plans. Long-term air quality monitoring data collected from this ECE demonstrated that outdoor smoke from wildfires and prescribed burns significantly impacted indoor $PM_{2.5}$ levels. We found that building and ventilation characteristics influenced indoor $PM_{2.5}$ concentrations and used indoor-to-outdoor (IO) $PM_{2.5}$ ratio to evaluate smoke intrusion into the building. Highest outdoor $PM_{2.5}$ concentrations were measured in August which corresponded to peak wildfire activity and the start of the academic school year. Despite similar $PM_{2.5}$ trends in different rooms, notable differences in maximum values and IO ratios were observed. A classroom without ventilation exhibited the highest indoor-to-outdoor (IO) ratio, while a classroom with mechanical ventilation had the lowest IO ratio. Some IO ratios exceeded 1.0, indicating possible indoor sources of $PM_{2.5}$ or inadequate ventilation and filtration. This underscores the importance of microenvironmental characteristics in smoke infiltration dynamics. It also demonstrates a strategy for enhancing resilience in the built environment by reducing $PM_{2.5}$ exposure to vulnerable populations using accessible technologies and tailored planning.

7BQ.5

Measuring Particulate Matter Emissions from Prescribed Fires. ANNAMARIE GUTH, Marissa Dauner, Sean Benjamin, Evan Coffey, Alexandra Fowler, Spencer Hoel, Chad Hoffman, E. Louise Loudermilk, Peter Hamlington, Michael Hannigan, *University of Colorado Boulder*

The western US has experienced an increase in wildfire activity, contributing to increased periods of poor air quality. Drier and hotter conditions due to climate change are increasing the severity and area burned during wildfires. Wildfires release large quantities of particulate matter (PM). Exposure to PM can have many negative short and long-term health impacts. Prescribed fires are a highly effective way of reducing wildfire risk but come with tradeoffs; for example, prescribed fire still releases PM. This project uses low-cost emissions tools (EPODs) to measure PM at prescribed burns throughout Colorado. EPODs have been used previously in published studies to measure emissions from cookstoves and trash burning. The EPOD uses a Plantower sensor to measure $PM_{2.5}$ and collects PM onto a quartz fiber filter to quantify amounts of elemental carbon and organic carbon, and complete organic speciation. For each burn, we quantify $PM_{2.5}$ emissions factors using the partial capture carbon balance method and modified combustion efficiencies. The placement of each EPOD at prescribed fires is determined by BluSky Playground, an interactive model developed by the USFS to predict ground plume movement and $PM_{2.5}$ concentrations. Terrestrial LiDAR scan (TLS) data was collected for 9 prescribed burns, which can be used to quantify fuel reduction at certain plot locations. We have partnered with several different county and forest service implementers around the state of Colorado. So far throughout this project in partnership with implementers, we have attended 21 prescribed burns, 13 pile burns, and 8 broadcast burns; burn windows for the types of burns are different which also impacts burning conditions. I will present emission factors for carbonaceous components of PM, combustion efficiency, and how $PM_{2.5}$ concentration varies with fuel reduction. I will discuss how these metrics and their variability are impacted by type of prescribed fire, environmental parameters, and landscape.

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7BQ.6

High-Resolution $PM_{2.5}$ Metals in Pittsburgh: Trends, Fireworks, and Wildfire Impacts from the ASCENT Network.

ZIHENG ZENG, Abhishek Anand, Theobard Habineza, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Nga Lee Ng, Coty Jen, Albert Presto, *Carnegie Mellon University*

Metal species in particulate matter ($PM_{2.5}$) are known contributors to harmful health effects and are often linked to combustion sources, both anthropogenic and natural. This study presents high-time-resolution data on metal concentrations in $PM_{2.5}$ collected in Pittsburgh, PA using an Xact 625i ambient metals monitor over a 13-month period. The monitor is part of the Atmospheric Science & Chemistry mEasurement NeTwork (ASCENT) and is located at the Lawrenceville site—marking the first such metal dataset from this location. Hourly concentrations of over 40 elements were measured via X-ray fluorescence (XRF), capturing both long-term trends and short-lived emission events. We identify distinct seasonal variations, with potassium exhibiting significant summer peaks, likely influenced by regional biomass burning and fireworks activity. To identify episodic contributions, we conducted a focused analysis on two high-concentration events: the June 2023 Canadian wildfire smoke episode and local July 4th fireworks. During these events, we observed sharp increases in elements such as K, Ba, Cu, and Sr, with metal-to-potassium and metal-to-$PM_{2.5}$ ratios offering diagnostic insights into source profiles. Background periods were used to define enrichment factors and contextualize these enhancements. Our results highlight the utility of continuous metal measurements for resolving short-term pollution episodes and improving source attribution. This work underscores the value of ASCENT's real-time metal monitoring approach for characterizing dynamic urban air pollution and complements traditional filter-based measurements in understanding the evolving chemical composition of $PM_{2.5}$

7CC.1

Hygroscopicity of Organic Aerosol from Wildfire Emissions.

NAGENDRA RAPARTHI, Anthony S. Wexler, Ann M. Dillner, *University of California, Davis*

In recent years, a significant decline in inorganic particulate matter (PM) concentrations has been observed in the United States, primarily due to increasingly stringent air quality regulations. In contrast, organic matter (OM) has become a more dominant and complex component of fine particulate ($PM_{2.5}$) emissions. Due to the vast chemical diversity of OM, comprising thousands of compounds with varying functionalities, its hygroscopic behavior remains insufficiently characterized. This limited understanding is particularly concerning in the context of wildfires, which have become increasingly frequent and intense. Wildfire-emitted organic aerosols not only threaten human health but also influence Earth's radiative balance and cloud microphysics. Yet, despite their atmospheric relevance, the hygroscopic properties of these organic aerosols remain poorly characterized. This study investigates the hygroscopicity of organic aerosols originating from both local and long-range transported wildfires using our recently developed filter-based water uptake method at three relative humidities (~84%, ~90%, and ~97%). $PM_{2.5}$ samples were collected on Teflon filters via the Interagency Monitoring of Protected Visual Environments (IMPROVE) network during wildfire events in Yosemite National Park (YNP), California, and during long-range smoke transport episodes at the Proctor Maple Research Facility (PMRF), Vermont, in 2023. Four samples representing three distinct wildfire phases in YNP and four samples representing two transport phases at PMRF were analyzed. Organic functional groups were characterized using Fourier-transform infrared spectroscopy (FT-IR), and inorganic constituents were quantified using energy-dispersive X-ray fluorescence (ED-XRF) and ion chromatography (IC), following IMPROVE protocols. The inorganic contribution to overall $PM_{2.5}$ hygroscopicity was estimated using the Extended Aerosol Inorganics Model (E-AIM), allowing organic contributions to be isolated and quantified. Results revealed that OM hygroscopicity varies significantly with stages of wildfire and atmospheric aging, highlighting the influence of combustion and chemical evolution on particle water uptake, thereby affecting atmospheric processes and climate models.

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7CC.2

Diffusion and Salting in Effects on Isoprene-Derived Secondary Organic Aerosol Mixture Proxy Hygroscopicity. NAHIN FERDOUSI-ROKIB, Stephanie Jacoby, N. Cazimir Armstrong, Alana Dodero, Martin Ahn, Ergine R. Remy, Zhenfa Zhang, Avram Gold, Joseph Woo, Yue Zhang, Jason Surratt, Akua A. Asa-Awuku, *University of Maryland, College Park*

Isoprene-derived secondary organic aerosol (SOA) constituents, such as the 2-methyltetrols (2-MT) and 2-methyltetrol sulfates (2-MTS), have been readily detected in atmospheric fine aerosols ($PM_{2.5}$). Isoprene-derived SOA compounds exist within aerosol mixtures containing inorganic salts, such as ammonium sulfate (AS). Despite its atmospheric significance, the water uptake of 2-MT, 2-MTS, and their mixtures are not well understood. In this study, we determine the physicochemical properties of 2-MT, 2-MTS, and their mixtures with AS. 2-MT and 2-MTS have been previously identified as viscous; thus, dynamic surface tension ($\sigma_{s/a}$) measurements were taken for both compounds to determine their organic diffusion coefficients (D_s). The droplet growth of the synthesized organics and AS mixtures was measured under subsaturated conditions (< 100% RH) using a humidified tandem differential mobility analyzer (H-TDMA) at a relative humidity (RH) of 88.2% ± 1.5%. Aerosol activation and droplet growth was also measured under supersaturated (> 100% RH) conditions using a cloud condensation nuclei counter (CCNC); supersaturation (SS) ranged from 0.3-1.4%. Both subsaturated and supersaturated hygroscopicity were parameterized by the single hygroscopicity parameter *κ.* Furthermore, aerosol viscosity and phase morphology were analyzed using atomic force microscopy (AFM) measurements. This study demonstrates how diffusion and salting-in effects influence the water uptake of SOA-proxy mixtures. The presence of inorganic compounds, such as AS, can enhance organic diffusion, leading to ideally well-mixed aerosol hygroscopic behavior that can be described by traditional Köhler theory. As a result, this work shows that for atmospherically ubiquitous isoprene-derived SOA like 2-MT and 2-MTS, the impact of its non-ideal thermodynamic properties must be considered in aerosol-cloud interactions.

7CC.3

Urban Aerosol Particles from One of the Largest Tropical Megacities Are Able to Act as Ice Nucleating Particles Facilitating Cirrus Cloud Formation. SEBASTIÁN MENDOZA-TÉLLEZ, Bingbing Wang, Jiyu Gao, Graciela Binimelis de Raga, Luis A. Ladino, *Universidad Nacional Autónoma de Mexico*

Mexico City (MC) is one of the largest megacities in tropical latitudes. Its size, population, large number of vehicles, diverse biota, and the variety of anthropogenic activities, result in high levels of air pollution. However, the pollutions levels, and hence, the aerosol composition has been reported to significantly differ along the city. Although northern MC is more polluted than the southern part, whether these differences in the aerosol concentration and composition could impact on cloud formation along the different local microclimates is highly uncertain. For example, the MILAGRO campaign (2006) demonstrated that polydisperse aerosol particles from northern MC were enriched in anthropogenic organic particles and that they can nucleate ice, under cirrus conditions, at relative humidities with respect to ice (RH_{ice}) and temperatures of ~122-128% and 210-230 K, respectively. However, the role of the southern aerosol particles, likely enriched in biogenic organics, in cirrus cloud formation is currently unknown.

Aiming to improve our understanding on the relationship between aerosol composition and ice nucleation in this large megacity, here we report the bulk and individual ice nucleating particles (INP) elemental composition as well as the ice nucleating abilities (via deposition nucleation) of size-selected aerosol particles collected in northern and southern MC in September of 2024. The ice nucleation experiments were carried out using the Xiamen University Ice Nucleation Chamber (XMU-INC) varying RH_{ice} between 209 and 221 K. It was found that besides the chemical composition differences between the northern and southern aerosol populations, the INP abilities of the aerosol particles from both parts of MC are rather comparable with ice formation taking place at RH_{ice} as low as 136.18% (220.52 K). Therefore, it appears that the ice nucleating abilities of these complex urban particles are not necessarily controlled by their chemical composition.

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7CC.4

A GPU-Enabled Aerosol Model for Global Kilometer-Scale Earth System Modeling. JEROME FAST, Balwinder Singh, Oscar Diaz-Ibarra, James Overfelt, Michael Schmidt, Brian Gaudet, Meng Huang, Chandru Dhandapani, Kai Zhang, Mingxuan Wu, Shuaiqi Tang, Kyle Pressel, Jaelyn Litzinger, Po-Lun Ma, *Pacific Northwest National Laboratory*

The lifecycle of aerosols is a key component of global Earth System Models since aerosols directly and indirectly affect atmospheric processes through their interactions with radiation and clouds. However, global models still contain relatively large uncertainties in the prediction of aerosol properties, such as number, size, and composition, and their interactions with the atmosphere. These uncertainties can be attributed to both imperfect parameterizations of aerosol processes and inadequate resolution. Global models typically have grid spacings of 50 km or more that cannot resolve the observed high spatial variability of aerosol properties as well as overlapping aerosols and cloud fields. Consequently, global Earth System Models have recently been developed to simulate atmospheric processes using grid spacings on the order of a few kilometers to better represent spatial variabilities in aerosols and clouds. One such model is DOE's next-generation Energy Exascale Earth System Model (E3SM) Atmosphere Model in C++ (EAMxx), formerly known as the Simple Cloud Resolving E3SM Atmosphere Model (SCREAM), that uses C++/Kokkos to take advantage of GPUs on exascale computers. Here we describe how the four-mode version of the Modal Aerosol Model (MAM4) has been ported to C++/Kokkos and integrated into EAMxx. Extensive tests were performed to ensure the ported code behaves in the same way as the original Fortran code used in earlier versions of E3SM. Predictions are compared with observations and simulations with coarser resolution and the computational cost is quantified to demonstrate the potential benefits of this new modeling framework. In addition, we discuss how this modeling framework will influence the development and testing of new aerosol parameterizations, including how new findings from laboratory and field measurements are integrated into the next generation of models.

7CC.5

Oxygen Vacancies as Features of Ice-Nucleating Metal Oxides. RYAN MITCH, Ayat Tassanov, Brendan Troesch, Mikyung Hwang, Konstantinos Alexopoulos, James Hodges, Miriam Freedman, *The Pennsylvania State University*

Metal oxides comprise a fraction of mineral dust aerosol and are susceptible to the formation of oxygen vacancies on their surfaces. However, the role that these sites play in inducing ice nucleation has not been previously investigated, despite their prevalence and propensity to enhance heterogeneous chemistry. To explore how oxygen vacancies influence the ice nucleation activity of metal oxides, we perform droplet immersion freezing assays on zinc aluminate ($ZnAl_2O_4$) and magnesium aluminate ($MgAl_2O_4$) spinels annealed at 900°C under air, N_2, and O_2 atmospheres. We observe that substituting Zn^{2+} cations for Mg^{2+} cations enhances the spinel ice nucleation activity, and that this enhancement is greatest upon switching from an oxidizing atmosphere to a reducing atmosphere. To better understand these results, we investigate the ice nucleation activity of zinc oxide (ZnO) and magnesium oxide (MgO), observing that ice nucleation occurs at warmer temperatures for ZnO than MgO after annealing under reducing conditions. Using density functional theory (DFT) calculations, we investigate the relationship between the thermodynamics of oxygen vacancy formation of the spinels and metal oxides studied and their ice nucleation activity. Our study is the first to characterize the role of oxygen vacancies on ice nucleation activity, which has impacts for understanding the fate and climate effects of mineral dust aerosol in the atmosphere.

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7CC.6

Ice Nucleation Activity of Polyvinyl Alcohol/Polyvinyl Acetate Polymer Solutions. Heidi L. Busse, Anjali Baikerikar, MIRIAM FREEDMAN, *The Pennsylvania State University*

In the environment, some organisms have evolved the ability to either 1) promote the nucleation of ice or 2) inhibit ice growth. The proteins that have evolved to carry out these tasks are in some cases quite similar, in that they both have uniformly spaced hydroxyl groups that can either template water molecules to form ice or bind to ice directly to inhibit its growth. The polymer poly(vinyl alcohol) (PVA) has been used as a synthetic model of these proteins, and it displays both ice nucleation promoting and ice growth inhibiting properties, depending on its molecular weight and concentration. In this study, we have synthesized PVA from poly(vinyl acetate) (PVAc) with different degrees of hydrolysis and different arrangements of the monomers. For these polymers, we observe that ice nucleation activity increases with concentration until a certain concentration is reached and then ice nucleation activity decreases with temperature. We relate these results to the crossover concentration, viscosity, solubility, molecular weight, and molecular structure of the polymers. Such studies of synthetic models can provide insight into the promotion of ice nucleation and inhibition of ice growth of biological macromolecules like proteins.

7DA.1

Using Machine Learning to Derive Long-Term Aerosol Liquid Water Concentrations from Aerosol Optical Properties. LIFEI YIN, Bin Bai, Shreya Suri, Yuhan Yang, James Sherman, Robert Swarthout, Pengfei Liu, *Georgia Institute of Technology*

Aerosol liquid water content (ALWC) is a critical component of ambient particulate matter, influencing the optical properties, radiative forcing, multiphase chemistry, and aging processes of atmospheric aerosols. However, long-term ALWC datasets are scarce due to the absence of direct measurement techniques. Since ALWC is closely tied to aerosol size, hygroscopicity, and ambient relative humidity (RH)—all of which affect aerosol optical properties (AOPs)—we propose a novel machine-learning approach to estimate ALWC utilizing a decade-long AOP dataset collected at the Appalachian Atmospheric Interdisciplinary Research Program (AppalAIR) site in Boone, NC. This work aims to understand decadal trends in ALWC in the southeastern United States, a region marked by high aerosol burden, elevated humidity, and substantial changes in aerosol chemical composition in the past ten years.

The AppalAIR site hosts one of the longest records (since 2012) of AOPs and humidified scattering enhancement factor f(RH) in the U.S. Starting in August 2024, additional particle number size distribution (PNSD) and chemical composition data are collected, enabling us to build a physically-based theoretical model that simulates aerosol optical properties under varying RH using Mie theory. Using this optical model constrained by observations, we trained Random Forest models to predict dry aerosol volume concentrations and hygroscopicity from AOPs, which allowed us to estimate ALWC directly from AOP measurements without requiring real-time size distribution or chemical composition.

Our trained and validated model will be applied to the long-term AOP dataset at AppalAIR to generate the first continuous, multi-year record of ALWC in the southeastern U.S. This novel dataset offers new opportunities to investigate long-term trends in aerosol water uptake, radiative properties, and aerosol-cloud interactions in a region heavily impacted by biogenic and anthropogenic emissions.

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7DA.2

A Lagrangian Time-Series Machine Learning Framework for Predicting Concentrations and Exploring Drivers of Cloud Condensation Nuclei in Marine Boundary Layer. Shengqian Zhou, Dong Qi, Hanyang Liu, Chenyang Lu, Yevgeniy Vorobeychik, JIAN WANG, *Washington University in St. Louis*

The concentration of cloud condensation nuclei (CCN) can strongly influence the albedo, lifetime, and coverage of marine low clouds and consequently the climate. At present, the key factors and processes driving the CCN concentration remain not well understood, and global models generally perform poorly in predicting CCN concentrations in remote marine boundary layer (MBL), contributing to substantial uncertainty in simulated aerosol-indirect forcing. While machine learning is a powerful tool for prediction and deciphering complex relationships in a multivariate system, its application to studying CCN processes remains limited. Additionally, existing machine learning models often use local environmental variables alone as input features, therefore cannot capture the processes during the long-range transport, which can strongly influence CCN concentrations in remote MBL. Here we present a Lagrangian time-series machine learning framework to better represent the dynamic processes driving CCN concentration in the atmosphere. Three-dimensional back trajectories of airmasses arriving at the receptor site were derived using a Lagrangian transport model. The time series of relevant environmental variables along the airmass trajectories were utilized as input features and fed into a long short-term memory (LSTM) model to predict the CCN concentrations at the receptor site. The model was trained and evaluated using multiyear CCN measurements on Graciosa Island in the eastern North Atlantic (ENA), and it demonstrates high prediction accuracy. In addition, while the model was built on measurements in the ENA, it can reproduce a large fraction of the CCN variation at another site in tropical South Atlantic, indicating that it captures the general processes that drive marine CCN concentration. Besides previously recognized wet removal, the model reveals that short-wave radiation is another key factor controlling CCN variations in the MBL of remote ENA. This Lagrangian time-series framework, which combines physics-driven airmass trajectory modeling and data-driven LSTM, can be applied to the prediction and mechanism understanding of other atmospheric components.

7DA.3

Identifying Local Emission Sources via an Integrated Computer Vision and Vision–Language Models (VLMs) Approach. JINTAO GU, Hongpufan Huang, Boyuan Niu, K. Max Zhang, *Cornell University*

The current National Emissions Inventory (NEI) estimates the number of wood stove appliances in each U.S. County by applying a fraction, derived from a survey of 2,984 responses across 21 states, to the number of occupied homes. However, the limited sample size and the methodology's inability to capture sub-county spatial variation hinder accurate estimation of woodsmoke-related PM emissions, which is critical for addressing neighborhood-level exposure equity issues and guiding policy changes. To overcome this limitation, we propose identifying wood stove units through visible residential rooftop features. Freestanding wood stove units often have distinctive, tall metal chimneys that comply with specific codes, as verified by our field survey in upstate New York. Our framework consists of two components: (1) data sources, including data collection methods, and (2) chimney identification techniques. In a pilot study, we evaluated the potential of vehicle-based videos, drone footage, and street view imagery, and assessed their adaptability to both urban and rural environments. For the chimney identification task, we propose combining Vision–Language Models (VLMs) with object detection computer vision (CV) techniques such as YOLOv11. Many challenges in aerosol source identification, including wood stove chimney detection, involve ambiguous appearance criteria and highly heterogeneous data sources, which complicate traditional object detection methods. VLMs, which can leverage contextual understanding and accommodate less rigid object definitions, demonstrate strong potential for accurate detection in such cases. We recommend broader adoption of VLMs in similar PM source estimation applications where context-driven identification is necessary.

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7DA.4

Application of Clustering Algorithms for Improved Source Apportionment with Photothermal Infrared Spectra from Individual Particles Collected in New York City. ABBYGAIL AYALA, Yao Xiao, Eduardo Ochoa Rivera, Kayleigh Reilly, Emily Costa, Xu He, Corin Tyler, Drew Gentner, Rachel O'Brien, Ambuj Tewari, Andrew P. Ault, *University of Michigan*

Characterizing the physiochemical properties of individual aerosol particles is critical to establish sources, improve climate models, and understand health impacts from air quality. Microspectroscopic techniques provide valuable single-particle characterization, but analyzing thousands of spectra collected from a campaign requires extensive time and human effort, which would benefit from improvements in automated processing. This work uses an unsupervised clustering method to group infrared (IR) spectra collected from field samples into classes that can be assigned to specific sources and forms of atmospheric aging. Particles collected during the New York City metropolitan Measurements of Emissions and TransformationS (NYC-METS) campaign were analyzed with optical photothermal infrared (O-PTIR) spectroscopy. This instrument uses a pump-probe system, with a continuous wave visible laser (532 nm) and a tunable IR laser (948-1860 and 2698-3002 cm^{-1}) to obtain photothermal IR (PTIR) spectra of individual aerosol particles, with a theoretical spatial resolution of ~0.5 μm. Unlike Raman spectroscopy, O-PTIR does not have issues with fluorescence overwhelming the signal, which can commonly occur with environmental samples. To analyze the thousands of spectra collected from this campaign, k-means clustering was used to group similar spectra together, reducing both analysis time and the potential for human bias. We were then able to distinguish particles containing primarily nitrate, ammonium sulfate, mineral or road dust, and organic species. Collection of PTIR spectra on field samples at this scale has not been done to date prior to this study. By using this clustering process, we were able to obtain an insight into aerosol composition from the NYC-METS field campaign, distinguishing trends as a function of sample location, time of day, and size of particles using vibrational spectroscopy. These findings will enable an improved understanding of source apportionment and atmospheric evolution of particulate matter in the New York metropolitan area.

7DA.5

Multiview Conformal Prediction (MVCP) Utilizes Infrared and Raman Spectra for Improved Atmospheric Microplastic Identification. REBECCA L. PARHAM, Eduardo Ochoa Rivera, Madeline E. Clough, Abbygail Ayala, Anne J. McNeil, Ambuj Tewari, Andrew P. Ault, *University of Michigan*

Spectroscopy techniques, such as infrared (IR) and Raman, are often used to analyze ambient atmospheric samples for microplastics (MPs). Unknown spectra are commonly identified using database matching methods, where the label with the highest similarity metric score is chosen if its score is above a set threshold. However, these scores have no statistical confidence associated with them, and most reported thresholds are arbitrary. Moreover, it is recommended to use both IR and Raman spectral inputs to improve the accuracy of MP identification due to their complimentary natures. Multiview conformal prediction (MVCP) is a machine learning method that uses scores from multiple spectral inputs to return prediction sets containing labels at a user-defined theoretical confidence. Herein, MVCP is assessed for identifying MPs in laboratory-generated samples of aerosolized MP particle types and atmospherically-relevant proxies. Spectra were collected with optical photothermal infrared and Raman (O-PTIR+Raman) spectroscopy, which utilizes a pump-probe system to collect IR and Raman spectra simultaneously for individual particles. The likeness between the collected spectra and an in-house reference library was calculated using the nearest neighbor similarity metric. A continuum of paired IR and Raman thresholds was then established to evaluate scores in a two-dimensional space. The size of returned prediction sets from MVCP were compared with its single-view counterparts (i.e. only IR or Raman), and the overall accuracy of MVCP was verified with empirical confidence. The capability of MVCP to remain unaffected by low-quality spectra—due to noise, fluorescence, or oversaturation—was also assessed. Finally, the method was used to demonstrate MP identification in environmental matrices by analyzing a sample of ambient particles spiked with aerosolized MP particles. The quality of MP identification was greatly improved by MVCP and should be applied to database matching at large.

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7DA.6

A Machine Learning Model for Automating Soot Morphology Analysis from TEM Images. TIMOTHY DAY, Khaled Mosharraf Mukut, Somesh Roy, *Marquette University*

Accurate characterization of morphology is important for understanding the physical and chemical properties of soot particles. Traditionally, soot morphology is analyzed experimentally via manual segmentation of Transmission Electron Microscopy (TEM). This manual process is labor-intensive and time consuming. In this work, we introduce a machine learning-based model to automate the manual segmentation process. This model, titled Soot Aggregate Geometry Extraction (SAGE), is built using a convolutional neural network trained through a novel two-phase approach: initial training on synthetic TEM images followed by refinement with manually segmented real TEM images. To test the robustness of the SAGE model it was then tested with a set of real TEM images obtained from multiple sources (i.e., obtained using different instruments in different conditions by different research groups). In these tests, SAGE showed an F1 score over 67.7%, demonstrating a good balance between correct particle detection and minimization of false positives. It was able to capture complex non-circular shapes of primary particles in soot aggregates and achieved a mean Intersection over Union score (a metric that measures how well the model captures the exact shapes of the primary particle in a TEM image) over 60%. SAGE significantly outperformed traditional segmentation techniques like circular Hough transform and Euclidean distance mapping. In domain-specific performance metrics, the particle size distributions generated by SAGE showed very good alignment with ground truth data, and median prediction errors were below 5% for radius of gyration and less than 1% for fractal dimension. While SAGE may not be perfect, it shows significant improvement over the state-of-the-art in TEM image segmentations. By reducing the bottleneck of manual segmentation while maintaining high accuracy, SAGE enhances research capabilities in studying soot properties, which could lead to improved understanding of soot's environmental and health impacts.

7IM.1

Capture and Preservation of Single Aerosol Particles Through an Aerosol-Into-Emulsion Transition Approach. YI-BO ZHAO, Li Li, Bernard Olson, Christopher J. Hogan, *University of Minnesota*

Analyses of single aerosol particles are commonly performed in a real-time and complex manner (e.g., optical tweezers or aerosol mass spectrometers), as there is a lack of capture and long-term storage methods preserving the chemical constituents of individual aerosol particles. We propose and demonstrate an aerosol-into-emulsion transition (AIET) approach to capture aerosol particles separately and preserve them for further analysis. Specifically, we develop an AIET system consisting of a temperature-controlled particle growth tube with water as the working fluid and a multi-nozzle impactor. The growth tube is based on the same principles as water condensation particle counters and growth collectors; aerosol particles grow several micrometers in diameter through water condensation. Subsequently, they are captured individually in a mineral oil/dodecane mixture with surfactants as water-in-oil emulsions for long-term storage. We find that the ability to collect droplets and maintain them as individual droplets in an emulsion is strongly sensitive to the physical properties of the collection oil (viscosity, surface tension) and surfactants. The AIET approach has been demonstrated with monodisperse fluorescent particles and in the collection of ambient aerosol particles. We envision that this new concept will enable greater choice in characterization techniques for single aerosol particles.

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7IM.2

Development and Validation of an Extractive Dilution System for In-situ Measurement of Residential Wood Heating Appliance PM Emissions Using a TEOM. GEORGE ALLEN, Mark Champion, *NESCAUM*

Measurements of in-situ residential wood heater PM emissions are needed for updated emission inventories and to assess the efficacy of state air agency wood stove change-out programs. Certification testing of wood heater PM emissions to demonstrate compliance with US-EPA standards is done using a dilution tunnel under tightly controlled laboratory conditions that may not reflect the installation, operating and fueling conditions of real-world use. To assess this difference in PM emissions in-situ, we developed an extractive dilution system that completely mixes the sample and matches the key dilution tunnel characteristics of dilution factor (DF), residence time and temperature to ensure that the condensation dynamics of semi-volatile organics in the tunnel and diluter are similar. Commercial dilution systems were evaluated but did not condense semi-volatiles and had issues with inlet clogging when sampling high-emitting devices. This diluter system uses 1-minute PM measurements from a Thermo-Scientific TEOM concurrent with measurement of stack flow using a vane anemometer to provide temporally detailed emissions data and to resolve issues with proportional sampling when using integrated PM measurements. A modular diluter design allows DF from 5 to 50 and residence times from 0.5 to 5 seconds. A short straight-through sample inlet line minimizes particle losses and avoids water vapor condensation in the sample stream without an external heater; the inlet line is easily cleaned or replaced. The simple design eliminates the need for validation of DF using inert tracer gases or CO_2. Performance was assessed by direct comparison to regulatory dilution tunnel PM emission rate measurements in the laboratory for six test runs on pellet and non-catalytic stoves; agreement was generally within 20%. Field performance was evaluated by 9 days of testing in a home in northern VT with the same two stoves, followed by technology transfer pilot testing in Fairbanks AK.

7IM.3

Understanding Surface Mediated Redox Chemistry in Charged Microdroplets. Michael Jacobs, FIROZ AHMED, *Texas State University*

Chemical reactions can occur more than six orders of magnitude faster in microdroplets than in a macroscale solution. A possible reason for the distinct chemistry observed in microdroplets is that the thermodynamics of reactive processes can be altered significantly in microdroplets relative to the bulk phase. Several methods exist for generating microdroplets, such as ultrasonication, condensation, gas nebulizers, and electrospray ionization (ESI). ESI is particularly popular due to its enhanced reaction rates and compatibility with mass spectrometry. Recently, researchers have focused on hydrogen peroxide formation in water microdroplets to explore microdroplet redox chemistry. Various mechanisms have been proposed for this process, including radical-mediated and electron-mediated pathways, however, the exact reason for faster redox chemistry at the microdroplet surface compared to the bulk phase remains unclear. It is believed that the electrical charge in microdroplets plays a crucial role in accelerating these reactions. The Rayleigh limit (RL) is the maximum amount of charge a droplet can carry and represents the point where electric repulsive forces overcome surface tension forces, leading to droplet fission. While the theoretical basis for RL was described in the 1880s, numerous experimental studies show droplets are unstable at sub-RL net charges. Computational studies suggest that achieving 20-30% of RL could significantly lower the reaction barrier, making redox reactions thermodynamically favorable. However, the effect of charge has to promote redox reactions in microdroplets has not been rigorously assessed experimentally.

In this talk, we use single droplet levitation techniques to explore the maximum amount of charge a droplet can carry and how charge influences redox reactivity in microdroplets. We use the quasi-elastic light scattering (QELS) technique to measure the surface tensions of levitated microdroplets of different compositions (high and low ionic strength aqueous droplets and non-aqueous organic droplets) with varying net charges. We present data validating the technique and show preliminary results that indicate surface tension of microdroplets decreases as their charge approaches the Rayleigh limit, leading to sub-RL coulombic fission. Ultimately, a rigorous understanding of how much charge a microdroplet can carry is necessary to understand how charge might influence redox chemistry in microdroplets. Going forward, these surface tension measurements will inform future studies examining how charge influences redox chemistry (and hydrogen peroxide formation) in microdroplets.

Keywords - Microdroplets, Redox Chemistry, Quadrupole Electrodynamic Balance, Rayleigh Limit, Electrospray Ionization

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7IM.4

Development and Characterization of a Hydration Spectrometer (HySpec) System for Studying Aerosol Cloud Interactions. OGOCHUKWU ENEKWIZU, Ernie R. Lewis, Arthur J. Sedlacek, *Brookhaven National Laboratory*

Aerosol-cloud interactions contribute the largest uncertainties to estimates of the Earth's energy budget because of the poor quantification of fundamental microphysical and chemical processes. A key process is the formation of cloud residuals – aerosol particles that undergo cloud processing and are left behind after cloud drop evaporation. These aerosol particles reenter the atmosphere with different microphysical, chemical, and optical properties than the cloud condensation nuclei (CCN) that formed the cloud drop and thus interact with incoming solar radiation or influence clouds differently. The measurement of cloud residuals is, however, challenging and often limited to either aircraft campaigns or mountain site stations that employ a counterflow virtual impactor (CVI) to separate the generally larger cloud residuals from smaller aerosol particles based on their inertia. Here, we integrate a pumped CVI (PCVI), developed for laboratory applications, with a modified CCN counter to isolate and sample cloud residuals in a controlled laboratory setting. Dry aerosol particles introduced to the CCN-PCVI, which we refer to as a Hydration Spectrometer system, are first exposed to supersaturation conditions in the CCN counter that will cause some particles to activate. The resulting population of cloud droplets and non-activated particles are immediately drawn into the PCVI, where a particle-free flow of gas directed opposite the particle-laden flow provides a controllable means of separating the non-activated aerosol particles while allowing cloud droplets to be transmitted. Cloud droplets exiting the PCVI are dried prior to subsequent analysis, forming residuals, and their microphysical and optical properties are quantified. We report the efficacy and performance of the Hydration Spectrometer system for different particle types and sizes over a range of flow and supersaturation conditions.

7IM.5

Investigations of Particle Evaporation Kinetics Using Ultra-High Purity Aerosolization and Heating. DEREK OBERREIT, Jikku Thomas, Michael Walker, *Kanomax FMT, Inc.*

Particle precursors in semiconductor process chemical have received increasing attention due to their ability to form a defect-causing particle through precipitation from droplets remaining on the wafer surface following liquid contact. This particle formation mechanism is mimicked using aerosolization of the liquid and subsequent analysis by common aerosol measurements. While this can provide insight into the propensity of dissolved contaminants in a process chemical to form defect-causing particles, it does not provide much insight into the ability to mitigate them using thermal techniques. In this work, we present a method for qualitatively determining the evaporation kinetics of the particle precursor material using high purity, nano-droplet aerosolization with a compact aerosol sample heater.

To demonstrate the capability of this system, we utilized tandem aerosolization - electrical mobility sizing using ultrapure water doped with varying concentrations of high molecular weight organics often found in ultrapure water. When the aerosol is heated, the semi-volatile components evaporate, which shifts the mode of the aerosolized particle distribution to smaller sizes. The kinetics of the particle evaporation is then probed by varying the aerosol flow rate through the heater at several precursor concentrations and heater temperatures.

The results of this study are expected to yield qualitative thermal decomposition profiles and rates, serving as guideposts for the effectiveness of thermal mitigation.

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7IM.6

Diffusion Constriction Study to Provide Virtually Limitless Resolution in Ion Mobility on Structures for Lossless Ion Manipulation (SLIM) Platforms. CARLOS LARRIBA-ANDALUZ, Mohsen Latif, *Purdue University*

Ion/Electrical mobility spectrometry (IMS), especially when paired with mass spectrometry (MS), has become an essential tool for probing the structure and composition of complex molecular mixtures. By separating ions based on their shape and size (collision cross section) rather than just mass-to-charge ratio, IMS enables powerful insights across fields like aerosols and its precursors, proteomics, and small-molecule analysis. Yet, despite its versatility, IMS continues to face a major limitation: resolution. Compared to MS, IMS offers relatively modest resolution, and while increasing the path length in modern systems can improve this, it comes at a steep cost—signal loss due to axial diffusion.

While radial diffusion has largely been tamed through radiofrequency (RF) confinement at low pressures, axial diffusion remains a bottleneck. Over long separations, ion packets naturally spread, degrading signal quality and limiting the technique's ability to distinguish closely related molecular species. In this work, we explore a new theoretical approach to overcoming this challenge. Building on the concept of diffusion autocorrection via spatially varying electric fields, we propose the use of asymmetric traveling waveforms to actively compress ion packets in the axial direction during transit. Specifically, waveforms with sharp voltage rises followed by gradual decays create a self-correcting electric field that counteracts packet broadening. Simulations based on the Nernst-Planck equation confirm that this field pattern can suppress diffusion over extended paths, preserving resolution and sensitivity far beyond what is currently achievable.

To enable this strategy, we propose a new SLIM-based architecture—CLIMB (Constricted Lossless Ion Mobility Board)—featuring densely packed electrodes and reduced inter-board spacing designed to generate near-linear field gradients over long distances. Although still at the conceptual stage, CLIMB could make it possible to baseline-separate isomers and isotopomers without relying on mass selection. If realized, this platform would represent a major leap in IMS performance and portability, opening new possibilities for high-resolution, real-time analysis in clinical, forensic, and environmental settings.

7RA.1

Multi-City Equity Assessment of Air Quality Intervention Policies. MOHAMMED AHMED, Daniel Gingerich, Andrew A. May, *The Ohio State University*

Over the past decade, numerous U.S. cities have introduced climate or air quality measures intended to reduce urban pollution, yet their equity implications remain underexamined. This study evaluates the impact of policy implementation on $PM_{2.5}$ concentrations in major U.S. cities (over 500,000 residents) from 2015 to 2025 using monthly $PM_{2.5}$ satellite data products aggregated to the census tract level. We apply difference-in-differences and triple difference methods to compare air quality trends in cities that adopted climate policies (e.g., emissions reduction plans, sustainability plans, and electrification mandates) with those that did not, while distinguishing between environmental justice (EJ) and non-EJ communities. We expect the findings to show statistically significant reductions in $PM_{2.5}$ in policy-implementing cities compared to cities that did not implement interventions, but the benefits are not expected to be uniformly distributed. In some cities, EJ communities may experience greater gains in some places, while other places may show minimal change or even a decrease compared to non-EJ areas. These expected results suggest that implementation strategies, not just a policy's existence, determine equity outcomes. The presentation will highlight how different cities performed in terms of air quality improvement and equity, and it will discuss what these differences mean for how we should monitor pollution and design better, more equitable climate policies in the future.

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7RA.2

Lactic Acid-Based Chemical Air Interventions Disrupt Aeroallergen Structure and Immunodetection. TESS EIDEM, Kristin Rugh, Mark Hernandez, *University of Colorado at Boulder*

Airborne allergens are a major driver of allergic respiratory disease and asthma. Most airborne allergens (aeroallergens) are exogenous proteins with three-dimensional structures recognized by the human immune system, triggering allergic responses. Therefore, air interventions that alter aeroallergen protein structure may reduce immune recognition and allergic response.

We evaluated a lactic acid (LA)-based aerosol spray for its ability to alter airborne allergen structure using the commercial Multiplex Array for Indoor Allergens (MARIA) immunoassay, which requires intact protein structure for antibody-based immunodetection. Dust containing cat, dog, pollen, and dust mite allergens was aerosolized into respirable particles within a 1 m^3 environmentally controlled chamber, and condensation capture was used to collect allergen-containing aerosols over time. Following baseline collection, airborne allergens were exposed to no treatment (control), LA aerosol spray, or aerosol spray without LA (placebo). All aeroallergens showed significant reductions after 5 minutes of LA aerosol spray treatment compared to control and placebo, ranging from 14–71% LA-dependent aeroallergen reduction, with the most pronounced effect observed in the dust mite group 1 allergen Der p1.

To investigate the mechanism of reduced MARIA immunodetection of airborne Der p1, we assessed Der p1 structure via circular dichroism spectroscopy. *In vitro* Der p1 LA treatment converted 18% of α-helical structure to unordered structure, increasing overall Der p1 disorder from 23% to 41%. Native polyacrylamide gel electrophoresis also confirmed protein conformational changes, showing altered migration of Der p1 after LA exposure. Importantly, these structural changes were irreversible upon LA removal by dialysis.

Ongoing studies continue to investigate whether Der p1 structural changes reduce human IgE immunodetection using sera from dust mite-sensitized patients. Overall, these findings support the potential of LA-based aerosol sprays as a novel air intervention strategy to mitigate allergic disease by altering the structure, and therefore immunodetection, of airborne protein allergens.

7RA.3

In-Situ Performance of an Electrostatic Precipitator in a Swine Facility and Its Comparison to Fibrous Filters. HASAN AL TARIFY, Qingqing Fu, My Yang, Bernard Olson, Christopher J. Hogan, Montserrat Torremorell, *University of Minnesota*

Electrostatic precipitators (ESPs) are devices that can remove aerosol particles with minimal pressure drops, resulting in lower power consumption for air handling systems. While they may also exhibit improved collection performance in laboratory settings, their behavior in real-world environments has rarely been investigated, especially in comparison to fibrous filters, to determine their suitability for practical use. This research aims to evaluate the performance of two-stage wire plate ESPs alongside high-efficiency filters in a swine facility, focusing on their ability to remove particulate matter and viruses throughout different seasons. Our findings indicate that ESPs exhibit higher collection efficiency from 0.5 µm to 10 µm compared to MERV 15 filters. Additionally, under the same flow rate conditions, the pressure drop of the ESP is only half that of the fibrous filter. Trials with porcine reproductive and respiratory syndrome (PRRS) virus also reveal that the ESP can eliminate viruses with an efficacy of up to 99.9%, highlighting its effectiveness in agricultural environments.

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7RA.4

Bridging the Biosecurity Gap: High-Efficiency Air Cleaning in Confined Animal Feeding Operations Using Cyclone Plasma Technology. ANTONIO BARATTA, Raj Singh, Hema Ravindran, Gediminas Mainelis, *KiposTech LLC*

Confined Animal Feeding Operations (CAFOs) are significant sources of hazardous bioaerosols and particulate matter (PM), often containing concentrations far exceeding ambient levels. These particles, particularly in the submicron range, readily penetrate avian respiratory systems and frequently act as carriers for airborne pathogens, including highly pathogenic avian influenza strains (e.g., H5N1). Existing air purification technologies, such as wet scrubbers, HEPA filters, and UV systems—are ill-suited for CAFO environments due to high operational costs, limited inactivation efficiency, maintenance complexity, and inability to remove fine particles or prevent secondary contamination.

This study introduces Bazooka™, a novel, integrated electro-mechanical air disinfection system specifically engineered for intensive livestock environments. The device combines cyclone-assisted non-thermal plasma (NTP) for continuous airborne pathogen neutralization with electrostatic precipitation for high-efficiency particulate removal and catalytic adsorption for ammonia and volatile organic compound (VOC) mitigation. This design is optimized to function under high airflow rates with minimal pressure drop, maintaining compatibility with large ventilation systems.

Experimental testing demonstrated Bazooka™'s ability to remove viral-sized particles (10–193 nm) at clean air delivery rates (CADR) of 160–370 CFM, with anticipated scaling to 1,000 CFM in future iterations. Field trials conducted in operational settings recorded an average 72 ± 9% reduction in airborne bacteria and 90 ± 23% reduction in fungal spores, with 5-log reductions in surface microbial loads as measured by ATP bioluminescence assays, indicating strong anti-biofilm performance. Unlike UV or ozone-based systems, Bazooka™ achieves disinfection without harmful byproducts.

Comparative analysis confirms Bazooka™'s superior performance over HEPA filters and wet scrubbers, particularly in removing $PM_{2.5}$, operating at a pressure drop of <100 Pa, and requiring significantly lower maintenance. These findings validate Bazooka™ as a first-of-its-kind solution tailored for CAFO biosecurity, simultaneously addressing pathogen, dust, and ammonia control in a compact, scalable form factor.

7RA.5

In-Situ Filtration and Air Cleaning. JEFFREY SIEGEL, *University of Toronto*

Filtration and air cleaning standards (eg, ASHRAE Standard 52.2, AHAM AC-1, ISO 16890) allow for comparison of air cleaning approaches at standardized laboratory conditions. However, they have limited applicability to performance in actual buildings because of variations in air flow rates, filter efficiency changes, filter installation conditions, room volumes, air mixing, and background loss rates, among many other factors. As many of these factors vary over time over short time scales, the same filter will also often perform differently in the same environment over time. This presentation reports on different approaches to assess air cleaning in-situ with the goal of providing filtration and air cleaner users with actionable information on performance. Although the available methods differ in approach, instrumentation, data analysis, reference/placebo condition, and level of standardization – the results are consistent in demonstrating that the amount of relative (effectiveness) and absolute reduction in particle concentrations resulting from the use of any given air cleaning approach varies considerably over time and between environments. This presentation reports on data on 15 different air cleaners (including both room and central filters/air cleaners and those using various types of media as well as various electronic air cleaning approaches) in 10 different residential, commercial, and institutional environments. The overriding purposes are to provide evidence that in-situ testing is essential, provide a variety of approaches and considerations for conducting such testing, and illustrate the use of in-situ air cleaning results when benefits (health or otherwise) are being evaluated.

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7RA.6

Assessing Window AC and Portable AC Filter Performance on Removing Particulate Matter from Wildfire Smoke. RILEIGH ROBERTSON, Henrik Helmig, Marina Vance, *CU Boulder*

Wildfires generate large amounts of particulate matter (PM), which pose significant health risks when inhaled. Indoor air filtration plays a critical role in reducing exposure but can be expensive. There is currently limited research investigating the performance of low-cost solutions that also address thermal comfort. In this study, we developed and evaluated the PM removal efficiency of 6 different materials inserted into a window AC unit and portable AC unit that maximize comfort, cost, and effectiveness during a simulated wildfire event. A cocktail smoker with Ponderosa Pine chips was used to inject the PM into a 38 m^3 chamber and left to decay with the AC units on. Particle sizers were used to measure the concentration of PM ranging from 10 nm to 10 µm. Clean air delivery rates were calculated for each of the filters, and the flow drop was recorded. All tested filters outperformed the control, confirming that the filter materials can effectively reduce occupant exposure to wildfire smoke. These solutions are low-cost and utilize a device that the home may already have with the added benefit of cooling.

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8AC.1

Chlorine Production from Photocatalysis of Iron Chloride Aerosol as a Potential Methane Sink. JIN YAN, Marie K. Mikkelsen, Luisa Pennacchio, Maarten van Herpen, Matthew S. Johnson, Mingyi Wang, *University of Chicago*

Atmospheric methane is the most important non-CO_2 greenhouse gas. It has a global warming potential 82 times that of CO_2 on a 20-year timescale and is responsible for about 0.5 °C of the present-day 1.5 °C gross warming, with a rapid rising trend. As methane having many diffuse natural sources like wetlands, the changes in atmospheric oxidation ability may greatly affect global methane budget. A recent study has observed that extensive formation of chlorine radicals over the North Atlantic when iron-rich mineral dust mixes with chloride-containing sea spray aerosol significantly contribute to methane removal. As chlorine radicals react with methane about 15 times faster than hydroxyl radicals, photocatalytic reactions of iron chloride may serve as a powerful sink for methane. Understanding the mechanisms behind methane loss is crucial for improving atmospheric models' predictions of the current methane budget and its impact on global warming over the coming decades.

This work presents recent laboratory results on the chemical mechanisms driving chlorine formation from photocatalysis of ferric chloride ($FeCl_3$), investigated as a surrogate for mineral dust-sea spray aerosols (MDSA) in atmosphere. We first quantify the gas-phase chlorine production yields from pure $FeCl_3$ water solutions when exposed to visible light at ~450-460 nm using iodide-adduct chemical ionization mass spectrometry. We then alter key atmospheric parameters including the iron-to-chloride ratio, solution acidity, the presence of oxidants such as hydrogen peroxide (H_2O_2), and different inorganic acids to explore how chlorine production by MDSA may be influenced by processes like chlorine recycling and interactions with acids in real atmosphere.

8AC.2

Modeling the Impacts of Volatile Chemical Products (VCPs) on Ozone and Secondary Organic Aerosol Using the SAPRC Mechanism. JESSSICA COATS, Amirashkan Askari, Craig Stroud, Arthur W. H. Chan, *University of Toronto*

Volatile Chemical Products (VCPs) are a source of Volatile Organic Compounds (VOCs) and include but are not limited to personal care products, solvents, and paints. As tailpipe VOC emissions have decreased, the focus has shifted towards VOCs from VCP sources. Once emitted, VOCs can form ozone and secondary organic aerosols (SOAs), which pose health concerns. Condensed chemical mechanisms, such as SAPRC07C are often used in chemical transport models to represent the large list of detailed, speciated VOC emissions. However, the SAPRC07C condensed mechanism has limited representation for many VOCs from VCP sources, limiting the ability to model VCPs and their impacts. To improve the representation, additional VOCs are added to the mechanism to represent VCPs. Three aspects were considered when selecting VOCs to add to the existing mechanism: the OH reactivity, SOA formation potential, and the existing SAPRC07C representation. A new speciated database for VCPs in Canada was used to determine the OH reactivity and potential to form SOA for each chemical species. Each chemical species was ranked relative to their product category and overall contribution to VCP emissions in Canada. The VOCs that contributed the most to emissions from VCPs were matched with the existing SAPRC categories to determine their current representation in the model. This approach to grouping VOCs will condense the VCP sources from over ten thousand to under thirty, allowing for improved mechanisms to be developed for the SAPRC. We evaluate the performance of this mechanisms in ECCC GEM-MACH by comparing against VOCs measured during an intensive field campaign in winter 2024 and in long term data sets in Canada.

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8AC.3

Illuminating Chemical Mechanism Gaps through Modeling Secondary Pollutants from Volatile Chemical Products. AMEL KSAIBATI, Huiying Luo, Abraham Dearden, Matthew Coggon, Katelyn Rediger, Carsten Warneke, Lu Tan, Damien Ketcherside, Lu Hu, Cort Zang, Tucker Melles, Audrey Lawrence, Megan Willis, Lauren A. Garofalo, Brett Palm, Julia Lee-Taylor, Shantanu Jathar, *Colorado State University*

Chemical mechanisms used in atmospheric studies describe the complex gas- and particle-phase chemistry of volatile chemical product (VCP) VOCs, yet gaps in representation or reliance on surrogate species often hinder accurate predictions of secondary pollutants such as ozone (O_3) and secondary organic aerosol (SOA). As VCP-derived VOC emissions dominate most urban VOC sources, addressing these deficiencies is critical for advancing air quality modeling. This study addresses the gap by using the Framework for 0-D Atmospheric Modeling and its aerosol module extension (F0AM-WAM) to simulate coupled gas-phase and organic aerosol formation and compare predictions with experimental observations. Recently, environmental chamber experiments performed at Colorado State University investigated the oxidation chemistry of 14 diverse VCP OVOC species, including benzyl alcohol, carbitol, and furan. Assessed mechanisms include the Master Chemical Mechanism (MCM) for well-characterized VOCs and the GECKO-A mechanism generator for structurally complex or underrepresented species. Model outputs were compared against gas-phase measurements (e.g., O_3, NO, NO_2), SOA yield, and high-resolution mass spectrometer data (e.g., PTR-ToF-MS, NH_4^+-CIMS). Carbitol for example, a solvent commonly added to inks and wood stains, is not explicitly accounted for in MCM and a smaller glycol ether is used as a surrogate in its place. When surrogate species in MCM deviate from experimental observations, and corresponding explicit species in GECKO-A yield better performance, it underscores the need to extract and develop reduced forms of these well-performing species and replace underperforming surrogates. While model predictions capture observed trends for certain OVOCs, substantial discrepancies persist for oxygenated intermediates and secondary products. This highlights limitations in current representations of VCP OVOC chemistry. Insights from this work will inform recommendations to improve VCP OVOC chemistry in atmospheric chemical mechanisms, ultimately enhancing 3-D atmospheric model predictions of air quality and human exposure risks.

8AC.4

Oxidative History Controls the Composition and Fate of Biomass-Burning-derived Phenolic compounds: Sequential OH and NO_3 Oxidation. MADELEINE SZE IN NG, David Pando, Bin Bai, Heather O. LeClerc, Pengfei Liu, Drew Gentner, Andrew Lambe, Nga Lee Ng, *Georgia Institute of Technology*

Biomass burning (BB) is a major source of phenolic volatile organic compounds (VOCs), contributing significantly to secondary organic aerosol (SOA) and brown carbon (BrC) through atmospheric oxidation. While nighttime nitrate (NO_3) radical oxidation of these VOCs forms BrC, real-world BB plumes experience sequential oxidation cycles, during which the NO_3 reactivity of phenolic VOCs and their early-generation products are potentially influenced by daytime exposure to hydroxyl (OH) radicals.

To simulate diel atmospheric oxidation of phenolic VOCs, we present results from serial OH-NO_3 oxidative aging experiments combining the Georgia Tech Environmental Chamber (GTEC) and a Potential Aerosol Mass oxidation flow reactor (OFR). We focus on three representative phenolic VOCs – phenol ($C_6H_5(OH)$), guaiacol (monomethoxy phenol; $C_6H_5(OH)(OCH_3)$), and syringol (dimethoxy phenol; $C_6H_5(OH)(OCH_3)_2$). Together, they represent the chemical diversity and atmospheric reactivity of phenolic VOCs, allowing us to elucidate how varying functional groups modulate sequential oxidation processes and SOA evolution. Time-resolved gas and aerosol chemical composition is monitored using an Aerosol Mass Spectrometer (AMS) and the Filter Inlet for Gases and Aerosol-Iodide-Chemical Ionization Mass Spectrometer (FIGAERO-I^--CIMS), which measure gas- and particle-phase products as a function of OH and NO_3 exposure, with additional chemical speciation via offline samples. The results demonstrate how progressive daytime oxidation fragments and functionalizes phenolic precursors and their early-generation oxidation products. Our preliminary result suggests that in general, NO_3 reactivity toward the plume is dependent on its daytime gas-phase OH aging, in which more-oxidized products produced in daytime may experience less subsequent NO_3-driven chemical changes. This OH oxidation-induced suppression potentially alters the chemical composition, SOA formation, and optical properties of BB SOA during nighttime. Our findings highlight the important role of diurnal oxidation cycling in controlling BB plume evolution, offering experimental constraints for improving the treatment of smoke plumes in atmospheric and climate models.

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8AC.5

Photooxidation of Dimethyl Selenide by OH and OH+NOx: Chemical Products and Bulk Aerosol Properties. ERIN BOWEY, Linhui Tian, Lillian Tran, Alexa Canchola, Michael Lum, Yumeng Cui, Ying Zhou, Don Collins, Ying-Hsuan Lin, Roya Bahreini, *University of California, Riverside*

Once methylated selenium (Se) compounds, such as dimethyl selenide (DMSe), are emitted into the troposphere, they are subject to daytime photooxidation by the OH radical. It has long been predicted that the atmospheric processing of these compounds contributes to the production of oxidized Se-containing organic and inorganic gaseous pollutants and secondary aerosol (SA), similarly to dimethyl sulfide (DMS). However, the details of the involved reactions, molecular identities of the products, and properties of the resulting SA remain largely unknown. This work aims to investigate the identity of gas and particle phase products, as well as the bulk properties of the aerosol generated by OH-initiated photooxidation of DMSe in the absence or presence of added NOx. An environmental smog chamber was used for the photooxidation experiments and monitored by a suite of on- and off-line analytical techniques, including mAMS, SEMS, (I^-) ToF-CIMS with FIGAERO, and aldehyde-targeted GC-MS. Increased particle effective density ($\rho_{p(eff)}$) and volume concentration was revealed in conditions with added NOx, although the mode of the volume distributions (d_m) was not significantly distinct. Identified products included organics such as particle-phase dimethyl selenone ($(CH_3)_2SeO_2$) without NOx and $C_2H_2N_2O_6Se$ with added NOx, gas-phase methaneselenonic acid (CH_4SeO_3) and CH_2SeO_4 without NOx, $CHSeNO_4$ with added NOx, and formaldehyde and CH_4SeO_5 under both oxidation regimes. Also, several inorganics emerged in both phases and both regimes, such as selenium dioxide (SeO_2), selenic acid (H_2SeO_4), and selenous acid (H_2SeO_3). Based on the accepted reaction products of DMS photooxidation, several Se-containing species observed in this work, such as CH_2SeO_4, CH_4SeO_5, and H_2SeO_3 were unexpected. This indicates comparable but still unique chemistry occurring in DMSe oxidation influencing the chemical composition and physical properties of the resulting gas and aerosol phase products.

8AC.6

Comparing the Heterogeneous Reactivity of Viscous and Gel State Particles. STEPHANIE SALAS, Craig Sheldon, Teresa Palacios Diaz, Katie Morton, Kyle McMillan, Ryan Davis, James F. Davies, *University of California, Riverside*

The phase state of aerosol particles directly influences the rate of heterogeneous chemistry. In the atmosphere, viscous phase states have been identified that significantly slow the rate of heterogeneous oxidation reactions by impeding the diffusion of oxidants and reactants/products in the particle. Recently, the formation of gel states in particles containing a mix of organic molecules and salts have been identified. In this work, we present an experimental platform to probe the composition of levitated aerosol particles and compare the reactivity of viscous and gel particles towards ozone. We use a linear quadrupole electrodynamic balance (LQ-EDB) to levitate individual particles and Mie resonance spectroscopy to determine the size and refractive index. Particles are ejected individually from the LQ-EDB to an open port sampling interface (OPSI) and aspirated into the electrospray ionization source to be sampled by an Orbitrap Q Exactive mass spectrometer to characterize the evolving chemical composition. Our results demonstrate that the reaction rate of viscous particles becomes slowed, while the reaction rate in gel particles becomes fully arrested after an initial period of rapid reaction. These observations are the first to demonstrate clear reactivity differences between viscous and gel states in aerosol particles, with implications for our understanding of heterogeneous aging in atmospheric aerosol.

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8AC.7

A Comparison of Ambient and Chamber Organic AMS Spectra Under Varying RO_2 Regimes. Elinor Caballero, Nadia Tahsini, Matthew Goss, Lesly Franco Deloya, Erik Helstrom, Jesse Kroll, HANNAH KENAGY, *University of Minnesota*

The fate of organic peroxy radicals (RO_2) is a key control on product distributions, and hence the amount and properties of secondary organic aerosol (SOA) produced, from volatile organic compound (VOC) oxidation. Historically, environmental chamber experiments of SOA formation were designed to access "limiting conditions" in which the fate of RO_2 was dominated entirely by reaction with a single co-reactant, namely either NO or HO_2. A new model-informed approach to chamber experiment design now allows us to run experiments that more closely match the atmospheric distribution of RO_2 fates, including mixtures of RO_2+NO, RO_2+HO_2, RO_2+RO_2, and RO_2 isomerization reactions. Here, we compare organic aerosol spectra measured by an aerosol mass spectrometer (AMS) during ambient measurements and during chamber experiments with a variety of RO_2 fate distributions. We use the cosine similarity score to quantify the level of similarity between ambient spectra and experimental spectra, testing our hypothesis that spectra from chamber experiments that better mimic atmospheric RO_2 fate distributions are more similar to ambient spectra than those collected during "limiting condition" experiments. In addition, we look for spectral markers of RO_2 fate from experiments and examine their patterns of spatiotemporal variability in ambient AMS data.

8BA.1

Understanding the Size and Prevalence of Respiratory Viruses in Hospital Settings. KERRY KELLY, Md. Tanvir Ahmed, Kamaljeet Kaur, Elizabeth Myers, Darrah Sleeth, Selah Willis, Chase Crimmins, Kristi Warren, *University of Utah*

Respiratory viruses, such as severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus, and seasonal influenza, are responsible for substantial cases of severe illnesses and death. For example, seasonal influenza epidemics result in approximately 3 to 5 million cases of severe illness and 290,000 to 650,000 respiratory deaths annually. Front-line workers can be particularly at risk for respiratory viruses; however, determining the size and viability of bioaerosols containing respiratory viruses remains a challenge. Although collecting airborne-virus genetic material is relatively straightforward, determining whether a bioaerosol contains viable virus is much more challenging because viruses can become inactive during sampling. In this study we use a novel instrumentation, the biocasade-viable virus aerosol sampler (BC-VIVAS), to understand the frequency, the size, and the viability of three respiratory viruses (influenza A, influenza B, and SARS-CoV2) in hospital settings. The BC is a 3-stage planar cascade impactor that gently collects airborne particles through impaction into a liquid medium. It separates aerosol samples into three size fractions, > 10 µm, 4 - 10 µm, and 1.5 - 4 µm. The VIVAS collects aerosols using laminar-flow water condensation to enlarge and collect aerosols smaller than 1.5 µm in diameter (when integrated with the BC), which are then captured in a liquid medium. We collected aerosol samples during the winter influenza/SARS-CoV2 season of 2024/2025 in four locations: 1) the dental school patient bay (with 40 patient chairs and numerous aerosol-generating procedures), 2) the medical intensive care unit, 3) the pulmonary unit, and 4) the waiting room of the emergency department. The preliminary results show that approximately 10% of the samples from the pulmonary unit and emergency department contained genetic material for SARS-CoV2 or influenza A or B. All of the genetic material occurred in the same size bin. The samples are currently being analyzed for cytopathic effects, and we anticipate discussing the viability results during this presentation.

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8BA.2

Weekly HVAC Filter Surveillance of Respiratory Viruses in University Settings: Linking Viral Loads to Airborne Viral Concentrations and Infection Risk. ZHOUYUAN WANG, Liang Zhao, Irene Xagoraraki, Kaisen Lin, *Michigan State University*

As COVID-19 transitions from a pandemic to an endemic disease, monitoring its presence in public spaces remains essential for effective public health management. Traditional clinical testing is increasingly limited by reduced participation and underreporting due to widespread home testing, highlighting the need for complementary surveillance tools, especially in high-occupancy indoor environments such as university buildings. Our previous study evaluated the potential of HVAC filters for SARS-CoV-2 detection through monthly dust collection and RT-ddPCR analysis. SARS-CoV-2 RNA was detected in 28-86% of pre-filter and 17-50% of final filter samples across different air handling units (AHUs), with significant variation among AHUs.

To capture community transmission trends with higher time resolution, we implemented weekly sampling between February and March 2025 and expanded detection targets to include other respiratory viruses, such as Influenza A. During this period, we concurrently monitored room occupancy and HVAC operational parameters (supply, return, and outdoor airflow rates) to evaluate their influence on viral loads on filters. Furthermore, we aim to estimate the fraction of virus-laden particles released by infected individuals that are captured by HVAC filters, considering particle deposition on indoor surfaces. This will enable estimation of time-averaged airborne viral concentrations and allow infection risk assessment through quantitative microbial risk assessment (QMRA).

Overall, our findings demonstrate that HVAC filter-based surveillance is a practical, non-invasive strategy for ongoing respiratory virus monitoring in non-healthcare settings. By leveraging existing building infrastructure, this approach supports data-driven public health responses during the endemic phase of COVID-19 and beyond.

8BA.3

Measurement of Airborne Respiratory Viruses Using an Electrostatic Particle Concentrator and Paper Immunosensors in Laboratory and School Environments. JAEGIL LEE, Chanhwi Park, Wonyoung Jeon, Jaesung Jang, *Ulsan National Institute of Science and Technology(UNIST)*

Airborne transmission of respiratory viruses poses significant public health risks, particularly in indoor environments. The COVID-19 pandemic has revealed that aerosol transmission is a major route of infection. Since airborne viruses typically exist at low concentrations, effective detection necessitates air samplers with high concentration and analysis instruments with a low limit of detection (LOD). An electrostatic sampler exhibits high collection efficiency across a wide range of particle diameters and can enrich collected airborne particles via small collection area and collection liquid volume.

In this study, we evaluated the collection and detection of three types of respiratory viruses—human adenovirus (HAdV), respiratory syncytial virus (RSV), and influenza A H1N1 virus (IAV)—using a laboratory-developed high-flow, high-collection-efficiency electrostatic particle concentrator (HEPC) in combination with paper-based electrochemical immunosensors. The HEPC operated at 40 L/min with different sampling durations (20, 40, and 60 minutes), and the collected viruses were measured using both the lab-made paper-based electrochemical immunosensors and RT-qPCR. The sensors achieved the LOD ranging from 202 to 5211 copies/m^3, depending on the viral protein target.

Based on the laboratory results, we conducted airborne virus monitoring in classrooms, cafeterias, and corridors of two elementary schools for 11 days in March and April 2025. On-site detection was performed with the immunosensors immediately after virus collection, and RT-qPCR was conducted in laboratory for validation. The results identified six virus-positive samples—three positives for HAdV, one for RSV, and two for IAV.

This monitoring platform demonstrated efficient air sampling in large indoor spaces, maintained acceptable operational noise levels (<50 dB), and enabled rapid (40-min sampling and 30-min detection) and cost-effective detection. This platform holds the potential for a rapid, field-deployable tool for airborne virus surveillance in future outbreaks and pandemic scenarios.

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8BA.4

Detailed Physical and Chemical Characterization of Respiratory Aerosol: Implications for Airborne Viral Viability.

RYAN DAVIS, Paul Tumminello, Andres Sanchez, Samantha Kruse, Stephen House, Monica Manginell, Jesse Cahill, Nisha Duggal, Linsey Marr, George Bachand, *Sandia National Laboratories*

Respiratory aerosol particles are chemically complex and include various salts and biomolecules. This chemical composition can vary across individuals and origins in the respiratory tract. Respiratory particles can also promote disease transmission by carrying viable pathogens from host to host. The chemical composition of these particles can influence the viability of embedded pathogens. As respiratory particles are exposed to the ambient environment, the chemical species can undergo humidity-induced phased transformations, altering the physical properties of the local environment that a pathogen is exposed to in the aerosol particle. Understanding and characterizing the chemical and physical properties of respiratory particles is thus important for predicting and understanding the viability of pathogens. Here, we discuss efforts to characterize the humidity-dependent phase transformations and chemical composition of model and real respiratory particles. We have characterized phase transformations using a dual-balance electrodynamic trap, where different morphologies can be identified based on optical and rheological properties of particles, and cryogenic electron microscopy imaging. Chemical composition has been characterized using mass spectrometry, cryo-electron energy loss spectroscopy, and atomic force microscopy with embedded infrared spectroscopy. Implications for viral viability and disease transmission will be discussed.

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8BA.5

Loss of Infectivity of Influenza Virus During Aerosol Sampling.

JIN PAN, Nisha Duggal, Seema Lakdawala, Meher Sethi, Nahara Vargas Maldonado, Vedhika Raghunathan, Anice Lowen, Linsey Marr, *Virginia Tech*

Our understanding of transmission of influenza virus and other respiratory viruses is limited by the ability to detect infectious virus in aerosol particles. In environmental samples, viral RNA is often recovered, but infectious virus has rarely been detected. Most aerosol sampling methods are believed to contribute to virus inactivation, but the magnitude of this sampling artifact is unknown. To investigate this question, we aerosolized influenza A virus suspended in human saliva into a small chamber. Aerosols were allowed to settle for 10 min onto either Madin-Darby canine kidney (MDCK) cells or a thin layer of Minimum Essential Medium (MEM) in Petri dishes. The sample in MEM was immediately transferred to MDCK cells. Aerosols that deposited directly onto cells led to the formation of ~100 plaques per dish. In contrast, aerosols that deposited first onto MEM led to the formation of only 0-2 plaques. Further experiments ruled out uneven aerosol distribution in the chamber or inefficient virus recovery as causes for this discrepancy. These findings indicate that aerosolized influenza A virus lost infectivity by approximately 2 $\log_{10}$ plaque forming units (PFU) within ~10 min unless it attached to cells quickly. As natural infection via inhalation occurs by direct deposition of virus onto cells, we hypothesize that sampling directly onto cells more accurately reflects the potential for exposure to lead to infection, whereas traditional aerosol sampling methods result in underestimation of the risk. In future work, we will evaluate the loss of infectivity of virus after deposition onto other collection substrates, such as agar and gelatin. We will also compare influenza virus to other respiratory viruses, such as SARS-CoV-2, to test our hypothesis.

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8BA.6

Comparing the Impacts of Aerosolization and Sampling Techniques on the Structural Integrity and Antigenicity Retention of Influenza A Virus-Like Particles. YUEZHI (AUGUST) LI, Ananya Benegal, Joseph V. Puthussery, Shu-Wen You, Michael Vahey, Rajan K. Chakrabarty, *Washington University in St. Louis*

Laboratory experiments to study respiratory virus aerosols rely on the rigor and reproducibility of aerosolization and sampling techniques. Conventional techniques could compromise on the viral structure and antigenicity, particularly for pleomorphic viruses like influenza A (IAV), yet very little information is available on this issue. Here, we evaluate three aerosolization methods (Collison, Blaustein Atomization Modules (BLAM), and jet nebulizers) and three bioaerosol samplers (liquid spot sampler (LSS), wet cyclone, and SKC BioSampler) for their efficiency in retaining the structural stability and antigenicity of filamentous IAV Virus-like particles (VLPs). VLPs provide a safe and practical alternative for studying highly pathogenic airborne viruses. The BLAM and jet nebulizers maintain 12–21% of filamentous structures, whereas the Collison nebulizer, which generates higher shear stress, reduces filament recovery to ~10%. The liquid spot sampler (LSS),owing to gentle, condensation-based sampling technique, retains approximately 30% of filamentous VLPs. The SKC BioSampler and wet cyclone sampler cause greater structural disruption due to higher shear stress and impaction forces and retains ~10% and ~7% of filamentous VLPs, respectively. Higher relative humidity (85%) improves filament retention by ~20% compared to dry conditions (25% RH). The antigenicity of Neuraminidase (NA), which is a surface protein responsible for viral release, exhibited a distinct binary loss. Between 30 and 40% of VLPs showed undetectable NA signal post-aerosolization, indicating greater susceptibility to structural degradation. These results point to the necessity of improving upon contemporary aerosolization and sampling strategies to characterize airborne filamentous viruses in controlled laboratory environments more accurately.

8BA.7

Impact of Carbon Dioxide and Relative Humidity on the Viability of Airborne E. coli and Bacteriophage MS2. Haocheng Sun, KAISEN LIN, *Michigan State University*

Understanding the survivability of airborne pathogens is essential for elucidating the transmission of respiratory infectious diseases. While environmental factors such as temperature, relative humidity (RH), and aerosol chemical composition have been extensively studied, the influence of indoor air constituents, particularly those in constant contact with pathogen-laden aerosols, remains underexplored. Among these, carbon dioxide (CO_2) is of special interest, as elevated indoor CO_2 levels often indicate high occupancy and/or poor air ventilation, conditions associated with increased infection risks. CO_2 can partition into aerosols, potentially altering aerosol pH. Previous studies have shown that aerosol pH significantly influences the stability of embedded pathogens. Thus, CO_2 may play a critical role in airborne pathogen inactivation. In this study, we investigated the impact of CO_2 concentration on the viability of airborne bacteria Escherichia coli (*E. coli*) and bacteriophage MS2 using a rotating drum system. Experiments were conducted at CO_2 levels of 450, 1000, and 5000 ppm to simulate indoor environments with varying occupancy and ventilation. RH conditions of 25%, 50%, and 75% were used to represent dry, intermediate, and humid indoor environments, respectively. Microbial inactivation was assessed by comparing viability before and after 1-hour aerosol aging. *E. coli* showed increased survival with higher RH, whereas MS2 exhibited decreased viability. Overall, elevated CO_2 levels demonstrated a protective effect on both microbes. Notably, at 75% RH, both 1000 and 5000 ppm CO_2 significantly enhanced the viability of *E. coli* compared to ambient CO_2 condition. The protective effects on MS2 were RH-dependent. The most pronounced enhancement in MS2 viability occurred at 5000 ppm CO_2 under low RH (25%), whereas at higher RH levels, viability peaked at 1000 ppm CO_2. Ongoing work is examining microbial survival in mucin-supplemented aerosols to better mimic human saliva. These findings offer new insights into how CO_2 affects the fate of airborne pathogens.

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8BQ.1

Ambient Air Quality Impacts During and After the 2025 Los Angeles Wildfires. PROVAT SAHA, Christopher Lim, Yumeng Cui, Steven Boddeker, Joseph Salazar, Zihan Zhu, Julia Montoya-Aguilera, Mohammad Sowlat, Payam Pakbin, Andrea Polidori, Jason Low, *South Coast Air Quality Management District*

The January 2025 Eaton and Palisades fires in Los Angeles County were some of the most devastating urban-wildland interface wildfires in California's history. There is significant concern from both the public and the research community regarding the air quality impacts of this event—particularly because many older homes were burned, raising concerns about emissions of various air toxics, including arsenic, lead, and asbestos. Air monitoring data from South Coast Air Quality Management District (South Coast AQMD) air monitoring stations and low-cost sensor (LCS) network across the South Coast Air Basin provided a valuable resource for assessing ambient air quality impacts during the fire, as well as the spatial and temporal extent of these impacts. Analysis of data from several stations revealed substantial increases in PM_{10}, $PM_{2.5}$, and several air toxic metals—including lead and arsenic—specifically at locations impacted by the smoke plume. However, within a few days once the smoke generation was over, pollutant concentrations returned to typical background levels. There are also potential air quality impacts during the cleanup and repopulation phases, due to resuspension of dust and ash that may contain air toxic metals and/or asbestos. To assess these impacts, South Coast AQMD conducted mobile monitoring surveys using a multi-metal mobile platform in both burn areas. These surveys enabled rapid, area-wide assessments of air toxics metals concentrations and helped identify potential exposure risks for cleanup workers. Following the mobile surveys, South Coast AQMD established five fixed monitoring sites in the two burn areas to conduct continuous monitoring of PM_{10} and $PM_{2.5}$, as well as time-integrated sampling for analysis of air toxics metals and asbestos. This presentation will discuss the observed air pollution enhancements during the fires, as well as South Coast AQMD's post-fire mobile and stationary air quality monitoring efforts in the affected areas.

8BQ.2

PM Exposure Associated With Burned Buildings During the Los Angeles Wildfires in 2025. MICHAEL KLEEMAN, Sean Raffuse, David T. Allen, Yosuke Kimura, Colette Schissel, *University of California, Davis*

The wildfires that occurred in Los Angeles during January 2025 were among the most destructive in the history of California. Approximately 57,000 acres burned, consuming more than 18,000 structures and resulting in 30 deaths. The urban nature of the fire generated significant concentrations of toxic compounds in the wildfire smoke, including lead, arsenic, and halogenated compounds associated with burned metals, plastics, and other building materials. The ash and soil within and around the wildfire zones was also enriched in toxic compounds, raising the possibility that debris removal and cleanup over a period of months could expose the ~18M nearby residents of Los Angeles to further levels of toxic air pollution. This presentation will predict air pollution exposures during both the active burning phase and cleanup phase of the wildfire using a source-oriented chemical transport model (CTM). During the burning phase, the spatial distribution of fire emissions were based on detailed, high resolution inventories of structures, structure contents and vegetation. The temporal evolution of the burned area was based on satellite observations. Emissions from specific regions and burn times were tracked. The fire emissions are combined with other air pollution emissions to predict how the emissions age in the atmosphere. During the cleanup phase, measured size and composition distributions of dust generated in the burned zone will be used to model deposition rates for different toxic compounds contained in the PM. The ability of the CTM to reproduce measured PM concentrations during and after the wildfire event will be evaluated. Tagging features within the CTM will be used to quantify wildfire contributions to ambient PM separated from other sources. Wildfire contributions to ultrafine, fine, and coarse particle PM will be discussed. Finally, population exposure and relative risk associated with burning natural vegetation vs. burning buildings will be presented.

