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A potential map of precipitation area using the geostationary meteorological satellite for the GSMaP

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The Global Satellite Mapping of Precipitation (GSMaP) produces accurate precipitation data with high time and spatial resolution (per 1hour, 0.1 degree) by utilizing the satellite microwave radiometer. At the time and place which all microwave radiometer satellites are not available, the GSMaP estimates where the precipitation area observed before that time will moves by using a cloud moving vector retrieved from the infrared brightness temperature (IR Tb) observed by the geostationary meteorological satellite (GMS) (GSMaP_MVK, GSMaP_NRT; v5.222.1). However this method has some possibility of missing the convective precipitation which develops quickly (Ushio et al. 2009), and uses only IR1 channel (10.5~11.5μm) of the GMS observation to calculate the cloud moving vector. Therefore, this study made more accurate data of estimated precipitation area by using multi-channel GMS observation, called potential map, and then improved the accuracy of GSMaP_MVK and GSMaP_NRT precipitation areas by utilizing the potential map.

As a precipitation area index of the GMS, we used difference of the Tb between IR1 channel and water vapor (WV) channel (6.5~7.0μm). This index is based on the assumption which a deep convective cloud with precipitation probably occurs at the area with a small Tb difference of IR1 and WV (Ohsawa et al. 2001). Moreover since almost all of geostationary satellites have the IR1 and WV channel, the index is available globally on a long-term basis. We used near surface rain observed by the precipitation radar of the Tropical Rainfall Measurement Mission (TRMM) (PR; 2A25, V7) and the rainfall intensity retrieved from ground-based precipitation radar of Japan Meteorological Agency (JMA) as the truth of the precipitation area and converted the Tb of the GMS to the probability of precipitation with simultaneous observation between the GMS and the precipitation radar.

At first we compared the precipitation area obtained from the GSMaP and the precipitation radar, and found that the GSMaP_MVK overestimated the precipitation area over the ocean without the microwave observation. And therefore we tried to identify the area which the GSMaP precipitation was less than 1.0 mm per hour and the possibility of precipitation obtained of the potential map was less than 15 % as non-precipitation area. As the result the threat score of the GSMaP_MVK precipitation detection was improved from 0.37 to 0.41 over the ocean without the microwave observation. As it is considered that the threat score of GSMaP_MVK with the microwave observation is 0.45, this improvement is regarded as significant. On the other hand, the GSMaP_NRT underestimated the precipitation area over the land and coast without the microwave observation. And then we identified the area which the potential map was more than 40 % as precipitation area. As the result the threat score of the GSMaP_NRT was much improved from 0.27 to 0.34 over the land and coast without the microwave observation. In these areas and conditions, we can expect that the GSMaP estimates the precipitation area more accurately by utilizing the potential map.

Keywords: microwave radiometer, GSMaP, GMS, precipitation radar, high time resolusion, mid-high latitude