COMPARISON OF PM2.5 MEASUREMENTS BY AIR QUALITY MONITORING STATIONS AND FILTER-BASED METHOD IN JAKARTA, INDONESIA
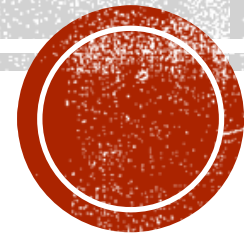
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INTRODUCTION

- Fine particulate matter, $PM_{2.5}$, is considered the most significant ambient air pollutant in terms of potential health impacts.

- The pollution haze and high $PM_{2.5}$ concentrations in several Indonesian cities have raised public awareness of the importance of air quality monitoring.

- The Indonesian government has been urged to immediately address air pollution issues and improve air quality monitoring in Indonesia

Pollution haze in Jakarta.
Photo courtesy: www.cnnindonesia.com

INTRODUCTION

- Indonesia is a vast archipelago with major cities scattered all over the island. It is very important for the government to be able to accurately assess the exposure of populations to $PM_{2.5}$ across municipal areas in Indonesia since each island/each city has their own characteristic.

- However, equity becomes the constraint in maintaining the sustainability of air quality management implementation across Indonesia. Several big cities in Indonesia already have an Air Quality Monitoring Station (AQMS) to monitor air quality, including $PM_{2.5}$, but only a few cities can maintain the operation of AQMS due to high costs.

INTRODUCTION

- Even the capital city, Jakarta, with area of 661.5 km^2, only has 5 AQMS within its region which is not sufficiently representative.

- Multi air quality methods are needed not only as a compliment but also as an alternate methods for air quality assessment in Indonesia

- Filter-based air quality methods are one of that has a high probability to be used as a part of air quality management implementation across Indonesia, which also can be utilized for source apportionment purposes

OBJECTIVE

To conduct a comparative study of PM$_{2.5}$ concentrations using a filter-based sampler and AQMS as an alternate method on air quality assessment

METHODOLOGY

The study was conducted at two sites in Jakarta City;

A. Central Jakarta (May 2022-January 2023). The site is in the middle of the city and surrounded by main roads

B. North Jakarta (February-July 2023). The site is close to the sea and near an industrial area related to coal shipping.

Air Quality Monitoring System Specification:

- Standard FRM Beta Attenuation Monitoring (BAM): Horiba APDA-371

- Data collection every 30 minutes. One day data were averaged to obtain daily $PM_{2.5}$ concentration

- The distance of AQMS station to sampling site in Central Jakarta is 3.5 km, while in North Jakarta is less than 1 km.

# METHODOLOGY

Filter-based sampler

- MetOne superSASS speciation sampler
- Flowrate : 6.7-6.9 L/m
- The sampling was carried out for 24 hrs once a week (Central Jakarta) and per three days (North Jakarta)
- Teflon filters were used for $PM_{2.5}$ analysis
- The height of the sampler were 8 m above the ground for Central Jakarta and 18 m from the ground for North Jakarta

$PM_{2.5}$ Measurement

The aerosol masses of $PM_{2.5}$ fraction was determined gravimetrically, by weighing the filters before and after exposure using microbalance, then divided by the volume of air passing through the filter to obtain the concentration of $PM_{2.5}$ ($\mu g.m^{-3}$).

