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CCN activity of aerosol and its relation to air mass origins: an analysis based on year-round observation at Noto, Japan

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IWAMOTO, Yoko[1*] ; KINOUCHI, Kento[2] ; MATSUKI, Atsushi[1]
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[1]Institute of Nature and Environmental Technology, Kanazawa University, [2]Graduate School of Natural Science and Technology, Kanazawa University
[1]Institute of Nature and Environmental Technology, Kanazawa University, [2]Graduate School of Natural Science and Technology, Kanazawa University

Atmospheric aerosols play an important role in controlling the earth ' s radiation balance and/or the hydrological system by acting as cloud condensation nuclei (CCN). For a quantitative evaluation of CCN characteristics in the East Asia, CCN activity of atmospheric aerosols in submicrometer size range were measured at Noto Ground-based Research Observatory (NOTOGRO), located at the tip of Noto peninsula, facing the Sea of Japan. The observation was conducted from October 2012 to September 2013, to investigate the seasonal variability in CCN activity of the atmospheric aerosols.

CCN efficiency spectra, where CCN number fraction is plotted against the diameter of aerosols, were obtained at four different supersaturation (SS) conditions (0.1%, 0.2%, 0.5% and 0.8%) by using a scanning mobility CCN analysis (SMCA) system (Moore et al., 2010). Hygroscopicity parameters kappa (Petters and Kreidenweis, 2007), which depends on the chemical composition of aerosols, were estimated through analyses of the CCN spectra. The bulk chemical composition of non-refractory submicrometer-sized aerosols was also measured by an aerosol chemical speciation monitor (ACSM). Seven-days backward trajectories at the height of 500 m above the sea level were calculated by using NOAA/HYSPLIT4 model.

The CCN activation diameters of the atmospheric aerosols were clearly larger than those of pure ammonium sulfate throughout the year. The mean kappa values ranged between those of pure ammonium sulfate (0.61) and several pure organic compounds (0 to 0.25). These evidences suggest that the atmospheric aerosols were mixture of ammonium sulfate and organics. The bulk chemical composition derived by ACSM also showed that organics, sulfate and ammonium were three major components throughout the observation period. The contribution of organics to the CCN activity of the atmospheric aerosols observed in this study was more apparent than those obtained in the previous studies in the East Asia. As most of the previous CCN studies in East Asia were conducted in the season significantly affected by Asian outflow of pollutants, current numerical models might overestimate CCN concentrations in the East Asia.

The mean kappa values were 0.30, 0.26, and 0.18 during the spring, autumn and summer, respectively. The difference in kappa values among the seasons might be caused by difference in air mass origin. Air masses to the NOTOGRO site came mainly from NW across the Sea of Japan during the autumn and spring, whereas air masses of Pacific origin, those passed over the Japan islands, prevailed in the summer. Relatively high kappa values were observed under the influence of continental polluted air masses with high sulfate concentration. On the other hand, organic aerosols derived by photochemical oxidation were dominant in summer, resulted in low kappa values. The variation in kappa values of organics with air mass origins will also be discussed.

References

Petters and Kreidenweis (2007), *Atmos. Chem. Phys.*, 7, 1961-1971.
Moore et al. (2010), *Aerosol Sci. Tech.*, 44, 861-871.

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