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8BQ.3

Real-Time Trace Element Insights from ASCENT During the 2025 Los Angeles Urban Wildfires. HAROULA D. BALIAKA, Ryan Ward, Sean Raffuse, Can Barut, Armistead G. Russell, Bradley Ries, Yumeng Cui, Roya Bahreini, Eleanor Bentley, Lelia Hawkins, David Hagan, John Seinfeld, Paul Wennberg, Richard Flagan, Nga Lee Ng, *California Institute of Technology*

Urban wildfires are an emerging air quality threat across the western United States, and real-time chemical composition data of urban fire plumes are vital for evaluating health impacts. The Eaton Canyon (Altadena) and Palisades firestorms in Los Angeles, which ignited in January 2025, led to widespread combustion of synthetic materials, raising concerns about the toxicity of the fine particulate matter. Real-time, high-resolution measurements from the Los Angeles Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT) site in Pico Rivera (14 miles downwind of Altadena) captured the plume, during which certain elements exhibited enrichment ratios far above background levels, with sharp spikes observed for Cl, Br, and certain metals such as Pb. Positive Matrix Factorization (EPA PMF v5.0) source apportionment was applied to disentangle background levels from fire-related enhancements and to identify distinct chemical fingerprints associated with the combustion of urban materials. To assess regional impacts, we integrated data from Caltech and additional ASCENT sites in Rubidoux, Riverside, and Joshua Tree into a spatial modeling framework.

8BQ.4

Metals in Wind-Dispersible Dust and Ashes During and After the 2025 Los Angeles Fires. JING LI, Yuan Yao, Haoxuan Chen, Qiao Yu, Priscilla Boo, Yifang Zhu, *University of California, Los Angeles*

The 2025 Los Angeles (LA) wildfires, which began on January 7 and were contained by January 31, ranked among the most destructive in California's history. These fires were notable for their proximity to densely populated Wildland-Urban Interface (WUI) areas. The Palisades Fire and Eaton Fire together destroyed 18,000 structures, potentially releasing large amounts of metals into the environment. Few studies have characterized the metal content in wind-dispersible dust and ashes. We collected 70 dust and ash samples from the areas surrounding the Palisades and Eaton fires in LA County over three periods: January (January 14-25, n = 32), February (February 10-11, n = 14), and March (March 9, 10, and 27, n = 24). All samples were collected using anti-static brushes onto weighing papers from surfaces such as mailboxes, windowsills, benches, and tables. We measured concentrations of 16 metals including lead (Pb), cadmium (Cd), and chromium (Cr) in these samples in ng/mg (ppm). Preliminary results showed that, taking Pb as an example, 8/33 samples from Eaton and 4/37 samples from Palisades exceeded the EPA screening level for Pb in soil (200 ppm). Samples from different periods showed significantly different Pb concentrations, with February (98 [47] ng/mg, median [IQR]) > January (51 [174] ng/mg) > March (49 [75] ng/mg) (ANOVA on Ranks, p = 0.033). Samples from the area impacted by the Eaton Fire (mostly Altadena and Pasadena communities, n = 33) had significantly higher concentrations than those from the Palisades Fire (mostly Pacific Palisades and Malibu communities, n = 37) (Mann-Whitney Rank Sum Test, p = 0.034), with the former at 74 [163] ng/mg and the latter at 47 [62] ng/mg. Ongoing analysis will explore spatial and temporal trends in other metals to better understand potential risks attributed to WUI fires on human and environmental health.

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8BQ.5

Particulate Matter Composition and Sources in the Urban-Wildland Interface After the 2025 Southern California Wildfire. CHUN-YING CHAO, Albert Kyi, Katarina Konon, Shihao Zhai, Chou-Hsien Lin, Evelyn Deveraux, Anna Neville, Daniel Sung, Pawel K. Misztal, David T. Allen, Lea Hildebrandt Ruiz, *University of Texas at Austin*

The 2025 wildland-urban interface (WUI) wildfire in Southern California (Eaton and Palisades Fire) burned over 37,000 acres and destroyed more than 15,000 homes and structures. The WUI wildfire extended into suburban and urban neighborhoods and resulted in complex pollutants from combustion fueled by vegetation, buildings, and vehicles. The impact of WUI wildfire residuals, such as ash and burned houses, on aerosol loading and chemical composition is still unclear.

To better understand the post-impact of WUI wildfire across Los Angeles County, this study (1) investigates the spatiotemporal chemical characteristics of aerosol and (2) identifies the source of organic aerosol (OA) using positive matrix factor (PMF). We deployed an Aerodyne high-resolution time-of-flight aerosol mass spectrometer in the mobile air quality lab to investigate in-situ aerosol composition after the WUI wildfire in Los Angeles from February 3 to 24. Mobile measurements were conducted in fire-affected neighborhoods with varying levels of impact, and indoor and outdoor stationary sampling was conducted in selected homes with different degrees of wildfire damage. In addition to the HR-ToF-AMS, a Vocus proton-transfer-reaction time-of-flight mass spectrometer (PTR-TOF-MS), a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS), an aethalometer, and a Toxic-Metal Aerosol Real-Time Analysis (TARTA) were deployed in the same mobile platform to comprehensively measure the impact of WUI wildfire.

PMF analysis identified five OA factors: hydrocarbon-like OA (HOA), less-oxygenated OA (LO-OOA), more-oxygenated OA (MO-OOA), cooking OA (COA), and nitrogen-containing OA (NOA). In previous studies, the NOA factor was found to be associated with combustion activities. Its mass spectrum profile showed substantial contributions of CO_2^+ signal (m/z 44), suggesting that this factor could be attributed to secondary OA (SOA) formation from wildfire combustion. The results indicate that the residual of WUI wildfire may potentially serve as a persistent post-fire source of SOA and impact long-term air quality.

8BQ.6

Fine and Ultrafine Particle Emissions and Dynamics in the Burn Zone Following the 2025 Los Angeles Fires. HAOXUAN CHEN, Qiyue Nie, Jing Li, Yuan Yao, Qiao Yu, Muchuan Niu, Vine Blankenship, Haroula D. Baliaka, Richard Flagan, Nga Lee Ng, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Yifang Zhu, *University of California, Los Angeles*

The increasing wildland-urban interface (WUI) fires pose complex challenges for air quality and public health due to their distinct aerosol emission characteristics. Even after full containment, WUI fire zones may continue to impact local air quality through persistent emissions from smoldering debris, ash resuspension, and post-fire cleanup or rebuilding activities. Yet, the characteristics and dynamics of fine aerosols in these post-fire environments remain poorly understood.

Following the full containment of the Eaton Fire, we conducted mobile and stationary aerosol measurements in the burn zone over multiple days during Phase 1: Hazardous Material Removal in February and Phase 2: Debris Removal in March of the Emergency Response. An electric vehicle platform equipped with multiple real-time aerosol instruments—including a condensation particle counter, DustTrak aerosol monitor, scanning mobility particle sizer, and aerodynamic particle sizer—was deployed to monitor particle concentrations and $PM_{2.5}$ mass concentrations, as well as particle size distributions spanning 13 nm to 20 µm. Compared to measurements at the ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) Pico Rivera site which is located approximately 20 km away, we observed distinct patterns of fine aerosol emissions and dynamics in the burn zone. Particle concentrations more frequently exceeded 1×10^4 particles/cm^3, with a dominant mode between 10–30 nm, suggesting primary aerosol emissions. Evidence of particle growth was also observed, likely driven by secondary formation mechanisms from abundant semi-volatile organic compounds. In addition, a submicron particle mode (0.5–1 µm) was frequently detected and associated with elevated $PM_{2.5}$ levels.

These findings highlight the complex and evolving nature of post-fire aerosol pollution in WUI fire zones, with implications for community exposure during ongoing cleanup and rebuilding activities. Our results underscore the importance of continued monitoring to better characterize exposure risks and inform post-fire air quality management strategies.

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8BQ.7

Post-Wildfire Indoor Pollution in WUI Areas: Establishing Baseline Contaminant Levels Before Home Reoccupation.
EHSAN GOFTARI, Hanyang Li, *San Diego State University*

As urban areas continue to expand, more people are living in or near wildland regions, known as the Wildland-Urban Interface (WUI), which has significantly increased communities' exposure to WUI fire hazards. To characterize toxic emissions and environmental concentrations in homes impacted by the 2025 WUI fires in Los Angeles (Eaton and Palisades fires), we performed a combination of indoor air quality measurements of particulate matter, black carbon, total volatile organic compounds, speciated toxic metal particulates using TARTA, and outdoor PM concentrations, as well as collecting wipe samples from indoor floors and surfaces contaminated with ash and soot. Following the fire, the homes located next to a burned structure had higher indoor concentrations of $PM_{2.5}$ (average of 6.48 $\mu g/m^3$), PM_{10} (average of 102.86 $\mu g/m^3$), and black carbon (average of 774 ng/m^3) than homes farther away from the fire or those that had been professionally cleaned. In terms of airborne metals, the average indoor concentrations of iron and copper over all the sampled homes were 60.59 and 3.92 ng/m^3, respectively. Most metals were either below U.S. EPA reference inhalation concentrations or below the detection limits of our instrument. While airborne metal levels were not high, the wipe samples revealed elevated concentrations of toxic metals, especially lead. In 75% of sampled homes, surface lead levels were above the EPA's safety limit of 5 $\mu g/ft^2$. These findings offer important data as indoor dust particles can be resuspended and become airborne during cleaning and remediation activities and pose risks to human health. The current phase of this study involves distribution of nearly 150 Airthings indoor PM sensors to the homeowners in fire-affected areas to continuously examine air pollutant dynamics throughout the post-fire recovery timeline during re-entry and reconstruction, as well as the long-term persistence of indoor contamination.

8DA.1

Integrated Screening Techniques Reveal Insight into Non-Traffic Emissions Sources.
Michelle S. Hui, JINTAO GU, Timothy Baker, Mohammed I. Mead, K. Max Zhang, *Cornell University*

Distributed air quality monitoring networks using low-cost sensors (LCS) promise to empower policymakers and citizens to enhance air quality management by developing tailored interventions. However, relatively few studies have investigated how to extract information on emission sources from citywide, fixed-site LCS networks, especially in terms of non-traffic sources. Commonly measured NO_2 concentrations are mostly indicative of traffic sources and $PM_{2.5}$ concentrations usually exhibit low diurnal variability. In this paper, we present an innovative, scalable screening method to acquire hyperlocal insight into non-traffic emission sources. This method integrates network analysis and peak analysis. Network analysis leverages the statistical power of the sensor network to compare data at a monitoring location to its peers within the network to identify hotspots driven by local sources rather than regional or meteorology-driven events. Peak analysis resorts to clustering on concentration spikes above the background values, reducing the influence of high background concentrations and low diurnal variability and emphasizing the impact of local emission sources. We demonstrate the capability of the proposed integrated screening techniques in identifying the influence of construction and nighttime cooking activities in the Greater London area without prior site-specific knowledge.

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8DA.2

Deploying a Comprehensive Air Quality Sensor Network in Elizabeth, NJ: Insights and Early Findings. GEDIMINAS MAINELIS, Catherine J. Hart, Jennifer Senick, Jackie Park-Albaum, John Evangelista, Clinton J. Andrews, Jie Gong, Sunyoung Kim, Abigail Andrews, Holly Josephs, Vijay Maddila, Deborah Plotnik, Jenna Myers, Yitong Li, Ge Gao, Carmen Rosario, Phaneendra Sivangula, Yousaf Shahid, *Rutgers, The State University of New Jersey*

The detrimental health effects of ambient air pollution, particularly in disadvantaged communities, are well-documented. This has ignited interest among local environmental groups and residents in enhancing local air quality monitoring and disseminating this information to the community. This presentation focuses on the City of Elizabeth, NJ, a community with elevated air pollution levels that is encircled by a major international airport, a shipping port, a petrochemical refinery complex, and a major highway.

With funding from the US EPA and NSF, a partnership between the Housing Authority of the City of Elizabeth (HACE), Groundwork Elizabeth (an NGO), and Rutgers University established a network of thirteen QuantAQ air quality monitors throughout the City of Elizabeth in 2024. The network monitors particulate matter (PM), ozone, and other gaseous criteria pollutants. A newly developed community dashboard displays air pollution data in HACE properties and provides actionable tips for residents to respond to air quality and thermal stress conditions. The outdoor network is supplemented by 23 indoor monitors (AirVisual) in participating households. At least one monitor of each type is collocated with the closest US EPA monitoring station.

The air quality data collected over approximately a year show variability among the monitoring stations, reflecting local and localized sources of air pollution. Average $PM_{2.5}$ concentrations were about 15 $\mu g/m^3$, with spikes reaching as high as 150 $\mu g/m^3$. Ozone concentrations measured by QuantAQ had a correlation coefficient of ~0.85 compared to the reference instruments but maintained a 10-20 ppb positive offset during nighttime hours. Indoor $PM_{2.5}$ concentrations varied considerably (3 – 300 $\mu g/m^3$ during a typical day), reflecting participants' cooking and lifestyle habits, e.g., smoking.

In addition to discussing the observed air pollution data in the city of Elizabeth, this presentation will highlight the lessons learned during the installation and information dissemination from the network.

8DA.3

Agent-Based Framework for Modelling Hyperlocal Air Quality in Urban Spaces. SATHISH SWAMINATHAN, Raghunathan Rengaswamy, V. Faye McNeill, *Columbia University*

Understanding and managing air quality at hyperlocal scales is crucial for public health, environmental justice, and smart urban planning. Conventional modeling approaches fall into two groups: first principles-based transport models, which are highly accurate but computationally intensive, and empirical models, which are efficient but often lack grounding in the fundamental physics of pollutant behavior. We introduce a novel multi-agent framework that bridges these paradigms by incorporating data-driven learning rooted in fundamental physics. The architecture leverages agent-based modeling to represent heterogeneous urban elements and behaviors, while maintaining a physically consistent core through mass conservation principles. The framework leads to an intelligent system capable of descriptive, predictive, and prescriptive environmental analytics. It is capable of assimilating real-world data to derive insights, make predictions, and inform interventions. By achieving a balance between computational efficiency and physical fidelity, this hybrid framework enables scalable and responsive air quality assessment at street-level granularity. This work details the development of the framework, including its physical and computational structure, and showcase its descriptive, predictive and prescriptive abilities. Hyperlocal mobile monitoring data for $PM_{2.5}$ from Chennai, India is used to demonstrate the framework. The results show the framework's potential for enabling context-aware, high-granularity air quality decision support systems in rapidly evolving urban environments.

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8DA.4

High-Resolution $PM_{2.5}$ Exposure Analysis in Africa: Assessing Long Term Trends for Effective Air Quality Management. PAA SEY, Paulina Jaramillo, Albert Presto, *Carnegie Mellon University*

Fine particulate matter ($PM_{2.5}$) poses significant public health risks globally, with particularly severe impacts across Africa due to elevated exposure. Chronic exposure substantially increases cardiovascular and respiratory disease burdens, contributing to approximately 1.1 million deaths annually across the continent. Despite an urgent need for robust air quality assessments, limited ground-level monitoring infrastructure hinders effective policy development and mitigation efforts. To address this gap, we developed a hybrid modeling approach that spatially downscales $PM_{2.5}$ from NASA GEOS-CF chemical transport model from 0.25 ° by 0.25 ° resolution (~25 km) to 0.01 ° by 0.01 ° resolution (~1 km). Our method integrates satellite-derived atmospheric measurements and high-resolution spatial covariates, including land use and vegetation indices, using a Random Forest regression. Our validation demonstrates high accuracy in capturing large-scale (0.25 ° resolution) variations, with cross-validation R^2 scores between 0.93 and 0.96, and strong spatial invariance (R^2 = 0.79-0.93) demonstrating native efficacy in fine-scale estimates (0.01 ° resolution). Annual $PM_{2.5}$ concentrations were analyzed across Africa, comparing locations with proactive air quality management policies to those lacking significant interventions. Population-weighted $PM_{2.5}$ exposure analysis between 2019 and 2024 reveals substantial reductions, particularly in countries with structured air quality management. For example, Ghana and Ethiopia saw substantial decreases in exposure, from 57.3 $\mu g/m^3$ to 30.9 $\mu g/m^3$ and from 26.7 $\mu g/m^3$ to 15.6 $\mu g/m^3$, respectively. In contrast, countries without structured interventions, such as Niger and Chad, exhibited smaller improvements. These findings highlight the effectiveness of targeted air quality initiatives and underscore ongoing disparities in pollution exposure across the continent. Our high-resolution modeling approach provides critical insights for policymakers, emphasizing achievable improvements through proactive air quality management and identifying regions urgently needing targeted interventions to sustainably enhance public health outcomes across Africa.

8DA.5

Leveraging Satellite Measurements, Surface Monitors, and Machine Learning for Estimating 20 Years of High-Resolution Gridded $PM_{2.5}$ in Ghana. ABHISHEK ANAND, Joe Adabouk Amooli, Daniel Westervelt, *Columbia University*

Exposure to air pollution is the second leading cause of death worldwide. This risk is dominated by exposure to fine particulate matter ($PM_{2.5}$). The risk is more critical in low- and middle-income countries, like those in sub-Saharan Africa, due to a lack of air pollution data to build effective policies. The data scarcity is attributed to the lack of resources for research-grade equipment. Our work addresses this critical gap in understanding air pollution and its health impacts in Ghana. We are utilizing freely available retrievals of aerosol optical depth, gas-phase pollutants, atmospheric optical properties and weather parameters from the NASA and European satellites for training various machine learning (ML) models to estimate 20 years (2005 - 2024) of daily surface $PM_{2.5}$ concentrations at 1km × 1km spatial resolution. The $PM_{2.5}$ values are validated against measurements (2018 - 2024) from a well-calibrated network of 106 reference monitors and low-cost sensors spread across Ghana, established through years of active efforts and collaborations with local partners. We found that a fully connected neural network (RMSE ~ 6.4 $\mu g/m^3$, R2~0.84) outperforms notable linear and ML models including LASSO (RMSE ~ 8.2 $\mu g/m^3$, R2~0.69), and eXtreme gradient boosting (RMSE ~ 6.8$\mu g/m^3$, R2~0.78) in estimating high-resolution gridded $PM_{2.5}$ in Ghana. The SHapley Additive exPlanations analysis shows that wind speed and total precipitation from European ReAnalysis 5, and absorbing aerosol index, and ozone from the TROPOspheric Monitoring Instrument to be the key features contributing to model accuracy. Our study stands to be one of the first in Africa to use advanced modeling techniques to generate actionable pollution data, with potential for expansion to other countries in sub-Saharan Africa. The dataset will be available through an open-access platform for local stakeholders to guide policy decisions targeting air pollution-related health and socioeconomic inequities for underserved populations.

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8DA.6

Predicting Current and Future Concentrations of Biogenic Aerosol Precursors Using Machine Learning and Detailed Chemical Modeling. SINA TAYYEBI NIA, Nazifa Sayeed, Namrata Shanmukh Panji, Chenyang Bi, Gabriel Isaacman-VanWertz, *Virginia Tech*

Natural biogenic and anthropogenic sources continuously emit reactive volatile organic compounds (VOCs) into the atmosphere, where they undergo oxidation to form oxygenated VOCs and secondary organic aerosol (SOA). Quantifying their concentration and chemical composition is crucial for constraining the formation pathways and loadings of secondary aerosols. Using ~5 years of in-canopy concentration measurements from a tower at a mixed-forest site in central Virginia, we examine discrepancies between modeled emissions and real-world observations of concentrations. We apply machine-learning approaches (Random Forest, feature importance) (i) uncover seasonal and regime-specific patterns in the measurement record, (ii) train predictive models for individual biogenic VOC species, and (iii) identify specific environmental drivers that current emissions models may not fully capture. Perhaps unsurprisingly, with sufficient training data, machine-learning models outperform these conventional mechanistic approaches in predicting VOC concentrations; we use this model to examine the ability to predict future periods beyond the training data set and examine differences between mechanistic and machine-learning models. Permutation and feature importance analyses reveal that the variables explaining VOC variability in our measurements are not entirely captured by conventional emissions and chemistry models (e.g., the importance of humidity and soil parameters is higher than expected for certain VOCs). To understand the impacts of these discrepancies on aerosol formation, we are implementing the SAPRC MechGen mechanism generator in an automated way into a 0-d dimensional box model alongside dry- and wet-deposition modules to include a far larger array of chemical pathways and aerosol precursors than previously possible. This addition improves detailed modeling of the impacts of changes in emissions and will enable studies of future emission scenarios, as well as the impact of meteorology on multi-generational chemistry.

8DA.7

Quantifying Aerosol Deposition Under Non-standard Environmental Conditions: Combined Experimental Measurement and Computational Modeling Techniques. REN GARITY, James Henry, Moein Mousavi, Andrew Metcalf, Prasad Rangaraju, John Saylor, *Clemson University*

Currently, there remains a lack of data on aerosol deposition under “non-standard” environmental conditions, which include extremes of temperature gradients, humidity gradients, and/or changes in flow turbulence. This talk will address the use of data assimilation and surrogate modeling to evaluate aerosol deposition mechanisms under non-standard conditions, specifically in the case of a physical lab-scale model of a spent nuclear fuel dry storage cask (SNF DSC) system. As aerosol deposition in this system can result from a combination of non-standard environmental conditions, a combination of experimental measurement and computational modeling is being employed to quantify deposition and isolate the effects of specific mechanisms. The mechanisms of interest being investigated include thermophoresis, turbophoresis, turbulent dispersion, Saffman lift, and Stefan flow.

We will present an overview of the design of the lab-scale SNF DSC and physical deposition experiments, detailing our use of surrogate modeling through dimensional similitude used to replicate conditions in a full-scale cask. Additionally, we will display the use of computational modeling for evaluating correlations between environmental conditions and deposition. Finally, as our goal is to understand the causes of deposition in this system, we will discuss how statistical analyses are being employed to isolate effects of individual mechanisms, furthering understanding of which mechanisms dominate in non-standard systems.

Alone, either physical measurements or computational modeling place limitations on the conclusions that can be drawn regarding aerosol deposition in non-standard systems. Rather than making associations, we will discuss how our work aims to bridge the gap between experimental and computational results by using statistical comparisons as a data assimilation tool. Significance and effect size provide a way to determine the magnitude of interactions, while linear regressions allow for isolating effects of individual mechanisms. In this way, we aim to advance understanding of aerosol deposition and provide meaningful constraints on the findings.

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8ES.1

TARTA: A Portable, Inexpensive Instrument for Real-Time Detection of Airborne Metal Particulates. BRENDA LOPEZ, Ehsan Goftari, Evan Gittings, Junbeom Jang, Christopher Wallis, Anthony S. Wexler, Hanyang Li, *San Diego State University*

Metal particulates in the atmosphere, emitted from various sources such as traffic, industrial processes, road dust, and waste burning, pose serious health risks, including respiratory diseases, cancer, and developmental effects. These metals are often present at low concentrations, making real-time detection challenging. Reliance on expensive, complex instrumentation creates barriers for widespread deployment and monitoring, particularly in communities living near major pollution sources. To address this gap, we developed the Toxic Aerosol Real-Time Analyzer (TARTA), which is an inexpensive and portable instrument for the detection and quantification of metal particulates. Following the successful development and field testing of TARTA 1.0, we introduce TARTA 2.0, featuring major hardware and usability enhancements: a reduced footprint (8” × 10”), lower weight (~6 lbs), a larger ground electrode, simplified optics, battery operation, improved limits of detection, and a touch-screen user interface. TARTA 2.0 has been deployed across diverse environments, including environmental justice communities, wildfire-affected regions (Eaton and Palisades fires), tire/brake wear and waste burning studies, and marine settings near the Tijuana River sewage outflow. Currently, we are developing TARTA 3.0, which incorporates a vacuum-enclosed spark system to enhance particle collection and sensitivity.

In this instrument exhibition, we will provide a hands-on demonstration of the latest hardware and software upgrades of TARTA. We will walk through the operation procedures, data visualization workflow, and demonstrate how to replace the electrodes (the only parts that need maintenance every few months) in just a few minutes. We will also showcase two graphical user interface modes of TARTA: Community Mode for user-friendly operation and Expert Mode for more advanced use. In addition, we will discuss possible field-deployment challenges and how we can address them based on the lessons we learned. Feedback on TARTA’s design, interface, and deployment strategies is welcomed to guide its continued development.

8ES.2

A Trace-Element Mass Spectrometer for Quantifying the Metal and Mineral Compositions of Single Particles in Real Time. Edward Fortner, JOHN JAYNE, Douglas Worsnop, Philip Croteau, Manjula Canagaratna, Alexander Gundlach-Graham, Martin Tanner, *Aerodyne Research, Inc.*

Detailed knowledge of atmospheric aerosol chemical composition continues to be crucial to address air quality impacts on human health and the environment. In the past two decades significant progress has been made using mass spectrometric techniques which have allowed real-time aerosol chemistry measurements, focusing primarily on inorganic and organic aerosol constituents. The capability to chemically characterize and quantify metal and mineral components in atmospheric aerosols, in real-time, at both the single particle and ensemble averaged levels, however, is lacking.

Metals are found across coarse, fine and ultra-fine aerosol particles. They are emitted into the atmosphere by anthropogenic sources such as vehicle emissions, brake and tire wear, biomass burning, and industrial operations. Quantification and speciation of metal constituents allows for improved source apportionment and is of increasing interest in the health community due to the potentially negative health effects of metals. Similarly, detection of metals and minerals in dust and sea salt can be used to identify their sources and to constrain predictions of coarse mode aerosol particles in global models. Coarse mode particles account for a dominant fraction of the global aerosol mass and can contribute significantly to the attenuation of solar radiation as well as impacting human health.

In this presentation we will introduce a new mass spectrometric method that addresses the need for real-time and quantitative measurements of metal and mineral aerosol constituents. The new instrument technology uses a microwave induced plasma coupled with a time-of-flight mass spectrometer to vaporize and ionize particles and detect their elemental compositions. This instrument, referred to as the mipTOF, provides fast, single particle measurement capability which is also able to quantify metal and mineral compositions with sub-femtogram per particle detection limits. We will present instrument operational details, some initial field measurement results and discuss how this new instrument technology fills a void with respect to current mass spectrometric aerosol measurement methods.

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8ES.3

Chemical Characterization and Quantification of Sub-Micrometer Aerosols Using NEMS-FTIR Spectroscopy with EMILIE. NIKLAS LUHMANN, Jelena Timarac-Popović, Tatjana Penn, Johannes Hiesberger, Veljko Vukićević, Mihnea Surdu, Radiance Calmer, Erine Alvino Démolis, Lionel Favre, Hajrudin Bešić, Silvan Schmid, Josiane P. Lafleur, Satoshi Takahama, Julia Schmale, *Invisible-Light Labs GmbH, Austria*

Ultrafine aerosol particles (UFPs <100 nm) play a critical yet poorly understood role in public health and atmospheric processes, largely due to the analytical challenges associated with their low mass and complex composition. Established techniques for aerosol quantification, such as aerosol mass spectrometry, only detect molecular fragments and cannot efficiently measure particles smaller than ~70 nm. In contrast, traditional FTIR lacks the sensitivity for routine analysis at ambient UFP concentrations, with sample collection up to several days. We introduce nanoelectromechanical system-based Fourier-transform infrared (NEMS–FTIR) spectroscopy, implemented in EMILIE™ , as a novel, fast solution for infrared analysis of aerosols down to 10 nm.

EMILIE™ integrates aerosol collection and analysis onto a single nanoelectromechanical chip, circumventing the need for sample transfer and associated artifacts. The enhanced sensitivity of NEMS-FTIR over conventional transmission spectroscopy permits measurements with sampling durations on the order of tens of minutes compared to hours or even several days. A recent study further demonstrated the performance of EMILIE™ for the analysis of nanoplastics such as PS, PP & PVC with detection limits as low as hundreds of picograms [1].

EMILIE™ provides a new capability for high-sensitivity infrared analysis of sub-micrometer aerosols in real-world environments. This presentation will highlight both the underlying technology and its practical deployment for urban and rural aerosol studies [2]. In this showcase, we will introduce the technology behind NEMS-FTIR, discuss recent results from field campaigns, and demonstrate the complete workflow: from aerosol collection using various accessories to spectral acquisition and analysis.

[1] Timarac–Popović, J., Hiesberger, J.,Šesto, E., Luhmann, N., Giesriegl, A., Bešić, H., Lafleur, J.P., and Schmid, S. (2025), Picogram-Level Nanoplastic Analysis with Nanoelectromechanical System Fourier Transform Infrared Spectroscopy: NEMS–FTIR. arXiv preprint 2504.10192, https://doi.org/10.48550/arXiv.2504.10192.
[2] Invisible-Light Labs GmbH (2025), Characterization of sub-micrometer urban aerosols with EMILIE™, Application note.

8IM.1

Measurements of Atmospheric Transport and Convection of Dust for High-Impact Numerical Emission Simulations (MATACHINES). SAMUEL JURADO, Franklyn Telles, Nour Kastoun, Helena Tsigos, Evelyn Keefe, *Yale University*

Dust plays a crucial role in Earth's climate system through direct and indirect radiative forcing, as well as through diverse physical, chemical, and biogeochemical interactions. Emissions from desert drylands—accounting for roughly 75% of global dust—are especially important given that these regions cover 41% of Earth's land surface and are home to nearly a third of the global population. Yet, current models struggle to represent dust emissions accurately, particularly under low-wind conditions where convective processes dominate. This study aims to improve understanding and modeling of convective dust emission processes in arid environments by: (1) directly measuring dry convective dust fluxes under weak wind conditions, (2) quantifying the contributions of moist convective dust storms, and (3) developing a kite-borne system to obtain vertical profiles of dust and meteorological parameters. Fieldwork will be conducted in the summer of 2025 at the Jornada Experimental Range in New Mexico. Here, the flux gradient method will be utilized by combining the sonic anemometer data measured by the Meteorological Sensor Array operated by White Sands Missile Range with 2 DustTrak DRX 8533 aerosol monitors deployed at 2m and 9m heights. During windy periods, a kite system will carry an aerosol monitor, a Kestrel weather meter, and an inertial measurement unit up to 40 meters above ground level to collect meteorological and dust concentration profiles. Measured PM_{10} fluxes will then be used to parameterize the convective dust emission model developed by Cakmur et al. (2004). These efforts aim to refine model representations of sub-windspeed threshold dust lifting and other poorly understood model sub-grid processes that may contribute significantly to the atmospheric aerosol burden.

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8IM.2

Portable, Tippable, and Water-Based: TSI's OmniCount CPC 3002. Noah Bock, Aaron Avenido, JUSTIN S. KOCZAK, Daniel R. Troolin, Andrea J. Tiwari, *TSI Incorporated*

Emerging and continuing trends in basic and applied aerosol research in the past several years have emphasized the need for portable, robust, and lower-cost measurement devices that still maintain sufficient accuracy and repeatability for confidence in the results. Applications with growing interest include indoor and outdoor ambient monitoring, mobile measurements of dynamic processes, and occupational health and safety assessment. TSI has developed a Portable Water-based Condensation Particle Counter (PWCPC) that serves this growing market and application space. The device makes dynamic, high-quality measurements more accessible for a broader audience, and has evolved from TSI's expertise in developing multiple generations of research-grade CPC technology.

This presentation will cover the underlying working principles and performance characteristics of the TSI OmniCount™ PWCPC including counting accuracy, detection efficiency and linearity, false count performance, time response, wick life, and influences of environmental factors on device performance. The presentation will conclude with examples of data from real-world usage to show the capabilities of the device and how it can help researchers meet their measurement goals and objectives.

8IM.3

Optimized Substrates for Single-Particle Analysis with Multiple Microscopy and Spectroscopy Techniques. KATHERINE KOLOZSVARI, Emily Costa, Holly Lawson, Andrew P. Ault, *University of Michigan*

Heterogeneity within the atmospheric aerosol is a key factor which adds to uncertainties in the global impact of aerosols on climate and health. There are many analytical techniques capable of offline single-particle analysis, and multiple complementary techniques are often used to determine the elemental composition, functional group information, morphology, and phase state of atmospheric particles. However, as each technique has different requirements for analysis, using multiple methods often requires samples to be collected onto multiple different substrates. This means that limited information can be collected from each individual particle, and cross comparison is limited to the population as opposed to the single-particle level. This is especially relevant for field samples, which often have high particle-to-particle heterogeneity, and also are unique snapshots of a specific time and place and therefore cannot be replicated. Herein, we present the fabrication of a gridded Ni-coated Si substrate with no background interferences for Raman microspectroscopy, photothermal infrared (PTIR) spectroscopy, and atomic force microscopy (AFM). For scanning electron microscopy coupled to energy dispersive x-ray (SEM-EDX) spectroscopy, the atmospherically-relevant background interference is minimal, and the overall background signal is lower in intensity than for Si substrates. The alphanumeric gridded pattern allows the location of the same particle across multiple analytical techniques. This enables a comprehensive insight into the identity of a single particle, allowing for the disambiguation of broad particle categories such as "carbon-containing," as well as allowing for in-depth study of particle types of interest collected during field research.

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8IM.4

A Low-Cost Solid Aerosol Generator of High Stability. RYAN WARD, Miranda Hack, V. Faye McNeill, *Columbia University*

A technique is described to aerosolize granular solid materials. A low-frequency audio speaker (subwoofer) is used to drive the airborne dispersion and entrainment of solid nanopowders into a continuous flow reactor. Surface area (SA) concentrations exceeding 10,000 $\mu m^2\ cm^{-3}$ at the outlet of the generator can be generated stably on the order of hours (~ 2% variation in SA concentration). Variation of the subwoofer's driving frequency between 40 and 100 Hz shows a surface area production maximum between 70 and 80 Hz, likely due to the resonance of the rubber dam upon which the granular material rests. Reproducible control over the SA is achievable in replicate trials of the same frequency, though some day-to-day output variability exists. Stable generation of particle SA is achievable for over 6 hours, a desirable outcome for experiments in a variety of contexts, in particular for steady-state flow reactors.

8IM.5

Standoff Aerosol Measurements Using Mid-Infrared Dual Frequency Comb Absorption Spectroscopy. GARRETT MATHEWS, Alyssa Lalko, Anna Ziola, Amanda Makowiecki, Kevin Williamson, Douglas A. Day, Masayuki Takeuchi, Scott Egbert, Graeme Gillespie, Anthony Harness, Robert Wright, Anne V. Handschy, Nazanin Hoghooghi, Peter Chang, Satoshi Takahama, Daven Henze, Jose-Luis Jimenez, Scott Diddams, Gregory Rieker, *University of Colorado*

Aerosols play an important role in the earth's radiation balance, present human health hazards, and pose national security threats via weaponized aerosols. Aerosol measurement technology has largely been limited to sampling-based approaches where aerosol particles must be extracted from their native environment. There remains a need for aerosol measurement techniques capable of performing in situ measurements to not disturb the system being studied and enable standoff detection of aerosolized threats. Here we present a standoff aerosol measurement system based mid-infrared dual frequency comb absorption spectroscopy.

Frequency comb lasers emit hundreds of thousands of discrete frequency elements (comb teeth) across a broad wavelength range. Dual-comb spectroscopy (DCS) utilizes two frequency combs to provide a tooth-by-tooth readout of the lasers' output spectra which enables absorption spectroscopy measurements over broad spectral bandwidths at high resolution. This unique attribute of DCS can decouple the spectrally broad aerosol absorption bands from the spectrally narrow absorption signatures of atmospheric gases (e.g., H_2O, CO_2, CH_4). Furthermore, the coherent, pulsed laser light can be transmitted over long distances enabling measurements of large plumes despite atmospheric turbulence.

We present the initial application of a mid-infrared dual comb spectrometer to measure aerosols in a standoff configuration. Submicron aerosol particles of dioctyl sebacate, levoglucosan, and oleic acid are generated in a laboratory test chamber equipped with zinc selenide windows, and the dual comb spectrometer is used to interrogate the samples. Contributions from atmospheric gas absorption are removed in post-processing resulting in measurements of the aerosol absorption spectra. Spectral fitting is applied to quantify aerosol concentrations, and aerosol identification algorithms are implemented to identify individual compounds in low signal-to-noise ratio scenarios.

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8IM.6

Regulatory Application of Microscopic Techniques to Understand Particle Morphology and Composition. CYNTHIA BERG, Cat Buhl, Angela Haar, Joshua Scheel, Hedy Ward, Selina Ibarra, *South Coast Air Quality Management District*

The South Coast Air Quality Management District (South Coast AQMD) is the government agency responsible for monitoring and regulating stationary sources of air pollution in the South Coast Air Basin and Coachella Valley (a portion of the Salton Sea Air Basin) in Southern California. The agency uses polarized light microscopy (PLM), Fourier-Transform Infrared Spectroscopy (FTIR), and scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS) to analyze particulate matter and understand the morphology and composition of particles to aid in the identification and attribution of sources. These instruments have been used to examine unknown particulate matter in response to community concerns and to identify possible emission sources for further investigation. Here we describe how these instruments and techniques are used to support agency efforts to enforce regulations and better understand sources of particulate matter in the basin. A long-term study of the composition of particulate matter fallout and source attribution in the Eastern Coachella Valley (January 2022 – December 2022) will also be presented. During this study fallout samples were collected and analyzed by SEM-EDS as part of efforts to distinguish the source of particulate matter, attributing it to local to agricultural operations or resuspended particulates from the Salton Sea playa.

8IM.7

Self-Calibrating Aerosol Absorption Using TDLAS with Tunable-Laser Photothermal Interferometry. JOEL CORBIN, Alireza Moallemi, Daniel Poitras, Timothy Sipkens, Jalal Norooz Oliaee, *National Research Council Canada*

Visible and infrared light absorption by nanoparticles such as soot, brown carbon, tarballs, graphene, metals, and dust underlies key processes and measurements in combustion, materials synthesis, climate, and medicine. Light absorption by black carbon is the measurand of the many photoacoustic or filter-based instruments that are used for monitoring toxic engine emissions during air-quality monitoring and emissions testing of on-road, airborne, and marine transportation. The airborne measurement of nanoparticle light absorption is therefore of broad scientific value, and requires reliable reference measurements for calibration.

Photothermal interferometry (PTI) has the potential to provide such reference measurements. In PTI, the aerosol absorption coefficient $ß_{abn}$ can be retrieved, for use in calculating a sample's imaginary refractive index, absorption function, mass absorption cross-section, or equivalent black carbon mass (eBC) as reported by most black-carbon sensors. Here, we propose the use of tunable-laser PTI (TL-PTI) as a self-calibrating reference technique for quantifying $ß_{abn}$. In TL-PTI, a wavelength-tunable laser is used to quantify the narrow absorption lines of a gas such as O_2 via direct absorption spectroscopy, providing a reference $ß_{abn,ref}$ in units of Mm^{-1}. The PTI signal is then calibrated to this $ß_{abn,ref}$. This gas-PTI signal can then be "switched off" by tuning the laser wavelength away from the absorption lines, so that only particulate PTI signals remain in the background-subtracted signal. The TL-PTI signal is directly related to light absorption for both aerosols and gases, since the PTI pump-laser modulation is slower than the thermalization timescales of both. We then show that the 760 nm calibration laser can be used to cross-calibrate a supercontinuum laser across wavelengths 400 – 840 nm. Thus, most instruments can be calibrated at their native wavelengths, and the fundamental spectral properties of nanoparticles can be measured. We present example measurements for NO_2 and nigrosine dye.

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8SA.1

Chemical Aging of Urban Aerosol: The POSEIDON-2024 Campaign. Christina N. Vasilakopoulou, ANGELIKI MATRALI, Andreas Aktypis, Christos Kaltsonoudis, Katerina Seitanidi, Kalliopi Florou, Georgia A. Argyropoulou, Maria Georgopoulou, Aikaterini Bougiatioti, Nikolaos Mihalopoulos, Spyros N. Pandis, *FORTH Institute of Chemical Engineering Sciences*

An intensive month-long campaign was conducted in September 2024 in the island of Poros, 50 km downwind of Athens. The major goal of the POSEIDON campaign was the quantification of the chemical aging of urban organic aerosol (OA) transported for hours over the sea, during a photochemically active period. The campaign included high-temporal resolution measurements of organic vapors (VOCs/IVOCs), OA and its chemical components, along with offline analysis of daily samples of both gaseous and particulate species. Measurements in Poros were combined with those of urban supersites in Athens (in Thissio and Demokritos).

PM_1 was modest (9.6 μg m^{-3}), primarily comprised of OA (50%) followed by sulfate (35%), black carbon (9%) and ammonium (6%). Nitrates were less than 1% since warm conditions (25±3^oC) favored volatilization of ammonium nitrate and rapid decomposition of organonitrates. Positive Matrix Factorization of the observed highly oxidized OA (O:C=0.77±0.08) AMS spectra yielded a three-factor solution. The two highly oxidized factors, more oxidized MO-OOA (64%) and less oxidized LO-OOA (29%) dominated, with a 7% contribution by hydrocarbon-like OA (HOA). The MO-OOA was related to aged biomass burning OA, indicated by its correlation to potassium, acetonitrile, and glycolic acid levels. LO-OOA was related to both anthropogenic (e.g., toluene) and biogenic (e.g. pinonaldehyde) organic vapors. $PM_{2.5}$ toxicity metrics in the small island were comparable to those in Athens' center.

The surprisingly frequent (70%) appearance of 20-30 nm mode particles (absent from Athens) suggested strong nucleation/growth over the Saronic Gulf downwind of Athens. The role of SO_2 sources (industry, shipping) as well as sources of ammonia/amines and biogenic VOCs in new particle formation was explored. OA's photochemical age, estimated with various techniques (photochemical clocks, Lagrangian modeling, etc.), was related to its composition. Results are compared to aging rates assumed in current chemical transport models.

8SA.2

Source Apportionment of Volatile Organic Compounds with Initial Concentrations of Continuous Speciation Monitoring Data and Time-integrated Measurements of Organic Markers. YI-HSIEN LIU, Kuan-Lin Lai, Chia-Yang Chen, Chang-Fu Wu, *National Taiwan University*

Volatile organic compounds (VOCs) contribute to the formation of secondary organic aerosols (SOAs) and ozone, both of which are harmful to human health and the environment. Positive Matrix Factorization (PMF) is widely applied for VOC source apportionment; however, conventional PMF may overlook variations resulting from photochemical aging. To address this, some studies have incorporated photochemical parameterization to account for chemical transformations. Nevertheless, overlapping chemical profiles continue to hinder accurate source identification. While the inclusion of organic compounds (OCs) has improved $PM_{2.5}$ source apportionment, limited research has integrated VOCs with organic molecular tracers. This study aims to enhance PMF analysis by incorporating initial VOC concentrations and selected organic tracers.

Hourly VOC monitoring and 12-hour integrated filter sampling were conducted during a 21-day period in summer at an industrial complex in southern Taiwan. A three-stage PMF modeling approach was applied, with the first stage focusing on VOC analysis; the second stage using initial concentration of VOCs, and third stage incorporating both initial VOC and OC markers. In Stage 2, seven factors were identified, with the three highest contributors attributed to Petrochemical Emissions, Synthetic Resin and Paints, and Industrial Emissions. In Stage 3, after incorporating OC data, additional sources were identified, including fungal sources, cooking sources and biomass burning, offering a more comprehensive source apportionment. These findings demonstrate that incorporating organic species can bridge gaps in VOC source apportionment, enhancing the resolution and accuracy of pollution source identification.

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8SA.3

Continuous Source Apportionment of Ultrafine Particulate Matter (PM0.1) at an Urban Site at Wintertime. GEORGIA A. ARGYROPOULOU, Christina N. Vasilakopoulou, Andreas Aktypis, Maria Georgopoulou, Christos Kaltsonoudis, Angeliki Matrali, Katerina Seitanidi, Christina Christopoulou, Panagiotis Kalkavouras, Nikolaos Mihalopoulos, Spyros N. Pandis, *Institute of Chemical Engineering Sciences, Greece*

Ultrafine particles (diameter less than 100 nm) can penetrate sensitive human organs (e.g., brain) and are strongly associated with adverse health effects. Their low mass concentration and susceptibility to interference from larger particles hinder their accurate and continuous characterization. The few previous $PM_{0.1}$ experimental source apportionment studies relied solely on cascade impactors, which offer low temporal resolution and are labor-intensive.

The Aerodynamic Aerosol Classifier (AAC, Cambustion) can function as a low pass separator with selectable cut-off. We used the AAC to separate $PM_{0.1}$ from larger particles, followed by a High-Resolution Time of Flight Aerosol Mass Spectrometer (HToF-AMS, Aerodyne Research Inc.) for the continuous $PM_{0.1}$ organic aerosol (OA) source apportionment. An SP2-XR (Droplet Measurement Technologies) for black carbon, and a Xact 625i (SailBri Cooper, Inc) for metals were also integrated for a comprehensive source analysis.

A month-long field campaign was conducted in the center of Athens, the capital of Greece, during the winter of 2025 to evaluate the numerous local anthropogenic sources of $PM_{0.1}$. Organic aerosol was the dominant component of $PM_{0.1}$ throughout the campaign, contributing approximately 70%, and peaked during the night. Approximately half of secondary $PM_{0.1}$ OA was highly oxygenated OA (OOA). The primary $PM_{0.1}$ was mainly hydrocarbon-like OA (HOA; 20-25%), followed by cooking OA (COA; 15-20%) and biomass burning OA (BBOA; 10-15%).

HOA and $PM_{0.1}$ black carbon were highly correlated, peaking during morning rush hour and increasing at night probably due to boundary layer effects. The most prominent elements detected were K, Zn, and Ag. Potassium closely tracked BBOA, with both peaking at night, confirming biomass burning as a significant $PM_{0.1}$ source. The temporal variations of the sources and their respective concentrations have been analyzed and will be discussed.

8SA.4

Real Time Source Apportionment in Four Chinese Cities Integrating Data from the AXA (ACSM-Xact-Aethalometer) Set Up. OLGA ZOGRAFOU, Manousos Ioannis Manousakas, Yuemei Han, Shaofei Kong, Yang Chen, Shuyan Xing, Jay G. Slowik, Kaspar R. Daellenbach, Rui Wang, Ningning Zhang, Qiyuan Wang, Jie Tian, Zhen Yang, Lei Cao, Fei Gao, Chongzhi Zhai, Zhenliang Li, Chao Peng, Feng Ding, Linjun Li, Konstantinos Eleftheriadis, Junji Cao, André S. H. Prévôt, *NCSR Demokritos, Athens, Greece*

Real-time source apportionment (RT SA) has emerged as a powerful tool for the identification of atmospheric Particulate Matter (PM) pollution sources under real-time conditions offering the advantage of immediate response to air quality threats. In the framework of the Sino-Swiss Cooperation on Air Pollution Source Apportionment for Better Air project, an RT SA software was developed to meet the demands of environmental authorities, researchers, and policymakers for real-time access on ambient PM sources. Online real-time instruments outclass the traditional offline methods, offering higher temporal resolution, enabling insights into the daily patterns of pollutants. Similarly, RT SA analysis outclasses the traditional offline SA methods which usually take up to months until post-measurements comprehensive results are obtained, even in the case of real-time online measurements. While valuable information in the long haul can be obtained from offline SA methods, RT SA offers access to real-time knowledge and the ability to take immediate actions.

The RT SA software integrates continuous data streams from a suite of online monitoring instruments collectively consisting the AXA set-up, including the Aerosol Chemical Speciation Monitor (ACSM), the Aethalometer, and the Xact elemental analyzer. These instruments provide high-resolution complementary chemical information, including organic aerosol (OA), inorganic ions (sulphate, ammonium, nitrate, and chloride), equivalent Black Carbon (eBC), and elemental composition.

For comparison, a second model, SoFi RT, served as the reference approach. They operate continuously at monitoring stations in Xi'An and Wuhan, China, where the required instruments are installed. After an initial seven-day calibration, both models deliver source apportionment results for total PM within minutes of each measurement.

The accuracy of the two models was evaluated by comparing their outputs to results from advanced, well-established SA techniques. The comparison showed relatively low uncertainty, supporting the reliability of these models as effective tools for real-time air quality monitoring and pollution mitigation.

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8SA.5

Chemical Characterization and Source Apportionment of Winter Organic Aerosols in Fresno, California, Through Combined FIGAERO-CIMS and SP-AMS Measurements.

WENQING JIANG, Ashutosh Kumar Shukla, Douglas Worsnop, Anita Avery, Harald Stark, Manjula Canagaratna, Mitchell Alton, Qi Zhang, *University of California, Davis*

Fresno, California experiences some of the highest wintertime PM concentrations in the US, driven by intense emissions coupled with the region's unique geographical and meteorological conditions that promote pollutant accumulation. To investigate the emission sources and formation pathways of PM in this region, we performed an intensive field campaign in winter 2023-2024 using a soot-particle aerosol mass spectrometer (SP-AMS) and a chemical ionization mass spectrometer (CIMS) coupled with a Filter Inlet for Gases and AEROsols (FIGAERO). Positive matrix factorization (PMF) was performed on the SP-AMS and CIMS datasets both separately and in combination (cPMF) to identify key sources and processes, leveraging SP-AMS's quantitative capabilities and CIMS's molecular-level resolution. The analysis resolved several primary sources, including biomass burning (BB), traffic, and cooking, alongside multiple secondary organic aerosol (SOA) types formed from pathways such as aqueous-phase chemistry in fog and aerosol water, as well as nighttime chemistry in the residual layer. BB emissions peaked during nighttime under low wind speed conditions, consistent with local residential wood burning for heating. Aqueous-phase SOA (aqSOA) factors were characterized by significant contributions from organic acids such as oxalic acid and malonic acid. One aqSOA factor showed a clear link with biomass burning, featuring enhanced signals of phenolic oligomers which are typical products of aqueous reactions involving BB-derived phenols. SOA factors associated with nocturnal residual layer chemistry showed strong morning peaks starting around 7 am, coinciding with rising nitrate concentration following boundary layer mixing. These residual layer SOA factors show enhanced signals of oxalic acid, malonic acid, $C_9H_{13}NO_2S$, and a group of CHON species likely generated via dark NO_3 radical reactions. This study highlights the importance of both primary emissions and secondary formation processes in contributing to PM pollution in Fresno.

8SA.6

A Comprehensive Study of Particulate Matter (PM) in the Eastern Coachella Valley (ECV) Community: Physico-Chemical Characterization and Source Apportionment.

JOSEPH SALAZAR, Yumeng Cui, Julia Montoya-Aguilera, Christopher Lim, Mohammad Sowlat, Steven Boddeker, Freyja Berg Lopez, Laura Saucedo, Cynthia Berg, Angela Haar, Stephen Dutz, James Rothchild, Eric Holden, Sina Hasheminassab, Matic Ivančič, Martin Rigler, Payam Pakbin, Andrea Polidori, Jason Low, *South Coast Air Quality Management District*

The enactment of Assembly Bill (AB) 617 by the California legislature and establishment of the Community Air Protection Program (CAPP) by California Air Resources Board (CARB) provided the opportunity for the South Coast Air Quality Management District (South Coast AQMD) to further address air quality issues in communities that are disproportionately impacted by air pollution. Eastern Coachella Valley (ECV) is an AB 617-designated community in the Salton Sea Air Basin that is impacted by several sources of particulate matter (PM), including desert and Salton Sea playa dust, agricultural burning, and motor vehicles. As part of efforts to better characterize emission sources in ECV, South Coast AQMD developed and implemented a comprehensive study from January 2022 through May 2023 to better characterize PM/dust and identify its sources and origins in the area. This campaign relied on a combination of time-integrated PM sampling techniques and time-resolved measurements by continuous monitors to fully characterize physical characteristics (size, shape, and morphology) and chemical composition (i.e., carbonaceous compounds, trace metals, and ions) of the PM/dust in this area.

This is part of two accompanying abstracts submitted to report on the results from this campaign. In this presentation, we will present findings from both time-integrated (filter-based) and continuous (real-time) PM_{10} measurements collected across ECV, alongside source apportionment results using Positive Matrix Factorization (PMF). This analysis identified five key contributors to PM_{10}: dust, chlorine-associated sources, Salton Sea emissions, agricultural/industrial activity, and secondary PM formed through atmospheric processes. We explore hourly, daily, and seasonal patterns across a 17-month period (Jan 2022–May 2023), describing PM_{10} sources and the sources impact on local air quality. These findings provide context for understanding community exposures and support the emission and exposure strategies as part of the AB 617 program.

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8SA.7

Characterizing Spatio-Temporal Variability and Sources of Particle-Bound Metals through Fixed-Site and Mobile Monitoring in Two Communities in the South Coast Air Basin.

PROVAT SAHA, Christopher Lim, Mohammad Sowlat, Steven Boddeker, Julia Montoya-Aguilera, Zihan Zhu, Sina Hasheminassab, Payam Pakbin, Andrea Polidori, Jason Low, *South Coast Air Quality Management District*

To improve understanding of the spatio-temporal variability and sources of particulate metals at the community scale, comprehensive measurements were conducted using a combination of fixed-site and mobile monitoring in two communities in the Los Angeles area—East Los Angeles, Boyle Heights, West Commerce (ELABHWC), and Southeast Los Angeles (SELA)—which are disproportionately impacted by localized air pollution sources. ELABHWC and SELA were designated by California Air Resources Board (CARB) to be part of Assembly Bill (AB) 617, a state-wide program established to reduce impact of air pollution in disproportionately impacted communities. Measurements included PM_{10} particle-bound trace metals and elements at two fixed sites (one in each community) over a multi-year continuous monitoring period, along with year-long mobile monitoring surveys using a multi-metal mobile platform (MMMP) to capture hyper-local spatial variability. Source apportionment analysis using the Positive Matrix Factorization (PMF) technique was applied to both stationary and mobile datasets. A five-factor solution was found to be the most interpretable for both mobile and fixed-site data. Both monitoring approaches consistently identified the same general source groups—industry, road dust, and soil dust—as dominant contributors to particle-bound trace metals in these communities. Additionally, two distinct factors, one with high sulfur and another with high chlorine, were identified in both mobile and fixed sites datasets. The derived factors from mobile monitoring data show strong concentration gradients, especially for road dust and industrial factors, and spatial variability of these factors concentrations correlates with relevant source-activity related land use variables such as road density and the density of metal industries. This presentation will provide a comprehensive summary of the source apportionment results and show how information obtained in this study has prompted plans to perform full PM speciation at two near-road sites as part of South Coast AQMD's Multiple Air Toxics Exposure Study (MATES VI).

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9AA.1

Evaluating Higher Temporal Observations in $PM_{2.5}$ in Relationship with Lower Temporal Long-Term Trends--Initial Observations from the Baltimore Social-Environmental Collaboration. BENJAMIN A. NAULT, Lalitha Aiyar, Daniel C. Blomdahl, Jewel Grant, Ayreanna Pettijohn, Mina Tehrani, Benjamin Werden, Amira Yassine, Kirsten Koehler, Peter F. DeCarlo, James Hunter, Benjamin Zaitchik, *Johns Hopkins University*

Baltimore, MD, is located in a very atmospherically-dynamic location. It is a receptor site of emissions and aerosol produced during transport from Ohio River Valley and the forested and agricultural areas of Appalachia, from the Chesapeake Bay, from the agricultural area of the Eastern Shore, and from the Washington, D.C., area, depending on the synoptic and local wind patterns. The greater Baltimore-D.C. area is fortunate to have higher concentration of monitoring sites compared to many other regions in the U.S.; however, these monitoring sites operate at low temporal resolution (e.g., 24-hr averaged data once every 3 – 6 days for composition and organic aerosol precursors). This may lead to missing events that may impact aerosol concentration (e.g., wildfire transport, bay breeze) as well as diel cycle that better indicates sources and chemistry control aerosol concentrations in an urban environment. As part of the DOE Urban Integrated Field Laboratory experiment, the Baltimore Social-Environmental Collaboration (BSEC) Air Quality team set-up a long-term, higher temporal (1-sec to 10-min resolution) supersite to measure aerosol concentration and composition with the Aerodyne TOF-ACSM-X, along with a suite of other instruments, to evaluate the sources and chemistry of aerosol in Baltimore. Initial results from these observations have highlighted the importance of localized primary emissions from cooking, fireplaces, and traffic towards the total organic aerosol budget that monitoring sites may not capture. Furthermore, mobile measurements to different locations in Baltimore indicate that very localized, primary aerosol emissions from traffic are not well captured by current monitoring systems, where the aerosol concentrations are a factor of 2 – 3 higher than the monitoring sites. The combination of higher temporal and spatial measurements highlight the importance of understanding sources of aerosol in a complex urban environment.

9AA.3

Exploring the Influence of Environmental Conditions on the Gas-Particle Partitioning of Organic Acids and Bases in the Greater Toronto Area. OLIVIA DRIESSEN, Ye Tao, Xiaoying Yang, Matthew Davis, Yutong Wang, Laura-Helena Rivellini, Jonathan Abbatt, Jennifer Murphy, Mayré Rodriguez Ramirez, RenXi Ye, Cora Young, Trevor VandenBoer, Sumi Wren, Jeremy Wentzell, Michael Wheeler, Alex K.Y. Lee, Elisabeth Galarneau, *University of Toronto*

The gas-particle partitioning of low-volatility and semi-volatile organic compounds (L/S-VOCs) plays a dominant role in the formation and growth of secondary organic aerosol. Improved knowledge of these processes is needed to better understand the health and climate effects of atmospheric particulate matter (PM), as well as the fates of various airborne pollutants. The phase distribution of L/SVOCs in the atmosphere can be impacted by environmental conditions such as temperature, the existing concentration of organic PM, and aerosol liquid water content (LWC). For many ionizable compounds, aerosol pH can also have a strong influence on partitioning. As SO_2 and NO_x emissions decrease and NH_x species increasingly dominate the buffer capacity of the atmospheric aqueous phase, wide variations in aerosol pH have been observed, carrying implications for the role of ionizable organics in aqueous PM. This project aims to investigate the impact of changing atmospheric conditions on the gas-particle partitioning of ionizable organic compounds, using summertime and wintertime measurements from two field campaigns conducted in the Greater Toronto Area (THECIX, July-August 2023; SWAPIT, January-March 2024). Applying a chemical partitioning space analysis that considers the impacts of pH, we estimate the phase distribution of a collection of semi-volatile organic acids and bases (e.g., trifluoroacetic acid, pyruvic acid, levulinic acid, pinonic acid, hydroxybutyric acid, monochloroacetic acid, oxalic acid, succinic acid, glutaric acid, malonic acid, pinic acid, phthalic acid, adipic acid, and several short-chain alkylamines) during the measurement periods. We assess the effects of temperature, relative humidity, aerosol LWC, pH, and organic aerosol loading on the partitioning behavior of these compounds. Gas- and particle-phase measurements on AIM-IC and SP-AMS are used to inform our modeling efforts, and predicted gas-particle partitioning is compared to measurements of organics on iodide-CIMS, MOUDI, and AIM-IC-MS.

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9AA.4

Seasonal Differences in the Phase States of Coastal Aerosols and the Role of Chemical Composition. KANURI ROUNDTREE, Renee Niles, Paul Tumminello, Maya Morris, Diana Tran, Rachel Tseng, Xitlali Ventura, Adam Cooper, Benjamin Carr, Jonathan Slade, *University of California San Diego*

Marine aerosols influence coastal atmospheric systems due to their ability to impact cloud formation, which is influenced by particle phase state (viscosity) and hygroscopicity. During a field campaign in La Jolla, CA, the phase states of coastal aerosols were examined across seasons (summer and winter) and diurnal cycles. The aerosol phase state was determined directly online from particle bounce using an electrical low-pressure impactor coupled to a scanning electrical mobility sizer. Findings demonstrated statistically significantly higher particle bounce during the winter compared to summer. This was attributed to a distinct, liquid-like sea spray aerosol (SSA) size mode measured during the summer field study. In addition, in the winter, there were higher levels of Chlorophyll A in the ocean and non-refractory organic carbon mass detected in the particles. This is consistent with previous studies of SSA phase state, which demonstrated increased viscosity during periods of high biological activity in a wave flume but shown for the first time in this natural coastal environment. It was suggested in that study that divalent cations such as Ca^{2+} and Mg^{2+} complex with organic anions producing semi-solid or gel-like particles. Aerosols were additionally collected on quartz-fiber filters and analyzed offline with ion chromatography. Na^{+} concentrations were utilized for tracing SSA and divalent cation enrichment. The results from the field are undergoing comparisons with laboratory studies on the phase state and hygroscopicity of synthetic SSA generated in a marine aerosol reference tank, generated systematically with varying artificial seawater composition incorporating different organic components (glucose and palmitic acid) and sea salts, including $CaCl_2$, $MgCl_2$, and NaCl. These results will be presented and are important in building an understanding of the factors impacting aerosol phase state and hygroscopicity, particularly in the context of the marine boundary layer.

9AA.5

Investigating Organic Aerosol Composition, Phase State, and Miscibility Across Two Cities with Evolving Vehicle Fleets. Kinjal Kolhe, Kamal Sahu, Harish C. Phuleria, JENNA DITTO, *Washington University in St. Louis*

In this work, we assess chemical composition, properties, and heterogeneity of urban aerosols measured in two cities: St. Louis, USA and Mumbai, India. While electric and hybrid vehicles are on the rise globally, their sales vary by country. In the U.S., this growth of hybrid and electric vehicles currently represents about 15-20% of new car sales, while in India this growth is closer to 5-10%. With urban aerosol composition transforming as a result of vehicle fleet electrification, we aim to explore whether this transition impacts the chemical/physical properties of urban organic aerosol mixtures, focusing on aerosol phase state with additional analyses of aerosol thermodynamic mixing favorability (miscibility). We performed a comparative analysis across urban background and roadway-adjacent $PM_{2.5}$ samples collected in St. Louis and Mumbai across several seasons. Additional paired indoor-outdoor samples were collected in St. Louis at an urban residence. All $PM_{2.5}$ samples were analyzed by gas chromatography-mass spectrometry and liquid chromatography-mass spectrometry tools, following both targeted and non-targeted approaches. Initial analyses of the urban aerosol's hydrocarbon composition focused on polycyclic aromatic hydrocarbons (PAHs), as US EPA-classified priority pollutants, and diagnostic ratios revealed the dominance of PAHs from pyrogenic sources in both environments. Total PAH concentrations in Mumbai were 3-4 times higher than in St. Louis, including for species like benzo[a]pyrene (a group 1 carcinogen), and showed predominance of pyrene in both cities. Leveraging non-targeted analyses beyond the aerosol mixtures' hydrocarbon components, our study investigates the transformation and evolution of urban outdoor aerosol in two different vehicle fleet electrification scenarios, and investigates resulting composition-dependent aerosol phase state and miscibility. Finally, paired indoor-outdoor samples are used to assess changes to chemical composition and phase state or miscibility properties upon indoor infiltration to residential environments.

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9AA.6

Trace Metal-Containing Aerosols in the Atmosphere of the Indian Ocean. JOHANNES PASSIG, Aleksandrs Kalamasnikovs, B Praphulla Chandra, Haseeb Hakkim, Marco Schmidt, Robert Irsig, Sven Ehlert, Andreas Walte, Thomas Fennel, Eric Achterberg, Ralf Zimmermann, *Mass Spectrometry Centre;Rostock University/Helmholtz Munich*

Atmospheric deposition of aerosols is a key source of iron and other micronutrients in remote ocean regions, where nutrient scarcity limits primary productivity and influences both marine ecosystems and carbon sequestration (Mahowald et al., 2018). While desert dust contributes the majority of trace metals by mass, its iron content is typically of low bioavailability. In contrast, anthropogenic sources—such as combustion processes—emit more soluble, pyrogenic forms of iron, which are increasingly recognized as a relevant source of bioavailable metals in many parts of the world. However, large uncertainties remain due to limited field data and a lack of sensitive methods for measuring metal solubility at low aerosol concentrations. We present initial findings from a shipborne campaign aboard the R/V Sonne across the Indian Ocean in late 2024, conducted within the framework of the GEOTRACES project. Using a single-particle mass spectrometer (SPMS) with resonant laser ionization (Passig et al., 2020), we analyzed the chemical composition of hundreds of thousands of aerosol particles. Although sea salt dominated the aerosol population, thousands of Fe-containing particles were detected, attributed to long-range transport. These included particles likely originating from mineral dust, mining emissions in Australia, and meteoritic sources. Many metal-rich particles displayed diverse signatures of secondary components such as sulfate, chloride, and dicarboxylic acids, suggesting distinct aging processes, transport histories, and potential solubility profiles. The SPMS's ability to resolve such internal mixtures at the single-particle level makes it a powerful tool for identifying sources and estimating the bioavailability of aerosol-bound metals. Our observations reveal a surprisingly high abundance and diversity of iron-containing aerosols in this understudied region, emphasizing their role in ocean biogeochemistry and nutrient cycling.

[1] Mahowald, N. et al. (2018), Nat. Commun. 9, 2614.
[2] Passig, J. et al. (2020) Atmos. Chem. Phys. 20, 7139–7152.

9AA.7

Photochemically, Traffic-, and Boundary Layer-Influenced New Particle Formation in the Urban Atmosphere of Ljubljana, Slovenia. KUMAR SARANG, Kristijan Vidovic, Petra Dolšak Lavrič, Samo B. Hočevar, *National Institute of Chemistry, Ljubljana, Slovenia*

New particle formation (NPF) is recognized as a major source of atmospheric aerosol particles and a key contributor to the burden of ultrafine particles (UFPs, <100 nm) and cloud condensation nuclei concentrations globally, thereby influencing radiative forcing and climate and pose significant health risks through respiratory exposure. Despite its importance, NPF remains poorly understood, particularly in polluted urban environments, due to challenges in detecting early molecular clusters, complex precursor chemistry, high condensation sinks, regional transport, and the non-linear interaction of local meteorology and emissions. Globally, NPF exhibits diverse seasonal patterns and intensities across various environments, underscoring the persistent need to study this process under a wide range of atmospheric and geographical conditions.

This study presents, for the first time, a 190-day dataset from an urban background site in Ljubljana, Slovenia, comprising particle number size distribution (PNSD) measurements alongside meteorological and air pollution data. The data enabled a comprehensive analysis of the atmospheric urban NPF events. Results highlight the roles of meteorological parameters (temperature, RH, wind speed, wind directions, and solar intensity), atmospheric oxidants (OH, O_3), and pollutants (BTX compounds, NO_x, SO_2 and $PM_{2.5}$) in shaping the diurnal behavior of NPF in Ljubljana. Inter-quantile overlap analysis effectively distinguishes the parameters that best separate NPF from non-NPF days, while principal component analysis identifies three distinct source regimes: i) traffic-related, ii) photochemically driven, and iii) boundary layer-influenced, corresponding to morning, noon, and evening NPF events, respectively. Moreover, the local NPF events in Ljubljana contribute approximately 45% to the city's annual UFP formation, underscoring their significance in urban air quality and regulatory contexts.

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9AA.8

A Novel Approach for the Spectral Based Source Apportionment of Carbonaceous Particulate Matter in the Atmosphere. TIBOR AJTAI, Csilla Gombi, Szabolcs Hodovány, István Magashegyi, Zoltán Bozóki, Abdul Rahman, Gábor Szabó, *University of Szeged, Hungary*

Light-absorbing carbonaceous particulate matter (LAC) has garnered increasing scientific attention due to its complex physicochemical properties and significant impacts on climate and human health. Real-time source apportionment and chemical characterization of atmospheric carbonaceous particulate matter (CPM) remain critical challenges in atmospheric research, necessitating advanced analytical approaches for accurate identification and quantification. The Absorption Ängstrom Exponent (AAE) – the slope of the absorption spectra in log-log representation – is the only real time measurable physical quantity of CPM, which has source specific and chemical composition relevancies. The first absorption based source apportionment method, so called Aethalometer model was demonstrated in the literature in 2008. However, in this model, additional and complicated low time resolution and off-line methods are used to determine the AAE of different sources resulted in limited reliability and accuracy in the estimation of CPM masses. Therefore, to address this pressing issue, an improved methodology for real-time source apportionment of CPM with high time resolution and improved reliability is deemed essential.
We proposed a simplified source apportionment model for the determination of CPM originating from different sources. The proposed method is based on the parallel measurement of size distribution and the wavelength dependent absorption responses of ambient aerosol using an experimentally verified thumb of rule relation between the total carbon (TC) and elemental carbon (EC) mass of different sources. Moreover, we also experimentally demonstrated the wavelength dependency of AAE using transmission measurement of filter accumulated aerosol for optical absorption coefficient (OAC) measurement, for the first time. The comparison of the proposed source apportionment and the Aethalometer models calculated on the same database as well as the limitation of Aethalometer model using different approximations are also demonstrated. Finally, we reveal and quantified the correlation between the measured AAE and other source specific markers of CPM.

9AA.9

An Uncertain Future for the Climate and Health Impacts of Anthropogenic Aerosols in Africa. JOE ADABOUK AMOOLI, Marianne T. Lund, Bjørn H. Samset, Sourangsu Chowdhury, Gunnar Myhre, Anne N. Johansen, Daniel Westervelt, *Columbia University/Lamont-Doherty Earth Observatory*

Limited data availability and distinct regional characteristics of sources lead to a wide range of future aerosol emissions projections for Africa. Here we quantify and explore the implications of this spread for climate and health impact assessments. Using the Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants (ECLIPSE), the Shared Socioeconomic Pathways (SSPs), and the United Nations Environment Programme (UNEP) emission projections, we find high scenario diversity and regional heterogeneity in projected air pollution emissions across Africa. Baseline emissions also vary in their sectoral split. Using 10 different emissions pathways as input to the Oslo chemical transport model version 3 (OsloCTM3), we find that regionally-averaged annual-mean population-weighted $PM_{2.5}$ concentrations exhibit divergent trends depending on scenario stringency, with Eastern Africa $PM_{2.5}$ concentrations increasing by up to 6 $\mu g\ m^{-3}$ (37 %, SD ± 2.7 $\mu g\ m^{-3}$) by 2050 under the UNEP Baseline, SSP370, and ECLIPSE current legislation scenarios. In almost all cases, excess deaths increase substantially, with increases of up to more than 2.5 times compared to the baseline. We also find a net positive aerosol-induced radiative forcing across Africa in all scenarios by 2050 except two high-sulfur emission UNEP scenarios, with values ranging from 0.03 $W\ m^{-2}$ in SSP119 to 0.27 $W\ m^{-2}$ in SSP585. The wide-spread in projected emissions and differences in sectoral distributions across scenarios highlights the critical need for accurate activity data and harmonization efforts in preparation for upcoming assessments such as the 7th Assessment Report of the Intergovernmental Panel on Climate Change.

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9AA.10

Quantification of Biomass Burning Organic Aerosol in the Greater Atlanta Area: Insights From Historic Data and ASCENT Measurements. RUIZHE LIU, Sohyeon Jeon, Alison Fankhauser, Yutong Liang, David Pando, Lu Xu, Ting Fang, Rodney J. Weber, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Nga Lee Ng, *Georgia Institute of Technology*

Fine organic aerosol (OA) in the southeastern U.S. is often characterized by strong interactions of biogenic and anthropogenic emissions. Results from prior short intensive campaigns have shown that biogenic hydrocarbons contribute substantially to secondary organic aerosol (SOA) in the greater Atlanta area, especially in summer. However, quantifications of specific SOA sources remain a challenge. This study utilizes measurements from the South Dekalb site in Atlanta, which is a part of the ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) observational network. In this work, positive matrix factorization (PMF) is applied to combined datasets from a Time of Flight-Aerosol Chemical Speciation Monitor (ToF-ACSM, $PM_{2.5}$) and an XRF-based trace metal monitor (Xact-625i, $PM_{2.5}$, Sailbri Cooper, Inc.). Integrating organic aerosol composition with elemental data, particularly potassium (K) as a tracer, enables a more robust apportionment of fresh and aged biomass burning OA (BBOA). Our results show that biomass burning contributes approximately 26% to the total OA in the region, with 33% of the SOA attributed to emissions from biomass burning sources. Building on this approach, we reanalyze historic aerosol mass spectrometry datasets from the greater Atlanta area to evaluate the influences of biomass burning emissions and quantify previously unrecognized BB-SOA contributions. The ubiquitous presence of BB-SOA, even in an area dominated by biogenic emissions, highlights the need to improve our understanding of their sources, properties, and impacts on air quality.

9AA.11

Aerosol-based Synthesis of Carbon Dots from Sargassum Waste. YIMING XI, Caitlin Cherenfant, Pratim Biswas, *University of Miami*

Sargassum is a type of floating brown algae that is increasingly thriving in the region known as the "Great Atlantic Sargassum Belt". Since 2011 [1], the massive influx of Sargassum to the Caribbean has emerged as a significant environmental challenge to the coastal regions, contributing to environmental waste and thus negatively impacting the coastal tourism and associated economic activities. The transformation of this environmental waste Sargassum into valuable carbon-based nanoparticles can present a satisfying approach to both mitigate the Sargassum inflow problem and to consolidate the carbon sequestrated from the atmosphere. In this study, carbon nanoparticles, including the fluorescent carbon dots (CDs) with high value were produced via a novel, continuous one-step aerosol-based pyrolysis method from dried, grinded waste pelagic Sargassum.

From the preliminary results of this study, this one-step aerosol-based method can yield carbon nanoparticles with bimodal peaks in outlet particle size distributions at 800 °C of pyrolysis. The first size mode peak, measuring (4.19 ± 0.31) nm, falls within the carbon dots (CDs) size range, and this peak can be further tuned via controlling the particle growth residence time. The CDs generated from this aerosol process exhibited a fluorescence emission peak of 432 nm at 320 nm excitation, in contrast to the 470 nm emission at 384 nm excitation for the CDs from the conventional microwave synthesis. The presentation will further demonstrate additional data which will provide additional understanding in addressing the environmental challenges posed by the Sargassum inflow and producing nanomaterials of value simultaneously.

Key Words: Aerosol Synthesis; Carbon Dots; Sargassum.

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9AA.12

Single-Particle Characterization of Aerosol Physicochemical Mixing State in the Southeastern United States. HOLLY LAWSON, Xu He, Rachel O'Brien, Andrew P. Ault, *University of Michigan*

The climate and air quality impacts of atmospheric aerosol particles are directly tied to their individual physicochemical properties, including size, chemical composition, and morphology. Another critical variable is aerosol mixing state, which describes the distribution of chemical species across a particle population and is influenced by the proximity of particle emission sources and chemical evolution (i.e., aging). These properties influence key atmospheric processes such as cloud formation, radiative forcing, and chemical reactivity. Single-particle analysis enables unique characterization of aerosol physicochemical mixing state, including the role of particle size and morphology, and its relationship with aerosol-driven atmospheric processes. This study focuses on the southeastern United States, a complex and dynamic region with diverse, seasonally variable emission sources, including secondary organic aerosol (SOA), biomass burning (BB), fly ash, soot, mineral dust, sea spray, and primary biological particles (PBAPs). In this study, online measurements (aerosol size distributions, cloud condensation nuclei number, hygroscopicity, etc.) are combined with offline single-particle analysis to investigate aerosol physicochemical mixing state. Aerosol samples in northwestern Alabama at Bankhead National Forest, using a miniature micro-orifice uniform deposit impactor (mini-MOUDI) as part of the ARM Mobile Facility 3 (AMF3) deployment. Samples were analyzed using single-particle analysis techniques, including optical-photothermal infrared (O-PTIR) spectroscopy, Raman microspectroscopy, and computer-controlled scanning electron microscopy with energy dispersive X-ray (CC-SEM-EDX) spectroscopy. This suite of analyses provides functional group, elemental, and morphological information at the individual particle level. Changes in single-particle physicochemical properties are compared under different meteorological conditions. This work contributes to a more complete understanding of aerosol complexity in the southeast U.S., with implications for aerosol-cloud interactions, air quality, and climate modeling.

