How the Use of an Atmospheric Smog Chamber Allows Us to Investigate the Impact of Urban Air Pollution on the Exacerbation of Pulmonary Fibrosis

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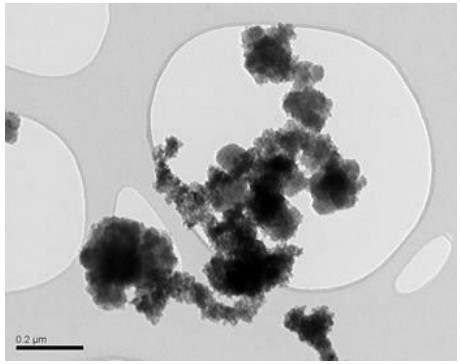
PolluRisk

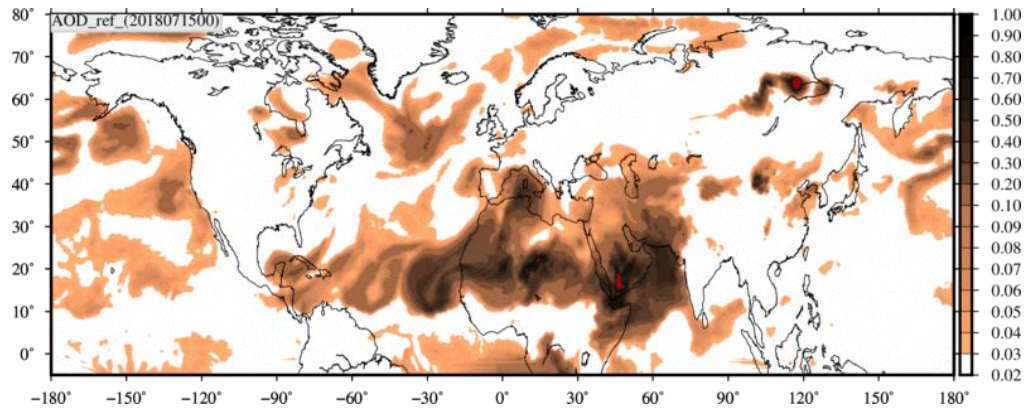
LISA: a French laboratory, dealing with atmospheric systems & aerosols

