Probabilistic Quantitative Precipitation Estimates with Space-based Radars

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Progress in precipitation estimation is critical to advance weather, water budget studies, and prediction of natural hazards caused by extreme rainfall events from local to global scale. An interdisciplinary challenge in remote sensing, meteorology and hydrology is the impact, representation, and use of uncertainty. Understanding of hydrometeorological processes and applications require more than just one deterministic "best estimate" to adequately cope with the intermittent, highly skewed distribution that characterizes precipitation. Yet quantitative precipitation estimation (QPE) from satellite-based radars (e.g. Global Precipitation Measurement GPM) is currently deterministic. We propose to advance the interpretation of radar measurement for precipitation with the use of probability as an integral part of QPE. The focus is on precipitation quantification and uncertainty characterization by taking advantage of the polarimetric multi-scale surface precipitation information for improved understanding of space-based precipitation remote sensing. Probability distributions of precipitation rates are established instead of deterministic values using models quantifying the relation between sensor measurements, algorithm and the corresponding "true" precipitation. This approach integrates sources of error in QPE and provides a framework to diagnose uncertainty when instruments sample raining scenes or processes challenging the assumptions of the QPE algorithms. Probabilistic QPE (PQPE) mitigates systematic biases from deterministic retrievals, quantifies uncertainty, and advances the monitoring of precipitation extremes with remote sensing. Perspectives for improved understanding and parameterizations of precipitation processes, estimation of precipitation at multiple scales, hydrological prediction and risk monitoring will be presented.

Keywords: Spaceborne Radar, Probabilistic Quantitative Precipitation Estimation