

Title : Validation of GSMaP Passive Microwave Precipitation Retrievals and improvement by Revised Method of Microwave Rainfall Normalization

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Abstract :

Passive microwave (PMW) sensors play a central role in satellite-based precipitation retrievals; however, sensor-dependent biases remain a major challenge, particularly for heavy precipitation. The Method of Microwave Rainfall Normalization (MMN) has been introduced in the Global Satellite Mapping of Precipitation (GSMaP) algorithm to reduce inter-sensor inconsistencies, but its impact on extreme precipitation and its applicability to different PMW sensors require further investigation. In this study, we revisit the MMN framework and propose a revised formulation designed to better control the influence of heavy precipitation while preserving inter-sensor consistency. The revised MMN utilizes the mean and standard deviation of precipitation rates to suppress excessive contributions from extreme values. We evaluate the performance of the revised MMN using gauge-calibrated ground radar observations from Radar-AMeDAS over Japan and surrounding oceanic regions as a reference dataset. The analysis focuses on multiple PMW sensors, including microwave imagers and microwave sounders, to assess sensor-dependent behavior before and after applying the revised MMN. Results demonstrate that the revised MMN effectively reduces sensor-dependent overestimation in heavy precipitation regimes, leading to improved root mean square error (RMSE) and more consistent precipitation estimates across sensors. While a notable improvement is observed for SSMIS over oceanic regions during summer, the revised MMN also shows positive impacts for other PMW sensors, indicating its broader applicability. These results suggest that the proposed MMN revision provides a robust framework for improving PMW-based precipitation retrievals and can contribute to the development of more consistent multi-sensor precipitation products in future algorithm updates.