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Estimating uncertainties associated with quasi-global satellite infrared-based retrievals over land

Sana Khan and Viviana Maggioni
George Mason University, Fairfax, United States (vmaggion@gmu.edu)

An accurate characterization of the global hydrologic cycle is essential not only to study and forecast climate variations, but also for extreme event mitigation and agricultural planning. Since precipitation is the major driving force of the hydrological cycle, current and future satellite missions with a focus on precipitation are critical to estimate hydrological variables globally. Error estimates associated with satellite precipitation retrievals are crucial to allow inferences about the reliability of such products in their operational applications. However, evaluating satellite precipitation error characteristics is challenging because of the inherent temporal and spatial variability of precipitation, measurement errors, and sampling uncertainties, especially at fine temporal and spatial resolutions.
This study proposes to use a stochastic error model – PUSH (Probability Uncertainty in Satellite Hydrology) – for estimating uncertainties associated with fine resolution satellite precipitation products. The framework is tested on the daily IMERG (Integrated Multi-satellitE Retrievals for GPM) infrared-only (IR) precipitation component using a satellite-based radar product (the Level-3 Dual-frequency Precipitation Radar, 3DPRD) as reference. PUSH decomposes the error into four components and employs different modeling approaches for each case: correct no-precipitation detection; missed precipitation; false alarm; hit bias. PUSH is calibrated globally over land for different climatological regions. The calibrated parameters are validated using an independent period to verify whether they can be applied to estimate uncertainties associated with future IR retrievals without degrading the model performance. The four error components are then investigated as a function of climate region to study their spatial variability.