lisa | Laboratoire Inter-universitaire des Systèmes Atmosphériques

Observation

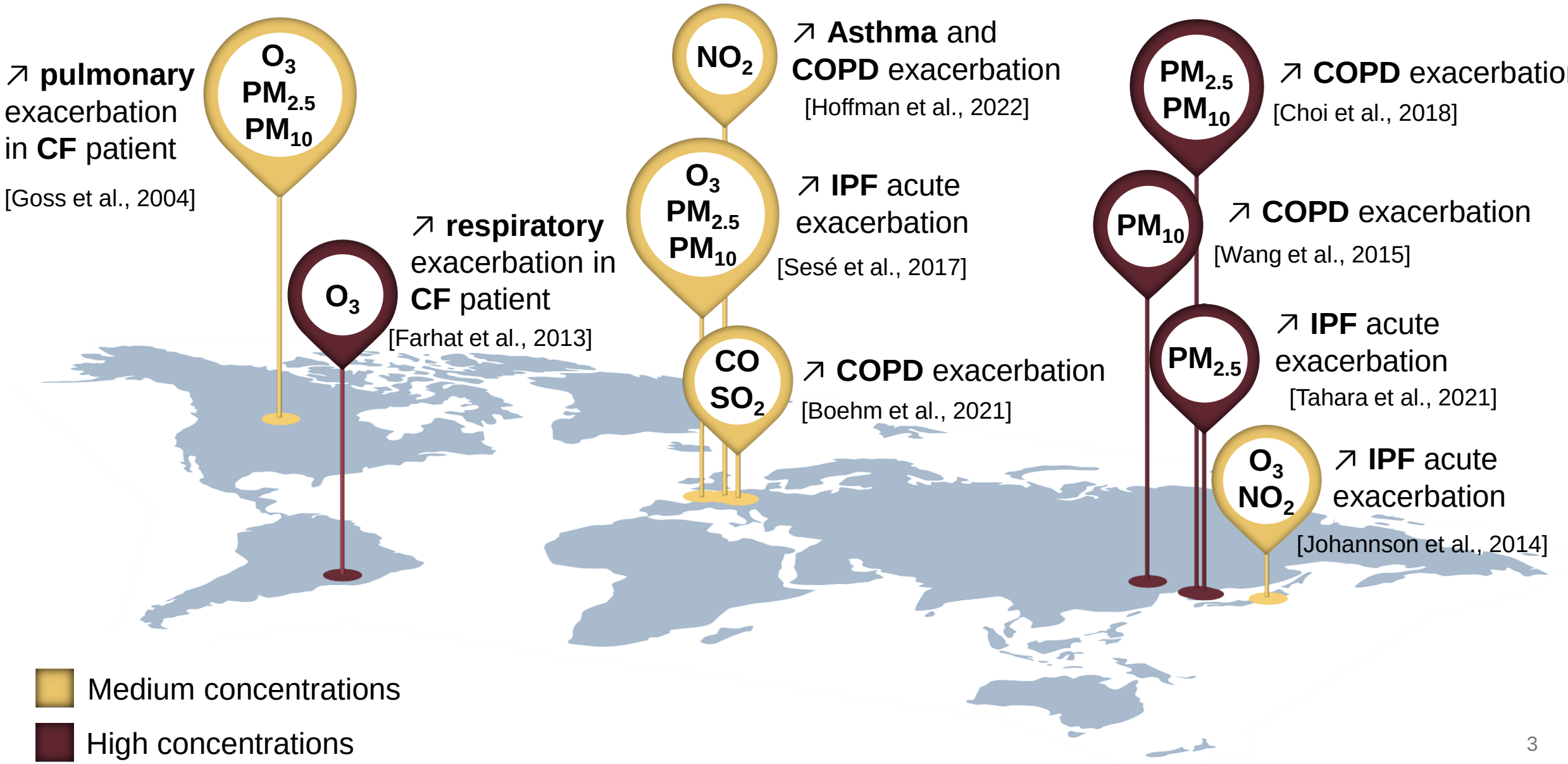


Experimental simulation at the lab



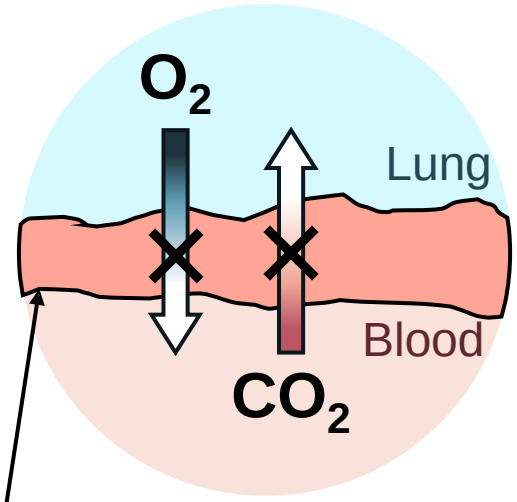
Modeling

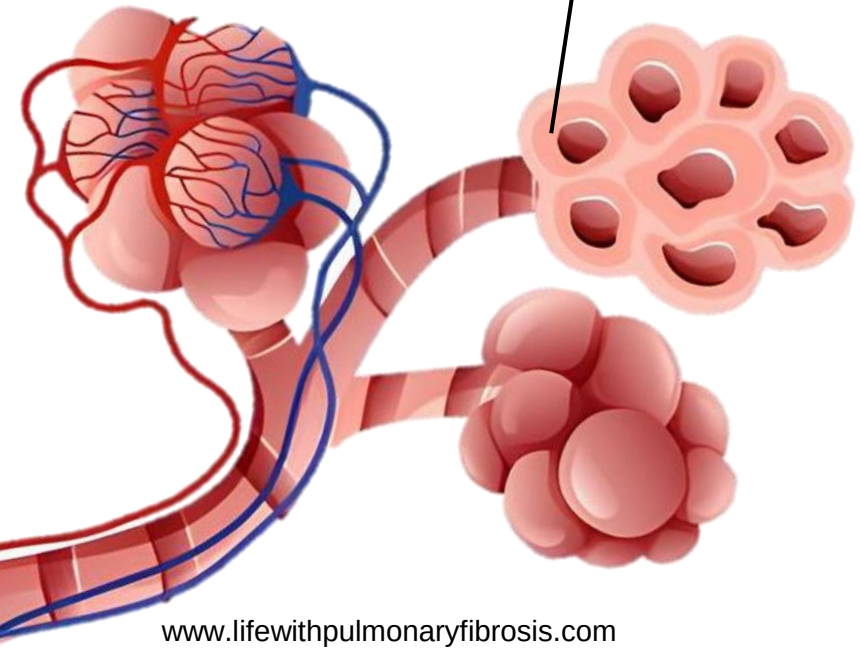
Urban air pollution: an exacerbator of respiratory/lung diseases?



Acute exacerbation of Idiopathic Pulmonary Fibrosis (IPF)

