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Development of a Cloud-Top Height Estimation Method by Geostationary Satellite Split-Window Measurements Trained with CloudSat Data

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Estimation of cloud-top height and visible optical thickness of upper-tropospheric clouds by brightness temperature (T_B) measurements of geostationary satellite at two infrared split-window wavelengths was conducted. These cloud parameters were estimated by regressing the measurements of 94-GHz cloud radar onboard *CloudSat* satellite in terms of T_B at 10.8 um (T_{11}) and its difference from T_B at 12 um ($\Delta T = T_{11} - T_{12}$) measured by geostationary satellite MTSAT-1R.

Estimation by geostationary satellite measurements are fairly useful in field campaigns aiming mesoscale cloud systems, where cloud-top heights are compared with the vertical profiles of ground-based measurements such as wind and cloud condensates in a short time interval. Hamada et al. (2008) conducted the estimation of cloud-top height by T_{11} and ΔT measured by GMS-5, using ship-borne cloud radar measurements. However, their ground-based result was limited to the non-rainy clouds, since cloud radar signal is heavily attenuated by precipitation particles. Spaceborne radar measurements enables an estimation of cloud-top height without concern for the existence of precipitation.

We examined the dependences of the estimates of cloud-top height on latitude, season, satellite zenith angle, day-night, and land-sea differences. It was shown that these dependences were considered as being uniform in tropics, except for the region with large satellite zenith angle. The dependences on latitude and season were negligible in tropics, while they became the most significant factor affecting the estimates at higher latitudes.

Estimation of visible optical thickness was also conducted, although limited to the non-rainy high clouds. The distributions of estimates in T_B-ΔT space were qualitatively consistent with those expected from a simplified radiative transfer equation, although the standard deviations of measurements were slightly large.

The near real-time products has already been provided on our Website (http://www-clim.kugi.kyoto-u.ac.jp/hamada/ctop/). Since the *CloudSat* conducts cloud radar observations on a global scale, the method adopted in this study can easily be applied to other current geostationary satellites with split-window channels, yielding hourly estimation map of cloud-top and optical thickness in global scale. We will show the results also using Meteosat Second Generation measurements.