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Probabilistic Quantitative Precipitation Estimates with Ground-based Radar Networks

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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). By using the WSR-88D radar network and rain gauge datasets across the conterminous US, an investigation of this subject has been carried out within the framework of the NOAA/NSSL ground radar-based Multi-Radar Multi-Sensor. Probability distributions of precipitation rates are computed instead of deterministic values using a model 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 rain typology were derived at a 5-min/1-km scale. This approach preserves the fine space/time sampling properties of the radar and conditions probabilistic QPE on the rain rate and precipitation type when computing probabilistic quantitative precipitation estimates (PQPE). The model components were estimated on the basis of a 1-year-long data sample. This PQPE model 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. Precipitation probability maps are accumulated to the hourly time scale and compare positively to the deterministic QPE. This approach to PQPE can readily apply to other systems including space-based passive and active sensor algorithms.