Thickened alveolar wall





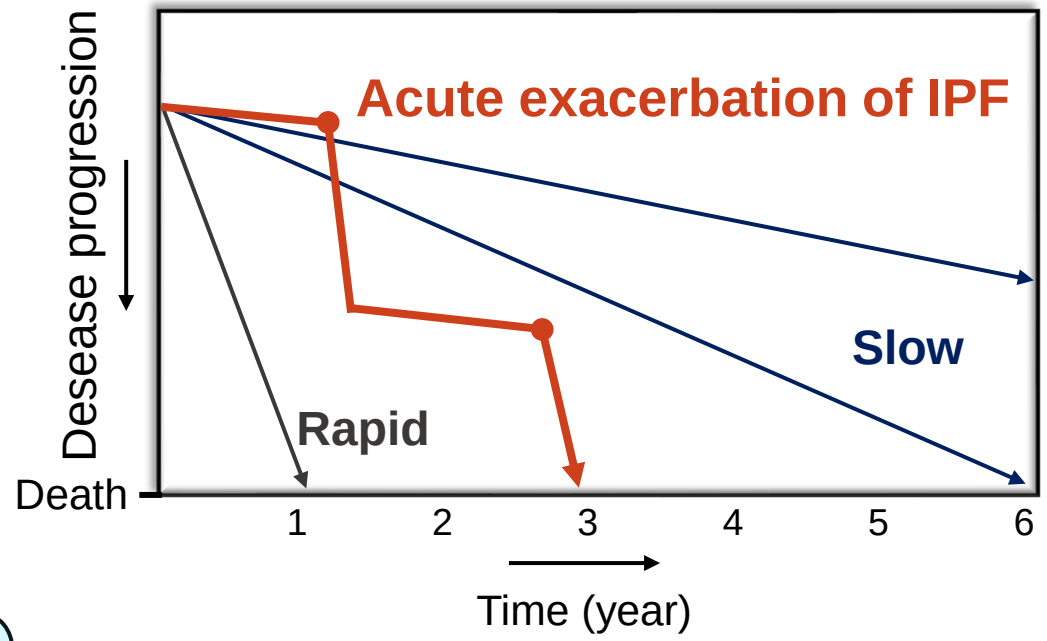
O_3

$PM_{2.5}$

NO_2

Epidemiological studies in urban cities

Adapted from [Ley et al., 2010] and www.pulmonaryfibrosis360.com



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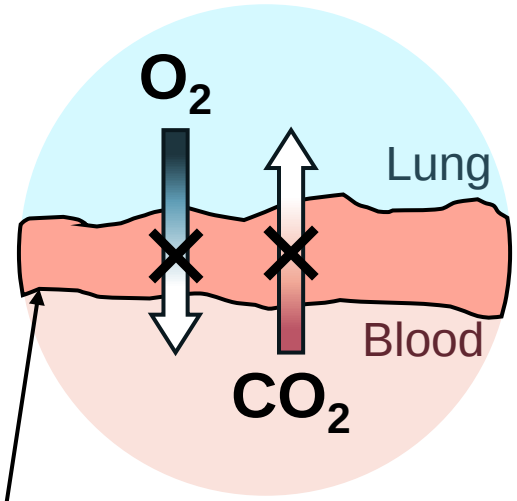
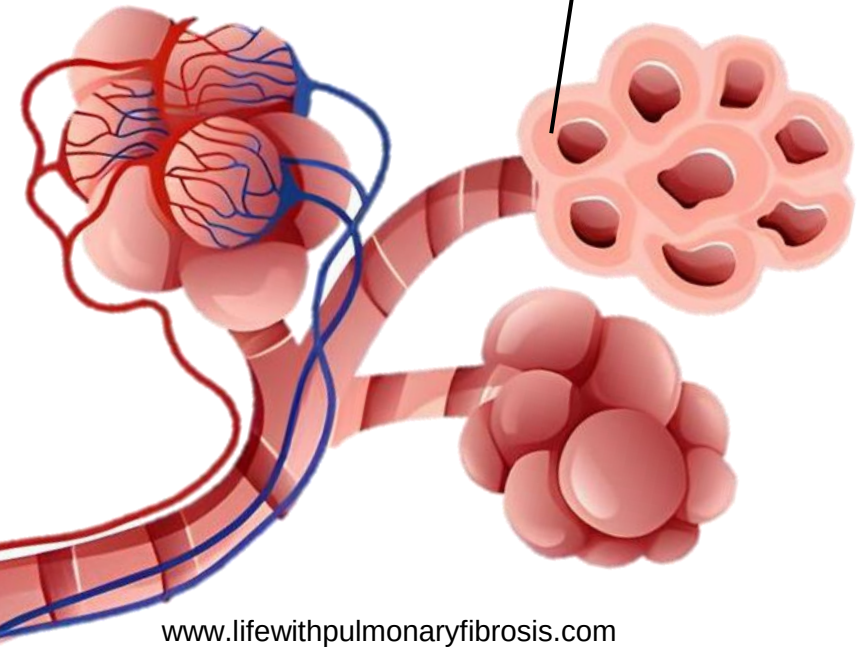
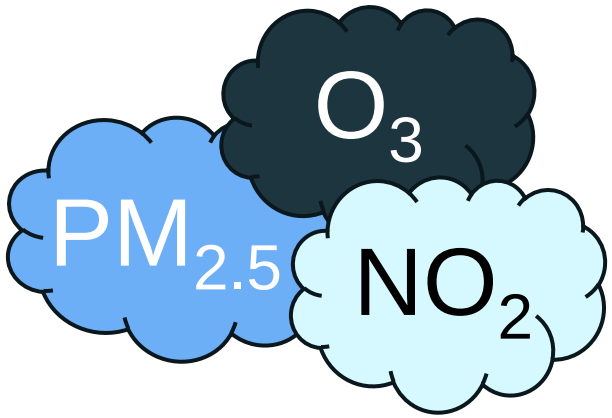
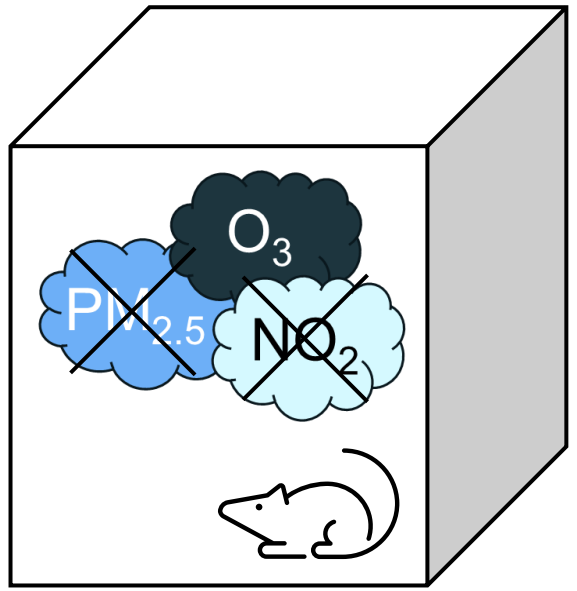






Epidemiological studies in urban cities

Exposure to one species at a same time → lack of reality



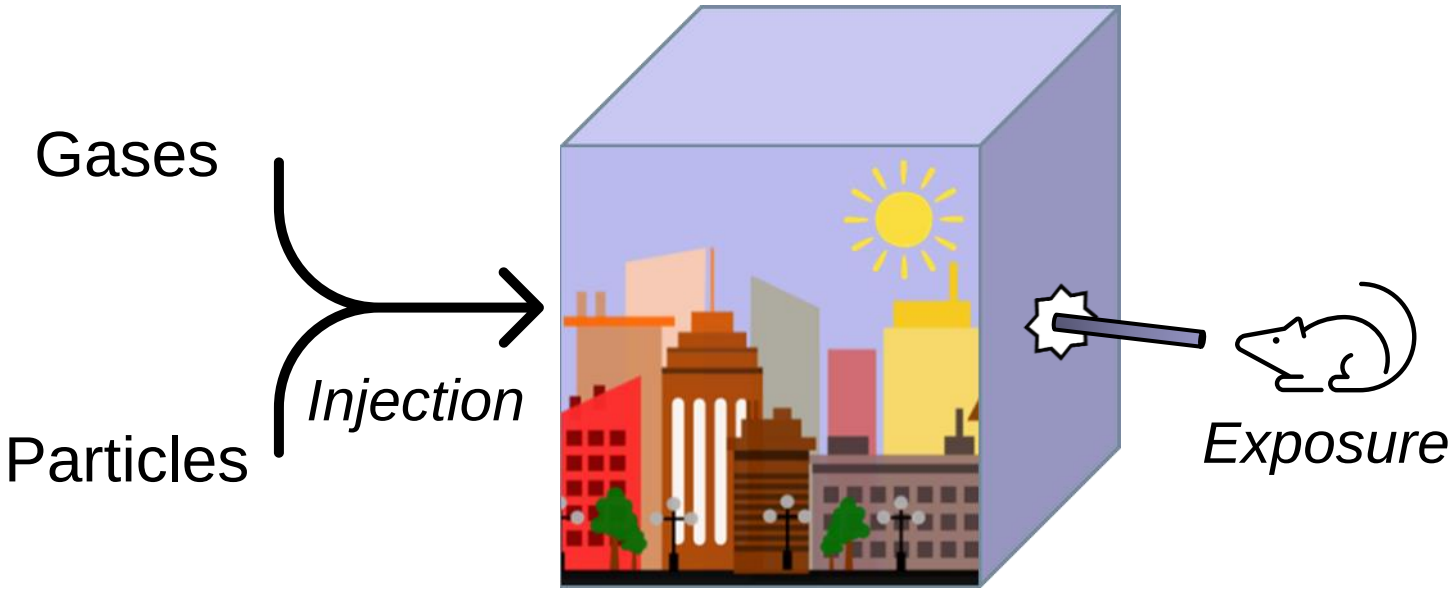
AND THE MEASUREMENTS?

www.lifewithpulmonaryfibrosis.com
www.passeportsante.net ©

Main purpose

How can we bring together the different scientific communities to complete the epidemiological studies?

