

Validation of Himawari-8 and MODIS observed water cloud microphysical and optical properties using ground-based observation data

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Along with the development of remote sensing technology, cloud remote sensing from the space has become a very powerful tool to gather information related to clouds, including cloud optical and microphysical characteristics, by covering sufficiently large areas. Those data are being implemented to cope/understand several issues related to climate change and hydrological cycle phenomena. Due to such broad implications, quality check of such space-observed cloud properties takes a very high priority. Such quality check can be fundamentally done by using ground-truth data; however, retrieval of cloud properties from ground-based observation data itself is a challenging task, which has also limited validation of cloud products made from observations by several sensors onboard several satellites. Taking this difficulty into account, we developed a cloud retrieval method by implementing spectral transmittances of near-infrared wavelengths observed by zenith-looking sky radiometer of SKYNET (<http://atmos2.cr.chiba-u.jp>). The retrieval accuracy has been quantified and cloud products from sky radiometer along with surface-observed global flux data of four SKYNET sites (Chiba, Fukuejima, Hedomisaki, and Miyakojima) of nearly one year period have been used to validate water cloud properties observed by the Himawari-8, a Japanese geostationary satellite, and the MODIS sensor onboard the TERRA and AQUA earth observation satellites. The temporal variation of cloud optical thickness (COD) from three independent instruments (Sky radiometer, MODIS, Himawari-8) is consistent, though they differ in magnitude. Generally speaking, COD from MODIS is found to be underestimated followed by Himawari 8 and sky radiometer. The underestimation of COD from satellite observations could be further justified by CODs estimated from the global flux data by assuming the fixed value of effective radius (R_e). On the other hand, R_e from MODIS is found to be overestimated followed by Himawari-8 and sky radiometer. The overestimation of R_e from satellite observations is consistent with prior studies. Data of long-term observation are being analyzed to quantify the error ranges of MODIS and Himawari-8 observed cloud properties (particularly COD) with respect to surface-based sky radiometer and global flux data. Similar analyses to validate ice cloud properties observed from satellites will be performed in the near future.

Keywords: Cloud, Satellite, SKYNET, Sky radiometer