Probabilistic precipitation rate estimates from GOES-R for hydrologic applications

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Abstract

The high-resolution and low-latency of GOES-R observations is essential for the monitoring and prediction of floods and flash floods, specifically in the Western United States where the vantage point of space can complement the degraded weather radar coverage of the NEXRAD network. The GOES-R rainfall rate algorithm will yield deterministic quantitative precipitation estimates (QPE). Accounting for inherent uncertainties will further advance the GOES-R QPEs that will be improved through the new bands, higher resolution, and basic algorithmic improvements. With quantifiable error bars, the rainfall estimates can be more readily fused with ground radar products and incorporated into ensemble hydrologic forecast applications. On the ground, the high-resolution NEXRAD-based precipitation products from the Multi-Radar/Multi-Sensor (MRMS) system, which is now operational in the National Weather Service (NWS), provide QPEs suited for flash flood monitoring and forecasting. However, NWS operations are challenged across the intermountain West due to a lack of suitable coverage of operational weather radars over complex terrain. An opportunity exists to combine the observations from GOES-R and MRMS to provide seamless, high-resolution and low latency precipitation estimates across the CONUS. The goal of this research project is to derive consistent, accurate and fine resolution precipitation rates with uncertainties over the CONUS. An already created MRMS-based precipitation database will provide an independent and consistent reference to document, analyze and design GOES-R QPE over a broad sample of precipitation situations. GOES-R precipitation estimates will be matched to the MRMS-based rainfall database in order to derive and analyze distributions of QPE uncertainties associated with the GOES-R deterministic retrievals. The probabilistic model mitigates biases compared to the deterministic GOES-R QPE and quantifies the associated uncertainty. It provides the basis for the generation of GOES-R precipitation ensembles suitable to 1) merge with MRMS-based probabilistic QPEs from ground radar-based algorithms already developed to advance multisensor QPE integration (Kirstetter et al. 2015a) and 2) serve as input to a framework being developed in an already funded project for probabilistic flash flood prediction across the U.S. (Gourley et al., 2013, 2016). The product will be further tested in an operational environment in order to improve its use for weather and water forecasting.