Improvement for infrared rainfall estimation algorithm of GSMaP using machine learning

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The Global Satellite Mapping of Precipitation (GSMaP) produce global precipitation data with one hour temporal resolution by using microwave radiometer (MWR) on board low-Earth-orbit satellites and Infrared (IR) radiometer on board geostationary meteorological satellites (GEOs). In the GSMaP, the rainfall observed by a MWR is propagating along with the moving vector calculated by GEO IR observations for the interpolation of the gaps in MWR observation coverage. Since the GSMaP rainfall rate complemented with IR algorithms is based on the assumption that deeper clouds are more likely to produce heavy rainfall, conspicuous underestimation of rainfall occurred for heavy precipitation from low-level cloud. Observation bands available for GEO have dramatically increased from the conventional about 3 to 9 after latest GEO called Himawari-8 was launched in October 2014. By using the Himawari-8 IR multi-channel observations, we created high-frequency precipitation data, called Himawari Rainfall Estimation Algorithm (HRA; Hirose et al. 2019). We used Random Forest (RF) machine learning method to make the HRA and used Ku-band precipitation radar (KuPR) observation of the Global Precipitation Measurement Mission (GPM) core satellite as truth of rain.

Hirose et al. (2019) verified the accuracy of HRA in the mid-latitudes of the Northern Hemisphere using radar-AMeDAS rain rate and showed that HRA has higher estimation accuracy for heavy rainfall caused by clouds with relatively low cloud-top height than GSMaP with only single IR band. In particular, the three water vapor bands, which became available for the first time on Himawari-8, has greatly contributed to the improvement for the estimation accuracy of the heavy rain. In this presentation, we show the results of global accuracy verification using ground-based radar network in the tropics. The HRA showed the same estimation accuracy in the tropics as the GSMaP MWR observation. In addition, GSMaP tended to overestimate rainfall over sea where rainfall was complemented by using only a single IR band, but HRA did not show such overestimation with IR multiband. The effectiveness of IR multi-band observation was confirmed even in the tropical region. We will also present the results of an attempt to improve estimation accuracy of the GSMaP cloud movement vector with single IR band by using machine learning approach.

Keywords: machine learning, GSMaP, Himawari-8