RESULTS

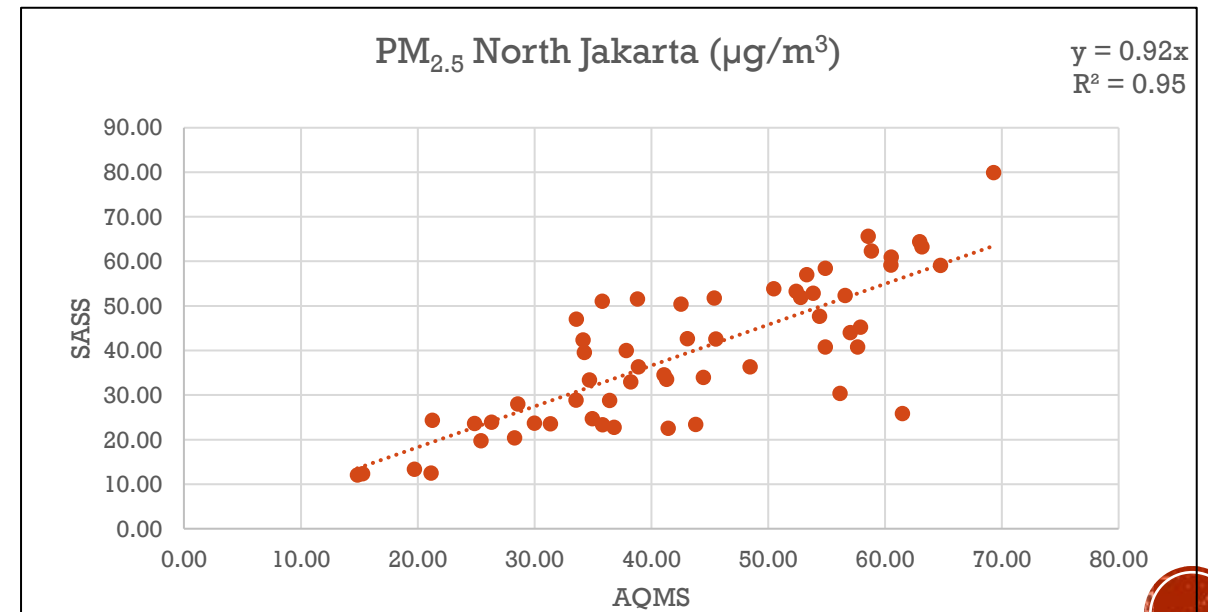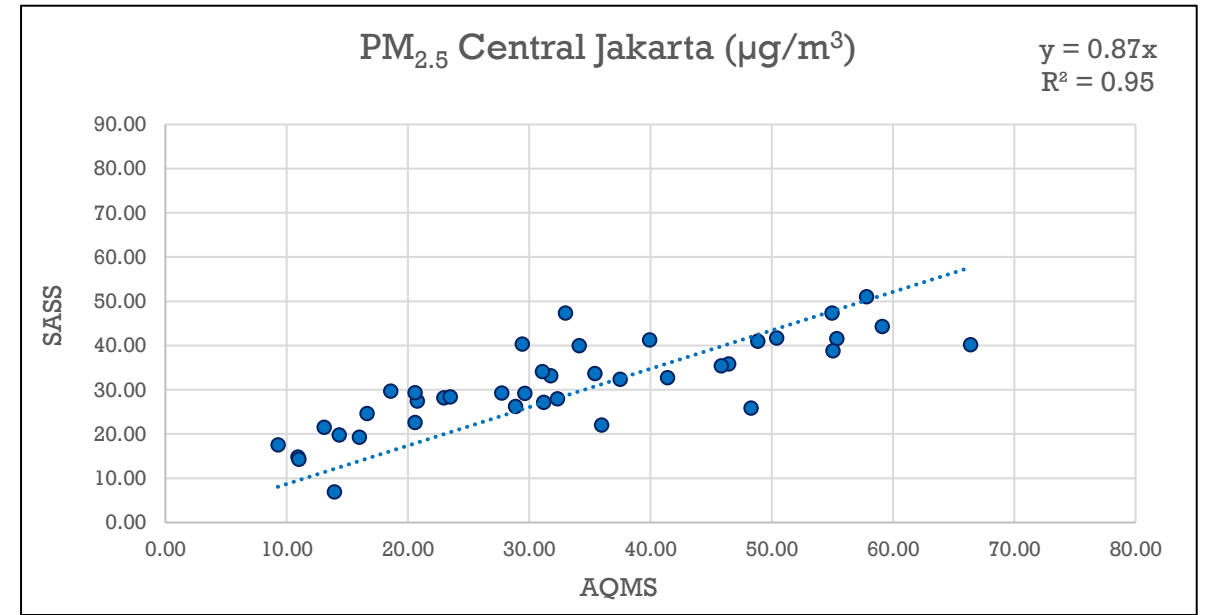Central Jakarta — PM2.5 conc. (ug/m3); AQMS, SASS
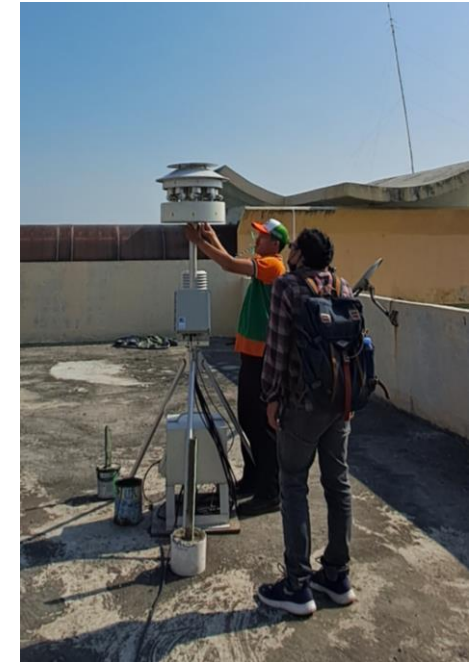
North Jakarta — PM2.5 conc. (ug/m3); AQMS, SASS
