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Measurement of the hygroscopic growth factor distributions of aerosol particles and the mass spectra of single particles

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Hygroscopicity is a property that relates to the lifetime, chemical reactivity and cloud condensation nucleus activity of atmospheric aerosol particles. The amount of water retained by the particles as a function of relative humidity (RH) is governed by the phase state and chemical composition. In this study, hygroscopic growth factor distributions of atmospheric aerosol particles and mass spectra of single particles selected by the growth factors were measured using a combination of hygroscopicity tandem differential mobility analyzer (HTDMA) and a high resolution time-of-flight aerosol mass spectrometer (AMS) in Nagoya.

The observation of urban aerosols was performed on Higashiyama campus of Nagoya University in June and July, 2013. After aerosols were passed through PM1 cyclone and dried in diffusion driers, 300 nm particles were selected in the first DMA of the HTDMA. The growth factor distributions of the particles were measured under humidified conditions (setting RH: 37%, 65%, and 87%). The measurements were performed in both humidification and dehumidification modes. The mass spectra of single particles with specific hygroscopic growth factors *g* (1.0 at setting RH of 37%; 1.0, 1.1, and 1.25 at setting RH of 65%; 1.0 and 1.5 at setting RH of 87%) were measured using the AMS. The size distributions of aerosol particles were measured separately. The concentrations of organic carbon and elemental carbon in parts of the study period were also obtained.

In the humidification mode, the averages of the growth factor distributions at setting RH of 37% and 65% did not show substantial hygroscopic growth in terms of mean *g* (1.00 and 1.02, respectively), and those at setting RH of 87% showed large mean *g* (1.48). In the dehumidification mode, mean *g* of the averages of the growth factor distributions at setting RH of 37% and 65% (1.07 and 1.18, respectively) were substantially larger than those in the humidification mode, suggesting the presence of metastable-state aqueous solutions in the particles. At setting RH of 87%, the mean *g* in the dehumidification mode was large (1.44) as in the case of the humidification mode. The mass spectra of single particles with specific *g* were extracted from the obtained data; the number of these spectra was 349.

Keywords: hygroscopicity, single particle