

Comparison of compositional characteristics of aerosol and rainwater samples collected in Nagoya

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Organic aerosol is one of major components of atmospheric aerosol particles. Some volatile organic compounds (VOCs) react in the aqueous-phase of cloud droplets, and after the evaporation of liquid water, they form aerosol, which is called aqueous secondary organic aerosol (aqSOA). Further, organic aerosols may also change to aqSOA through aging in the aqueous phase. Although a number of laboratory experiments and model simulations have explored the mechanism of aqSOA formation, the mechanism in real atmospheric environments is still unclear. To find a clue to understand how aqSOA is formed in cloud droplets through aqueous-phase reactions, this study compares compositional characteristics of water-soluble components in aerosol and rainwater samples, as a means to compare the components of aerosols before and after the reactions in the real atmosphere.

Aerosol and rainwater samples were collected on campus of Nagoya University in Nagoya, Japan. The organics therein were fractionated into humic-like substances with a neutral nature (HULIS-n), humic-like substances with an acid nature (HULIS-a) and high-polar water-soluble organic matter (HP-WSOM). The optical properties of the samples were measured using a fluorescence spectrophotometer and an ultraviolet-visible spectrophotometer. Fourier transform infrared spectroscopy (FT-IR) was used to compare the chemical structural characteristics of aerosol and rainwater samples.

The analysis of the 3D fluorescence spectra shows that the HULIS-n-to-HULIS-a ratios based on the fluorescence intensity of two spectra regions (excitation wavelength from 240 to 260 nm and emission wavelength from 400 to 460 nm, and excitation wavelength from 320 to 360 nm and emission wavelength from 420 to 460 nm) from aerosol samples were in most cases larger than those of rainwater. A possible explanation is that some of the low-polar fluorescent substances (fluorescent substances in HULIS-n) were decomposed to non-fluorescent substances and that more-polar fluorescent substances (fluorescent substances in HULIS-a) were formed by aqueous-phase reactions. The FT-IR results present that HULIS-n and HULIS-a in aerosol samples show a smaller fraction of carboxyl group but a larger fraction of carbonyl group than those in rainwater samples, implying that the oxidation of carbonyl groups to carboxyl groups occurred for HULIS-n and HULIS-a, and/or that aqSOA containing carboxyl group was formed from VOCs. Because the presence of water in the samples for the FT-IR analysis may have influenced on the quantification of functional groups, compositional characteristics of aerosol and rainwater samples should be further compared using other instruments such as an aerosol mass spectrometer.