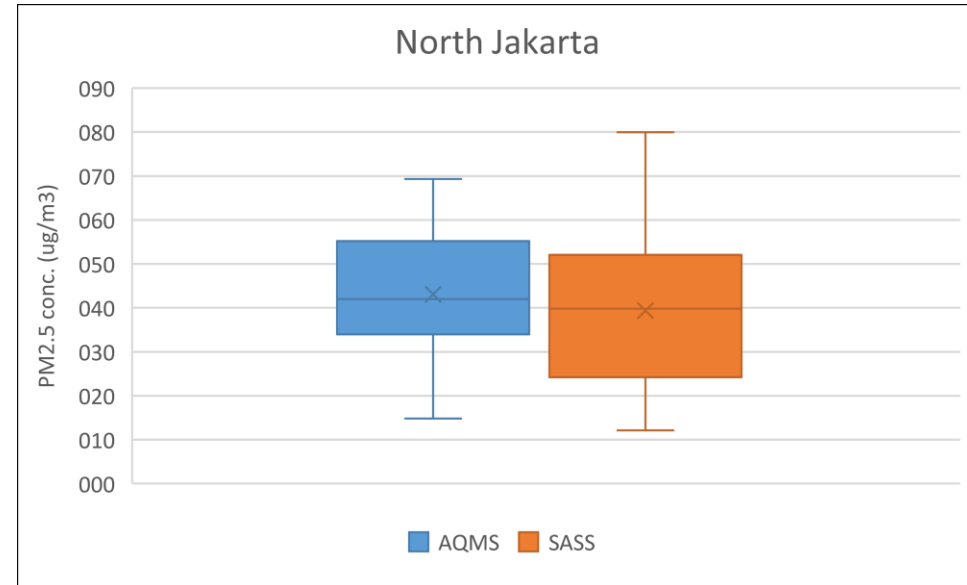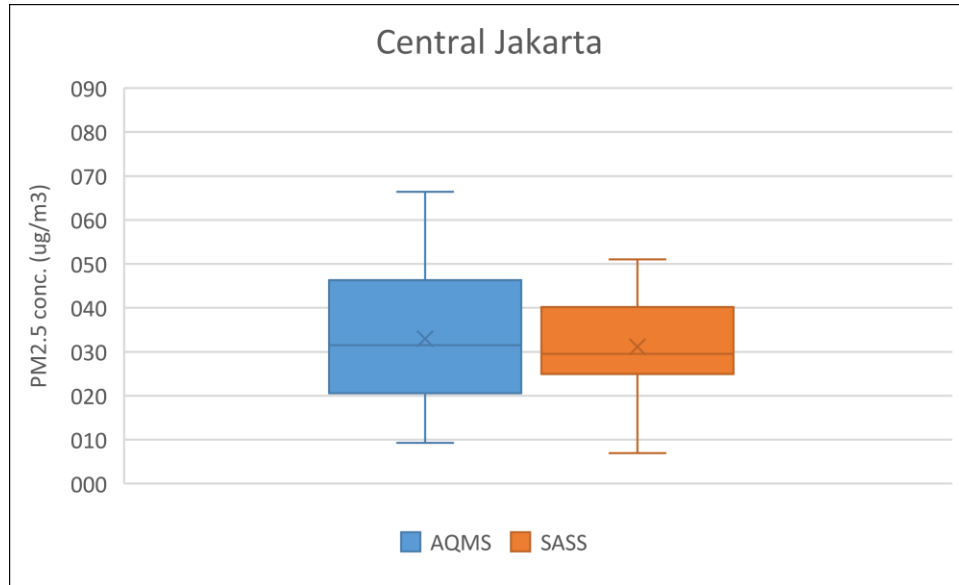
- The results showed that $PM_{2.5}$ in Central Jakarta was 33.0 ± 15.4 μg/m^3 by AQMS and 31.1 ± 10.0 μg/m^3 by SASS, while in North Jakarta was 43.1 ± 13.7 μg/m^3 by AQMS and 39.3 ± 16.0 μg/m^3 by SASS.

