

Hygroscopicity of aerosol particles and CCN activity of less hygroscopic aerosol particles observed in Nagoya in summer

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Hygroscopic property of atmospheric aerosol particles closely relates to the cloud condensation nuclei (CCN) activity. Thus, a detailed understanding of this property is important for the assessment of the effect of aerosols on climate. In the urban atmosphere, aerosol particles could be externally mixed in view of hygroscopicity by the emissions of hydrophobic particles (primary organics and black carbon) and the inflow and in-situ formation of hydrophilic particles. The hygroscopicity of aerosol particles and the mixing state may change by the condensation of secondary components on both hydrophobic and hydrophilic particles, especially in summer. Mochida et al., (2008) measured the hygroscopic growth factor (HGF) of aerosol particles and examined the correlation between the mass concentrations of chemical species and the particle number concentrations in specific HGF ranges in Tokyo. They reported that the particle hygroscopicity changed rapidly by the secondary formation of organics. In this study, we also analyzed the correlations between the number concentrations of aerosol particles in specific HGF ranges and the mass concentrations of chemical species. In addition, we analyzed the fraction of CCN for less hygroscopic particles and assessed the diurnal variations.

Atmospheric aerosol measurements were performed in August 2011 in Higashiyama campus, Nagoya University, and the data in the period from 16 to 25 August were used for the analysis. The sampled aerosol was classified according to the differences in particle HGF at 85% relative humidity, using the hygroscopicity tandem differential mobility analyzer (HTDMA). The CCN fraction of the aerosol particles selected using the HTDMA were measured in combination with a cloud condensation nuclei counter (CCNC). The HGF distributions of aerosol particles with the dry mobility diameter of 150 nm were observed every 6 hours. The CCN fraction of particles with HGF of unity was measured under 1% supersaturation (SS) condition every 1.5 to 4.5 hours and under 0.5% SS condition every 6 hours. The CCN fraction of particles with HGF of 1.1 was measured at 1% SS every 6 hours.

The HGF distributions in the observation period were bimodal. In 23 August, more hygroscopic particles accounted for a large fraction of 150 nm particles. One possible reason is that air masses with sulfate aerosol formed in the plume from Sakurajima were transported to Nagoya without large influences from other urban areas from which less hygroscopic particles were supplied. Correlations between the number concentrations of particles in specific HGF ranges and the mass concentrations of chemical species were found, being similar to the study by Mochida et al., (2008). In our study, however, the correlation between moderately hygroscopic particles and ozone was weak. It is possible that oxygenated organics were not formed locally, but were transported mainly from outside the Nagoya metropolitan area in the first three days. The number fraction of CCN in less hygroscopic aerosol (HGF = 1) varied greatly with time, suggesting the changes in the amount of hydrophilic components in the particles with apparent HGF of unity during the observation period.

Reference

Mochida, M., T. Miyakawa, N. Takegawa, Y. Morino, K. Kawamura, and Y. Kondo (2008), Significant alteration in the hygroscopic properties of urban aerosol particles by the secondary formation of organics, *Geophys. Res. Lett.*, 35, L02804, doi:10.1029/2007GL031310.

Keywords: urban aerosol, cloud condensation nuclei, HTDMA, hygroscopic growth