A Study of Cloud-to-Rain Conversion Processes for Warm Cloud over East Asia and the North Pacific from A-Train Observations

Takuro Michibata[1] and Toshihiko Takemura[1]

[1] *Research Institute for Applied Mechanics, Kyushu University, Fukuoka, Japan*

This study examines the microphysical conversion processes (i.e., cloud droplet to drizzle and precipitation) over East Asia and the North Pacific using CloudSat and MODIS products. An analysis is restricted only for single-layer water cloud to properly focus on the aerosol-cloud-precipitation interaction. The regional analysis of the effects of aerosols on water cloud physics by Michibata et al. (2014) has been extended here to investigate the relationship between the microphysical conversion processes and macrophysical factors including environmental conditions (e.g., liquid water path (LWP) and lower-tropospheric static stability (LTSS)).

The vertical microphysical structure depicted by "contoured frequency by optical depth diagram (CFODD)" represents a difference of the cloud-to-drizzle transition process between East Asia and the North Pacific, which implying aerosol-cloud interaction around the cloud base in the polluted condition. We further examine a microphysical conversion rate for drizzling cloud to discuss the cloud lifecycle more quantitatively, which appears in the CFODD. Most of the samples are concentrated within < 0.1 [g m^{-2} s^{-1}] of the conversion rate and range from 30 to 180 [min] of its timescale, and the characteristics are susceptible to the cloud droplet number concentration (N_c). Although the conversion rate monotonically decreases with increasing N_c in a stable condition over the polluted East Asia, this tendency is not obvious in an unstable condition and performs lower conversion rate. These results suggest that the conversion process from cloud water to rainwater should be considered with not only the cloud microphysical parameters but also environmental conditions (i.e., atmospheric stability and aerosol types), which has generally not included in the model parameterization in the microphysical process.

Key words: aerosol-cloud-precipitation interaction, microphysics, conversion rate

References

Michibata, T., K. Kawamoto, and T. Takemura, 2014: The effects of aerosols on water cloud microphysics and macrophysics based on satellite-retrieved data over East Asia and the North Pacific, *Atmos. Chem. Phys*, **14**, 11935-11948.