- Both sites showed that the mean $PM_{2.5}$ concentrations measured on the superSASS filters were slightly lower than from AQMS. However, the differences are less than 10%
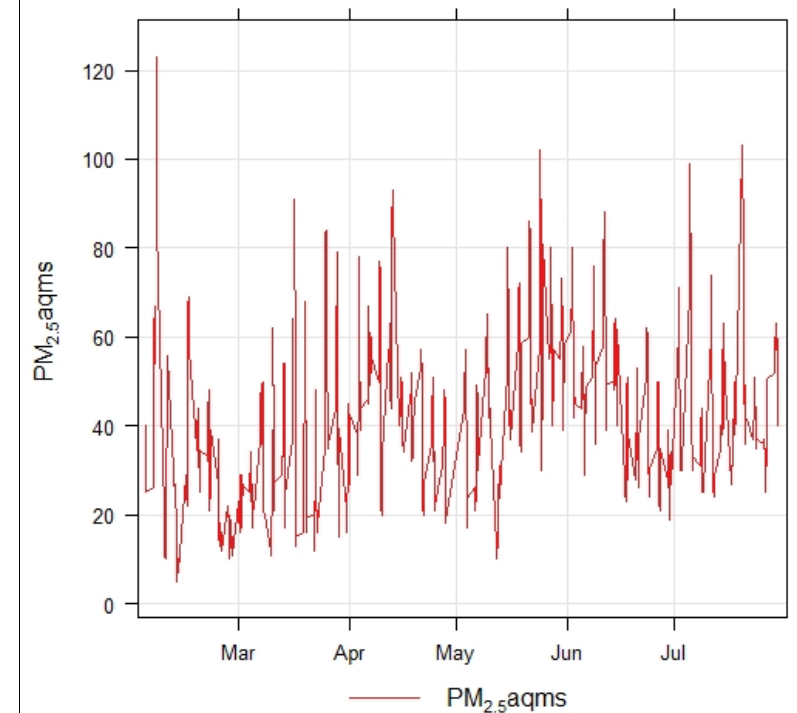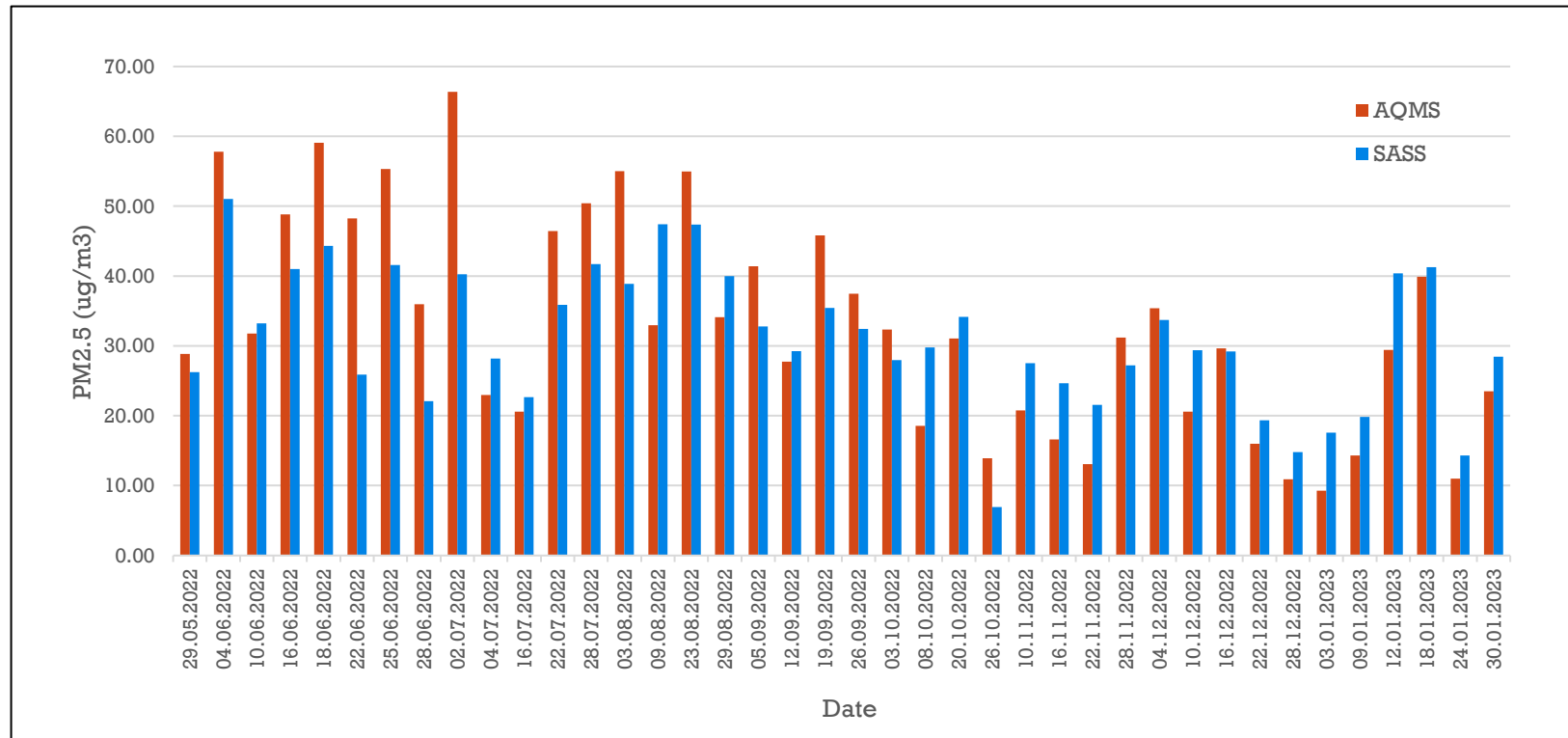
RESULTS