→ **POLLURISK PLATFORM** [Coll et al., 2018]



Chemical processes
& Aging in smog chamber

FIPOLL 2022

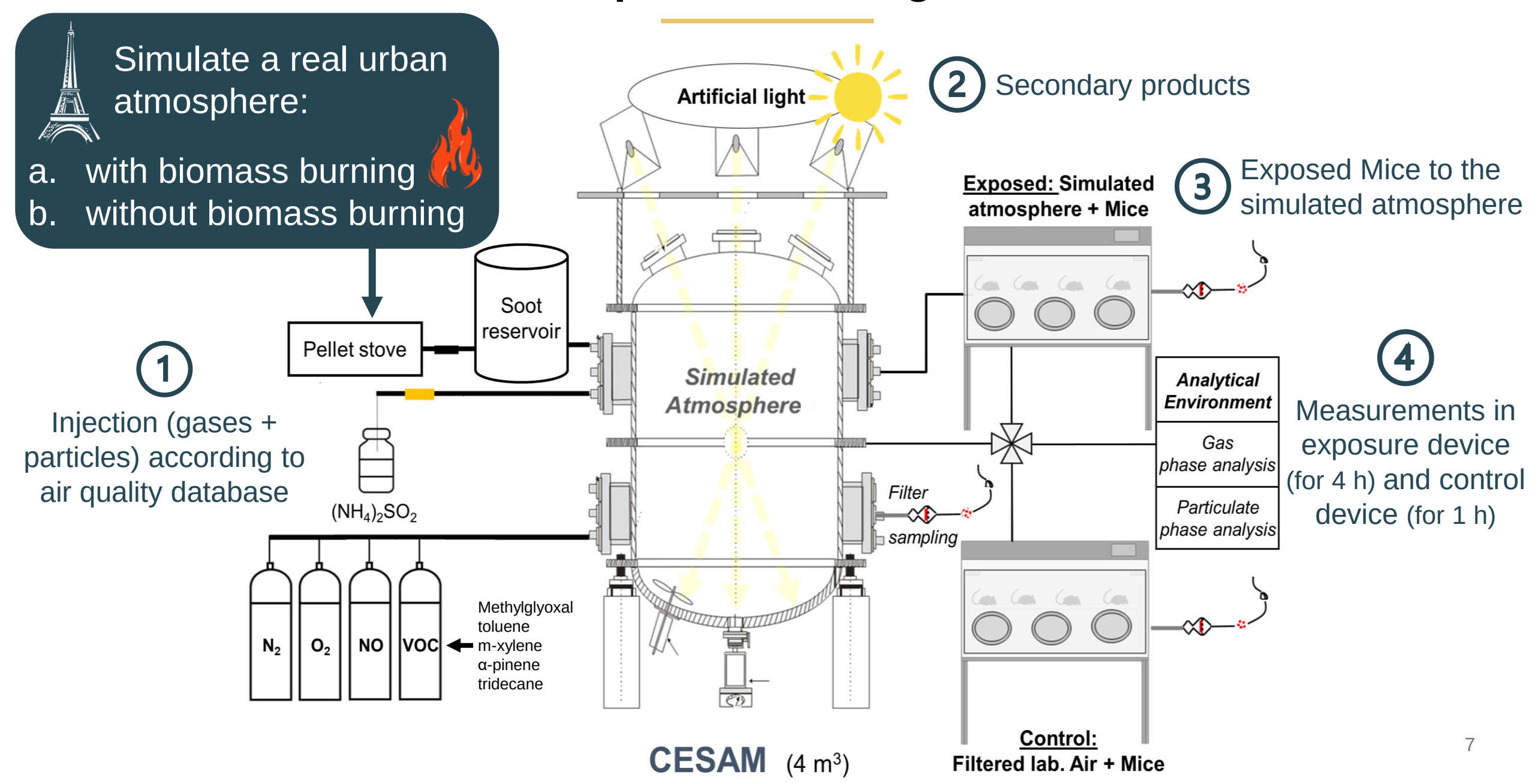
Air pollution and pulmonary fibrosis

Is there a link between **urban air quality** and **exacerbation of idiopathic pulmonary fibrosis?**

Experiment design

Simulate a real urban atmosphere:

