High-temporal-resolution elemental characterization of fine-mode aerosols in springtime Asian outflow: Emission and removal characteristics, and comparison with model simulation

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Trace metals in aerosol particles exhibit the various impacts on the ocean biogeochemistry (Mahowald et al., 2018). We conducted the semi-continuous measurements of elemental composition of fine mode ($PM_{2.5}$) aerosols using an automated X-ray fluorescence analyzer (PX-375, Horiba, Ltd., Asano et al., 2017) in a remote island, Fukue (32.75ºN, 128.68ºE), in Japan in the spring of 2018. Here we report the temporal variations of mass concentrations of geochemically important elements for this period, namely sulfur (S), lead (Pb), copper (Cu), manganese (Mn) and iron (Fe), and their relationships with some tracers, carbon monoxide (CO), black carbon (BC), and calcium (Ca). Positive correlation of Pb and Cu with CO and BC were found during the observation period, indicating the emission sources of these metals share the region where the large CO (and BC) emission sources are located. Further analyses of concentration-weighted trajectories also suggested the similar geographical characteristics of these elements and combustion tracers. We extracted the continental outflow air masses with minimized impacts of the (especially wet) removal during the transport to elucidate the emission ratio of Pb and Cu to CO, which were evaluated, for the first time in Asian outflow, to be 97.8 and 37.4 μg/g, respectively. The wet removal of Pb together with BC was also investigated based on the precipitation along the air mass transport. Impacts of Asian dust and anthropogenic (i.e., combustion) sources on Fe in $PM_{2.5}$ aerosols were diagnosed by using the measured BC concentration with the emission ratio of iron oxides to BC, and by comparing those simulated by the IMPACT model (Ito et al., 2019). Fraction of combustion-derived Fe for fine mode aerosols was evaluated to be less than 20% on average during the observation period.

References

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