9AA.13

Determination of a Tracer for Non-tailpipe Emissions Using an Aerosol Chemical Speciation Monitor. DHIVYA MANICKAM, Samuel La Salle, Madeline Cooke, Lisa Wingen, Adam Thomas, Berenice Rojas, Véronique Perraud, Sanjeevi Nagalingam, Alex Guenther, Barbara Finlayson-Pitts, James Smith, *University of California, Irvine*

As the automotive fleet transitions from combustion engine power to electric vehicles, non-tailpipe emissions will become an increasingly relevant anthropogenic air pollution source. To further understand non-tailpipe sources, such as brake and tire wear, widespread monitoring and characterization is required. While the metal composition of tire and brake wear particles has been studied previously, there are no existing tracer organic molecules that have been identified for brake and tire wear. The Aerosol Chemical Speciation Monitor (ACSM) is an easily deployable instrument that measures non-refractory aerosol particle composition. This instrument has been commonly combined with Positive Matrix Factorization (PMF) to differentiate and identify sources in ambient measurements. However, there are no reference spectra available for brake wear, making it difficult to distinguish from other organic aerosol sources. We present measurements by an ACSM of submicron aerosol particles during both laboratory studies of brake emissions and field studies at a heavily trafficked near-roadway site. Laboratory experiments were conducted using a custom-built dynamometer to generate emissions from two common disc brake pad types, ceramic and semi-metallic, under light and harsh braking conditions. Mass spectra from the ACSM showed high similarity in organic emissions across both brake pad types for each braking condition. To see if brake emissions were present in roadway environments, the ACSM was deployed at a field site next to the i710 freeway in Long Beach, California. Source apportionment of the organic fraction was conducted with PMF to identify contributing factors. An initially unidentified factor appears to have influences from non-tailpipe emissions based on distinct features. These findings demonstrate that contributions of non-tailpipe emissions to urban aerosol can be detected by the ACSM.

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9AC.2

Halogen Activation by Photosensitized Processes in Atmospheric Aerosol Particles. ELEANOR MIKO, Sergey Nizkorodov, *University of California, Irvine*

Secondary organic aerosols (SOAs) are formed by the photochemical oxidation of primary organic matter and volatile organic compounds (VOCs) in the atmosphere and represent a major fraction of global atmospheric organic aerosols. One particularly uncertain aspect of atmospheric aerosol chemistry is the role of photosensitized processes. In aerosol particles, these processes have been proposed to form halogen atoms and radical ions, which are highly reactive and important oxidizers of both organic and inorganic tropospheric compounds. These products may additionally lead to the formation of halogenated compounds with further implications for tropospheric and stratospheric chemistry. While it is known that some SOA compounds act as photosensitizers, their efficiency in photooxidation of halogen ions has not been investigated, and further research is necessary to develop a more detailed understanding of the mechanisms for photosensitized production of halogen atoms, radical ions, and other halogenated products. For this work, photosensitization by SOA produced from the photochemical oxidation of distinct types of VOCs will be compared: (1) SOA produced by ozonolysis of terpenes, such as ????-pinene, representative of forest environments; (2) SOA from ????-pinene oxidized by OH in the presence of nitrogen oxides, representative of forest air affected by air pollution; (3) SOA from naphthalene, representative of heavily polluted urban air. In addition to these SOA, we will also examine particles produced by burning biomass, representative of air affected by wildfires. Analysis will involve methods such as Ultra-High Performance Liquid Chromatography High-Resolution Mass Spectrometry (UHPLC-HRMS) and Ultraviolet-Visible (UV-Vis) spectroscopy. These experiments are ongoing, and initial results are expected by the time of the AAAR meeting.

9AC.3

Identifying Gas- and Particle-Phase Tracers to Quantify the Extent of Chlorine Oxidation in the Remote Atmosphere. SEAMUS FREY, Hannah Kenagy, Yaowei Li, Frank Keutsch, Jesse Kroll, *MIT*

Chlorine radical (Cl)-initiated oxidation of volatile organic compounds (VOCs) is thought to be an important process in the marine atmosphere, but its extent and product yields remain uncertain. Estimates of the global importance of Cl-initiated oxidation vary by over an order of magnitude; this prevents an accurate understanding of methane's (CH_4) Cl sink, the efficacy of proposed methane abatement strategies via increased Cl formation from iron-salt aerosols (ISA), and the role of Cl in secondary organic aerosol (SOA) formation. Here, we conduct laboratory studies aimed at improving estimates of the extent of Cl-initiated VOC oxidation, via the identification and quantification of chemical tracers of Cl oxidation. Oxidation experiments are conducted in a temperature-controlled, 7.5 m^3 Teflon chamber using 340 nm UVA lights to initiate photochemistry. Gas- and particle-phase composition is monitored using an Ammonia Chemical Ionization Mass Spectrometer (NH_4^+-CIMS) and a High-Resolution Aerosol Mass Spectrometer (HR-AMS), respectively. Experimental conditions are controlled such that 1) only one of the first two oxidation steps is Cl-initiated, with the other being OH-initiated, and 2) no NO_x is added, so the peroxy radical (RO_2) fate is dominated by reaction with the hydroperoxyl (HO_2) radical. We begin identifying possible Cl-tracers from the reactions of Cl with isoprene and dimethylsulfide (DMS), two model VOCs. Promising gas-phase Cl-tracers are identified and quantified using NH_4^+-CIMS, and the HR-AMS is used to identify particle-phase Cl-tracers. Tracer and SOA yields are compared with previous studies' results of Cl-initiated oxidation carried out under different reaction conditions. These results are discussed in the context of ambient tracer measurements to assess the extent of Cl-initiated oxidation in the real atmosphere, both in the present-day and in future scenarios involving enhanced Cl production by ISA.

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9AC.4

Measurements and Modeling of Urban Secondary Organic Aerosol as a Function of Precursor Volatility Class in the Los Angeles Area During Summer 2022. MELISSA MORRIS, Benjamin Schulze, Andrew Jensen, Douglas A. Day, Pedro Campuzano-Jost, Anne V. Handschy, Melinda Schueneman, Seonsik Yun, Dongwook Kim, Donna Sueper, Harald Stark, Benjamin Murphy, T. Nash Skipper, Havala Pye, John Crounse, Joost A. de Gouw, John Seinfeld, Paul Wennberg, Jose-Luis Jimenez, *CIRES & University of Colorado Boulder*

Urban secondary organic aerosol (SOA) contributes significantly to degraded air quality with the potential for human health risks. Air quality in Los Angeles, CA has improved over the last decade, but is now plateauing. Regulations on vehicle emissions have increased the importance of volatile chemical products and cooking emissions in the formation of SOA. These sources emit a range of gas-phase SOA precursors, from volatile organic compounds (VOCs) to semi- and intermediate-volatility compounds (S/IVOCs). In summer 2022, measurements were made to quantify the amount of SOA formed by VOCs vs. by lower volatility precursors. To our knowledge, these are the first direct measurements of ambient SOA production from discrete volatility ranges.

The measurement setup included dual oxidation flow reactors (OFRs, which simulate ~2 days of atmospheric aging in ~3 minutes). Both ingested ambient air; one OFR was equipped with an electrically conductive polymer inlet that denuded lower volatility species, and the other was run without an inlet. Previous work in our group has characterized volatility-based absorption of gas species by polymer tubing (Morris et al, AMT, 2024). We used a Vocus 2R-proton-transfer-reaction time-of-flight mass spectrometer, an aerosol mass spectrometer and a scanning mobility particle sizer.

The amount and diurnal cycles of SOA and SOA potential were similar between 2022 and 2010. Gas-phase concentrations have changed, indicating a shift in the relative importance of precursor sources. The measurements suggest that ~40% of the SOA formed in the OFR is from compounds with volatilities in the SVOC and lower IVOC range. Results are compared to a constrained box model developed at Caltech, and to the CMAQ photochemical transport model, which runs the chemical mechanism CRACMM, developed at U.S. EPA. Both models overpredict the SOA formation potential of ambient air, and rely too heavily on higher volatility species to generate SOA.

9AC.5

Insights on the Importance of Intermediate and Semi-volatile Organic Precursor Compounds in the Formation of Ambient SOA. MARKUS MUELLER, Tobias Reinecke, Markus Leiminger, Todd Rogers, Martin Graus, *IONICON Analytik GmbH., Innsbruck, Austria*

Quantifying the influence of intermediate (IVOC) and semi-volatile organic compounds (SVOC) on the formation of SOA is challenging because of the difficulties in detecting such low-volatile gas-phase compounds. Recently, a novel approach was introduced for studying the contribution of these compounds to ambient SOA formation. This method utilizes the well studied absorption processes of low volatiles onto polymer tubing to separate volatility classes prior to injection into an oxidation flow reactor for rapid oxidation of ambient air. Hence, via automated addition and removal of absorbing polymer tubing, the SOA formation potential of the sample can be studied with and without IVOCs and SVOCs. However, although clear effects are reported, the identification of specific compounds of IVOCs or SVOCs, that drive the additional SOA formation, remains challenging.

To fill this gap, we apply the novel IONICON Laminar-flow Oxidation reactor (ILOx) for rapid photochemical aging of ambient air in Innsbruck, Austria. Importantly, the ILOx reactor's CFD-optimized sheath air design allows for transmitting IVOCs and even SVOCs with lowermost losses. The aged ambient air is then analyzed by a FUSION PTR-TOF 10k equipped with a CHARON particle inlet to measure gas-phase and condensed particulate organics. The instrument is operated in fast reagent ion switching mode. Proton transfer reaction of organic analytes with H_3O^+ primary reagent ions provides highly quantitative results while soft adduct ionization with ammonium ($A.NH_4^+$) produces almost fragmentation free mass spectra of oxidized organics. Hence, gas-phase and condensed organics are analyzed at highest analytical precision and lowermost limits of detection (~100 ppqV and ~20 pg/m³, respectively).

By periodically switching inlet ports from ambient air to the ILOx reactor, with and without absorbing conductive PTFE tubing, compounds that contribute to the oxidation potential and SOA formation can be directly identified. Herein we present first insights gained with this optimized method.

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9AC.6

How Size-Dependent Aerosol Surface Tension Descriptions Impact Predictions of Hygroscopic Growth and Cloud Droplet Activation. EMILY WERNER, Makaila Hammond, Alison Bain, *Oregon State University*

One of the largest uncertainties in climate models and understanding Earth's energy budget comes from the lack of understanding of atmospheric aerosols. Atmospheric aerosols can be a combination of liquid and solid particulate matter suspended in the atmosphere that have different chemical compositions and distributions. When surface active molecules are present in atmospheric aerosol, a reduced surface tension during hygroscopic growth may reduce the cloud droplet activation barrier. Here, we apply Köhler calculations to droplets containing one of two surfactants, Triton X-100 or sodium octanoate, mixed with NaCl and glucose, and predict their surface tension during hygroscopic growth. We compare a computationally inexpensive, simple kinetic model that predicts both the size- and concentration-dependent surfactant partitioning during hygroscopic growth to assuming a surface tension of water, and a surface tension of a macroscopic solution of the same total composition. When solutions contained a surfactant mass fraction of 0.952, the predicted surface tension throughout hygroscopic growth is reduced relative to the surface tension of pure water (72 mN/m) to 63.5 mN/m and 61.9 mN/m for Triton X-100 and sodium octanoate, respectively. Predictions also showed a 50 nm dry diameter aerosol with surfactant mass fractions of 0.033 and 0.333 were not sufficient to significantly lower the surface tension at cloud droplet activation.

9AC.7

Liquid-Liquid Phase Separation of Atmospheric Aerosols: Effect of Oxygen to Carbon Ratios on Dynamics of Partitioning. NATHAN EDDINGSAAS, Jay Denison, *Rochester Institute of Technology*

Atmospheric aerosols consisting of organic and inorganic components may undergo liquid-liquid phase separation (LLPS) under ambient relative humidities. A typical LLPS structure consists of an organic shell surrounding an inorganic core. Literature states that LLPS occurs when the ratio of oxygen to carbon (O:C) of the organic components is between ~0.56 and ~0.71. Majority of studies look at systems of one organic and inorganic component, and those which study multiple organic components focus on the average O:C ratio of the system to determine if LLPS occurs. Using optical and Raman microscopy, we studied how the composition of each phase changes as the ratio of organic components and average O:C ratio fluctuates.

Individual aerosol droplets (25 – 300 µm) containing ammonium sulfate, polyethylene glycol (PEG) (O:C 0.56), and sorbitol (O:C 1.0) were placed on a hydrophobically coated slide. The ratio of PEG to sorbitol was varied to stay within an average O:C ratio of 0.56-0.71. For optical microscopy, the slide was placed in a flow cell with a humidity generator, and the radii of the core and shell were measured, as a function of ratio of PEG to sorbitol. For Raman microscopy, the slide was placed in a closed cell containing a saturated salt solution to obtain the desired relative humidity, and spectra were recorded in a 20x20 grid mapped the entire droplet.

LLPS only occurred when the average O:C ratio was between 0.56 and 0.71; however, the O:C ratio of the individual organic molecules determined where it resided during phase separation: lower O:C in the shell, higher O:C in the core with the ammonium sulfate. This result shows that there is not necessarily a strict separation between organic and inorganic species during LLPS.

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9AC.8

Using Tryptophan as an Indicator of pH in Bioaerosol Particle Fluorescence for Temporal Resolution of Aerosol Chemistry.

HUNTER RICHARDS, Zhenyu Ma, Allen E. Haddrell, Herek L. Clack, *University of Michigan*

Introduction

While the role of pH in respiratory virus inactivation has recently been discussed [1], measuring the change in pH of aerosols carried in the rapidly changing dynamics of exhaled breath is required to better connect this relationship to transmission of human respiratory diseases. To better understand the potential effect that an increase or decrease in pH has on the inactivation of certain respiratory viruses, it is first necessary to characterize the change in pH of a bioaerosol over time. Common fluorophores found in bioaerosol particles such as amino acids like tryptophan [2] can be exploited to interrogate pH change in exhaled bioaerosols that are relevant to the transmission of infectious disease. In our previous experiments, it was determined that a higher pH correlates with stronger 310-400 nm fluorescence, in response to 280 nm excitation, for aerosols containing tryptophan. From these results, using tryptophan as a pH-dependent fluorophore opens the possibility to monitor in situ the change in pH of bioaerosols.

In this study, a wideband integrated bioaerosol sensor (WIBS, Droplet Measurement Technologies) is used to analyze the fluorescence intensity of aerosolized solutions within a closed chamber containing a CO_2 sensor, using tryptophan fluorescence as an indicator of pH. An exploration of the effect of relevant environmental parameters, such as relative humidity and CO_2 concentrations, on aerosol pH provides insights into the impact on viral inactivation, climate implications, and air pollution control methods.

Experimental Procedure

A solution of 5% mass fraction of solute (MFS) sodium chloride (NaCl) and sodium bicarbonate ($NaHCO_3$) with tryptophan was aerosolized using a handheld nebulizer (Mesh Nebulizer Model YM-3R9) into a closed chamber. A portable CO_2 monitor (SAF Aranet4) recorded temporal changes in CO_2 concentrations in the chamber while a Wideband Integrated Bioaerosol Sensor (WIBS) instrument sampled aerosols from the chamber to measure aerosol fluorescence intensity over time.

The WIBS instrument sampled from the chamber at a flow rate of 0.3 liters per minute for 10-20 second intervals at designated points in time over a 90 minute period. This period of time was sufficient to identify the rapidly-changing aerosol chemistry during the first 10 minutes post-aerosolization, with stable conditions forming for each solution after roughly 50 minutes in our prior experiments to establish optimal experimental procedures. The WIBS instrument measures bioaerosol fluorescence intensity of the aerosols sampled from the chamber at predetermined time intervals by using a Xenon flash lamp to excite tryptophan at its known excitation wavelength of 280 nm, which produces fluorescent emission at 310-400 nm wavelength.

The chamber conditions were adjusted for relative humidity and CO_2 concentration to determine the effect of these parameters on aerosol pH.

Results

The recorded fluorescence intensity spectra of sampled aerosols generated from bulk solutions of known pH were plotted in terms of relative abundance. At a higher bulk solution pH, aerosols generated from a solution mixture of NaCl and $NaHCO_3$ with added tryptophan exhibit a higher fluorescence intensity. With the introduction to the chamber of the aerosolized NaCl + $NaHCO_3$ solutions, the CO_2 concentration in the chamber steadily rose over the duration of the chamber experiment before reaching a relatively stable condition after 40 minutes. Pairing the temporal evolution of CO_2 concentration in the chamber with the time-resolved fluorescence intensity of aerosols sampled by the WIBS instrument, fluorescence intensity decreased as the CO_2 concentration increased correlating with an increase in aerosol pH.

Summary and Conclusions

As CO_2 concentration increases over time, a reduction in fluorescence intensity was observed for the solution containing tryptophan as a fluorophore. This indicates an increase in bioaerosol pH as CO_2 concentrations increase. Using WIBS to monitor fluorescence intensity of bioaerosols mimicking exhaled breaths paired with CO_2 concentration monitoring can help better understand the relationship between pH and virus inactivation.

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9AC.9

Measuring Protein Dynamics in Levitated Microdroplets.

VIOLA FIELGEIN, Michael Jacobs, *Texas State University*

It is increasingly appreciated that the unique physicochemical properties of microdroplets are capable of accelerating a wide array of different chemistries compared to reactions in macroscale solutions. While much has been made about the increasing importance of surface reactions in microdroplets, we still lack a fundamental understanding of the molecular mechanisms driving accelerated chemistry in microdroplets. Notably, several recent studies have observed significantly accelerated biochemical reactions in microdroplets, including post-translational modifications and protein digestion. It is well understood that proteins adsorb to the air-water interface and denature, but the extent and nature of this process in microdroplets and its impact on reaction kinetics such as enzymatic reactions, remain unclear.

To develop a more fundamental understanding of how confinement in microdroplets can lead to altered enzymatic kinetics, we are using single droplet levitation techniques to study the dynamics and reaction kinetics of proteins in individual microdroplets with well-defined compositions. Here, we describe our recent work examining the dynamics of a model protein, green fluorescent protein (GFP), in levitated microdroplets of different compositions. Microdroplets are levitated within a quadrupole electrodynamic trap (QET), and the folded state of GFP is assessed in situ by monitoring changes in fluorescence intensity over time. Our preliminary results show that GFP intensity can significantly decrease in microdroplets in second to minute timescales, suggesting the protein's structure is perturbed in microdroplets. Because similar changes in fluorescence intensity are not observed in macroscale solutions with the same compositions, we believe that partitioning to the air-water interface is the main driving force altering protein dynamics in microdroplets. Ultimately, by studying protein dynamics in microdroplets of different size and composition, we aim to tease out whether the rate acceleration of biochemical reactions in microdroplets is a surface driven process or if there is some other driving force.

9AC.11

Characteristics of Size - Resolved Organic Aerosols Using Offline Aerosol Mass Spectrometry: NYC-METS, Part of the 2023 AEROMMA Campaign.

XU HE, Corin Tyler, Yao Xiao, Emily Costa, Delaney Schulteiss, Kayleigh Reilly, Ruizhe Liu, Athena Xu, Nga Lee Ng, Drew Gentner, Andrew P. Ault, Rachel O'Brien, *University of Michigan*

Urban areas often suffer from high ozone and PM events, both of which can have detrimental effects on human health. New York City has periods of high particulate matter (PM) concentrations each summer, much of which is formed through secondary processes. There is a wide range of biogenic and anthropogenic sources, including volatile chemical products (VCPs), that contribute to volatile organic compound (VOC) emissions. Their contribution to the formation of secondary organic aerosols (SOA) in urban environments is not well characterized. To improve our understanding of the changes in the composition and size distribution of urban organic aerosols (OA), aerosol particles were collected at a ground site in Manhattan during the summer of 2023 as part of the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) campaign. The chemical composition and concentration of the aerosols as a function of particle size were analyzed using offline high-resolution time of flight aerosol mass spectrometry (HR-ToF-AMS) and with liquid chromatography (LC)-Orbitrap mass spectrometry. Combining organic family fragment group information obtained from HR-TOF-AMS with the molecular distribution from LC-Orbitrap enabled a detailed characterization of organic aerosol composition across the full-size distribution (56 nm to 5.6 um). Comparison of aerosol composition and organic mass loading under different weather conditions is used to examine the influence of sources on SOA formation. 12 and 24-hour size resolved samples are compared to online data sets collected during the campaign. Both qualitative and quantitative comparison provide insights into characteristics OA mass that are retained during offline analysis. Overall, these results investigating chemical composition, concentration, and urban aerosol size distribution will improve our understanding of OA composition and possible sources within megacities as VOC emissions changes.

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9AC.12

Understanding Secondary Organic Aerosol (SOA) Formation over the Southeast USA in the Context of the DOE AMF3 Field Measurements at the Bankhead National Forest (BNF).

MANISHKUMAR SHRIVASTAVA, Brian Gaudet, Alla Zelenyuk, Jerome Fast, Sijia Liu, Sergey Nizkorodov, Celia Faiola, Gregory W. Vandergrift, Zezhen Cheng, Swarup China, *Pacific Northwest National Laboratory*

The Southeast U.S. is a well-known hotspot for biogenic emissions and secondary organic aerosol (SOA) formation, influenced by dynamic interactions between natural and anthropogenic sources. The recent deployment of the Department of Energy's third Atmospheric Radiation Measurement Mobile Facility (AMF3) at Bankhead National Forest (BNF) in Alabama provides a unique opportunity to study these processes through long-term, continuous measurements of aerosol, gas-phase, and meteorological properties.

In this study, we use the Weather Research and Forecasting Model coupled with Chemistry (WRF-Chem) to investigate SOA formation over the Southeast U.S., with a focus on the BNF site. Our simulations resolve the formation of isoprene epoxydiol (IEPOX)-SOA driven by interactions between biogenic isoprene and anthropogenic sulfate, incorporating updated parameterizations based on recent laboratory studies. Additionally, we explore how acyclic terpenes emitted by stressed vegetation influence SOA formation compared to cyclic terpenes from healthy plants. By including updated SOA yields, volatility, and viscosity differences between acyclic and cyclic terpenes, we estimate their impacts on SOA mass and cloud condensation nuclei (CCN) formation.

We also assess the potential of AMF3 observations to constrain and evaluate key SOA processes within WRF-Chem. This integrated approach aims to reduce uncertainties in aerosol-cloud interactions and improve our predictive understanding of atmospheric composition over the SE USA.

9AC.13

Measurements of Aqueous-Phase Secondary Organic Aerosol Processing.

JOHN SHILLING, Jesse Anderson, Will Cantrell, Richard Flagan, Jose Fuentes, Gourihar Kulkarni, Mikhail Pekour, Hamed Sadi, Raymond Shaw, Suryadev Singh, ManishKumar Shrivastava, Jaemin Yeom, Maria A. Zawadowicz, Alla Zelenyuk, Yuzhi Chen, Tania Guatam, *Pacific Northwest National Lab*

Several field and modeling studies have suggested that cloud processing could be a significant and sometimes dominant source of secondary organic aerosol (SOA), which has a major influence on the Earth's energy balance. However, relatively few studies have investigated the formation and processing of SOA in authentic cloud droplets. Instead, most studies are conducted in bulk solutions or on deliquesced aerosol particles and results are extrapolated to liquid water content characteristic of clouds. We describe two types of experiments in which we investigate the role cloud processing may play in generating SOA. In the first series of experiments, SOA was generated from the photooxidation of isoprene and alpha-pinene in the Pacific Northwest National Laboratory (PNNL) environmental chamber and the SOA vapors were extracted into a second chamber where they interact with deliquesced sulfate particles at varying pH and at relative humidity (RH) approaching 100%. We measure the SOA formation efficiency and chemical composition that results under these near-saturation experiments. We shall also present preliminary measurements of the fate of isoprene expoxydiols (IEPOX) when injected into a synthetic cloud formed in the Michigan Technological University Pi cloud chamber as a function of the cloud liquid water content.

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9AC.14

Formation of Aqueous SOA From Water-Soluble Gaseous Products of Monoterpene Oxidation. MATT ZARAGOZA, Lisa Wingen, Sergey Nizkorodov, Annmarie Carlton, *University of California, Irvine*

Aqueous secondary organic aerosol (aqSOA) refers to compounds that are produced by the chemical transformations of small organic molecules into less volatile molecules in aqueous environments, such as cloud droplets and wet aerosols. The amount and impact of aqSOA produced from gaseous products of oxidation of common volatile organic compounds (VOCs) are still highly uncertain. A large fraction of these VOC oxidation products can be classified as water-soluble organic carbon ($WSOC_g$), and they can undergo aqueous photochemical processing upon exposure to ultraviolet radiation in aqueous environments to generate aqSOA. This project aims to quantify the mass yields and chemical composition of aqSOA from gaseous products of alpha-pinene oxidation. A mixture of alpha-pinene oxidation products was generated in an oxidation flow reactor using the hydroxyl radical ($^{\bullet}OH$) as the primary oxidant. The oxidation products were passed through a Teflon 0.2 µm filter to remove particulate matter, allowing only gaseous oxidation products to pass through. A glass mist chamber was used to partition $WSOC_g$ into aqueous mist droplets, mimicking atmospheric aqueous environments. Aqueous $WSOC_g$ samples were irradiated with 254 nm radiation in presence of H_2O_2 in order to simulate $^{\bullet}OH$-driven aging over various time periods. Photooxidized samples were atomized, and AMS and SMPS instruments were used to determine aqSOA mass yields and chemical composition. Separately, an Orbitrap high-resolution mass spectrometer was used to measure the formula distribution of aqSOA compounds, and a total organic carbon analyzer was used to quantify the changes in dissolved organic mass concentration. There was a noticeable increase in particle-phase mass concentration for both the AMS and SMPS as photooxidation time increases, indicating the formation of aqSOA. Results from this experiment will help models better describe aqSOA formation from the aqueous processing of water-soluble alpha-pinene oxidation products.

9AC.15

Phthalate Transfer and Enrichment in Artificial Sea Spray Aerosols. MOLLY HEDIN, Kanuri Roundtree, Diana Tran, Maya Morris, Xitlali Ventura, Jonathan Slade, *University of California, San Diego*

Phthalates (Phthalate Acid Esters; PAEs) are widely used toxic plasticizers, acting as binding agents in everyday products. Their contamination in our environment is widespread, and previous studies have identified the air-sea exchange of PAEs in many major oceans around the world. The enrichment and transfer specifics of PAEs in the aerosol phase occurring at the air-sea interface remain unknown. The transfer of PAEs from the ocean to the aerosol phase includes mechanisms of bubble bursting and wave breaking. To simulate ocean conditions, a Marine Aerosol Reference Tank (MART) is used to study the enrichment and air-sea transfer of PAEs. Artificial seawater at a salinity of 35 ppt, and a sea surface microlayer (SML) of palmitic acid (PA) at a concentration of 35µM, were used to mimic ocean conditions. Three different PAEs found in previous field studies were applied to the surface of the artificial ocean matrix at environmentally relevant concentrations, around 3ng/L; Dimethyl phthalate (DMP), Dibutyl phthalate (DBP), and Di(2-ethylhexyl) phthalate (DEHP) were used as they range in carbon chain length and bulk. Aerosols generated from the MART were collected on quartz fiber filters with a pore size of one micron. The particles are pushed through a flow of purified air, with the relative humidity and temperature measured via a Vaisala probe, and a size distribution via a scanning electrical mobility sizer. The concentration of PAEs on collected aerosol filters, in the SML extracted via a glass sheet, and bulk seawater samples were determined by GC-MS. Using this data, enrichment factors with respect to Na+ for PAE aerosol transfer were obtained. This work provides insight into how PAEs enter the atmosphere, their potential effects on air pollution, and a greater understanding of their environmental impact in the marine boundary layer.

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9AC.16

Acidity-Driven Shifts in Aerosolized Sodium Sulfate Crystal Structure via Raman Microspectroscopy and Implications for Isoprene-Derived Secondary Organic Aerosol Formation. MADELINE COOKE, Ali Alotbi, Cara Waters, Lindsay Heagle, N. Cazimir Armstrong, Carlie Poworoznek, Zhenfa Zhang, Avram Gold, Jason Surratt, Andrew P. Ault, *University of Michigan*

Sea spray aerosol (SSA) contributes significantly to global aerosol budgets, and the NaCl present often heterogeneously reacts with H_2SO_4 to form Na_2SO_4 within particles of varying acidity. The acidic particles can subsequently undergo reactive uptake of isoprene-derived oxidation products, such as isoprene epoxydiols (IEPOX), to form significant amounts of secondary organic aerosol (SOA). While the complex pH-dependence of IEPOX-SOA formation with ammonium sulfate aerosol has been widely explored, there has been minimal research on pH-dependent SOA formation with sodium sulfate. Herein, aerosolized solutions of Na_2SO_4 mixed with different amounts of H_2SO_4 (pH = 1, 1.3, and 3) were used as seed aerosol to take up IEPOX and form SOA. We unexpectedly observed a distinct crystal structure (phase III) in more acidic particles using Raman spectroscopy, based on characteristic peaks for $\nu_{as}(SO_4^{2-})$ at 1077, 1130, and 1199 cm^{-1} versus 1101, 1131, and 1152 cm^{-1} for $\nu_{as}(SO_4^{2-})$ in typical crystalline Na_2SO_4 (phase V). The presence of phase III in iSOA indicates a more acidic environment. Our results show that reactive uptake of IEPOX to seed particles increases acidity (i.e., pH decreases) over time. This has important implications for IEPOX-SOA formation, particularly on aged SSA in marine and coastal environments.

9AC.17

Reactions Between Small Atmospheric Carbonyls and Ammonium Sulfate. MELISSA GALLOWAY, Brian Henesey, Stephanie Ingwer, Hope Tracey, Lily Gaskill, Shirin Abbasi, Lotus Medley, Grace Tomasetti, Elizabeth Obarow, Rachael Holappa, Adelaide King, Daniel Griffith, Heidi Hendrickson, *Lafayette College*

Aqueous reactions of aldehydes with amines or ammonium salts have been implicated in atmospheric brown carbon formation processes. Recent work has started to identify the products of these reactions, especially those responsible for visible light absorbance. However, few studies have looked at the reaction products of ammonium with a mixture of aldehydes. Supercritical fluid chromatography-mass spectrometry is used to aid in the separation and identification of the reaction products of mixtures of small difunctional, water soluble carbonyls (e.g. glyoxal, methylglyoxal, and glycolaldehyde) with ammonium sulfate. We present structural comparisons between products formed from the reaction of a single aldehyde with ammonium and a mixture of carbonyls and ammonium sulfate. Product formation and light absorption also vary as a non-linear function of the ratio of each carbonyl in solution. The results of these studies will allow us to better understand the aqueous chemistry occurring in atmospheric aerosol droplets.

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9AC.18

Chemical Pathways of Humidity-enhanced Organic New Particle Formation in Monoterpenes: Methodology and Mechanism. TIJESUNI ADEOYE, *University of Vermont*

Organic New Particle Formation (NPF) is a pivotal atmospheric process that contributes 10–80% of cloud condensation nuclei. However, the role of relative humidity (RH) remains poorly understood, with previous studies limited by high variability (>50%) and unrealistically high VOC mixing ratios (>100 ppb). We developed optimized VOC injection and dilution techniques that led to achieving measurement variability of less than 10% even at parts per trillion mixing ratio levels of the VOC. This has allowed reliable investigation of RH effects at atmospherically relevant conditions (<10 ppb) in the University of Vermont Environmental Chamber (UVMEC). Previous work with six monoterpenes revealed two distinct enhancement patterns: α-pinene and α-terpineol showed high VOC threshold enhancement (around 5-10 ppb) while β-pinene and sabinene revealed low VOC threshold enhancement at sub-ppb range. All experiments were conducted with an ozone mixing ratio of 500 ppb. Each of these two classes comprises VOCs with similar abstractable hydrogens and OH radical yields, suggesting autoxidation and hydroperoxide reactions, respectively, as two important mechanisms contributing to humidity enhancement. To isolate the predominant pathway, we studied γ-terpinene and α-terpinene, which are compounds with similar hydrogen contents but different OH yields. Both were enhanced at low VOC threshold (0.25 and 0.075 ppb, respectively), indicating autoxidation as the primary humidity-dependent pathway while hydroperoxide reaction appears to be secondary. We validated this hypothesis by studying camphene, a monoterpene with limited abstractable hydrogen content. Replicate humid versus dry experiments revealed no NPF enhancement at a mixing ratio of 5 ppb, confirming autoxidation's crucial role. Although humidity-enhanced NPF likely involves physicochemical contributions that include surface area effects and particle seeding, our methodology enables focused investigation of chemical mechanisms. Hence, this work identifies autoxidation as the dominant chemical pathway.

9AC.19

Effect of Relative Humidity on Biogenic New Particle Formation in the Presence of a Seed Aerosol. ADAM BUDZYN, Giuseppe Petrucci, *University of Vermont*

The impact of relative humidity (RH) on new particle formation (NPF) from biogenic precursors of secondary organic aerosol (SOA) remains poorly understood. Previous studies have shown conflicting results, with elevated RH at times resulting in enhancements in NPF and other times a suppression. Previous work done in our group has shown that decreasing the mixing ratio of the volatile organic compound (VOC) can lead to an enhancement in NPF under higher humidity (60%) conditions. However, these works and many others in the field conduct experiments under pristine conditions, that is an environment where there are no pre-existing particles. Use of a seed aerosol as a condensation sink results in two possible pathways for the VOC oxidation products, either NPF or condensation onto the seed aerosol. We hypothesize that NPF can occur if the VOC reacts rapidly enough, providing an instantaneous supersaturation of these products to form new particles.

This study looks at the effects of humidity on NPF of SOA in the presence of an organic seed aerosol (squalane). It focuses on how humidity can enhance the formation of particles and how changing the physical parameters of the seed, for example number density and/or area, affects NPF. Experiments were conducted with 5 ppb α-pinene, 500 ppb ozone, and either under dry (0% RH) or humid (60% RH) conditions. The squalane parameters were varied with number densities ranging from 1500 to 3500 #/cm^3 and the geometric mean diameter from 120 to 240 nm. All aerosol measurements were made with a scanning mobility particle sizer with a long-differential mobility analyzer to monitor new particle formation and the larger seed particles.

Results obtained in this study show that experiments performed under humid conditions in the presence of a seed aerosol can increase NPF (relative to dry conditions) from 18% up to 36% and NPF rate from 17% to over 500% based on total seed surface area. This indicates that water alters the NPF process either chemically or physically resulting in more particles formed even with a condensation sink scavenging VOC oxidation products.

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9AC.20

Nucleation Closure Study from 2023 Pittsburgh Field Campaign. DARREN CHENG, Dominic Casalnuovo, Christine Troller, Coty Jen, *Carnegie Mellon University*

Particle size distributions are used to calculate nucleation rates during new particle formation (NPF) events. However, the low time resolution and poor sensitivity of instruments used to observe the size distribution of freshly nucleated particles can lead to inaccurate estimates of nucleation rates. We calculated nucleation rates in Pittsburgh, PA from particle size distributions measured with the new high time resolution Condensation Particle Counters For Atmospheric Rapid Measurements (CPC FARM) and gas precursor concentrations measured with a chemical ionization mass spectrometer (CIMS). The CPC FARM nucleation rates were calculated by examining the rate of appearance of particles into the smallest size bin at 1.6 nm. The gas precursor nucleation rate was calculated by modeling the formation of clusters through a transient form of the acid-base reaction model. Good agreement between particle and gas-based nucleation rates is observed during sulfuric acid-driven NPF events. This study demonstrates that atmospheric nucleation rates in Pittsburgh change rapidly due to inhomogeneous mixing and advection of nucleation precursors and freshly formed clusters.

9AC.21

Gas-Phase Photooxidation of Dimethyl Selenide (DMSe): Mechanistic Insights and Comparison to Dimethyl Sulfide (DMS). LINHUI TIAN, Erin Bowey, Michael Lum, Don Collins, Roya Bahreini, Ying-Hsuan Lin, *University of California, Riverside*

Dimethyl selenide (DMSe) is a volatile organoselenium compound emitted from marine and terrestrial sources. Structurally analogous to dimethyl sulfide (DMS), DMSe is expected to undergo similar atmospheric photooxidation processes. However, its gas-phase oxidation mechanism remains unclear.

In this study, we conducted OH-initiated photooxidation of DMSe in an environmental chamber and analyzed gas-phase products using iodide chemical ionization mass spectrometry (I--CIMS). Several oxidation products were identified that are structurally analogous to known DMS oxidation products, including selenium dioxide (SeO_2), methaneselenonic acid (CH_4SeO_3), and CH_2SeO_4. Time series comparisons with established DMS oxidation products (e.g., DMSO, MSIA, MSA) reveal that certain Se-containing species, such as CH_4SeO_3 and CH_2SeO_2, show similar growth profiles and relative abundance patterns to their sulfur counterparts, suggesting conserved oxidative branching in early-stage photooxidation.

However, the fractional abundance and evolution of other Se-containing products, such as CH_4SeO_4, C2H6SeO4, and OCSe, show considerable differences from those of DMS analogs. These differences imply selenium-specific reaction channels, potentially involving altered radical reactivity, enhanced formation of highly oxygenated species, or secondary molecular rearrangements not observed in sulfur systems.

Our results demonstrate that while DMSe and DMS exhibit overlapping oxidative pathways, DMSe photooxidation yields a broader and more diverse set of gas-phase organoselenium compounds. The molecular-level insight from high-resolution CIMS highlights the need to incorporate selenium-specific pathways into atmospheric oxidation models to better understand Se fate, oxidant budgets, and secondary pollutant formation.

Keywords:
Dimethyl selenide, atmospheric oxidation, organoselenium, gas-phase mechanism, CIMS, reaction mechanism, DMS analog

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9AC.22

Photochemically-driven Property Changes of Irradiated Carbonyl-Containing Volatile Organic Aerosol Mimic Solutions. AVA BATTAGLIA, Kira Baker, Maia Merriman, Erin O'Leary, Michael Haines, Melissa Galloway, Joseph Woo, *Lafayette College*

Carbonyl-containing volatile organic compounds (CVOCs), such as glyoxal (G) and methylglyoxal (MG), are commonly observed in aqueous atmospheric aerosols across a wide range of atmospherically relevant contexts. Due to their high reactivity under both dark-aged (nighttime) and irradiated (daytime) conditions, a wide range of oligomeric products have been observed in mixtures containing CVOCs and inorganic salts. The relative yields and pathways of these products have also been shown to depend on the presence of sustained gas-liquid interfaces (e.g. droplet surfaces), where surface-active compounds can locally accumulate and undergo enhanced chemical activity. This study compares the physical properties (surface tension and UV/visible absorbance) of dark-aged and UV-exposed CVOC/ammonium sulfate mixtures. Surface tension and absorbance properties of specific, individual oligomeric compounds are also reported for both dark and irradiated conditions.

9AC.23

Dynamic Surface Tension Measurements of VOC-Exposed Hanging Droplet Aerosol Mimics. MICHAEL HAINES, Tzu-An Kuan, Bruno Loyola San Martin, Joseph Woo, *Lafayette College*

Surface tension is a crucial property that affects an aerosol's ability to partition mass to and from the air surrounding it, and by extension its ability to activate into cloud droplets under supersaturated conditions. Proof-of-concept measurements have indicated that the surface tension of a suspended water droplet will shift when in the presence of evaporated organic compounds in the air surrounding it, with changes that would be greater than expected of the resulting bulk concentration from the relatively small amounts of gas that are being transferred into the droplets. This study aims to take a more systematic approach to this phenomenon by exposing hanging droplets of water and near-saturation ammonium sulfate solution to a variety of common water soluble volatile organic compounds (e.g. ethanol, acetone, isopropanol.) Time-resolved surface tension measurements are reported, demonstrating that changes to the equilibration time for exposed droplets can be observed depending on VOC moieties and droplet polarity.

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9AC.24

Heterogenous Nitration and Oligomerization Reaction of BSA Protein with Urban Air. RILEY SMITH, Aleksandra Volkova, Rachel L. Davey, Erick Mattson, J. Alex Huffman, *University of Denver*

Proteins are found in the aerosol phase primarily as a component of biological particles such as pollen or spores. While proteins can promote allergenic or other effects directly, they can also undergo heterogeneous reaction to promote post-translational modification of the proteins. A heterogeneous reaction mechanism driven by gas-phase ozone (O_3) and nitrogen dioxide (NO_2) has been shown to promote both nitration and oligomerization of exposed tyrosine residues within analyzed proteins. Nitrated proteins modified in this way can produce an increased IgE response in rat models, thus suggesting that proteins embedded in pollen could become more allergenic when exposed to urban air pollution. BSA (bovine serum albumin) was used as a standard protein analyte and loaded onto syringe filters, then exposed to a constant flow of ambient air through Teflon tubing. Samples were placed at the Rocky Flats North and La Casa air monitoring sites operated by the Colorado Department of Public Health and the Environment (CDPHE) in the Denver metro area of Colorado. After 2-4 weeks of exposure for each sample, the BSA protein was extracted off the filters using a PBS buffer flush and analyzed via high performance liquid chromatography (HPLC). The degree of nitration was then determined by comparing peaks produced at wavelengths of 280 nm, for unmodified protein detection, and 357 nm, for nitrated protein detection. A separate analysis using size exclusion chromatography (SEC) was performed to measure the relative degree of dimerization or oligomerization. Previous preliminary work from our group showed the relative ratio for oligomerization to nitration increased when exposure time increased, but only a small number of samples were available for that initial set of observations. This work continues that project to observe nitration and oligomerization degrees over a wider range of exposure conditions. Updated results will be discussed.

9AE.1

Modeling the Development of Coccidioides Spores in Convective Dust Plumes Using the Flux-Gradient Method. EVELYN KEEFE, Samuel Jurado, Franklyn Telles, Toby Ault, Nour Kastoun, Helena Tsigos, Tyler Sanders, Kylie Miller, Simran LaBore, Jack Halberstadt, *Cornell University*

The movement and transport of dust and particulate matter through Earth's atmosphere can have immense effects on radiative forcing and atmospheric chemistry, as well as prominent impacts on air quality and human health. The transport of pathogens via dust particulates presents an important consideration for flux modeling in addition to public health, and has unique implications for our collection area in New Mexico. Coccidioidomycosis, caused by fungus of the Coccidioides genus and known colloquially as "Valley Fever", is an infection caused by the inhalation of fungal spores suspended and transported by dust particulates. Spores are found within the soil of arid locations such as our data collection site and released when dust is suspended and transported through the air. Though recognized for over 80 years in other regions of the American Southwest, Coccidioides was discovered in April 2025 for the first time in New Mexico; awareness of the disease is limited. Understanding dust emissions and potential spread via convective dust plumes is an important aspect of understanding how atmospheric conditions can increase the risk of transmission and infection. This study aims to connect the transmission of valley fever with boundary layer behaviors by examining flux gradients within situations where convective plumes may be present. Previous studies have used particulate matter concentrations or wind speeds as direct proxies for infection; this study aims to link infection to convective atmospheric conditions via parameterized wind speed variability. We utilized PM_{10} dust flux data collected in summer 2025 from the White Sands Missile Range Meteorological Sensor Array located in the Jornada Experimental Range in New Mexico and the North American Regional Reanalysis (NARR) dataset. We will use the model described by Cakmur et. al (2004), parameterized using PM_{10} fluxes collected at Jornada, to estimate spatio-temporal dust emissions from NARR wind speeds. This will allow for further exploration of the relationship between convective dust events and dust flux exposure, and how these events may be related to the transmission of Valley Fever in New Mexico.

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9AE.2

Finger Lake Effect Precipitation and Its Influence on Pollen Levels and Public Health. KYLIE MILLER, Jack Halberstadt, *Cornell University*

Finger Lake Effect precipitation events are hypothesized to locally reduce airborne pollen concentrations due to increased moisture and altered wind patterns. To investigate this relationship, we are in the process of deploying weather stations around Cayuga Lake, aimed at capturing key lake effect variables such as temperature, humidity, wind direction, and precipitation intensity. Our study will compare pollen counts in regions directly influenced by lake effect precipitation with nearby areas outside the precipitation zone, assessing how pollen levels respond to the dynamic interplay of rainfall and lake-driven winds. Pollen sampling will be conducted using a tethersonde and kitesonde (for a portable alternative) system equipped with a custom-designed pollen catcher, allowing vertical profiling of particulate concentrations before, during, and after lake effect events. In addition to quantitative measurements, a qualitative component will explore the impact on local residents through a survey assessing allergy symptoms before and after these weather events. By integrating atmospheric data with biological and human health observations, this study aims to provide a more comprehensive understanding of how Finger Lake Effect phenomena influence air quality and public health, particularly during peak pollen seasons in the Finger Lakes region.

9AE.3

Surface Charge-Dependent Electrostatic Interactions in Cellular Uptake of Nanoparticles. SATSUKI TAKAI, Taiki Nagaya, Emi Fukuda, Yasuto Matsui, *Kyoto University*

Nanomaterials have significant utility in both industry and biomedical applications. However, their cellular uptake mechanisms and safety profiles remain insufficiently understood. Several studies have indicated that receptor-mediated endocytosis contributes to the cellular uptake of nanoparticles, and that surface potential may influence the extent of uptake. Nevertheless, few studies have quantitatively evaluated the uptake of nanoparticles with identical surface modification but differing surface potentials.

This study aimed to quantitatively clarify the dependence of nanoparticle uptake and kinetics on surface potential, using particles differing only in surface potential within receptor-mediated endocytic pathways. Receptor-dependent uptake of carboxyl-modified nanoparticles was assessed by flow cytometry using endocytosis inhibitors and natural ligands for low-density lipoprotein receptors (LDLR) and scavenger receptors (SR). Additionally, three types of carboxyl-modified nanoparticles with distinct surface potentials (−30.30 ± 0.88 mV, −45.13 ± 1.20 mV, −57.36 ± 1.68 mV) were exposed to A549 cells, and differences in uptake behavior were analyzed by fluorescence microscopy. Co-localization analysis with endocytic markers was performed to quantify uptake dynamics.

Inhibition of clathrin- and caveolae-mediated endocytosis significantly reduced the number of nanoparticle-positive cells. The addition of ligands also suppressed uptake, confirming the involvement of LDLR and SR. Particles with more negative surface potential exhibited faster uptake, especially within the range of −30 to −40 mV. In contrast, the maximum uptake amount was not dependent on surface potential.

These findings suggest that nanoparticle uptake occurs via receptor-mediated endocytosis and may be facilitated by electrostatic interactions between nanoparticles and cellular receptors. Notably, more negatively charged particles appear to bind more rapidly to receptors, resulting in accelerated internalization. Future studies will include aerosol-phase exposure to evaluate how airborne particle charge influences cellular uptake efficiency. Exploring how physicochemical properties of particles affect their interactions with cells will establish in vitro alveolar exposure models that can simulate realistic deposition and uptake dynamics.

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9AE.4

Development of a Simplified In-Vitro Aerosol Exposure Chamber for Enhanced Dispersion and Deposition Efficiency.

SEOYEON PARK, Chang-gyu Woo, *KOREATECH*

The evaluation of inhalation toxicity of aerosolized substances has traditionally relied on in-vivo animal testing, which raises ethical concerns and presents challenges in terms of cost, time, and species extrapolation. As a result, in-vitro methods are increasingly being adopted for regulatory and research applications. However, ensuring uniform and efficient delivery of dry powder aerosols to cell cultures remains a critical challenge in in-vitro systems.

In this study, we developed a simplified and compact aerosol exposure chamber designed to deliver dry powder aerosols with improved dispersion and deposition efficiency. The chamber features a three-stage inlet configuration comprising a particle loading unit, a dispersion guide, and a perforated distribution plate. Three types of distribution plates with different hole sizes were fabricated to compare aerosol flow behavior and deposition performance.

Dry powder was introduced into the chamber via vacuum-driven airflow, generated by restoring the internal pressure from sub-atmospheric to ambient. The dispersed particles settled onto the bottom exposure surface (multi-well plate), and deposition characteristics were analyzed using optical microscopy. A pre-drying treatment of the powder was applied to reduce moisture-induced agglomeration and improve flowability.

The internal pressure of the chamber recovered within 30 seconds, during which most of the particles were delivered. Based on sedimentation calculations for the test particles, the total exposure process was estimated to be completed within approximately 10 minutes. Pre-drying treatment significantly enhanced dispersibility and reduced variation in deposition. Maximum deposition efficiency reached 25.40%, and the deposited dose was estimated at approximately 13.06 μg/cm². For particles under 20 μm, deposition uniformity showed a deviation of less than ±30% across wells.

Compared to conventional powder exposure methods, this chamber requires a smaller sample loading (as low as 100 mg) and eliminates solvent-related interference. Its simple operation and minimal sample waste make it a practical and cost-effective tool for in-vitro inhalation toxicity studies, supporting ethical alternatives to animal testing.

This work was supported by the Bio industry technology development project (grant number: 20018463) funded by the Ministry of Trade, Industry & Energy (MOTIE, Korea).

9AE.5

Elemental and Organic Carbon at Three Sampling Sites Surrounding a Wood-Pellet Manufacturer in a Rural North Carolina Town.

CLAUDIO SANCHEZ, Zhenduo Yao, Dylan James, Andrew George, Kathleen Gray, William Vizuete, Glenn Morrison, *University of North Carolina, Chapel Hill*

Wood pellet manufacturing sites are frequently located in small rural communities in the southeastern US. These communities have expressed concern about the environmental impact of these sites due to site emissions and truck traffic. To evaluate the potential impacts on the community, we measured a variety of air pollutants at three sites surrounding a wood pellet manufacturer in rural North Carolina. The sampling sites were chosen based on favorable meteorology (generally upwind, downwind, neither) and access to properties, and they formed an approximately even-sided triangle around the manufacturing site. Using a combination of meteorological measurements, real-time sensors, active and passive samplers, we quantified wind-direction, temperature, humidity, PM_{10}, PM 2.5, PM organic carbon (OC) and elemental carbon (EC), speciated PM composition and VOCs at each site from July through November of 2024. Here we discuss the PM_{10}, EC and OC results captured using a high-volume sampler; the collection periods were typically 1 week. During this period, PM_{10} ranged from ~5-20 $\mu g/m^3$ and values were consistent with the nearest monitoring station. Median OC and EC were 3.9 and 0.18 $\mu g/m^3$. Site 2, located near an intersection with a traffic light that led to the entrance of the manufacturer, experienced slightly lower PM_{10} than sampling sites 1 and 3, located respectively near the rear fence line and on the other side of a freeway from the manufacturer . However, Site 2 had higher EC/OC ratios than sites 1 and 3 (averaging 95% and 35% higher respectively). Since EC can be associated with diesel emissions, these observations suggest that a major impact of this site is the localized emissions from diesel trucks used to deliver wood to the manufacturer.

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9AP.1

Visualization and Optimization of Charged Particle Dynamics in Electrostatic Precipitators. WEI-CHUN WANG, Chih-Wei Lin, Chih-Chieh Chen, Sheng-Hsiu Huang, *National Taiwan University*

Background : Electrostatic precipitators (ESPs) are widely used in air pollution control due to their low operating cost and high collection efficiency. Their applications range from industrial emissions to indoor air purification and kitchen fume treatment, highlighting their versatility.However, the internal mechanisms of ESPs remain abstract, highlighting the need for intuitive tools to visualize particle behavior and improve understanding of air pollution control.
Method and Material : The visualization system was constructed using transparent acrylic panels. A two-stage ESP was used, with stainless steel needles (0.04 cm) in the first stage generating corona discharge to charge particles, and parallel aluminum plates in the second stage providing a uniform electric field for collection. An ultrasonic nebulizer with 10% sodium chloride solution was used to test particle generation stability and visibility. A collimated LED light at the ESP outlet enhanced particle visibility, while a camera was positioned laterally at 90° to the light path for trajectory observation under different electric field strengths.
Result : Preliminary results show that particle trajectories changed with increased downstream electric field strength, indicating variations in their initial charge states. At fixed electric field strength, activating the charger and increasing voltage caused greater deflection toward the positive electrode. Higher airflow velocities reduced particle collection efficiency, while stronger electric fields enhanced collection but increased cleaning frequency.
Conclusion : These results suggest that optimizing electric field strength and airflow conditions is key to balancing collection efficiency and maintenance needs in electrostatic precipitators. Additionally, higher airflow speeds made particle visualization more challenging, while stronger electric fields made the particles more visible as they deflected more sharply toward the electrode. Further studies should refine these parameters to improve both collection efficiency and visualization clarity.

9AP.2

Practical Concerns Add Potential Risk Factors for Stratospheric Aerosol Injection Strategies. MIRANDA HACK, V. Faye McNeill, Dan Steingart, Gernot Wagner, *Columbia University*

High-altitude aerosols have the potential to lower global temperatures by backscattering a small fraction of incident shortwave radiation, a phenomenon best understood through the formation of stratospheric sulfate aerosol in the wake of volcanic eruptions. With the ability to rapidly and inexpensively offset warming, climate mitigation via stratospheric aerosol injections (SAI) presents an opportunity to temper key climate risks as a potential supplement to addressing the root cause by cutting greenhouse-gas emissions. But such a strategy is not without considerable environmental risk itself. Solid mineral candidates have been proposed as an alternative to sulfate SAI, potentially minimizing the associated risks of ozone depletion and localized stratospheric warming. However, practical and interdisciplinary limitations of SAI – particularly as it pertains to the deployment of the proposed “lower-risk” mineral candidates” – have largely gone unexplored.

Macroscopic factors like governance and degree of deployment coordination may influence resultant aerosol lifetimes and sAODs, which often dictate tropospheric climate impacts, while supply chain factors add limitations to feasible candidate selection. Microscopic factors, predominantly dispersal and injection technology, will play a key role in governing the resultant size distributions and radiative properties of proposed solid mineral aerosol candidates. Here, we show that these practical considerations fundamentally dictate the magnitude of and distribution of risk associated with an SAI strategy. Technical, geopolitical, and economic constraints will ultimately narrow the design – and associated risk – space for feasible SAI strategies.

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9AP.3

Understanding the Hygroscopicity of Organosulfates through Density Functional (DFT) Calculations and Molecular Dynamics (MD) Simulations. SHEUNG KI CHAN, Tianren Zhu, Ying-Lung Steve Tse, Man Nin Chan, *The Chinese University of Hong Kong*

Organosulfates (OS), also known as organic sulfate esters are the most abundant class of organosulfur compounds, which contribute up to 30% of total aerosol mass, showing their ubiquity in atmospheric aerosols. Recent research has extensively studied the formation and reaction pathways of OS and revealed that some OS exhibit non-crystallizing behavior during dehydration. Meanwhile, their physiochemical properties, for instance, hygroscopicity are yet to be comprehensively understood. As aerosol particles absorb moisture from surroundings, they undergo alterations in size, physical state, and composition, consequently impacting their physicochemical properties such as acidity, viscosity, and optical properties, which in turn influence air quality, cloud formation, and atmospheric reactions.

This study focuses on exploring the hygroscopic nature of short-chain OS aerosols through Density Functional Theory (DFT) calculations and Molecular Dynamics (MD) simulations. Using a computational approach, Raman spectra were generated for both concentrated and dilute OS aerosols to study the molecular motions of OS molecules. Stretching of sulfate ester group, $\nu_s(SO_3)$ is found at around 1065 cm^{-1} while the stretching of O–H bond in water molecules, including ν_s(–OH) and ν_a(–OH) occurs at a range from approximately 3250 cm^{-1} to 4000 cm^{-1}. Furthermore, the intermolecular forces between the sulfate ester group and water molecules were examined to understand the hygroscopic behavior of OS at a molecular level.

9AP.4

Smoldering Eucalyptus Leaves and Wood Results in Both High Viscosity Tar Balls and Low Viscosity Biomass Burning Organic Aerosol. CHANGDA WU, Evan Chartrand, Hamed Nikookar, Julia Zaks, Mei Fei Zeng, Steven Rogak, Allan K. Bertram, *University of British Columbia*

Uncontrolled burning of eucalyptus forests in Australia is a major source of atmospheric smoke, primarily composed of biomass burning organic aerosol (BBOA). Viscosity and phase state are fundamental physical properties that impact the behavior of aerosols in the atmosphere and have not been characterized for eucalyptus BBOA. In this study, we generated BBOA in the lab by smoldering eucalyptus leaves and wood in a tube furnace, and measured viscosity and phase state using transmission electron microscopy, optical microscopy, and fluorescence recovery after photobleaching. Early-stage burning of eucalyptus leaves produced non-hygroscopic tar balls with viscosities exceeding 10^9 Pa s. In contrast, late-stage burning produced hygroscopic BBOA with much lower viscosities (~3×10^1 Pa s), differing by over seven orders of magnitude. Eucalyptus wood produced two types of hygroscopic BBOA: early-stage particles with viscosities below 3×10^3 Pa s and late-stage particles below 3×10^2 Pa s. We used a resistor model and our viscosity data to estimate the atmospheric lifetime of brown carbon within BBOA. The results suggest that brown carbon in tar balls from early-stage leaf burning may be resistant to whitening by ozone due to its high viscosity. In contrast, brown carbon in lower-viscosity BBOA—from later-stage leaf burning and all stages of wood burning—may react quickly with ozone (lifetime 0.4-6.7 days), leading to particle whitening and changes in their radiative properties.

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9AP.6

Impact of Particle Phase State on the Competition Between Condensation and Coagulation. KIEUDIEM NGUYEN, Meredith Schervish, Pascale Lakey, James Smith, Manabu Shiraiwa, *University of California, Irvine*

The particle size distribution is a critical property for radiative forcing and cloud activation of atmospheric aerosol particles. The evolution of particle size distribution is influenced by condensation and coagulation. While condensation drives the growth of secondary organic aerosols (SOA), coagulation leads to scavenging of small particles to reduce particle number concentrations. It has been shown that amorphous semisolid and glassy solid phase states in SOA can cause kinetic limitations for condensational growth, but their impact on the competition between condensation and coagulation has not been evaluated. In this work, we implement coagulation into the kinetic multilayer model of gas-particle interactions (KM-GAP) to simulate the evolution of the particle size distribution by condensation and coagulation for particles with different phase states. Equilibration timescales of SOA partitioning (τ_{eq}) and coagulation timescales (τ_{coag}) are calculated for liquid, semisolid, and highly viscous particles in the presence of condensing organic compounds with different volatilities for closed and open systems. Our results show that τ_{eq} is shorter for condensation of semi-volatile compounds into low viscous particles in a closed system, but it will be prolonged to hours or days for condensation of semi-volatile and intermediate volatile compounds into semisolid and highly viscous particles ($D_b \leq 10^{-15}$ cm^2 s^{-1}), which makes coagulation a competitive process. We also illustrate that coagulation is less significant for the growth of SOA in chamber experiments with the presence of relatively low particle number concentration, while coagulation becomes important during nanoparticle growth, which is evidenced by the emergence of a bimodal size distribution in the growth of freshly nucleated particles.

9AP.7

Investigating Influence of Particle Size on Volatility of Aerosols. SUNANDAN MAHANT, Markus Petters, *University of California, Riverside*

Existing saturation vapor pressure estimation methods need validation through experimental data. Particle evaporation rates depend on the compound saturation vapor pressure, the tension of the particle/air interface, and the accommodation coefficient. Here we used a tandem differential mobility analyzer to characterize evaporation rates as a function of temperature and particle size for initial mobility diameters between 10 nm and 500 nm. The experiments are motivated by the need to probe the potential influence of phase transitions on interfacial tension and vapor pressure. Experimental results were found to be in good agreement with a kinetic evaporation model, initialized with saturation vapor pressure at a standard state, enthalpy of vaporization, a single value of the accommodation coefficient, and a single value of particle/air interfacial tension. Thus the results suggest that the existing estimation method works well even for particles where the Kelvin effect significantly enhances evaporation rates.

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9AP.8

Study of Linear Depolarization Ratios Across a Wide Range of Scattering Angles for Particles of Diverse Sizes, Shapes, and Complex Refractive Indices. PRAKASH GAUTAM, Justin Maughan, Hans Moosmüller, Kurt Ehlers, Raiya Ebini, Christopher M. Sorensen, *Desert Research Institute*

Polarimetry is a valuable technique for remote sensing of atmospheric aerosol particles, with the linear depolarization ratio (LDR) being a key parameter used to characterize particle properties. This study investigates the LDRs of various aerosol particles, including nearly spherical and irregular aluminum oxide (Al_2O_3), Arizona Road Dust (AZRD), and molybdenum disulfide (MoS_2) particles, using both laboratory measurements conducted at a wavelength of 532 nm over a scattering angle range from 0.32° to 177.6° and theoretical model computations for spheroids and Gaussian random spheres. The results demonstrate that the LDR is strongly influenced by particle size, shape, and refractive index, with significant variations across different scattering angles. In the forward-scattering regime, LDR values are small due to scattering being dominated by diffraction, while in the side-scattering regime, LDR increases, peaking around 140° to 160°, before decreasing in the back-scattering regime. This study further explores the relationship between LDR and particle morphology, as well as the impact of the imaginary part of the complex refractive index on LDR, with results showing that higher absorption leads to lower LDRs. Overall, this study contributes to a better understanding of how LDR behaves for different particle types and scattering angles, enhancing our understanding of the optical properties of aerosol particles towards improved polarimetric remote sensing retrievals.

9AP.9

Determination of Complex Particulate Refractive Index Spectra Using Colloids. Justin Maughan, KURT EHLERS, Christopher M. Sorensen, Prakash Gautam, Raiya Ebini, Hans Moosmüller, *Desert Research Institute*

We present analytical methods to infer the real and imaginary parts of refractive indices of particles suspended in a non-absorbing medium. The foundation of this method is to suspend the particles in non-absorbing media of a variety of refractive indices and measure the spectral light scattering from and extinction through the suspension. If the real part of the particle refractive index can be matched to that of the medium refractive index (cost effective liquids go to n = 1.62, expensive ones to 1.87), both the scattering and extinction coefficients will pass through a minimum, yielding the real part of the particle refractive index spectra. The imaginary part of the particle refractive index can then be obtained in certain situations using, for example, Rayleigh and Rayleigh-Debye-Gans formalisms (Moosmüller et al., 2025). When index matching is not possible, extrapolation methods and methods involving scattering/absorption measurements using multiple medium refractive indices may be used to infer particle complex refractive indices. We present several of these methods together with sensitivity analyses.

Reference: Moosmüller, H. J. B. Maughan, P. Gautam, and C. M. Sorensen (2025). A Mixing Rule for Imaginary Parts of Refractive Indices of Aerosols or Colloids in the Rayleigh Regime. J. Quant. Spectrosc. Radiat. Transfer, 331, 109254, doi.org/10.1016/j.jqsrt.2024.109254.

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9AP.10

Angle-Resolved Light Scattering Study of Spherical and Non-Spherical Particles. Prakash Gautam, ANDREW RAMIREZ, Hans Moosmüller, *Desert Research Institute*

We present laboratory measurements of angular light scattering intensity for aerosolized, micron-sized, irregularly shaped aluminum oxide (Al_2O_3) abrasive powders with varying grit sizes. Measurements were performed over a scattering angle range of 0.32° to 177.6°. First, we show that light-scattering-inferred diameters agree well with intensity-weighted mean sizes, highlighting the importance of intensity-weighted size distributions. Second, we visualize the wide-angle data using three approaches: (a) logarithmic intensity vs. linear scattering angle (θ), (b) logarithmic intensity vs. the logarithmic magnitude of the scattering wave vector, q (Q-space analysis), normalized at forward scattering, and (c) logarithmic intensity (for the last ≈ 20° of θ) vs. linear phase angle (180°−θ). This combination provides a comprehensive view of scattering across the forward, side, and backscattering regimes. Measurements were compared with Mie theory for homogeneous spherical particles matched by the volume-equivalent size distribution of the (Al_2O_3) particles, as determined by an aerodynamic particle sizer. Results matched well in the forward regime (shown in Q-space) but poor matching in the side and backscattering regimes, as seen in θ and (180°−θ) space, respectively.

9AP.11

Characterization of Particle Deliquescence and Aerosol Hygroscopic Growth using a Bipolar Aerosol Charge Conditioner. SANGHEE HAN, Sunandan Mahant, Markus Petters, *University of California, Riverside*

Particle deliquescence and aerosol water uptake are important properties of atmospheric aerosols. A number of methods have been developed to characterize the properties, including observing changes in gravimetric mass, optical properties, or electrical mobility diameter upon humidification. One common challenge of all of these methods is the need to control the relative humidity along the entire measurement trajectory. For example in humidified tandem differential mobility analysis, this requires control over temperature and water vapor concentration within both sample and sheath flow. Here we introduce a new method, using a temperature controlled bipolar charge conditioner to characterize deliquescence and particle hygroscopic growth. First, particles are mobility classified using a differential mobility analyzer. The water vapor content is measured using a dew-point hygrometer. Then the sample flow is passed through a ^{210}Po neutralizer. Relative humidity inside the neutralizer is controlled by the temperature. Particles that are deliquesced are larger thus causing an increase in the fraction of singly and multiply charged particles. The charge fractions are measured using a mobility particle size spectrometer operated in scanning mode. We show that this setup can be used to characterize the deliquescence relative humidity as well as approximate the aerosol water content. A main advantage of this technique is the simplification of the humidification control system that is used in traditional humidified tandem differential mobility analyzer systems.

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9AP.12

Influence of Humidification on the Light Absorption by Aerosols: Laboratory Measurements and Model Calculations.
ZEWEN ZHENG, Christopher Cappa, *University of California, Davis*

Light-absorbing carbonaceous aerosols (LACs) contribute to climate warming, although uncertainties persist. The intricate mixing state of LACs poses challenges in accurately estimating their radiative impact. Aerosol liquid water can be a dominant component in aerosol mass. Some models predict that water uptake can affect absorption, but lack clear experimental validation. This study characterizes the RH-dependent light absorption enhancement from water uptake ($f(RH)_{abs}$) of LACs, generated by atomizing commercially available absorbing material (nigrosine (NG) and fullerene soot (FS)) mixed with ammonium sulfate (AS) water solution. Measurements were conducted on size-selected particles using a custom-built humidified-cavity attenuated phase shift single scatter albedo monitor (H-CAPS-SSA), which enables concurrent measurement of hygroscopicity and optical properties. For NG+AS mixtures, $f(RH)_{abs}$ was found to increase with RH. The $f(RH)_{abs}$ values exhibited minimal dependence on the NG:AS ratio and was well reproduced by homogeneous Mie theory until AS was dominant (1:4 NG:AS by mass) where the potential impact of liquid-liquid phase separation could substantially impact absorption. Observed $f(RH)_{abs}$ remains at 1 before the DRH of AS for FS + AS mixtures but increases as AS takes up water. Very recent thermodenuder and size distribution measurements confirmed a significant amount of pure AS externally mixed with FS + AS internal mixtures. With more AS mixed with FS, the measured $f(RH)_{abs}$ increases at the same RH value after DRH, and becomes higher than predictions from standard core-shell Mie theory, regardless of the assumed mixing state, when AS mass dominates in the mixture. Theory suggests this unexpected high $f(RH)_{abs}$ arises from morphological changes induced by humidification. Since the absorption enhancement from a dry AS coating is limited, the observed $f(RH)_{abs}$ becomes comparable to the full lensing effect from a wet AS shell.

9BA.1

Towards Real-Time Surveillance of Airborne Allergens Using a Biosensor-based Indoor Air Quality Monitoring Platform.
DAS BEDADEEP, Meng Xu, Joshin Kumar, Shu-Wen You, Rajan K. Chakrabarty, *Washington University in St. Louis*

Airborne particles from house dust mites, particularly the allergens Der f 1 from *Dermatophagoides farinae* and Der p 1 from *Dermatophagoides pteronyssinus*, are major indoor triggers of allergic reactions. These allergens, released from mite feces and body fragments, are small enough to remain suspended in air and reach the lower respiratory tract. In sensitive individuals, they can cause symptoms such as sneezing, nasal congestion, itchy eyes, and asthma attacks. Continued exposure, especially in enclosed environments, can lead to chronic airway inflammation and increased risk of respiratory illness. Due to their widespread presence and significant health impact, there is a growing need for fast and accurate indoor detection of these allergens.

To address this challenge, we developed a label-free electrochemical sensor for the rapid detection of Der f 1 and Der p 1. The sensor is built on a cost-effective, screen-printed carbon electrode modified with Prussian Blue for strong charge retention and graphene oxide to enhance electron transport. Specific antibodies for Der f 1 and Der p 1 are immobilized on the electrode surface to capture the allergens from air samples. When the allergens bind to the antibodies, they cause a measurable change in surface capacitance, which is detected using electrochemical impedance spectroscopy.

For sampling, the sensor is integrated with a wet cyclone bioaerosol collector that draws in indoor air, concentrates airborne particles into a small liquid volume, and delivers it directly to the sensor surface. This combined approach ensures efficient sample collection and fast on-site analysis. The sensor's quick response, low cost, and disposable format make it well-suited for routine monitoring in homes, schools, and workplaces. By providing early detection of harmful dust mite allergens, this platform enables timely interventions—such as ventilation or cleaning—to help reduce both immediate allergic reactions and long-term respiratory health risks.

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9BA.2

Infectivity of Non-Enveloped Viruses Depends on Initial Droplet Size. RACHAEL SNODGRASS, Alexandra Longest, Aaron Prussin II, Linsey Marr, *Virginia Tech*

When viruses carried in respiratory droplets are released into the air, the droplets may settle onto surfaces. The virions may then remain infectious on timescales sufficient to allow transmission to occur through contact with the droplets. Many environmental factors can impact the loss of infectivity of a virion in a droplet, including relative humidity (RH), temperature, viral structure, and the size of the droplet. It is well known that RH impacts the rate of virus inactivation, but there is a large gap in data pertaining to physiologically relevant droplet sizes. The objective of this experiment was to determine the effect of initial droplet size on the inactivation of the bacteriophage MS2, a model organism for non-enveloped viruses, at varying relative humidities. We quantified the loss of infectivity, or decay, of MS2 in two droplet sizes (1 µL and 1.8x10-4 µL) at three relative humidities (30, 50, 70 %) and four time points (0, 0.33, 1, 2 hours). A droplet-on-demand dispenser (DoD) was utilized to achieve a more physiologically relevant droplet size (1.8x10-4 µL) compared to a more traditional method of pipetting (1 µL). Droplets containing an initial titer of 4.18×1011 PFU/mL were dispensed on a superhydrophobic polystyrene petri dish and resuspended after the specified time for quantification of infectivity by plaque assay. We observed more rapid decay of virus in the small droplets generated by the DoD compared to the pipetted droplets. Overall, this experiment suggests that the stability of non-enveloped viruses is highly dependent on droplet size as well as other environmental factors. The study of physiologically relevant droplet sizes is essential to inform strategies for effective control of virus transmission.

9BA.3

Performance Evaluation of Bioaerosol Samplers in an Environmentally Controlled Chamber. MARINA NIETO-CABALLERO, Kevin Barry, Emily Kraus, Kristin Rugh, Mark Hernandez, Sonia Kreidenweis, *Colorado State University*

Accurate characterization of bioaerosols is critical for understanding their roles in human health and atmospheric processes. However, current bioaerosol samplers vary widely in collection efficiency and may introduce biases due to microbial stress, cell damage, or loss of nucleic acid integrity. As part of the NSF-funded BROADN project (Colorado State University), this study aims to improve and standardize bioaerosol sampling methodologies by systematically evaluating the performance of five widely used samplers—two filter-based (SASS 3100 and polycarbonate filters) and three liquid-based (Coriolis-µ, BioSpot-VIVAS, and SKC-BioSampler)—under environmentally controlled chamber conditions.

Experiments were conducted in a 10 m^3 chamber at the University of Colorado Boulder, under two relative humidity regimes (25% and 80%) to mimic dry and humid environments. Microbial suspensions of Pseudomonas syringae (gram-negative) and Lysinibacillus parviboronicapiens (gram-positive) were nebulized using the SLAG nebulizer, selected for its low biological impact. Bioaerosols were sampled in parallel using the five samplers to ensure consistent exposure. Post-collection analyses included traditional culturing, quantitative PCR (qPCR), SYTO-9/PI fluorescence microscopy for live/dead cell visualization, and ice nucleating particle (INP) assays to evaluate activity relevant to atmospheric processes.

Preliminary results indicate that liquid-based samplers outperformed filter-based methods for maintaining viability and genomic integrity of gram-negative bacteria, particularly under high humidity conditions. Differences in sampler performance were also observed in INP activity preservation and membrane integrity assessments. These findings highlight the importance of sampler selection based on experimental goals—whether assessing microbial viability, diversity, or atmospheric functionality.

This study contributes critical data toward the standardization of bioaerosol sampling protocols and offers practical guidance for researchers selecting methods for diverse indoor and outdoor applications in aerobiology, public health, and atmospheric science.

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9BA.4

Microbial Resistance in Saharan Dust: Identification of Antibiotic-Resistant Bacteria in Aerosol Samples Collected at Puerto Rico. DYLAN TRISTANI-RODRIGUEZ, Travis Santana, Francees Barreto, Janet K. Hatt, Claribel Luciano-Montalvo, Borja Riquelme, Konstantinos T. Konstantinidis, Natasha DeLeon-Rodriguez, *Interamerican University of Puerto Rico, Metropolitan Campus*

The Sahara Desert is a significant source of atmospheric mineral dust that, carried by winds across the North Atlantic Ocean, impacts the North America, Caribbean, and Mexico. Although it has been shown that particles transported during these events affect air quality and human health by promoting respiratory and skin allergies, few studies have explored the microbial communities present in these dust clouds and their potential impact on human health. This study aimed to identify organisms in Saharan dust capable of resisting antibiotics, as well as to characterize the antibiotic resistance genes (ARGs) they carry and their similarity to clinically relevant ARGs and those found in human-populated environments. Samples were collected during Saharan dust events in Puerto Rico using passive deposition methods and were subsequently exposed to six antibiotics: levofloxacin, tetracycline, penicillin, ciprofloxacin, vancomycin, and kanamycin. DNA was then extracted from the surviving enrichment cultures and analyzed metagenomically. Gram-positive bacteria were identified in all samples, despite the expectation that they would not grow under the selective pressure imposed by the antibiotics. Among the MAGs (metagenome-assembled genomes), Bacillus toyonensis and Bacillus thuringiensis were the two most abundant bacterial species. Both species carried ARG associated with mechanisms such as antibiotic target alteration and target protection, which help them withstand growth inhibition. Although B. toyonensis harbored a higher number of unique resistance genes, B. thuringiensis exhibited greater relative abundance, contributing more significantly to the total ARG load detected. B. toyonensis is commonly used in the formulation of probiotics and B. thuringiensis is an insecticide due to its pathogenicity to insects. Finally, we observed that these species are common in urban environments, suggesting that their ability to carry ARGs could make them environmental vectors of antibiotic resistance genes to bacteria that pose a risk to public health.