a. with biomass burning
b. without biomass burning

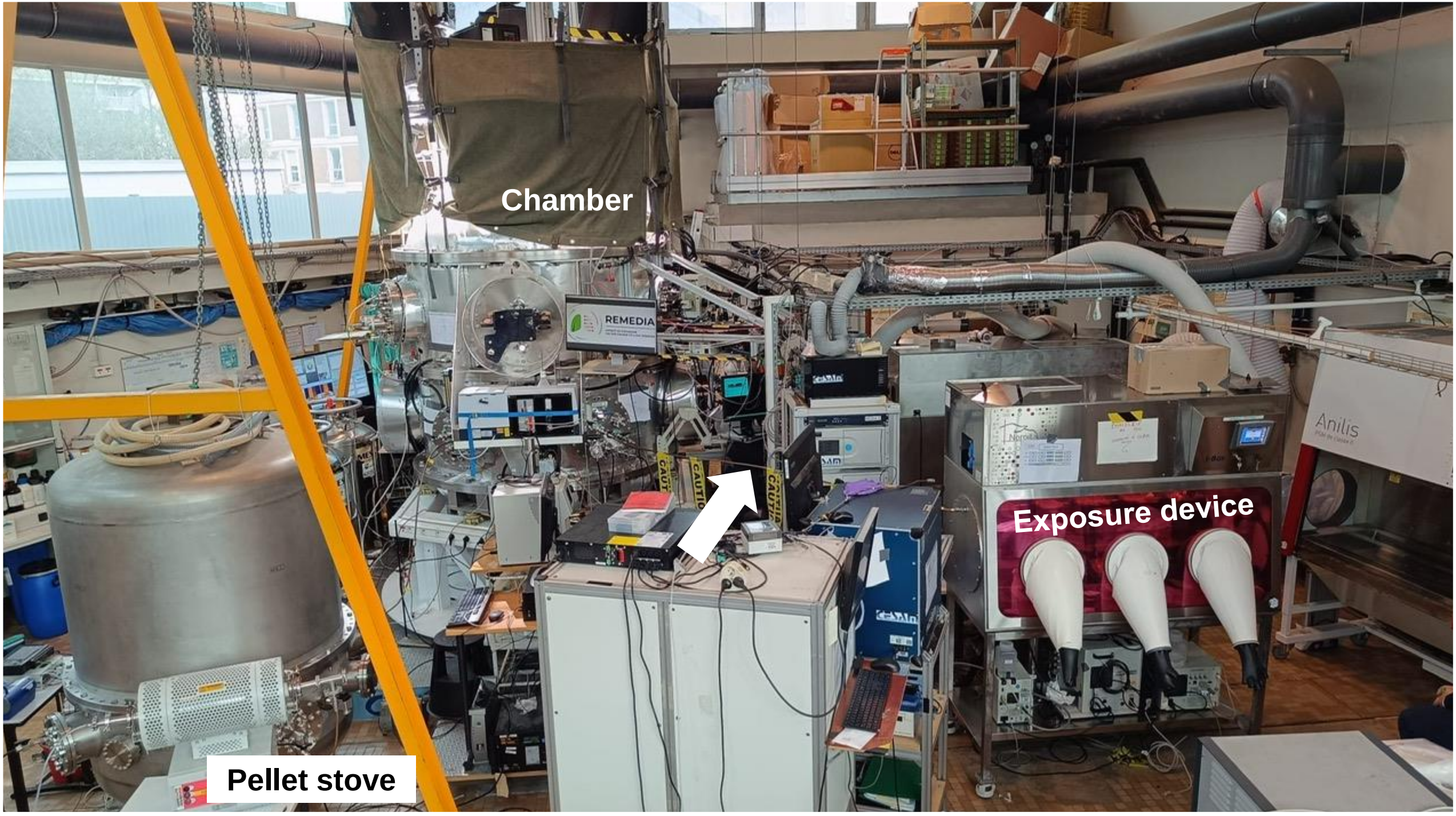


1 Injection (gases + particles) according to air quality database

2 Secondary products

3 Exposed Mice to the simulated atmosphere

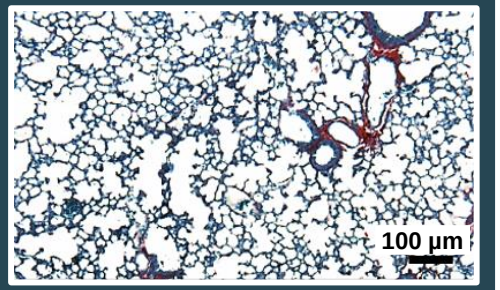
4 Measurements in exposure device (for 4 h) and control device (for 1 h)


Chamber
REMEDIA
Exposure device
Anilis
Pellet stove

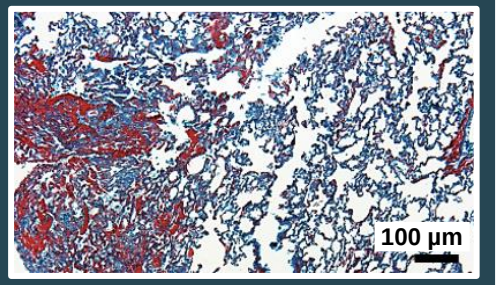
Presentation of the experiment

Exposure of 2 models of mice (C57Bl6 , ♂, 2 months old)

Intact lung



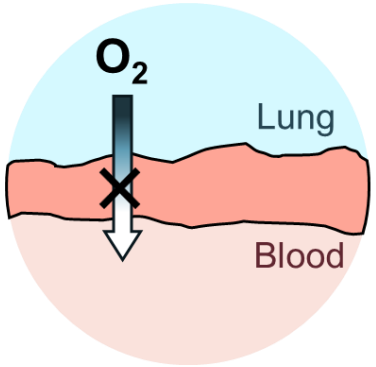
Pulmonary Fibrosis (PF) by repeated instillations of low doses of bleomycin



[Yegen, PhD thesis, 2022]

