Evaluation of IMERG over CONUS complex terrain using environmental variables

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The spatial and temporal variability of rainfall in complex terrain remains challenging to capture from ground-based observations. It promotes integrated satellite-based precipitation products (SPPs) with quasi-global coverage. The development of spaceborne rain retrieval algorithms that combine infrared (IR), and passive microwave (PMW) observations was accelerated with the Tropical Rainfall Measuring Mission (TRMM) and its successor Global Precipitation Measurement (GPM). The Integrated Multi-Satellite Retrievals for GPM (IMERG) algorithm intercalibrates, merges and interpolates all available PMW retrievals, microwave-calibrated IR satellite estimates, and rain gauges. Yet, IMERG is associated with multiple uncertainties over complex terrain. These uncertainties can be traced back to the merging components of PMW and IR precipitation retrievals. For example, PMW estimates are characterized by more pronounced biases over mountainous terrain that can be explained by the observed ratio between ice aloft and the surface rainfall. Hence it is important to understand how PMW algorithms resolve the topographically induced rainfall.

This study evaluates the GPM-era IMERGV06B and its components (PMW, IR and morph) over CONUS mountainous areas by using the Ground Validation Multi-Radar Multi-Sensor (GV-MRMS) radar-based Quantitative Precipitation Estimation (QPE) as reference at 0.1deg and half hourly spatiotemporal resolution. It aims to understand the uncertainties of IMERG due to topographically induced rainfall processes. Precipitation mechanisms depend on several environmental and physical parameters that are considered for a detailed uncertainty analysis of SPPs in this study. Specifically, the impacts of orographically forced upward motion and horizontal moisture flux convergence on IMERG and its component are investigated to capture uncertainty sources.