9BA.5

Evaluating the BioCascade – Viable Virus Aerosol Sampler's Size-Separation Efficiency and Ability to Maintain Virus Viability. MD. TANVIR AHMED, Kamaljeet Kaur, Kerry Kelly, *University of Utah*

Effectively capturing and preserving airborne viruses is essential for early detection, outbreak prevention, and improving public health responses to respiratory infections. However, current air sampling methods often struggle to efficiently retain virus viability in collected bioaerosols. The BioCascade - Viable Virus Aerosol Sampler (BC-VIVAS) system is designed to collect viable bioaerosols in four aerodynamic diameter bins: >10 µm, 4–10 µm, 1.5–4 µm, and <1.5 µm. This study evaluates this system's size-selective separation efficiency using monodisperse fluorescent polystyrene latex spheres (PSLs). It also assesses the ability of this system to maintain MS2 bacteriophage viability as well as the minimum airborne virus concentration needed for the bacteriophage to lyse E. coli cells. Size-selectivity testing demonstrated effective separation of fluorescent PSLs into three aerodynamic diameter bins. However, PSLs >10 µm in diameter were not efficiently collected, likely due to losses during atomization or dryer. Viability testing confirmed that MS2 bacteriophages were successfully detected at airborne concentrations as low as approximately 820 pfu/m^3 following atomization and drying. These findings highlight the BC-VIVAS system's potential for size-selective, viability-preserving air sampling in support of epidemiological monitoring and infection control.

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9BA.6

Characterization of Airborne Microbial Pathogens Associated with Crop Plants. WILSON MASIH, Harison Masih, *St. John's Inter College, Hospital Road, Agra, India*

Microbes are associated with dust or airborne particles like fragments, fibers, cells and spores of microorganisms that were present as bioaerosol is a collection of particles suspended on the surface of plants, these dust particle settled and cause infection in plants, they are potential sources of pathogenic microorganisms that can grow and damage plant parts the by causing infections that affect the agro-economic sector of that Geographical reason. The various microorganisms and viroid are known to cause severe plant diseases, in the present study the dust samples were collected with sterilized cotton swabs and the samples were transferred on culture media (PDA and NA) plates and incubated for 5-7 days at 30ºC for fungi and 24 to 48hours at 28ºC for growth of bacteria and pure culture isolates (fungi and bacteria) were maintained on slants and isolates were identified by gram's staining, Lacto-phenol and biochemical tests. Plant pathogens such as Alteranria spp., Helminthosporium spp. Fusarium spp, Xanthomonas spp., and Erwinia spp., were found to be associated with tomato fruit, dragon-fruit stem cauliflower leaf and cauliflower curd . Plants are constantly exposed and threatened by various pathogenic microorganisms in the environment. Diseases caused by pathogens, including bacteria, fungi and viruses, cause significant crop losses worldwide. The growth of most plant pathogens is discontinuous because it affects either the pathogen or the host seasonally. These pathogens negatively affect the food quality, nutritional quality and cause food spoilage, reduce yield as well as potential food loss and producing endotoxins and Mycotoxins which pose health problems.

9BA.7

Development of a Disposable dLAMP Chip for Respiratory Syncytial Virus RNA Quantification. YUHUI GUO, Deepak Sapkota, Zhenpeng Qin, Hui Ouyang, *The University of Texas at Dallas*

Nucleic acid testing is widely used in the bioaerosol field to identify and quantify airborne pathogens collected by bioaerosol samplers. PCR is the most commonly used method for detecting viral RNA; however, it typically requires several hours to complete, regardless of the type, RT-PCR, qPCR, or digital PCR. Digital LAMP (Loop-Mediated Isothermal Amplification) offers a faster alternative, completing reactions within 60 minutes and detecting RNA concentrations as low as 10 copies/µL. However, the chip used in dLAMP is expensive and has currently been discontinued. In this study, a membrane-based chip for dLAMP RNA quantification has been developed that eliminates the need for complex fabrication or specialized equipment. A track-etched polycarbonate (PCTE) membrane with uniform pore size and cylindrical structure was purchased from STERLITECH, costing less than $1 per membrane. Each pore serves as an individual nanoreactor for DNA or RNA amplification. The total number of pores, averaging 6,340 ± 20, was verified using a ZEISS Axio Observer microscope. The membrane was pretreated to remove polyvinylpyrrolidone. The final chip configuration consists, from bottom to top, of a glass slide, the membrane, a polycarbonate spacer ring, heat-resistant double-sided tape, and another glass slide. Mineral oil is used to prevent sample evaporation. Calibration was performed using serial dilutions of RSV A2 quantitative RNA (ATCC VR-1540DQ, from 10^6 to 10^0 copies/µL), yielding a linear response with $R^2 = 0.97$. This approach can be adapted for quantitative nucleic acid testing of a wide range of airborne viral and bacterial targets, providing a rapid and accurate method for bioaerosol analysis.

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9BA.8

Establishing the Dynamics of Environmental Influenza Virus Loads During Human Infection in a Tightly Controlled Indoor Setting. KARIN BRETT, Sterling Knight, Zachariah Broemmel, Byron Hauser, Elizabeth Petzold, Christopher Woods, Nicole C. Rockey, *Duke University*

Seasonal influenza viruses cause significant human health and economic burdens, resulting in over 200,000 hospitalizations and an estimated $11.2 billion in costs annually in the United States alone. These viruses spread through the environment when infected individuals emit virus-laden droplets and aerosols that deposit on surfaces or remain airborne before ultimately reaching a susceptible host and initiating an infection. Understanding how environmental loads vary by host, setting, and time into an infection is critical to accurately determining exposure risks associated with influenza virus spread in indoor environments. Defining the impact of environmental parameters (e.g., relative humidity, temperature, air exchange rate) on virus contamination is also beneficial for identifying effective engineering control strategies. While previous studies have successfully detected influenza virus nucleic acid and infectious virus loads in aerosols and on surfaces in real-world settings, these data are difficult to interpret because the sources and age of the detected viral loads are largely unknown.

Here, we address these knowledge gaps by using a controlled human infection model to assess environmental influenza virus contamination over the course of a viral infection, from pre-symptomatic to post-symptomatic illness. In this model, participants are inoculated with a seasonal influenza A virus strain and closely monitored over the subsequent eight-day quarantine period, allowing for the daily collection of aerosol and surface samples their rooms. Environmental samples are being assessed for viral RNA concentrations, and positive samples will be further evaluated for infectious virus loads. By working in this tightly controlled yet realistic setting, our results will establish how environmental loads vary by host, viral, and environmental factors. Ultimately, this research will inform more environmental monitoring work that can accurately assess exposure risks and identify when mitigation strategies should be employed to reduce influenza virus transmission in indoor settings.

9BA.9

Survival Mechanisms Triggered in Escherichia coli by HVAC-Aerosolization Induced Stress- A Molecular Dynamics Study. LEILY KHALEGHI, *Texas A&M University*

Indoor airborne pathogens increasingly display antimicrobial resistance (AMR) genes, with the most diverse and equitable antimicrobial-resistant populations found in hospitals. According to recent studies, indoor environmental factors, particularly airflow pressure, trigger stress response genes that incidentally support AMR behavior. Membrane-bound proteins are believed to activate as a survival mechanism to pressure caused by aerosolization, particularly the efflux pump and mechanosensitive channel proteins. The goal of this study was to visualize the specific molecular mechanisms employed by the small mechanosensitive channel to guard the cell against aerosolization stress and investigate how these mechanisms interact with common antibiotics to induce antibiotic resistance or susceptibility. This was done using the Schrodinger platforms Wizard, Glide, SiteMap, and Desmond. Molecular docking of the antibiotics Ampicillin, Gentamycin, Kanamycin, Sulfamethoxazole-Trimethoprim, and Chloramphenicol to the protein structure yielded Glide Docking Scores, measuring the strength of the binding event. Molecular dynamics simulations were conducted for the protein, protein-antibiotic complex, and protein-antibiotic (unbounded) environment. For each of the three scenarios, two molecular dynamics simulations were performed: one at 300 K and 1.01325 bar pressure and one at 300 K and 1.150112 bar pressure. From these simulations, Simulation Interactions Diagrams were produced to determine the simulation's stability, as well as the protein's flexibility. Additionally, plots of the channel's opening width vs. time were collected from the simulation data. For both the bound and unbound environments, the channel's openings widen at high pressure, and the overall width of the Carboxy-Terminal Domains increases. The data indicates that it is the pressure change that primarily affects channel activity, with the simulations visualizing the opening mechanism of the protein.

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9BA.10

Zeolite for Passive Control of Poultry Bioaerosols. JOHN CATE, Maria King, *Texas A&M University*

The rise of antimicrobial-resistant (AMR) bacteria in residential poultry environments poses significant public health risks, particularly in under-regulated backyard chicken coops. Zeolite, a naturally occurring aluminosilicate mineral with ion-exchange, adsorptive, and antimicrobial properties, offers potential as a passive mitigation strategy. This study evaluates the effectiveness of zeolite bedding in reducing both the abundance and airborne dispersal of antibiotic-resistant bacteria in a simulated chicken coop environment. Experimental coops were outfitted with either a bare dirt floor or zeolite bedding. Microbial sampling was conducted over ten days using surface swabs and high-volume bioaerosol collectors, including a wetted wall cyclone and the BioFlyte impaction-based sampler. Quantitative PCR, Illumina sequencing, and antibiotic susceptibility testing assessed bacterial load, resistance profiles, and microbiome composition. Molecular dynamics simulations were employed to investigate binding interactions between zeolite and bacterial membrane components to explore mechanistic interactions further. Chicken manure collected from dirt flooring was spread over zeolite and exposed to ventilation airflow for ten days at room temperature. Bioaerosol sampling revealed a shift in the composition of the aerosolized microbiome over zeolite compared to the original manure sample. Preliminary results indicate that zeolite bedding reduces culturable bacterial counts and suppresses the prevalence of resistant strains. These findings support using zeolite as a low-cost, passive intervention to mitigate AMR spread and microbial exposure risks in backyard poultry systems.

9BA.11

Impact of Hydration Levels on Respiratory Aerosol Emissions. MAHENDER SINGH RAWAT, Dinushani Senarathna, Byron Erath, Sumona Mondal, Sarah K. Sirsat, Andrea Ferro, *Clarkson University*

Investigations of aerosol emission and particle size distributions during phonation have confirmed that emission rates can vary tremendously; over two orders of magnitude. Prior work has shown that variables such as loudness, frequency, and age influence the emission rates. Nevertheless, these factors do not entirely explain the wide disparity observed in emission rates.

To overcome this knowledge gap, we experimentally evaluated the effect of hydration level on respiratory aerosol emissions. This study proposes that well-hydrated (Hy) individuals produce more respiratory aerosols during vocalization than dehydrated (Dhy) individuals, as dehydration decreases saliva and respiratory tract lining fluid production and modifies the rheology of these fluids.

To investigate this hypothesis, we measured respiratory aerosol emissions during phonation from participants in both a hydrated and dehydrated state. Aerosol measurements were recorded by at TSI (Shoreline, MN, USA) Model 3321 Aerodynamic Particle Sizer (APS) while expiratory flow was measured using a well-sealed, half mask connected to an iWorx (Dover, NH) TA Model 220 spirometer.

Each participant performed the same vocal exercises in a randomized order that included the open vowel /a/, forced breathing at a similar flow rate as the open vowel /a/, running speech, and normal breathing. Based on our preliminary results from 15 participants (9 females and 6 males), we observed that during vocal activities, participants in a dehydrated state emitted approximately 15% fewer particles, both in terms of particle number emission rate and concentration, compared to when they were hydrated. This trend was consistent for particles ranging in size from 0.5 to 20 microns. Depending on the hydration condition, 1-3 of the 15 participants were identified as extreme outliers, with emission rates exceeding the third quartile (75th percentile value) plus three times the interquartile range.

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9BA.12

Reducing In-Cabin Exposure To Pollen Allergens- A Controlled Study of Cabin Filter Performance Against Key Asthma Triggers. John McKeon, MATTHEW HARDWICK, John Ryan, Angela Southey, Oliver Dsa, *Allergy Standards Ltd*

Asthma remains a major global public health issue, with airborne pollen identified as a significant trigger, contributing heavily to disease burden worldwide. Among the wide range of aeroallergens, specific pollen-derived allergens—Phl p 5 (from timothy grass), Bet v 1 (from birch), and Amb a 1 (from ragweed)—stand out as leading agents in inducing allergic asthma symptoms. Amb a 1 alone accounts for over 99.9% of ragweed allergenicity. As urban populations spend considerable time traveling in enclosed motorized vehicles annually, in-cabin air quality has emerged as a critical factor in respiratory health. Despite the confined environment, insufficient attention is often paid to the air filtration systems within vehicles.

This study was bespoke designed to evaluate the efficacy of automotive cabin air filters in mitigating pollen exposure. A specialized test rig (plenum) was engineered to securely accommodate standard cabin filters, which was then integrated into a vehicle's air handling system. Controlled pollen aerosols—containing known concentrations of Phl p 5, Bet v 1, and Amb a 1—were introduced via the duct inlet to simulate real-world pollen infiltration. The downstream air was monitored to assess the filters' pollen removal performance.

The results demonstrated high filtration efficiency: the cabin filter removed 99% of particles larger than 3 µm, and significantly reduced allergen concentrations—with a 99.8% reduction for Phl p 5, and over 99.9% reductions for both Bet v 1 and Amb a 1. Further testing is recommended to assess VOC removal efficiency. These findings underscore the critical role that correctly installed, high-efficiency cabin air filters can play in protecting vehicle occupants from allergenic pollen exposure, particularly for individuals with asthma or allergic rhinitis. Implementing and maintaining effective cabin filtration systems could be a practical intervention to mitigate the global burden of pollen-induced asthma symptoms.

9BA.13

Bioaerosol Deposition across Different Scales. JAMES BURKE, *Defence Science and Technology Laboratory*

A bioaerosol spray released into the open air is subject to highly variable dispersion downwind due to fluctuating meteorological effects such as the wind speed, meander, and atmospheric stability. The transport of the aqueous droplets is also affected by the evaporation rate linked to the ambient relative humidity. These uncontrolled conditions result in a spatially heterogenous surface deposit of bioaerosol that is variable over time.

In the case of a hazardous and environmentally persistent pathogen, it is critical that the material deposited onto surfaces can be reliably quantified to determine the extent of the hazard, and then again following decontamination to confirm the effectiveness of bioremediation. Surface samplers, such as swabs or sponges, and other collection tools can be used for estimating surface contamination using a quantitative assay. It is important that such technologies are selected and qualified for their high sampling efficacy through a robust test method, predicated on the ability to produce a controlled bioaerosol deposit onto a range of relevant natural and manmade surfaces.

Capabilities have been developed at Dstl to deposit aerosols of a surrogate pathogenic bacteria (Bacillus thuringiensis, HD-1 cry -strain) over multiple size-scales; from centimetre scale coupons to confined, large spaces for more complex and representative surfaces (such as shrubs, turf, paving slabs). This work is a systematic study to minimise surface-to-surface variability, while enabling a practical footprint within which several types of surfaces can be treated within a single dissemination event. Smaller sized coupons were inserted into rigs during larger scale experiments involving more complex surfaces, to provide confidence in the measurement of bacterial density due to the well-validated method for recovery and analysis from these smaller coupons.

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9BA.14

Heterogeneous Ice Nucleation of Bacteria. DEVAKA ARIYASENA, Heidi L. Busse, Mozhde Hamidizade, Carolee Bull, Miriam Freedman, *The Pennsylvania State University*

Ice-nucleating bacteria are the most efficient ice nucleators among both natural and anthropogenic ice nucleating particles. These bacteria consist of specialized ice-nucleating proteins that are anchored to their outer membrane and play a crucial role in ice formation, enabling bacteria to facilitate ice nucleation at temperatures close to 0 °C. The literature lacks studies on freezing spectra across different bacterial strains and species, as most of the studies have focused on the ice nucleation of Snomax®, a commercial product consisting of inactivated bacterial cells. In addition, the fundamental mechanisms of protein-mediated ice nucleation, including its molecular and structural foundations, remain inadequately explored and understood. In our study, we investigated whether different bacterial strains have different ice-nucleating activities. We selected five different viable bacterial strains based on different lengths of the ice-active domain and different amino acid compositions. We performed a freezing droplet assay using a microfluidic chip that can contain 375 droplets. We observed different ice nucleating activities among the 5 bacterial strains. To further understand what causes different ice nucleation activities, we characterized whether changes in the ordering of amino acids influence ice nucleation. We selected 3 new bacterial strains having the same amino acids, with roughly the same count compared to our first study, but a different ordering of amino acids. We observed different ice nucleation activities when the ordering of the amino acids differed for two of the strains. Our results demonstrate that ice nucleation activity differs considerably between different bacterial strains, suggesting that the impact of bacteria on ice nucleation should be assessed using a wide variety of bacterial strains and species.

9BA.15

A Fully Integrated System for Rapid On-Site Monitoring of Airborne Culturable Bacteria Using Machine Learning and On-Chip Microscopy. IN HO KIM, Hyun Sik Ko, Ki Joon Heo, Jae Hak Shin, Jae Hee Jung, *Sejong University*

Airborne culturable bacteria are key indicators for assessing indoor air quality (IAQ), yet current measurement methods rely on colony-forming unit (CFU) counting, which is time-consuming and unsuitable for real-time monitoring. Traditional approaches require long sampling durations for low-concentration bioaerosols and over 24 hours of incubation, limiting their practicality for timely IAQ management.

We present a fully integrated, on-site monitoring system that enables rapid and automated quantification of culturable bacterial bioaerosols. The system continuously collects and enriches airborne bacteria by inertial separation, selectively capturing particles larger than 1 μm into a thin liquid film. This process achieves a ~1.1×10^7-fold concentration ratio with 99.9% collection efficiency for Escherichia coli bioaerosols.

The concentrated samples are directly cultured and analyzed using a chip-scale lensless imaging module integrated with a portable incubator. Microcolonies are automatically detected and counted via a machine learning-based object detection algorithm. This system achieves a detection limit of 30 CFU/m^3 and delivers quantitative results with 95% accuracy in less than 3 hours—significantly reducing the time required for culturable bioaerosol analysis compared to conventional methods.

By combining high-efficiency concentration, miniaturized imaging, and automated analysis, this system enables real-time, on-site assessment of airborne culturable bacteria. The proposed approach represents a significant advancement in IAQ monitoring and offers potential for early detection of microbial contamination in diverse indoor environments such as hospitals, schools, and public facilities.

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9BA.16

Advancing Real-Time Bioaerosol Monitoring and Forecasting in Ireland Using Novel Optical Instrumentation and Machine Learning: The Bohemian Project. DAVID O'CONNOR, Jiayao Chen, Gemma Davis, Padraig Flattery, Emma Delemere, Shirley Coyle, Mingming Liu, *Dublin City University*

The BOHEMIAN (Biological and Chemical Aerosol Monitoring and Modelling) project aims to establish Ireland's first real-time bioaerosol surveillance network and predictive forecasting framework. Historically, Ireland has lacked systematic monitoring of airborne biological particles, such as pollen and fungal spores, despite their significant public health implications. To address this, BOHEMIAN deployed three Swiss-made Swisens Poleno devices co-located with traditional Hirst volumetric samplers at sites in Dublin, Carlow, and Mullingar.

Using advanced holographic and fluorescence-based particle detection, the Poleno devices generate terabytes of daily data. Supervised machine learning models were trained on purified aerosol samples (e.g., Poaceae, Cupressaceae, Betula), enabling real-time classification. Comparisons between Poleno and Hirst samplers show good agreement, with R^2 values ranging from 0.4 to 0.7 across key allergenic species. Notably, Cupressaceae time series data from both instruments demonstrated excellent temporal concordance. Furthermore, Poleno total particle counts showed significant correlation with PM_{10} readings from co-located EPA monitors ($R^2 = 0.64$), demonstrating additional utility in chemical aerosol detection.

An ensemble of daily pollen forecast models has also been developed using integrated meteorological and biological data. Initial forecast performance (R^2 ~0.5) has enabled live dissemination through Met Éireann and Asthma Society platforms, with social media posts reaching 10–20k views per day during peak season.

BOHEMIAN represents a step-change in environmental monitoring and public health response. Upcoming expansions include three new sensor sites, integration of mobile hyperlocal air quality data (e.g., Google Air View), and citizen science deployments. Our results validate novel instrumentation and AI workflows for real-time, species-level bioaerosol forecasting and open avenues for personalized air quality exposure mitigation.

9BA.17

Development of a Condensation-Growth-Based High-Concentration Liquid Sampling System for Effective Management of Viral Aerosols. JAE HAK SHIN, In Ho Kim, Joon Young Park, Jae Hee Jung, *Sejong University*

Bioaerosols are airborne particles originating from biological sources. Among them, viral aerosols serve as major transmission vectors for infectious diseases such as SARS, MERS, and COVID-19, posing a serious threat to public health. In particular, the COVID-19 pandemic has underscored the need for effective management techniques for infectious viral aerosols. This requires rapid and efficient collection as well as accurate analysis.

In this study, we developed VAiLS (Virus Aerosol-into-Liquid Sampler), a high-concentration liquid collection system designed to capture and concentrate viral aerosols present in the atmosphere at low concentrations. The VAiLS system integrates particle condensation-growth technology with cyclone-based liquid collection and incorporates a conditioner to reduce the influence of initial humidity on collection performance. System performance was evaluated using potassium chloride (KCl) particles and bacteriophages. We assessed particle collection efficiency, concentration performance, and viral viability under various condensation temperatures. Results showed that higher condensation-growth temperatures improved collection efficiency, while viral viability decreased due to thermal stress at elevated temperatures.

The VAiLS system enables the transformation of airborne viruses into liquid-phase samples compatible with various microbiological and molecular analysis techniques. These capabilities highlight its potential as an effective tool for real-time monitoring, environmental surveillance, and public health response to airborne viral threats.

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9BA.18

Transmission from Sink to Patient: An Evaluation of Sink Generated Bioaerosols and their Role in Hospital Acquired Bacterial Infections. JoHannah Buehrer, Qing Dai, Kayla Fericy, Joshua Granek, Claudia Gunsch, A-Andrew Jones, Joe Brown, Glenn Morrison, BARBARA TURPIN, *University of North Carolina at Chapel Hill*

Healthcare-associated infections (HAIs) pose a significant public health risk. Hospital sinks and associated plumbing are one likely source. This study investigates bioaerosol emissions from sink p-traps to assess their potential role in pathogen transmission in the hospital context. We designed an aerosol chamber system that contains a functioning sink that meets hospital standards and used it to quantify the bioaerosol emission rate from the sink. We used *FAmp Escherichia coli* as a model for *Pseudomonas aeruginosa*. We operated the chamber at an air change rate (ACR) of 2 h^{-1}, spiked *E. coli* into the p-trap and collected 30 min aerosol and deposition samples. We collected bioaerosol samples with an Anderson cascade impactor and a BioSpot sampler, as well as deposition samples. We used MI agar which is selective for *E. coli*. All samples were cultured. Across five experiments, deposition plate counts were substantial, while $PM_{5.0}$ bioaerosol samples were close to detection limits. We estimated that bioaerosol and large droplet emission factors were on the order of 1 x 10^{-10} to 2 x 10^{-10} and 3 x 10^{-9} to 1 x 10^{-8} CFU emitted per CFU spiked, respectively, although uncertainties are large. We provide order-of-magnitude estimates of infection risk via bioaerosol transmission for patients in a hospital room (ACR = 6 h^{-1}) with *Pseudomonas aeruginosa* colonized in the sink plumbing; we discuss implications, limitations and future directions.

9BA.19

Bioaerosol Generation Due to Water Splashing in Handwash Basins in Clinical and Non-clinical Settings. SUDHEER SALANA, Amin Shirkhani, Adriana Jimenez, Bhavarth Shukla, Chang-Yu Wu, *University of Miami*

Traditionally, handwash basins have been fundamental components of patient care rooms in hospitals. However, these basins can also facilitate the transmission of infectious microbes that colonize the faucets and drains. One possible route of transmission could involve bioaerosol generation when microbial biofilms in handwash basin drains are disrupted by water splashing during handwashing and other routine activities. In this study, we aimed to investigate the potential for microbial transmission through this route in both clinical and non-clinical settings. To achieve our objective, we conducted bioaerosol sampling in a restroom located in an academic building, and in five patient care rooms at a hospital. In each room, aerosol samples were collected on REMEL™ Blood Agar, BBL™ Chromagar™ Candida, and HardyCHROM™ CRE agar plates using an Andersen impactor, and in Tryptic Soy Broth using the BioSpot-VIVAS™ sampler, both before and after turning on the water faucets to simulate water splashing events. To verify that the microbial species collected during water splashing originated from the disruption of biofilms in the wash basin drains, swab samples were also collected from the drain area of the wash basin using disposable swabs prior to aerosol sampling. Preliminary results demonstrate a significant overlap of the microbial species, particularly pathogenic Gram-negative bacilli, between the swab samples and the air samples collected using both the Andersen impactor and BioSpot-VIVAS™, supporting the hypothesis that the microbes colonizing the drains were aerosolized due to the impact of water splashing in wash basins. Our findings suggest that water splashing in handwash basins may represent a potential pathway for the transmission of infectious microbes, and additional research is urgently needed to assess its contribution to disease transmission in various clinical and non-clinical settings.

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9BA.20

Exhaled Breath Sample Recovery Comparison Between Samplers for SARS-CoV-2 and Influenza Virus. ANNA PULLEY, Petri Kalliomäki, Jianyu Lai, S.-H. Sheldon Tai, Jennifer German, Filbert Hong, Barbara J. Albert, Yi Esparza, Aditya Kiran Srikakulapu, Denwash Rastogi, Maria Schanz, Isabel Sierra Maldonado, Molly Oertel, Naja Fadul, Arantzazu Eiguren-Fernandez, Gregory S. Lewis, Kathleen McPhaul, Kristen K. Coleman, Donald K. Milton, *School of Public Health, University of Maryland, College Pk*

Characterizing the exhaled breath of people infected with respiratory viruses such as SARS-CoV-2 and influenza is essential to understanding and mitigating airborne transmission. A need exists for a portable air sampler which can efficiently and accurately characterize exhaled breath aerosols (EBA) from humans with respiratory infections to identify particle sizes where virus predominates. The Gesundheidt-II (G-II) uses a large cone for EBA collection and size fractionates particles into 2 stages (<5 µm & >5 µm). We developed the novel BioCascade Exhaled Breath Sampler (BEBS), which uses a smaller cone in combination with the BioCascade and BioSpot-VIVAS, to collect EBA into 4 size fractions (<1.5 µm, 1.5-4 µm, 4-10 µm, and >10 µm). To validate the BEBS, we collected EBA samples from participants enrolled in two separate projects studying SARS-CoV-2 and influenza virus, and compared its performance against the G-II. We collected two, 30-minute EBA samples from each participant using the G-II and BEBS sequentially during the same visit. Participants in the SARS-CoV-2 study sang and shouted intermittently throughout the sampling period, whereas participants in the influenza study intermittently recited the alphabet. For both samplers, we measured virus recovery via qRT-PCR. We found that the two samplers had moderate agreement in SARS-CoV-2 RNA collection (κ=0.595), and low agreement in influenza RNA collection (κ=0.186). Despite differing sampling flow rates (125 LPM in G-II, 12 LPM in BEBS), viral RNA predominated in the fine aerosol fraction (<5 µm) for both samplers and infection types. However, our research was limited due to variation in vocalization activities by infection type. In the future, we plan to study the impact of vocalization activities and infection type on viral particle sizes.

9BA.21

An Electrostatic Sampler for Continuous Collection of Airborne Respiratory Viruses. NHAN DINH NGO, Aija Zhou, Thanh H. Nguyen, Vishal Verma, *University of Illinois at Urbana−Champaign*

Over recent decades, epidemics and pandemics of respiratory viral diseases, such as flu and COVID-19, have caused significant economic losses and numerous deaths. Effective sampling of airborne viruses with high enrichment and preserved infectivity is critical for rapid measurement and response.

Here, we introduce the eBioSampler, an innovative airborne virus sampler utilizing an electrostatic particle concentrator with a unique collection electrode design. This design enables simultaneous fresh buffer injection and collected sample withdrawal, maintaining a continuous liquid layer over the electrode surface. This liquid layer significantly reduces impaction force and deposition losses, thereby minimizing virus viability loss during sampling.

eBioSampler's performances were validated against the SKC BioSampler as a reference. Physical particle collection efficiency was assessed using a SMPS (TSI, model 3938) with polydispersed NaCl particles. Biological collection efficiencies were tested with Influenza A virus (H1N1) strain A/California/07/2009. Viral viability was assessed via plaque assay, and total viral particle collection was quantified by qPCR.

The eBioSampler achieved nearly 100% physical collection efficiency for particles greater than 50 nm at a sampling voltage of greater than −6 kV. Furthermore, it collected 4.62 times more viral genes and preserved the viability of collected viruses 9.4 times better than the SKC BioSampler. These results demonstrate the eBioSampler's superior capability for efficiently collecting real airborne viruses while preserving their infectivity, making it a valuable tool for rapid and accurate viral surveillance.

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9BQ.1

Prescribed Burning in the WUI: PM Household Infiltration. SEAN BENJAMIN, Evan Coffey, Michael Schaezlein, Malena Toups, Michael Hannigan, *University of Colorado Boulder*

Due to the rise in the frequency and damage of Wildland Urban Interface fires, there has been increased interest in prescribed burning as a wildfire mitigation tool. However, there are risks associated with prescribed burning including smoke impacts on nearby residents. As prescribed burns are often located near residential areas to protect those communities from future uncontrolled wildfires, the smoke from these prescribed fires can travel the short distance and infiltrate homes. We use custom low cost sensor monitoring packages to investigate the particulate matter (PM 2.5) infiltration into residences near prescribed fires and the relative impact that fire size, environmental conditions, and effective home age have on this infiltration.

9BQ.2

Predicting Solar Photovoltaic Generation Impacted by Severe Wildfire Smoke. ALI AMADEH, Fenya Bartram, Bo Yuan, K. Max Zhang, *Cornell University*

The negative impact of wildfire smoke on solar photovoltaic (PV) generation by reducing the amount of solar irradiance reaching the modules has been observed worldwide. In the summer of 2023, smoke from Canadian wildfires spread to the northeastern U.S., impacting solar PV output in the region. The New York Independent System Operator (NYISO) day-ahead forecasts for this period significantly overpredicted PV output. We presents novel machine learning-based models for predicting the hourly solar capacity factor (CF), focusing on improving predictive performance during periods of severe wildfire smoke. The results demonstrate a R2 value of up to 0.85 for the severe wildfire periods (aerosol optical depth (AOD) above the 99.99th percentile) from our models, significantly outperforming NYISO's R2 value of 0.50 across six load zones included in the analysis. The greatly enhanced performance arises from two innovations. First, we adopted a series of data products, newly available in the public domain, from the High-Resolution Rapid Refresh Smoke (HRRR-Smoke) weather forecasting system. These include predictions of the AOD and the downward shortwave radiation flux (DSWRF) incorporating aerosol impacts. Our study marks the first time the HRRR-Smoke wildfire AOD product has been used in solar electricity forecasts. Second, we employed upsampling strategies to address the data imbalance issues due to the inherently infrequent nature of wildfire events. As the data products are publicly available, our methodology can be readily adopted by power system operators to enhance predictions of solar electricity production during periods of wildfire smoke, ensuring the reliability of power grids with high penetration of solar energy.

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9BQ.4

Regional Radiative Impacts of Dark Brown Carbon in the Southeast United States. ALEXANDRA NG, ManishKumar Shrivastava, Brian Gaudet, Cenlin He, Zezhen Cheng, William Vizuete, *University of North Carolina at Chapel Hill*

Aerosols influence the Earth's radiative budget, directly by absorption (warming) or scattering (cooling), and indirectly as cloud condensation nuclei. While most organic aerosols primarily scatter light, black carbon (BC) and brown carbon (BrC) contribute significantly to absorption. BC and BrC are emitted from fossil fuel burning and biomass burning. Recently, dark brown carbon (d-BrC), a subset of BrC, has been found to contribute a direct radiative effect of +0.208 W/m2 which is comparable to BC. However, dark brown carbon has not been incorporated into air quality models. In this work, we introduced primary dark brown carbon as a new species in WRF-Chem, assuming an emission rate to be 20% of organic carbon from biomass burning. We modeled dark brown carbon (d-BrC) in the Southeast United States from June 12th, 2013 to June 30th, 2013 with the Weather Research and Forecasting model coupled with chemistry (WRF-Chem) version 4.2. We utilized novel experimentally-derived refractive indices for dark brown carbon. The model was evaluated with ground-based organic aerosol and gas measurements collected during the Southern Oxidant and Aerosol Study 2013 field campaign, as well as 9 flights with radiative forcing measurements. The implications of the model evaluation on the importance of dark brown carbon in radiative budgets will be discussed.

9BQ.6

Stabilization of Low Solubility Brown Carbon at the Air-Water Interface by Stearic Acid. ANNABEL EDWARDS, Elizabeth Lyon, *Denison University*

Our work is motivated by the stabilization of low aqueous solubility secondary brown carbon at the air-water interface by simple fatty acids. We use stearic acid and laboratory-produced brown carbon as model compounds to explore if interactions among organic components in aqueous aerosols affect surface composition and surface tension. We collect and resolubilize particulates synthesized from iron-catalyzed reactions in acidic guaiacol solution. We then spread dilute methanol solutions of polyguaiacol at the air-water interface. Pure polyguaiacol films are unstable upon surface area compression in a Langmuir-Blodgett trough. At dilute concentrations, polyguaiacol partitions into the water subphase and minimally impacts water's surface tension. Jointly depositing stearic acid and polyguaiacol on the water surface results in mixed films with distinct behavior. In comparison to pure stearic acid films, gas-liquid and liquid-solid film packing transitions occur in polyguaiacol-stearic acid mixed films at larger surface areas. Because mixed films show changes at larger surface areas, models that rely on fatty acid concentrations and packing alone likely underpredict the effect of surface tension lowering in more complex aqueous aerosol mixtures. After full compression of the mixed film, visual inspection suggests the formation of multilayer stearic acid – polyguaiacol structures that remain at the air-water interface. Ongoing work will investigate the surface stability, structure and composition of these multilayers. These preliminary results underscore the need to investigate the role of secondary products of biomass burning on surface composition in addition to bulk aerosol properties.

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9BQ.7

Improving Wildfire Emission Representation in Global Models: Lessons from the May 2023 Canadian Fires.

FARZANEH TAKSIBI, Benjamin Gaubert, Alma Hodzic, William Vizuete, *University of North Carolina at Chapel Hill*

Wildfire emissions are highly uncertain due to variability in fuel, fire behavior, and meteorology, making it challenging for models to reproduce observed pollution episodes. This work improves the representation of primary organic aerosol (POA) within wildfire emissions in MUSICA (Multi-Scale Infrastructure for Chemistry and Aerosols) by updating species-resolved emission factors with an emphasis on POA, implementing a diurnal cycle of fire emissions (DCFE), and applying a plume-rise scheme that better captures the vertical distribution of injected smoke. We modify the QFED inventory with Canada-specific scaling factors based on Carbon Monitoring System (CMS) carbon-flux data and derive a DCFE from documented fire activity patterns to reflect realistic emission timing. A revised plume-rise parameterization is introduced to increase injection heights under strong fire and convective conditions.

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Model performance is evaluated against observations across North America, focusing on the transport and intensity of POA and related carbonaceous species (e.g., CO, $PM_{2.5}$, OA and BC). We analyze the May 2023 Canada wildfire events and quantify how emission timing and vertical injection—together with planetary boundary layer height (PBLH)—shape downwind POA concentrations, chemical processing, and long-range transport into the United States. Results demonstrate where refined emission factors, DCFE, and plume rise improve model–observation agreement for extreme wildfire smoke, with a primary emphasis on POA behavior.

9BQ.8

Evolution of Black Carbon upon Coating at the Wildland-Urban Interface with Biomass Burning Organic Aerosol Versus Coatings of Volatile Chemical Products in Urban Environments.

CHRISTIAN ESCRITT, Katrina Betz, Micah Miles, Elijah Schnitzler, *Oklahoma State University*

As the instances of severe wildfire increase across much of the US, the interactions between emissions of biomass burning and urban sources at the wildland-urban interface (WUI) become more critical to air quality and climate change. In the urban environment, uncoated aggregates of black carbon (BC), which initially have fractal branched morphologies, are commonly emitted from diesel engines. When biomass burning emissions are transported across the WUI, these BC aggregates are exposed to biomass burning organic aerosol (BBOA), composed of many compounds with wide ranges of chemical, physical, and optical properties, including volatility. The components of BBOA will partition onto the BC aggregates, and the resulting coatings will cause changes to the aggregates, specifically, compacting them into more sphere-like morphologies as well as changing the hygroscopicity of BC, which impacts its interactions with radiation and clouds. Here, we investigate the effects of different volatility fractions of BBOA, representative of different ages of plumes with respect to dilution in the atmosphere, on BC restructuring. From series of diameter growth factors for coated and coated-denuded BC particles, we determine that, as volatility decreases, more coating is necessary for the same amount of restructuring. This is two-fold because, as the plume travels and becomes lower volatility, less overall material is present in the plume. In urban environments, volatile chemical products (VCP) are also a significant source of organic compounds. Geranyl esters are representatives of these compounds, and we show they are extremely efficient at restructuring BC, due to their physicochemical properties (e.g., volatility). We will discuss the results and their implications in the context of previous studies of BC restructuring. Broadly, our observations indicate that fresh wildfire plumes may have more potential to impact the morphology of BC at the WUI while low concentrations of VCP can restructure BC in urban environments.

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9BQ.9

Wildfire Smoke Fungal Bioaerosols Include Disease-Causing Pathogens Confirmed in Mouse Models. LEDA KOBZIAR, Borna Mehrad, Krista Bonfantine, Zifan Zhao, Phinehas Lampman, Nicolas Anger, Karen Garrett, Sam Fox, Ashish Adhikari, Michael Remke, Jason Smith, *University of Idaho College of Natural Resources*

The frequency, extent, and/or severity of wildfires have increased in recent decades in many regions across the globe. Current research on the health consequences of wildfire smoke has focused on non-biological particulate matter, while far less is known about smoke as a potential vector for human or animal pathogens. In this study, we captured bioaerosol samples during wildfires, prescribed burns, and laboratory combustion experiments in seven different locations across the US. Both culture-dependent and -independent methods were used to study the mycobiome of smoke. Cultured isolates (n = 191) included 80 unique fungal species, of which 13 putative human pathogens were recovered. More than 300 fungal taxa were assigned to ASVs from Illumina sequencing of the ITS region of fungal rRNA, and nine genera with human pathogenic or allergenic properties (Aspergillus, Cryptococcus, Candida, Cladosporium, Aureobasidium, Epicoccum, Alternaria, Fusarium, and Malassezia spp.) were found consistently across locations. To establish a causal role for the isolated smoke fungi in human disease, we tested four isolates in experimental mouse models. We inoculated smoke-derived Aspergillus fumigatus into the lungs of immunocompromised mice wherein the animals developed histological evidence of invasive pulmonary aspergillosis; after which the organism was isolated from infected lungs. To assess isolates for hypersensitivity lung disease, we tested the effect of repeated intra-pulmonary inoculation of four additional fungal isolates in immunocompetent mice. We found that exposure to the fungal strains caused physiologically and histologically distinct lung diseases in experimental animals. This study provides evidence that wildfire smoke can disperse fungal pathogens that maintain their virulence and may pose the risk of human disease.

9BQ.10

Evidence of New Particle Formation from Plastic Combustion During Biomass Burning Events. MARWA EL-SAYED, Zezhen Cheng, Yuzhi Chen, Qian Zhao, Nurun Nahar Lata, Gregory W. Vandergrift, Alla Zelenyuk, Swarup China, *Embry-Riddle Aeronautical University*

Biomass burning has become an increasingly significant contributor to air pollution in the United States due to the rising frequency and severity of wildfires. This study investigates the formation and characteristics of nano-plastic particles produced from the combustion of commonly used plastics under controlled laboratory conditions. As part of the 2024 SMOKE (Study of Molecular, Optical, and Kinetic properties of combustion Emissions) campaign, polyvinyl chloride (PVC) and polystyrene (PS) were burned at 600 °C. Both online and offline analyses were conducted to characterize primary organic aerosol (POA) and secondary organic aerosol (SOA) from combustion-emitted volatile organic compounds (VOCs). Single-particle mass spectrometry using miniSPLAT revealed SOA nucleation in the absence of seed particles, providing direct evidence of new particle formation (NPF) from plastic combustion. SOA mass concentrations were approximately 1,000 μg/m³ for PS and 100 μg/m³ for PVC. Evaporation experiments of size-selected particles at room temperature showed high non-volatile fractions—46% PS POA, 83% PS SOA, 86% PVC POA, and 96% PVC SOA—indicating low volatility and high atmospheric persistence. Ice nucleation tests demonstrated that PVC POA had appreciable ice-nucleating activity under supersaturated conditions (saturation ratios from ~1.2 to 1.4), with active fractions up to ~0.1, whereas PVC SOA exhibited negligible ice-nucleating ability even at high supersaturation. Chemical analysis identified CHO-type compounds and chlorine-containing organics in PVC SOA, while both POA and SOA from PS were dominated by CNO-type particles. Elemental analysis further confirmed >0.1% chlorine content in PVC particles, classifying them as CNOCl-type. This work has implications for the potential for plastic combustion, particularly during biomass burning, to influence atmospheric composition and climate, and emphasize the need to update climate models to include plastic-derived aerosols.

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9BQ.11

Real-Time Quantification of Refractory Brown-Carbon Tarballs Using the SP2. JOEL CORBIN, Fengshan Liu, Brett Smith, Alireza Moallemi, Rym Mehri, John Liggio, Jalal Norooz Oliaee, Keyvan Ranjbar, Timothy Sipkens, *National Research Council Canada*

Wildfire smoke and marine engines may both emit refractory, strongly light-absorbing carbon materials commonly known as “tarballs” or “tar brown carbons” (TBs). In spite of mounting evidence that TBs light absorption can dominate over soot (or “black carbon”) in the atmosphere (Chakrabarty et al., 2023; Cheng et al., 2024; Adachi et al., 2024; Corbin et al., 2019), there is still no common real-time, high-throughput technique for TB analysis and quantification.

Previous work has demonstrated that the single-particle soot photometer (SP2) is capable of detecting highly absorbing TBs (Sedlacek et al., 2018; Corbin and Gysel-Beer, 2019). Corbin and Gysel-Beer (2019) showed that the time-resolved light-scattering and laser-induced incandescence (LII) signals of the SP2 were combined to identify TB signatures. However, this approach required detailed analysis and a carefully tuned SP2. In particular, the position-sensitive “split” detector of the SP2 was required for the time-resolved analysis. Such position-sensitive analysis requires detailed validation and signal averaging. Also, it is not possible in simpler continuous-wave LII instruments (Kammerer et al., 2023) including the commercially available SP2-XR. Therefore, there remains a need for real-time TB quantification techniques.

In this work, we performed a laboratory study of tarballs using a custom tarball-generation setup, developed as part of this work. Measurements of particle absorption cross-section at 400 to 900 nm by photothermal interferometry (Corbin et al., 2025) combined with particle volume measurements by SMPS will be used to report mass absorption coefficients (MACs) as a function of tarball annealing temperatures, up to 550 °C. The resulting SP2 signals are investigated using detailed modelling approaches (Michelsen et al., 2015). Additional experiments using pulsed 1064 nm radiation will also be discussed. Based on this detailed work, we demonstrate the approach using real-world samples of wildfire smoke measured from an aircraft platform.

9BQ.12

Impact of Local Wildland-Urban Interface Fires on PM_1 Concentration and Composition in an Indoor Environment. BENJAMIN WERDEN, Michael Link, Benjamin A. Nault, Dustin Poppendieck, Peter F. DeCarlo, *Johns Hopkins University*

The frequency and intensity of wildland-urban interface (WUI) fires are increasing. Smoke from WUI fires has a unique chemical profile unlike wildland-only fires due to the combustion of urban structures, household materials, and natural vegetation. As a result, WUI fires have distinct and variable smoke compositions. The increase in frequency of WUI fires leads to higher exposure of residents to this mixture of chemical species. To investigate the indoor infiltration and chemical composition of WUI smoke, we conducted a series of controlled fire experiments using a test house. Emissions from small-scale surrogate residential fires, conducted outside the structure, infiltrated the indoor environment where PM_1 concentrations and composition were measured using a suite of instruments, including aerosol mass spectrometry.

Different mitigation measures, including varying grades of whole-house filters and air cleaners were used to observe the effectiveness of PM control options on indoor concentrations. Indoor PM_1 concentrations reached up to 400 $\mu g\ m^{-3}$, with chemical profiles ranging from organic-dominated to chloride-rich, depending on the source material burned. Filters were effective at reducing indoor aerosol concentrations, demonstrating the importance of mitigation strategies in minimizing exposure during WUI fire events.

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9CA.2

Determination of Organic Tracers in Atmospheric Particulate Matter Using Thermal Desorption - Pyrolysis with Gas Chromatography. ALENA KUBATOVA, Brett Nespor, Richard Cochran, Haewoo Jeong, David Delene, Frank Bowman, Evguenii Kozliak, *University of North Dakota*

The chemical composition of organic atmospheric particulate matter (PM) is still a riddle. A variety of methods were developed to determine various organic species, typically involving chromatography with mass spectrometry, yet the limitation of these methods is focus on volatile and extractable constituents. Thermal desorption (TD) methods have been shown to be an effective replacement for the solvent extractions, providing a rich portfolio of tracer species yet representing only volatile organic PM fraction. Although the value of pyrolysis (Pyr) for analysis has been shown, much less is known about PM-related pyrolytic product tracers. Such high molecular weight tracers may include species derived from microplastics (e.g., styrene from polystyrene) or wood burning (e.g., lignin from lignocellulosic biomass) or traces from pollen rupture and biomass abrasion.

We have employed TD-Pyr with gas chromatography-mass spectrometry that enabled the characterization of both volatile and nonvolatile atmospheric markers focusing on agriculturally active North Dakota. Based on the composition of TD fractions evolving below 400 °C, harvesting activities appeared to be related to an increased abundance of longer chain alkanes (waxes). The TD fractions also contained biogenic fatty acids and their methyl esters, along with other biogenic OC tracers including levoglucosan and 6,10,14-trimethyl-2-pentadecanone. By contrast, pyrolytic fractions have shown long homologous series of n-alkenes, n-alkylbenzenes, PAHs, n-alkanes, and substituted phenols, which were further differentiated by Pyr temperature. We were able to interpret and ascribe the observed hydrocarbon profiles to lipid pyrolysis. Novel pyrolytic indicators were developed reflecting the breakdown of biogenic plant lipids, providing a more representative and comprehensive characterization of PM. According to these new indicators, the biogenic portion of PM in North Dakota appeared to be most abundant, although some sampling periods showed anthropogenic contributions.

9CA.3

Airborne Organic Aerosol Characterization in the Los Angeles Basin, California, During the AEROMMA 2023 Summer Campaign. SARAH ALBERTIN, Alison Piasecki, Ann M. Middlebrook, Science Team AEROMMA, *CU-CIRES/NOAA CSL*

The NOAA Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) experiment operated a large suite of instruments onboard the NASA DC-8 aircraft during the summer of 2023 to address critical scientific questions around emergent emissions and chemical transformations in U.S. urban areas. In particular, the emergence of poorly characterized and regulated volatile organic compounds, along with biogenic emissions pose a continuous challenge to our understanding of the processes driving organic aerosol (OA) formation and future air quality.

In this study, we report OA measurements over the Los Angeles (LA) basin for 3 afternoon research flights using a high-resolution time-of-flight aerosol mass spectrometer. Overall, the aerosol mass is dominated by organic components (74 % on average), with a pronounced mass concentration gradient from the eastern LA urban area, to the harbor area and to the open ocean. Variability in OA mass concentration is observed as a function of time of day. In particular, the OA mass concentration in the LA urban area peaks at mid-afternoon, as observed in previous studies. Primary OA (POA) and oxygenated OA (OOA) components are identified using positive matrix factorization. Different OOA factors are resolved, showing a spatial evolution of OOA in the area. Notably, a fresher OOA is found to be the largest OA contributor over the LA basin. POA also exhibits an important east-west gradient and correlates with primary anthropogenic tracers. Future work will further characterize these components, using complementary aerosol and gas phase measurements taken on board the DC-8 during AEROMMA. Comparisons with previous studies in the LA basin will be presented, showing the evolution of OA composition and sources over the past decade in this area.

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9CA.4

Report of Concentration, Optical Characteristics, and Source Identification of Brown Carbon Emissions in Tehran. Ali Darvishi Omrani, Gulden Ormanova, Motahareh Naseri, Yousef Rashidi, MEHDI AMOUEI TORKMAHALLEH, *Independent Researcher, Sari, Mazandaran, Iran*

Light-absorbing carbonaceous (LAC) aerosols, including black carbon (BC) and brown carbon (BrC), play a critical role in regional climate forcing and urban air quality. However, long-term multi-wavelength assessments of BrC and BC, especially in complex urban environments like Tehran, remain limited. This study presents a comprehensive analysis of BrC and BC from four stations in the Tehran megacity over four years (2018–2021) using Aethalometer data (at λ = 370 and 880 nm, respectively) spanning four years at a site impacted by the outflow of smoke. The city's complex topography, varied emission sources, and atmospheric transport pathways significantly impacted these light-absorbing carbonaceous components concentrations across these stations, with annual mean concentrations varying from 36 ng m−3 to 45,737 ng m−3. the BC concentrations peaked during the pre-monsoon season (930 ± 685 ng m−3). Source contributions were analyzed using the absorption angstrom exponent (AAE) which showed biomass burning dominance (>50 %) at most cites. BrC concentrations were consistently higher than the BC, indicating the prevalence of biomass burning aerosols. Angström ˚ coefficient (A˚ 370/880) values were predominantly > 1 (mean ± standard deviation: 1.25 ± 0.31) while values <1 were more prevalent during the wet season, which suggests a stronger influence of fossil fuel combustion. The highest concentrations occurred under northerly air massesfrom fire-dense regions. Local waste burning and industrial combustion also caused extreme BrC and BC level under favorable wind. We identified 35 air pollution episodes, and analyzed their relation to 500 hPa geopotential height and blocking types. Most were linked to Ω-shaped and Rex-type anticyclonic blocking, reducing vertical mixing and increasing pollutant accumulation. Potential Source Contribution Function (PSCF) modeling indicated contributions from both local emissions and regional transport. The findings underscore the need for targeted mitigation strategies during persistent anticyclonic episodes, which enhance BrC and BC pollution in Tehran.

Keyword: Brown carbon, Black carbon, optical characteristics, source identification

9CA.5

Black Carbon Trends Reflect Changing Particulate Matter Emissions in SoCAB Since 2010 . ANNE PERRING, Ekaterina Balsan, Joshua P. Schwarz, Georgia Michailoudi, Jeff Peischl, Nell Schafer, Steven Wofsy, Josh DiGangi, Glenn Diskin, *Colgate University, CIRES CU Boulder*

Refractory black carbon (rBC), a component of atmospheric aerosol that results from incomplete combustion, is associated with negative health impacts. California has a long history of implementing strict emissions regulations to improve urban air quality, many of which have targeted particulate matter, PM, a criteria pollutant of which rBC is a subset. Since rBC is a primary emission that has no secondary atmospheric source, it is a useful tracer for evaluating the efficacy of regulations targeting PM emissions and it can be used along with gas-phase measurements of other combustion products like CO and CO_2 to track changes in combustion efficiency over time. Here we present a series of airborne measurements of rBC concentrations made in the Southern California Air Basin since 2010 (during multiple campaigns) using the NOAA Single Particle Soot Photometer (SP2). We examine changing correlations of rBC with CO and CO_2 on both weekdays and weekends to infer changes in rBC emissions from diesel trucks, and we track the evolution of rBC microphysical parameters (rBC mass distributions and coating state) through the different campaigns as these parameters affect the atmospheric lifetime and fate of rBC and may indicate changes to SoCab chemistry relevant for SOA formation. Our larger goal is to evaluate the effect of California's recently-implemented Clean Air Regulations for Heavy Duty Diesel Vehicles, which required that older vehicles upgrade to a 2010 or newer Engine Model Year with a phased implementation that applied to the oldest vehicles in 2015 and to the whole fleet in January of 2023. Thus, our 2010 data pre-dates these emissions regulations, while our 2023 data was collected several months after the rules were fully implemented.

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9CA.6

Investigating Air Quality Impacts of Rocket Emissions at Cape Canaveral Using Low-Cost Sensors. SPARTACUS STEPHENS, Marwa El-Sayed, Tonmoy Ghosh, *Embry-Riddle Aeronautical University*

Over the past five years, commercial spaceflight activity at Kennedy Space Center in Florida has surged by more than 310%, prompting increased concern over the environmental and public health implications of rocket emissions. Rocket launches emit various air pollutants, notably particulate matter (PM)—including black carbon (BC)—and nitrogen dioxide (NO_2), both of which are regulated under the U.S. Clean Air Act due to their association with adverse health outcomes. However, existing U.S. Environmental Protection Agency (EPA) monitoring stations are located 20 to 40 miles away from launch pads, making them inadequate for capturing localized, near-field air quality impacts. To bridge this data gap, we deployed low-cost TELLUS AirU Pro sensors—calibrated against reference-grade monitors—at three locations within 15 miles of Launch Pad 39A, including areas adjacent to the pad and near the Apollo Visitor Center. These sensors measured concentrations of $PM_{2.5}$, PM_{10}, carbon monoxide (CO), ozone (O_3), and nitrogen oxides (NO_x) before, during, and after launch events to analyze pollutant dispersion over time and space. This research provides some of the first ground-based, real-time observations of localized air quality changes associated with modern rocket activity. The results can be used to validate existing models of rocket emission impacts and offer actionable insights for enhancing environmental health and safety strategies. More broadly, the study contributes valuable empirical data to support improvements in atmospheric emissions modeling and promotes the adoption of more sustainable practices across the aerospace sector.

9CA.7

Exploring the Charge State of Black Carbon-Containing Aerosol. MEGAN NEUMANN, Joshua P. Schwarz, Samantha DeLone, Matthew Forbes, Steven Ciciora, *National Oceanic and Atmospheric Administration*

A less-commonly measured parameter of aerosol microphysics is aerosol charge state, which may reflect aerosol source, composition, or interaction. The presence of electrical charge on aerosol particles has been shown to depend weakly on aerosol composition and is attributed to ionization mechanisms including: electrostatic interactions, radiation, and cosmic ray ionization. Charged aerosols are more likely than their neutral counterparts to grow through collision and coagulation, are more active as cloud condensation nuclei, are affected by areas of charge separation in the atmosphere, and may take part in different chemical processes than uncharged aerosols. In this work, aerosol charge state was investigated for aerosol particles in the size range ~100-800 nanometers and those containing black carbon (BC) in the mass range 1-150 fg. We used a single particle soot photometer and a novel electrostatic filter to quantify aerosol charge state. Measurement validation was carried out with uniformly charged, randomly charged, and neutralized Monodisperse Polystyrene Latex Spheres (PSLs) and laboratory-generated BC particles. Charged particle fraction measurements of both interior and exterior ambient aerosols were made over a month, and the collected data was compared to data from multiple test flights on NASA's WB-57F high altitude research plane during the NOAA SABRE test flight campaign, 2025. Although the concentration of ambient aerosols changed day-to-day, we find that quite consistently ~60% of ambient aerosols at ground level were charged, with larger aerosols having a higher charged percentage than smaller particles, consistent with aerosol equilibrium charge state theory. Additionally, BC particles internally mixed with optically significant amounts of non-refractory materials had a higher charged fraction than uncoated black carbon and the same charged fraction as scatter particles consistent with the change in aerosol size. BC composition did not significantly influence charged fractions observed. Variability in BC size resulted in more variability in population charge state than was observed in the total accumulation-mode aerosol population.

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9CA.8

Characterizing Aviation Fuel Emissions Using Low-Cost Air Quality Sensors. TONMOY GHOSH, Marwa El-Sayed, *Embry-Riddle Aeronautical University*

The aviation sector is a significant source of atmospheric pollutants, driving the urgent need to assess cleaner alternatives such as Sustainable Aviation Fuels (SAFs). SAFs have the potential to markedly reduce emissions of carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) compared to traditional fuels like Jet A and leaded aviation gasoline (AvGas). However, real-world emissions from these fuels remain insufficiently characterized across varying operational conditions and altitudes. This study utilizes a network of low-cost air quality sensors integrated onto Unmanned Aerial Vehicles (UAVs) and ground-based platforms to characterize emissions from a range of aviation fuels, including AvGas, Jet A, UL94, and several SAF blends. Field measurements are conducted at Embry-Riddle Aeronautical University's Daytona Beach campus, combining airborne and stationary sampling to capture high-resolution spatiotemporal data on key pollutants: $PM_{2.5}$, PM_{10}, CO, CO_2, NO_2, and SO_2. Instruments used include the TELLUS AirUpro monitor, PurpleAir, Alphasense OPC-N3, Plantower, Sensirion SPS30, and Vaisala AQT-400, all of which are calibrated against EPA reference analyzers to ensure data reliability. In addition to field monitoring, controlled engine tests at the Peter Vosbury Turbine Engine Laboratory and test cells enable direct comparisons of emission profiles between conventional and alternative fuels under standardized conditions. These comprehensive measurements provide real-time data across different altitudes and engine loads, filling critical gaps in the understanding of aviation-related emissions. The findings will inform environmental impact assessments, support policy reform, and guide aviation industry efforts toward cleaner and more sustainable air transportation. Ultimately, this work contributes to global sustainability goals by generating actionable, empirical data to mitigate the environmental and public health impacts of aviation emissions.

9CA.9

Microscopic Evolution of Soot and Sulfur-Induced Particles in Urban Aerosols: A Fractal and Chemical Perspective. VAISHNAV BARTARIA, Auroop Ratan Ganguly, Ashok Jangid, Ranjit Kumar, *Dayalbagh Educational Institute Dayalbagh Agra*

Soot and organic particles emitted from fossil fuel combustion and biomass burning play a pivotal role in Earth's climate system by absorbing solar radiation, altering cloud microphysics, and contributing to atmospheric warming. These particles can act as cloud condensation nuclei and ice-nucleating agents, influencing both short- and long-term climate feedbacks. In this study, aerosol samples were collected from a high-emission urban region in northern India and analyzed using Field Emission Scanning Electron Microscopy (FESEM) coupled with energy-dispersive X-ray spectroscopy (EDX) to investigate the morphochemical evolution of soot and sulfur-induced new particle formation (NPF). High-resolution FESEM imaging revealed diverse particle morphologies, including fractal soot aggregates and tar balls, transitioning toward compact core–shell structures due to atmospheric aging. The fractal dimension (Df) was used as a quantitative metric to assess aggregation complexity, internal mixing states, and structural compactness over time. An increase in Df indicated progressive compaction and oxidation, with sulfur- and oxygen-rich coatings altering hygroscopicity and optical behavior. Simultaneously, nucleation bursts were driven by elevated SO_2 levels and photochemical precursors, forming ultrafine sulfur-rich particles that often adhered to aged soot surfaces. These results provide mechanistic insight into how sulfur-driven chemistry and aging processes modulate the physical structure and chemical reactivity of soot and organic aerosols. The integration of fractal analysis with chemical imaging advances our understanding of their radiative forcing potential and toxicity. This study emphasizes the need for improved atmospheric representation of aged soot in climate models and underscores their relevance to both air quality regulation and public health risk assessments.

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9CC.1

Atmospheric Aging Impacts on the Ice Nucleation Abilities of Mineral Dust in the Cirrus Cloud Regime. CAROLINA RAMIREZ-ROMERO, Luis A. Ladino, Sebastián Mendoza-Téllez, Jonathan Abbatt, *University of Toronto*

After sea spray, mineral dust is the second-largest natural contributor of airborne particles worldwide. Due to its abundance and physicochemical properties, mineral dust influences the formation of mixed-phase and cirrus clouds by acting as ice nucleating particles (INPs). In particular, feldspars can nucleate ice under cirrus cloud conditions at a relative humidity with respect to ice (RH_{ice}) of ~127%. For this reason, feldspars may be good candidates for cirrus seeding by promoting cloud thinning, a solar management technique to mitigate climate warming. However, it is unknown how aging mechanisms in the upper troposphere may modify the physicochemical properties of feldspars, affecting their ice nucleation (IN) and cloud seeding abilities.

Here we present results on the ice nucleation abilities via deposition nucleation, before and after aging mechanisms, of various types of feldspar (i.e., orthoclase, plagioclase, and microcline). Experiments were conducted in the University of Toronto Continuous Flow Diffusion Chamber (UT-CFDC) at temperatures between 213 and 223 K. Particle aging was induced by the formation of organic coatings, specifically tricarballylic acid and dioctyl sebacate, which were subsequently oxidized by OH radicals in the Toronto Photo-oxidation Flow Tube. Different aging conditions (e.g., equivalent to days to weeks in the atmosphere) were studied to evaluate the effect on IN efficiency. Our results indicate that the IN ability of feldspars is influenced by aging mechanisms, conditions expected in the upper troposphere.

9CC.3

Advancing Black Carbon Mass Absorption Cross-section Estimation Using Machine Learning Models. UZZAL KUMAR DASH, Andrew A. May, Haikal Rozaidi, Dominic Blackston, Aadit Shah, *The Ohio State University*

Black carbon (BC), a light-absorbing component of atmospheric aerosols, plays a significant role in Earth's climate system. Its impacts are typically quantified using chemistry-climate models, but predictions of BC mass concentrations often diverge due to inconsistencies in aerosol microphysics among models. Model evaluation using observations is essential, yet most ground-based and remote sensing observations quantify BC indirectly via light absorption measurements rather than direct mass concentrations. Converting absorption measurements to mass concentrations often assumes a constant, wavelength-specific mass absorption cross-section (MAC), which may not capture real-world variability. Alternately, relating light absorption measurements and modeled BC mass concentrations requires assumptions about the applicable light scattering theory and aerosol properties (e.g., mixing state, complex refractive index). To address these limitations, we propose a third approach: a statistical framework that employs multiple regression and machine learning models to estimate the temporal variability of the mass absorption cross-section of black carbon (MAC_{BC}). This enables more accurate conversion of aerosol light absorption measurements to BC mass concentrations for both filter-based absorption photometers and remote sensing platforms, with the potential to improve the evaluation of chemistry-climate model predictions. Building on our previous work, which used ground-based observations from a single DOE campaign, we expanded our MAC_{BC} prediction tool by constructing comprehensive database incorporating airborne observations from nine NASA and five DOE field campaigns. Multiple regression and machine learning models were trained on this database where we incorporated additional input variables such as the Absorption Ångström Exponent (AAE), Scattering Ångström Exponent (SAE), and Single Scattering Albedo (SSA), along with existing input parameters including multi-wavelength absorption and scattering coefficients and aerosol particle size distributions. The trained models were evaluated using an independent validation dataset, and potential sources of systematic bias in predicted MAC_{BC} values were diagnosed.

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9CC.4

Relating Physicochemical Properties of the Aerosols Emitted from Jet Aircraft to Contrail Formation. ANSON REGI, Connor Malley, Sungho Hwang, Tonghun Lee, Vishal Verma, *University of Illinois Urbana Champaign*

Condensation trails (Contrails) are linear clouds that are formed in the upper troposphere (10-14 km) by water vapor condensing onto aerosols present in aircraft engine exhaust. Contrails can persist as cirrus-like clouds and contribute to radiative forcing, with a net positive effect. A key component in contrail formation is the presence of soot particles from fuel combustion, which act as nuclei for ice crystals to form. The objective of this study is to examine critical soot properties, e.g. primary particle diameter (D_p), mobility diameter (D_m), specific surface area (SSA), porosity (Φ) and chemical composition, and how they impact the ice nucleating potential (INP) of soot particles.

Representative soot particles were generated by the combustion of aviation fuels like Jet-A and Sustainable Aviation Fuel (SAF) in a lab-scale combustor. These particles are then sampled and imaged using Transmission Electron Microscopy (TEM) to determine D_p. Brunauer-Emmett-Teller (BET) analysis is employed to quantify SSA and porosity using nitrogen gas adsorption. The emissions are simultaneously collected onto quartz filters for elemental and organic carbon analysis while a part of it is diluted and directed to a Scanning Mobility Particle Sizer to assess D_m. The INP of soot particles are analyzed by channeling these emissions into an atmospheric chamber that simulates upper tropospheric temperature, pressure and relative humidity.

Preliminary results indicate that D_p of soot generated from Jet-A fuel combustion is in the range of 20-40 nm, and the SSA is 49.4 m^2/g. The development of the atmospheric chamber for the measurement of ice nucleation is in process and the results investigating the relationship between these physicochemical parameters and INP will be presented. Our future efforts are directed towards developing a predictive model to link these properties of the generated soot with its INP.

9CC.5

Effect of Salts on Protein Aggregation and Ice Nucleation Efficiency. ROYA SAFA, Sarah D. Brooks, Daniel Thornton, *Texas A&M University*

Biological aerosols can act as highly efficient immersion ice nuclei by catalyzing freezing events at warmer temperatures than other ice nucleating particles. Our research indicates protein nucleation efficiency is modulated by concentration, aggregation, divalent cations, and electrostatic interactions. Measurement of ice nucleation and zeta potential showed that higher protein concentrations enhance ice nucleation activity through a greater surface area provided by higher repulsive electrostatic interactions. In addition, protein aggregation as measured by dynamic light scattering, can be altered by interactions with metal cations, which in turn affect the ice nucleation activity. This study examines the effects of the most abundant seawater divalent cations (Mg^{2+}, Ca^{2+}, and Sr^{2+}) on the aggregation size and ice nucleation properties of select proteins (cytochrome c, Snomax®, RuBisCo and thyroglobulin). RuBisCo maintained high ice nucleation efficiency even as ionic strength increased, highlighting its uniqueness in ice nucleation activity. Notably, thyroglobulin demonstrated exceptional stability, with consistent aggregation sizes across varying cationic ionic strengths. These findings provide valuable insights into the role of proteins and ice nucleation processes.

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9CC.6

A Contact Nucleation Study of Levitated Supercooled Water Droplets upon Collision with Mineral Dust Particles. UPASNA B. RAI, Jingchuan Chen, Kyle McMillan, Ryan Davis, Margaret Tolbert, Sarah D. Brooks, *Texas A&M University*

Pure water droplets in the atmosphere remain in the liquid phase until supercooled to approximately -38°C, at which point they freeze homogeneously. At warmer temperatures, freezing is initiated heterogeneously by ice nucleating particles (INPs) via immersion, deposition or contact ice nucleation. While contact nucleation is capable of initiating freezing at the warmest temperatures, it remains the most poorly characterized and least understood of the heterogeneous ice nucleation pathways. To address this, we conducted a series of contact nucleation experiments in a custom-built Dual-Balance Linear Quadrupole Electrodynamic Balance. In this novel apparatus, dry aerosols serving as potential INPs are made to collide with a single supercooled water droplet levitated in the balance. We examined a range of atmospherically relevant INPs including quartz, Arizona Test Dust, Pahokee Peat Soil, Soda Feldspar, and Mt. St. Helens volcanic ash at sub-freezing temperatures ranging from -5°C to -20°C. Notably, quartz, a silicon dioxide mineral found abundantly across the globe, exhibited contact nucleation at temperatures between -8°C and -10°C. This temperature is much higher than previous studies of immersion ice nucleation on quartz, highlighting the enhanced efficiency of contact nucleation in promoting ice nucleation in clouds. In contrast to quartz, the other mineral dusts considered here did not facilitate ice nucleation upon contact until cooled to at least -18°C. Our results demonstrate that contact nucleation presents an ice nucleation pathway for certain mineral dusts like quartz to facilitate ice cloud formation at warmer temperatures than previously considered. These findings contribute to a better mechanistic understanding of ice nucleation in mixed-phase clouds with implications for the global radiative balance and climate predictions. Further studies using this levitation-based approach can help resolve existing uncertainties in aerosol-cloud interactions and atmospheric ice formation.

9CC.8

A Comprehensive Analysis of Ice Nucleating Particles in a Subarctic Urban Environment during the ALPACA Campaign. SAMANTHA GREENEY, Evelynn Buxton, Russell Perkins, Sonia Kreidenweis, Paul DeMott, Ezra Levin, Emily Costa, Kerri Pratt, Brice Temime-Roussel, Barbara D'Anna, Kathy Law, Rodney J. Weber, Jessie Creamean, *Colorado State University*

Ice nucleating particles (INPs) influence cloud properties, precipitation, and radiative forcing, yet their sources and characteristics remain poorly understood, especially in polluted high-latitude environments. This study investigates the size and composition of immersion-mode INPs during the Alaskan Layered Pollution And Chemical Analysis (ALPACA) field campaign, conducted in Fairbanks, Alaska, from January 17 to February 25, 2022. Fairbanks is a unique location with extreme cold, frequent temperature inversions, and persistent wintertime pollution. We report data from a combination of online measurements from a continuous flow diffusion chamber (CFDC) and offline filter and size-resolved Davis Rotating-drum Unit for Monitoring (DRUM) impactor samples. These were supported by contextual aerosol size and composition data.

Our findings show that while the aerosol population was dominated by smaller particles in both number and mass concentrations, INP activity was concentrated in the larger (1.21 - 12 μm) size range. INPs were primarily composed of heat-labile organic material across all size ranges and temperatures, with over 90% of INPs at –15°C and –20°C identified as heat-labile and likely proteinaceous or biological in origin. Local sources, such as lichen and road gravel, were likely contributors to the observed INP population. Compared to other urban and Arctic sites, Fairbanks exhibited higher INP concentrations at lower temperatures and lower concentrations at higher temperatures. These results provide new insight into subarctic INP sources during poor air quality and emphasize the importance of particle size and local emissions in determining INP activity and abundance.

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9CE.1

The Effect of Flavoring and Coil Choice on Toxic Emissions from Electronic Cigarettes. BIANCA MARTINEZ, Elham Fazeli, Yeongkwon Son, Andrey Khlystov, *Desert Research Institute*

Various flavors and customization options in electronic cigarettes (e-cigs) enhance product attractiveness and, therefore, can increase vaping usage especially among youth. Flavoring chemicals are known to increase harmful e-cig emissions, such as carcinogenic carbonyls. However, it is unclear how the coil age and the choice of e-cig liquid flavor affects e-cig toxic emissions. This study explores emissions of carbonyls, polycyclic aromatic hydrocarbons (PAH), and metals during e-cig use with different flavoring chemical compounds and coil usage conditions. A 'mod' type (SMOK V18 Mini, 0.15ohm, dual meshed coil, 90W) e-cig was used to generate e-cig aerosols at different coil ages (puffing range 0–600 puffs). Benzaldehyde flavoring (5mg/mL) at 50% PG and 50% VG carrier liquid was used. Puff topography was 4-sec per puff at 0.9 LPM. 5 puffs with a 30-sec puff interval duration were collected per sample. Unflavored carrier liquid was used as baseline. The aerosols were collected in a 2,4-Dinitrophenyl hydrazine (DNPH-C) silica coated cartridge for carbonyls, while glass fiber and Teflon filters were used for other analysis, such as PAHs and metals. Collected samples in DNPH cartridge were analyzed using high-performance liquid chromatography with photodiode array detection (HPLC-PDA) for carbonyls, PAHs were analyzed using gas chromatography mass spectrometry (GC-MS), and metals were determined using inductively coupled plasma mass spectrometry (ICP-MS). Carbonyl emissions were higher for fresh coils (20-200 puffs) for both flavored and unflavored liquids. PAHs were observed for both benzaldehyde and unflavored carrier liquid. For example, compounds such as naphthalene, fluorene, pyrene and vanillin were observed and showed variation through the puffing range for both flavored and unflavored liquids.

9CE.3

Investigating Atmospheric Emissions of Nanoplastic Fibers from Domestic Tumble Dryer Activities: A Study Using Aerosol Mass Spectrometry. MICHAEL A.R. TAWADROUS, Alex K.Y. Lee, Arthur W. H. Chan, *University of Toronto*

Polyester textiles are a recognized source of microplastic pollution, predominantly through fiber shedding during laundering. While the release of fibers into wastewater has been extensively studied, airborne emissions generated during machine drying remain poorly characterized, particularly at the nanoplastic scale. This study addresses this knowledge gap by investigating the release, characterization, and emission factors of airborne polyester nanoplastic fibers from tumble dryers using a multi-instrument approach. Aerosol Mass Spectrometry (AMS), Ultra-High Sensitivity Aerosol Spectrometer (UHSAS), and Aerodynamic Particle Sizer (APS) were combined to provide polymer-specific chemical identification, high-resolution size distributions, and real-time concentration measurements. Three polyester blankets with different fabric constructions, pile weave and two knitted types, were tested under controlled drying conditions.

Results show that fabric structure and moisture content are key parameters influencing nanofiber release. Pile weave fabrics exhibited higher emissions than knitted fabrics, attributed to the looser fiber ends characteristic of their construction. Emission levels also scaled with fabric moisture: higher moisture content led to greater nanofiber shedding, likely due to moisture-induced weakening of fiber integrity. Emission factors were calculated using AMS-derived organic mass concentrations. For the pile weave fabric, the emission factor was estimated to be about 5 tonnes per year in Canada. When adjusted to realistic household conditions (3.7 kg load and 3.8 drying cycles per week), this scaled to a national estimate of 66 tonnes per year. The two knitted fabrics contributed significantly less to between 10 and 16 tonnes annually.

Further characterization using size-resolved AMS and the UHSAS revealed that each blanket releases nanofibers within distinct size ranges where the majority of airborne PET fibers ranged from 100 nm to 500 nm in diameter, with larger fibers also captured by APS. Additionally, siloxane-related compounds, commonly used in textiles, were detected in emissions, indicating that polymer additives may be co-released with nanoplastics.

This work highlights the importance of textile structure and moisture in airborne nanoplastic generation and underscores the need to consider drying as a significant but overlooked source of environmental nanoplastics.

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9CE.4

Detection of and Protection from VOC "Spikes" Generated during Everyday Cooking, Cleaning, and Artistic Activities.

Sonam Devabhaktuni, Sathyaraj Devabhaktuni, DEVABHAKTUNI SRIKRISHNA, *PatientKnowhow.com*

Prior work characterized extreme levels of volatile organic compound (VOC) generation during cooking such as when frying oils/fats. Last year at AAAR, we presented measurements using low-cost TVOC sensors on extremely high levels of VOC generated ("spikes") during everyday cooking, cleaning, and artistic activities. The VOC-generating substances tested included lysol, vodka, nail polish, toasting bread, hair mousse, markers, peanut butter, ice cream, and sunscreen. When an updated version of the same low-cost TVOC sensor was able to detect VOC that the older model was unable to, raising the question of whether certain VOC species are being missed by one or both models. To address this question, in this research, we compare the measurements of both versions of the low cost TVOC sensors to a factory-calibrated photoionization detector (PID) in a test matrix of TVOC measurements of spikes observed with these and additional substances. Given the unpredictability of spikes these results motivate wider use of low-cost VOC counters to offer real-time warning of potentially risky spikes, while recognizing the gaps in their detection of certain VOC species. These warnings can be used to selectively initiate (trigger) VOC air cleaning for indoor occupants at a distance, and if air cleaning of indoor VOC is inadequate, personal protection such as P100 elastomeric respirators with organic vapor.

