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Probabilistic Quantitative Precipitation Estimates with Ground and Space-based Radars

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The uncertainty structure of radar quantitative precipitation estimation (QPE) is largely unknown at fine spatiotemporal scales near the radar measurement scale (1-km/5-min for ground-based radars, 5-km/instantaneous for space-based radars). By using the WSR-88D radar network and rain gauge datasets across the conterminous US, an investigation of this subject has been carried out on the NOAA/NSSL Multi-Radar Multi-Sensor and on the NASA/JAXA TRMM and GPM space-based radars. Probability distributions of precipitation rates are computed instead of deterministic values using models quantifying the relation between radar reflectivity and the corresponding “true” precipitation. The probabilistic model considers multiple sources of error in radar QPE as well as the impacts of correction algorithms on the radar signal. Ensembles of reflectivity-to-rain rate relationships accounting explicitly for factors including rain typology were derived at the estimation scale. This approach preserves the fine space/time sampling properties of the radar and conditions probabilistic QPE on the precipitation rate and precipitation type when computing probabilistic quantitative precipitation estimates (PQPE). This PQPE approach provides the basis for precipitation probability maps and the generation of radar precipitation ensembles. Maps of the precipitation exceedance probability for specific thresholds (e.g. precipitation return periods) are demonstrated. PQPE compares positively to the deterministic QPE.