Additional information of precipitating cloud life stages for Improvement of rain rate data estimated from Himawari-8

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Rain observation with microwave radiometer satellites is essential to make global rain observation data with high temporal resolution. However microwave satellites cannot cover a global area since the number of them is limited. In such an area where no microwave satellite is available, improvement of rain estimation accuracy is expected by using rain information obtained from geostationary meteorological satellites (GMS) with high temporal resolution. Kühnlein et al. (2014) reported that they could estimate rain with high temporal resolution same as GMS by using a statistical method called Random Forest (RF) , which 10 channels information of brightness temperature observed from METEOSAT Second Generation (MSG-2) GMS are associated to truth of rain observed from ground-based radar. In this method, first some channels are selected from among GMS observations to make a classification tree deciding rain or no rain areas. Then the number of tree is increased in the same way, and finally rain or no rain area is decided by majority of all tree’s results. In addition rain type classification and rain rate estimation are possible by the RF method. This study produced a new rain estimation product with high temporal resolution by applying this RF method to the only third generation GMS, Himawari-8 for compensating the lack of microwave satellites observation network. Moreover we used the Global Precipitation Measurement (GPM) main satellite instead of ground-based radar for the truth of rain used in machine learning for expanding the analysis area to all of the Himawari-8 observing area.
For verification of the above product, the threat score of the rain area estimated from Himawari-8 was calculated by comparing with rain observed by ground-based radar in near Japan region as the truth. As a result, the threat score in daytime is very high value more than 0.5, and that in night time is more than 0.42, which are conditionally comparable to microwave rain estimation. Next we verified effectiveness of Himawari-8 new additional channels to rain estimation. Then in rain area classification, a visible blue channel (0.46μm) is most effective and in rain type classification a near Infrared channel (1.6μm) is most effective. Route mean square error of rain rate is about 1.3 mm par hour but strong rain greater than 8.0 mm par hour is tend to be underestimated. This is partly because that it is difficult to distinguish thick convective cloud from thin cirrus since the rain rate estimated by RF method is mainly based on cloud top temperature (height) information obtained from Himawari-8 observation of brightness temperature. To overcome this problem, we tried to improve an accuracy of estimating convective rain rate by using temporal variation information of rainy cloud. First a moving vector of rainy cloud is calculated from every 10 minutes global observation of Himawari-8. Next we added temporal variation information of rainy cloud brightness temperature obtained by tracing rainy cloud with the moving vector into the RF method. As a result the Himwari-8 rain rate product is improved with life stage information of rainy cloud. We intend to show example analysis of the improved Himawari-8 rain product in near Japan region.
Himawari-8 GMS data is released from the Center for Environmental Remote Sensing, Chiba University. We used near surface rain observed by GPM (Ku PR) and rain intensity observed by ground-based radar in the Japan Meteorological Agency as the truth of Rain

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