9CE.5

Coupling a Gas Chromatograph to a Chemical Ionization Mass Spectrometer for Isomer-resolved Measurements of Airborne PFAS.

CHENYANG BI, Yufan Hu, Michael Davern, Joji Sherman, Mitchell Alton, Anita Avery, Nathan Kreisberg, Barbara Turpin, Jason Surratt, John Jayne, Manjula Canagaratna, *Aerodyne Research Inc.*

Per- and polyfluoroalkyl substances (PFAS), often referred to as “forever chemicals,” are widely used as water-resistant coatings and surfactants in a range of consumer and industrial products. PFAS represent a broad class of compounds with diverse functional groups and heavily fluorinated carbon chains. Their industrial synthesis often results in mixtures of structural isomers (e.g., linear and branched forms) due to similarities in chain-based structures and the lack of stereochemical constraints during production. These structural isomers can exhibit significant differences in their fate, transport, and toxicity, making isomer-specific analysis essential. While chemical ionization time-of-flight mass spectrometry (CI-TOF-MS) has been used for real-time detection of PFAS in air, it is unable to resolve isomers and is typically calibrated only for the linear-chain isomer of each PFAS class. Consequently, techniques that enable isomer-resolved molecular characterization are essential for understanding the atmospheric fate and transport of individual PFAS isomers. In this study, we couple a thermal desorption aerosol gas chromatograph (TAG), which enables sample preconcentration and isomer separation, with a CI-TOF-MS using iodide as the reagent ion. The TAG-CI-TOF-MS enables the switch between real-time CI-TOF-MS analysis and isomer-resolved gas chromatograph analysis. We demonstrate the instrument performance on separating and preconcentrating analytes by injecting PFAS liquid standards and by measuring oxidation products formed from the reaction of fluorotelomer alcohols (FTOHs) with hydroxyl (OH) radicals in an oxidation flow reactor.

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9CE.6

Measuring Atmospheric Plastic and PFAS Nanoparticles with the High-Resolution Time-of-Flight Aerosol Mass Spectrometer. ADAM DEITSCH, D. Orsini, Jie Zhang, Archana Tripathy, Sara Lance, *University at Albany*

While interest in emerging pollutants like micro/nanoplastics (MNP) and per/polyfluoroalkyl substances (PFAS) has been growing over recent years, both MNP and PFAS present major challenges for both indoor and outdoor air quality measurements. Despite the growing body of evidence for various environmental and human health issues related to this broad set of chemical compounds, many questions remain regarding atmospheric sources and concentrations, as well as chemical processing during atmospheric transport, which likely control their ultimate impact. Here we present data collected with a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) and Scanning Mobility Particle Sizer (SMPS) for in-laboratory polytetrafluoroethylene (PTFE) nanoparticle calibrations and discuss these results in the context of air measurements collected in New York State.

9CE.7

Design of an Active Sampler for Characterization of Total Ionic Per- and Polyfluoroalkyl Substances (PFAS) in Indoor Air. MARGOT FRANCINI, Naomi Chang, Barbara Turpin, *UNC-Chapel Hill*

Per- and polyfluoroalkyl substances (PFAS) are ubiquitous indoors. Despite this, their fate and transport are not well characterized due to limitations in air sampling methodology, particularly for ionic PFAS. To address this knowledge gap, low-cost, accurate collection of gas- and particle-phase ionic PFAS is necessary. The goal of this study was to design a novel integrated air sampler that accurately measures the total concentration (particle- and gas-phase) of ionic PFAS species in indoor air, guided by evidence that quartz fiber filters (QFFs) adsorb ionic PFAS gases, in addition to collecting particles. We found that six QFFs in series effectively captured the 13 perfluoroalkyl carboxylic acids (PFCAs) we measured with <15% breakthrough when sampling indoors at 10 L min^{-1} over a six-day period. Notably, results revealed that there are more ionic PFAS in the gas phase than widely recognized, in agreement with a modest number of previously reported outdoor denuder measurements. Additionally, the proportion of gas-phase breakthrough across backup QFFs relative to front filter loading varied by ionic PFAS class, suggesting that physicochemical properties have a complex influence on gas-particle interactions and filter partitioning. To further optimize sample collection, we provide a second-generation prototype sampler design and initiate consideration of alternative front filter materials with smaller (or zero) PFAS adsorption artifacts and low PFAS background values. This work aids the development of low-cost, accurate, and separate particle- and gas-phase measurements, lending critical evidence to more comprehensive human exposure assessments for ionic PFAS.

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9CE.8

Micro- and Nano-plastic Particles in Ambient Aerosol Detected from 2002 – 2014 Using Single-Particle Mass Spectrometry. MARYJANE ITEGHETE, Francesca Saraniti, Maja Urban, Deborah Gross, *Carleton College*

Micro- and nano-plastics (MNPs) are contaminants of emerging concern in water, soil, and air, and are known to accumulate in the bodies of animals and humans. While microplastics (~1 µm – 5mm in diameter) have been found in water and soil throughout the globe, airborne detection of these species has been more difficult. Typical infrared light-based methods for identification of microplastics are not effective in the size range of airborne aerosol particles, which are more likely to be in the nanoscale (1 – 1000 nm in diameter). The first report of airborne MNPs was published in 2015. Here we use single-particle mass spectrometry to identify polystyrene, one of the most common species reported in MNPs, in ambient air measured in real time in studies carried out around the globe in the years 2002 – 2014.

Using the single-particle mass spectra of polystyrene latex spheres (PSLs), typically used for size calibration, as a guide, we used a combination of K-means clustering and querying the single-particle mass spectra to identify ambient particles containing polystyrene. Our method was validated using datasets constructed by combining ambient aerosol particles (dust particles, organic particles, and all detected particles from various studies) with PSL particles, to ensure that the polystyrene spectra could be differentiated from ambient particles. Polystyrene MNPs were found in datasets from all urban and suburban areas that were investigated, but were absent in a dataset from a remote area. This method can be applied to identify other polymer species in airborne MNPs using authentic standards and single-particle mass spectrometry.

9CE.9

Scented Volatile Chemical Products: Emerging Indoor Pollutants Driving Rapid Atmospheric Nanoparticle Formation and Growth. SATYA PATRA, Nusrat Jung, Brandon E. Boor, *Purdue University*

Scented volatile chemical products (sVCPs), increasingly popular for indoor fragrance applications, are emerging pollutants of significant concern due to their role in indoor atmospheric nanoparticle formation and associated respiratory health risks. We conducted comprehensive indoor field measurements in a residential test house to investigate new particle formation (NPF) driven by sVCP emissions, specifically focusing on terpene-rich products, including air fresheners, personal care products, cleaning products, and scented wax melts. Using advanced instrumentation, including a particle size magnifier–scanning mobility particle sizer (PSMPS) and a proton transfer reaction time-of-flight mass spectrometer (PTR-TOF-MS), we measured real-time nanoparticle size distributions down to 1 nm and terpene concentrations in the indoor air. Our results consistently showed that sVCP use considerably elevates indoor terpene mixing ratios (10–1000 ppb), significantly exceeding levels observed in outdoor forest environments (<10 ppb). These terpenes react readily with indoor ozone, initiating intense NPF events characterized by particle nucleation rates approaching 10^5 cm^{-3} s^{-1} and condensational particle growth rates as high as 300 nm h^{-1}, orders of magnitude greater than typical outdoor NPF events. Consequently, indoor nanoparticle concentrations frequently reached 10^6–10^8 cm^{-3} during indoor sVCP use, comparable to or even surpassing nanoparticle emissions from known combustion-based aerosol sources such as candles, gas stoves, and diesel engines. Importantly, the rapid particle formation and growth associated with sVCP usage substantially enhance nanoparticle inhalation exposure, yielding respiratory tract deposited dose rates similar to or greater than those from traditional combustion-based indoor aerosol sources. Our findings demonstrate that sVCPs significantly impact indoor air quality, underscoring the urgent need for expanded toxicological evaluation and greater consideration of sVCP emissions in indoor environmental management and regulatory frameworks.

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9CM.1

Accelerated Degradation and Low-Latency Continuous Monitoring of PFAS Using Microdroplet Oxidation and Open Port Mass Spectrometric Sampling. Nathan Bays, SAMANTHA KRUSE, Trinity Griffus, Paul Tumminello, Ryan Davis, *Sandia National Laboratories*

The detection and destruction of perfluoroalkyl substances (PFAS) in water supplies is of great importance due to their environmental persistence and associated health risks. This study explores the integration of advanced oxidation techniques with the unique interfacial chemistry of aerosolizing PFAS-laden waste streams to enhance degradation efficiencies. Utilizing a custom aerosol generator, microdroplets were produced from aqueous solutions of perfluorooctanoic acid (PFOA) and other chain lengths to probe interfacial reactivity. The oxidation processes employed included the incorporation of ozone and/or UV-C light, alongside the addition of hydrogen peroxide, sulfite, or iodide to the solution. To evaluate destruction efficiencies, impacted droplets were collected in either a sampling chamber or in-line filtration, where ion chromatography (IC) revealed PFOA degradation through the release of fluoride ions (F^-) into the solution. Subsequent liquid chromatography-mass spectrometry (LC-MS) analysis quantified residual PFOA concentrations and identified degradation products. This setup allows for continuous monitoring of degradation processes with minimal response time delay, facilitating the rapid optimization of oxidation mechanisms. Preliminary data shows promising results, with enhanced degradation in the aerosol phase relative to bulk.

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9CM.2

Filtration Efficiency and Deposition Behavior of Nanoparticles Through Electret Filter Media. GENHUI JING, Sean Vanlandingham, Thaddeus Ptak, Shawn (Sheng-Chieh) Chen, *Virginia Commonwealth University*

Electret filter media have been widely applied in HVAC systems, respirators, and other air filtration applications due to their ability to achieve high particle removal efficiency with low pressure drop. This enhanced performance is attributed to the electrostatic attraction between charged fibers and airborne particles, which provides significant energy savings compared to purely mechanical filtration.
In this study, eight different electret filter media were evaluated. The initial size fractional penetration was measured using monodisperse NaCl particles with mobility diameters of 30, 50, 80, 100, 200, 300, 500, and 700 nm. These nanoparticles were generated via an atomizer and classified by a Differential Mobility Analyzer (DMA). The filtration efficiency for each particle size was quantified by the ratio of concentration of up- and downstream, which was measured by an Ultrafine Condensation Particle Counter (UPC).

The deposition mechanisms of different filters were further examined by analyzing the attachment behavior of NaCl and KCl nanoparticles with opposite electrical polarity on the fiber surfaces. Scanning Electron Microscopy (SEM) was employed to visualize the spatial distribution of deposited nanoparticles, providing insight into nanoparticle electrical polarity-dependent deposition mechanisms and the influence of fiber charge polarity and distribution on the deposition process.

The results enhance the understanding of the mechanisms of performance deterioration in electret filter media and provide suggestions for the design of effective electret-based composite filter.

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9CO.1

Characteristics of Particulate Matter from Sustainable Aviation Fuel Combustion in a miniCAST Soot Generator.

RAPHAEL MAERKL, Edward Winstead, Bruce Anderson, Matthew Brown, Eva-Lou Edwards, Carolyn Jordan, Francesca Gallo, Susan Mathai, Sayantee Roy, Michael Shook, Elizabeth Wiggins, Luke Ziemba, Richard Moore, *NASA Langley Research Center*

Contrails form on aircraft engine particle emissions and contribute substantially to the overall climate impact of aviation. Reduced soot particle number concentrations from zero-aromatic sustainable aviation fuels (SAFs) have been shown to decrease the number of contrail ice crystals and the contrail radiative forcing. Soot particle size distributions as well as soot morphology are expected to play a significant role in the corresponding contrail ice particle number concentrations and resulting radiative forcing. While in-situ case studies comparing SAF combustion to conventional fuel use exist, a systematic parameter study on single fuel parameters and SAF blending ratios is essential in determining corresponding sensitivity of soot characteristics.

The Jing Ltd miniCAST Series D soot generator is used to perform these parameter studies with small amounts of liquid fuel. We change the soot particle properties by varying nitrogen mixing gas and oxidant air flow rates. Test series varying single fuel parameters such as sulfur, aromatic, or naphthalene content allow isolating their impact on soot particle number concentration, size distribution, or morphology. Similarly, the influence of small step variations in SAF blending ratios can be examined.

The measurements are carried out under controlled laboratory conditions with a suite of aerosol microphysical and optical instrumentation connected to the miniCAST exhaust line. The particle exhaust stream can either be probed in its raw state or after passing through a thermodenuder to remove gas-phase components.

These laboratory results are compared to ground-based and in-flight measurements performed during the 2023 EcoDemonstrator campaign. This ensures that miniCAST particles serve as valid cruise emission surrogates and findings are transferable to real-life aircraft engine emission scenarios.

The results of this study will uncover the fuel chemical compositions and combustion parameters which minimize contrail ice particle formation. This way, benefits of the limited resource SAF can be maximized by not only reducing soot particle numbers but also identifying soot size distributions that minimize ice particle activation potential.

9CO.2

Exploring VOC Emissions from Structure and Prescribed Fires.

CLARA MCMULLIN, Sungwoo Kim, Abigail Maben, Shantanu Jathar, Gabriel Isaacman-VanWertz, *Virginia Tech*

The number and intensity of wildfires is increasing, and fires are increasingly encroaching on populated areas. While in recent years there has been more of a focus on understanding emissions from these fires, there is still a large gap in knowledge about burning structures and other built materials. These fuels contain a large amount of potentially hazardous chemicals not found in natural systems, raising concerns about the resulting emissions. In this project, samples were collected onto sorbent packed cartridges by flying drones over prescribed and wild structure fires. After collection, the samples were analyzed through thermal desorption – gas chromatography and mass spectrometry (TD-GC/MS) calibrated using hydrocarbon standards. Data were analyzed comprehensively using recently-developed automated workflows and approaches to catalog and quantify all analytes found in a set of samples. Analytes were identified using existing mass spectral libraries and machine learning classification approaches. These methods enable a comprehensive and semi-quantitative evaluation of the composition of the gases emitted. This presentation will focus on the composition of emissions and how they vary by fuel and conditions.

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9CO.3

Smoke and the City: Differentiating Aged Wildfire Smoke and Urban $PM_{2.5}$ Using Integrated Air Quality Measurements.

RYAN DURUISSEAU-KUNTZ, Cheol H. Jeong, Christi Jose, Bradley H. Isenor, Greg J. Evans, *SOCAAR, University of Toronto*

The growing threat of wildfires, fueled by climate change, raises concerns for air quality, health, and climate. Wildfires are a growing source of fine particulate matter ($PM_{2.5}$), a hazardous pollutant that impacts respiratory, cardiovascular and cognitive health in humans. Wildfire $PM_{2.5}$ is transported long distances and mixes with urban air pollution, complicating its detection and our understanding of health impacts. The contribution of wildfire smoke to total $PM_{2.5}$, especially in urban centers, is a research priority which could enhance air quality management and public health protection. As smoke is transported, photochemical reactions induce chemical changes producing $PM_{2.5}$ with large variations in composition and toxicity. Unravelling how aging affects wildfire $PM_{2.5}$ composition could indicate its relative toxicity compared to other $PM_{2.5}$ sources. This research aims to distinguish aged wildfire $PM_{2.5}$ from the urban background.

During the 2023 wildfire season, data were collected at the Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR) in Toronto. Measurements from an Aerosol Chemical Speciation Monitor (ACSM) were used to assess changes in aerosol composition. The light absorbing properties of black carbon (BC) during wildfire events supported evaluation of aging extent. An analysis of carbon monoxide (CO) concentrations, ACSM organic aerosol aging tracers, and $PM_{2.5}$ mass concentrations identified 6 probable wildfire smoke events in 2023. Using the NOAA HYSPLIT model, plume transport times were estimated to range from 13-72+ hours. Molecular tracers m/z 60 (levoglucosan) and m/z 44 (CO_2^+) aided determination of relative aging during each wildfire event. Events with longer transport times corresponded to decreased m/z 60 and increased m/z 44. The absorption angstrom exponent (AAE) of BC was found to be a predictor of air masses impacted by aged smoke. Decreasing AAE's were observed downwind of wildfire locations. Variation in $PM_{2.5}$ composition between wildfire events will also be explored.

9CO.4

Effect of SAF on Particle Emissions from Gas Turbine Engine.

HIROYUKI YAMADA, Toshiki Kaneko, *Tokyo Denki University Graduate School*

Effects on Sustainable Aviation Fuel (SAF) addition to traditional Jet fuel (Jet A1) on particle number emissions over 10 nm have been evaluated with a small gas turbine engine which maximum output is 210 N. The tested engine was small compared with a gas turbine engine used for aircraft, however the NOx and particle number emissions factor of the tested engine were almost the same level with those of actual aircraft jet engines.

As for SAF, Hydrotreated Esters and Fatty Acids (FEFA) and Catalytic Hydrothermolysis Jet (CHJ) were tested. HEFA consists mainly of parafine and no aromatics are contained. On the other hands, CHJ contains aromatics over 20 %.

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9DA.3
Identification of Viruses in Complex Air Metagenomes. LUIS ANGEL NINO BARREAT, Chang-Yu Wu, *University of Miami*

We introduce an innovative metagenomic approach for monitoring long-term virus diversity patterns across landscapes. From a 34-year collection of airborne eDNA samples from northern Sweden, we were able to identify 9,242 viral sequences of 233 genera and 74 families, associated with diverse hosts. Worthy of mention is the detection of 61 human-associated virus genus. Additionally, the strong temporal correlation between the presence of *Lyssavirus* and the Red Fox *Vulpes vulpes* demonstrates the capacity to link viral abundance with wildlife reservoirs, offering valuable information for One Health programs and ecosystem management. This proof-of-concept trial emphasizes the power of airborne environmental metagenomics as a minimally invasive technique for sustained monitoring of viral diversity.

9DA.4
Enabling Community Aerosol Science with the ACT Python Library for ARM and Beyond. ADAM THEISEN, Zachary Sherman, Kenneth Kehoe, *Argonne National Laboratory*

The Atmospheric data Community Toolkit (ACT) is an open-source Python library developed by the Atmospheric Radiation Measurement (ARM) user facility to streamline access to and analysis of atmospheric data, with growing utility for the aerosol science community. ACT offers a unified framework to ingest, process, quality control, and visualize data from a wide range of data sources. By supporting standardized workflows and promoting reproducibility, ACT lowers technical barriers and enables broader community participation in the analysis of aerosol observations.

Built on familiar scientific Python libraries such as xarray and matplotlib, ACT includes modules for plotting time-series, distributions, and aerial data, as well as tools for applying automated data quality checks and flagging. ACT also integrates natively with ARM data formats and is extensible to other networks and campaigns, making it an ideal tool for intercomparison studies, instrument evaluation, and educational outreach.

Development of ACT's third roadmap is currently underway, with a strong emphasis on community engagement, modularity, and long-term sustainability. This roadmap builds on feedback from users and collaborators across atmospheric science domains. By aligning development priorities with the needs of aerosol researchers, the ACT team seeks to ensure that the toolkit continues to evolve as a responsive, flexible resource that supports open, reproducible science across observational networks.

https://github.com/ARM-DOE/ACT

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9HR.1

Ineffective Quality Control Measures Could Affect Electronic Cigarette E-Liquids' Secondhand Aerosol Emissions. SARAH FRESQUEZ, Daniel Walker, Talia Chavis, Sinan Sousan, *Department of Public Health, East Carolina University*

Electronic cigarette (ECIG) e-liquids offer varying nicotine concentrations and ratios of propylene glycol (PG) to vegetable glycerin (VG). Increasing VG content can enhance the visibility of puff "clouds," which correlates with increased $PM_{2.5}$, particulate matter 2.5 µm or smaller, mass concentrations, known to be associated with increased morbidity and mortality. E-liquids with different PG/VG ratios are widely available through third-party websites that may lack proper quality control. While users expect products to reflect their labeled contents, discrepancies in nicotine, PG, and VG levels can lead to unexpected $PM_{2.5}$ emissions. This study conducted chemical analyses of third-party e-liquids and measured secondhand $PM_{2.5}$ mass concentrations in a controlled chamber during 30-minute sessions. Experiments were performed using combinations of four freebase nicotine concentrations and five PG/VG ratios. The actual chemical values were compared to manufacturer-labeled values, revealing inconsistencies. For example, products labeled as containing 0.0 mg/mL nicotine were found to have up to 0.4 mg/mL. Those labeled 9.0 mg/mL ranged from 6.6–9.7 mg/mL; 18.0 mg/mL ranged from 13.6–25.7 mg/mL; and 48.0 mg/mL ranged from 34.7–44.7 mg/mL. Only 5 of 20 e-liquid combinations had VG levels within ±5% of their labeled values. The most extreme discrepancy showed a measured 19 PG / 81 VG ratio versus a labeled 80 PG / 20 VG. Measured $PM_{2.5}$ mass concentrations reached up to 72,049 µg/m³. Based on actual chemical analysis, higher VG content consistently resulted in increased $PM_{2.5}$ mass concentrations. These findings highlight quality control issues in commercially available e-liquids and demonstrate the public health risks associated with high secondhand $PM_{2.5}$ emissions. Stricter regulation and more accurate labeling of ECIG products are critical to protecting users and those exposed to secondhand aerosol.

9HR.2

A Numerical Model of Pollen Dispersion in an Allergen Exposure Chamber. LAURA HAYA, Nick Ogrodnik, Suzanne Kelly, Edgar Matida, William Yang, *Red Maple Trials*

Allergen exposure chambers (AECs) are specialized facilities used to expose clinical study participants to a controlled environment containing specific aeroallergens at specific concentrations. AECs have been used to help characterize allergic respiratory disease and contribute to the clinical development of treatments (Pfaar and Zieglmayer, 2020). While AECs vary in size and in their mechanisms used to dispense and disperse allergen, they must all be able to maintain a stable and narrow allergen concentration, homogenous across participant seating (Pfaar et al. 2021). The necessary airflow and particle dynamics to achieve this can be complex, and it may not be possible to fully characterize them experimentally.

A 3D numerical simulation of the EnviroGold™ AEC (Ottawa, ON) has been developed to simulate the dispersion of Timothy grass pollen (38 µm mean diameter) at target concentration 3,500 ± 500 particles/m^3 and was validated against experimental data collected with laser particle counters in the operational AEC. Simulations were performed using Unsteady Reynolds Averaged Navier Stokes equations with a Shear Stress Transport turbulence model, and Lagrangian particle tracking.

Time and grid sensitivity analyses established that a 5-million element grid, and 1-ms time-step adequately resolved the flow field and met stability criteria. The particle spatial distribution and room-average pollen concentration stabilized by 40 seconds and the simulation was run for an additional 20 seconds. Numerical room-average pollen concentration was within 9% of experimental average (3,934 vs. 3,613 ± 151% particles/m^3, respectively). Location-specific results were within 14-19% of experimental.

This is the first known numerical framework of an AEC. It has elucidated certain features of the complex flow patterns in the EnviroGold AEC which contribute to the generation of uniform pollen distribution. The framework may be extended in future work to simulate the dispersion of other aeroallergens including irregularly-shaped pet dander or dust.

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9HR.3

Ambulatory Puff Topography of Participants in a Weeklong Natural Environment Observation Study. GLORIA MBAKA, Edward Hensel, Logan Kelly, Leo Holman, Nathan Eddingsaas, Risa Robinson, *Rochester Institute of Technology*

A weeklong observation study of participants who use electronic cigarettes is in progress. Candidates who pass the IRB approved subject screening protocol are enrolled in a study which queries their behavioral response using ecological momentary assessment, samples biomarkers of exposure and health effect, and monitors their puff topography. Each participant is provided with one or more custom wireless Personal Use Monitors designed to accommodate their own-choice ecig. Puffing data is recorded for seven days. Data is downloaded from each monitor upon return to the lab, and data is analyzed to quantify puffing behavior as a function to tobacco product characteristics. As of press time, candidates have been identified who choose to use Hyde Edge, Hyde Disposable, Geekbar Pulse, Geekbar Pulse X, Juul, and various Lost Mary ecigs. Puffing behavior consisting of mean puff flow rate, duration, puff count, and mean cumulative aerosol consumption is reported for participants enrolled during the first 12 months of a five year study. Preliminary results will quantify the effect of product characteristics such as ecig brand, eliquid flavor, and emissions yield on commonly accepted puff topography parameters. Results will inform regulatory guidelines on product characteristics for ecigs and eliquids.

9HR.4

Effect of Non-Thermal Plasma on the Allergenicity of Airborne Allergens. HUNTER RICHARDS, Zhenyu Ma, Herek L. Clack, *University of Michigan*

Introduction

An allergic reaction is an immune response in which Immunoglobulin E (IgE) antibodies are produced in response to foreign substances that are typically considered harmless. Allergens are proteins or glycoproteins that can induce IgE antibody production in genetically predisposed individuals (Torres-Borrego & Sanchez-Solis 2023; Bannon 2004).

Anaphylaxis is a severe and potentially fatal allergic reaction that is rapid in onset. Airborne anaphylaxis is defined as the occurrence of anaphylactic reactions to inhaled allergens rather than through contact or ingestion. Anaphylaxis through inhalation is a much less frequent route and is largely understudied but may also go undiagnosed or unreported. Foods found to trigger reactions through inhalation include cow's milk, peanut, sesame, and lentils (Ridolo et al. 2022). The current guidance on prevention of airborne anaphylaxis includes avoidance of environments where allergen aerosols or vapors may be present. However, it is not always possible to entirely avoid exposure and this presents a dangerous situation for highly sensitive individuals.

Nonthermal plasma (NTP) has been studied for its applications within food safety, with uses that include reducing the impacts of microorganisms, foodborne pathogens, and chemical contaminants (Pignata et al. 2017), among others. NTP produces reactive species, such as ·OH and $1O_2$, that can denature proteins (Bora et al. 2022). NTP plasma was found to induce changes in the secondary structure of Ara h 1 and reduce IgG-binding capacity of Ara h 1 in whole peanut and dry defatted peanut flour for bulk surface treatments (Venkataratnam et al. 2019). Based on the success of reducing allergenicity of peanuts when treated by NTP on surfaces, we expect to see similar results for airborne applications.

Non-thermal plasma was shown to reduce the amount of a 64 kDa protein band, corresponding to peanut allergen Ara h 1, using Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDS-PAGE) (Hsu et al. 2023). The immunoreactivity of Ara h 1 was significantly decreased as plasma treatment time increased, shown with immunoblotting and enzyme-linked immunosorbent assay (ELISA) (Hsu et al. 2023).

With this understanding that proteins are susceptible to NTP treatment, there is potential for NTP to be successful in denaturing airborne allergens to the point that their allergenicity is reduced.

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Experimental Procedure
Using commercially available peanuts and peanut flour, aerosolized peanut solutions are treated with nonthermal plasma. Samples with and without treatment at the inlet and outlet of the nonthermal plasma reactor are analyzed with gel electrophoresis to assess changes in known allergens.

Ara h 1 migrates as a 63-kDa band, Ara h 2 migrates as a doublet at 20 and 17 kDa, and Ara h 3 consists of a series of polypeptides from 45 to 14 kDa (Yapo-Crezoit et al. 2017). We expect the results of untreated airborne peanut samples to be similar to these results when analyzed with gel electrophoresis, while treated samples would exhibit a change in the distribution and intensity of bands indicating a change in proteins.

Changes in the characteristics of molecular weights may cause changes in allergenicity (Venkataratnam et al. 2019). Analyzing a sample with an Enzyme-Linked ImmunoSorbent Assay (ELISA), the change in allergenicity of aerosolized peanut solutions following nonthermal plasma treatment is evaluated to determine optimal treatment methodology.

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9HR.5
In Vitro Neurotoxicity Analysis for Mapping Alzheimer's Disease Risk Due to Particulate Matter Exposure. Yuezhi (August) Li, Joseph V. Puthussery, KEYAO SONG, Jessica Restivo, John Cirrito, Rajan K. Chakrabarty, *Washington University in St. Louis*

Dementia, encompassing various neurodegenerative disorders, affects over 55 million individuals worldwide, with over 10 million new cases reported annually. Among all these disorders, Alzheimer's disease (AD) is the leading cause of dementia. Recent epidemiological and animal studies have provided increasing evidence for a potential causal link between exposure to particulate matters (PM) and AD development, highlighting the necessity to elucidate the underlying mechanisms of this association.

This study aims to investigate how air pollutants induce AD by establishing a Neurotoxicity Index (NTI) that gauges the impacts of different $PM_{2.5}$ constituents on neural health. We selected various major PM components, including organic matter, sulfate, nitrate, ammonium, black carbon (BC), dust, and transition metals, that are representative of emissions from urban, agricultural, and natural sources. By exposing the neuron-like Neuro 2a (N2a) cells to these pollutants, we first examined their influence on N2a cell viability. The cells were exposed to a concentration gradient of each PM component for 24 hours to determine the lethal concentration of 50% cell death (LC_{50}). The PM components have a wide range of LC_{50} values. For example, copper oxide (CuO), a common pollutant from vehicular braking, shows an LC_{50} of 2.5 μg/mL, whereas BC from incomplete combustions has an LC_{50} of 120 μg/mL. Notably, copper sulfate, which is water-soluble, exhibits a much higher LC_{50} of 58 μg/mL than the insoluble CuO. This indicates that the subsets of the same PM component can have different neurotoxicity and may affect the neurons via different mechanisms. Following cell viability, we will continue to examine the influence of air pollutants on other crucial neurotoxicity indicators such as mitochondrial function, reactive oxygen species generation, and amyloid β plaque formation. The complete NTI will be instrumental in translating cellular-level changes into actionable health risk data.

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9HR.6

Pulmonary Disease Risks Linked to $PM_{2.5}$ and Black Carbon Using Emergency Room Visits and Hospital Admissions in Karachi. HAIDER KHWAJA, Fatim Sannoh, Zafar Fatmi, Nadeem Rizvi, Aftab Turabi, Kamran Khan, Mirza M. Hussain, Azhar Siddique, David Carpenter, *University at Albany*

Air pollution is a major problem of concern in developing countries of South Asia. No prior studies exist in a megacity Karachi, Pakistan evaluating the short-term effects of ambient air pollution on pulmonary diseases. This study delved into the linkage between fine particulate matter ($PM_{2.5}$) and black carbon (BC) levels and pulmonary emergency room visits (ER) and hospital admissions (HA). Daily $PM_{2.5}$ samples were collected at four monitoring sites in Karachi for six continuous weeks each quarter. A time-series analysis using a Generalized Linear Model (GLM) estimated the relative risk of associations between $PM_{2.5}$, BC and pulmonary diseases. Data revealed fluctuations between $PM_{2.5}$ exposure and pulmonary diseases across different sites. Significant associations were observed at the University of Karachi (KU) and Macro sites, where $PM_{2.5}$ exposure correlated with increased risk of shortness of breath (SOB) among both sexes, with a stronger risk for females at the KU site. Males at the Macro site exhibited higher risks for total pulmonary diseases. Age-stratified analysis showed higher risks for pulmonary diseases in patients aged 0-50 at the KU, Macro, and Malir sites. $PM_{2.5}$ exposure was associated with SOB and asthma among this age group, with significant risks at delayed lag days. Exposure of high levels of BC was significantly associated with asthma among patients aged 0-50 and chronic obstructive pulmonary disease (COPD) among the elderly at the KU site. The findings accentuate the pressing pulmonary health risks from $PM_{2.5}$ and BC exposure, beckon a call for targeted interventions to mitigate air pollution and its health impacts, especially among vulnerable populations in major cities of Pakistan.

9HR.7

Exposure Assessment of Solid Carbon Materials Through Atmospheric Carbon Dioxide Solidification Process. EMI FUKUDA, Satsuki Takai, Taiki Nagaya, Yasuto Matsui, *Graduate School of Engineering, Kyoto University*

Carbon Capture, Utilization and Storage (CCUS) is one of the most promising technology to address climate change and global warming. In particular, the process of converting CO_2 into solid carbon nano materials such as carbon nanotubes (CNTs) and carbon nanofibers (CNFs) is regarded as a more effective method for stable storage and resource recovery compared to gaseous CO_2. Therefore, it is considered a critical strategy for achieving a low-carbon society.

Some studies have suggested inhalation risks among workers in CNTs and CNFs manufacturing facilities. However, there is little data concerning occupational exposure assessment in CCUS laboratories or facilities. The purpose of this study is to quantify and assess the potential exposure of workers to solid carbon products generated in a research facility developing CO_2 solidification technology. To assess exposure, particle number concentrations were measured using Dust Meter (Compliant with Japanese labor law), Fast Mobility Particle Sizer (FMPS) and Optical Particle Sizer (OPS) during the entire work process. In addition, personal exposure was evaluated during the operation using the personal air sampling method. Collected products, personal breathing zone samples, and area samples were analyzed by transmission electron microscopy (TEM).

As a result, all particle sizes showed high concentrations (number/m^3) during the operation of the solidification stainless chamber. TEM observations of the filter collected by the low-pressure impactor showed that most of the solid carbon was CNFs, with a few CNTs. Concentrations of dust with large particle sizes were low in all environments and situations, and personal exposures were small for each worker.

In summary, our results showed that a few CNTs may be produced under certain conditions and the potential for worker exposure to CNF-like structures and their fine fragments in the process of solidifying atmospheric carbon dioxide.

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9HR.8

Online City Air Toxicity Monitoring Using Rats. CHENYU ZHU, Maosheng Yao, *Peking University*

Conventional approaches to studying the health effects of air pollution such as particulate matter (PM) are generally offline, which involve air sampling, lab-controlled exposure, then followed by tissue sectioning and blood examinations. Here, we have used rats for real-time sensing air toxicity through analyzing breath-borne biomarkers from rats by an integrated sensor array. The eight gaseous biomarkers in the exhaled breath of rats include total volatile organic compounds (TVOC), CO_2, CO, NO, H_2S, H_2O_2, O_2, and NH_3. The results showed that $PM_{2.5}$ significantly affected the relative levels of multiple breath-borne biomarkers from rats, especially NO, H_2S, H_2O_2, and O_2. Further, we have developed an automated, low-cost, and time-resolved system for noninvasive monitoring of eight breath-borne biomarkers from rats. We deployed the system to 13 cities in China to monitor the health effects of real-world air pollutants on a 24/7 basis during the 2023 winter and 2024 spring. Using the results of eight biomarkers, we have derived an air toxicity index (ATI) for assessing the overall health effects of city air. Using the EconML model, we quantified the causal effects of the same magnitude of change in the mass concentrations of $PM_{2.5–10}$ and $PM_{2.5}$ on the levels of breath-borne VOCs, CO, NO, H_2O_2, and H_2S from rats in each city. Results showed that $PM_{2.5–10}$ and $PM_{2.5}$ had different health effects in different cities and seasons. Using Deep Neural Networks (DNN) coupled with SHapley Additive exPlanations (SHAP), the contribution of $PM_{2.5}$ to the overall air toxicity was quantified, which exhibited complex nonlinear patterns in real-world environments. Overall, this work pioneers a new research paradigm for non-invasive, real-time monitoring of PM health effects and has yielded significant novel findings in field applications.

9HR.9

Exposure Studies of Living Organisms Using the PolluRisk Platform II : How is the Oxidative Potential a Relevant Metric to Assess the Health Impact of Air Pollution. PATRICE COLL, Lucy Gerard, Ambre Delater, Clément Buissot, Sophie Lanone, Thomas Audoux, Laurent Alleman, Davy Rousset, Albane Barbero, Anouk Marsal, Gaëlle Uzu, The PolluRisk Team, *Université Paris Cité and Univ Paris Est Creteil, CNRS, LISA*

Air pollution is the cause of 6.67 million premature deaths per year worldwide, ranking it as the second leading risk factor for premature death worldwide. («Impacts on Your Health | State of Global Air» 2024) Moreover, a major concern is the fact that 99% of the world's population is exposed to levels of air pollution that exceed the thresholds recommended by the WHO.

This major issue induces a need for a metric that can assess the health impact of air pollution to which an individual is exposed. Recently, Oxidative Potential (OP) has been proposed as a potential metric. The OP of Particulate Matter (PM) is their ability to oxidize molecules in the pulmonary environment[SL1] , inducing the formation of ROS (Reactive Oxygen Species). OP is usually attributed to a source of emissions and not to a chemical species (as there are thousands of them). The original aim of the OP concept is to identify the most problematic sources, in terms of their health impact. Hence, this would enable decision-makers to tackle the problems associated with these sources (Weber, 2021 ; He et Zhang ,2022).

Our study aims to measure the OP related to realistic simulated air masses in the laboratory (thanks to the PolluRisk platform) using different acellular methods in order to:
- intercompare different OP determination techniques used at the laboratory, including online technics.
- to evaluate the link between OP and health effects assessed on exposed preclinical models.

During this campaign, two types of atmospheres were created:
- An atmosphere representative of a moderately polluted city (experiment 1).
- An atmosphere representative of a moderately polluted city with the addition of a biomass combustion source (experiment 2).

To study the health impact of simulated air pollution, mice were exposed for 7 days to these simulated air masses. Two types of mice were exposed, “healthy” mice and mice with pulmonary fibrosis representing vulnerable populations.

Bronchoalveolar lavage was performed in mice to collect cells from the lower respiratory tract, followed by cytological analysis to examine and characterize these cells.

Perspectives will describe the gain of measuring the OP online on the PolluRisk platform, during the preclinical models (or cells on the short term) exposures.

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9HR.10

Exposure Studies of Living Organisms Using the PolluRisk Platform I: How the PolluRisk Platform is Simulating at the Laboratory Urban Air Quality and Its Health Impacts. AMBRE DELATER, Patrice Coll, Spyros N. Pandis, Sophie Lanone, The PolluRisk Team, *Université Paris Cité and Univ Paris Est Creteil, CNRS, LISA*

It has been widely accepted that there are clear relations between exposure to atmospheric pollution and Health impacts (epidemiology and toxicology studies). This explicit demonstration has been supported – as an illustration - regarding mortality and morbidity effects of long-term exposure to low-level $PM_{2.5}$, BC, NO_2 and O_3 (analysis of European cohorts in the Elapse project).

We have developed the PolluRisk platform, that reproduces for days the atmospheric phases (gases/aerosols) similar those of cities that are highly, mid- or low-polluted. It is mainly resulting from the coupling of an atmospheric simulation chamber (cesam.cnrs.fr) and of exposure devices able to host preclinical models (isolators from Noroit® company). The principle of such an atmospheric simulation is described on the platform website : pollurisk.eu

The experimental protocol consists in the continuous injection of primary pollutants (NOx, COVs mix, SO_2, soot, inorganic salts and potentially mineral dust particles if needed) at low concentrations (ppb levels) in air in the chamber. With a 4 hours residence time in the chamber, the mixture is exposed to an artificial solar irradiation, allowing secondary pollutants such as O_3, NO_2, HCHO, etc. as well as complex polyfunctional organics including Secondary Organic Aerosol (SOA) to be formed, reaching a chemical steady state. Isolators are then “fed” with a constant flow of such a mixture. The “reference” isolator is filled up with filtered air only.

We will illustrate the results regarding 2 experiments (one simulating a summer mid-polluted city atmosphere and one simulating a winter mid-polluted city atmosphere, both for a duration of 7 days). We will present 1/ the SOA characterization including Organics, Nitrate or Sulfate content 2/ the functionalized particulate compounds observed 3/ some biological characterizations of the exposed mice lungs. These results clearly state the interest of Atmospheric Simulation chambers to support such exposure studies devoted to Health Impacts of Air Quality.

9IA.1

Isocyanates Emission Tests from Polyurethane Products. YUJI FUJITANI, Yoshikatsu Takazawa, Go Suzuki, Satoshi Inomata, Rie Yanagisawa, Eiko Koike, *National Institute for Environmental Studies*

The study evaluated the emission of isocyanates from automotive seat components and cushions using a microchamber method, based on JIS standards for assessing semi-volatile organic compounds (SVOCs) released from building materials. A 13L quartz glass chamber was used to control temperature and humidity while circulating air at 20 mL/min for 24 hours. The emission rate of 2,4-TDI was found to be 25-67 ng/m²/hour under conditions of 28°C and 50% relative humidity. As temperature and humidity were increased (e.g., 45°C and 60°C), the emission rate of 2,4-TDI increased significantly, with a 20-fold increase observed at 60°C compared to 28°C. The study also found that higher humidity led to faster emission rates. Furthermore, the emission of particles was evaluated using a CPC. When no piece of test samples in the quartz glass chamber were present, the particle concentration was zero. With one piece of sample, the particle concentration increased, and a higher temperature led to an increase in particle concentration. The study confirmed that urethane samples emitted particles. The calculated particle emission rates were $1\text{-}24 \times 10^6$ particles/m²/hour. Overall, the study demonstrated the relationship between temperature, humidity, and the emission of both isocyanates and particles from automotive seat materials and cushions, providing important data on the potential exposure to harmful substances in living environments.

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9IA.2

Resuspension Behavior of Settled Dust Particles in the Infant-Occupied Indoor Environment. BRIAN MAGNUSON, Chunxu Huang, Satya Patra, Brandon E. Boor, *Purdue University*

During key motor development stages between 6 and 18 months of age, infants frequently disturb settled indoor dust on flooring surfaces through crawling, as their hands and limbs repeatedly contact the floor. These activities can lead to the inhalation of resuspended dust particles, increasing exposure to harmful contaminants commonly present in household dust, including per- and polyfluoroalkyl substances (PFAS), heavy metals, microplastics, flame retardants, plasticizers, allergens, and microorganisms. To better inform inhalation exposure estimates, it is critical to characterize the size-dependent transport behavior of dust particles during crawling. Resuspension experiments were conducted in the Inert Controlled Environmental Chamber (ICEC), which maintained conditions representative of infant-occupied indoor environments while supplying filtered air to isolate resuspended particles. Surface contact impulses simulating infant locomotion during crawling and play were generated using a robotic platform. Resuspended particles were characterized by aerodynamic diameter, optical diameter, and fluorescence using an aerodynamic particle sizer (APS), optical particle sizer (OPS), and wideband integrated bioaerosol sensor (WIBS), respectively. Size-resolved dust resuspension fractions were calculated using a single-zone material balance model for each crawling event. These experiments aim to improve our understanding of particle resuspension dynamics and their implications for infant inhalation exposure during critical developmental stages.

9IA.3

Characterization of Eraser Wipe Solid Extraction Method Targeting Indoor and Outdoor Surface Films Influenced by Biomass Burning Aerosol. JOSEPH BERBERICH, Janie (Yeaseul) Kim, Holden Schoenherr, Christopher Cappa, Elise Palombella, Shareen Ashby, Victoria Barber, Rachel O'Brien, *University of Michigan*

Wildfires produce immense quantities of biomass-burning aerosol (BBA) particles, which present health challenges for people living downwind, including oxidative stress, inflammation, and respiratory issues. Wildfire smoke may infiltrate, and BBA particles can deposit onto surfaces indoors and influence surface film development. Surface films act as a source and sink for semi-volatile organic compounds, a site for chemical reactions, and a means for resuspension of aerosol particles once perturbed. As humans spend ~90% of their time indoors and indoor environments have much greater surface-area-to-volume ratios than outdoor environments, chemical exposure (transdermally or respiratorily) to surface films can be important to understanding human health in fire-impacted areas. Based on economic and logistical challenges, passive/offline sampling approaches to analyze BBA-influenced surface films are desirable. However, common extraction approaches have limitations; liquid extraction surface analysis (LESA) is often impractical for porous or vertical surfaces, and solid-phase extraction with Kimwipes can have poor extraction efficiencies. Herein, we propose and validate a solid-phase extraction of surface films using poly(melamine-formaldehyde) polymer sponges, commercially available for low cost as the Mr. Clean Magic Eraser® (ME). We probe a matrix of analytes (polar and nonpolar), approaches (commercial sponge, treated sponge, LESA, and Kimwipe), and surfaces commonly found indoors to evaluate our extraction efficiency and application space. We use high-resolution Orbitrap mass spectrometry (MS) and offline high-resolution time-of-flight aerosol mass spectrometry (HR-ToF-AMS) to analyze samples for qualitative and quantitative information. We compare our validation experiments to various surfaces sampled with ME wipes at UC Davis campus (outdoors, 2024) and Californian homes near/next to wildfires (outdoors/indoors, 2025). Our analysis will help improve the methodological landscape to extract BBA-influenced surface films for indoor and outdoor surfaces.

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9IA.4

Modeling Of Indoor Contaminants Using CFD. ROY KING, Suresh Dhaniyala, *Clarkson University*

The quality of our indoor air depends on the outdoor air pollutants that are introduced and contribution of indoor pollutant sources. The fate of these pollutants is dependent on the losses of these particles in the space and the role of ventilation systems in moderating their concentrations. Our current approach to model indoor air quality is based on simple box models for mixing but quiescent flow for particle losses. The accuracy of these models in capturing air quality in real-world spaces must be established. Here, we use a combination of low-cost sensors and research-grade instruments to obtain CO_2 and particle concentration data over two years in a real-world university classroom. The data is collected in the room as well as in the ventilation system. We then used information about number of students and ventilation filters along with a box model to predict indoor air quality over time and compared against experiments. The box model is seen to predict average behavior in the room but misses out in capturing some of the observed heterogeneity in particle fate characteristics. We then use Computational Fluid Dynamics(CFD) to model detailed flow characteristics in the room and combine simulations with particle tracking. The simulation results are then compared against real-world experiments. I will present details of the box and CFD models and discuss our experimental validation effort.

9IA.5

Fluorescent Aerosol Particles in Outdoor and Mechanically Ventilated Indoor Air in a Subtropical Urban Environment. YANHAO MIAO, Yu Chung Pang, Patrick K. H. Lee, *City University of Hong Kong*

Bioaerosols are ubiquitous in built environments and influence indoor air quality and human health. However, real-time, high-resolution data on their spatiotemporal dynamics—particularly in mechanically ventilated commercial buildings—remain limited. In this study, we simultaneously measured fluorescent aerosol particles (FAPs; 0.5–10 μm) in outdoor air and in the indoor air of seven mechanically ventilated commercial buildings (offices and lobbies) in subtropical Hong Kong using two mobile laser-induced fluorescence instruments. The detected FAPs, originating from both biological and non-biological sources, included three biologically relevant classes: bacteria-like, fungi-like, and pollen-like particles. On average, the indoor fraction of FAPs was significantly higher (4.32 ± 1.15%) than outdoors (2.83 ± 0.81%). Fungi-like FAPs dominated bioaerosol concentrations both indoors (19.72 ± 24.08 L^{-1}) and outdoors (28.03 ± 24.97 L^{-1}). Across all buildings, indoor and outdoor FAP concentrations showed similar temporal patterns and were significantly correlated. Diurnal trends were evident, with peak concentrations during daylight hours (08:00–18:00). Pollen-like FAPs exhibited the highest indoor-to-outdoor ratio (1.45 ± 1.35) during daytime. Particles larger than 2 μm were closely associated with human activity under mechanical ventilation. These findings offer new insights into indoor bioaerosol dynamics and support improved strategies for exposure mitigation and indoor air disinfection.

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9IA.6

Low-Cost Sensors in Household Kitchens: Monitoring Cooking Emissions from Induction Stoves and Air Fryers. JOSHUA HARPER, Tianyuan Li, Robert T. Nishida, *University of Waterloo*

Cooking is a major source of fine and ultrafine particles (UFPs) that contribute to respiratory and cardiovascular health risks in household kitchens. While induction stoves and air fryers have recently gained popularity as efficient alternatives to traditional gas and electric resistance stoves, their particle emissions remain poorly characterized. Low-cost sensors present an opportunity for the general public to make informed decisions about indoor air quality in households, such as switching on kitchen rangehoods during cooking. Previous studies have shown that consumer-grade sensors generally fail to detect the generation of UFPs and fine particles smaller than 0.3 µm produced by traditional gas stove cooking.

In this study, we characterize particle emissions from an electric resistance stove, an induction stove, and an air fryer during standardized heating and cooking activities. We also use these activities to evaluate the suitability of low-cost sensors for indoor air quality monitoring during electric cooking. Transient particle emission rates and size distributions were measured using multiple consumer-grade optical particle sensors (Plantower PMS5003, Sensirion SPS30) collocated with a research-grade instruments (GRIMM miniWRAS), which combine optical and electrical mobility-based measurements to provide size-resolved particle concentrations and optical properties. The results show that most cooking activities emit significant concentrations of fine and ultrafine particles. Consumer-grade optical sensors respond poorly to particle emissions from cooking, displaying sensitivity primarily to changes in the concentration of larger particles. By characterizing the particle emissions from electric cooking, the findings underscore the need for the development of low-cost, UFP sensors to support evidence-based decisions for improving air quality in households.

9IA.7

Quantifying Changes in Indoor $PM_{2.5}$, VOCs, NO_2, CO, and CO_2 Pollution Associated with Gas-to-Induction Stove Replacement Programs. Katie Kearns, JESSICA TRYNER, Ashley DeMichele, Garrison Davis, Jason Posner, Annie Carfaro, Daniel Bertoldi, Misbath Daouda, Maria Fe Aragon, Sydney Jones, Michael Johnson, *Access Sensor Technologies*

Cooking and stove use is a source of indoor fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), and volatile organic compound (VOC) pollution. We highlight three studies focused on investigating changes in indoor levels of these pollutants associated with residential gas-to-electric stove replacement, using a common sampler - the compact, multi-pollutant (real-time and integrated) monitoring Home Health Box (Access Sensor Technologies).

In a concluded study in New York City, $PM_{2.5}$, NO_2, CO, and CO_2, were measured in 20 low-income households during a gas-to-induction stove intervention. Homes were split evenly between the intervention and control groups and three repeat week-long measurements were collected in each home. NO_2 was also sampled using passive diffusion badges in a subset of homes to validate electrochemical sensor measurements. Compared to control homes, induction stove homes experienced a 56% reduction in daily NO_2 concentrations (95% CI: −61.9%, −15.2%). Controlled cooking tests revealed sharp NO_2 spikes in gas homes (median 197 ppb) versus minimal changes in induction homes (median 14 ppb).

In Buffalo, $PM_{2.5}$, NO_2, CO, and CO_2 are currently being measured in 21 low-income homes before and after a gas-to-induction stove swap using just the real-time sensors in the HHB. Data collection is underway. A third study, launching in California where 300 low-income homes will be transitioning from gas to induction cooking, will build on these prior efforts by incorporating the HHB's sorbent tube samplers to measure BTEX compounds in addition to the core pollutants from the previous. $PM_{2.5}$ filter samples will also be analyzed for inorganic compounds using x-ray fluorescence.

Across sites, the HHB demonstrates strong potential as a scalable tool for characterizing indoor pollutant exposures associated with cooking, evaluating stove transition impacts, and informing health-protective electrification policy.

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9IM.1

Formation and Growth Analysis of Combustion-Generated Particles Using Size Distribution Measurements from 0.8 to 100 nm. CHANAKYA BAGYA RAMESH, Daoru Han, Yang Wang, *University of Miami*

The development of the high-resolution differential mobility analyzer (HRDMA) has enabled researchers to obtain high-resolution size distributions of particles smaller than 3 nm. This advancement has allowed several studies to examine particles in the sub-3 nm range (Bagya Ramesh & Wang, 2023). Other studies have focused on ultrafine particles (4 nm ≤ D_p ≤ 100 nm) using the nano-DMA. However, no study to date has examined a continuous particle size distribution spanning from the molecular scale (1 nm) to the larger particulate scale (100 nm) that captures the entire formation and growth process of combustion-generated particles. A key challenge arises from the fact that the HRDMA and nano-DMA use different transfer functions and loss corrections. This could lead to a mismatch in the size distribution data when attempting to combine measurements from both instruments. In this study, our goal is to (1) develop a framework for data inversion that allows us to obtain a continuous size distribution and minimize discrepancies between HRDMA and nano-DMA measurements, and (2) use the combined size distributions to quantitatively understand the formation and growth of combustion-generated particles. Our preliminary data shows that, in the premixed-flat flame synthesizing titanium dioxide, under the precursor (titanium isopropoxide) feed rate of 490 µmol/hr, the particle size distribution shows a peak diameter of 14.6 nm. In the overlapping transition size range (2 to 7 nm), where both HRDMA and nano-DMA measure particle sizes, we observed a mismatch between the size distributions (-53% to +61%), but the derived size distributions are in the same order of magnitude and have a similar shape. By using an aerosol population balance mode, we further examined the formation and coagulation growth rates of the titanium dioxide nanoparticles. The combination of the HRDMA and nano-DMA can enable detailed diagnosis and prediction of aerosol formation and growth in high-temperature reactors.

Bagya Ramesh, C., & Wang, Y. (2023). Ions Generated from a Premixed Methane-Air Flame: Mobility Size Distributions and Charging Characteristics. Combustion Science and Technology, 196(16), 4041–4056.

9IM.2

Functional Improvements to a Water Condensation-Based Viable Airborne Virus Sampling Technology: The BioSpot-VITA Bioaerosol Sampler. BRADEN STUMP, Dominick Heskett, Gregory S. Lewis, Arantzazu Eiguren-Fernandez, Brian Annis, Patricia Keady, *Handix Scientific Inc.*

In the wake of the SARS-CoV-2 pandemic and outbreaks of avian influenza, the sampling of viable airborne viruses has proved to be paramount to the scientific community for improving public health surveillance and response. Traditional bioaerosol samplers, such as filters and impactors, damage airborne virus through mechanical stresses and desiccation, negatively effecting the viability of the captured biological material. Moderated water condensation growth tube (WCGT) collection contains core technology that does not desiccate or stress incoming bioaerosol, maintaining sample integrity of the viruses captured, and has been used in several landmark aerovirology studies to capture viable virus from the air from infected humans or animals. However, current WCGT samplers have limitations that can restrict ambient aerosol studies. Instrument size, weight, and noise can negatively affect ability to complete research without compromising air flow rate and captured sample concentration. This presentation discusses the design, implementation, and results of redesigning a WCGT technology to better perform practical aerovirology sampling, named the BioSpot-VITA bioaerosol sampler. Critical design requirements were derived from scientists involved in publications related to airborne virus sampling. The “base technology” of the BioSpot-VIVAS bioaerosol sampler was then redesigned to meet the needs of scientists without compromising scientific integrity, which was then characterized in the lab and field tested for virus capture. Weight of the instrument (noted as the most important requirement to improve upon) compared to the VIVAS was reduced by 41%, volume was reduced by 33%, noise level of instrument was reduced by 10dBA. Factors such as air flow rate, sample concentration level, collection efficiency of sampling virus-sized particles into liquid in a petri dish, and ease of use were found in lab testing to be unchanged and in some operating circumstances further optimized. For cutting-edge aerovirology research to evolve, the technology used to complete it must also evolve to meet researcher requirements.

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9IM.3

Determination of Effective Density of Sub-Micron Size Using Pre-Determined SMPS Data. Jaeho Oh, Jungho Hwang, JEONG HOON BYEON, *School of Mechanical Engineering at Yeungnam University*

Particle effective density is a parameter for combining particle bulk density and shape of aerosol particles. It is employed to convert the number-based concentration to a mass-based concentration and to ascertain the relationship between the aerodynamic and Stokes diameters.

Effective density is often determined by utilizing a DMA to classify particles based on electrical mobility, followed by serial mass measurements with an aerosol particle mass analyzer (APM) or aerodynamic diameter measurements with an electric low-pressure impactor (ELPI).

Since the ambient atmosphere is a low-particle concentration environment, it is problematic that using a DMA for classification based on electrical mobility diameter will result in a lower resolution because of the extremely low number concentration emitted by the DMA's efficiency.

A corona charger used in Hyun et al. (2015) and a lab-made two-stage low-pressure impactor with a 130 nm cut-diameter were used in this investigation to assess the effective density.

SMPS is used in this investigation to determine the size distribution, and measurements of the current carried by charged particles were made both upstream and downstream of the impactor following corona charger. By assuming an arbitrary effective density, the previous study transformed the particle size distribution into an aerodynamic diameter-based distribution (DeCarlo et al., 2004).

where, is the effective density, is the density of water (1 g/cm^3), d is the particle diameter, C is the slip correction factor and subscript m and a refer to mobility and aerodynamic, respectively.

Particle size distribution of downstream of the impactor was obtained by calculating the collection efficiency of the impactor from particle size distribution of upstream of the impactor.

For the both particle size distribution of upstream and downstream, theoretical current were calculated using charging theory presented in Hinds, (1999). By comparing the calculated current and the measured current, the effective density was iteratively assumed and the effective density that minimizes the difference between current was determined.

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9IM.4

Leveraging Passive and Active Field Campaigns to Characterize Dust Abundance and Properties in the Southern Colorado Plateau. FRANKLYN TELLES, Helena Tsigos, Samuel Jurado, Nour Kastoun, *Northern Arizona University*

This methodological study evaluates approaches for measuring dust emissions, transport pathways, and deposition patterns across the southern Colorado Plateau using a combination of passive and active field campaigns. Passive measurements include dust traps and snowpack surveys to capture seasonal dust deposition, while active sampling is conducted through the STARDust (Sonde Technology for Aerosol Retrieval and Dust) project. STARDust employs a low-cost, do-it-yourself (DIY) system: a kite-based platform equipped with an Air Quality Egg sensor and custom-built dust capture devices designed for sample return and detailed analysis. While previous research has documented dust emissions and deposition in the region, this work offers a novel methodological focus on capturing the timing, spatial variability, and physicochemical composition of airborne dust. These testing efforts aim to fill key gaps in dust transport monitoring, improve forecasting capabilities, guide land management practices, and address associated public health concerns. Specifically, we assess the ability to detect primary upwind dust sources ("hotspots") and to quantify changes in dust fluxes following wildfires, meteorological events, and land-use disturbances. Additionally, the project engaged seven undergraduate students from Cornell University in field deployments and data collection, fostering STEM identity development through hands-on research and collaborative instrument design. This work is grounded in community-based science and place-based education, connecting air quality research with local and Indigenous knowledge systems, and engaging students and community members in understanding dust processes in their own landscapes.

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9IM.5

Measuring Molecular Transport in Levitated, Viscous Microdroplets Using Confocal Fluorescence Microscopy.
FARHAD IZADI, Michael Jacobs, *Texas State University*

The viscosity and phase state of aerosol particles impact climate and air quality by influencing reactivity, hygroscopicity and ultimately human health. Aerosol particles can exist in glassy or gel-like phase states with significant diffusion limitations. In these diffusion-restrictive phase states, strong chemical gradients can form in particles, which ultimately affects their reactivity and atmospheric fate. Single particle levitation techniques have been used to measure the phase states of suspended microdroplets and particles. These techniques typically report on either the viscosity of the particle (e.g., by measuring relaxation timescales of coalesced particles) or diffusion of water, Dw (e.g., via isotopic exchange measurements). However, diffusion of molecular species other than water cannot necessarily be predicted from a particle's viscosity and Dw. As a result, new techniques are required to measure the transport of molecules within levitated particles.

In this work, we use our recently developed quadrupole electrodynamic trap confocal microscopy (QET-CM) technique to investigate the phase and mixing states of coalesced microdroplets. By coalescing two microdroplets with different compositions, we create droplets with strong chemical gradients. Using a low-cost spinning disk confocal microscope, we are able to measure the evolving 3D spatial distribution of fluorophores the levitated microdroplet as the chemical gradient relaxes. In initial measurements, we demonstrate the capabilities of the QET-CM technique by measuring the molecular diffusion of various fluorescent dyes (including as rhodamine 6G and fluorescein) in glucose microdroplets exposed to different relative humidities. In addition, we demonstrate that our technique can also measure charge distribution within highly viscous systems by using a pH-sensitive fluorescent dye to measure the relaxation of pH gradients within merged droplets. Ultimately, the QET-CM technique has the capability of reporting on a wide variety of different transport phenomena in highly viscous microdroplets that were previously inaccessible using single-droplet levitation techniques.

9IM.7

Enhancements in Portable Gas Chromatography-Mass Spectrometry Instrumentation for VOC Analysis.
DEVON HIGGINS, Lindsay Harrington, Sara Button, *INFICON, Inc.*

Recent innovations in portable Gas Chromatography-Mass Spectrometry (GC/MS) instruments have expanded the ability of researchers to perform high-resolution gas phase chemical analysis in locations inaccessible to traditional benchtop systems such as remote field environments, at specific point-sources, or in mobile platforms like aircrafts or automobiles. For over two decades, INFICON has been the leader in the portable GC/MS industry with HAPSITE® the most widely deployed chemical identification system in the world. HAPSITE CDT, a new person-portable GC/MS developed by INFICON, was initially designed to offer an easy-to-use platform for the rapid quantitative analysis of toxic industrial chemicals, chemical warfare agents (CWAs), and complex environmental threats from air, water, or soil samples. The development of an environmental variant of HAPSITE CDT included hardware and method modifications to better optimize the instrument's performance for volatile organic compounds (VOCs) relevant to atmospheric processes. These modifications improve chromatographic resolution dramatically and extend sensitivity across a wide range of vapor pressures (from 0.085 mmHg to 2980 mmHg at 25°C). The ppb-level detection limits achieved by this variant of HAPSITE CDT enables high-resolution, quantitative gas-phase VOC measurements, critical for studying new particle formation, secondary organic aerosol (SOA) precursors, and emissions from biogenic or anthropogenic sources. The instrument's innovative sample introduction design supports quick, tool-free swapping between modular cartridges containing thermal desorption tubes, injection ports for the analysis of solvent extracts or solid-phase microextraction (SPME) fibers, or a survey-mode hand probe for continuous MS-only measurements. This flexibility streamlines sample collection across a variety of use cases, from point-source analysis to real-time environmental surveys. Overall, the portability, flexibility, and ruggedness of HAPSITE CDT make it a valuable tool for real-time, in situ VOC measurements in dynamic and remote atmospheric environments.

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9IM.8

Development of the Molecular Isomer Resolving Aerosol Collector and Analyzer (MIRACA) for Organic Aerosol Chemical Characterization. YAN WEN, Sarah Ellies, Yeongkwon Son, Andrey Khlystov, *Desert Research Institute*

To address the need for high-time resolution measurements of detailed chemical composition of organic aerosols (OA), we are developing a molecular isomer resolving aerosol collector and analyzer (MIRACA). The device combines automatic aerosol collection and extraction using solvents of different polarity. The collected aerosol extracts can be either collected for offline analysis or analyzed on-line if coupled to an analytical instrument. By using a liquid chromatograph – ion mobility – high resolution mass spectrometer (LC-IM-HRMS), molecular isomers in the collected samples can be resolved. The goal is to enable rapid measurements highly-resolved chemical composition of both particulate and gaseous components of OA, with a particular focus on biomass burning aerosols. We developed and tested two proof-of-concept prototypes: one using an impactor for particle collection and one using a filter. The gas phase components are collected using a sorbent cartridge. To evaluate MIRACA's performance, laboratory-generated levoglucosan and pyrene aerosols were collected and extracted, demonstrating the device's ability to accurately quantify OA composition. The prototype was then applied to measure levoglucosan and major polycyclic aromatic hydrocarbons (PAHs) in aerosols from controlled laboratory-scale biomass burns, completing sample collection and extraction within one hour.

9IM.9

Microfluidics-Based Capture and Transfer of Single Aerosol Particle-Droplets for Surface Enhanced Raman Spectroscopy Analysis. WENDY FLORES-BRITO, Thomas Brubaker, Ryan Sullivan, *Carnegie Mellon University*

Physicochemical analysis of individual aerosol particles continues to be a challenge since few techniques exist that can preserve an aerosol's individual identity while transferring the particle for subsequent chemical analysis. Here, we present initial results from combining our microfluidics-based aerosol droplet capture method with surface enhanced Raman spectroscopy (SERS) for online chemical analysis. The droplet capture method features direct activation of aerosol particles into droplets by water vapor condensation followed by droplet capture into an open channel microfluidic device while potentially maintaining their individual particle–droplet pair identity in an immiscible fluid. We compare the use of a Sequential Spot Sampler or Cloud Condensation Nuclei Counter as our droplet activation columns by collecting the fluorescein salt containing single-particle-droplets into the oil-filled open channel of the microfluidic device. The droplet capture efficiency was evaluated as a function of microdroplet size using fluorescence microscopy. Additionally, we present our microfluidic device design for incorporating SERS nanoparticles with the captured and transferred particle-droplet pairs; along with initial SERS test results.The combination of these methods will create a promising technique for the sampling and chemical analysis of single aerosol particles using small microfluidic devices.

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9IM.10

Next-Generation Optical Instrumentation for Comprehensive Aerosol and Cloud Characterization. MATTHEW FREER, *CloudSci*

Innovations in atmospheric particle measurement must keep pace with emerging needs in air-quality management, climate research, and biodefence. CloudSci is advancing a complementary suite of optical sensors aimed at delivering size-resolved, composition-sensitive data across the full aerosol–cloud particle size range. This poster provides a first look at four new platforms—spanning prototype to proof-of-concept stage—and the companion analysis tools that underpin real-time data reduction.

Passive Aerosol Imager (PAI). PAI integrates digital in-line holography with an open-path sample volume to passively record scattering patterns of ambient particles from ~1 µm to 200 µm. A machine-vision pipeline based on convolution converts raw holograms into size, aspect-ratio, and spatial distributions in less than 1 second per frame, enabling continuous coarse-mode monitoring without sampling artefacts.

Aerosol Multi-Angle Sizing Spectrometer (A-MASS). A-MASS will be an aircraft-mounted particle sizing probe (0.1–1 µm). We present initial sizing and concentration results for various laboratory-generated aerosols and plans for future field testing.

Marine Cloud Condensation Nuclei Counter. In response to the need for lower-power, autonomous marine CCN instrumentation, the MCCNC employs a thermal gradient diffusion chamber design in a compact footprint. Initial results from proof-of-concept testing are presented.

Single Aerosol Particle Spectrometer (SAPS). SAPS leverages a particle collection and trapping system to confine individual super-µm particles at ambient humidity and perform Raman spectroscopy. Initial spectra of test particles and particle collection efficiency rates are examined.

The poster will present first-light datasets from a range of laboratory and field deployments, performance intercomparisons, and uncertainty analysis. Anticipated applications include: (i) real-time allergen and spore surveillance, (ii) aerosol–cloud interaction research, (iii) improved source apportionment in coarse-particle air-quality episodes, and (iv) rapid bioaerosol threat identification. Collectively, these technologies aim to lower logistical barriers while expanding the dimensionality of in-situ aerosol and cloud observations.

9IM.11

CADS: the Coarse Aerosol Detection System for Characterizing Coarse Mode and Biological Particles in Real Time. PATRICIO PIEDRA, Prakash Gautam, Nicholas Beres, Hans Moosmüller, *The Probitas Project, Inc.*

The study of aerosol is very important in multiple contexts ranging from air quality and its effects on respiratory health to atmospheric processes such as precipitation formation. Aerosol instruments are typically specialized according to particle size including (1) fine and (2) coarse aerosol. Fine aerosol consists of particulate matter (PM) up to 2.5 µm (i.e., $PM_{2.5}$) while coarse aerosol consists of PM above 2.5 µm in aerodynamic diameter. Coarse aerosol up to 10 µm (i.e., PM_{10}) is relevant for air quality, visibility, direct solar radiative forcing, and climate change, and serves as cloud condensation and ice nuclei (which generally depends on their chemical composition and surface morphology). Real-time classification and characterization of biological and other coarse mode aerosol poses significant challenges, such as minimizing sampling losses during measurement, distinguishing internal and external mixing, and obtaining size-dependent composition information. In addition, it is often necessary to have more than one instrument to characterize both fine and coarse aerosol due to difficulties related to different size and optical regimes. This research is developing the Coarse Aerosol Detection System (CADS), which consists of a combination of three different optical techniques for aerosol characterization: (1) Angularly Resolved Elastic Scattering (ARES), (2) Fluorescence Spectroscopy (FS), and (3) Digital In-Line Holography (DIH), integrated with a Machine Learning (ML) architecture for particle classification. The three techniques complement each other well toward comprehensive aerosol characterization, allowing one of the broadest optical sizing capabilities available, with aerosol sizing between ~0.5 to ~50 µm, at least. In addition, the ensemble of measurements will provide particle size, type, optical properties, and composition, including DIH particle images. Here, we are demonstrating the feasibility of the three optical techniques for individual coarse and biological particle characterization and preparing for further integration, testing, and calibration of these techniques. If successful, CADS has the potential to become an essential tool for monitoring coarse and biological aerosol in real time.

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9IM.12

Impact of Topography Monitor on Total Particulate Matter Emissions from Electronic Cigarettes. CAMILO GARZON, Gloria Mbaka, Logan Kelly, Nathan Eddingsaas, Edward Hensel, Risa Robinson, *Rochester Institute of Technology*

Methods:
The puffing behavior of electronic cigarette users can be monitored with hand-held topography monitors. In this scenario, ecig users inhale aerosol from their own-choice electronic cigarette into their mouth through the monitor. This study quantifies the moderating effect of topography monitors on the aerosol total particulate matter yield per puff, YTPM [mg/puff], and aerosol mass concentration, CTPM [mg/mL], delivered to the mouth of the user. Several wPUM™ topography monitors have been developed for popular electronic cigarettes including the Juul, NJoy Ace, Hyde Edge (2 variants), Geekbar Pulse, and Geekbar Pulse X. Each monitor underwent triple redundant calibration profiles under no load, dry load (empty ecig), and wet load (aerosol generating ecig) conditions. In addition, the emissions characteristics of each ecig was described using at least nine “Activation Flow Rate” profiles whereby the puff flow rate varied while puff duration was fixed at 3.5 sec. The emissions were conducted a second time with a wPUM™ topography monitor in series between the ecig and emissions system inlet. The mass yield and aerosol mass concentration were compared for each ecig across its range of operating conditions.

Results:
The presence of the monitor in the flow path of the aerosol, between the exit of the ecig and the entrance to the user’s mouth, affects the yield and mass concentration to differing extent. The effect of monitoring is quantified as a function of flow rate for each ecig model, puff flow rate, and user-selected operating condition. Calibration curves and emissions model surfaces permit accurate quantitation of mass dose and aerosol mass concentration exposure of the user under realistic ambulatory natural environment conditions.

Conclusions:
Comprehensive characterization of ecigs in the absence and presence of monitoring devices enables accurate estimates of aerosol constituent exposures experienced by ecig users.

9IM.13

Integrating New Facilities for Aerosol Measurements with Eddy Covariance Flux Measurements for Improved Understanding of Atmosphere-Biosphere Interactions. ANDREW METCALF, James Henry, Thomas O'Halloran, *Clemson University*

We present on new facilities at Clemson University for the measurement of aerosols and vertical fluxes of carbon dioxide and water vapor. The first facility is a portable trailer with a 92 ft tall telescoping tower to support flux measurements and characterization of turbulence and vertical mixing. The trailer has a climate-controlled enclosure with two standard instrument racks to support sensitive instruments, namely aerosol instrumentation. The base facility is equipped with a scanning mobility particle sizer and optical particle counter to cover size distribution measurements from 5-3000 nm. A tricolor absorption photometer measures aerosol absorption properties as a proxy for determining the influence of biomass burning on a given airmass. The second facility is an NSF-sponsored Community Instrument and Facility, a single-particle soot photometer, for the quantification of black carbon aerosol mass and mixing state. These facilities are requestable together or individually for ground-based deployments over a variety of land surface types.

A critical component to the success of these new facilities is the data assimilation across whatever instrumentation is simultaneously deployed at the trailer and satellite remote sensing over the region of deployment. Together, these multiple data sources can combine to improve understanding of aerosols’ impact on atmosphere-biosphere exchange, reduce uncertainties in carbon flux estimates, and enhance confidence in satellite-based assessments of air quality.

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9IM.15

CADET: Chamber for Aerosol Deposition Evaluation and Testing. JAMES LIU, Tom Pilholski, Benjamin Alvarez, Terrence Garcia, Michael Schuit, *JHU/APL*

The detection and remediation of surface-deposited particles are important components of an effective response to an aerosol release of hazardous chemical and/or biological material. However, few benchtop platforms exist for studying post-release detection and mitigation strategies. To address this need, we developed the Chamber for Aerosol Deposition Evaluation and Testing (CADET) – a compact, single-pass system engineered for reproducible assessment of aerosol-surface interactions. The primary component of CADET is a 72.5-L rectangular chamber constructed from static-dissipative PVC and equipped with a mixing fan, temperature-humidity sensor, and centrally mounted mesh tray for supporting test surfaces. Custom flow distributors were developed as optional accessories for the aerosol input and exhaust flow paths to facilitate uniform distribution of particles within the chamber. Performance characterization included transmission and deposition efficiency tests using fluorescent tracer aerosols introduced via an ultrasonic nozzle into an upstream plenum. Particle deposition was evaluated using fluorescently labeled polystyrene particles of varied diameters and stainless-steel coupons of differing surface textures. Future work will include assessment of biological particle deposition, with potential applications in disease transmission or bio-defense.

9IM.16

Quantitative Uncertainty and Post-Processing for Micro-Aethalometers Measuring Black Carbon. Timothy Sipkens, JOEL CORBIN, Kerry Chen, Laura-Helena Rivellini, Jonathan Abbatt, Jason S. Olfert, *National Research Council Canada*

Aethalometers estimate black carbon mass concentrations by monitoring light attenuation through a particle filter as it becomes laden with aerosols. As the uncertainties in the resulting measurements are not easily quantified via a bottom-up traceable approach, there is a need for inter-device comparisons to provide operationally defined uncertainties. The present work compared five micro-aethalometers to known mass concentrations of laboratory-generated soot, generated using an inverted propane flame and a Centrifugal Particle Mass Analyzer-Electrometer Reference Mass Standard (CERMS). Since our aerosol model represents a simple source of eBC, with negligible content of non-absorbing PM and stable gas-phase composition, our results provide a lower limit on between-instrument reproducibility. Uncertainties were found to scale with mass concentration, with multiplicative errors between devices of approximately 10 % in the best case of long sampling times and/or high mass concentrations. A quantitative expression is provided for the uncertainty in the aethalometer measurements as a function of mass concentration, sampling interval, and flow rate. An open-source algorithm is also provided for the unsupervised reanalysis of aethalometer data over varying periods to reach a specified target uncertainty.

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9IM.17

A Tandem-Dma Setup for Accurate Reaction Kinetics Determination of Particles in the Sub-4NM Size Range. CHRISTIAN LUEBBERT, Luis-Javier Perez-Lorenzo, Juan Fernandez de la Mora, *Yale University*

We present a tandem-DMA setup consisting of two planar DMAs connected with a tube furnace. The first DMA (DMA_1) is a regular DMA (Seadm P4). While the second DMA (DMA_2) is a novel prototype equipped with 256 electrometers instead of an exit slit, which reports the arriving mobility distribution instantaneously, without scanning of the voltage. This configuration allows for efficient 2D sampling.

In the furnace interconnecting both DMAs (L: 29cm, D: 4.45mm) the particles undergo reactions such as evaporation of neutrals and charges. At a sample flow rate of 0.6lpm the furnace flow is laminar and the entry length short compared to the total tube length and therefore well-approximated by a developed flow profile. Combined with the known diffusion coefficients, this flow boundary condition allows calculating the reaction rate k based on the recorded product spectrum for each DMA1 selected ion.