Expo.
7 days

Oxygen saturation



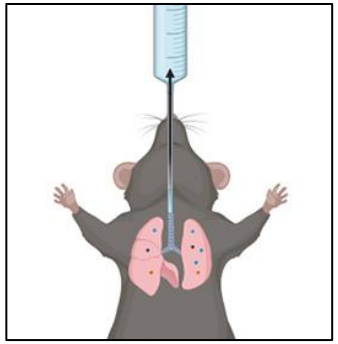
Sacrifice

+7 days

Acute alveolar damage evaluation

Inflammation, oxidative stress, apoptosis Bulk RNAseq

Bronchoalveolar lavage



[Poli et al. 2023] ©

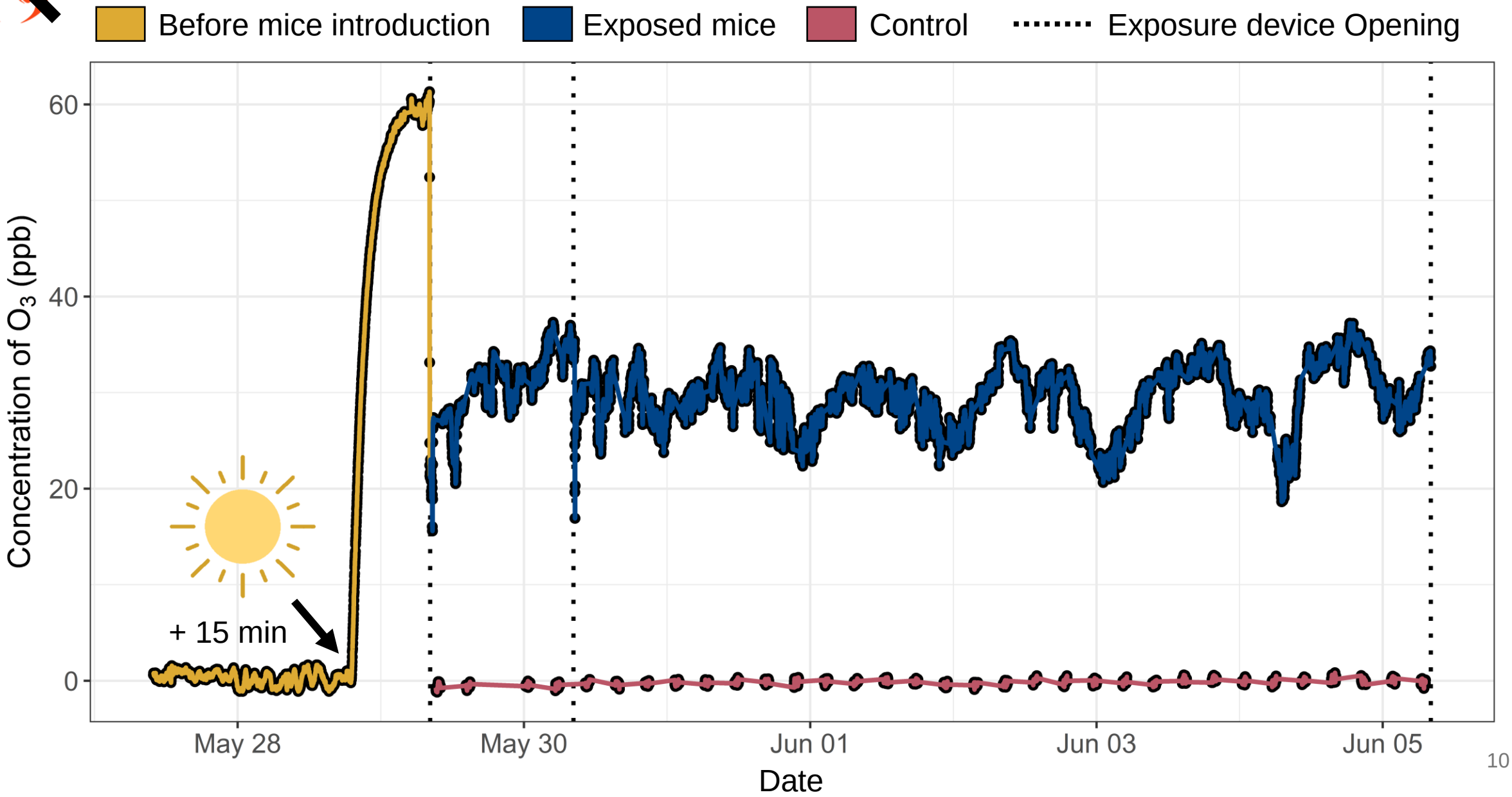
Sacrifice

+21 days

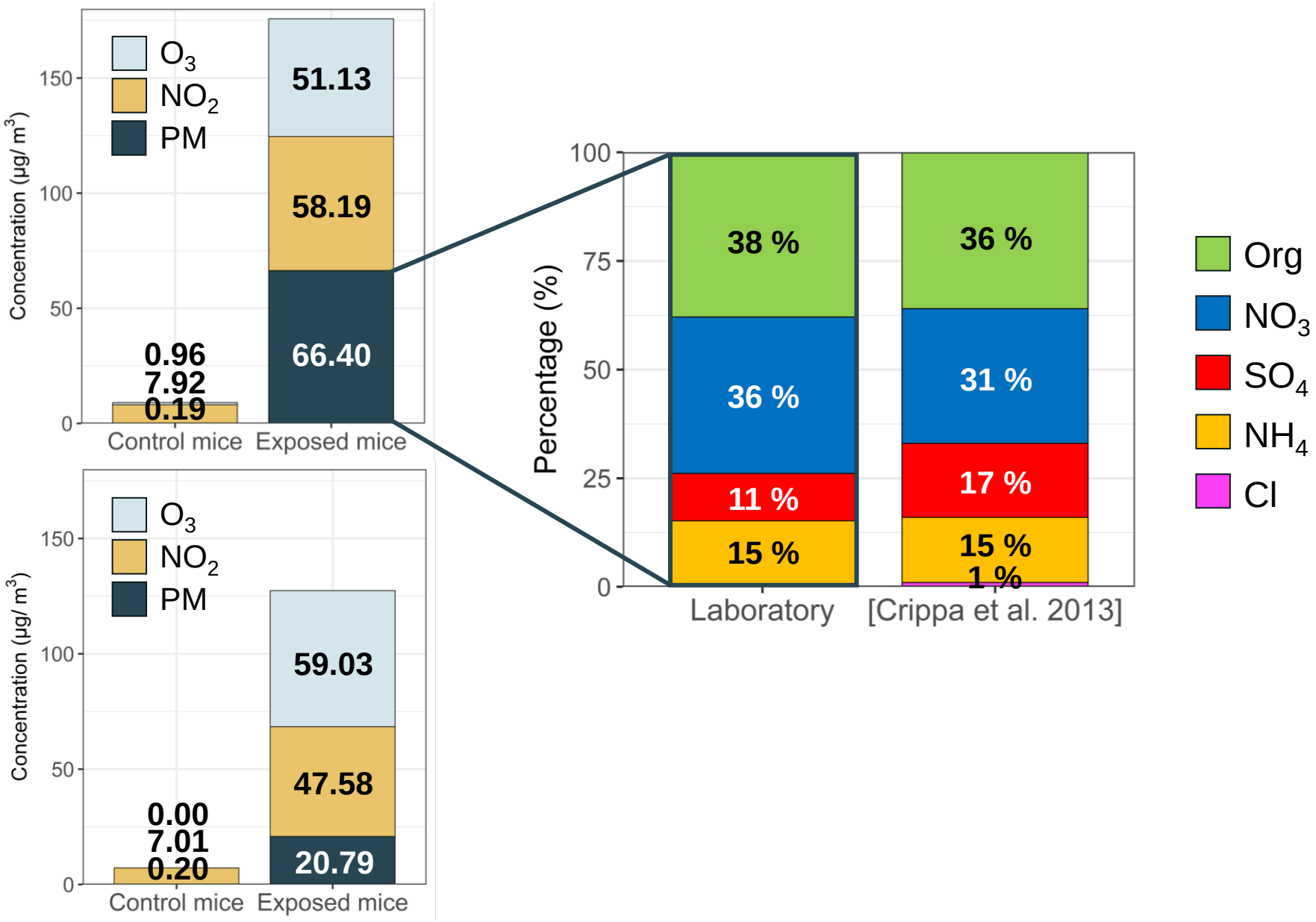
Pulmonary Fibrosis evaluation

Lung compliance, quantification of fibrosis and collagen, pro-fibrosing markers

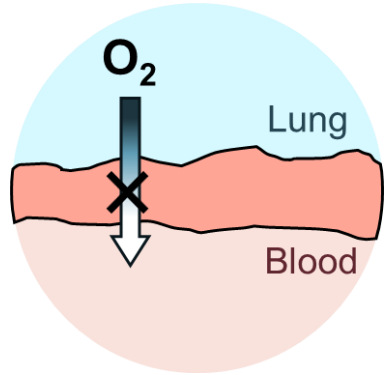
Illustration of a time variation (ozone concentration)