PM2.5 all

$y = 0.90x$
$R^2 = 0.95$
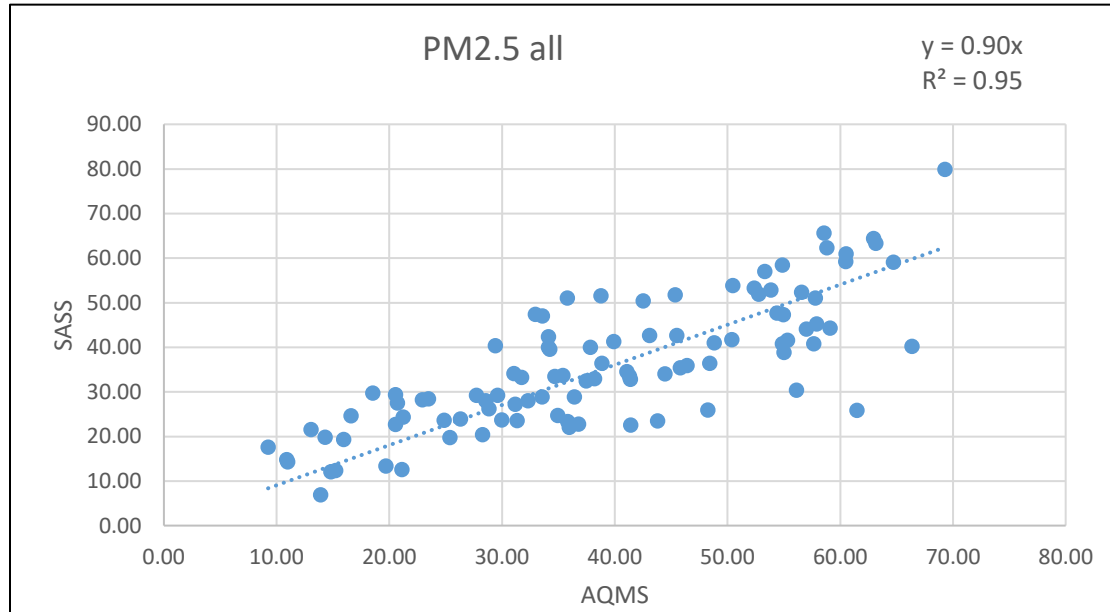
The results gave a good correlation with a coefficient of determination value (R^2) of 0.94 and 0.95 for Central and North Jakarta respectively, and the R^2 of overall results was 0.947