A variety of ionic liquids particles are generated by a bipolar electrospray source in a clean chemically defined manner. Resolutions of around 50…60 provided by both DMAs allow resolving the exact number of molecules which they are built from up to typically 40mer. With large building blocks such as bulky ionic liquids the corresponding particle diameters are in excess of 3nm. A transition between a size range in which the particles properties are dominated by individual ion-ion interaction and a regime where the particle material can be treated continuum-like is observed for ionic liquid particles in this size range. The first being characterized by material specific “magic states” in both, structure and reactivity.

9IM.18

Dynamic Aerosol Mass and Number Concentration Calibration Using a Propellant Driven Atomizer Coupled to a Well-Mixed Chamber. NATHAN KREISBERG, Nagaraja Rao, Susanne Hering, Philip Croteau, Benjamin A. Nault, John Jayne, Gino Pena, Bradley Ries, Erin Bowey, Yumeng Cui, Nga Lee Ng, Armistead G. Russell, Ann M. Dillner, Roya Bahreini, *Aerosol Dynamics Inc.*

Instrument calibration techniques usually rely on a mostly static process using a constant source of calibration aerosol for sampling. Whether mass- or number-based, calibrations typically require exposure over a range of concentrations performed stepwise in time. Here an alternative approach is presented involving a more dynamic process of sampling an initially high concentration aerosol from within a stirred chamber while filtered replacement air leads to an exponential decay in concentration. A novel propellant driven atomizer is used to generate reproducible polydispersed particle distributions that can be tailored to meet the needs of the instrument to be calibrated. We show that this process is highly reproducible and predictable with characterizable internal losses. For instruments requiring mass-based calibration, the use of a fixed volume injection loop as the source of calibrant material converts the calibration basis to one of mass instead of number as performed in the traditional approach of counting mobility-sized particles. The choice of calibrant is only limited by solubility and requires sub-mg of material offering the potential to calibrate with hard to procure compounds (e.g. deuterated or synthesized organics).

The new approach is compared to the traditional approach with an emphasis on novel uses. Results of the atomizer and well-mixed chamber method development are reported with two test cases. To demonstrate a mass-based calibration, results of an ammonium nitrate response measured by an Aerosol Chemical Speciation Monitor (Aerodyne ToF-ACSM) are compared to a scanning mobility particle sizer (TSI 3938L89) and theoretical expectation. In a second example, a number-based calibration is performed on a suite of adiabatic condensation particle counters (Particles Plus 15000-OEM) against a reference CPC (ADI MAGIC 250). The PP CPC requires calibration over a range of concentrations that this dynamic, scalable approach provides in a short time (<10 min) with little interaction.

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9IM.19

Uncertainty Analysis of Atmospheric Aerosol Particle Size Spectra from Portable Optical Particle Spectrometers.
Christopher Solares, Maria A. Zawadowicz, SARAH PETTERS, *University of California, Riverside*

Atmospheric aerosols are a key component of air pollution and their number and mass concentrations can be estimated using optical particle counters and spectrometers. Convenient though this may be, fundamental properties that determine how aerosols scatter light are their water uptake and refractive index, which vary with environmental conditions and particle composition and thus introduce uncertainty. A simulation framework tailored to optical particle spectrometers was developed to estimate the refractive index of ambient aerosols by integrating data from aerosol mass spectrometry and humidity sensors. Aerosol-water interactions were modeled using κ-Köhler theory and AIOMFAC, for the purpose of calculating a dynamic refractive index adjusted for aerosol composition and water uptake. This wet refractive index was used to generate Mie scattering values, whereby differing refractive index settings (polystyrene latex spheres, ammonium sulfate, and dynamically adjusted refractive index) could be evaluated for their particle and aerosol size distribution accuracy via Monte Carlo simulations. Performance metrics included counting efficiency, particle sizing, and size distribution reconstruction using a variety of error analysis methods such as percent error, error distribution, and R-squared analyses. Ammonium sulfate calibrations showed better sizing performance, as well as detection efficiencies, than polystyrene spheres, and allowed for broader detection ranges. This approach improves the accuracy of aerosol size spectra through postprocessing of optical particle spectra with the added benefit of co-located composition and humidity measurements.

9IM.20

Preliminary Ambient Comparisons of BlueSky O_3 and NO_2 with Reference Sensors and Between Purple Air SD and Flex PM Sensors.
Zoe Lynch, TATIANA PECCEDI, Ty Kaji, Erick Mattson, Alina Pantano, J. Alex Huffman, *University of Denver*

The poster will be a preliminary presentation of two joint undergraduate research projects investigating the capabilities of two sets of relatively inexpensive air quality monitors sensors. The first project deployed two TSI BlueSky 8145 air quality monitors at the Colorado Department of Public Health and Environment (CDPHE) Rocky Flats North monitoring site alongside reference O_3 (2BTech Model 205) and NO_2 (2BTech Model 405) monitors. Several months of data were collected from the co-located instruments at one minute time resolution to compare the relative accuracy and variability of the two gas measurements reported from the BlueSky units. By comparing both one-minute and four-hour average data, preliminary results over one month of data suggests relatively poor correlation between the BlueSky and reference sensors, but additional analyses will be performed and presented to test these initial observations. The second BlueSky sensor was deployed part of the measurement period at the Kennedy Mountain Campus (KMC) of the University of Denver, in the low mountains northwest of Fort Collins, Colorado as a first set of ambient gas-phase measurements at the site. Analyses will be presented to compare the sensors for longer period of time and as a function of temperature and other variables.

The second project will present an overview of 18 months of particulate matter (PM) data collected using six Purple Air (PA) PM sensors at the KMC. Three sets of PA sensors are deployed, where each set is a pair of the SD-II and Flex models. The data provides an opportunity to compare the two PA sensor types over a long timeframe and across widely varying temperature conditions. Both projects also provide an initial overview of the KMC site as a promising location for growing collaborative opportunities for ambient atmospheric measurements in the Northern Front Range region.

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9IM.21

Low Cost Instrumentation and Kitesonde Kit. SIMRAN LABORE, Helena Tsigos, Jack Halberstadt, Franklyn Telles, *Cornell University*

STARDUST (Sensing, Tethering, and Aerosol Retrieval for Dust and Urban Science with Thunderbirds) is an interdisciplinary initiative focused on the development of novel, low-cost instrumentation to democratize environmental data collection and analysis. Central to this effort is the creation of a "Thunderbird" kitesonde kit, an affordable, portable alternative to traditional atmospheric sensing platforms. Designed with community use in mind, the kit integrates modular meteorological and aerosol sensors with a flexible kite-based system capable of sampling airborne dust at varying altitudes.

A key motivation behind STARDUST is to expand access to air quality data, particularly among Indigenous communities and local experts such as firefighters, who can use this information to assess and respond to environmental health threats, ranging from uranium exposure near abandoned mines to wildfire smoke and Valley Fever pathogens. By grounding instrument design in the principles of place-based education (PBE) and Indigenous Traditional Ecological Knowledge (ITEK), the project invites community co-design, fosters student-led field campaigns, and prioritizes tools that reflect both scientific rigor and local knowledge.

The system's components, including the kite, aerosol sampler, weather meter, and mounting tools, are selected with strict attention to cost-effectiveness, weight constraints, and operational flexibility. The total cost, estimated at ~$3,400, is a fraction of conventional alternatives such as radiosondes, tethersondes, and LiDARs. Future iterations informed by consultations with professional kite designers and atmospheric researchers will further refine the Thunderbird's usability in real-world field campaigns.

Ultimately, this work aims to bridge the gap between advanced atmospheric science and grassroots environmental stewardship, enabling communities to not only collect their own data but also interpret it in the context of their lived experiences and priorities.

9RA.1

Growth State of Aerosolized Bacillus Altitudinis Impacts its UV Susceptibility. EMILY KRAUS, Samuel Bryan, Margot Thomas Gatel, Adam Gillison, Amaya GarciaCostas, Sonia Kreidenweis, Mark Hernandez, *University of Colorado Boulder*

Airborne pathogens continue to pose significant public health risks in indoor congregate spaces. UV disinfection can effectively inactivate airborne pathogens in the built environment but inconsistent inactivation results in lab studies have limited broader deployment of UV technologies. This work examines how an oft overlooked biological factor of growth stage influences UV_{254} susceptibility of a UV-tolerant airborne isolate closely related to *Bacillus altitudinis*.

Airborne UV susceptibility experiments were conducted in a $10m^3$ chamber under two relative humidity levels (25% and 60%) to simulate common indoor conditions. *B. altitudinis* was cultured to a defined growth stage (exponential or stationary) prior to aerosolization in the chamber with a Collison nebulizer. Five-minute composite samples (~40 L air) were collected via condensation capture (VIVAS) over the course of 50 mins. Susceptibility at exponential and stationary phase was assessed with counts of colony-forming units (CFUs/L air) and genome equivalents (ge/L air) with propidium monoazide quantitative PCR (PMA-qPCR) across four doses of UV_{254} exposure to calculate inactivation rate constants (k values).

Preliminary results indicate that stationary phase *B. altitudinis* is distinctly less susceptible to UV_{254} exposure compared to the same isolate in exponential phase. Furthermore, general airborne persistence of *B. altitudinis* (without exposure to UV) is heightened in stationary phase. Results may be indicative of the upregulation of DNA repair and stress response mechanisms that occur when bacteria progress into the stationary phase of their cell cycle.

Results from this work address a critical knowledge gap by characterizing a previously unaccounted biological variable affecting UV disinfection efficacy in laboratory studies. Collectively, these findings can inform on the standardization of UV disinfection challenges to support technology adoption and safer, more effective airborne pathogen control in occupied indoor spaces.

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9RA.3

Frequency Variation of Non-Thermal Plasma Effects on Inactivation of Single-Stranded DNA Virus. EMILY HONG, Zhenyu Ma, Herek L. Clack, *University of Michigan*

Airborne viruses are a bioaerosol of interest due to the growing concern over respiratory viruses. The COVID-19 pandemic and recent measles outbreak have brought more attention to airborne viral diseases. There is a need for the development of advanced environmental control methods which can prevent and reduce the airborne spread of viruses. The structural diversity of viruses makes it difficult to extrapolate a single virus's inactivation to other viruses. Viruses can vary based on their enveloped status, genomic material, and single or double stranded genomic material. Many previous studies have focused on the single stranded RNA virus, MS2 [1,2]. This study determines the effects of changing the frequency of our non-thermal plasma (NTP) on the performance of the plasma to inactivate single stranded DNA virus ϕX174. Through plaque assays, we have achieved 0.38 log (61%) inactivation of ϕX174 after momentary passage of the aerosols through the NTP reactor. These experiments were performed at 300 Hz and 20 kV. Previous studies have shown the largest log reductions of infectious MS2 occur at 350 Hz and 20kV when varying the frequency of the discharge from 10 to 1000 Hz [3]. However, due to the variation in virus characteristics, it is not possible to conclude 350 Hz results in the greatest log inactivation of ϕX174. By assessing the response of ϕX174 when treated at a variety of frequencies using our NTP experimental setup, it is possible to determine the greatest log reduction conditions for inactivation with this setup.

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9RA.4

Energy Recovery Ventilation (ERV) and Indoor Air Pollution. Onyinye A. Ezeifeka, YEVGEN NAZARENKO, *University of Cincinnati*

Indoor air quality has a significant impact on health, well-being, productivity, and learning. There are different technical solutions to ensure adequate indoor air quality while maximizing the energy efficiency of buildings. The most effective solution in regions where indoor air must be heated or cooled is the energy recovery ventilators (ERVs). ERVs minimize energy consumption in buildings while maintaining adequate indoor air quality. ERVs were estimated to provide energy savings on heating ~40% and cooling ~8%, with a payback period of only 2 years. However, very little is known about the effects of ERVs on the removal, circulation, and transformations of indoor air contaminants, including their physical and chemical transformations, and practically no research has been performed to specifically assess the impact of ERVs on nanoaerosols (ultrafine airborne particles) and volatile organic compounds (VOCs) in indoor air associated with adverse health effects. A problem of fresh air contamination from the outflow of indoor air inside an ERV has been identified. Therefore, it is imperative to fill the knowledge gap in our understanding of ERVs' impact on nanoaerosols, and how they are related to gaseous air contaminants, including VOCs. We assessed aerosol deposition, dynamics, and generation inside ERVs, the chemical signatures of the particles, including aerosol generation arising due to wear and tear, and cross-contamination and carry-over between air streams and resuspension from surfaces inside ERVs. The findings will help manufacturers design a new generation of ERV systems that provide better indoor air quality.

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9RA.5

Bazooka™: A First-of-Its-Kind Non-Thermal Plasma–Electrocyclone–Catalytic System for Real-Time Removal of Airborne Pathogens, Dust, and Ammonia in Poultry Farms. RAJ SINGH, Hema Ravindran, Antonio Baratta, Gediminas Mainelis, *KiposTech LLC*

Over the past two decades, poultry farms have experienced a 100-fold increase in losses due to airborne disease outbreaks. In 2022 alone, highly pathogenic avian influenza (HPAI) caused over $3 billion in industry damages, tripled egg prices, and destabilized national food supply chains. A single infected bird can trigger a rapid farm-wide outbreak, forcing costly and environmentally damaging culling events. At the farm level, outbreaks result in $100,000 to $1 million in annual losses, with up to 65% of poultry infections being airborne in origin.

To address this escalating threat, we present Bazooka™, a first-of-its-kind active air treatment system designed for high-velocity, dust-laden poultry environments. Developed by KiposTech, Bazooka™ combines three advanced modules in a compact, washable form:

Lightning Discharge Plasma Reactor for non-thermal plasma-based microbial and viral inactivation.
Electrocyclone Module for efficient submicron dust separation under turbulent airflow.
Catalytic Adsorption Chamber for high-throughput ammonia and VOC removal.
Prototype validation at 400 CFM demonstrated >90% disinfection of airborne bacterial and fungal spores, >70% $PM_{2.5}$ removal, and a pressure drop of <100 Pa. CFD simulations indicate scalability up to 1,000 CFM without efficiency loss or increased resistance. Unlike filters or UV systems, Bazooka™ operates continuously alongside axial fans and within corrosive, humid environments, without requiring infrastructure changes, frequent maintenance, or downtime.

Pilot deployments are underway across U.S. poultry farms, including a third-party evaluation with Agrotop, a global poultry infrastructure leader. Bazooka™ is integrated with KiposEye, an AI-powered air quality monitoring platform enabling real-time data visualization and ventilation optimization.

Bazooka™ transforms passive ventilation into active, intelligent bioaerosol control, offering farmers a scalable, low-maintenance, and scientifically validated solution to reduce disease risk, enhance flock performance, and strengthen agricultural resilience.

9RA.6

Integrated Studies on Improving Respirators Performance and Minimizing Aerosol Exposure. XINYI NIU, Michael Yermakov, Sergey A. Grinshpun, Jun Wang, *University of Cincinnati*

Respirators, such as N95 filtering facepiece respirators (FFRs) are essential for protecting healthcare workers (HCWs) and the general public from hazardous aerosols. However, their effectiveness can be compromised by poor fit, prolonged use, and design limitations. This research presents a comprehensive set of strategies to improve respirator performance and reduce aerosol exposure.

Prolonged use of N95 FFRs often leads to facial irritation, prompting HCWs to apply skin protectants. Using a standardized manikin-based protocol, we evaluated the impact of common protectants on respirator performance. Applying skin protectants to some models showed no effect on total inward leakage, while others exhibited measurable reductions in protection.

We also examined the effect of converting head straps to ear-loop systems, which are often preferred for HCWs for ease of use. While this change degraded fit, the addition of a novel faceseal significantly improved the performance of respirators.

Respirator fit is typically evaluated using the condensation particle counting (CPC) method; however, the optical particle counting (OPC) method is also a viable alternative. We found that humidity in sampling tubes influences OPC accuracy. While dryer tubes reduced humidity, they also caused particle losses at larger sizes.

Additionally, we evaluated a novel wearable device, the Exposure Protection Integrated Communicator (EPIC), which uses dual OPCs for real-time respirator monitoring. EPIC correlated well with PortaCount® in manikin-based testing; however, human subject results varied due to demographic and humidity effects. Caucasian males achieved better respirator fit than other demographic groups, highlighting the need for inclusive respirator design.

While faceseal leakage often contributes more to particle penetration than filter media, filter performance remains critical. We evaluated biodegradable, antibacterial PLA membranes enhanced with vitamin K derivatives and glyceryl tributyrate, which showed improved filtration efficiency and breathability, offering a sustainable alternative to conventional materials.

Together, these integrated studies advance respirator fit optimization, real-time performance monitoring, and sustainable material development, ultimately enhancing respiratory protection.

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9RA.7

Cleaner Air on a Budget: Assessing the Real-world Efficacy of DIY Air Cleaners in Urban Apartments. VIVIAN ACHAO SURGELAS, Jenna Myers, Yiyi Wu, Phaneendra Sivangula, Evangelos K. Stefanidis, Jackie Park-Albaum, Deborah Plotnik, Jie Gong, Clinton J. Andrews, Jennifer Senick, Sunyoung Kim, Gediminas Mainelis, *Rutgers, The State University of New Jersey*

Air pollution is a pressing health and environmental concern worldwide. Urban areas, like the City of Elizabeth, New Jersey, which is surrounded by dense industrial and transportation infrastructure, have higher concentrations of air pollutants. In such areas, indoor air cleaning devices are essential, as outdoor air pollutants can infiltrate indoors, adding to indoor sources and elevating pollutant concentrations.

This study focused on the real-world efficacy of do-it-yourself (DIY) air cleaners. With researchers' guidance, 14 participating seniors (5 smokers and 9 non-smokers) built and installed DIY air cleaners for their apartments. Hourly $PM_{2.5}$ concentrations and indoor/outdoor $PM_{2.5}$ concentration ratios were measured by low-cost Air Visual monitors (IQAir Inc.) and analyzed for different time periods before and after the participants installed their air cleaners. The participants' behavior was unscripted, and indoor pollution sources were not controlled. Changes in $PM_{2.5}$ concentrations were evaluated during active (6 am to 10 pm) and rest (10 pm to 6 am) periods. Data were assessed during one-month and one-week periods before and after the DIY cleaner installation.

The $PM_{2.5}$ concentrations were reduced in 9 apartments out of 14 when a one-week period before/after installation was considered. The overall average $PM_{2.5}$ concentration was reduced by ~5 $\mu g/m^3$ (or ~11%) based on a one-week comparison. The indoor/outdoor (I/O) $PM_{2.5}$ ratios decreased in 10/14 apartments. The overall average I/O $PM_{2.5}$ ratio decreased by ~33% during rest hours and ~12% during active hours. A strong reduction was seen in all 5 of the smokers' apartments: ~51% at night and 48% during the day. Overall, this community participatory case study exhibits findings that are robust to naturalistic resident behavior and demonstrates that the low-cost DIY air cleaners can serve as tools to mitigate indoor $PM_{2.5}$ exposures, especially where strong indoor sources are prevalent.

9RM.1

Design, Build, Deploy: CU GeoData's Lower-Cost Sensor Network as a Blueprint for Undergraduate Engagement with Local Communities and Science. NOUR KASTOUN, Samuel Jurado, Kylie Miller, Evelyn Keefe, Franklyn Telles, *Cornell University*

Sensor networks and low-cost field instrumentation have been utilized to increase data accessibility and study local phenomena. However, little work has been done on leveraging these methods to increase undergraduate student connection to local communities, particularly with regard to understanding local air quality and aerosol transport. CU GeoData, a student-run project team, is developing a sensor network around Cayuga Lake consisting of soil moisture sensors and Air Quality Eggs, supplemented with weather stations and a sap flow sensor at key strategic locations, with the overarching goal of connecting Cornell students to the Ithaca community. This sensor network will serve as a test for student-developed sensors including 3D printed weather stations and a water probe, as well as provide a robust dataset for local studies of lake effect and air quality from a multidisciplinary, collaborative approach combining meteorology, hydrology, pedology, and data science. This dataset will allow for PM data from the AQ Eggs and aerosol collection from kitesonde and tethersonde launches to be paired with meteorological profiles and other local environmental data for a more complete picture of regional aerosol transport and impacts. This can serve as a blueprint for engaging undergraduate students in fieldwork and community-centered science, providing hands-on experience with instrumentation design, sensor selection, and data applications for community needs. Once the robustness of the sensor network is properly assessed, future work may involve replication of the sensor network and data analysis through co-production with local Indigenous peoples, K-12 schools, and other communities to address community-identified issues and promote local data sovereignty.

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9RM.2

Comprehensive Cost-Benefit and Implementation Feasibility Analysis of Lower-Cost Particulate Matter Sensor Deployment Models based on Extended Field Observations.

Riley Ortt, Gabriella Gonzalez, Abigail Hadden, PINGFAN MO, Junhyuk Jeon, Chong Qiu, *University of New Haven*

Exposure to air pollutants like particulate matters (PMs) can pose significant adverse effects on human health and the environment. The ambient air quality is currently monitored by a network of air quality monitoring stations using federal Equivalent Methods (FEMs). Although highly accurate, FEMs are expensive to implement, leading to a current air monitoring network with a low density of FEM stations, often concentrated in metropolitan areas. Since PM concentrations could vary within a short distance, the current FEM network may not provide some communities with timely and relevant PM pollution information. While not as rigorous as FEM ones, lower-cost PM sensors (LCPMs) have become widely available. However, independent evaluations on their long-term field performance remain elusive. Complex pricing structures also create barriers for community stakeholders and policymakers to accurately determine the feasibility of establishing their own air monitoring stations with these sensors.

In this study, a commercial LCPM was deployed in New Haven, Connecticut for two years (June 2022 – June 2024) to independently evaluation its long-term performance. The LCPM performed well during the first 12 months and was able to capture elevation of PM levels during the Canadian Wildfires in 2023, but experienced premature sensor failures afterwards. Our results suggested that with a network of LCPMs may serve as a semi-quantitative air monitor network to provide early/cautionary warnings of local air quality to communities, but the cost consideration will require more complex models. Therefore, comprehensive cost-benefit and feasibility analysis models have been developed in single-point and network modes, considering initial and recurring costs, sensor network maintenance optimization, per capita financial burden, and other financial and societal factors. We applied our models in regions in the United States and South Korea based on the local market conditions to evaluate the applicability of our models with global perspectives. Our models may provide quantitative tools for the public to make informed decisions on how to best utilize lower-cost air monitors for their community air quality monitoring needs.

9RM.3

Integrating ASCENT, Satellite and CMAQ Data over Atlanta, GA: More Questions than Answers.

MERVE EKE, Ruizhe Liu, Weixin Zhang, Katherine Paredero, Yifeng Wang, Yongtao Hu, Sohyeon Jeon, Ann M. Dillner, Roya Bahreini, Nga Lee Ng, Armistead G. Russell, *Georgia Institute of Technology*

2023 saw the initiation of the Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT) and the beginning of data from the Tropospheric Emissions: Monitoring Pollution (TEMPO) satellite-based instrument that is gathering gas-phase pollutant data in conjunction with the Geostationary Operational Environmental Satellites (GOES) instruments capturing aerosol optical depth (AOD). Both TEMPO and ASCENT data are more complete for 2024. These data are integrated with Community Multiscale Air Quality (CMAQ) model simulations to investigate the degree to which the model can reproduce these new, more detailed data. Historically, evaluating model performance has been limited as routine measurements have not had hourly $PM_{2.5}$ composition. ASCENT provides long-term high-resolution PM data with chemical speciation and particle size distributions. There are 12 ASCENT sites and one of them is in South DeKalb which is downwind of the Atlanta metropolitan area and includes routine measurements. Using ASCENT, model performance is evaluated with not only $PM_{2.5}$ mass concentration, but also concentrations of sulfate, nitrate, ammonium, organic, elemental metals and black carbon (BC). In this study CMAQ and ASCENT-South DeKalb observations are used to examine how $PM_{2.5}$ concentration and speciation differ across 2024. The hourly results showed that CMAQ misses the afternoon peak in sulfate, and that organic matter (OM) and BC are the components that contribute most to the gap between CMAQ and ASCENT $PM_{2.5}$ concentration. Comparison of TEMPO vertical column densities found that CMAQ captured the spatial trends in NO_2 and HCHO, but was biased low. Collectively, these results suggest that emissions inventories for a variety of species may be biased low and that the model is missing processes leading to the higher afternoon observations and more rapid reductions in the evening.

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9RM.4

Back Trajectory Analysis on the Sources and Transport of Nucleation Precursors at the DOE ARM Bankhead National Forest Site. CONNOR SETO, Tamanna Subba, Chongai Kuang, James Smith, *University of California, Irvine*

New particle formation (NPF) is a process whereby aerosol particles are generated in the atmosphere and subsequently grow. While NPF is known to occur at a variety of sites from rural forests to urban megacities, the conditions under which this process occurs are not well understood. Although studies in the Southeast US (SE US) are limited, some have reported strong NPF events during specific times of year. The SE US experiences a complex mix of biogenic and anthropogenic influences on aerosol physicochemical processes, however the roles of those influences and their interactions on NPF remain poorly characterized. The recent deployment of the DOE Atmospheric Radiation Measurement (ARM) User Facility at the Bankhead National Forest (BNF) site in northwestern Alabama provides long-term measurements to characterize the conditions that drive NPF in the SE US. This study leverages particle and gas-phase measurements at the BNF site, along with a suite of meteorological observations to provide insights into the properties of NPF events.

This study provides an overview of NPF events observed at BNF. Initial measurements show a higher frequency of NPF events in January and March, with event days occurring ~50% of the time in those months. Results indicate that NPF events are more likely to occur in the winter and spring months in the SEUS.

In addition, we used NOAA's HYSPLIT back trajectory model to infer potential sources and transport patterns of gas-phase species known to influence nucleation. Specifically, we used Potential Source Contribution Function (PSCF), an analysis method that uses modeled back trajectories to visualize the transport of relevant precursors to the site. The results highlight the significance of emission sources both south (Birmingham, AL) and north (Ohio River) of the site. The analysis also suggests the role of northwesterly winds in transporting nucleation precursors to the site.

9RM.5

Quantifying Lake Spray Aerosol Acidity: A Colorimetric Approach. MIA B. KAUFFMAN, Samantha L. Bell, Cara Waters, Nicolas A. Buchenau, Haley E. Plaas, Jason Surratt, Andrew P. Ault, *University of Michigan*

Aerosol acidity (pH) is an important physicochemical property of particles that affects atmospheric secondary organic aerosol (SOA) formation through acid-driven multiphase chemical reactions involving fine particulate matter (PM < 2.5 μm, $PM_{2.5}$) and other water-soluble gases. Lake spray aerosol (LSA), formed by wave-mediated bubble bursting, is generated above bodies of freshwater and is an important contributor to PM in the Great Lakes region both in coastal regions near freshwater lakes and rural, inland regions after transport. In comparison to sea spray aerosol (SSA) generated from the ocean, LSA is relatively understudied despite its distinct source and atmospheric chemistry above the Great Lakes. This is due to differing ion concentrations between lakewater and seawater. For instance, in lakewater, the total organic carbon concentrations are on the same order of magnitude as the inorganic ion concentrations and instead of Na^+ and Cl^- being the dominant ions in solution, they are Ca^{2+} and CO_3^{2-} , a weak base. These affect the bulk solution and resulting aerosol pH. In addition, LSA can affect the partitioning of semi-volatile gases (e.g., HNO_3 and NH_3) into the particles through the increase of competing cations (Ca^{2+} and Na^+) in the atmosphere which also influences aerosol pH. Currently, LSA acidity is poorly understood and has only been estimated utilizing indirect methods (proxy methods and thermodynamic models) but has never been directly measured. Herein, we explore direct measurements of LSA pH utilizing a colorimetric technique for aerosol generated from synthetic lakewater samples. This study explores the differences in pH between lakewater and LSA and the influence of water-soluble gases on LSA acidity which will help us better inform thermodynamic models and understand the effect of LSA on atmospheric chemistry in regions with freshwater lakes.

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9RM.7

Physico-chemical Properties of Free Tropospheric Mineral Dust at the Remote Pico Mountain Observatory, in the Azores. IAN NORWOOD, Renato Pinto Reveggino, Shreya Joshi, Lynn Mazzoleni, Paulo Fiahlo, Swarup China, Bo Zhang, Andrea Baccarini, Kaelan Anderson, Megan Morgenstern, Simeon Schum, Claudio Mazzoleni, *Michigan Technological University*

To improve climate modeling, it is essential to enhance our understanding of the lifecycle of atmospheric particles and their interactions with clouds and radiation, particularly in understudied remote regions such as the marine free troposphere. To address this need, we investigated atmospheric particle properties at the elevated Pico Mountain Observatory (2225 m a.s.l.) in the Azores, Portugal. The observatory typically sits above low marine clouds, sampling free-tropospheric air masses transported across the North Atlantic Ocean from North America or recirculated from North Africa. During measurement campaigns conducted in the summer months between 2012 and 2018, we characterized atmospheric particles by measuring light-scattering coefficients using a three-wavelength nephelometer, particle concentrations with a two-channel optical particle counter, and black carbon equivalent mass and iron-containing dust concentrations using a seven-wavelength aethalometer. Aerosol samples were also collected on various media for off-line bulk and single particle analysis. We used retroplume simulations from the FLEXible PARTicle dispersion model (FLEXPART) to interpret the results based on the air mass origin, transport path, transport time, and source type and region.

We investigated the physico-chemical characteristics of atmospheric particles, focusing on their optical properties and individual particle morphology and elemental makeup. In this presentation, we emphasize the properties of particles collected during episodes dominated by mineral dust transport. Specifically, we use the Ångström exponent derived from the scattering data as an indicator to identify dust events. These properties are relevant to the particles' interactions with clouds and radiation, especially owing to the location of the atmospheric particles sampled at the station.

9RM.8

Analyzing NO_2 Emissions in Croplands using TEMPO Data. XUEYING YU, *University at Albany, State University of New York*

Understanding the patterns of atmospheric NO_2 emissions over croplands is vital to maintaining air quality and environmental health. However, current monitoring systems lack crucial information about fine-scale temporal and spatial emission pattern. Even though satellite instrument provides a large amount of fine-resolution data, separating emission signal from background signals is difficult, especially over agricultural regions. Existing NO_2 datasets generally lack detailed information on short-term pulsing events and agricultural drivers. Unlike traditional ground-based methods, satellite remote sensing combined with machine learning tools can readily discriminate between morphologically and temporally indistinguishable emission signals. Our analysis of TEMPO and Sentinel-5P satellite data, focused on croplands in New York, Wisconsin, and Minnesota, contributes valuable insight into seasonal, diurnal, and spatial NO_2 patterns. Most trends align with known agricultural practices, but we also observed novel short-term spikes likely driven by weather events. More broadly, this work can be used to address questions about agricultural emissions and their climatic impacts, and to help ensure that cropland management strategies are environmentally sustainable.

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9RM.9

Year-long Measurements of $PM_{2.5}$ Composition and Size Distributions at the ASCENT Joshua Tree Site. GINO PENA, Bradley Ries, Erin Bowey, Eleanor Bentley, Armistead G. Russell, Ann M. Dillner, Nga Lee Ng, Lelia Hawkins, Roya Bahreini, *University of California, Riverside*

The Joshua Tree National Park (JTNP), located adjacent to the rural city of Joshua Tree downwind of Los Angeles and Riverside counties, has unique features that make it historically among the most polluted national parks in the US. Higher than typical ozone concentrations have been observed at the site in the summer due to transport of polluted air masses from the Los Angeles Basin as well as stratospheric intrusion events. As part of the NSF- funded ASCENT network, we have deployed an ACSM, Xact-625i, Aethalometer, and SMPS at JTNPBlack Rock site to characterize the $PM_{2.5}$ composition and submicron aerosol size distributions since Summer 2024. In this work, we present seasonal and diurnal characteristics of aerosols. Local meteorology and back-trajectory analysis are used to infer sources of the elevated ozone. Furthermore, covariability among $PM_{2.5}$ organic, inorganic, and elemental components are used to identify instances of transported wildfire plumes to the site and their influence on local air quality. Overall, the instruments available as part of the ASCENT network allow for a comprehensive long-term characterization of $PM_{2.5}$ at this national park and provide insights into the sources of pollution at Joshua Tree.

9SA.1

Understanding Sources Contributing to Photochemical Ozone Formation in NYC Metro Using Low-Cost Sensor Data and PAMS VOC Data. JAMES NIMO, Md. Aynul Bari, Lucille Borlaza-Lacoste, Scott Miller, Cheng-Hsuan Lu, Philip K. Hopke, *University at Albany, State University of New York*

Tropospheric ozone is a pervasive urban air pollutant that poses significant health risks, particularly in densely populated regions like the New York City (NYC) metropolitan area. Although efforts to reduce emissions of ozone precursors e.g., nitrogen oxides (NOx) and volatile organic compounds (VOCs) have been implemented, ozone exceedances remain frequent, underscoring the need for a deeper understanding of precursor sources and their dynamic contributions. Traditional air quality monitoring networks often lack the spatial coverage and temporal resolution needed to capture fine-scale variability in complex urban environments. This study addresses these challenges by integrating high-resolution, low-cost sensor measurements (O_3, NO, NO_2, CO, $PM_{2.5}$) with Photochemical Assessment Monitoring Stations (PAMS) VOC data and applying receptor modeling techniques e.g., weighted non-negative matrix factorization (NMF) and positive matrix factorization (PMF) to identify and quantify the contributions of diverse sources to ozone formation in the NYC metropolitan area. Low-cost sensors deployed throughout the NYC during 2023-2024 provide granular, continuous data on criteria air pollutants, enhancing detection of localized emission hotspots and temporal fluctuations. Receptor models leveraged these datasets along with PAMS VOC to disentangle the influence of mobile sources, industrial activities, fugitive emissions, and biogenic emissions on ozone chemistry. By refining source profiles and incorporating updated, localized data, this integrated approach offers critical insights into the spatial and temporal dynamics of ozone formation in NYC. The results will assist in developing appropriate policy and management initiatives to reduce O_3 pollution in NYC metro.

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9SA.2

Attributing PM Sources within a Swine Production Facility via PMF Modeling of Particle Size Distribution Data. PRADEEP KUMAR, Seyit Uguz, Shalini Tiwari, Youwen Yang, Zonggang Li, Yuanhui Zhang, Xufei Yang, *South Dakota State University*

Particulate matter (PM) in swine production environments poses significant respiratory health risks to both animals and human workers. However, the relative contributions of specific PM sources remain inadequately characterized. This study quantified PM concentrations and particle size distributions (PSDs) in a wean-to-finish swine production room and a farm office using a GRIMM 11-D optical particle counter (OPC) during both summer and winter seasons. Source apportionment was conducted using Positive Matrix Factorization (PMF) based on the PSD data. Results indicated that concentrations of $PM_{2.5}$, PM_{10}, and total suspended particles (TSP) were highest in the production room during winter and lowest in the office during summer. PMF modeling effectively identified and quantified key PM sources across all scenarios. The dominant contributors included feed handling, animal activity, ventilation systems, and infiltration of outdoor air. To enhance source characterization, supplementaryques such as Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDX), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and Ion Chromatography (IC) were employed. Furthermore, a modified OPC-N3 sensor was evaluated as a low-cost alternative to the GRIMM OPC for PM monitoring, demonstrating promising utility for field applications. These findings provide a comprehensive understanding of PM sources and seasonal dynamics within swine production facilities, offering valuable insights for targeted mitigation strategies and air quality management.

9SA.3

Source Apportionment of $PM_{2.5}$ Air Pollution in Lahore, Pakistan. WAJIH UR REHMAN, *COMSATS University Islamabad*

Air pollution is a big problem in India and Pakistan and a regional effort is required to mitigate the problem. This research focuses on $PM_{2.5}$ air pollution especially in Lahore, so that extent of the problem can be studied and investigated both in Pakistan as well as in India. $PM_{2.5}$ samples were collected in an urban location in Lahore and analysis of various species including organic, inorganic and metals were investigated to understand the complexity of the problem. It is expected that by identifying various sources' contributions on overall air quality, complexity of the problem of air pollution can be identified. By employing suitable mitigation strategies, problem of pollution in Lahore and adjoining areas (including India) can be reduced.

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9SA.4

Sources of $PM_{2.5}$ and PM_{10} Trace Elements at Two Sites in the Inland Empire of Southern California. BRADLEY RIES, Yifan Ding, Mohammad Sowlat, Payam Pakbin, Armistead G. Russell, Ann M. Dillner, Nga Lee Ng, Akula Venkatram, Roya Bahreini, *University of California, Riverside*

Direct tailpipe emissions from vehicles in urban environments have reached an all-time low. Because of this, emissions from sources other than the exhaust - such as brake wear, tire wear, and particles resuspended from the roadway itself - are gaining importance. To study the contribution of these sources to atmospheric aerosols in the Inland Empire of Southern California, $PM_{2.5}$ and PM_{10} concentrations of trace elements were measured using the Xact 625i Ambient Continuous Multi-Metals Monitor at two sites: a near-road site in Ontario, CA (managed by the South Coast AQMD) and a suburban site in Rubidoux, CA (managed by South Coast AQMD and also instrumented and funded by NSF ASCENT - Atmospheric Science and Chemistry mEasurement NeTwork). Meteorological parameters, concentrations of NOx, CO, black carbon, and total aerosol concentration were also available at the sites. Vehicular traffic data from the California Department of Transportation were used to investigate how vehicle type and driving patterns in the Los Angeles basin influenced the observations. Positive matrix factorization (EPA PMF v5.0) was used to determine the contribution of tail-pipe and non-tailpipe emissions to overall $PM_{2.5}$ and PM_{10} elemental concentrations. PMF resolved 6 and 7 factors, respectively, as sources of $PM_{2.5}$ and PM_{10} elements at each sampling location, including factors representing brake wear, tire wear, and resuspended dust particles. Our findings show that resuspended dust and brake wear are substantial contributors to both PM_{10} and $PM_{2.5}$ with tire wear also playing a small role. Specific traffic patterns, such as morning and evening rush-hour traffic were correlated with the non-tailpipe factors. The poster will present detailed PMF factor profiles, including marker elements for each source, the temporal trends of these factors, and their correlation with traffic characteristics. This study highlights just how important emissions of non-tailpipe sources are and can help provide insights for air quality management strategies.

9SA.5

Development of Nitrogen Dioxide Source-Receptor Matrix for Rapid Health Impact Assessment of Emission Control Scenarios in the United States - Case Study in New York City . Huy N.Q. Tran, Manish Soni, Catherine Seppanen, SARAVANAN ARUNACHALAM, *University of North Carolina at Chapel Hill*

Exposure to nitrogen dioxide (NO_2) is responsible for ~ 140,000 — 180,000 premature mortalities in the U.S. annually (Camilleri et al., 2023; Valencia et al., 2023). Existing screening tools such as the Co-benefits Risk Assessment (COBRA) (EPA, 2025) allows quick health impact assessment for various emissions control scenarios associated with fine particulate matter ($PM_{2.5}$) and ozone but lack assessment for NO_2. In this project, we develop a new source-receptor matrix (SRM) for NO_2 as a reduced complexity tool that allows quick assessment of nitrogen oxides (NOX) emission control scenarios on air quality and human health in the U.S. We used 574 generic NOx-emitting nonpoint and point sources that are distributed over areas with strong variation in observed NO_2 and anthropogenic NOx emissions across the U.S. Contributions of NO_2 from each of the generic sources to receptors over the 12US1 domain (12 km x 12 km grid resolution) are quantified by finite-difference (zero-out) simulations for each of the 574 sources utilizing the Community Multiscale Air Quality (CMAQ) model version 5.4 (US EPA Office Of Research And Development, 2022) and the U.S. National Emissions Inventory for base year 2016. We utilized outputs of such simulations as a training dataset to develop a new NO_2 SRM which provides quick estimation of grid cell-level NO_2 impact of potential anthropogenic NOX sources at any location in the U.S. domain. Similar to COBRA's implementation for $PM_{2.5}$ and O_3, we adapted the NO_2 SRM to provide rapid health impact assessment of emission control scenarios at the county level on various source sectors and fuel types. We integrate the NO_2 SRM as a supplemental component to existing air quality and health impact assessment tools developed for New York City including the ZIP Code Air Pollution Policy Assessment, ZAPPA (Shukla et al., 2022) and Tract-level Air Pollution Policy Assessment (TRAPPA) tool (Naess et al., 2024). We will present results from two different policy scenarios in NYC that focus on transportation (on-road sources) and energy (building emissions) at the census tract resolution, and associated benefits due to reductions in NO_2.

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9SA.6

Quantification, Source Characterization, and Health Risk of BTEX Compounds in Northern India. BHUPENDRA SINGH, *Central University of Haryana, India*

As India is rapidly industrializing and its population is increasing rapidly, especially in the Haryana region, there is an impending concern about toxic air contaminants such as BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes), which have been known to cause adverse health effects. This research will analyse the concentration of volatile organic compounds (VOCs) and their sources and emission routes, and evaluate the human health risks during the five-year timeframe (2018-2022). The secondary data were procured from Central Pollution Control Board (CPCB) monitoring stations in Haryana. Time trends of the total VOC (TVOC) concentration were examined, as well as diagnostic ratios (T/B, X/E, X/B, E/B) to help determine the likely sources. Lifetime Cancer Risk (LCR) and Hazard Quotient (HQ) parameters were used to quantify human health risks. Correlation coefficients were generated to determine the interdependence of criteria between BTEX compounds. The TVOC concentrations showed a moderate increasing trend, rising from 0.11 µg/m³ in 2018 to a peak of 38.82 µg/m³ in 2021, before slightly decreasing to 27.08 µg/m³ in 2022. The source diagnostic ratios during the study period were inconsistent, which signifies a combination of vehicular and industrial pollutants. In aggregate, the HQ values did not exceed 2.04 in 2020, implying possible non-carcinogenic health threats. The mean LCR was 2.67 10 -4 (2019) and 4.79 10 -4 (2021), which is higher than permissible limits, and reveals high cancer risks. The high correlations (r = 0.893 to 0.940) between BTEX compounds point to a common or co-located source of emissions. The shift in VOC variability was also related to the effects of meteorological conditions and photochemical changes. This paper notes the increasing concentration of VOCs along with the health risks present in Haryana. The results highlight the importance of focused air quality management and public health mitigating measures against the risk of long-term exposures to the BTEX compounds.

Keywords: BTEX; Urban areas; Interspecies ratios; Carcinogenic and non-carcinogenic risks.

9UA.1

Impacts of Emission Profiles on Urban SOA Formation. Azad Madhu, MYOSEON JANG, *University of Florida*

Secondary organic aerosol (SOA) in urban environments is formed primarily from the photooxidation of a diverse set of alkane and aromatic hydrocarbons (HCs) due to the emissions from anthropogenic activity such as fuel and consumer product usage. For application for SOA simulations at regional scales, parameters that represent SOA formation should be validated against SOA data that is produced from the simultaneous photooxidation of a diverse set of HCs. This study employs parameters of alkane and aromatic HCs to simulate SOA formation from complex anthropogenic hydrocarbon mixtures using the Unified Partitioning and Aerosol Phase Reaction (UNIPAR) model. The model is demonstrated against SOA chamber data collected under various NO_x and seed conditions. Mixtures with different fractions of alkanes and aromatics are used to examine the impacts of variable fuel usage (i.e. gasoline vs. diesel) on SOA formation in urban environments. Measured SOA yields are significantly enhanced in lower NO_x experiments while they are not significantly impacted by inorganic seed conditions. Model simulations indicate that alkane products represent the majority of SOA formation when aromatic and alkane concentrations are comparable. However, the oxidants formed from the gas phase chemistry of aromatics played an important role by accelerating alkane oxidation.

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9UA.2

High Aerosol Optical Depths Observed From the Ground and Air During the 2024 NASA ASIA-AQ Field Campaign. RICHARD MOORE, Sayantee Roy, Francesca Gallo, Carolyn Jordan, Michael Shook, Elizabeth Wiggins, Edward Winstead, Luke Ziemba, ASIA-AQ Science Team, *NASA*

We present an analysis of airborne aerosol extinction profiles measured by the NASA DC8 during the 2024 NASA Airborne and Satellite Investigation of Air Quality (ASIA-AQ) and compare integrated aerosol optical depth (AOD) from the aircraft to ground measurements made by AERONET and PANDORA sensors. ASIA-AQ is a unique dataset that covers multiple major urban areas within Southeast Asia, including: Manila, Philippines; Seoul, South Korea; Bangkok and Chiang Mai, Thailand, and the west coast of Taiwan. Especially high aerosol loadings were observed due to strong biomass burning influences in Chiang Mai, while the organic aerosol optical properties varied significantly between Manila, Seoul, and Bangkok. Measured single scatter albedos (i.e., the ratio of light scattering to extinction) were found to be particularly low in Manila. Additional sources of variability in the observed AOD and aerosol vertical profiles include boundary layer heights and aerosol humidification. The suitability of ground-based and satellite sensors for relating column aerosol parameters (AOD) to surface air quality relevant parameters ($PM_{2.5}$) will be discussed.

9UA.3

Spatial Variations of $PM_{2.5}$ in Baltimore: Leveraging In-Situ and Satellite-Based Measurements. GRACE KOWALSKI, Darryn Waugh, Peter F. DeCarlo, Benjamin A. Nault, Kirsten Koehler, Drew Gentner, Colby Buehler, Shobha Kondragunta, Hai Zhang, Gaige Kerr, *Johns Hopkins University*

Exposure to $PM_{2.5}$ poses significant health risks, including aggravating asthma and contributing to cardiovascular and respiratory morbidity and mortality. Accurately quantifying the spatial distribution of $PM_{2.5}$ is critical for protecting public health and ensuring environmental equity. However, our understanding of microscale spatial variability in $PM_{2.5}$ remains limited, making it challenging to identify and support vulnerable populations at the city level. To address this, we use a combination of in-situ and satellite-derived observations to analyze the spatial patterns of $PM_{2.5}$ concentrations across Baltimore. For in-situ observations, we use a network of low-cost multipollutant monitors deployed throughout Baltimore and select regulatory monitors from the Maryland Department of the Environment (MDE). For satellite-based estimates, we leverage 1km resolution surface-level $PM_{2.5}$ products derived from aerosol optical depth observation. We use the National Oceanic and Atmospheric Administration' s (NOAA) Visible Infrared Imaging Radiometer Suite (VIIRS) product, and two products from Washington University in St. Louis' Atmospheric Composition Analysis Group. Preliminary results indicate that the overall spatial variation in $PM_{2.5}$ is weak with interquartile ranges being, on average, 8% of the city-wide mean across sensor type and with some seasonal variation. In terms of spatial gradient, $PM_{2.5}$ concentration exhibits a very slight southeast to northwest gradient in concentration across Baltimore. We also investigate the extent to which $PM_{2.5}$ concentrations are inequitably distributed among different minoritized populations within Baltimore.

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9UA.4

Understanding Ambient Air Quality at Underserved Neighborhoods in New York State Through Low-cost Monitoring Techniques and Community Engagement. MD. AYNUL BARI, James Nimo, Scott Miller, Cheng-Hsuan Lu, Elias Dueker, Brian Pavilonis, *University at Albany, State University of New York*

In the United States, current ambient air quality observation networks are limited in characterizing climate-driven pollutants like black carbon and brown carbon that affect exposure across regional to neighborhood scales. Studies indicate that minority and low-income communities of color are disproportionally burdened with exposure to air pollution. Under the EPA's initiatives of enhanced air quality monitoring for communities, the goal of this study was to improve the current understanding of ambient air quality across underserved neighborhoods in New York State (NYS) by establishing a community-driven air quality network platform. To address community-specific air quality issues, an enhanced air quality monitoring network for communities consisting of 15 sites was developed in and near underserved neighborhoods in NYS Capital District, Hudson Valley Region, and in New York City. Cost-effective monitors and low-cost sensors were used to measure black carbon (BC), brown carbon (BrC), and several criteria pollutants (CO, NO_2, O_3, CO, $PM_{2.5}$) as well as total volatile organic compounds (TVOC) and CO_2. The monitors were first calibrated by collocating them with reference monitors and corrected data were used for further analysis. As complementary measures, we are also conducting weekly indoor and outdoor monitoring and measure BC, BrC, CO, $PM_{2.5}$, TVOC, and CO_2. Our findings will provide an improved understanding of community-specific air quality exposure, can benefit the general people to improve their knowledge, increase public awareness, and inform policy makers the need to reduce air pollution across underserved neighborhoods.

9UA.5

Cooking Organic Aerosol Drives High PM Events in Wintertime Mineola, NY. ADAM DE GROODT, Emily Barnes Franklin, Joseph Ko, Michael Vermeuel, Trey Maddaleno, Roisin Commane, Dylan Millet, Delphine K. Farmer, *Colorado State University*

Understanding the drivers of regulatory exceedances is critical to address the air quality and human health impacts of fine particulate matter (PM1). Regulations targeting industrial and vehicular emissions have successfully reduced some air pollutants such as sulfur compounds, nitrogen oxides (NOx), and black carbon (BC), but have not reduced organic aerosol (OA). OA continues to be a major component of PM in urban environments, affecting air quality and human health. However, aerosol composition and its sources are poorly characterized in the New York metropolitan area during the winter, a season which has substantially different meteorological conditions and potential sources of PM than the more extensively studied summer. To address this, we characterize the composition of refractory and non-refractory PM_1 in Mineola NY during the winter to identify sources and drivers of wintertime PM and compare them to summertime observations at the same location. We find that OA dominates both winter (68%) and summer (86%) non-refractory PM_1, with non-refractory inorganic PM contributing more to winter (32% vs 14%), and BC contributing 6% of winter PM_1 mass. Source apportionment using Positive Matrix Factorization (PMF) identifies OA from cooking (COA) drives local high PM events, contributing up to 81% of total OA mass. These findings highlight strong seasonal contrasts in aerosol composition and indicate that cooking emissions are a major contributor to elevated wintertime PM in this urban environment.

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9UA.6

Spatial Variations of Non-Tailpipe Particulate Matter and Associated Oxidative Potential in Toronto, Canada. NICOLE TRIEU, Cheol H. Jeong, Yee Ka Wong, Christi Jose, Xing Wang, Greg J. Evans, *University of Toronto*

While tailpipe emissions have decreased in the past decades, non-tailpipe (NTP) particulate matter (PM) emissions, such as those from the wear of materials found in roads, brakes, and tires, and road dust resuspensions, are increasing. NTP emissions contain redox-active metals that can generate reactive oxygen species, potentially causing oxidative stress and adverse health effects. However, the toxicity and spatial variability of NTP PM in urban environments remain poorly understood, highlighting the need for further research. One promising metric for assessing the toxicity of PM is the oxidative potential (OP), which reflects the ability of PM to oxidize biologically relevant molecules and generate reactive oxygen species. To better understand the spatial variation of NTP and their contributions to PM's OP, particularly with particle size and chemical composition, we conducted an extensive sampling campaign in Toronto, Canada, during the fall, winter and summer seasons in 2023-2024. Weekly $PM_{2.5}$ and PM_{10} samples were collected using over 80 portable PM sampling devices across 40 sites. The metal composition of $PM_{2.5}$ and PM_{10} was determined, and the OP was determined using the acellular ascorbic acid, glutathione and dithiothreitol assay. Our study aims to develop land-use regression models to characterize the spatial distribution of non-tailpipe emissions using metal markers and measures of OP to better assess exposure to non-tailpipe PM. This work also explores the relationship between OP and the chemical composition of PM in Toronto, focusing on locations with varying contributions of NTP PM. Preliminary findings suggest that NTP markers (e.g., Fe, Cu, Ba) in PM exhibited strong spatial but weak temporal variation. In addition, annual land use regression models were developed for these metals, with proximity to highways, major roads, and traffic signals as dominant predictors. The small buffer distances selected in the models also highlight the highly localized nature of NTP emissions.

9UA.7

Ambient Measurements of Fuel Oil Combustion Emissions in New York City. MITCHELL ROGERS, Lijin Zhang, Tori Hass-Mitchell, Taekyu Joo, Drew Gentner, *Yale University*

The residential combustion of fuel oil has historically been a known source of sulfur dioxide and fine particulate ($PM_{2.5}$) trace metals, yet ambient measurements downwind of fuel oil combustion remain limited. Despite shifts towards cleaner fuels and energy sources, New York State continues to be the largest consumer of fuel oil for residential use in the United States, and blends containing residual fuel oil (i.e., No. 4) are still actively burned in several hundred boilers across New York City (NYC). In this work, we examine pollutant contributions from fuel oil combustion sources in the surrounding metropolitan area by leveraging two years of gas-phase and particle-phase measurements, including trace metals by the Xact 625i, at the Queens College ASCENT (Atmospheric Science and Chemistry mEasurement NeTwork) site in NYC. Fuel oil source profiles derived from these downwind measurements are compared to previously established emissions factors and inventory estimates for distillate and residual fuel oil combustion. Fuel oil plumes identified in this study contain several metals that have been previously demonstrated to be toxic and carcinogenic, including nickel, chromium, and vanadium. We also evaluate spatiotemporal variations in the contribution of fuel oil combustion to ambient trace metals, black carbon, organic aerosol, and gas-phase criteria pollutants in NYC. Additionally, collocated Scanning Mobility Particle Sizer (SMPS) measurements are examined to investigate enhancements in ambient ultrafine particles from residential fuel oil combustion in neighboring communities. The contribution of fuel oil combustion to urban air pollution in NYC is evaluated in the context of shifts in energy policies and fuel consumption at the local and state levels, and demonstrates the continued influence of fuel oil-related sources on several pollutants of concern.

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9UA.8

Comparison of Personal Exposures to $PM_{2.5}$ and Ozone using Mobile and Stationary Air Monitors in Elizabeth, New Jersey.

JENNA MYERS, Carmen Rosario, Victoria Wei, Phaneendra Sivangula, John Evangelista, Jackie Park-Albaum, Clinton J. Andrews, Jennifer Senick, Deborah Plotnik, Gediminas Mainelis, *Rutgers, The State University of New Jersey*

Air pollution results in thousands of deaths due to cardiorespiratory inflammation, oxidative stress, and other negative outcomes. In urban areas, the sources of personal exposures range from car exhaust and industrial emissions to secondhand smoke. Through monitoring air pollution, we can assess residents' exposures and associated health risks. This study evaluated and compared personal exposure to two criteria air pollutants via mobile and stationary monitoring.

The study was performed in the City of Elizabeth, NJ, USA, which is surrounded by a seaport, Liberty International Airport, highways, and a refinery. Personal Air Monitors (PAM), Personal Ozone Monitors (POM), AQLite Air Monitoring Packages (all from 2B Technologies, Inc.), and various low-cost air monitors were placed within mesh backpacks to measure particulate matter ($PM_{2.5}$) and ozone. These backpacks were worn throughout the city to determine the personal air pollutant exposures of twenty-one senior citizens. During seven days in summer 2024, a total of forty-three walks were completed, spanning between 15 and 25 minutes. The pollutant levels from these walks were compared to air quality data measured by a sparse network of nearby community-level stationary monitors (QuantAQ Modulair), installed as part of EPA and NSF-funded projects that use spatial interpolation to map pollutant levels between monitoring sites.

The differences in concentration between personal and stationary monitors were affected by time of day (morning versus afternoon) and the surrounding environment (e.g., traffic density). Overall, $PM_{2.5}$ was positively correlated between mobile and stationary monitors (Spearman's rho = 0.496), whereas ozone data had no association (Spearman's rho = -0.012). Although average mobile and stationary $PM_{2.5}$ (~13 $\mu g/m^3$ and ~12 $\mu g/m^3$, respectively) and ozone (~45 ppb and ~41 ppb) concentrations were similar, the averages obfuscate air pollution hotspots within the city that is observed with personal monitors only, which underscores the value of personal mobile monitoring.

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10AA.1 – INVITED

Tales from the Smoky Side of the Anthropocene. ARTHUR J. SEDLACEK, Timothy Onasch, Ernie R. Lewis, *Brookhaven National Laboratory*

The Anthropocene—characterized by human activity becoming the dominant force shaping Earth's ecosystems and geophysical processes—has seen a marked increases in wildfire frequency and intensity. These wildfires are now routinely exerting their weather-altering and health-impacting effects on regional and continental scales. While several studies over the past decade have focused on the rapid changes in the properties of biomass burning aerosols near the source, much less is known on how aerosols age on the regional and continental scales.

We will discuss a framework for elucidating the evolution of biomass burning aerosols wherein the lifecycle of these aerosols can be partitioned into three distinct regimes: (i) near the source ("local"), lasting a few days; (ii) hundreds of kilometers to continental scales ("regional"), lasting a few days; and (iii) thousand kilometers or global scale ("global") at ages more than a few days. We will present examples of the rapid, and sometimes dramatic, transformations in aerosol properties that occur in the local regime by highlighting the formation and optical properties of tar balls, a special class of light-absorbing organic aerosols (known as brown carbon (BrC) and the rapid increase in coating mass on black carbon (BC) particles. We will then move to the regional and global regimes where dilution, slower atmospheric processes, and episodic cloud processing can further impact the properties of these aging aerosols. We show that thickly-coated BC particles created in the local regime enter a phase of no increase in increase in coating mass, which delineates the regional regime. Following this few-day quiescent period, a slow loss of the coating mass occurs, delineating the global regime. Such dynamism makes a compelling argument that more studies on the regional and global regimes are required to better understand and quantify the complex aging of aerosols over their complete lifecycle.

10AA.2

Evolution of Fresh Biomass Burning Aerosol Physical, Chemical, and Optical Properties upon Increase of Combustion Temperature. ZEZHEN CHENG, Valentina Sola, Gregory W. Vandergrift, Sijia Liu, Ryan Poland, Michael Caraway, Xena Mansoura, Schuyler Lockwood, Tania Gautam, Amna Ijaz, Yuzhi Chen, John Shilling, Nurun Nahar Lata, Payton Beeler, Laura Fierce, Gourihar Kulkarni, Alexander Laskin, Sergey Nizkorodov, Marwa El-Sayed, Geoffrey Smith, Rawad Saleh, Swarup China, ManishKumar Shrivastava, Alla Zelenyuk, *Pacific Northwest National Laboratory*

Biomass burning aerosols (BBA) have important but poorly constrained impacts on Earth radiative forcing. This is partially because their complex physical, chemical, and optical properties are poorly understood due to the chaotic nature of combustion. Here, we conducted the first Study of Molecular, Optical, and Kinetic properties of combustion Emissions (SMOKE) Campaign at the Environmental Molecular Science Laboratory to systematically investigate the physical, chemical, and optical properties of BBA generated from pine needle combustion at 300 ºC, 400 ºC, 600 ºC, and 900 ºC with a constant air-to-fuel ratio. The size distribution of BBA decreases with the increase in combustion temperature, and that for 900 ºC emission shows an increase in the number fraction of particles larger than 500 nm. Mass absorption cross-section of BBA at 405 nm (MAC_{450}) increases from 0.27 m^2/g to 3.1 m^2/g from 300 ºC to 600 ºC, but decreases to 0.12 m^2/g at 900 ºC. Contrarily, absorption Ångström exponent decreases from 5.0 to 3.3 as combustion temperature increases from 300 ºC to 900 ºC, suggesting light-absorbing species might be more absorbing at higher combustion temperatures. The single particle mass spectrometer (miniSPLAT) analysis reveals a significantly higher intensity of inorganic species and char at 900 ºC BBA compared with other samples. The offline chemically resolved size distribution analysis confirms that these inorganic species dominate the large particle size for 900 ºC emission. This might explain the decrease of MAC_{450} at 900 ºC since these non- or weakly absorbing inorganics contribute to a significant fraction of total aerosol mass and can counterbalance the MAC_{450} of strongly absorptive species. Moreover, offline scanning electron microscopy analysis reveals an increase in organic particle viscosity with an increase in combustion temperature, and fresh tar balls and soot can be generated at 900 ºC.

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10AA.3

Particle-scale Diversity in Organic Composition of Fresh and Aged Wildfire Emissions. JOHANNES PASSIG, Ellen Iva Rosewig, Aleksandrs Kalamasnikovs, Haseeb Hakkim, Marco Schmidt, Thomas Gröger, Mika Ihalainen, Anni Hartikainen, Markus Somero, Pasi Yli-Pirilä, Olli Sippula, Kerneels Jaars, Pieter Gideon van Zyl, Kajar Köster, Stefan Siebert, Saara Peltokorpi, Liqing Hao, Angela Buchholz, Annele Virtanen, Ville Vakkari, Andreas Walte, Ralf Zimmermann, *Mass Spectrometry Centre;Rostock University/Helmholtz Munich*

Wildfire smoke significantly impacts air quality, human health, climate, and Earth system processes (van der Werf et al., 2017). The atmospheric aging of these aerosols involves complex chemical and microphysical transformations that alter their optical properties, radiative forcing, and cloud-forming potential. For example, organic coatings can enhance light absorption via lensing effects and increase hygroscopicity (Cheng et al., 2024). A central but poorly understood factor in this context is the aerosol mixing state—the distribution of optically and nucleation-active substances across the particle ensemble.

In this study, we present single-particle mass spectrometry data from a boreal forest smoke experiment, resolving the distribution of both hydrophilic molecules and hydrophobic polycyclic aromatic hydrocarbons (PAHs). We show that glyoxal and methylglyoxal are directly emitted during combustion, contributing to the initial hygroscopicity of the particles. Upon photochemical aging, we observed the rapid formation of oxalate, coinciding with a moderate increase in hygroscopicity. At the same time, high initial levels of the softwood combustion marker retene and other PAHs rapidly declined. The similar timescales of oxalate formation and PAH degradation suggest a prolonged co-existence during aging.

Importantly, our single-particle analysis shows that these hydrophilic and hydrophobic substances are not segregated into different particle types but are broadly co-distributed across the particle ensemble. This co-existence implies that both optical lensing and droplet activation effects are widespread in aged wildfire smoke and must be considered in atmospheric models and climate impact assessments.

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[2] Van der Werf, G. et al. (2017), Earth Syst. Sci. Data, 9.

10AA.4

Evidence for Brown Carbon Whitening with Increasing Plume Age During Wildfire Seasons in Western Canada. MOHAMAD H. AL-JABIRI, Jason S. Olfert, Laura-Helena Rivellini, Stephanie R. Schneider, Jonathan Abbatt, *University of Toronto*

The atmospheric abundance of black carbon (BC) and brown carbon (BrC) aerosol particles has been measured using aethalometry at three locations (Kamloops, BC; Prince George, BC; Joussard, AB) in Western Canada through the 2023 and 2024 wildfire seasons (June to November). Intense wildfires in 2023 led to higher median BC levels (0.44, 0.55, 0.28 μg m^{-3}) than in 2024 (0.31, 0.25, 0.18 μg m^{-3}) for Kamloops, Prince George, and Joussard, respectively. The season-wide averages for the aerosol Absorption Angstrom Exponent for 2023 and 2024 are 2.05 and 2.1, respectively, indicating the presence of BrC. The average BrC absorption observed was 0.0285 Mm^{-1} and 0.010 Mm^{-1} at 375 and 470 nm, where the BrC is evaluated by subtracting the absorption due to BC at those wavelengths from the total measured absorption (using BC mass absorption coefficients of 24.1 and 19.1 m^2 g^{-1} at 375 and 470 nm). The Trajectory Fire Interception Method (TFIM), where spatial and temporal overlap between atmospheric back trajectories and satellite fire counts is assessed, was used to calculate the average atmospheric transport time and age of a fire plume. The TFIM approach demonstrated that there is a marked decrease in the ratio of BrC to BC with increasing atmospheric transport time. Specifically, there is a decrease of between 44 to 56 % in BrC/BC at 375 nm as the average atmospheric transport time increases from < 10 hours to > 72 hours. This indicates that significant atmospheric BrC whitening occurs on a timescale of 2 to 3 days. This is the first evaluation of the BrC atmospheric whitening timescale using season-long data sets measured at multiple locations.

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10AA.5

Dark Brown Carbon Dominates Shortwave Absorption in Urban Emissions. YUEZHI (AUGUST) LI, Joshin Kumar, Gwan-Yeong Jung, Taveen S. Kapoor, Joseph V. Puthussery, Guodong Ren, Jordan A. Hachtel, Zezhen Cheng, Nurun Nahar Lata, Benjamin Sumlin, Chenchong Zhang, Dishit Ghumra, Ganesh Chelluboyina, Swarup China, Rohan Mishra, Rajan K. Chakrabarty, *Washington University in St. Louis*

Brown carbon aerosols are important climate forcers that alter the Earth's radiative budget by absorbing and scattering incident solar radiation. However, brown carbon's highly variable absorption properties render challenges in measuring and modeling its climatic impacts. Despite new evidence showing strong brown carbon absorption in the visible-infrared wavelengths, current climate models constrain brown carbon light absorption in ultraviolet-blue ranges and its sources to biomass burning, inducing large uncertainties. The increasing anthropogenic activities due to global urbanization have also led to growing sources of brown carbon particles, highlighting the urgency to understand their optical and physicochemical properties more thoroughly.

In the airmasses of Houston area, deemed the epicenter of United States' oil industries, we observed refractory brown carbon aerosols (dark brown carbon) that contribute to ~50% of the total shortwave absorption across the visible and near-infrared wavelengths. Particle-scale measurements also show strong brown carbon absorption in the visible-infrared wavelengths, with mean imaginary refractive index of 0.106 and 0.055 at 550 and 1047 nm, respectively. Experimental compositional analyses complemented by electronic structure calculations suggest the formation and emission of these particles from anthropogenic high-temperature combustion as primary aerosols alongside black carbon. This dark-brown-black-carbon continuum in high-temperature combustion systems is controlled by the degree of sp2 hybridization of the carbon atoms. Our findings provide the first observations of dark-brown carbon in urban emissions and underscore the need for its incorporation in emission inventory and aerosol-radiation models for an improved estimate on the direct radiative forcing and associated climatic effects from urban aerosols.

10AA.6

Vertical Gradients in New Particle Formation and Growth: Influence of Agricultural Emissions. Bri Dobson, Daniel Katz, Mitchell Alton, Harald Stark, Tamanna Subba, Douglas Worsnop, Chongai Kuang, Manjula Canagaratna, ELEANOR BROWNE, *University of Colorado Boulder & CIRES*

Agricultural activities ranging from changing land and water use to the application of fertilizer have been a defining characteristic of the Anthropocene. Increased demands for food and biofuel as well as changes in environmental factors will alter agricultural emissions in the coming decades. How aerosol processes respond to such changes remains an open question with implications for future agricultural productivity and ecosystem and human health. To address these knowledge limitations, we have been investigating new particle formation and growth across multiple seasons at the United States Department of Energy Southern Great Plains research facility in Lamont, Oklahoma, an agriculturally intensive region. We use measurements of particle formation precursors (e.g., NH_3, amines, H_2SO_4, oxygenated organic molecules (OOMs)) at the surface, vertically resolved measurements of 1-3 nm aerosol-cluster concentration from the tethered ballon system, and WRF-Chem modeling. We have found that agricultural emissions of reactive nitrogen compounds, namely NH_3, amines, and nitrogen oxides play a central role in nucleation and growth processes. Due to the relatively high surface temperatures and low sulfuric acid concentrations, new particle formation is generally favored aloft. A notable exception occurs when amines are present, and cluster growth is observed at the surface. WRF-Chem results suggest that vertical mixing of NH_3 may play a defining role in determining the variability in boundary layer profiles of nucleation. High NO mixing ratios affect the formation of OOMs, specifically by depressing the formation of "dimer" molecules formed from peroxy radical cross reactions. As a result, sesquiterpene oxidation products rather than monoterpene oxidation products dominate the extremely low volatility compounds that contribute to growth, a finding consistent with emission factors from crops in the area. Overall, these findings highlight that future prediction of aerosol processes in agricultural regions requires improved understanding of agricultural emissions.

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10AC.1

Precursor Concentration and Molecular Structure Influence the Viscosity and Volatility of Secondary Organic Aerosol Derived from Sesquiterpene Ozonolysis. SIJIA LIU, Amna Ijaz, ManishKumar Shrivastava, Sergey Nizkorodov, Celia Faiola, Alla Zelenyuk, *Pacific Northwest National Laboratory*

Sesquiterpenes, with their complex molecular structures, yield SOA with unusually low volatility and high viscosity, but their SOA remain under-characterized compared to SOA from monoterpenes. Moreover, plant stress can increase emissions of acyclic sesquiterpenes, such as β-farnesene, further modulating SOA yield, composition, and phase behavior. To improve our understanding and better characterize SOA from sesquiterpenes, we performed batch-mode chamber ozonolysis of two sesquiterpenes (β-caryophyllene and β-farnesene) at three initial concentrations (300, 100, and 30–50 ppb). We employed the state-of-the-art single-particle laser-ablation mass spectrometer (miniSPLAT) to determine particle composition, morphology, and density, and conducted evaporation-kinetics measurements to quantify volatility and infer viscosity. We also used nanospray desorption electrospray ionization high-resolution mass spectrometry (nano-DESI-HRMS) to elucidate molecular composition of SOA, and thermal desorption- thermal desorption–gas chromatography-quadrupole time-of-flight mass spectrometry (GC-QToF MS) of sorbent tube samples to validate the chamber VOC concentrations. Our results demonstrated that both precursor concentration and molecular structure strongly affect the properties of the resulting SOA. MiniSPLAT evaporation kinetics measurements revealed that lowering the precursor concentration reduced the volume fraction remaining (VFR) from 57 % to 49 % for β-caryophyllene and from 63 % to 59 % for β-farnesene under humidified conditions, but VFR remained similar under dry evaporation conditions, suggesting high relative humidity has a greater influence on the SOA from lower concentration. Nano-DESI-HRMS analysis indicated that by reducing the initial precursor concentration in both systems decreased the ELVOC fraction and enhanced the relative abundance of SVOCs. β-farnesene SOA had a consistently higher average O/C ratio (0.55) than β-caryophyllene SOA (0.40), and at all concentrations, β-farnesene yielded a larger fraction of LVOC and ELVOC species. These findings will improve our understanding of sesquiterpene-derived SOA and provide critical insights for improving models of organic aerosol formation and phase state in the atmosphere.

10AC.2

The Influence of Road Salt on Nitryl Chloride Formation from Aerosol and Urban Grime Surfaces in Urban, Continental, Wintertime Environments. EMMA MCLAY, Trevor VandenBoer, Nasrin Dashti, Cora Young, *York University*

Chlorine radicals, which often react much quicker than hydroxyl radicals, can play a role in atmospheric oxidation pathways that can lead to ozone and secondary organic aerosol formation. Nitryl chloride ($ClNO_2$), a precursor to chlorine radicals, is formed from heterogeneous reaction of chloride-containing surfaces with N_2O_5. $ClNO_2$ formation is predominantly studied in coastal regions with sea-salt influence, and on chloride-containing aerosol surfaces. Despite this, $ClNO_2$ has been observed in continental regions where road salt (i.e. NaCl) is used in the wintertime for de-icing. In urban areas, the prevalence of urban grime, the films on impervious outdoor surfaces containing deposited aerosols, could serve as a surface for heterogeneous reactivity. To investigate these understudied areas, aerosols and urban grime were sampled in Toronto, ON during a four-week winter period where cold and snowy conditions were experienced along with road salt application. Sampling took place at two locations contrasting in their distance from road salt sources. Ionic composition determination revealed evidence of chloride depletion relative to sodium, possibly indicative of $ClNO_2$ formation, in all urban grime samples and some aerosol samples. More depletion was seen in the grime than in the aerosols indicating that chloride loss may occur post-deposition on the grime surface itself. As well, more depletion was seen relative to sodium, magnesium, and calcium combined, potentially indicating reactivity of other chloride salts (e.g. $CaCl_2$ and $MgCl_2$) that are sometimes used for de-icing. Fractions of nitrate, which would increase from $ClNO_2$ production, were higher in grime at the location further from road salt sources likely because of longer aerosol transport times pre-deposition. Direct reaction of N_2O_5 with urban grime samples in a coated-wall flow tube reactor coupled with an iodide-adduct chemical ionisation mass spectrometer will be conducted to determine the potential $ClNO_2$ production, as opposed to other chloride activation or displacement reactions.

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10AC.3

Vertically Resolved Chemical Speciation of Organic Aerosols at ARM Southern Great Plains. SHAN GU, Lindsay Yee, Gregory W. Vandergrift, Swarup China, Darielle Dexheimer, Allen Goldstein, *University of California, Berkeley*

Organic aerosol (OA) measurements are typically conducted at ground level, with limited vertical characterization above. To address this gap, we performed vertically resolved chemical speciation of OA samples collected onboard the DOE Atmospheric Radiation Measurement (ARM) Tethered Balloon System (TBS) at the Southern Great Plains (SGP) site in Lamont, OK, during summer 2023. The SGP deployment featured strategically designed daytime and nighttime TBS flights with sample collection at defined altitude bins (e.g., 0–250 m, 250–500 m, 500–750 m, 750–1000 m), enabling higher vertical resolution than cumulative flight sampling approaches.

We employed complementary high-resolution techniques—comprehensive two-dimensional gas chromatography coupled with high-resolution time-of-flight mass spectrometry (GC×GC-HRToF-MS) and nanospray desorption electrospray ionization (nano-DESI) for molecular formula assignment—to identify specific tracers and infer potential OA sources. At SGP, we observed distinct vertical signatures in aloft samples, including elevated levels of long-chain alkanes (C > 26), which are located in the low-volatility range of the semi-volatile organic compound (SVOC) space among the compounds detected by our GC×GC-HRToF-MS analysis. These compounds are typically associated with oil-related emissions from transportation sources and their enhancement aloft suggests emissions from upwind sources that were transported aloft to the observation site.

Additionally, we observed a decline in the number of identifiable compounds with increasing altitude, potentially indicative of unique chemical processing or aging processes occurring aloft, which may produce compounds not well represented in the existing libraries – including the potential formation of novel species aloft and/or upward transport of processed compounds. These findings highlight the value of vertically resolved OA measurements in understanding aerosol chemical evolution and constraining source contributions in rural environments influenced by multiple sources, including anthropogenic, biomass burning, and biogenic emissions. Such insights can ultimately inform the development of more accurate representations of aerosol-cloud interactions in atmospheric models.