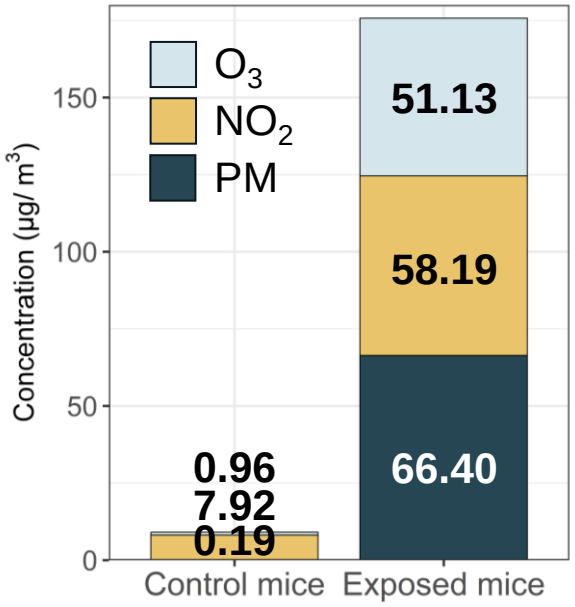


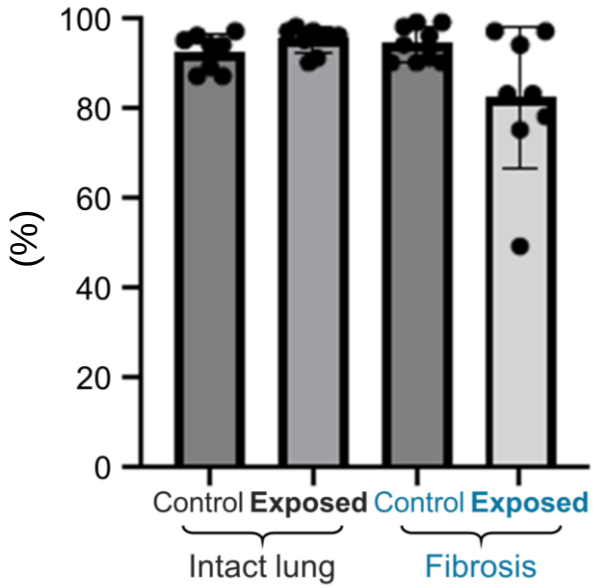
Concentration and composition of the simulated atmosphere



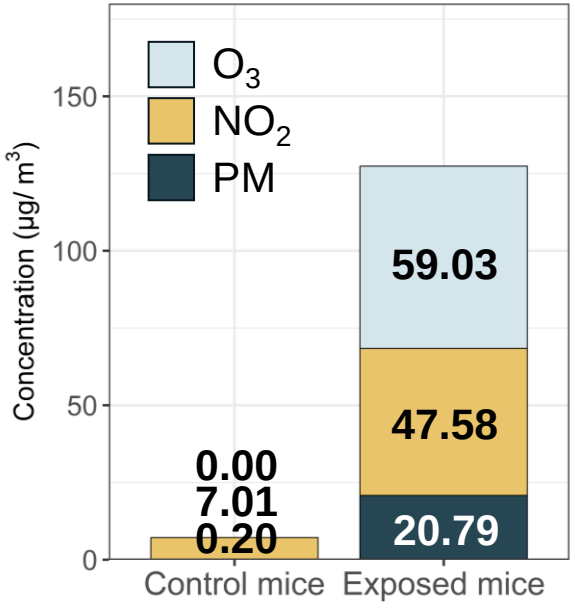
Oxygen saturation (SpO2) at day 7

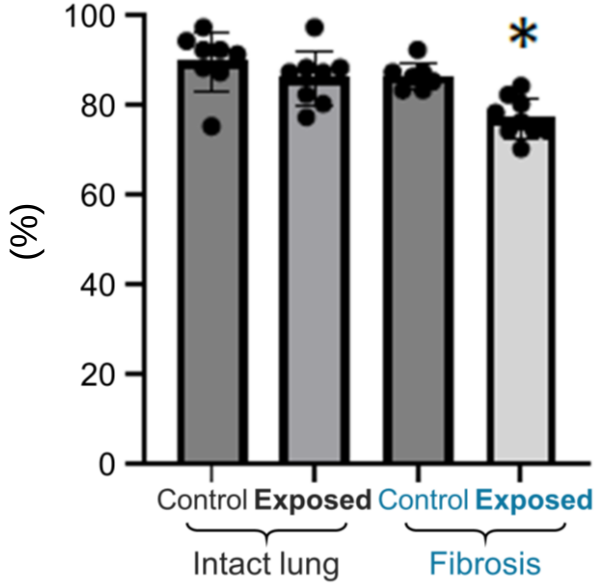






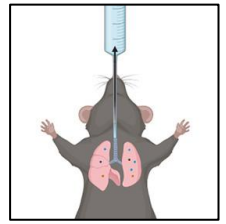
Decrease of the hemoglobin dioxigen saturation

