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Rain radar measurement error estimation using data assimilation in an advection-based nowcasting system

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The quantification of measurement uncertainty for rain radar data remains challenging. Radar reflectivity measurements are affected, amongst other things, by calibration errors, noise, blocking and clutter, and attenuation. Their combined impact on measurement accuracy is difficult to quantify due to incomplete process understanding and complex interdependencies. An improved quality assessment of rain radar measurements is of interest for applications both in meteorology and hydrology, for example for precipitation ensemble generation, rainfall runoff simulations, or in data assimilation for numerical weather prediction. Especially a detailed description of the spatial and temporal structure of errors is beneficial in order to make best use of the areal precipitation information provided by radars.

Radar precipitation ensembles are one promising approach to represent spatially variable radar measurement errors. We present a method combining ensemble radar precipitation nowcasting with data assimilation to estimate radar measurement uncertainty at each pixel. This combination of ensemble forecast and observation yields a consistent spatial and temporal evolution of the radar error field. We use an advection-based nowcasting method to generate an ensemble reflectivity forecast from initial data of a rain radar network. Subsequently, reflectivity data from single radars is assimilated into the forecast using the Local Ensemble Transform Kalman Filter. The spread of the resulting analysis ensemble provides a flow-dependent, spatially and temporally correlated reflectivity error estimate at each pixel. We will present first case studies that illustrate the method using data from a high-resolution X-band radar network.