10AC.4

Advancing Aerosol Chemistry Studies with an LED-powered Environmental Chamber: From Modeling-Assisted Control of Secondary Organic Aerosol (SOA) Coating to Multiphase Reactions. YUE ZHANG, Miska Olin, Sining Niu, Hannah LeClear, Christopher Rapp, Jiayun Zhao, Jason Surratt, Daniel Cziczo, *Texas A&M University*

Previous studies have demonstrated that isoprene could undergo multiphase reactions with acidic sulfate particles to form isoprene-derived secondary organic aerosols (SOA). However, it remains unclear if gas-phase oxidation products from terpenes also undergo similar multiphase reactions to form SOA. To bridge this knowledge gap, a Texas A&M environmental chamber (TAMEC) was used to allow limonene and beta-caryophyllene to react with hydroxyl radicals (OH) in the presence of ammonium bisulfate (acid) and ammonium sulfate (neutral) seed particles. The TAMEC consists of a 10-m^3 fluorinated ethylene propylene (FEP) bag in a temperature-controlled insulated enclosure (between −40 and 40 C) that is equipped with LED UV-C 273 nm lights. An aerosol dynamics model, namely TUTAMU Chamber Aerosol Model (TUTAMUChAM), was utilized in real-time during the experiments to assist in avoiding self-nucleation and deriving precise organic coating thickness on the seed particles for multiphase reactions to happen. By using a Vocus Chemical Ionization Mass Spectrometer (CIMS) in the ammonium mode, a high resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS), and other particle characterization techniques, we have demonstrated that intermediate peroxides species from limonene photo-oxidation was partitioning into the acidic aerosols to initiate multiphase reactions. The presence of acidic sulfate seed particles enhanced the production of SOA from limonene but suppressed the production of SOA from beta-caryophyllene, while a significant increase of the abundance of organosulfates were observed in both conditions. Such increase in organosulfate were also accompanied by changes in the physicochemical properties of aerosols. Given that ambient aerosols are often acidic, especially in the Southeastern U.S. areas with abundant terpene emissions, such results may provide improved parameterizations in predicting air quality and understanding the climate impacts of aerosols.

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10AC.5

Unexpected Stereochemical Specificity for Organosulfates Formed from Isoprene-Epoxide Ring Opening Reactions as a Function of Aerosol Acidity. ANDREW P. AULT, Madeline Cooke, N. Cazimir Armstrong, Cara Waters, Qiyuan Zhao, Scarlet Aguilar-Martinez, Yuzhi Chen, Ziying Lei, Zhenfa Zhang, Avram Gold, Paul Zimmerman, Jason Surratt, *University of Michigan*

Chirality is a central property of organic molecules that plays a key role in chemical properties and biological impacts of molecules with only a slight difference at a single stereocenter within a molecule. In secondary organic aerosol (SOA) species with different stereoisomers are assumed to be present equally within racemic mixtures, unless there is an initial stereospecificity of the condensing or reacting oxidized VOCs. Unexpectedly, we found that certain stereoisomers of organosulfates are formed preferentially from isoprene epoxydiols without initial stereospecificity. This surprising result is confirmed with computational chemistry showing a significant energy difference in the formation of certain stereoisomers. In addition, we see a pH-dependent shift in the mechanism of reaction from an SN1 dominating the lowest acidities studied to an increase in the concerted SN2 mechanism at higher pH values. These results were enabled through a combination of advanced analytical methodologies, specifically hydrophilic interaction liquid chromatography coupled with mass spectrometry (HILIC/ESI-HR-QTOFMS) that can separate the MTS diastereomers and computational chemistry studies using advanced sampling methods to explore the reaction mechanisms. Identifying this unexpected chirality from racemic precursors and connecting it to mechanisms occurring within atmospheric aerosols has broad importance for SOA chemical composition, physicochemical properties, and potentially human health after inhalation. Further studies are needed to determine the breadth of this chirality within aerosols and its potential implications.

10AC.6

Chemical Composition and Volatility Distribution of Secondary Organic Aerosol Formed through Multiphase Chemical Reactions as a Function of Sulfate Seed Acidity. SINING NIU, Miska Olin, Christopher Rapp, Siddharth Gopalakrishnan, Hannah LeClear, Jason Surratt, Daniel Cziczo, Yue Zhang, *Texas A&M University*

The climate properties of secondary organic aerosol (SOA) are poorly understood, not only due to variations of their chemical composition but also uncertainties in their volatility distribution and phase state. Previous studies have shown that atmospheric aerosols are often acidic, and these acidic aerosols can also affect the physicochemical properties of SOA, further complicating their climate effects.

In this study, we conducted environmental chamber experiments to investigate the formation of SOA from the oxidation of biogenic volatile organic compounds by hydroxyl radicals in the presence of neutral (ammonium sulfate) and acidic (ammonium bisulfate) seed particles. The molecular composition and thermal desorption behavior of SOA particles were detected and quantified using a Vocus chemical ionization mass spectrometer coupled with a Vaporization Inlet for Aerosols. Volatility distribution of the SOA was derived using the thermogram method established in our previous work, and positive matrix factorization (PMF) was applied to identify components with distinct thermal desorption patterns. In addition, SOA mass and bulk chemical composition were characterized using a Scanning Mobility Particle Sizer and a High-Resolution Aerosol Mass Spectrometer (HR-AMS).

Our results demonstrated enhanced formation of organosulfates (OS) under acidic conditions, with highly functionalized OS exhibiting lower volatility and higher viscosity compared to SOA formed via neutral seeds. In addition, HR-AMS analysis revealed elevated oxygen-to-carbon (O/C) and hydrogen-to-carbon (H/C) ratios under neutral seed conditions, suggesting that the presence of acidic seeds may promote the formation of sulfur-containing oligomers. This highlights the complexity of aerosol acidity effects on SOA composition and the need to decouple OS formation from overall oxidation state metrics. Our findings highlight the importance of accounting for OS formation and the effects of aerosol acidity in atmospheric chemical transport models to better constrain SOA formation, volatility, and phase state, thereby reducing uncertainty in climate and air quality predictions.

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10BA.1 – INVITED

Report on Workshop on "Bioaerosols in the Earth System".
SONIA KREIDENWEIS, Allison Aiken, Kathleen Weathers, et al., *Colorado State University*

Microbial communities are increasingly recognized as integral components of the Earth system, but the role of airborne microbes—the aerobiome—is not yet fully understood. While the dispersal of pathogens and allergens has long been studied due to implications for health and agriculture, recent research has expanded to consider the broader potential environmental functions of bioaerosols, which are hypothesized to include impacts on climate and ecology. The COVID-19 pandemic further amplified attention to bioaerosols by revealing critical knowledge gaps in aerosol behavior and factors governing pathogen viability during transport. At the same time, advances in sequencing technologies—especially for ultra-low biomass samples—have enabled deeper characterization of airborne microbial communities, even in remote and extreme environments such as polar regions and high-altitude sites, that have revealed the widespread nature and incredible diversity of atmospheric bioaerosols.

Efforts are underway to integrate various bioaerosol types and their diverse sources into regional and global Earth system models, to provide a more comprehensive understanding of their ecological and climatological roles. However, progress is hindered by lack of data on emissions rates, transformations in the atmosphere, interactions with the environment across local to global scales, and sparse monitoring data for model validation. Further progress also requires increased interdisciplinary collaboration across atmospheric science, biology, ecology, chemistry, engineering, and other disciplines.

We report on findings from a recent workshop, “Bioaerosols in the Earth System”, that convened researchers from diverse fields to review emerging findings, identify persistent gaps, and explore new directions for innovation. The workshop aimed to catalyze collaboration and to begin to chart a path toward transformative research and practical advancements in understanding environmental bioaerosols.

10BA.2

Quantification of Bioaerosol Emission Flux Over a Semi-Arid Grassland.
LILLIAN JONES, Rutambhara Joshi, Kevin Barry, Thomas Hill, Jay Ham, Sonia Kreidenweis, Delphine K. Farmer, *Colorado State University*

Understanding the rates of exchange (flux) of particulate matter between Earth’s surface and the atmosphere is essential to determining global aerosol loading, but there is a significant deficit of quantitative particle flux estimates, particularly for bioaerosols. Bioaerosol fluxes may be estimated by measuring (1) the vertical gradients in bioaerosol concentration and a scalar property and (2) a direct flux of that scalar. In this case, we measure airborne DNA as the bioaerosol tracer and temperature and sensible heat flux as the scalar and associated flux. This study seeks to determine the magnitude of DNA fluxes using the modified Bowen ratio method, and to understand the seasonal and meteorological dynamics of DNA flux between the semi-arid grassland and the atmosphere. A pilot study in October of 2023 established a methodology and confirmed the feasibility of such a measurement. We took thirty uniform flux measurements in the spring, summer, and fall of 2024 and the winter of 2025 to produce a robust dataset that reflects the potential seasonality of bioaerosol flux. The flux results thus far have been generally positive in value, indicating that the grassland may be emitting bioaerosols into the atmosphere. In the spring, fluxes ranged from -98.4 to 1,054 pg DNA m^{-2} s^{-1} with a median flux of 25.7 pg m^{-2} s^{-1}; in the fall, fluxes ranged from -95.0 to 88.1 pg m^{-2} s^{-1} with a median flux of 17.6 pg m^{-2} s^{-1}. The lower median flux and smaller range of fluxes in the fall as compared to the spring suggest potential seasonality of DNA emissions. This data will provide insight into the mechanisms of bioaerosol emission, enable the modeling of aerobiome dynamics, and decrease uncertainty in bioaerosol abundance in the atmosphere.

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10BA.3

Air Microbiome Dynamics During the 2024 Boston Marathon. KATHERINE ARAYA, Vivian Tat, Sarah Alnemrat, Riley Watson, Madison Farnsworth, Justin Nguyen, Kostiantyn Botnar, Sean Kinahan, Shanna A. Ratnesar-Shumate, David Kimmel, Hema Narra, Christine Tomlinson, George Golovko, Kamil Khanipov, *The University of Texas Medical Branch*

Our air is a major medium for disease transmission, yet the dynamic ecosystem of microbial life that is present in the air — especially during mass gatherings— remains uncharacterized. We have collected aerosol samples from the 2024 Boston Marathon, a global event that attracted over 30,000 runners from more than 120 countries and approximately 500,000 spectators. *We hypothesized the Boston Marathon induces detectable shifts in the air microbiome including the presence of antimicrobial resistance (AMR) genes.* Aerosol samples before (N=4), during (N=4), and after (N=4) the marathon along the event route as well as background samples (N=7) were collected and analyzed to investigate the impact of mass human movement on the air microbiome. Bioaerosol samplers equipped with Teflon PTFE filter collected at a rate of 100 liters per minute for 24 hours at each location. DNA was extracted and isolated from the air filters using Zymo Biomics DNA miniprep kit and sequenced using Oxford Nanopore MinION P2Solo flow cell. Dorado super accurate model was used for basecalling. The workflow-metagenomics pipeline which utilized the core_nt database filtered at ≥90% identity to characterize the microbial community and presence of AMR genes. Results revealed significant differences in AMR gene presence in the air microbiome before versus after the marathon indicating an unhealthier environment for humans. The data strongly suggests that large-scale human movement in civilian mass events can disrupt airborne microbial ecosystems. The study's findings have significant implications for the development of early warning systems such as targeted nanopore air surveillance protocols and subsequent targeted interventions. Future work will focus on health outcome patterns linked to this mass gathering event and analytical frameworks to further support proactive biosurveillance in diverse contexts. All data and bioinformatic pipelines will be made publicly available.

10BA.4

Investigating the Role of Bioaerosols in Antimicrobial Resistance Transmission in Environmental Settings. NISHTHA CHAUHAN, Jillian Goodrich, Joe Brown, Freddy Soria, Olivia Ginn, *University of Georgia*

Antimicrobial resistance (AMR) is an escalating global health threat, driven by the persistence and dissemination of resistant microbial agents in various environmental reservoirs. Bioaerosols, microscopic airborne particles, serve as potential hotspots for AMR, facilitating the transmission of resistant genes across ecosystems and posing significant risks to human and environmental health. Our research spans diverse environmental settings, including field studies conducted in Bolivia, to assess microbial risks associated with AMR in both urban and rural contexts, considering the influence of geographical and socioeconomic factors. This study employs metagenomic analysis to investigate the presence, distribution, and diversity of AMR genes in airborne environments surrounding open wastewater canals and other sources of fecal contamination, characterising microbial communities and their resistance profiles across different environments. We collected both presumptive source media and aerosol samples and will compare the resistance profiles between paired samples using Nanopore short-read shotgun sequencing. Samples have been collected and extracted, while metagenomic analysis is ongoing. The analysis will explore the potential of bioaerosols as vectors for the transmission of resistant pathogens and assess how aerosolisation influences microbial kinetics related to resistance expressions. This study contributes to the global effort to monitor environmental reservoirs of infectious diseases and AMR, bridging gaps in current detection methodologies, risk assessments, and intervention approaches.

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10BA.5

Determining Bioaerosol Composition in Swine Production Facilities Through Next Generation Sequencing. PRADEEP KUMAR, Shalini Tiwari, Seyit Uguz, Zonggang Li, Jose Gonzalez, Yuanhui Zhang, Xufei Yang, *South Dakota State University*

Bioaerosols refer to airborne particles of biological origin, including bacteria, fungal spores, viruses, pollen grains, plant detritus, and insect fragments. Inside swine barns, bioaerosol concentrations can reach exceptionally high levels, posing significant health risks to both humans and animals. Understanding the microbial composition of these aerosols is critical for identifying their sources and developing cost-effective mitigation strategies. Despite rapid advancements in next-generation sequencing (NGS) technologies, no NGS-based studies on microbial composition in U.S. swine facilities have been published since 2014. In this study, air sampling ($PM_{2.5}$ and PM_{10}) was conducted in swine farms located in South Dakota and Illinois using personal cyclones with PTFE-coated glass fiber filters. In addition to air samples, potential source samples including feed, feces, skin, plant detritus, and settled dust were collected. DNA was extracted from all samples, and both 16S rRNA gene sequencing and shotgun metagenomic sequencing were performed using the Oxford Nanopore platform. Bioinformatic analyses were conducted using EPI2ME and other computational tools. The results revealed that Firmicutes was the most abundant bacterial phylum in indoor PM samples, consistent with previous studies. At the genus level, Clostridium and Streptococcus were predominant. 16S rRNA sequencing indicated that $PM_{2.5}$ and PM_{10} had nearly identical microbial compositions, which differed significantly from any of the potential source samples. Shotgun metagenomic sequencing provided greater taxonomic resolution and also detected the presence of fungi and viruses. Notably, this approach identified antibiotic resistance genes (ARGs) in PM_{10} samples. Several bacterial species, including members of the genera like Ruminococcus and Clostridium, were identified as potential ARG hosts through gene assembly and annotation. This study enhances our understanding of airborne biohazards in and around swine farms and highlights the potential for airborne transmission of antibiotic resistance. These findings are essential for guiding future source attribution efforts and prioritizing targeted mitigation strategies.

10BA.6

Evaluation and Characterization of Bioaerosols from Different Poultry House Environment of Naini, Prayagraj, India. HARISON MASIH, *SHUATS, (Allahabad) Prayagraj, Uttar Pradesh, India*

In the present scenario the poultry farms, chicken shops include the residues of feed, bedding, dust particles and bird's feathers. Poultry farming is a very common small scale industry in towns, rural and urban residential areas. It is a significant source of microbial airborne contamination, which may play an important role in spreading microbial infections, exacerbate the breathing and respiratory problem in the workers that has drawn attention on public health issues in the society, study was conducted from January - April, 2025. Sampling of bioaerosol was performed by passive air sampling method (settle plate method), from ten different areas of Naini, Prayagraj, including major air pollutants and weather conditions viz., Temperature, humidity, AQI and average $PM_{2.5}$, PM 10. NA and SDA plates were exposed in the indoor and outdoor areas for 15-30 minutes and plates were incubated at lab conditions for culture of bioaerosols. Viable microbial count was recorded and selected colonies were identified by gram's staining, Lacto-phenol and biochemical methods. Incidence of bioaerosols were observed from indoor and outdoor environment i.e., minimum 4062.80 and 4849.15 (CFU/m^3), maximum 7863.48 and 8125.60(CFU/m^3) and fungi minimum 2568.74 and 2752.22 (CFU/m^3) maximum 4508.40 and 4927.78(CFU/m^3). Microbes were characterized i.e., Gram negative and gram positive bacteria, yeasts, molds and Keratinophilic fungi like., Bacillus species, Staphylococcus spp. Aspergillus niger, Aspergillus fumegatus, Aspergillus flavus, Aspergillus spp., Alternaria spp., Candida spp., Cladosporium spp.,Chysosporium spp., Mucor spp., Penicillium spp., maximum bioaerosols were recorded in summer as compared with winter season. Higher concentration bioaerosol release endotoxins and Mycotoxins during decomposing of keratinous, organic substances and long term exposure of airborne microbial cells and spores causes the skin infections, allergic infections, asthma, respiratory infections and adverse impact on animals and human health.

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10CO.2

Tracing the Physico-chemical Evolution of Soot Primary Particles via Molecular Dynamics Simulations of Acetylene Pyrolysis. EVAN GVENTER, Khaled Mosharraf Mukut, Eirini Goudeli, Georgios A. Kelesidis, Somesh Roy, *Marquette University*

Soot is a carbonaceous particulate formed during combustion that poses significant environmental and public health risks. It is challenging to accurately characterize properties of soot due to the complexity of hydrocarbon combustion systems and the range of scales involved. This study is an extension of our previous exploration of chemical, physical, and morphological properties of soot primary particles using reactive molecular dynamics (MD) simulations of acetylene pyrolysis. Using the ReaxFF forcefield, a series of reactive MD simulations of acetylene pyrolysis were performed to capture the inception of soot primary particles. The primary particles thus obtained were then separated and put into a simulation box with more acetylene molecules in another set of reactive MD simulations to see how their characteristics change as they grow. Several different growth patterns of incipient particles at four different temperatures and densities were simulated. During this simulated growth process, each incipient soot primary particle grew from clusters of around 1400 carbon atoms to more than 4000 carbon atoms. An initial analysis reveals the growth of incipient particles takes place in stages – a stage of mass growth, usually in conjunction with an increase in aliphatic carbons, followed by a stage of chemical reorganization, where aliphatic carbons gradually form aromatic bonds. These observations indicate that primary particles appear to go through multiple mass accumulation and chemical restructuring periods as they mature. While the mass of the particles grew from around 17000 amu to more than 50000 amu, their radius of gyration grew from around 1.6 nm to 2.3 nm. During this process, the C/H ratio of the particles also increased, albeit slightly. This work indicates that during their growth, incipient soot particles go through a complex evolution of their physicochemical properties, providing valuable insight into the pathways of soot formation.

10CO.3

The Effect on Soot and its Gaseous Precursors of Trans-decalin Doping in a Laminar Non-Premixed, Ethylene-Fueled, Planar Mixing Layer Flame (PMLF). CHRISTIAN P. BJORK, Mahmoud K. Ashour, Evangelos K. Stefanidis, Scott W. Wagnon, Chiara Saggese, Francesco Carbone, *University of Connecticut*

Cyclo-alkanes can represent up to 40% of blends composing diesel and traditional Jet and Synthetic Aviation Turbine Fuels (JF and SATFs). SATFs are considered the path forward for reducing soot emissions and contrail formation from aviation propulsion. To properly predict the combustion and emission behaviors of real fuel blends, it is imperative to generate experimental databases highlighting the chemistry of each component class in the blend, with decalin isomers often being selected as cyclo-alkanes for surrogate mixtures mimicking real fuels. This study characterizes two Planar Mixing Layer Flames (PMLFs), one fueled by nitrogen-diluted ethylene, and another where 1500ppm of ethylene is replaced with trans-decalin. Conditions are selected so the flames have similar maximum temperatures, isolating the effect of doping. An important feature of PMLFs is that horizontal cross sections are self-similar and can be modeled as 1D Counterflow Flames (CFs) with low strain rates that are several millimeters thick. These advantages make them ideal for performing spatially resolved measurements without perturbations from sampling, necessary for the development and validation of chemical kinetic models. Laser Induced Emission Spectroscopy (LIES) and capillary sampling followed by GC/MS analysis resolve the horizontal profiles of soot volume fraction (f_v) and C0-C18 gaseous species, respectively. Elastic Laser Light Scattering (E-LLS) is used to find the 1D-CFs equivalent to the PMLF cross sections, and combined with LIES to quantify the E-LLS equivalent diameter of soot particles ($d_{6,3}$). Trans-decalin doping boosts the mole fraction of several aromatics, f_v increases by 25%, and $d_{6,3}$ grows up to 1.66x compared to the base ethylene PMLF. The size increase is attributed to a boost in soot coagulation ensuing nucleation enhancement caused by trans-decalin doping. The chemical kinetic model of Lawrence Livermore National Laboratory is used to model the experimental results and find areas of improvement for its predictive capabilities.

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10CO.4

Toxic Gas and Particle Emissions from the Pyrolysis of Spacecraft Materials. XIAOLIANG WANG, Bjoern Bingham, Salix Bair, Matthew Claassen, Marit Meyer, Claire Fortenberry, W. Patrick Arnott, John Watson, Judith Chow, *Desert Research Institute*

Fires are catastrophic to space activities. As mission durations increase, the chances of fire are likely to increase. In the sealed spacecraft environment, fire risks are greater than in most terrestrial locations because toxic gases and particles can quickly reach dangerous levels. Characterization of toxic pollutant emissions from fires is critical for the design of smoke detectors, respirators, fire extinguishers, and post-fire cleanup strategies. This study investigated the pyrolysis of four common spacecraft-relevant materials, including Kapton, polytetrafluoroethylene (PTFE), Teflon/Kapton/Teflon (TKT) wire insulation, and Velcro™. Multiple gases that would cause immediate concern for the health of the astronauts were detected. Kapton emitted high levels of carbon monoxide and hydrogen cyanide. PTFE and TKT emitted multiple toxic fluorine-based gases including carbonyl fluoride and hydrogen fluoride. Some of these gases had fluorination reactions with surfaces, which should be considered for surface corrosion protection and postfire clean-up procedures. Velcro™ had the highest $PM_{2.5}$ emission factor. Most particles were in the submicron size range, with mode diameter peaked in the 100–200 nm range. The particles were nearly electrically neutral, carrying <0.15 net elementary charges per particle, indicating that the natural charge level would not affect ionization smoke detector sensitivity. Organics dominate the chemical composition of the emitted particulate, and their speciation and toxicity effects warrant further research.

10CO.5

The Role of Black Carbon Emitted from Aircraft Engines as a Condensational Sink of Oil and Sulfur Particles. BENJAMIN A. NAULT, Andrew Freedman, Edward Fortner, Bruce Anderson, Steven Baughcum, Matthew Brown, Josh DiGangi, Francesca Gallo, Francisco Guzman, Jennifer Klettlinger, Kevin Sanchez, Michael Shook, Gregory Smallwood, Elizabeth Wiggins, Edward Winstead, Luke Ziemba, Richard Miake-Lye, Richard Moore, *Aerodyne Research, Inc.*

Black carbon (BC) emissions from aircraft engines have been studied due to its role as ice nuclei (IN) and its interactions with radiation. With advancements in aircraft engine technology, and the usage of sustainable aviation fuel (SAF), BC emissions have greatly reduced. An understanding of the role of other emissions from aircraft engines is needed as they may have different impacts towards IN potential. The emissions can include sulfur and oil, and depending on how they are emitted, the role of BC as a condensational sink (CS) may impact the observed emission ratios for these two particle classes. Here, we use observations collected from ground-based observations of aircraft emissions from the Boeing ecoDemonstrator project (2021 – 2023). During these tests, the emissions from a various combustor design in turbofan using different fuels were sampled on the NASA Langley Mobile Laboratory with various instruments to quantify the particle emissions, including an SP-AMS, a CAPS PMssa, and a heated SMPS for size distributions of non-volatile particles. We found that burning of Jet-A fuel led to a CS from BC of $\sim 3\times10^{-5}$ s^{-1} at the highest thrusts (>70%) on the staged lean-burn combustor; significantly less than observed on the "conventional" combustor. This led to a decrease in the normalized particle sulfate emission factor of 4 between the conventional and staged combustor engine approximately similar thrust values and nominally similar sulfur content. Burning the SAF fuel in the staged combustor decreased the CS by almost an order of magnitude to $\sim 4\times10^{-6}$ s^{-1}. This led to a decrease in particulate oil and sulfate emissions at the highest thrusts (>70%) by ~20% (sulfate) and ~10% to >100% (oil) than compared to burning Jet-A with the same engine. The impact of reduced CS for IN is being further evaluated.

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10CO.6

Dependence of Secondary Organic Aerosol Formation on Combustion Conditions in Simulated Prescribed Fires.

MUHAMMAD ABDURRAHMAN, Michael Caraway, Thomas Carroll, Kruthika Kumar, Anita Anosike, Nicholas Kusumo, Ariana Deegan, Ryan Poland, John Allen, Mac A. Callaham, Joseph O'Brien, Edward Fortner, Amanda Frossard, Geoffrey Smith, Rawad Saleh, *University of Georgia*

We examined the dependence of secondary organic aerosol (SOA) formation on combustion conditions for burns representative of prescribed fires, as part of the second Georgia Wildland Fire Simulation Experiments (G-WISE-2). Combustion experiments were performed using fuel beds that featured fine and woody surface fuels as well as a forest floor organic layer (often termed duff by fire managers) for select experiments. We created different combustion conditions by systematically varying surface fuel compactness, mass loading (250 g/m2 – 1500 g/m²), moisture content (5% - 30%), fuel bed area (0.5 m2 - 1.0 m²), and wind speed (0.5 m/s – 1 m/s). Emissions were aged in an oxidation flow reactor and characterized using a scanning mobility particle sizer (SMPS), a soot particle high-resolution aerosol mass spectrometer (SP-AMS), and a real-time VOC analyzer (AROMA-VOC). OH exposure, estimated via Toluene decay, indicated an equivalent atmospheric photochemical age of 4 to 6 days across all experiments. Results show a strong dependence of SOA formation on combustion conditions, quantified using fire radiative energy normalized by fuel-bed mass (FREnorm). SOA formation from burns involving only surface fuels increased with both fuel moisture content and mass loading but decreased as the fuel-bed area expanded. The highest SOA yields were observed under low-efficiency combustion conditions, particularly in burns containing duff and in compacted fuel beds, producing nearly an order of magnitude more SOA compared to burns with non-compacted surface fuels alone. Overall, our results reveal a strong inverse correlation between FREnorm and SOA formation. Specifically, inefficient combustion, marked by lower FREnorm, generates higher levels of SOA precursors leading to elevated SOA formation. These findings suggest that the large variability in SOA formation in biomass-burning emissions reported in the literature are in part due to differences in combustion conditions across different studies.

10IA.1

Understanding the Effect of Wildfire Smoke and Hvac Settings on Indoor Air Quality Using Networked Sensors.

FIONA HOPEWELL, Tristalee Mangin, Colin Schermerhorn, Kerry Kelly, *University of Utah*

Poor indoor air quality (IAQ) is associated with numerous adverse human health effects. Yet, it has been less frequently studied than outdoor air quality. We have been operating a 21-node IAQ network since 2023, and our initial studies suggested that wildfire smoke infiltration occurs more frequently in buildings with certain types of HVAC systems, specifically those that have air-side economizers. This study focuses on the summer of 2024 (May 15 to October 31) when six significant wildfire smoke events, where the outdoor AQ was above 30 ug/m^3, affected the University of Utah and each event ranged from 1 days to 7 days in length. It aims to further understand the impact of wildfire smoke on indoor $PM_{2.5}$ and CO_2 concentrations using the sensor network (17 indoor and four outdoor). The sensor locations are categorized into three building HVAC types: 1. variable air volume systems with a MERV 13 filter and an airside economizer, 2. dedicated outdoor air system with a MERV 13 filter, and 3. Window mini split air handling unit with MERV 8 filter. Our results showed that HVAC 1 had the highest indoor-to-outdoor $PM_{2.5}$ correlation and hourly average $PM_{2.5}$ concentrations compared to HVAC types 2 or 3. Additionally, we are working with the facilities management on a pilot program to evaluate the effectiveness of HVAC management strategies to mitigate $PM_{2.5}$ infiltration during wildfire smoke events.

Conflict of interest: Dr. Kelly has a financial interest in Tellus Networked Sensor Solutions, Inc., which commercializes environmental monitors.

Program Topics: Indoor Air: Sensors Driving Indoor Air Optimization

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10IA.2

Investigating the Impacts of Building HVAC Systems on Aerosol Composition and Concentration in Different Seasons. XINXIU TIAN, Benjamin A. Nault, Bryan Berman, Bryan Cummings, Shannon Capps, Michael Waring, Peter F. DeCarlo, *Johns Hopkins University*

This work investigates how aerosols change in concentrations and chemical composition as they move through heating, ventilating, and air-conditioning (HVAC) systems in different seasons. In indoor spaces lacking strong emissions, outdoor-originated aerosols are the main contributor to aerosols observed indoors. Upon transport to the indoor environment through building HVAC systems, outdoor aerosol concentrations and chemical composition are modified due to filtration and air temperature control (heating or cooling), especially when the indoor-outdoor temperature gradient is substantial. To investigate the impact of a modern HVAC systems on outdoor to indoor transport of aerosols, measurements were conducted in a new HVAC system on the Johns Hopkins University Campus in Baltimore, MD during November 2021 and July 2023. During both measurement periods, the instrumentation sampled air from a valve-switching system pulling from four zones inside of the HVAC system: 1) return air, 2) mixed air where outdoor air is mixed with returned indoor air, 3) post filter and heating coil, and 4) supply - post cooling coil. We measured the concentration and chemical composition of particulate matter, gases, temperature, and relative humidity using a variety of instruments including 1) high-resolution time-of-flight aerosol mass spectrometer (HR-Tof-AMS), 2) scanning mobility particle sizer (SMPS), 3) three PICARRO gas concentration analyzers measuring CH_4, CO, CH_2O, CO_2, NH_3, and 4) Quant-AQ MODULAIR. Results from this study demonstrate that the primary source of PM in the building originates outdoors. Positive Matrix Factorization on the organic component of the aerosol indicated 4 different sources in winter and 5 different sources in summer. The identified factors changed in relative concentration as they passed through the HVAC system. The results suggest that the filtration efficiency of the MERV filters in the HVAC varied for different species in different seasons, and the installed filters did not achieve the expected filtration levels in both seasons.

10IA.3

Impact of Wildfire Smoke on HVAC Filter Performance and Indoor Air Quality. SHIBO WANG, Qisheng Ou, Dongryul Park, Keonwang Lee, Hyungho Park, David Y. H. Pui, *University of Minnesota*

Introduction:
As wildfires increase in frequency and intensity across many regions, their emissions pose a growing and serious threat to indoor air quality (IAQ), particularly in buildings that rely heavily on mechanical ventilation systems. HVAC filters are widely used to remove airborne particles and are often the primary defense against outdoor pollution. However, existing filtration standards—such as ASHRAE 52.2 or ISO 16890—are based on standardized test aerosols like potassium chloride or DEHS, which do not reflect wildfire smoke's physical or chemical complexity. Wildfire-derived aerosols are typically composed of fine soot, sticky tar-like agglomerates, and semi-volatile organic compounds, all of which may interact with filter fibers in ways that compromise filtration efficiency. A clearer understanding of filter aging under wildfire exposure is urgently needed to assess indoor exposure risks and inform public health guidance and building operation strategies during smoke events.

Method
This study evaluated the performance of three commercially available MERV-13 HVAC filters under multiple particle loading scenarios. Laboratory experiments were conducted using smoldering wood smoke, potassium chloride (KCl), and DEHS oil aerosols. In parallel, field tests were performed during prescribed burns in savanna environments to capture real wildfire smoke loading. Filtration efficiency for 300 nm particles—a representative submicron size—was continuously monitored as a function of cumulative loading mass (mg/cm²). Scanning electron microscopy (SEM) was employed to assess surface morphology changes and observe fiber-particle interactions. Based on the measured degradation behavior, a dynamic mass balance model was constructed, incorporating η as a function of loading mass, to simulate indoor $PM_{2.5}$ concentrations under a range of conditions including varying outdoor smoke concentrations, HVAC runtimes, and infiltration rates. Scenarios with and without portable air cleaners were also simulated to explore mitigation strategies.

Results
Filters that relied primarily on electrostatic capture mechanisms showed rapid degradation in filtration efficiency under wildfire smoke exposure, especially when loaded with smoldering or flaming smoke. In contrast, filters with greater mechanical filtration capacity demonstrated more stable performance over time. SEM analysis revealed progressive surface coverage by oil-like droplets, consistent with charge neutralization effects and reduction in active filtration sites.

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Field-collected filters exhibited similar droplet accumulation and fiber coverage patterns, validating the laboratory-generated smoldering smoke as a realistic proxy for real-world loading. Simulation results showed that under severe wildfire smoke conditions (e.g., 200 µg/m³) and continuous HVAC operation, indoor $PM_{2.5}$ concentrations could exceed 90–120 µg/m³ within a few days—far above WHO and EPA recommended exposure limits. Filter lifespan was shown to decrease from 60 days to under 5 days under such conditions. However, simulations also demonstrated that improving natural particle decay—such as by using portable air cleaners—could reduce indoor concentrations by more than 50 percent.

Conclusions
Wildfire smoke causes accelerated degradation of HVAC filter performance due to sticky particle deposition and electret charge loss. This degradation significantly increases indoor $PM_{2.5}$ levels, even in buildings with active filtration. Experimental and modeling results suggest that replacement strategies and IAQ mitigation approaches must be adapted to account for the realities of wildfire aerosol behavior and loading. Conventional test methods may underestimate these effects and should be reconsidered in light of wildfire-specific risks.

10IA.4
Investigating the Particulate Matter and CO_2 Relationship During Wildfire and Prescribed Burn Smoke Events. C. VICTORIA MCCRARY, Sara Jones, Perry Hystad, Molly Kile, Parichehr Salimifard, *Oregon State University*

Wildfire smoke is detrimental to occupant health. Ventilation and air cleaning can help maintain and improve indoor air quality (IAQ). Carbon dioxide (CO_2) is used as an IAQ proxy for occupancy and ventilation rate, with CO_2 monitoring employed for ventilation control. This practice implies that PM could be controlled by maintaining CO_2 levels. However, it is unclear whether the relationship between CO_2 and PM is consistently correlated. Therefore, we used linear regression to assess the validity of using CO_2 as a reliable proxy for PM using data collected at a preschool located in Southern Oregon that experiences frequent wildfire smoke events. PM (µg/m³) and CO_2 (ppm) were measured using collocated low-cost (PurpleAir PA-I and PA-II) and mid-cost (IC Sentinel) sensors. We placed these sensor pairs in three different rooms at the preschool: a classroom with a window air conditioning unit, a classroom with mechanical ventilation, and a staff room with a mini-split and heat recovery ventilation. We selected consecutive workdays that captured comparable occupancy and scheduling before, during, and after smoke events. Preliminary results indicated that PM concentrations varied significantly between wildfire smoke and non-wildfire smoke days. CO_2 concentrations notably fluctuated between days and rooms. The interaction between PM and CO_2 displayed different patterns each day, with smoke days exhibiting a more consistent pattern than non-smoke days. We intend to conduct additional analysis that examines different PM size ranges to explore how the particle size fraction is affected by the PM and CO_2 relationship, explore different mechanical ventilation types across schools, and quantify the correlations using statistical analysis.

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10IA.5

Mass Balance Model for Estimating Indoor and Outdoor Contributions to Residential $PM_{2.5}$ and Indoor-Generated $PM_{2.5}$ Composition Profile. YIXIANG WANG, James Schauer, Marilyn Black, Michael Bergin, Junfeng Zhang, Linchen He, *College of Health, Lehigh University*

As individuals spend the majority of their time indoors, indoor air pollution—particularly fine particulate matter ($PM_{2.5}$)—plays a substantial role in overall personal exposure. Indoor $PM_{2.5}$ originates from both outdoor infiltration and indoor activities, and distinguishing their respective contributions is critical for effective exposure mitigation and air quality management.

We conducted a field study in 43 residences in Shanghai, where 48-hour $PM_{2.5}$ samples were collected simultaneously indoors (bedrooms) and outdoors under two controlled conditions. In the "True Filtration" scenario, a portable air purifier equipped with coarse, HEPA, and activated carbon filters was used. In the "Sham Filtration" scenario, the same device was fitted with only a coarse filter. To isolate infiltration from outdoor air, windows remained closed throughout both sampling periods.

Collected $PM_{2.5}$ samples were analyzed for mass concentration and chemical composition, including organic matter (OM), elemental carbon, metals, and other trace elements. A mass balance model was applied to quantify indoor source contributions and derive the emission composition profile.

Results showed that indoor sources were responsible for 60±26% of total indoor $PM_{2.5}$ under True Filtration and 63±17% under Sham Filtration. Organic matter was the predominant indoor-generated component, contributing 69% during Sham Filtration and rising to 92% during True Filtration. The OM fraction was remarkably consistent across households, with strong linearity observed in both filtration settings (R^2 = 0.97–0.98).

These findings demonstrate the model's versatility across diverse indoor environments and highlight its potential to enhance our understanding of indoor $PM_{2.5}$ exposure and source characteristics, providing a foundation for more targeted air quality interventions.

10IA.6

Advancing Approaches to Estimate Deposition Loss Rate Constants and Penetration Factors for Fine and Ultrafine Particles into Residences. SAEED FARHOODI, Haoran Zhao, Mohammad Heidarinejad, Brent Stephens, *Illinois Institute of Technology*

Much of human exposure to fine and ultrafine particulate matter of outdoor origin occurs inside buildings, particularly in residences. The penetration factor of those pollutants through leaks in a building's exterior enclosure assembly is a key parameter that governs their infiltration and persistence. However, experimental data for particle penetration factors in real buildings remain limited. In previous studies, we have sought to improve methods to measure envelope penetration factors for $PM_{2.5}$ and ultrafine particles (UFPs) in residences under infiltration conditions, but have been constrained by challenges in accurately estimating indoor deposition loss rate constants, which are key to informing estimates of penetration factors. Here we revisit data collected from 22 existing homes in Chicago, IL USA in which an instrumentation system that combined a scanning mobility particle sizer and optical particle sizer connected to an automatic switching system was deployed alongside a procedure to naturally elevate indoor concentrations near ambient levels and allow concentrations to decay towards background levels to allow for estimating loss rate constants and penetration factors from the resulting time-resolved data. The method was originally deployed in a variety of both single-family and multi-family homes with a range of vintages and building envelope characteristics (e.g., airtightness), as well as in a subset of homes before and after energy efficiency retrofits (e.g., air sealing and insulation). In revisiting this dataset, we have developed an algorithmic searching method to systematically scan potential values for initial and background (i.e., peak and valley) concentrations and identify likely values and ranges for deposition loss rate constants, which are then used in estimation of penetration factors using a regression approach with a discretized mass/number balance on indoor particles of outdoor origin. When applied to a total of 34 home visits with a mean (SD) estimated air change rate of 0.47 (0.40) per hour, preliminary estimates of mean (SD) total indoor loss rate constants (deposition + air change rate) were 0.65 (0.25) per hour for $PM_{2.5}$ and 1.03 (0.40) per hour for total UFPs, and mean (SD) penetration factors were 0.75 (0.52) for $PM_{2.5}$ and 0.68 (0.36) for total UFPs. Failure rates to resolve both parameters were on the order of approximately 20%.

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10SA.1

Characterization of Aerosol Types Using a 2D Angstrom Exponent Approach Across Multiple Sites. ASTA GREGORIČ, Matic Ivančič, Irena Ježek Brecelj, Gašper Lavrič, Bálint Alföldy, Albert Presto, Amalia Muñoz, Mila Ródenas, Luca Ferrero, Luca D'Angelo, Martin Gysel, Benjamin Brem, Marco Pandolfi, Jordi Rovira, Nikolaos Mihalopoulos, Panagiotis Kalkavouras, Tuukka Petäjä, Lauri Ahonen, Tobias Hammer, Konstantina Vasilatou, Martin Rigler, *Aerosol d.o.o.*

Aethalometers (AE33, AE36, AE36s, Aerosol Magee Scientific) are widely used to measure equivalent Black Carbon (BC) concentrations and source apportionment (SA), based on the absorption Ångström exponent (AAE) typically calculated from two wavelengths (470–950 nm). This method distinguishes BC from solid (biomass burning) and liquid fuel (fossil fuel – traffic related) combustion and is a well established source apportionment method for urban aerosol. However, aerosol absorption spectra often show complex features, particularly in the UV-visible range, that deviate from a single power-law model. These features are influenced by organic chromophores like Brown Carbon (BrC), whose absorption varies widely with chemical composition, photochemical aging, and mixing state with BC. Mineral dust and interactions with Aethalometer filter material also affect AAE measurements.

To improve source discrimination, we conducted measurements across several urban and remote locations from 2023 to 2025 using a 9-wavelength AE36s Aethalometer (340–950 nm), complemented by laboratory experiments with controlled aerosol sources. The AAE was analyzed in two spectral bands: $AAE_{590–950}$ and $AAE_{400–590}$, enabling differentiation between distinct absorption signatures.

Results show that traffic-related BC exhibits low AAE in both ranges, with minor spectral deviations due to transparent coatings. An increase in $AAE_{400–590}$ indicates rising BrC contributions, allowing distinction between urban aerosols and fresh biomass-burning plumes. Saharan dust events were clearly separated by high $AAE_{400–590}$ and consistently low $AAE_{590–950}$ values.

This 2D AAE approach refines source apportionment in urban settings, improves detection of special events like Saharan dust intrusions, and allows for case-specific absorption coefficient corrections for improved accuracy in atmospheric assessments.

10SA.2

A Comprehensive Study of Particulate Matter (PM) in the Eastern Coachella Valley (ECV) Community: Mass Closure and Comparisons between Time Integrated Sampling and Real-Time Continuous Monitoring Data. JOSEPH SALAZAR, Yumeng Cui, Julia Montoya-Aguilera, Christopher Lim, Mohammad Sowlat, Steven Boddeker, Freyja Berg Lopez, Laura Saucedo, Cynthia Berg, Angela Haar, Stephen Dutz, James Rothchild, Eric Holden, Sina Hasheminassab, Matic Ivančič, Martin Rigler, Payam Pakbin, Andrea Polidori, Jason Low, *South Coast Air Quality Management District*

The enactment of Assembly Bill (AB) 617 by the California legislature and establishment of the Community Air Protection Program (CAPP) by California Air Resources Board (CARB) provided the opportunity for the South Coast Air Quality Management District (South Coast AQMD) to address air quality issues in communities that are disproportionately impacted by air pollution. Eastern Coachella Valley (ECV) is an AB 617-designated community in the Salton Sea Air Basin that is impacted by several sources of particulate matter (PM), including desert and Salton Sea playa dust, agricultural burning, and motor vehicles. South Coast AQMD developed and implemented a comprehensive study from January 2022 through May 2023 to better characterize PM/dust and identify its sources and origins in the area. This campaign relied on a combination of time-integrated PM sampling techniques and time-resolved measurements by continuous monitors to fully characterize physical characteristics (size, shape, and morphology) and chemical composition (i.e., carbonaceous compounds, trace metals, and ions) of the PM/dust in this area.

This is part of two accompanying abstracts submitted to report on the results from this campaign. In this presentation, we will evaluate mass closure and chemical agreement between time-integrated and real-time PM_{10} measurements collected side-by-side at a school located in a residential neighborhood within ECV. Reconstructed mass (Σ ions + elements + OMC + EC) was compared to PM_{10} Mass for closure analysis. Mass-closure calculations were performed independently for each platform; seasonal composites were then compared to identify systematic biases and source-specific discrepancies. Results show that estimated reconstructed mass varied appreciably with season. Continuous monitors and time-integrated method generally under-predicted gravimetric mass. Despite these offsets, both approaches captured coherent temporal trends and similar elemental profiles, indicating that five major PM_{10} contributors—natural dust, chlorine-rich sources, Salton Sea emissions, agricultural/industrial activity, and secondary aerosol that drive PM_{10} dynamics in ECV.

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10SA.3

Improving Characterization of Cooking Organic Aerosols (COA) via Novel Source Apportionment Analysis of HR-ToF-AMS. ASHUTOSH KUMAR SHUKLA, Wenqing Jiang, Qi Zhang, *University of California, Davis*

Positive matrix factorization (PMF) is widely applied to high-resolution time-of-flight aerosol mass spectrometry (HR-ToF-AMS) data to identify PM pollution sources. However, traditional PMF on full organic data often struggles to resolve complex sources such as cooking, particularly in areas where multiple anthropogenic sources are extensively mixed. Cooking organic aerosols (COA) are increasingly recognized as a significant component of urban particulate pollution. Despite their importance for public health and regulation, cooking emissions remain difficult to resolve due to compositional and temporal similarity to other sources.

In this study, we present a novel and rigorously validated source apportionment (SA) approach to improve the resolution of COA using PMF and HR-ToF-AMS. Data were collected during a winter 2023–2024 field campaign in Fresno, located in California's San Joaquin Valley (SJV)—one of the most polluted regions in the United States. Instrumentation included a HR-ToF-AMS and a chemical ionization mass spectrometer (CIMS) equipped with a Filter Inlet for Gases and AEROsols (FIGAERO). We applied PMF to full organic matrix (PMF_{Full}), as well as separately to hydrocarbon ions (PMF_{CH}) and remaining oxygenated ions (PMF_{Oxi}).

This approach successfully resolved a distinct COA factor along with multiple other OA sources from biomass burning and vehicular emissions. These sources exhibited substantial overlaps with COA, particularly during nighttime, reflecting increased emissions from cooking, residential wood burning, and traffic, combined with the reduced boundary layer height typical of winter conditions in the SJV. It was also supported by CIMS measurement which identified fatty acid species – key molecular markers of cooking emissions. On average, COA contributed approximately 10.6% to OA mass, emphasizing its significance as a major primary PM source in the region. This study demonstrates an advanced SA strategy that improves COA characterization through novel analysis of HR-ToF-AMS data, enabling clear resolution of complex emission sources in polluted urban environments.

10SA.4

Source Apportionment of Organic Aerosol Informed by ASCENT Instrumentation at Look Rock, Great Smoky Mountains National Park. NICOLAS A. BUCHENAU, Cade Christensen, James Renfro, Bill Hicks, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Nga Lee Ng, Jason Surratt, *University of North Carolina at Chapel Hill*

The Atmospheric Science and Chemistry Measurement Network (ASCENT) site in Look Rock, Great Smoky Mountains National Park is intended to characterize the aerosol typical of the rural Southeastern United States and is located between sources of biogenic and anthropogenic emissions. Deployment of ASCENT instrumentation to Look Rock, especially the time-of-flight aerosol chemical speciation monitor (TOF-ACSM, Aerodyne Research Inc.) has demonstrated the predominance of organic aerosol within $PM_{2.5}$ at the site, which occurs in the context of a long-term decline in sulfate aerosol. Understanding the origins of organic aerosol at Look Rock may shed light on aerosol formation processes contributing to much of the background aerosol found in the rural Southeastern United States. Source apportionment of TOF-ACSM organic mass spectra using positive matrix factorization (PMF) is used to characterize organic aerosol (OA) types at Look Rock in 2024. The additional ASCENT instrumentation, the Aethalometer AE33 (Magee Scientific), Scanning Mobility Particle Sizer (SMPS, TSI Inc.), and Xact 625i (Sailbri Cooper Inc.) provide additional context on aerosol physical and chemical properties to aid in interpreting TOF-ACSM source apportionment results. Source apportionment of 2024 ASCENT Look Rock data are compared against prior source apportionment studies which analyzed data collected at Look Rock in 2013. PMF analysis reveals the presence of hydrocarbon-like organic aerosol (HOA) in 2024, a component of OA previously unobserved in 2013. In addition, PMF of 2024 data confirms the continued presence of biomass burning aerosol, isoprene-derived secondary organic aerosol (SOA), and oxidized SOA.

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10SA.5

Long-Term Source Apportionment at 12 Sites in the Western United States from 2000-2020. KAMALJEET KAUR, Jenna Krall, Cesunica Ivey, Heather Holmes, Kerry Kelly, *University of Utah*

Long-term source attribution is essential for evaluating the effectiveness of PM 2.5 reduction strategies. However, inconsistencies in chemical speciation methodologies over time present challenges in assessing source contributions. This study addresses these issues by combining Positive Matrix Factorization and Chemical Mass Balance to characterize PM 2.5 sources over a 20-year period (2000–2020) across 12 monitoring sites in five western U.S. states: Utah (Bountiful, Hawthorne, Lindon), California (Fresno, Bakersfield, Modesto, Visalia, Sacramento), Nevada (Reno, Las Vegas), Idaho (Boise), and Colorado (Commerce City). Between five and eight distinct source factors were identified at each site, including secondary ammonium nitrate (AN), secondary ammonium sulfate (AS), dust, chloride, organic carbon (OC)-rich, elemental carbon (EC)-rich, EC-Cu-rich, Cl-Zn-rich, and aged sea salt. Across most sites, PM 2.5 concentrations declined significantly, with annual reductions ranging from -0.38 to -0.037 μg/m³ per year, except in Boise and Commerce City. Reductions in AN, AS, EC-rich, and EC-Cu-rich contributions reflect the impact of national regulations targeting mobile, point, and area sources, leading to decreased emissions of NO_x, SO_2, and primary PM 2.5 . Despite increases in vehicle miles traveled (VMT), declining EC-rich (vehicle-related) concentrations at most sites (-0.099 to -0.028 μg/m 3 per year) highlight the benefits of reduced per-vehicle emissions. OC-rich concentrations, particularly in winter and associated with biomass burning, showed the most substantial seasonal declines (-0.238 to -0.045 μg/m³ per year), pointing to the effectiveness of local and national efforts to reduce residential wood combustion. In contrast, dust contributions generally increased (0.00067 to 0.024 μg/m³ per year), likely driven by growing regional aridity and VMT. These results demonstrate the long-term success of air quality policies in lowering PM 2.5 concentrations, while also highlighting emerging challenges such as dust.

10SA.6

Source Apportionment of Sulfate Aerosol at the ASCENT Cheeka Peak Observatory Site. OLIVIA HAKAN, Odelle Hadley, Courtney Winck, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Nga Lee Ng, Joel A. Thornton, *University of Washington*

Cheeka Peak Observatory (CPO) is a remote atmospheric measurement field site located on the Olympic Peninsula of Washington, roughly 75 miles from the nearest city of Port Angeles and less than 5 miles from the Pacific Ocean. As part of the Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT), the site is equipped with an aerosol chemical speciation monitor (ACSM), an aethalometer (AE33), an Xact multi-metals monitor (Xact 625i), and a size mobility particle scanner (SMPS) to measure aerosol concentration and composition in near-real time. These instruments measure non-refractory mass loading and composition, light-absorbing particle concentration, concentrations of 46 different elements, and the total particle number concentration and size distribution, respectively. With low wintertime average concentrations of 0.17 μg m-3 organics, 0.03 μg m-3 sulfate, 0.04 μg m-3 nitrate, 0.05 μg m-3 ammonia, and 0.01 μg m-3 chloride at CPO, it is often possible to identify episodic events with relatively low concentration perturbations and analyze their potential sources. Here we analyze speciated aerosol data collected by the ACSM to characterize sulfate sources in the remote Pacific Northwest over several months during the 2023-2025 time period. In this analysis, we have identified several major events, including transported biomass burning from wildfires across the US and Canada, and long-range transport of volcanic sulfate plumes from Kamchatka across the Pacific Ocean. Additionally, we use positive matrix factorization (PMF, SoFi) to apportion the aerosols into distinct sources over several month-long periods of data collection. During this time, we have also observed impacts from maritime vessel traffic, marine-originating methanesulphonic acid, and new particle formation.

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11AA.1

Recent Progress on Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT): Advanced, Ground-based Aerosol Measurement Network Across the U.S. NGA LEE NG, Roya Bahreini, Ann M. Dillner, Armistead G. Russell, Richard Flagan, James Flynn, Drew Gentner, Robert Griffin, Lelia Hawkins, Jose-Luis Jimenez, Jingqiu Mao, Shane Murphy, Albert Presto, Sean Raffuse, Allen Robinson, John Seinfeld, Jason Surratt, Joel A. Thornton, *Georgia Institute of Technology*

The Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT) is a new comprehensive, high time-resolution, long-term monitoring network in the U.S. for characterization of aerosol chemical composition and physical properties. ASCENT consists of a network of 12 advanced aerosol measurement sites across the country, leveraging existing monitoring locations and facilities. Each site is equipped with a suite of advanced aerosol instrumentation, including an Aerosol Chemical Speciation Monitor (ACSM, non-refractory aerosols, $PM_{2.5}$), an Xact (trace metals, $PM_{2.5}$), an Aethalometer (aerosol light absorption, black and brown carbon, $PM_{2.5}$), and a Scanning Mobility Particle Sizer (SMPS, aerosol number size distribution and concentration, PM1). All ASCENT sites were operational and sampling as of May 2024. We will present an overview of intercomparisons of ASCENT instrument measurements across different sites, including comparisons with collocated $PM_{2.5}$ data from other monitoring networks. Analysis of SMPS and chemically-speciated $PM_{2.5}$ measurements facilitates evaluation of the fraction of $PM_{2.5}$ mass concentration that is in PM_1 in urban, rural, and remote locations. While organic aerosols dominate $PM_{2.5}$, source apportionment analysis at select sites reveal diversity in organic aerosol composition and sources, with differing impacts from biogenic emissions, anthropogenic activities, and widespread influence of biomass burning emissions. Updates on the development of the data infrastructure will also be provided, including accessibility to different data levels such as real time raw data, near real time data with automated quality control, and annual validated data. The high time-resolution, speciated aerosol measurements at ASCENT sites have provided new insights into the characteristics of aerosols in diverse geographical regions and facilitated collaborative studies across academia, industry, and government. We welcome new collaborative opportunities leveraging the ASCENT infrastructure to advance our understanding of aerosol sources and properties and their impacts on air quality and health.

11AA.2

Validation of In Situ Size-Resolved Composition Model from the 2023 AEROMMA Airborne Field Mission Against Ground-Based and Remote Sensing Aerosol Optical Measurements. HAN N. HUYNH, Adam Ahern, Charles Brock, Ming Lyu, Samuel Taylor, Xiaoli Shen, Justin Jacquot, Daniel Cziczo, Alison Piasecki, Ann M. Middlebrook, Sarah Albertin, Daniel Murphy, Glenn Diskin, Charles K. Gatebe, Johnathan Hair, *CU-CIRES/NOAA CSL*

One of the primary objectives of the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) 2023 field mission was to measure aerosol and trace gas properties to help evaluate and improve the satellite products of the Tropospheric Emissions: Monitoring of pollution (TEMPO) instrument. There was a comprehensive suite of aerosol instruments on the NASA DC-8 aircraft, including measurements of aerosol size distribution (3 nm–50 µm), aerosol chemical composition (from both single particle and aerosol mass spectrometers), and aerosol optical measurements over the UV-Vis wavelengths. The DC-8 aircraft also performed multiple vertical profiles that provided important points of comparison between the *in situ* and remote sensing measurements including satellite retrievals, such as direct comparison of column-integrated aerosol optical depth (AOD) and aerosol layer height.

We will give a brief overview of our complete aerosol profile constructed from combining the *in situ* aerosol microphysical, chemical, and optical measurements with a special focus on East Coast urban flights over Toronto, New York, and Chicago. The size-resolved aerosol composition and vertical profile provides key atmospheric features of these urban cities, including the wildfire smoke events in July-August 2023. Including sensitivity analyses of collocation of the following three modes of aerosol measurements, the *in situ* observation-derived AODs were validated against AOD values derived from both (1) ground-based measurements (e.g., Aerosol Robotic Network, AERONET) and (2) remote sensing measurements onboard a NASA G-V aircraft with a down-looking, high-spectral-resolution lidar (HSRL) that was operated in patterns in the vicinity. In addition, these active remote sensing measurements at ambient RH conditions were compared to the extinction vertical profile at ambient RH derived from our dry, *in situ* aerosol measurements onboard the DC-8. The AEROMMA *in situ* composition and size distribution data can provide direct validation of the accuracy of and underlying assumptions of aerosol retrievals from AERONET and HSRL. Overall, our observation-based aerosol profile yielded AOD values within 10% of reported HSRL AODs – a remarkably close agreement in part due to their excellent collocation. Because of the unavailability of many close AERONET sites to DC-8 spiral locations, AERONET AODs are on average about 2x higher than both observation-based AODs and HSRL AODs. The results from this ongoing study will provide the bases for future validation against aerosol data products from the TEMPO satellite as they become available.

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11AA.3

Temperature Dependence of Gas-Phase Precursors of Secondary Organic Aerosol During Summertime in New York City. MIA TRAN, Mitchell Alton, Anita Avery, Minguk Seo, Jo Machesky, Taekyu Joo, Manjula Canagaratna, Jordan Krechmer, Andrew Lambe, Drew Gentner, *Yale University*

Fine mode particulate matter ($PM_{2.5}$) is an important criteria pollutant with significant health impacts. Approximately 80-83% of $PM_{2.5}$ is organic aerosol, 73-76% of that is secondary organic aerosol (SOA), which is formed via the chemical processing of anthropogenic and biogenic emissions of gas-phase organic compounds in the atmosphere. Previous $PM_{2.5}$ measurements in New York City have demonstrated that there is a positive correlation between SOA concentration and ambient temperature, emphasizing the importance of better understanding the influence of temperature on reactive volatile organic compound (VOC) precursor emissions in the context of increasing temperatures and more frequent heat waves. To quantify and further understand the temperature dependence of VOC precursors and their sources in NYC, a suite of VOCs, as well as intermediate volatility organic compounds (IVOCs) and semi-volatile organic compounds (SVOCs), were measured using proton transfer reactor-time of flight mass spectrometry (PTR-ToF-MS) during the NYC-METS (New York City metropolitan Measurements of Emissions and TransformationS) ground campaigns of summer 2022 and 2023. These intensives were associated with the larger AEROMMA (Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas) and AGES+ (AEROMMA+CUPiDS, GOTHAAM, EPCAPE, STAQS) collaborative projects. PTR-ToF-MS data was collected at 4 Hz alongside temperature, wind speed, and wind direction data with a collocated sonic anemometer. The high temporal resolution and broad scope of compounds measured was used to examine temperature dependencies for a diverse range of compounds, while also considering other influential variables, such as population density, source distributions, meteorology, and photochemistry. Additionally, source apportionment via positive matrix factorization (PMF) was performed to identify source factors and their temperature dependence for comparison to individual VOCs.

11AA.4

Non-Tailpipe Emissions from Ambient and Laboratory Measurements: Commonalities in Environmentally Persistent Free Radicals, Reactive Oxygen Species and Oxidative Potential of Brake Wear, Tire Wear and Road Dust. SUKRITI KAPUR, Kasey Edwards, David Herman, Madeline Cooke, Adam Thomas, Tsuyoshi Ito, Hiroyuki Hagino, Junichi Hosoya, Tazuko Morikawa, Lisa Wingen, Véronique Perraud, Andrea De Vizcaya Ruiz, Michael Kleinman, James Smith, Barbara Finlayson-Pitts, Manabu Shiraiwa, *University of California, Irvine*

Non-tailpipe emissions, make up an important but understudied class of vehicular pollutants. Due to lack of regulations, emissions from non-tailpipe sources, primarily brakes, tires and resuspended dust are on the rise. As non-tailpipe emissions continue to rise, it becomes increasingly important to understand their health implications and oxidative potential. We studied environmentally persistent free radicals (EPFRs), reactive oxygen species (ROS), and oxidative potential (OP) of $PM_{2.5}$ collected near freeways in Santa Ana (I-5) and Long Beach (I-710), comparing them to laboratory- generated brake wear particles (BWPs), road dust, and tire tread (fresh and used). Our results show a strong correlation among non-tailpipe markers in the field samples, highlighting contribution of NEE to $PM_{2.5}$ near freeways. EPFRs in fresh tire tread were found to be comparable to ambient levels, and higher than in road dust. EFPRs from used tire tread showed highest value out of all samples (2.38 ± 0.73 pmol μg^{-1}), likely due to photoaging of tire tread. BWPs and fresh tire tread formed hydroxyl radicals exclusively in aqueous phase, while ambient PM generate carbon-centered radicals and hydroxyl radicals. Three different brake wear PM_{10} with varying copper content (0.8-6.4%) showed that a higher copper content leads to higher ROS and oxidative potential with dithiothreitol (DTT) activity. These results have important implications for understanding health effects from vehicular non-tailpipe sources.

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11AA.5

Reactivity of Brake Wear Particles: Reactive Oxygen Species Generation by Fresh Emissions and Iron Solubilization during Atmospheric Processing. JENNY P.S. WONG, Amelia K. Williams, Gloria G. Simmons, *Mount Allison University*

As vehicle electrification reduces tailpipe emissions, non-tailpipe sources such as brake wear particles (BWP) are expected to dominate traffic-derived particulate matter. Despite their growing importance, the health impacts of BWP, via reactive oxygen species (ROS) production, and the effects of atmospheric processing remain poorly understood.

This laboratory study investigates two aspects of BWP reactivity using particles generated to simulate mechanical wear from a semi-metallic brake pad: 1) the production of ROS by soluble and insoluble components of fresh BWP, and 2) the impact of aqueous atmospheric processing on iron solubility, as iron can drive Fenton(-like) reactions that generate ROS. Results indicate that both soluble and insoluble components contribute to ROS production, with the insoluble fraction dominating. This contribution is likely driven by surface-mediated reactions, as suggested by differential ROS production across size fractions of fresh BWP. Upon aqueous-phase processing, partial and fast conversion of insoluble to soluble iron was observed. Collectively, these findings demonstrate that the oxidative potential, and thus health impacts, of BWP evolve with atmospheric age, as changes in metal solubility alter the relative contributions of soluble and insoluble components involved in ROS production.

11BA.1

Towards Accurate Real-Time Bioaerosol Monitoring. KONSTANTINA VASILATOU, Christina Giannakoudaki, Reto Abt, Kevin Auderset, Benoit Crouzy, Sophie Erb, Ahmed Oguzhan Erdogdu, Elias Graf, Kenjiro Iida, Gian Lieberherr, Hiromu Sakurai, Julia Schmale, Christian Wälchli, Stefan Horender, *METAS Federal Institute of Metrology*

Bioaerosols are ubiquitous in the atmosphere, but their concentration and composition can vary significantly in time and by location. They can act as cloud condensation nuclei and ice nuclei, influencing the hydrological cycle and climate. Moreover, information on bioaerosols can underpin ecology studies on vegetation shifts and invasive species and is also crucial for agriculture and forestry, where real-time data about the presence of pathogens are necessary for protecting agricultural production.

For more than sixty years, bioaerosol monitoring was based on manual methods, i.e. particles were collected on a substrate and then counted with an optical microscope. These methods suffer from poor time resolution and long delays in data availability. Recent technological developments and machine learning (ML) have made it possible to automate bioaerosol monitoring. In this work, we will present a laboratory-based method for characterizing the performance of automated bioaerosol monitors as a whole unit (i.e. hardware plus identification algorithms) based on the use of well-controlled pollen aerosols and a reference method for particle counting known as Lagrangian Particle Tracking (LPT) using the Double-Pulse Shake-the-Box (STB) processing algorithm. The experiments were carried out with the SwisensPoleno Jupiter bioaerosol monitor (Swisens, Switzerland). This monitor combines light scattering, digital holography and ultraviolet laser-induced fluorescence (UV-LIF) with artificial intelligence, providing measurements of particle size and shape, number concentration and particle identification/classification. The performance of the ML algorithm was characterized in terms of pollen-taxon true-positive classification rate under controlled environmental conditions, and the calibration of the total particle number concentration was extended up to 70 µm to cover almost the entire size range of airborne pollen particles. Based on this, a new method has been developed to determine taxon-specific calibration factors for the Poleno, which are traceable to national standards. The method can be applied to any type of bioaerosol monitor.

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11BA.2

Development of a High-Plex Biosensor Platform for Airborne Pathogen Detection and Building-Integrated Exposure Control. NICHOLAS HEREDIA, *SafeTraces Inc.*

Airborne transmission of infectious pathogens remains a leading driver of health risk in indoor environments. We are developing a next-generation biosensor system capable of high-plex detection of airborne respiratory pathogens, with the goal of enabling real-time exposure risk mitigation. A working version of the biosensor currently supports 4-plex detection of pathogens and is undergoing development toward field integration and a pathway to detect up to 100 airborne targets in a single reaction.

The system leverages quantitative PCR and cartridge-based assay design to enable specific, multiplexed detection from aerosol samples. As the biosensor evolves, it will be integrated with a modeling and analytics framework that contextualizes sensor outputs with metadata such as building ventilation parameters, occupant density, and time-resolved environmental data. This risk model will be used to inform and automate engineering controls—such as HVAC optimization, filtration upgrades, and other building-level interventions—via direct integration with building management systems.

Initial deployments are being planned at U.S. military medical centers, providing a structured testbed for validating the system under real-world conditions. By combining molecular biosensing with exposure modeling and intervention automation, the platform aims to transform building air management from a passive to a proactive paradigm. It is designed to support both acute event response (e.g., outbreak containment) and continuous air safety assurance in high-risk environments.

This effort represents a novel convergence of bioaerosol detection, exposure analytics, and smart building control technologies, and contributes to a new frontier in precision environmental health protection.

11BA.3

Water-Injection Based BioCascade Impactor for Size-Fractionated Bioaerosol Collection. MOHAMMAD WASHEEM, Amin Shirkhani, Sudheer Salana, Yu-Ju Chen, Luis Angel Nino Barreat, Bright Amponsem, Amir R. Sharafudin, Sripriya Nannu Shankar, Arantzazu Eiguren-Fernandez, John Lednicky, Chang-Yu Wu, *University of Miami*

The BioCascade Impactor (BC) is a novel air sampling device that collects size-fractionated bioaerosols into three distinct size bins (>10, 4.1–10, 1.5–4.1 µm) through gentle liquid impaction. However, under low relative humidity conditions (<40% RH), the collection medium experiences high evaporation rates that lead to concentrating medium (other than water) and potential viability loss. This limitation is particularly concerning in occupational exposure monitoring, which requires prolonged sampling durations (≥3 hours). To address liquid loss and viability challenges, we developed jBioCascade, an upgraded BioCascade model incorporating a water injection system that stabilizes collection medium volume to prevent concentration fluctuations. This controlled liquid system injects sterile water at a user set interval and constant volume into sample collection dish to counteract evaporation. Experiments were conducted to evaluate liquid evaporation rates and viability conservation of Bacteriophage MS2 under varying humidity conditions. BioCascade was tested at 50%, 70%, and 90% RH in a controlled chamber and at 40% RH for ambient sampling, using 2 mL of 0.1X Phosphate buffer saline (PBS) as starting volume. The jBioCascade was also tested at 40% RH to determine water injection rates needed to stabilize PBS and virus transport medium (VTM). MS2 viability was assessed via plaque assays, and the results were analyzed using Two-Factor ANOVA. Viability conservation remained significantly high at 70% RH ($p < 0.05$) as compared to other RHs and was statistically similar at 50% and 90% RH ($p > 0.05$). Evaporation rate increased as RH decreased, with losses of 11 µL/min for PBS and 13 µL/min for VTM at 40% RH. The injection system was shown the capability to counteract this loss and can potentially be used for long-duration airborne pathogen sampling in fluctuating humidity conditions. Future deployments in occupational environments will validate its effectiveness in epidemiological surveillance and occupational assessment.

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11BA.4

Concentrated and Viable: Improved Bioaerosol Sampling via Virtual Impactor Enhanced Water Condensation Collection. DREW JONES, Emily Kraus, Kristin Rugh, Mark Hernandez, Marina Nieto-Caballero, Sonia Kreidenweis, Shantanu Jathar, *Colorado State University*

Water condensation-based air samplers can collect bioaerosols with high efficiency while avoiding issues with filter-based sampling, for example desiccation and the need for subsequent extraction from the filter before analysis. However, direct comparison between the methods is complicated by a magnitude or more difference in sampling flowrates. Virtual impactors can concentrate the sampled air, permitting condensation-based sampling at greater equivalent flowrates for particle sizes above the virtual impactor's cut-point. A virtual impactor was designed based on the work of Romay et al. (2002), using a single multi-nozzle opposing jet layout. The virtual impactor's 50% cut-point and concentration factor were characterized with non-biological aerosols. The virtual impactor was integrated with a water condensation-based sampler, the Aerosol Devices BioSpot GEM. The bioaerosol collection performance of the combined concentrator/sampler was then compared with unmodified samplers in chamber studies using both gram-negative and gram-positive aerosolized bacteria in separate trials. Further field testing was carried out in Fort Collins, CO in the Summer of 2025. The total amount of genetic material collected by each sampler was quantified using qPCR. PMA-qPCR was utilized to measure cell membrane damage. Microscopy using live-dead staining was also used to gain insights about sampler consistency. The virtual impactor was demonstrated to be capable of concentrating the sampled bioaerosols without significantly affecting the bioaerosol sample integrity. The implication of this research is the availability of a different method of bioaerosol sampling where low ambient concentrations would have previously required the use of higher flowrate filter-based samplers.

11BA.5

Performance of a Novel Personal Passive Sampler in a Calm-Air Environment. TAEWON HAN, Gediminas Mainelis, *Rutgers, The State University of New Jersey*

This research further advanced the novel Personal Rutgers Electrostatic Passive Sampler (P-REPS) for improved bioaerosol sampling performance, focusing on maintaining sample viability and culturability during long-term sampling. The 37 mm and 47 mm wide P-REPS versions incorporate a base with a clip, poly(vinylidene fluoride) (PVDF) film holder, and a static-dissipative outer shell. Inside P-REPS, the permanently polarized ferroelectric PVDF film is placed in a holder and wound in a spiral configuration, with opposing polarized surfaces facing each other and spaced 2.25 mm apart to create a sufficiently strong electrostatic field between the layers. Small magnets are incorporated into all three parts, allowing quick assembly and disassembly. Both sampler versions are 1-inch tall and designed to be worn in the personal breathing zone.

The P-REPS prototypes were tested in a newly built walk-in chamber using various bacteria and fungi, and their performance was compared against 37 mm PTFE settle filters and IOM personal samplers. P-REPS were placed in the "breathing zone" of two rotating manikins. Four-hour samples collected by all devices were eluted and analyzed using adenosine triphosphate (ATP), microscopy, and culture techniques. The Relative Luminescence Units (RLU) of cells captured by the P-REPS exceeded those collected by a settle filter by a factor of 3-4, indicating the effectiveness of the passive electrostatic capture mechanism compared to gravity alone. Comparison of microorganism concentrations measured by P-REPS and IOM showed that P-REPS achieves an equivalent sampling rate of about 0.5-1 L/min, i.e., comparable to active personal samplers. These results show that P-REPS offers a viable and easy-to-use tool to estimate personal exposure to biological aerosols.

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11CA.1

Primary and Secondary Particle Emissions from Residential Wood Combustion: Appliance Type, Fuel, and Aging Effects. ALEXANDRE ALBINET, Céline Degrendele, Yamina Allouche, Abd El Rahman El Mais, Ali Hnaino, Serge Collet, Sergio Harb, Nicolas Karoski, Vincent Fuvel, Jason Bardou, Mehdi Dionigi, Ahmed Abida, Yannick Dupuis, Chrsitophe Richet, Rachel Gemayel, Jérôme Beaumont, Théo Claude, Laurent Meunier, Robin Aujay-Plouzeau, Céline Ferret, Nathalie Bocquet, Andrea Baccarini, Nikunj Dudani, Pabrito Ray, et al., *INERIS*

Residential wood combustion is a major source of $PM_{2.5}$ during winter and emits significant amounts of carbonaceous compounds, with the organic fraction featuring varying volatility. These undergo (photo-)oxidation in the atmosphere, forming secondary organic aerosols (SOA), which contribute notably to $PM_{2.5}$ concentrations. The SOA formation potential and processes from these emissions are still poorly understood especially for nighttime conditions. Emissions data on residential pellet appliances (stoves and boilers) are also limited, making it crucial to improve knowledge of their primary emissions, such as black carbon (BC), and potential for secondary particle formation. This study aimed to (1) evaluate and compare primary particle emissions and secondary particle formation potential from pellet, logwood, and oil appliances, and (2) assess day- and night-time aging of logwood stove emissions. Experiments were conducted using nine modern residential heating appliances: three pellet stoves and boilers, one logwood boiler and stove, and one oil boiler. Emissions were diluted (20-50×) and aged using a potential aerosol mass oxidation flow reactor (PAM-OFR) under daytime (OH radicals, OFR-185) and nighttime (NO_3 radicals, dark-OFR-iN_2O_5) conditions. The study investigated the effects of appliance output (nominal, reduced, intermediate), real-life logwood use (beReal protocol), and fuel type (hardwood vs. softwood). Primary and secondary emissions were characterized on-line using numerous instruments ((CHARON)-PTR-ToF-MS, CI-ToF-MS, Xact, PTAAM-2λ, AIR-monitor, HR-ToF-AMS, ACSM, AAC, CPMA, SMPS, CPC, AE33, gas analyzers) located before and/or after the PAM-OFR providing detailed information on the particulate and gaseous chemical composition, PM size distribution, density, number concentration and light absorption properties. PM samples were also collected on filters/grids before and after the PAM-OFR for gravimetric, morphological and chemical analyses. We will compare primary (PM and BC) and secondary emissions across appliances, outputs, fuels, and aging conditions. This work was supported by ADEME (EPOCHAG and WOODNIGHT projects, n°206C0004 and 2262D0034) and the French Ministry of Environment.

11CA.2

Volatility Resolved Optical Properties of Biomass Burning Aerosols from Simulated Wildland Fires in the G-WISE-2 Campaign. RYAN POLAND, John Allen, Muhammad Abdurrahman, Mike Lesiak, Michael Caraway, Thomas Carroll, Ariana Deegan, Mac A. Callaham, Joseph O'Brien, Rawad Saleh, Geoffrey Smith, *University of Georgia*

Wildland fires represent a significant source of refractive carbonaceous aerosols, emitted on a spectrum of external mixing between brown carbon (BrC) and black carbon (BC). Two variables have been shown to dictate the relevant contributions of BrC and BC for wildland fires: (1) The moisture content of the fuels, existing between dry (~1.5%) (wildfires) and wet (5-18%) (prescribed fires) and (2) the inclusion of organic-rich duff layers in the fuel bed (McQueen et al. 2024; Zhang et al. 2021). The Georgia WIldland-fire Simulation Experiment 2 (G-WISE-2) campaign expands upon these findings by probing the effects that the dry composition, moisture content, density, and compactness of constructed fuel beds have on the chemical and optical properties of emitted aerosols (Saleh and O'Brien 2025). In the work presented here, custom-built photoacoustic (PAS) and cavity ring-down (CRD) spectrometers were operated downstream of parallel thermodenuders at 100ºC and 300ºC to quantify the intensive optical properties (namely the absorption Angstrom exponent (AAE) and single-scatter albedo (SSA)) of biomass burning aerosols from G-WISE-2 experiments in different "volatility regimes". For dry fuel beds which exclude the duff layer, we observe an AAE of ~1 and SSA of ~ 0.3 after thermodenuding at 300ºC, indicating a remaining population consisting predominantly of BC. However, for burns where duff is present in the fuel bed, AAE values remain as high as 3 following thermodenuding at 300ºC, suggesting the presence of extremely low volatility BrC and BC coatings. We investigate whether the emission of these low volatility absorbers is a stronger function of combustion efficiency or specific fuel bed composition.

