4.178 Size-resolved hygroscopicity of atmospheric aerosols in a mid-latitude forest in Japan.

Early Career Scientist

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Abstract:

The hygroscopicity of aerosol particles is governed by their chemical composition, which can be size-dependent because of their different origins and/or atmospheric processes. The resulting size dependence of the hygroscopicity is not characterized well. The size-resolved aerosol hygroscopic growth at 85% relative humidity (30, 50, 70, 100, 200, 300, and 360 nm) and size-resolved aerosol composition (>70 nm) were measured using a hygroscopic tandem differential mobility analyzer and an aerosol mass spectrometer, respectively. The size-dependence of the hygroscopicity of aerosol particles (k_t) and organic components therein (k_{org}) were characterized. The k_t increased with the increase in the particle dry diameters. This can be explained by the size-dependence of fractions of inorganic salts, for super-100 nm particles. The k_{org} increased with the increase in the particle diameters in the range of 70–200 nm. Positive matrix factorization analysis of the mass spectra of bulk organics resolved a less-oxygenated organic aerosol component (LOOA) and a more-oxygenated organic aerosol component (MOOA). The size-resolved organic mass spectra were also attributed to those two factors using the least squares regression method. The volume fraction of LOOA was inversely correlated with k_{org}. The hygroscopicity parameters of LOOA and MOOA were estimated to be 0.06 and 0.27, respectively. Organics accounted for more than 50% of the water uptake by ≤100 nm particles. LOOA was estimated to account for 70% of biogenic secondary organic aerosol (BSOA). BSOA is estimated to contribute to 20% of water uptake by 70 and 100 nm particles and 13%–9% for larger particles. The result indicates a small contribution of

fresh BSOA to the aerosol water uptake on average under the studied conditions. However, the large mass fraction of BSOA (67% for 100 nm particles) suggests its importance to the particle hygroscopicity after aging.