Development of snowfall estimation method in Global Satellite Mapping of Precipitation (GSMaP) product

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The Global Precipitation Measurement (GPM) mission is an international collaboration to achieve highly accurate and highly frequent global precipitation observations. As one of Japanese GPM products, Global Satellite Mapping of Precipitation (GSMaP) product has been provided by Japan Aerospace Exploration Agency (JAXA) to distribute hourly global precipitation map with 0.1x0.1 deg. lat/lon grid. In previous versions of the GSMaP products, areas with lower temperatures have been regarded as missing, because a snowfall estimation method was not implemented in the GSMaP algorithm. On the other hand, the GPM Core Observatory launched in February 2014 flies also in mid-high latitudes with the Dual-frequency Precipitation Radar (DPR) and the GPM Microwave Imager (GMI) and it can be a major opportunity to improve the accuracy of the GSMaP product.

This study reports a snowfall estimation newly implemented in the GSMaP product version V04 (algorithm version v7), which was released on January 2017. The snowfall estimation method can be divided into a classification method of rain and snow and a snowfall intensity estimation method when judged to be snow by it. Here, the rain/snow classification method is based upon Sims and Liu (2015), and inputs the surface type, surface temperature, temperature decrease, relative humidity, surface pressure, skin temperature. Based on the results of past ground observations, the method determines whether rain or snow.

The snowfall intensity estimation method was developed based upon a method by Liu and Seo (2013), but, this study utilized the intersection dataset of the GPM Core Observatory and CloudSat (CloudSat-GPM Coincidence Dataset) by Dr. Joe Turk (NASA/JPL). This data can be helpful in a case of strong snowfall, as compared to Liu and Seo (2013) using only the CloudSat data. This statistical method using radar observations to train the GMI data is based upon information contained in the first three principal components resulted from Empirical Orthogonal Function (EOF) analysis of the GMI data. The method first transforms the brightness temperature vector into EOF space and then retrieves a probability of snowfall by using the radar-trained lookup table. Using a relation between radar reflectivity and snowfall intensity, we can retrieve snowfall rate as well. As future tasks to improve the method, how to define snowfall regime types can be still needed to examine further.

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