Chemical composition of atmospheric aerosols over Jakarta megacity

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We have implemented a comprehensive observation of air pollutants and greenhouse gases around Jakarta megacity in Indonesia since 2016 to quantify anthropogenic emissions from the city and characterize them in terms of socioeconomic activities in the city.

In addition to the continuous monitoring systems of NO_x, SO_2, O_3, CO, CO_2, CH_4, and meteorological parameters, we installed three continuous dichotomous aerosol chemical speciation analyzers (ACSA-14, Kimoto) at Bogor (center of Bogor city) in 2016, Cibeureum (mountainous area, background-like site) in 2017, and Serpong (Jakarta suburb) in 2019. The ACSA-14 can automatically measure not only the mass concentrations of $PM_{2.5}$ and $PM_{10-2.5}$ and optically measured black carbon (OBC), but also the chemical composition of $PM_{2.5}$ and $PM_{10-2.5}$ (nitrate ion (NO_3^-), sulfate ion (SO_4^{2-}), water soluble organic compounds (WSOC), ammonium ion (NH_4^+)), simultaneously. The measurement interval is 3 hours to extend the replacement interval of filter tapes and chemical reagents for the chemical composition analysis of $PM_{2.5}$ and $PM_{10-2.5}$.

The averages of $PM_{2.5}$ from November 2017 to October 2019 are 23.9 $\mu g/m^3$ at Bogor and 18.3 $\mu g/m^3$ at Cibeureum. The seasonal averages of $PM_{2.5}$ observed at Bogor and Cibeureum in the dry season (May to October in 2018/2019) are 34.2 and 28.0 $\mu g/m^3$, which are 2.4 and 3.2 times higher than those of rainy season (November 2017/2018 to April 2018/2019), respectively. While the long-term trends of $PM_{2.5}$ observed at Bogor are similar to Cibeureum, the averaged $PM_{2.5}$ concentrations at Bogor in the dry and rainy seasons are 1.2 and 1.6 times larger than Cibeureum, respectively.

We compared the chemical composition of $PM_{2.5}$ observed at three sites in February 2020. The amount of SO_4^{2-} (20.9%) is almost same as WSOC (20.8%) at Bogor. The dominant components at Cibeureum are SO_4^{2-} (27.4%) and WSOC (13.4%). While the most dominant component at Serpong is WSOC (22%), the percentage of NO_3^- (13.2%) at Serpong is larger than Bogor (11.8%) and Cibeureum (8.7%). The NO_3^-/SO_4^{2-} ratio at Serpong (1.76) is higher than Bogor (0.82) and Cibeureum (0.43). These results suggest that the urban pollution caused by NO_x in automobile exhausts is significant at Serpong compared to Bogor and Cibeureum.
In our presentation, we will also present the result of $PM_{10-2.5}$, OBC, and the other species.

Keywords: atmospheric aerosols, PM2.5, chemical composition, urban monitoring, Indonesia