Characteristics of Cloud Condensation Nuclei over the Urban Areas Measured at Tokyo Skytree

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Atmospheric aerosols influence the Earth’s radiation budget directly through absorption and scattering of solar radiation, and indirectly by modifying the properties of clouds. However, climate models still face large uncertainties as a result of insufficient understanding of aerosol-cloud interactions[1]. Thus, further studies on aerosol-cloud interaction are needed to improve climate models and to make better predictions of climate change. To investigate cloud condensation nuclei (CCN) characteristics over the urban areas, where few fixed-point observations are conducted in the world, CCN properties of atmospheric aerosols were observed at the Tokyo Skytree (TST) in Tokyo.

Measurements were carried out at TST (35.71°N, 139.81°E, 458m,a.g.l), from 3 to 30 June 2016. In this study, aerosol number size distribution, condensation nuclei (CN) number concentrations ($N_{CN}$), CCN number concentrations ($N_{CCN}$) with four supersaturations (SS%) were measured. Fog droplet size distributions and fog droplet number concentrations ($N_{Fog}$) were also measured. Using these data, we obtained the hygroscopic parameter ($κ$) and the effective radius ($R_{eff}$) of fog droplets. The results obtained at TST were compared with observation data of the summit of Mt. Fuji[2] where similar observations were made.

The average value of $N_{CCN}$ at TST was larger than that of the summit of Mt. Fuji.[2]. The average value of $κ$ at TST was smaller than that of the summit of Mt. Fuji. The CCN properties of aerosols did not vary significantly with air mass origins. As a result of the CCN characteristics of the period covered with clouds without drizzle, there was no positive correlation between the $N_{Fog}$ and $N_{CCN}$. Also, there was no negative correlation between $R_{eff}$ and $N_{CCN}$ like the microphysical relationship known as the Twomey effect[3]. This is considered to be due to the small variation of $N_{CCN}$ at TST. The relationship between $R_{eff}$ and $N_{CCN}$ under SS0.12% could be regarded as part of the negative correlation between $R_{eff}$ and $N_{CCN}$ obtained at the summit of Mt. Fuji.

References

Keywords: cloud condensation nuclei number concentration, condensation nuclei number concentration, effective radius, fog droplet number concentrations
$N_{CCN}\text{@SS0.123}\%$ vs. $R_{eff}$

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図 $R_{eff}$と$N_{CCN}\text{@SS0.123}\%$(青)、$N_{CCN}\text{@SS0.15}\%$(渡辺, 2015)(黒)の関係