$PM_{2.5}$ Central Jakarta ($\mu g/m^3$)

$y = 0.87x$
$R^2 = 0.95$

$PM_{2.5}$ North Jakarta ($\mu g/m^3$)

$y = 0.92x$
$R^2 = 0.95$

RESULTS

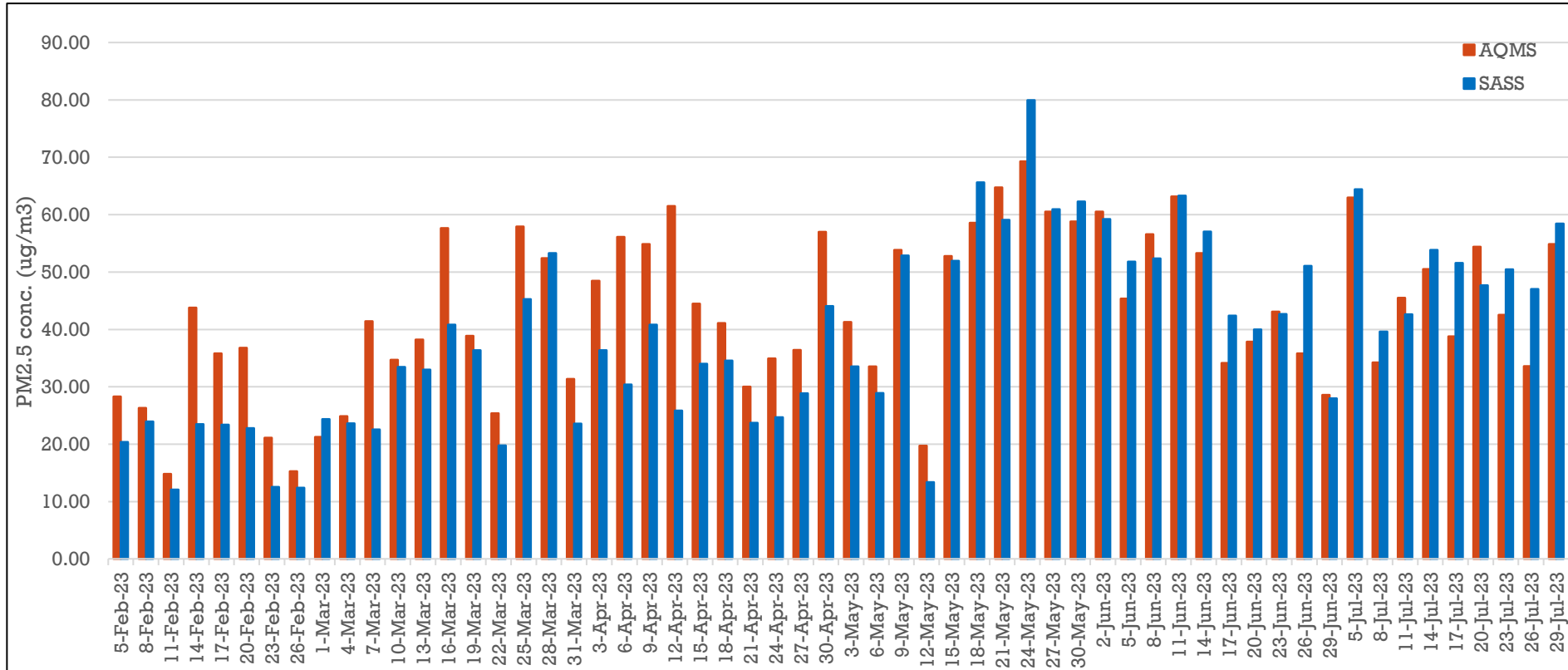*Daily PM$_{2.5}$ concentration in Central Jakarta*

The measurements of daily PM$_{2.5}$ in Central Jakarta were in the range of 7-67 ug/m^3. Its shows that the AQMS measured higher PM$_{2.5}$ daily concentration compared to the SASS units, mainly on days with PM$_{2.5}$ concentrations were higher than 30 ug/m^3 as seen in June - September 2022 in Central Jakarta.