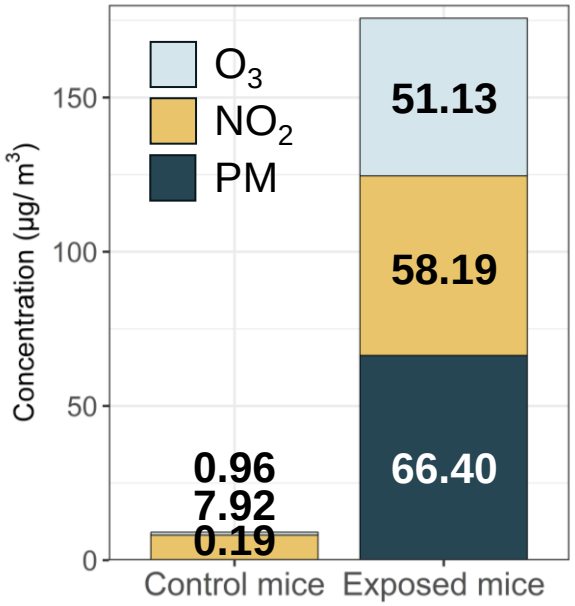


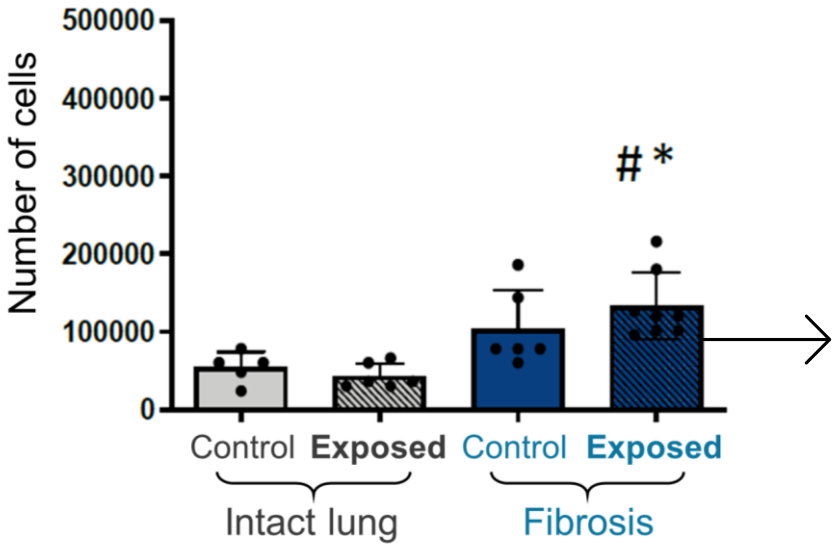


Significant decrease of the hemoglobin dioxigen saturation

Number of cells in the bronchoalveolar lavage at day 21

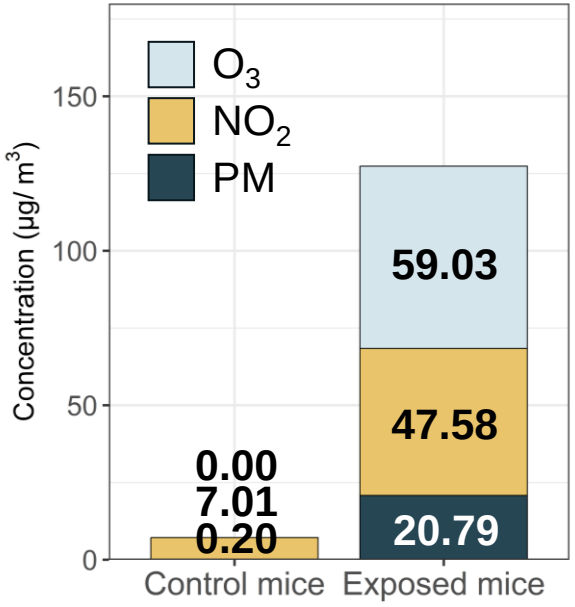


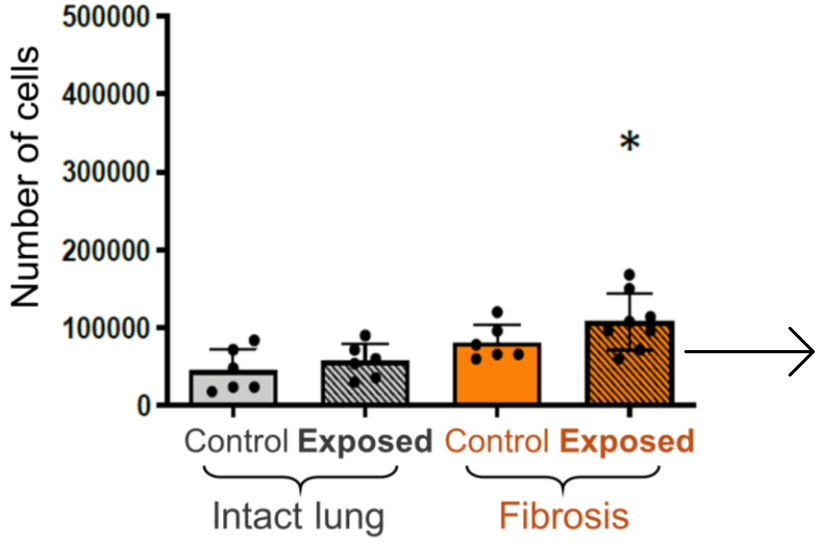




More cells (≈macrophages, lymphocytes) in comparison :

- with control mice **(intact lung)** * ($p<0.05$)
- with control mice **(fibrosis)** # ($p<0.05$)





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The POLLURISK platform: a versatile tool

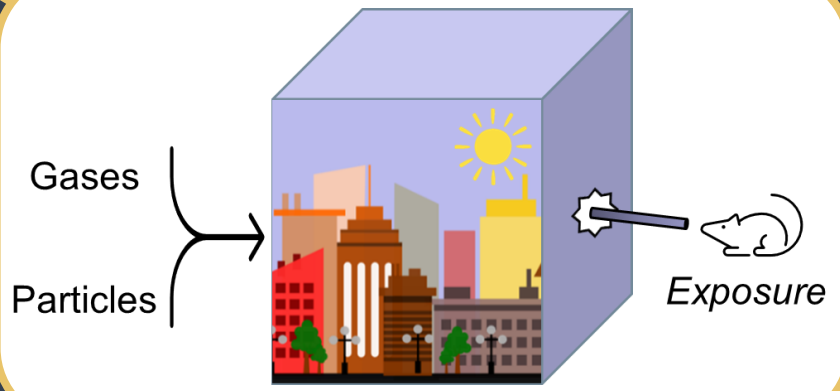
On maternal pregnancy
[Guilloteau et al., 2022]
[Lu et al. 2022]

On adult
[Blayac et al., 2024]
[Belgacemi et al. 2023]

***In vivo*: Biomedical studies**

In this study (on IPF) :
→ Decrease of oxyhemoglobin
→ Increase of macrophages

POLLURISK platform



Assessment on the species with greatest impact on health

Assessment of air quality actions

***In vitro*: Description of the mecanisms**

Comparison of oxidative stress

Oxidative Potential as indicator

Instrument measurements: sensors

Species formation

Validation

Challenges:
- Improve representativeness of simulations
- Extend chemicals analysis
- Extend biological experiments

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Thank You !