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11CA.3

Humidity-Driven Changes in the Light Absorption Properties of Biomass Burning Secondary Brown Carbon. MUHAMMAD ABDURRAHMAN, Rawad Saleh, *University of Georgia*

The effect of secondary brown carbon (SBrC) from biomass burning on atmospheric radiative balance is poorly constrained, partly due to the evolution of its optical properties during photochemical aging, which is influenced by environmental conditions such as relative humidity (RH). While previous studies have studied RH effects on SBrC absorption, they often focused on SBrC formation from surrogate species rather than actual combustion emissions. Here, we performed experiments to investigate the evolution of SBrC absorption due to photochemical aging, using emissions from two common forest fuels: pine needles and duff (organic forest floor layer). Smoldering combustion was conducted in a 7.5 m^3 smog chamber pre-conditioned at either low (20%) or high (80%) RH. After allowing primary particles to deposit onto chamber walls, precursor gases were exposed to UV light to form secondary organic aerosol. Absorption at 422 nm and 532 nm was measured using a photoacoustic spectrometer, and particle size distributions were monitored using a scanning mobility particle sizer. The imaginary part of the refractive index (k) was retrieved using optical closure. For pine-derived SBrC, absorption under low RH initially increased and then gradually declined, losing ~17% and ~23% of its initial value at 422nm and 532 nm, respectively. At high RH, absorption exhibited a similar trend but at a much faster rate, with over 90% loss at both wavelengths, indicating accelerated photobleaching. The duff-derived SBrC also exhibited a steady decline in absorption at low RH, leading to an overall 67% loss. Under high RH, absorption initially dropped sharply but then gradually increased, suggesting a dynamic interplay between photobleaching and chromophore formation. These findings demonstrate that RH significantly influences the evolution of SBrC absorption in a fuel-specific manner, with higher RH enhancing SBrC reactivity by promoting greater interaction between oxidants and aerosol constituents.

11CA.4

Exploring the Impact of Wildfire Smoke on Cloud-Aerosol Chemistry at Whiteface Mountain, NY: Organic Acids and Growing Importance of Ammonium. ARCHANA TRIPATHY, Christopher Lawrence, Sara Lombardo, Paul Casson, Rudra Patel, Lily Hammond, Kathleen DeMarle, Richard Brandt, Scott D. McKim, James Schlemmer, James Schwab, Haider Khwaja, Mirza M. Hussain, Elizabeth Yerger, Phil Snyder, Dan Kelting, William May, Sara Lance, *Atmospheric Sciences Research Center, University at Albany*

Organic compounds are vital to atmospheric chemistry, with clouds playing a key role in their formation and transformation. Di-carboxylic organic anions, such as oxalate, act as tracers for aqueous-phase chemical processes. This study presents summer measurements of three organic acids (formic, acetic, oxalic), inorganic anions, and cations in cloud water, aerosol, and cloud droplet residual samples obtained 2018-2024 from the summit of Whiteface Mountain (WFM), a forested site in the Adirondack Mountains of northern New York State. Contributions of these acids to dissolved organic carbon (DOC), ion balance, and acidity are assessed in both cloud and aerosol samples. The current study builds on prior studies linking oxalate-to-DOC ratios with ozone concentrations, from which inferences have been made about biogenic volatile organic carbon (BVOC) contributions to secondary organic aerosol (SOA) formation, and we present new insights based on comparisons between cloud water and aerosol phases. We further expand upon the findings of Lawrence et al. (2023), which showed that more than half of the cloud water samples at WFM exhibit excess ammonium (i.e. exceeding sulfate plus nitrate concentrations) in recent years, by evaluating the relationship between excess ammonium and organic acids in both the cloud and aerosol phases particularly under conditions influenced by wildfire smoke with elevated black carbon (BC) levels. Additionally, we investigate the temperature and ozone relationship, particularly on clear air days, to assess potential interactions between BC and ozone in less polluted conditions vs smoky conditions. These findings provide new insights into multi-phase chemistry and SOA formation processes at a remote forested site downwind of many natural and anthropogenic sources and frequently influenced by wildfire smoke in summer.

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11CA.5

Reducing the Exposure to Soot and Carcinogenic Polycyclic Aromatic Hydrocarbon Emissions from Jet Fuel Combustion by Pentanol Blending. Constantinos Moularas, Una Trivanovic, Irini Tsiodra, Nikolaos Mihalopoulos, GEORGIOS A. KELESIDIS, *Rutgers, The State University of New Jersey*

Here, the potential of jet fuel blending with pentanol is explored to assist the reduction of soot and carcinogenic polycyclic aromatic hydrocarbon (PAH) emissions from aircraft engines. The concentration, morphology, nanostructure and chemical composition of soot generated by enclosed spray combustion of jet fuel and pentanol are characterized using real-time and time- integrated sampling instrumentation. Increasing the pentanol content in the fuel blend enhances the oxidation of soot, decreases its mass concentration up to 70 % and the concentration of its constituent carcinogenic PAHs up to 20 %. Soot agglomerates and primary particles emitted by combustion of jet fuel blends with pentanol are smaller and have a more disordered nanostructure than those produced using standard jet fuel. This reduces the soot effective density up to 40 % and increases its specific surface area (SSA) up to 45 %. The measured physicochemical properties are interfaced with a multi-path particle dosimetry model to derive the surface area and genotoxic potential of the lung deposited soot for an exemplary exposure scenario at an airport. It is shown that the deposited soot surface area increases by blending jet fuel with 20 vol % of pentanol due to the large soot SSA produced at these conditions. Further increasing the pentanol content in jet fuel to 40 vol%, reduces the deposited soot surface area and genotoxic potential up to 56 and 74 %, respectively. Thus, optimization of the pentanol content in jet fuel could eliminate the public health impact of soot and PAH emissions from aircraft engines.

11CO.1

From Fuel to Smoke: Composition of a Flame from a Prescribed Fire and its Near-Field Plume. ALLA ZELENYUK, Schuyler Lockwood, Zezhen Cheng, Tracy Baker, Ashley Bradley, Kendall Hughey, Joey Chong, Stephen Baker, Emily Lincoln, Shawn Urbanski, David Lignell, Zisimos Toumasatos, Georgios Karavalakis, David Weise, Timothy Johnson, *Pacific Northwest National Laboratory*

Predicting smoke emissions is important for modeling the spread and energy release of a wildland fire. Though emissions higher up in smoke plumes have been studied, the composition and chemical processes in the flame itself (both at and above the fuel source) that directly influence the plume emissions are not well-understood.

Recently we conducted over 50 controlled burns of longleaf pine needle beds to characterize in real-time the evolution of gas-phase effluents and aerosol particles emitted by the flame as a function of height above the fuel bed. The gases were primarily analyzed using a Fourier transform infrared spectrometer, while aerosol particles were characterized using a single particle mass spectrometer, miniSPLAT, condensation particle counter, and Engine Exhaust Particle Sizer. Three fixed heights (20 cm, 50 cm, and 80 cm above the fuel bed) were established to facilitate the measurements of the persistent (pyrolysis), intermittent (flame), and plume (smoke) phases of effluents in and above the flame, respectively.

Preliminary results show that gas-phase products were dominated primarily by CO_2 in the plume and flame regions, while CO, CH_4, C_2H_2 and C_2H_4 are significant contributors in the fuel zone. Particle properties, including their number concentrations, size distributions, compositions and morphology were also shown to vary greatly by zone. Particles in plume and intermittent zones were dominated by fractal agglomerates of primary spherules dominated by elemental carbon, while particles in the persistent zone comprised of a mixture of spherical particles and agglomerates with higher effective densities and contained high fractions of organics (i.e., polyaromatic hydrocarbons). Finally, particle number concentrations decreased significantly with the height above the fuel bed.

These findings suggest the physicochemical characteristics of the emissions are not uniform with respect to the height above the fuel, and these differences need to be accounted for in modeling of fire dynamics.

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11CO.2

Generating and Characterizing Smoke Aerosol for HEPA Filter Media Loading. DRAKE LARSON, Spencer Phillips, Jaime Gibson, *Mississippi State University*

The Institute for Clean Energy Technology (ICET) at Mississippi State University (MSU) performs applied research regarding HEPA filter performance for the Department of Energy nuclear complex. One area of interest is HEPA capability during fire scenarios. Currently there is little data available. More thorough data is needed to support facilities in safely planning for fire scenarios.

The Flat Media Loading System (FMLS1) was designed to fill the void in the context of fire and soot behavior by reducing the time and resources it takes to fully characterize assembled AG-1 filters. This system's focus is collecting performance characterization data of flat media samples of AG-1 HEPA filter media.

A miniature Combustion Aerosol Standard soot generator (miniCAST) was chosen for this research. The miniCAST allows fine control of the particle geometric mean diameter with good stability. However, a few difficulties have presented themselves in this application.

This work has shown that the particle size of the output soot changes drastically when diluted. This is likely due to chemical reactions in newly formed soot particles. This issue was discovered due to a need for dilution of samples to prevent exceeding the concentration limit of the particle sizing instrument (Scanning Mobility Particle Sizer). It was found that changing the dilution ratio changes the particle size greatly. This led to the need for a soot growth chamber, to allow an appropriate residence time for the soot to agglomerate and form into matured particles. Changing the dilution ratio now has a minimal effect on resulting particle size distributions. As dilution is still needed for sizing, the aerosol challenge presented to the filter media samples is also diluted, resulting in slow loading results. This paper presents work performed to increase filter loading times by understanding the relationship between soot aerosol before and after dilution.

11CO.3

Coating Thickness and Coating Volatility of Black Carbon Particles from Simulated Wildland Fires Depends on Combustion Conditions. JOHN ALLEN, Ryan Poland, Muhammad Abdurrahman, Mike Lesiak, Mac A. Callaham, Michael Caraway, Thomas Carroll, Dongli Wang, Joseph O'Brien, Rawad Saleh, Andrew Metcalf, Pengfei Liu, Geoffrey Smith, *University of Georgia*

The Georgia WIldland-fire Simulation Experiment (G-WISE) was a multidisciplinary campaign that studied combustion emissions from fuels collected in various eco-regions of Georgia at either high or low moisture levels. From G-WISE, McQueen et al. (2024) concluded that the impact of net cooling or warming from the aerosols of wildfire smoke is dependent on fuel-bed composition and moisture content. Black carbon (BC) is a primary absorber emitted in wildfire smoke which can be measured at the single particle level using incandescence signals in the Single Particle Soot Photometer (SP2). In 2025, the second iteration of G-WISE (G-WISE-2) expanded the investigation of wildfire fuel conditions by testing more fuel-bed conditions such as specific moisture, mass loading, and further exploring the impacts of a high organic surface fuel known as duff (Zhang et al, 2022). During G-WISE-2, two SP2's were deployed in parallel and downstream of a thermodenuder to quantify BC concentration, coating thickness and volatility as a function of the fuel-bed condition. Coating thickness with SP2 was measured via the conventional "leading-edge-only (LEO) fit" coating analysis and through the particle's "delay time" which is the time between the peak of incandescence (BC) and the peak scattering signal (coating). The thermodenuder was used at 100°C or 300°C to evaporate BC coatings of differing volatility. Using the delay time method for BC coating quantification, we show that the burning of the duff fuel layer led to heavily coated BC particles with ultra-low coatings, often persisting even after thermodenuding at 300°C. At higher moisture levels of the duff layer, its resistance to high temperature combustion resulted in the smoke being dominated by the combustion of fine surface fuel and we observed reduced BC coating thickness and volatility as indicated by relatively small changes in delay time between non-thermodenuded and at 300°C thermodenuded BC populations.

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11CO.4

Simulating Biomass Burning Emissions: Organic Acid Production from Lignin Under Variable Combustion and Aging Conditions. ESTHER OLONIMOYO, Elise Aggrey, Akua A. Asa-Awuku, *University of Maryland*

Biomass burning is a major atmospheric source of organic acids, yet the influence of specific fuel components and combustion conditions on their formation remains poorly constrained. In the atmosphere, organic acids contribute to secondary organic aerosol (SOA) formation, affect cloud condensation nuclei (CCN) activity, and influence regional air quality and climate. This study investigates the production of 13 low molecular weight organic acids from the thermal degradation and oxidative processing of lignin, a key structural biopolymer in biomass and a proxy for plant-derived fuels. Controlled experiments were conducted in a tube furnace at 200°C, 300°C, and 400°C to simulate smoldering and flaming fire conditions. Aqueous hydrogen peroxide (10%, 25%, and 50% H_2O_2) was used as an oxidant to mimic post-emission oxidative aging. Lignin mass and oxidant strength were systematically varied to determine their effect on organic acid yields.

Among the target compounds, acetic acid and malonic acid showed the highest concentrations across all conditions. Adipic acid and citric acid remained relatively constant, while heavier acids (butyric, isovaleric, valeric, and glutaric) were consistently below detection limits. Our findings suggest that combustion temperature, fuel loading, and oxidative strength each play roles in modulating organic acid production, with lower temperatures and higher oxidant concentrations favoring higher yields of lighter acids identified in the particulate phase. This work provides new insights into the mechanisms driving organic acid formation during biomass combustion and post-emission aging, with implications for air quality, aerosol formation, and climate modeling. This work also contributes to closing the knowledge gap between laboratory simulations and real-world biomass burning, offering valuable data for refining emission inventories and improving chemical transport model predictions of atmospheric organic acid burdens.

11CO.5

Parameterizing Residential Coal Emissions as a Source of Soluble Iron in an Earth System Model. HALEY E. PLAAS, Rui Li, Douglas Hamilton, Mingjin Tang, *North Carolina State University*

Anthropogenic activities have altered the atmospheric burden and deposition fluxes of biogeochemically relevant trace metals, including iron (Fe). Fe content and solubility (i.e., bioavailability to primary producers) in combustion aerosol is modulated by the chemical properties of fuel-sources, as well as burn technologies applied between emission sectors. In this work, total and soluble Fe concentrations were measured in five distinct combustion aerosol types collected across China. Then, using the Mechanism of Intermediate complexity for Modeling Iron (MIMI), an atmospheric iron module embedded in the Community Earth System Model (CESM), we modified Fe solubility at its point of emission according to novel measurements. Modeled Fe deposition fluxes to key oceanic regions were assessed under pre-industrial (PI), present day (PD), and future (FU) anthropogenic emissions scenarios. By distinguishing residential from industrial coal burning in model simulations, we report a 3-fold increase in PD global soluble Fe fluxes stemming from anthropogenic sources (0.9 Tg yr-1 in the base simulation and 0.27 Tg yr-1 in the sensitivity case). Increases in soluble Fe deposition were most evident in the northeastern Pacific Ocean, in the Bay of Bengal, and across southeastern Asia. Model-observation comparisons suggest that model performance (ability to capture soluble Fe concentrations measured in aerosol at the Earth's surface) was improved for these regions and for the South Atlantic. By the end of the century, model outputs suggest that soluble Fe deposition to marine systems could be decreased by 7 to 32 Gg yr-1, indicating more significant perturbations to biogeochemistry attributed to residential combustion not previously captured in Earth Systems Models. Our results highlight and quantify uncertainties related to trace metal delivery to ocean ecosystems in the Anthropocene.

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11IA.1

A Study of $PM_{2.5}$ Behavior in Indoor Environments Using Canonical and Grand Canonical Ensembles. Buddhi Pushpawela, ISHIKA SINGH, *The University of Alabama in Huntsville*

This study presents a theoretical investigation of $PM_{2.5}$ aerosol dynamics in indoor environments using the framework of statistical mechanics, with a focus on the canonical and grand canonical ensembles. $PM_{2.5}$ poses serious health risks, especially in enclosed or poorly ventilated spaces with significant accumulation. Traditional macroscopic models often neglect the microscopic thermodynamic fluctuations relevant to such confined systems.

In this work, we modeled unventilated indoor spaces using the canonical ensemble, where the particle number, volume, and temperature are fixed, and ventilated environments using the grand canonical ensemble, which allows for fluctuations in particle number due to particle exchange with the surroundings. Simulated monthly PM 2.5 concentration data for both ventilated and unventilated conditions are used to parameterize models. Using the canonical partition function, we derived expressions for internal energy, entropy, and the distribution of microstates. The grand partition function is employed to compute the chemical potential, average particle number, and entropy as functions of environmental parameters such as ventilation rate and particle influx. This ensemble-based approach provides a theoretical framework for understanding the thermodynamic behavior of particles in confined indoor systems. By linking microscopic statistical mechanics with macroscopic environmental conditions, our study provided insights into how ventilation influences aerosol stability, particle fluctuations, and system equilibrium. This work also highlights the importance of ensemble selection in modeling real-world finite systems and demonstrates the value of statistical mechanics in addressing the challenges in indoor air quality.

11IA.2

Atmospheric Nanoparticle Growth Dynamics with the Application of Whole-Room Far-UVC Radiation. BRIAN MAGNUSON, Shohoria Afrin Shorno, Chunxu Huang, Ernest Blatchley III, Brandon E. Boor, Nusrat Jung, *Purdue University*

Far-UVC radiation (222 nm) is an effective method for the inactivation of pathogens through whole-room irradiation with its low potential for damaging the skin and eyes of occupants. However, studies have shown that Far-UVC applications can lead to the formation of byproducts such as ozone. In indoor environments, reactions between ozone and volatile organic compounds (VOCs) can result in the formation of atmospheric nanoparticles, which grow via coagulation and condensation. While Far-UVC radiation can effectively inactivate airborne pathogens, the generation and growth of these nanoparticles introduces a potential respiratory exposure risk. We conducted field experiments in the Purdue zero Energy Design Guidance for Engineers (zEDGE) Test House, representative of a residential environment, to investigate atmospheric nanoparticle formation and growth during Far-UVC irradiation. Krypton Chloride (KrCl) excimer lamps were ceiling-mounted for whole-room exposure. Twenty-four-hour experiments with timed lamp activation were performed to account for diurnal fluctuations in ambient ozone levels. Particle size distributions from 10 to 500 nm were measured using a scanning mobility particle sizer (SMPS), and indoor/outdoor ozone was monitored with ozone analyzers. We observed clear particle growth in the 10 to 100 nm range during Far-UVC operation, with number concentrations increasing by up to fourfold. Upon lamp deactivation, concentrations returned to background levels. We will report estimated particle growth rates under different experimental conditions to assess the roles of coagulation and condensation in driving nanoparticle evolution. These findings highlight nanoparticle formation and growth as a secondary consequence of Far-UVC use in indoor spaces and underscore the need for mitigation strategies to reduce potential health risks.

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11IA.3

Consumer products, Lights, and Environmental Air cleaning in Normal conditions (CLEAN) Home Indoor Field Study Overview. Sofie Schwink, Rileigh Robertson, Ethan Richter, Rebecca Mesburis, Douglas A. Day, Seonsik Yun, Matt Shulman, Andre Schaum, Annamarie Guth, Sean Benjamin, Jose-Luis Jimenez, Joost A. de Gouw, Kelvin Bates, Qing Ye, Michael Hannigan, MARINA VANCE, *University of Colorado Boulder*

The use of volatile chemical products (VCPs) indoors, such as cleaning products and personal care products, can lead to significant emissions of volatile organic compounds (VOCs) to the indoor environment and the atmosphere. VOCs can react with oxidants to form secondary organic aerosol (SOA) indoors even at very low indoor oxidant concentrations. Some oxidants, like ozone, typically enter the indoor environment from outdoor air, but there are also indoor oxidant sources, like the use of chlorine bleach. During the Consumer products, Lights, and Environmental Air cleaning in Normal conditions (CLEAN) Home Indoor Field Study, we will investigate indoor SOA formation and properties from interactions of common indoor SOA precursors with several oxidants in a real home. This study will take place from May - July 2025 in a single-family home in Boulder, Colorado. For each experiment, two indoor perturbations will be tested in sequence. The initial perturbations include mopping with a cleaning liquid, operating a gas stove, injecting smoke into the house, or house baseline (no perturbation). The second perturbations include ozone injection, wiping surfaces with bleach, wiping with bleach plus turning on a 254 nm germicidal ultraviolet (GUV) lamp, turning on a 222 nm GUV lamp, and turning on a 254 nm GUV lamp. Measurements to be performed during the campaign include particle size distributions, chemical speciation of VOCs and aerosol particles, trace gases, and several low-cost sensor measurements. Observing SOA formation and properties in real-world environments under realistic indoor conditions is important for understanding how using common consumer products can impact indoor and outdoor air quality.

11IA.4

A Blueprint for Far-UVC Use in Airborne Pathogen Control. STEVE MARTIN, Richard Williamson, James Montavon, Jacob Swett, *Blueprint Biosecurity*

Background: Protecting people from infectious aerosols in their indoor air is a remarkable opportunity for improving public health, but comes with significant challenges. Recent standards, such as ASHRAE 241, set equivalent clean air delivery rate targets to reduce airborne transmission risk. While increased ventilation and added filtration can meet these targets in some settings, many environments—such as classrooms, gyms, and restaurants—require impractically high ventilation rates to achieve sufficient infection risk mitigation. This gap highlights the need for additional strategies to supplement traditional air quality interventions. Far-UVC – an emerging type of germicidal UV light – could be one of these strategies.

Methods: To develop an actionable roadmap for far-UVC disinfection, we conducted extensive literature reviews, semi-structured interviews with over 100 experts from academia, industry, government, healthcare, and the non-profit sector, and performed parametric modeling using the Wells-Riley infection risk framework. This multidisciplinary effort evaluated far-UVC's potential to inactivate pathogens in diverse settings, focusing on technical domains such as disinfection efficacy, photobiological safety, materials compatibility, and indoor air chemistry.

Key Findings: Far-UVC can be both safe and effective when properly implemented. Current evidence supports its safety below existing exposure guidelines, with studies showing minimal DNA damage in skin and eyes due to limited tissue penetration. When integrated with other air cleaning technologies like ventilation and filtration, far-UVC offers a cost-effective and energy-efficient way to achieve equivalent clean air delivery rate targets, particularly in spaces where increased ventilation is impractical. However, key knowledge gaps must be addressed to ensure responsible deployment, particularly regarding: 1) pathogen susceptibility in human respiratory aerosols, 2) standardization of efficacy testing, 3) potential novel photobiological effects, 4) indoor air chemistry impacts, and 5) practical implementation considerations. These findings are summarized in the Blueprint for Far-UVC, a reference document developed to align scientific evidence with regulatory, engineering, and public health needs.

Our presentation will also outline how this blueprint has informed the launch of the Airborne Infection Resilience (AIR) Program, a five-year initiative to coordinate and accelerate the research needed for safe and effective global deployment of far-UVC. Project AIR includes a large-scale clinical trial, foundational safety and air chemistry studies, and engagement with standards and regulatory bodies. We will highlight areas where the UV community—particularly those focused on emitter development, photobiological measurement, and international standards—can contribute to ensuring far-UVC realizes its potential as a practical tool for airborne transmission suppression.

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11IA.5

Understanding VOC Levels in an Office: The Impact of Acid-Base and Oxidation Surface Chemistry. JILLIAN DOWNEY, Jonathan Abbatt, *University of Toronto*

Gas-phase volatile organic compounds (VOCs) impact indoor air quality, as some are harmful irritants. Indoor surfaces act as reservoirs for VOCs and, even in the absence of direct VOC sources, VOC gas-phase concentrations are buffered through the emission of compounds stored in these reservoirs. Several factors may influence surface fluxes; for example, surface pH impacts acidic and basic VOC partitioning. Surface pH can be influenced by human activities such as cooking or cleaning that emit ammonia or acetic acid, increasing or decreasing the surface pH, respectively. Additionally, the role of surfaces may be influenced by an indoor oxidant like ozone. In this manner, surfaces not only act as a direct VOC emission source but also as a reactive medium, resulting in the release of oxidized VOCs.

In this work, we investigated how the addition of ammonia and ozone affects the air composition of an office. Painted and glass surfaces were aged in an office, placed in a flux chamber, and the emissions of acidic/basic species were measured using a Vocus PTR-MS. To investigate the role of surface pH, ammonia was introduced into the chamber, and changes in the acidic/basic species were monitored. Pronounced levels of amines and amides are released with ammonia addition. Additionally, to investigate the role of surface emissions and ozonolysis, clean air and ozone-filled air was added to a flux chamber attached to the office wall. VOC emission rates from the flux chamber with and without ozone were compared to ambient VOC levels in the office to assess the contribution of surface flux and ozonolysis to indoor air composition. Overall, this work demonstrates that surfaces play a dominant role in determining indoor VOC concentrations, and that human activities not only affect indoor air quality through direct emissions but also by driving secondary chemical processes.

11RM.1

Estimating the Air Quality Co-Benefits of Preventing Deforestation-related Fires. RICARDO MORALES BETANCOURT, Fernando Garcia-Menendez, Amy P. Sullivan, Diego Roberto Rojas-Neisa, *Universidad de los Andes*

The main link between health and deforestation control is the occurrence of fire. In South America, the forest loss process is almost always preceded or mediated by fire. Nearly all fires in the Amazon are linked to deforestation. In turn, landscape fires are the main source of regional air pollutant emissions, significantly deteriorating air quality. The health burden of deforestation-related landscape fires is still understudied. In this work, we used the chemical transport model WRF-Chem to estimate the fraction of ground-level aerosol concentration attributable to deforestation-related fires in South America. We developed a BAU scenario (i.e., uncontrolled deforestation) and completed a year-long simulation with WRF-Chem for the year 2018. This BAU case was evaluated against ground-based BB tracer observations (e.g., levoglucosan and others), and remote sensing products. The modeling domain of 3240 x 3240 km covered the northern half of South America with a horizontal resolution of 9 × 9 km. We accounted for the uncertainty in biomass burning (BB) emissions by using two commonly applied emission inventories (FINN1.5 and GFED4). To further explore the relationships between fires and deforestation practices, we run two additional sensitivity scenarios in which only BB emissions from forests (i.e., those potentially attributable to deforestation) were included, for both FINN and GFED4. Our results show a wide range of estimates of BB emissions from forests across inventories but suggest that these are the dominant source of primary particles and aerosol precursors in the region. Our results also suggest that potentially thousands of deaths could be avoided if BB emissions from forests are suppressed, due to the expected decrease in long-term exposure to $PM_{2.5}$ resulting from effective deforestation and wildfire control. This work shows that if National Commitments for deforestation control are met, reductions in BB emissions could substantially improve air quality in South America.

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11RM.2

Influence of Wildfire Smoke on the Regional Air Quality in the U.S. Midwest. Parth Thakre, Kerstin Cox, Samantha Galicki, GOURI PRABHAKAR, *Purdue University*

The Midwestern United States is largely an agricultural region without active wildfires. Yet, in the recent years many days in the summer months have experienced smoky skies due the long range transport of smoke from wildfires in Western U.S. and Canada. The current study aims to investigate whether this smoke has influenced ground level air quality in this region, and if so, how it has changed over the last two decades. The study analyzes long-term concentrations of atmospheric aerosol species indicative of wildfire emissions measured at 14 ground sites across eight Midwestern states through the IMPROVE (Interagency Monitoring of Protected Visual Environments) network. Preliminary findings indicate significant seasonal changes in wildfire-associated aerosol components, namely Organic Carbon (OC), Elemental Carbon (EC), and Potassium. The ratio OC:EC appears to be a better indicator of wildfire smoke instead of absolute concentrations of the individual species. The analysis also suggests a statistically significant increase in wildfire smoke influence on aerosol composition during the summer in the last decade compared to the past. Understanding these changes over recent years is crucial to assessing future air quality trends and risks to human health from exposure to wildfire smoke in this region.

11RM.3

African Dust Transported to Barbados in the Wintertime Lacks Indicators of Chemical Aging. CASSANDRA GASTON, Haley Royer, Michael Sheridan, Hope Elliott, Edmund Blades, Nurun Nahar Lata, Zezhen Cheng, Swarup China, Zihua Zhu, Andrew P. Ault, *University of Miami*

African dust is transported across the Atlantic Ocean to the Caribbean and south and southeastern US in summer and parts of the Caribbean and South America in the winter and spring. During transport, African dust has the potential to undergo chemical “aging” by reacting with acidic gases that could transform its biogeochemical, radiative, and air quality impacts. However, whether African dust undergoes chemical aging is open for debate. We present evidence that dust collected on the easternmost Caribbean island of Barbados lacks indicators of chemical aging. Samples were collected during the ATOMIC/EUREC^{4}A campaign, which occurred during the wintertime when dust is transported at lower altitudes and, therefore, could undergo more extensive aging than in the summertime. Traditional bulk chemical indicators of chemical aging such as dust, non-sea salt sulfate, and nitrate mass concentrations show strong temporal correlations suggestive of dust chemical aging. However, single-particle evidence from computer controlled-scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (CCSEM/EDX), elemental mapping, and time-of-flight secondary ion mass spectrometry (TOF-SIMS) reveals that aging is associated with sea spray and co-transported smoke rather than dust. Our work has implications for understanding dust impacts on clouds, nutrient deposition, direct radiative forcing and further underscores the importance of single particle methods to unambiguously elucidate chemical aging mechanisms.

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11RM.4

Recalcitrant Brown Carbon: Chemical Characteristics of Biomass Burning Organic Aerosol vs Soil Dust. RACHEL O'BRIEN, Janie (Yeaseul) Kim, Willow Hwang, Cassandra Gaston, Ann M. Dillner, Andrew P. Ault, Benjamin A. Nault, Manjula Canagaratna, Elise Palombella, Christopher Cappa, *University of Michigan*

Brown carbon (BrC) in aerosol particles and cloud droplets can contribute to climate warming by absorbing solar radiation in the visible region of the solar spectrum. Large uncertainties remain in our parameterization of this warming, in part due to gaps in our knowledge of the atmospheric lifetimes of the light absorbing molecules in the mixtures. An important removal pathway includes chemical transformations that fragment the chromophore, thus removing its ability to absorb visible light. BrC is emitted from solid fuel combustion like wildfires (biomass burning organic aerosol, BBOA) and it can also be found in soil derived aerosol particles. A fraction of BrC from wildfires has been found to retain its brown color for days or longer in the atmosphere. The longer-term behavior of the BrC from soil derived aerosol is not well characterized, but we expect it to also retain some color. The characteristics of this recalcitrant material are important to characterize because it can contribute to warming long after the more photolabile portion has bleached. Here we characterize the chemical composition of soil derived dust samples and evaluate the extent to which soil dust is representative of the recalcitrant brown fraction of BBOA collected from smoldered samples generated in lab (pine, oak) as well as aerosol particles collected in Barbados after transport from Africa in a biomass burning plume.

11RM.5

Distinguishing Regional And Local $PM_{2.5}$ Influences Using Sensor Networks: Evidence From West Bengal, India. SATHISH SWAMINATHAN, Panagiotis Reskos, V. Faye McNeill, *Columbia University*

The Indo-Gangetic Plain (IGP), situated along the foothills of the Himalayas, is among the most polluted regions globally, with air quality influenced by both anthropogenic and natural factors. Key anthropogenic sources include stubble burning, industrial emissions, and urban activities from densely populated cities. Meteorological phenomena such as long-range atmospheric transport, temperature inversions, and fluctuations in boundary layer height further modulate pollutant dispersion and concentration. West Bengal is uniquely positioned as the only state in the IGP that is bordered by both the Himalayan foothills to the north and the Bay of Bengal to the south. This geographical placement makes it particularly susceptible to the combined effects of cold air diversion from the mountains and monsoonal precipitation driven by the sea. West Bengal is also one of the first Indian states with an extensive state-owned, sensor-based air quality monitoring network comprising over 200 low-cost sensors. This infrastructure enables high-resolution analysis of spatiotemporal $PM_{2.5}$ patterns at the district level. In this study, we apply machine learning techniques to distinguish between regional and local influences on $PM_{2.5}$ concentrations using sensor data alone. Time series decomposition and clustering techniques are used to identify signatures at different temporal scales and group locations with similar signatures. Meteorological inputs are then introduced to assess the effectiveness of the method in describing the relative contribution of regional and local factors across a geographically diverse state.

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12AA.1

Aerosol Acidity Modulated by Temperature Through Semi-Volatile Species. James Campbell, Rodney J. Weber, JINGQIU MAO, *University of Alaska Fairbanks*

Temperature modulates aerosol pH through several ways. While the increased solubility (Henry's law constant) of semi-volatile gases at lower temperatures is well recognized, the temperature dependence of acid dissociation constants has received less attention. More importantly, the simultaneous increase in both Henry's law constant and acid dissociation constant at lower temperatures amplifies volatility shifts for species like NH_3 and HNO_3. In our recent work by Campbell et al. (2024), we show that reduced NH_3 volatility at extremely cold conditions (< -30 ℃) enhances aerosol neutralization in ammonium-sulfate aerosols. Building on this, we investigate pH behavior across a broad temperature range in ammonium-sulfate-nitrate aerosols. Our results highlight that aerosol pH is governed by the interplay between NH_3 and HNO_3 volatility, modulated by ambient temperature and the relative abundance of total NH_3, total HNO_3 and total H_2SO_4. These findings provide key insights into aerosol acidity and secondary aerosol chemistry on a global scale.

12AA.2

Exploring Spontaneous Oxidation Chemistry at the Air-Water Interface of Microdroplets Using a Suite of Mass Analyzers and Ionization Sources. PAUL TUMMINELLO, Nathan Bays, David Schafer, Leonid Sheps, Jared Echternach, Ryan Davis, *Sandia National Laboratories*

Aerosol particles, which are ubiquitous in Earth's atmosphere, play a key role in atmospheric processes such as cloud seeding, pollution transport, and heterogenous reaction mechanisms. Aerosol interfacial chemistry, specifically the air-water-interface (AWI), has recently become a topic of interest in the literature. For example, some studies utilizing pure water microdroplets have demonstrated the spontaneous formation of hydrogen peroxide, suggesting the spontaneous formation of hydroxyl radicals at the AWI. Validation of these results and further elucidation of the mechanistic pathways for these observations occurring on microdroplets may revolutionize our understanding of the atmospheric oxidant budget, having far reaching implications in pollution transport timescales and atmospheric lifetimes.

In this work, microdroplets were generated by a custom-built sprayer apparatus which allowed for online, continuous sampling of both aerosol and gas phase reaction products as well as collection of larger, impacted aerosol particles for offline analysis. Online sampling utilized Orbitrap mass spectrometry coupled with an open-port sampling manifold to record real-time, high-resolution composition information. A triple quadrupole liquid chromatography mass spectrometer was employed to characterize the particles collected via impaction. Gaseous byproducts were analyzed with a photoionization time-of-flight mass spectrometer and a cryo-focusing gas chromatography mass spectrometer. Gaseous volatile organic carbon (VOC) compounds intermixed with the carrier gas (UHP O_2/N_2 mixtures) prior to microdroplet generation provided the maximum equilibration time possible between a given VOC and water microdroplets. Preliminary results of microdroplet generation, wherein average particle diameter centered ~20 μm, in the presence of various mixtures of carrier gases and VOCs (e.g., methane, ethane, butene, isoprene), will be presented. Oxidation products were observed, although in far lower concentrations than previously reported in the literature. Potential reasons for these observations will be discussed.

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12AA.3

Aerosol Inhibition on Photochemical Surface Ozone Formation in Present Day and Under Future Climate and Air Quality Scenarios. G.S. Gopikrishnan, DANIEL WESTERVELT, Jayanarayanan Kuttippurath, *Columbia University*

Aerosols significantly influence tropospheric oxidation and ozone formation by modulating photolysis rates and radical sinks. This study employs the GEOS-Chem model to analyze different aerosol heterogeneous uptake coefficients (0, 0.1, 0.2 and 0.4) and their effects on photochemical ozone levels across global regions under future Shared Socioeconomic Pathways (SSP) scenarios. Lower uptake coefficients lead to an increase in the concentration of radical species like HO_2 and reduce the extent of aerosol-inhibited regime (AIR) in regions such as India and East Asia which are currently within AIR, leading to a notable increase in surface ozone (40–50%), particularly during colder months. Projections for 2046 indicate a global reduction in AIR, resulting from stricter emission controls. By 2096, the extent of AIR further diminishes, with regions like Southeast Asia transitioning to NOx-limited conditions, though aerosol uptake of HO_2 continues to elevate surface ozone levels by 10–15% in heavily aerosol-loaded areas. In India, during monsoon in 2022, the decrease in aerosol surface area caused an ozone increase of 10–20 $\mu g/m^3$ when compared to that of 2018. On average, eighty percent of this increase in surface ozone due to reduction in PM can be mitigated by reducing anthropogenic NOx emissions by 25–50%. Thus, we recommend integrated strategies addressing aerosols, precursor emissions and regional meteorology to combat ozone pollution.

12AA.4

Spacecraft Reentry: A Novel Source of Aerosol to the Stratosphere. DANIEL MURPHY, *NOAA CSL*

Measurements of aerosol particles in the stratosphere show that metals that were vaporized during the reentry of rocket boosters and satellites accumulate in the stratosphere. These metals are incorporated into natural sulfuric acid particles in the stratosphere. Over 20 elements from reentry were detected and were present in ratios consistent with alloys used in spacecraft. The mass of lithium, aluminum, copper, and lead from the reentry of spacecraft exceeds the cosmic dust influx of those metals. Remarkably, about 10% of stratospheric sulfuric acid particles larger than 120 nm in diameter contain aluminum and other elements from spacecraft reentry. With the rapidly increasing number of spacecraft reentry events, in the coming decades a majority of sulfuric acid particles in the stratosphere could contain novel metals from spacecraft in addition to the meteoric metals that are already present.

These metal-containing particles are found in the same air that contains the ozone layer. The addition of materials from spacecraft might affect heterogeneous chemistry in the ozone layer or change ice nucleation in polar stratospheric clouds.

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12BA.1

Characterizing Springtime Pollen Rupture and Vertical Transport in the Southeastern US. TAMANNA SUBBA, Allison Steiner, Maria A. Zawadowicz, Ashish Singh, Chongai Kuang, *Brookhaven National Laboratory*

Pollen, a primary biological aerosol particle (PBAP) (diameter >10 µm), is emitted from the terrestrial biosphere and can undergo atmospheric transformations, particularly rupture into sub-pollen particles (~0.15 µm) under favorable environmental conditions. These processes may significantly impact aerosol number budgets and influence cloud condensation nuclei activity, thereby playing a role in warm cloud formation processes. The contribution of pollen, especially via rupture, to aerosol size distributions, vertical transport, and cloud interactions remains uncertain. To address this gap, we investigate the behavior of pollen and sub-pollen particles during the peak emission period in spring 2025 in the southeastern US. Our study combines comprehensive ground-based measurements from the third Atmospheric Radiation Measurement (ARM) Mobile Facility deployment at Bankhead National Forest with regional simulations using the Weather Research and Forecasting modeling coupled with Chemistry (WRF-Chem) model. The observational dataset includes aerosol number concentrations, bulk mass concentrations, coarse-mode aerosol optical depth, linear depolarization ratios, meteorological variables, and vertical profiles from tethered balloon system deployments. In addition, we will use targeted model simulations to investigate the regional impacts of pollen and their rupture processes. We identify 3-8 potential pollen event (PPE) days in March and April, characterized by elevated near-surface lidar depolarization ratios (>0.1), enhanced organic aerosol fractions, and increased sub-micron particle concentrations. These elevated depolarization signals frequently extend to the top of the boundary layer, potentially indicating lofted pollen and sub-pollen particle transport. Frontal thunderstorms and convective events further promote vertical redistribution. Together, these integrated observational and modeling approaches will help quantify the role of pollen and sub-pollen particles in accumulation- and coarse-mode aerosol number concentrations, their vertical transport, and their potential influence on modulating warm cloud formation processes.

12BA.2

Convective Storms Alter Local Bioaerosols and Ice Nucleating Particles Through Cold Pools and Rain. TERESA FELDMAN, Janeshta Fernando, Chamari Mampage, Claudia Mignani, Marina Nieto-Caballero, Thomas Hill, Brian Heffernan, Drew Juergensen, Christine Neumaier, Tyler Barbero, Charles Davis, Lexi Sherman, Ben Ascher, Jacob Escobedo, Nick Falk, Sean Freeman, Gabrielle Leung, Allie Mazurek, Daniel Veloso-Aguila, Leah Grant, Susan van den Heever, Russell Perkins, Paul DeMott, Sonia Kreidenweis, Elizabeth Stone, *University of Iowa*

Bioaerosols can significantly affect both human health and the climate, but further study is needed to understand how meteorology alters bioaerosol properties. To this end, bioaerosol concentrations, sizes, and types were measured in Northern Colorado as part of the BioAerosols and Convective Storms study. The first campaign (summer 2022) had drought-like conditions while the second (summer 2023) had near record rainfall. Offline samples were analyzed for bioaerosol tracers and ice nucleating particles (INPs), while online methods characterized fluorescent particles and INPs. Precipitation for both campaigns generally elevated bioaerosols based on fluorescent particle number concentrations, with an average increase of 3x pre-storm levels. Cold pools of air formed under thunderstorms had more varied impacts on bioaerosols, significantly enriching fluorescent particles for roughly half of the considered cases (n=56). Rain and cold pools mixed with rain generally led to a smaller particle size mode (1-4 µm) for supermicron fluorescent particles compared to isolated cold pools (2-10 µm), likely due to differences in bioaerosol emission and transport mechanisms. Despite no significant correlations during 2022 (n=29), changes in fluorescent particle concentrations correlated significantly (n=27, $p<0.05$) with cold pool perturbations of temperature (r_s=-0.45), wind speed (r_s=0.53), and relative humidity (r_s=0.61) during 2023. These correlations indicate cold pools with stronger meteorological perturbations led to greater enrichment of local bioaerosols. Fungal spores were enriched more than pollen and gram-negative bacteria by convective storms, with pollen and endotoxin tracers often below detection. The fungal spore tracer primarily increased in particles 2.5-10 µm for samples during storms, correlating with increases in heat labile INPs at -15 °C for the same particle sizes (r=0.91, n=8, $p<0.01$). Convective storms significantly increase local bioaerosol and INPs through rain and cold pools, creating the potential for high exposure risks and storm ingestion of biological INPs.

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12BA.3

Wet Deposition of Bioaerosol Tracers. JANESHTA FERNANDO, Teresa Feldman, Chamari Mampage, Claudia Mignani, Marina Nieto-Caballero, Thomas Hill, Brian Heffernan, Christine Neumaier, Tyler Barbero, Charles Davis, Lexi Sherman, Ben Ascher, Jacob Escobedo, Nick Falk, Sean Freeman, Gabrielle Leung, Allie Mazurek, Daniel Veloso-Aguila, Leah Grant, Susan van den Heever, Russell Perkins, Paul DeMott, Sonia Kreidenweis, Elizabeth Stone, *University of Iowa*

The BioAerosols and Convective Storms (BACS) field campaigns examine the exchange of bioaerosols between the terrestrial biosphere and atmosphere. The objectives of this study are to evaluate bioaerosol wet deposition and the extent of below- and in-cloud scavenging. Chemical tracer analysis provides insight to three classes of bioaerosols: fungal spores by mannitol; gram-negative bacteria by endotoxins; and pollen and plant matter by fructose, glucose, and sucrose. Samples were collected in the Central Plains Experimental Range in Northern Colorado from May-June of 2022 and 2023. In 2022, cumulative precipitation was 10 mm across five rain events during a 26-day campaign period. In contrast, 2023 experienced significantly higher rainfall, with 119 mm accumulated from 21 rain events over a 32-day period. Increased precipitation and ambient fungal spore and mannitol concentrations in 2023 contributed to significantly higher and more variable wet deposition of fungal spores compared to 2022, while carbohydrate wet deposition per rain event remained consistent across both years. Below-cloud scavenging was estimated from bioaerosol tracer concentrations at the surface, using three different assumptions for the vertical profile: vertical distributions were well-mixed, decreased slightly with altitude, and were enhanced in an aerosol layer detected at 120 m above the surface by drones. Upper estimates of below-cloud scavenging consistently accounted for less than 25% of total bioaerosol tracer wet deposition, suggesting that in-cloud scavenging is the dominant process contributing to wet deposition. These results imply a significant fraction of atmospheric bioaerosol aerosol is present in clouds, where they act as cloud condensation nuclei or ice nucleating particles and are subsequently removed through precipitation.

12BA.4

Vertical Profiles of Fluorescent and Coarse Mode Particle Properties in the Colorado River Basin and Southeastern United States. MARIA A. ZAWADOWICZ, Chongai Kuang, Tamanna Subba, Shawn Serbin, Olga Mayol-Bracero, Darielle Dexheimer, Mirtha Salatti, Russell Perkins, Paul DeMott, Jessie Creamean, Zezhen Cheng, Gregory W. Vandergrift, Ashfiqur Rahman, Nurun Nahar Lata, Swarup China, *Brookhaven National Laboratory*

Bioaerosols—aerosols of biological origin—have wide-ranging atmospheric implications, including acting as ice-nucleating particles (INPs) to trigger ice formation in mixed-phase clouds. The potential impacts of bioaerosols on clouds depends on the vertical extent of biological material, yet vertical profiles of speciated aerosols can be difficult to measure without deploying dedicated bioaerosol samplers on airborne platforms such as an aircraft or a tethered balloon. This project investigates the vertical profiles of atmospheric bioaerosol concentrations during the ARM Surface-Atmosphere Integrated Laboratory (SAIL) campaign in the Colorado River basin and third ARM Mobile Facility (AMF3) deployment to Bankhead National Forest (BNF). During SAIL, we deployed a novel, small-footprint fluorescence sensor alongside a Size- and Time-resolved Aerosol Collector (STAC) sampler and a collector for off-line quantification of immersion ice nuclei concentrations (IcePuck) on ARM's tethered balloon system (TBS) during spring and summer of 2023. We obtained simultaneous vertically resolved profiles of fluorescent aerosol concentrations, accumulation and coarse-mode size distributions, and samples of aerosol for subsequent analysis with high-resolution mass spectrometry and microscopy at the Environmental Molecular Sciences Laboratory (EMSL) for identification of specific particle morphologies. In addition, we also deployed a coarse-mode optical particle counter to measure vertically-resolved size distributions of particles up to 35 µm. At BNF, we have analyzed the available in-situ aerosol measurements to constrain possible influence of coarse-mode biological aerosol and classify characteristic regimes in preparation for TBS deployments that will take place later this year. Measurements of vertical profiles of coarse-mode particles are rare, yet essential to capture the vertical extent of surface-atmosphere interactions, as the coarse-mode particles tend to be limited to surface sources such as dust or pollen. These studies are designed for comprehensive characterization of spring and summertime aerobiome in the continental United States, its vertical extent, and its interactions with clouds as a potential source of INPs.

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12CA.1

Enhancing Organic Characterization from TOF-ACSM Mass Spectra Using Collocated Functional Groups Measurements for ASCENT Sites. NA MAO, Manjula Canagaratna, Nga Lee Ng, Satoshi Takahama, Ruizhe Liu, Sohyeon Jeon, Theobard Habineza, Albert Presto, Seonsik Yun, Douglas A. Day, Jose-Luis Jimenez, Elena Goodspeed, Yingjie Shen, Shane Murphy, Haroula D. Baliaka, Ryan Ward, John Seinfeld, Richard Flagan, Nicolas A. Buchenau, Jason Surratt, Ann M. Dillner, *University of California, Davis*

The Atmospheric Science and Chemistry mEasurement NeTwork (ASCENT) is a new high time resolution network that employs Time of Flight Aerosol Chemical Speciation Monitors (ToF-ACSM) to measure organics and other species in aerosol particles. Eight ASCENT sites have parallel functional group measurements from Fourier Transform Infrared Spectroscopy (FTIR) analysis of filter samples: six are Interagency Monitoring of Protected Visual Environments (IMPROVE) sites with routinely collected filters and two other sites are collecting filters for FTIR analysis. To enhance the organic characterization provided by ToF-ACSM at ASCENT sites and elsewhere, we qualitatively investigate the relationship between ACSM fragment ions and functional groups quantified by FTIR analysis, specifically carboxylic acids, alcohols, non-acid carbonyls, and alkane CH groups. In this study, we systematically explore the connections between fragment ions (m/z 29, 43, 44, 55, 57, 60, 69, 71, and 73) and their associated functional groups (carboxylic acids and alcohols) at several ASCENT sites, including Atlanta, Denver, Pittsburgh, and Yellowstone. We employ statistical methods from simple multilinear regression (ML) through more complex statistical methods like stepwise regression (SR) and Elastic Net (EN). Our research encompasses various chemical representatives, including 22 pure compounds, 20 lab-generated mixtures, and a year's ambient ACSM data from ASCENT sites, varying in their organic carbon to oxygen (O:C) and hydrogen to carbon (H:C) ratios and sources, and covering categories such as hydrocarbon-like organic aerosol (OA), biomass-burning OA, cooking OA, and oxidized OA. The response to the alcohol group is generally somewhat linear with m/z 29, whereas the carboxylic acid functional group is nonlinear with m/z 44. Currently, the alcohol groups are predicted more accurately than carboxylic acids. Additionally, the Elastic Net model demonstrates superior predictive performance, as indicated by metrics such as R^2, bias, and error across all three models.

12CA.2

Optimized Source Apportionment Using Total Carbon and Black Carbon Measurements: Integrating Multidimensional BC-Tracer and AAE Models. MARTIN RIGLER, Matic Ivančič, Iasonas Stavroulas, Eleni Liakakou, Georgios Grivas, Panagiotis Kalkavouras, Lara Bubola, Irena Ježek Brecelj, Bálint Alföldy, Gašper Lavrič, Nikolaos Mihalopoulos, Asta Gregorič, *Aerosol d.o.o.*

The 2021 WHO guidelines for $PM_{2.5}$ and PM_{10} (WHO, 2021) have been reflected in the updated US and EU air quality directives, reducing the annual mean concentration for $PM_{2.5}$ to 9 μg/m³ in the US and 10 μg/m³ in the EU. While less than 1% of the European population is exposed to $PM_{2.5}$ levels above the current standards, this figure increases to 97% when compared to the new WHO guidelines. To efficiently reduce $PM_{2.5}$ concentrations, it is essential to implement accurate and real-time source apportionment and targeted mitigation strategies, particularly for carbonaceous aerosols (CA), which significantly contribute to $PM_{2.5}$ mass and vary greatly in composition based on their sources and aging processes.

A one-year measurement campaign (03/2024-03/2025) with the new 9-λ Aethalometer model AE36s (340 – 950 nm) and new Total Carbon Analyzer prototype was conducted at an urban background site ATMOS in Athens (Greece). Ångstrom Absorption Exponent (AAE) was analyzed for the long (AAE_{long}; 590-630-880-950 nm) and short spectral range (AAE_{short}; 400-470-520-590 nm) separately, which allowed us to distinguish between different absorption fingerprints (D. G. Kaskaoutis, 2021; Gregorič et al., 2025). Coupled with the apportionment of the CA, which is based on the simplified TC-BC method, where the organic carbon (OC) content is calculated as the difference between total carbon (TC) and black carbon (BC), and the 2D BC tracer method to separate organic carbon into the primary and secondary OC (POC, SOC, Ivančič et al., 2024), the new method allows for enhanced insight to the CA composition and aging.

We used a spectral clustering method to group absorption measurements according to their position in the multidimensional AAE plot and diurnal profiles to individual clusters (Cn). Results revealed a clear separation of different aerosol sources and aging states in the 2D AAE. Traffic-related BC aerosol is characterized by low AAE in both wavelength ranges; in contrast, however, increases if particles are coated with brown carbon (BrC). Additionally, two events were distinctly separated from other sources: mineral dust by a strong increase in AAE_{short} and a consistently low AAE_{long}, and wildfire plumes, which exhibited extraordinarily high values in both AAE axes. The advanced analysis of TC-BC data using the 2D BC tracer method, for example, for the summer CA fingerprint, shows a significant contribution of SOC to CA, while most primary emissions originate from traffic-related BC (BC_{LF}) and primary OC (POC_{LF}).

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12CA.3

Characterization and Laboratory Testing of an Oxidation Flow Reactor (DOFR) to Study Secondary Organic Aerosol Formation. ANSSI ARFFMAN, Stephen Robertson, Miikka Dal Maso, Markus Nikka, Pauli Simonen, Anette Karppinen, Gordon McFiggans, *Dekati Ltd.*

The atmospheric ageing of gases released by different sources can form low vapor pressure compounds that condense to aerosol particles called secondary aerosols. The oxidation flow reactors (OFR) are used for simulating atmospheric ageing in a short time scale for studying the potential of different sources to form secondary aerosols but also for producing secondary organic test aerosols for different applications. Especially, OFR's are useful tools in studying the aging of transient emissions sources owing to their high time resolution compared to environmental chambers and compact size. Despite the limitations of accelerated photochemistry of OFRs, they provide properly used a joint metrics that can be used to compare the potential of different precursor sources to produce secondary aerosols.

In this study, we present characterization results and secondary organic aerosol (SOA) ageing experiments with a new commercially available OFR called Dekati Oxidation Flow Reactor (DOFR) and its associated sampling unit. The DOFR design is similar to the previously introduced Tampere University Secondary Aerosol Reactor (TSAR). The characterizations performed for the DOFR include the photochemical ageing range, the gas and the particle residence time distributions, and particle losses of reactor and sampling unit. The DOFR was then used for ageing toluene and a-pinene precursor vapors and the SOA yields were determined using the Electrical Low Pressure Impactor (ELPI) and a simplified chemical kinetics model. In addition, the effect of seed particle morphology and concentration on SOA production was measured with soot and ammonium sulfate seed particles.

The ageing range was found to span 1 – 35 days with the CO tracer oxidation experiment. The toluene precursor oxidation experiments showed comparable results to previous studies showing 10% – 30% yields for tested toluene concentrations. The different seeds were found to have significant effect on nucleation and could practically inhibit the nucleation entirely.

12CA.4

Regurgitation of Black Carbon Aerosols from the Ocean During a Cyclone. ASHISH SONI, Pawan S. Soyam, Shivdas Bankar, Thara Prabhakaran, Harindra J. Fernando, Devmi Gamage, Griffin Modjeski, Selina Bolella, Joaquim Goes, Charles Kovach, Sudarsan Bera, A. Aravindhavel, Maria Laura Zaffoli, Amit Tandon, Mahen Konwar, P. Murugavel, Pramod Safai, Stefano Decesari, Maria Cristina Facchini, Craig M. Lee, Nandakumar Kalarikkal, *Indian Institute of Tropical Meteorology*

In-situ observations of atmospheric Black Carbon (BC) aerosols over the northern Indian Ocean are sparse, especially during the Indian Summer Monsoon season due to harsh and challenging oceanic conditions associated with strong south-westerly winds and rough sea states. In the present study, we measured atmospheric BC over the Arabian Sea (AS) during June on board a research expedition. While BC is expected to decrease as we move away from continental landmass, surprisingly, despite negligible land-based combustion activities at this time of the year, a zone of high BC was observed offshore within a narrow band impacted by the Biparjoy cyclone. The median BC concentration was two-fold higher within the cyclone-impacted zone than in the region east of this zone. Airmass back-trajectory and satellite fire map analysis revealed that savanna burning in Africa could significantly affects elevated BC signals over the AS. However, the absence of correlation of BC with biomass-burning tracers inside the high-BC zone clearly suggested some other active source(s). Correlation analysis of BC with oceanic deep-water vertical mixing indicators as well as atmospheric processes provides vital pointers that a significant amount of this BC can be regurgitated from waters, which are brought to the surface from depth, as the deep ocean is one of largest reservoirs of BC aerosols. These findings demand a nascent scope for controlled simulation experiments to estimate regurgitated BC from the ocean to reduce its uncertainty.

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12CM.1

Detection of and Protection from VOC "Spikes" Generated during Everyday Cooking, Cleaning, and Artistic Activities.

Sonam Devabhaktuni, Sathyaraj Devabhaktuni, DEVABHAKTUNI SRIKRISHNA, *PatientKnowhow.com*

Prior work characterized extreme levels of volatile organic compound (VOC) generation during cooking such as when frying oils/fats. Last year at AAAR, we presented measurements using low-cost TVOC sensors on extremely high levels of VOC generated ("spikes") during everyday cooking, cleaning, and artistic activities. The VOC-generating substances tested included lysol, vodka, nail polish, toasting bread, hair mousse, markers, peanut butter, ice cream, and sunscreen. When an updated version of the same low-cost TVOC sensor was able to detect VOC that the older model was unable to, raising the question of whether certain VOC species are being missed by one or both models. To address this question, in this research, we compare the measurements of both versions of the low cost TVOC sensors to a factory-calibrated photoionization detector (PID) in a test matrix of TVOC measurements of spikes observed with these and additional substances. Given the unpredictability of spikes these results motivate wider use of low-cost VOC counters to offer real-time warning of potentially risky spikes, while recognizing the gaps in their detection of certain VOC species. These warnings can be used to selectively initiate (trigger) VOC air cleaning for indoor occupants at a distance, and if air cleaning of indoor VOC is inadequate, personal protection such as P100 elastomeric respirators with organic vapor.

12CM.2

The Need for Efficient COVID-19 Engineering Controls.

Yun-Hui Kao, Sheng-Hsiu Huang, Yu-Mei Kuo, Chih-Wei Lin, CHIH-CHIEH CHEN, *National Taiwan University*

Biomedical tools such as vaccines and antiviral drugs are essential, but their development takes time, so they can only be considered the second line of defense against COVID-19. Engineering measures are more ready and preventive than biomedical tools and should be deployed as the first line of defense. New engineering containment methods/devices that could change how WHO and national CDCs manage viral aerosols in current and future pandemics are being developed.

This study analyzes and summarizes the importance and necessity of developing a complete set of "pandemic extinguishers" to effectively stop the spread of COVID-19 and other airborne diseases. From the perspective of control hierarchy, source control is the most effective way to eliminate emissions, followed by pathway control and receptor control. From the user's perspective, these devices are designed and used separately for infected or healthy people.

Control devices should be designed based on the wearer's health status and the dispersion of bioaerosols. Breath-Taking Hoods are designed for infected and asymptomatic people to remove the exhaled breath aerosols and protect the environment. The Breath-Responsive Powered-Air Purifying Respirators are designed to protect healthy people. Indoor air cleaners with adequate clean air delivery rates can reduce health risks in indoor environments. Critical ill patients can use portable medical quarantine hoods when negative isolation wards are unavailable. Walk-in hoods with filtered incoming or outgoing flow for dining or other activities can be used by healthy or infected people, respectively. Aerosol-free toilets are also essential in the overall control scheme. Notice that many new products still need to be added to the FDA certification list, and performance testing methods and accredited laboratories still need to be prepared. We need to move fast before the next virus hits us.

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12CM.3

Modeling Particle Charging and Deposition Behavior in Single-stage Wire-plate Electrostatic Precipitators. AUSTIN ANDREWS, Christopher J. Hogan, *University of Minnesota*

Accurate modeling of particle deposition in electrostatic precipitators (ESPs) requires coupled modeling of fluid flow, electrostatic potential, particle charging and migration. Often, ESP performance predictions are difficult to extrapolate to other ESP geometries or operating conditions, because of the coupled physical processes governing particle behavior in ESPs. In this presentation, we introduce a theoretical framework using cumulative deposition distribution functions (CDDFs), derived from stochastic particle trajectories, to calculate mass transfer coefficients, improve ESP performance predictions, and provide clearer insight into the behavior of particles in ESPs. Using a recently developed electrohydrodynamic flow solver coupled with particle trajectory simulations, we analyze particle penetration and charging behavior in a single-stage wire-plate ESP, achieving strong agreement with experimental results. We also compare these results to analytical CDDF models representing two limiting cases commonly used in ESP modeling, i.e., the well-mixed (exponential distribution) and ballistic (Heaviside distribution) limits. Our findings demonstrate that computed CDDFs are strongly dependent on initial particle position and size and are not adequately described by these simplified models. However, once obtained, CDDFs allow for efficient exploration of effects such as variations in inlet concentration profiles and ESP length without requiring further simulations.

12CM.4

A Brief History of Bioaerosol Sampling: From Early Innovations to Future Prospects. GEDIMINAS MAINELIS, *Rutgers, The State University of New Jersey*

Effective bioaerosol sampling techniques are fundamental to understanding airborne microbial exposure and its implications for health and environmental science. While bioaerosol researchers typically do not give much thought to how their sampling tools have evolved, the history of bioaerosol sampling technologies offers a window into technological development and the state of science in the past, while also offering guidance for future developments. The earliest documented observations of bioaerosols date back to Darwin's 1833 discovery of airborne mold spores, demonstrating the natural transport of microbial particles through the air. Louis Pasteur's 1860 experiment, designed to disprove spontaneous generation, inadvertently demonstrated passive bioaerosol sampling principles, as bacteria settled under gravity into the nutrient broth. Thus, early bioaerosol sampling techniques relied on passive collection methods, such as sedimentation plates, which were limited by environmental variability and low collection efficiency. By the late 19th and early-mid 20th centuries, the development of active sampling methods, such as impingers (e.g., sampling flask and bacterial Aeroscope) and impactors (e.g., Andersen impactor), revolutionized bioaerosol collection by incorporating controlled airflow for enhanced particle capture on solid or liquid media. The development of filter-based samplers further enhanced collection precision, allowing for prolonged sampling durations and concentration-based analysis. The introduction of the electrostatic sampling concept in the 1940s has provided new avenues for improving collection efficiency and preservation. A renewed interest in passive sampling technologies offers the possibility of inexpensive tools that could be widely distributed over wide spatial areas. However, many challenges still remain, including long-term sampling, personal exposure assessment, compatibility of sampling methods, improving detection limits, standardization of sample analysis protocols, real-time detection technologies, and integration with molecular analysis. This presentation will highlight the key milestones in bioaerosol sampling technology, addressing current challenges and exploring emerging innovations that may shape the future of the field.

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12NP.1

Nanoscale High-Entropy Alloy Catalysts from a Flame Aerosol Process. Shuo Liu, Chaochao Dun, Jeffrey Urban, MARK SWIHART, *University at Buffalo - SUNY*

In metal alloys combining five or more elements in near equiatomic concentrations, the entropic contribution to the total Gibbs energy overcomes the enthalpic contribution to stabilize a solid solution structure. Thus, this class of materials has become known as high-entropy alloys. Historically, most research on high-entropy alloys focused on mechanical property enhancement, in part because conventional high-entropy alloy fabrication methods produce powders or bulk materials. More recently, novel synthesis methods have enabled production of high-entropy alloy nanomaterials with outstanding performance in energy-related applications, particularly in catalysis where the catalyst activity and stability can be rationally modified by the interaction among multiple elements.

Here, we present a one-step, continuous, and scalable flame aerosol synthesis route to produce supported high-entropy alloy nanoparticles. In contrast to conventional flame spray pyrolysis, this method separates the flame and particle formation processes. This allows it to provide a relatively lower reaction temperature at which nanoparticles form by a droplet to particle, rather than gas to particle, route. The droplet drying process is extremely fast, so the metallic elements can be combined uniformly in a single FCC alloy phase independent of their thermodynamic miscibility. Excess H_2 is supplied to the flame, providing a reducing atmosphere in the reaction chamber. Moreover, a support material can be dispersed in the precursor solution, to introduce heterogeneous nucleation sites for alloy particle growth. The resulting high density of nuclei allows high mass loadings of sub-5 nm nanoparticles on supports. We show that highly dispersed high-entropy alloy (e.g. RuRhPdIrPt) nanoparticles can be deposited on various support materials, such as graphene, MOFs, carbon nanotubes, and metal oxides. We also present an in situ strategy to form the high-entropy alloy nanoparticles and mesoporous silica support simultaneously. We show that less reducible metals (e.g. W) can be incorporated into the high entropy alloy nanoparticles, even when that metal alone could not be reduced by hydrogen in the presence of water. Finally, we show that graphene-supported high-entropy nanoparticles outperform their single-component counterparts in a representative electrocatalysis application (hydrogen oxidation reaction).

12NP.2

Aerosol-Enabled One-Step Synthesis of ZIF-Derived Porous Carbon Spheres. MOHAIMINUL CHOWDHURY, Wei-Ning Wang, *Virginia Commonwealth University*

We report a novel, scalable, one-step synthesis of zeolitic imidazolate frameworks (ZIF)-derived porous carbon spheres via an aerosol-assisted route. We conducted systematic experiments to address two key issues in aerosol-based ZIF synthesis, i.e., rapid solvent evaporation and the delayed deprotonation of organic linkers. This precursor optimization enables homogeneous nucleation and formation of ZIFs inside microdroplet reactors, thereby facilitating the in-flight carbonization of the ZIF structures. The effect of synthesis temperature on the surface area, pore architecture, and morphology of the resulting carbon spheres was systematically investigated. Structural and chemical analyses, including X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDAX), Fourier transform infrared spectroscopy (FTIR), and nitrogen sorption, verified the successful formation of mesoporous carbon. The features of the as-synthesized ZIF and the derived porous carbon were also compared with those of the conventionally synthesized ones. This work offers a facile and continuous approach that addresses limitations of batch processes, offering a promising route for the scalable production of ZIF-derived porous carbons for applications in energy storage, catalysis, and environmental remediation.

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12NP.3

Evaluation of Sub-50 nm Colloidal Silica Detection and Non-Volatile Residue Control for Liquid Filtration through Aerosolization-Based Techniques. ZHENGYUAN PAN, Qisheng Ou, Daniel R. Troolin, David Y. H. Pui, *University of Minnesota*

The membrane filtration is an important technique to protect the processing liquid from contaminants, such as silica Nanoparticles (NPs), that can interfere with chip production. As semiconductor manufacturing advances toward the 1.4 nm node by around 2027, the industry demands contamination detection and control at least at the single-digit nanometer level. However, conventional optical particle counters may hit their limits at around 20 nm due to the low refractive index of silica NPs and microbubble interference. Aerosolization-based technique by aerosolizing the colloidal particles and detecting them using a Scanning Mobility Particle Sizer (SMPS) is capable of measuring a broader size range, down to 2 nm. As the liquid sample is greatly diluted after aerosolization, the Minimum Detectable Concentration Limit (MDCL) of this technique could be high. In this work, we aimed to investigate and optimize the MDCL of the aerosolization-based technique while maintaining its sensitivity to small particles. The residue control through droplet size control and dissolved Non-Volatile Residue (NVR) removal was first studied. Then, testing methods using either an aerosol generator combined with an SMPS or a Condensation Particle Counter (CPC) without a Differential Mobility Analyzer (DMA) were conducted to measure 5 to 50 nm NPs. Linear correlations between liquid-borne and air-borne particle concentrations were obtained for both methods. The results demonstrate that the DMCL can be optimized by flexibly controlling the threshold detectable size of CPC, avoiding using the DMA, especially for sub-20 nm particles.

12NP.4

One-Step Synthesis of Nanostructured Spinel-Type High Entropy Oxide (HEO) Materials by the Flat Premixed Droplet-Seeded Flame (FPDSF) Method. OWEN S. FUHR, Serdar Yildirim, Tyler Park, Xiao-Dong Zhou, Francesco Carbone, *University of Connecticut*

High Entropy Oxides (HEOs) have emerged as promising materials in catalytic and energy storage applications due to their structural stability and compositional flexibility. In this study, nanostructured spinel-type HEO materials composed of Fe, Cr or Cu, Mn, Co, and Ni have been synthesized using the Flat Premixed Droplet-Seeded Flame (FPDSF) method, which enables rapid, scalable, and highly controllable synthesis and thermophoretic deposition of compositionally complex metal oxide nanoparticles. Thermophoretically deposited HEO films are analyzed using Transmission and Scanning Electron Microscopy (TEM and SEM) and X-ray Diffraction (XRD). Microscopy analyses reveal polycrystalline nanoparticle aggregates spanning multiple length scales, and XRD identifies clear diffraction peaks consistent with a single-phase spinel magnetite (Fe_3O_4) structure, confirming the successful incorporation of multiple transition metals into a homogeneous oxide lattice. Size Distribution Functions (SDFs), measured from 0.75 nm to 50 nm using dilution sampling followed by High-Resolution Differential Mobility Analysis (HR-DMA), reveal a particle mode centered around 1 nm to be predominant in number at a Height Above the Burner (HAB) of 30 mm. Preliminary electrocatalytic tests FPDSF-synthesized HEO nanoparticles have yielded promising results. Additionally, HR-DMA results are being cross-validated with TEM analyses performed on samples collected directly on TEM grids over ~50 ms sampling intervals using a double-acting pneumatic actuator. This study demonstrates the potential of the FPDSF method as a cost-effective, rapid, and scalable synthesis route for producing nanosized high-entropy oxides with precise compositional control and promising catalytic performances.

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12RM.1

Deep Convection Leads to Ultrafine Particle Formation and Growth in the Upper Troposphere at Continental Mid-Latitudes. MADELINE COOKE, John Ortega, James Smith, *University of California, Irvine*

Ultrafine aerosol particles impact climate and weather as a main source of cloud condensation nuclei in the upper troposphere. A wide body of research has demonstrated that the vertical transport of boundary layer pollutants to the upper troposphere during atmospheric convection drives new particle formation in the tropics. Less attention has been paid to continental midlatitudes. During the summertime in the United States, atmospheric convection occurs daily in many regions, particularly in the Southeast. However, the extent to which convection influences upper tropospheric ultrafine particle formation in this region remains unclear. Herein, we report on measurements of ultrafine particles in the upper troposphere during the Deep Convective Clouds and Chemistry (DC3) campaign in May to June of 2012. Across twenty-one flights tracking convective outflow plumes, ultrafine particles were frequently observed. For the majority of flights (~70%), the average number concentrations (N_{100nm}) of particles with diameters between 8 – 100 nm were 10 – 500 cm^{-3}. Several flights exhibited elevated N_{100nm}, with concentrations exceeding 1000 cm^{-3}. Gas-phase measurements were compared for six flights, with three representing elevated N_{100nm} and three, low N_{100nm}, revealing that sulfuric acid and oxidized organic vapors likely contribute to ultrafine particle formation in this region. One particular flight followed a plume and intersected it several times showing that ultrafine particles grew due to photochemical aging at a rate of 2.4 ± 0.1 nm hr^{-1}. Condensation of sulfuric acid can only explain a small fraction of this measured growth. Future measurements are needed to constrain these processes in atmospheric models, particularly of the molecular speciation of both gas-phase precursors and ultrafine composition. Upper tropospheric ultrafine particles in this region may become more important as climate models project increasing frequency and intensity of atmospheric convection in the future.

12RM.2

Estimating Planetary Boundary Layer Influence at the Helmos Hellenic Atmospheric Aerosol & Climate Change (HAC)2 Station Using Remote Sensing Techniques and In-Situ Measurements. OLGA ZOGRAFOU, Maria Gini, Prodromos Fetfatzis, Konstantinos Granakis, Romanos Foskinis, Christos Mitsios, Carolina Molina, Aiden Jönsson, Paul Zieger, Mika Komppula, Alexandros Papayannis, Athanasios Nenes, Konstantinos Eleftheriadis, *NCSR Demokritos, Athens, Greece*

Aerosol-cloud interactions introduce significant uncertainties in climate models, and thus their study under real-time conditions by in-situ measurements is essential in the effort to mitigate climate change. High-altitude stations (HAS) offer great possibilities to investigate these interactions, particularly cloud formation processes with respect to aerosol availability, air mass origin and air mass type. HAS often reside in the Free Troposphere (FT). A challenging issue in HAS measurements analysis is the segregation between FT and Planetary Boundary Layer (PBL) influenced air masses, as the definition and quantification of the PBL are inherently vague.

The Helmos Hellenic Atmospheric Aerosol and Climate Change ($(HAC)^2$) station in Greece (2314 m a.s.l.) is the only HAS in the eastern Mediterranean. The CALISHTO (Cloud-Aerosol InteractionS in the Helmos Background TropOsphere) and CHOPIN (Cleancloud Helmos OrograPhic sIte experiment) campaigns were conducted at Mount Helmos during the autumn-winter periods of 2021–2022 and 2024–2025, respectively, with the scope of enhancing the understanding on the processes driving mixed-phase clouds formation. Both in-situ (GHGs, aerosol size distributions, aerosol optical properties, meteorological data, etc) and remote sensing (Doppler lidar) measurements at a number of sites and the (HAC)2 were used to investigate PBL influence at $(HAC)^2$.

A set of metrics was established, including the water vapor mixing ratio, the accumulation mode (particles with a diameter > 95 nm) number concentration, and the ratio of eBC to CO, as proxies for estimating PBL influence at (HAC)2 without remote sensing measurements. A logistic regression model was trained using periods with both in-situ and remote sensing data, enabling PBL influence estimation from in-situ metrics alone. The model was tested on a subset of the common dataset, and the overall agreement between remote sensing and model predictions exceeded 80 %.

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12RM.3

Evaluation of Arctic Aerosol Mass Scattering Efficiency using Airborne Observations. LUKE ZIEMBA, Matthew Brown, Josh DiGangi, Glenn Diskin, Eva-Lou Edwards, Francesca Gallo, Susan Mathai, Richard Moore, Amin Nehrir, Michael Shook, Armin Sorooshian, Jian Wang, Edward Winstead, *NASA*

The climate impact of ambient aerosols depends on the composition, size, and vertical distribution of the particles in the atmosphere. To compute radiative effects, global climate models often need to translate between particle mass concentrations and optical properties using empirically- or theoretically-derived mass scattering (and absorption) efficiencies. But, inherent in this process are assumptions regarding the material properties of the aerosol mixture, the particle size distribution, and the vertical profile of aerosols in the atmosphere. Assessing the mass scattering efficiency is especially challenging in the Arctic, where mass concentrations are low and remote sensing validation is difficult. Here, we use airborne observations made from the NASA P3 aircraft during the ARCSIX (Arctic Radiation Cloud aerosol Surface Interaction Experiment) campaign in 2024 based at Pituffik Space Base in northwest Greenland. Speciated aerosol mass concentration and size distribution measurements, combined with measurements of scattering coefficient, are used to assess assumed mass scattering efficiencies. Measurements of particle refractive index are used to corroborate Mie Theory calculations. Seasonal differences (i.e., between spring and summer) and the vertical profile are discussed. Finally, sub-saturated hygroscopicity measurements are used to extrapolate dry measurements to ambient RH, and in-situ extinction profiles are compared to coincident lidar observations.

12RM.4

Biogenic Effects on New Particle Formation at a Subalpine Site in Colorado. ANNA KAPP, Darielle Dexheimer, Gregory W. Vandergrift, Zhenli Lai, Nurun Nahar Lata, Swarup China, Zezhen Cheng, James Smith, *University of California, Irvine*

The Surface Atmosphere Integrated Field Laboratory (SAIL) was a unique long-term field campaign that took place in southwestern Colorado, USA, 1 September 2021 - 15 June 2023. One of the objectives of SAIL was to explore the seasonal variability of particle sources and sinks, which has implications on the life cycle of aerosols and their impacts on atmospheric and surface radiative budgets. The SAIL site saw frequent new particle formation (NPF) events during the observation period. This presentation explores the seasonal variability of NPF events and compares aerosol composition during a period of intense NPF to a period without events. Size distributions obtained with a scanning mobility particle sizer showed an increase in atmospheric NPF events during the winter-spring transition period (February-June) and, to a lesser extent, the fall-winter transition period (September-December). Summertime (June-July-August) was characterized by dominant ~100 nm mode and no clear nucleation mode.

Twelve-hour samples of bulk aerosols were collected on Polytetrafluoroethylene (PTFE) filters during and after an NPF event in May 2023. Data from these filter samples indicates that the relative abundance of sesquiterpene oxidation products in aerosol was elevated when NPF was taking place and decreased afterwards. In concert with the sesquiterpene oxidation products, the molecular weight of the average compound was at a maximum of 230 amu during the NPF event, this decreased to 217 amu after the NPF event. Conversely, the average O:C ratio was at a minimum of 0.5 during the NPF event, this ratio went up to 0.67 after the event. NPF therefore appears to be driven by an increase in larger but less oxidized compounds. Overall, the molecular level data showed that NPF events may be associated with biogenic volatile organic compounds, which points to the ways local ecology can affect particle formation and growth.

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