RESULTS

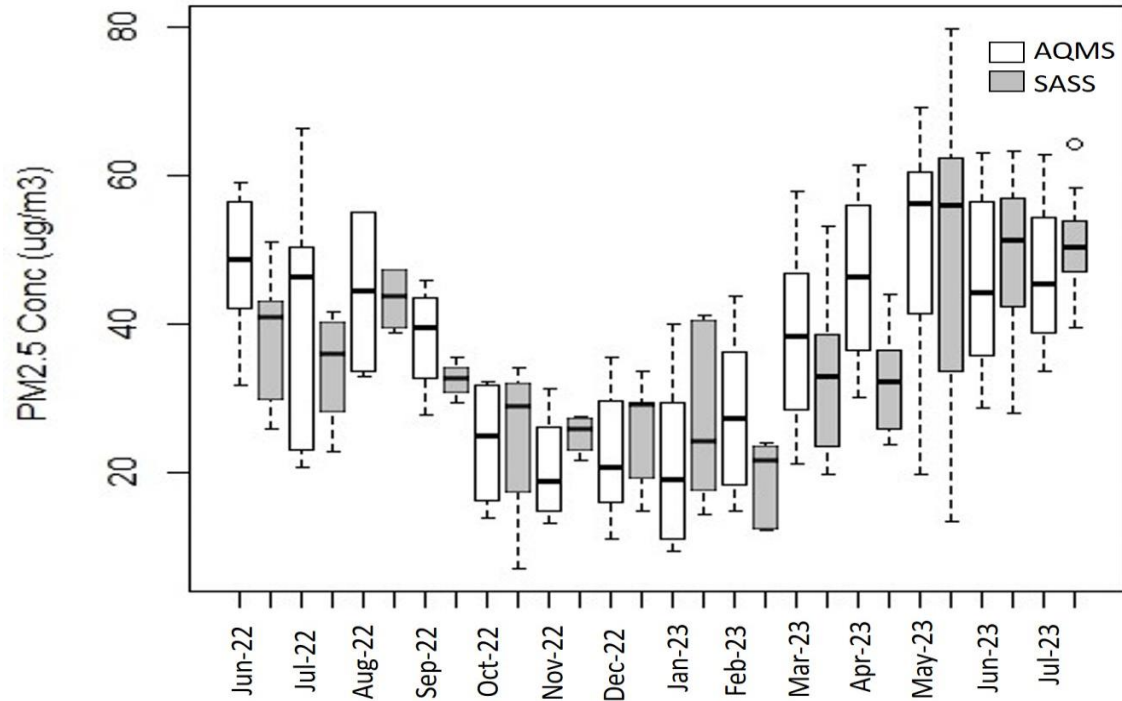Daily PM$_{2.5}$ concentration in North Jakarta

