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Accurate characterization of uncertainties in precipitation estimates derived from space-borne measurements is critical for many applications including water budget studies or prediction of natural hazards caused by extreme rainfall events. The GPM precipitation Level II (active and passive) and Level III (IMERG) estimates are compared to the high quality and high resolution NEXRAD-based precipitation estimates derived from the NOAA/NSSL’s Multi-Radar, Multi-Sensor (MRMS) platform. The NEXRAD network has undergone an upgrade in technology with dual-polarization capabilities and the MRMS products, after having been adjusted by rain gauges and passing several quality controls and filtering procedures, are 1) accurate with known uncertainty bounds and 2) measured at a resolution below the pixel sizes any GPM estimates, providing great flexibility in matching MRMS samples to grid scales or “footprints”. Collectively, these MRMS products provide an independent and consistent reference research framework for directly evaluating post-launch GPM precipitation products across a large number of meteorological regimes as a function of resolution, accuracy and sample size.

A comparison framework was developed to examine the consistency of the ground and space-based sensors in term of precipitation detection, typology (e.g. convective, stratiform) and quantification. Several aspects of satellite precipitation retrieval are evaluated such as precipitation detectability and distributions, separation of systematic biases and random errors, influence of precipitation sub-pixel variability and comparison between satellite products. At the Level II precipitation features are introduced to analyze satellite estimates under various precipitation processes. Specific factors for passive (e.g. surface conditions for GMI) and active (e.g. attenuation of the radar signal, non uniform beam filling for DPR) sensors are investigated. Prognostic analysis directly provides feedback to algorithm developers on how to improve the satellite estimates. Comparison with TRMM products serves as a benchmark to evaluate GPM precipitation estimates. A the Level III the contribution of Level II is explicitly characterized and a rigorous characterization is performed to migrate across scales fully understanding the propagation of errors. This cross products characterization acts as a bridge to intercalibrate microwave measurements from the GPM constellation satellites and propagate to the combined and global precipitation estimates. Future perspectives are presented.