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A study on the source based optical properties of organic aerosol at Anmyeon Island, Korea

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Aerosol and clouds play important roles in determining the earth's climate. They generally act to cool or warm the climate by scattering and absorption and also by affecting clouds. In this study, sensitivity of the radiative forcing of carbonaceous aerosol are investigated based on a one-year measurement of particulate matter that is less than or equal to 2.5 μm in aerodynamic diameter (PM2.5) at a Global Atmospheric Watch (GAW) station in South Korea. The measurement site was Anmyeon Island (36.32°N, 126.19°E, altitude 45.7 m) located on the western coast of Korea. A daily PM2.5 samples were collected from June 2015 to May 2016 for every sixth day. A PM2.5 High volume air sampler (TE-5005BLX, Tisch Environmental, Inc., Ohio, USA) were installed on the roof and operated at a flow rate of 1.1 m3/min. Pre-baked quartz filters (TISSQUARTZ 2500QAT-UP, PALL life Science) were used for the sampling.

Using these samples, we analyzed carbonaceous aerosol (water soluble (WSOC), insoluble (WISOC) organic aerosols and elemental carbon (EC)) and calculated aerosol optical properties such as the extinction, absorption coefficient, and radiative forcing (RF). The results showed that there is seasonal characteristics on the optical properties of organic and elemental carbon aerosol. The results also showed that aerosol size distribution and imaginary refractive index influence significantly on the radiative forcing(RF). Hygroscopicity is also an important factor in aerosol optical properties. As the hygroscopic growth factor (HGF) increased, the RF of aerosol was negatively enhanced because of the increase in water content. Finally, we investigated the relationship between source of organic aerosol and particle light extinction (scattering, absorption). The contribution of source identified optical properties based on the results of positive matrix factorization (PMF) model was obtained from the WSOC, WISOC and EC. Five source identification and apportionment (biogenic source, local biomass burning, secondary organic aerosol, transported biomass burning and the mixed sources) were considered from this model. The analysis of source apportionment to the scattering and absorption coefficients was performed by multilinear regression (MLR) model. Based on these results, we concluded that the organic aerosol optical properties of Anmyeon Island are affected by regional and local sources and depend on aerosol size distribution as well as their physico-chemical characteristics.