It can be seen that there is a shifted pattern of SASS results since 15 May 2023. These were due to the anthropogenic activities and changes in the wind direction.
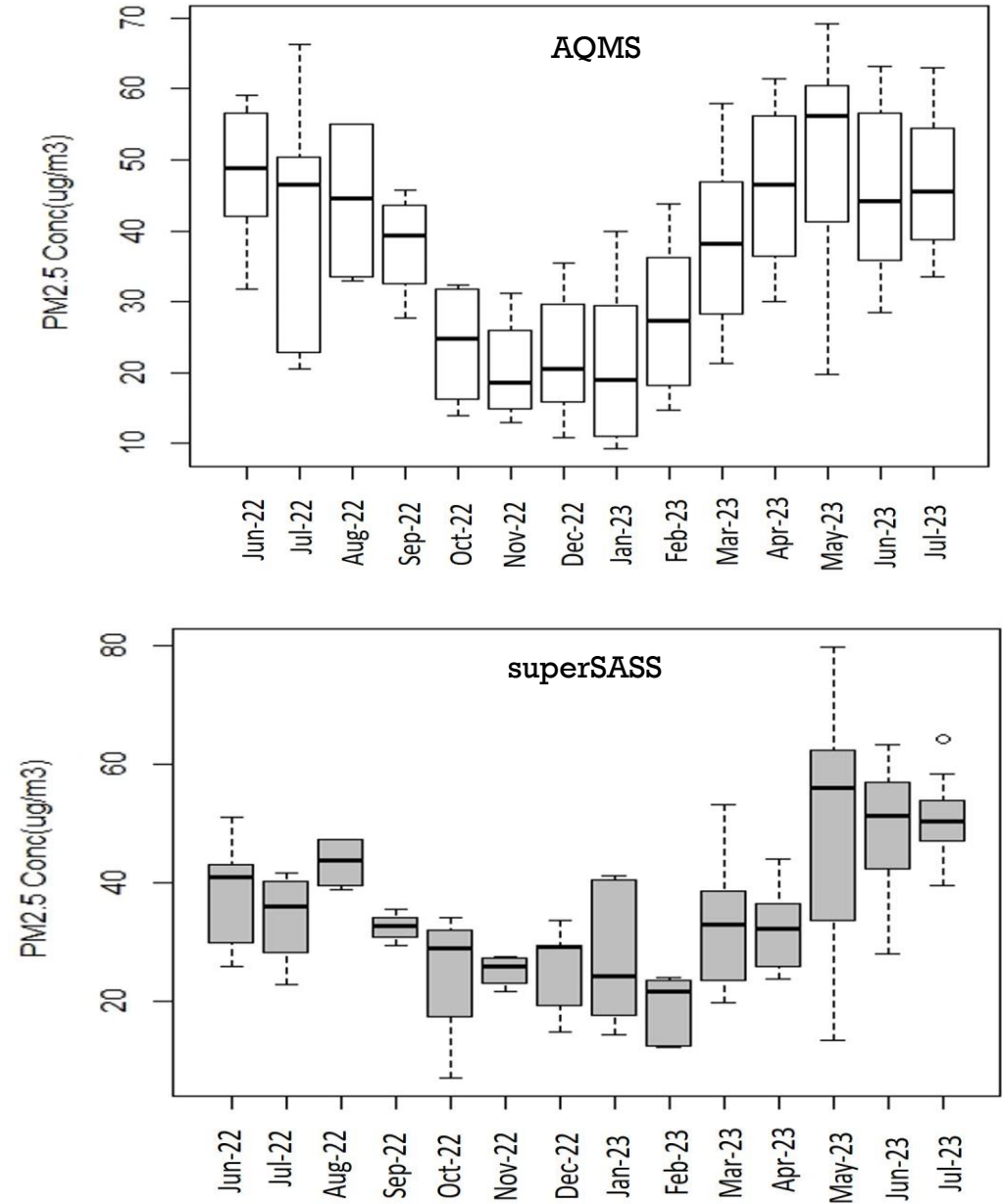
RESULTS

Monthly PM$_{2.5}$ concentration in Jakarta

The monthly PM$_{2.5}$ concentration measured by AQMS and superSASS showed seasonal variation. Both measurement showed lower concentration in wet season (Oct-Feb) and higher on dry season (Mar-Sept)

CONCLUSIONS

- The superSASS sampler is promising methods for air quality assessment methods in Indonesia. Although it does not provide real-time monitoring and can not be functioned as an early warning of high pollution, this method will be useful to provide comprehensive air quality data and source apportionment in its area.

- This studies conducted to compare the $PM_{2.5}$ concentration from superSASS to AQMS in two sites in Jakarta; Central and North Jakarta. The site in Central Jakarta was close to major roads while North Jakarta was close to a variety of anthropogenic activities including a coal stockpile and loading dock. As a results, mean of $PM_{2.5}$ concentration in North Jakarta was higher than in Central Jakarta

- The results showed good agreement between $PM_{2.5}$ concentration from the superSASS and from AQMS with the mean difference less than 10% and with coefficient of determination (r^2) of 0.947

- The time series of daily $PM_{2.5}$ concentration in North Jakarta collected by superSASS sampler showed the influence of wind directions.