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Development of a probabilistic precipitation-nowcasting approach at DWD

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At Deutscher Wetterdienst (DWD) a pilot project has been set up to start the development of its future seamless INtegrated FOrecastiNg sYstem (SINFONY). The focus during the pilot project is on severe summertime convective events. One aspect of the project concerns the improvement of the existing nowcasting system and the extension to an ensemble approach.
The operational radar-based precipitation nowcasting at DWD employs the so-called optical flow technique. It uses composites of quality-assured terrain-following low elevation radar reflectivity measurements. With this approach, the motion vector of individual reflectivity pixel in the composite is estimated from previous observations and the position is linearly extrapolated into the future. The intensity of advected pixels is kept constant during the whole forecast. Deterministic predictions are provided in time steps of 5 minutes with forecast periods of 2 hours and updates every 5 minutes.
To account for the limited predictability of precipitation, especially in convective situations, a transition from deterministic to probabilistic nowcast is necessary. Thus, the aforementioned algorithm is extended to an ensemble approach. Two different types of inherent forecast uncertainties are addressed: the uncertainty in the propagation of precipitation structures (advection uncertainty), and the uncertainty regarding strengthening and weakening of precipitation during the forecast (dynamic uncertainty).
One possibility to assess the advection uncertainty is the variation of parameters within the optical-flow approach, for example the weighting of the motion of individual pixels in comparison to the large-scale motion. Another option to estimate the advection uncertainty is the use of NWP ensemble simulations. Assuming that the NWP ensemble simulates a realistic variance of the wind vectors within the nowcasting range, these can be used for the nowcasting ensemble generation.
The dynamic uncertainty is considered with a scale-dependent auto-regressive extrapolation of precipitation intensity that is perturbed by correlated stochastic noise in the course of the forecast. This approach is based on the Short-Term Ensemble Prediction System (STEPS) which exploits the scale-dependence of predictability of precipitation. With this method, large-scale precipitation (e.g. frontal rain) is predicted to be more persistent than small-scale precipitation (e.g. associated with thunderstorms). An ensemble is generated by different realizations of stochastic perturbations.
Results for different case studies and the one-month ensemble verification for Germany during May and June 2016 are presented. This period is characterized by a variety of severe convective events in particular with respect to heavy precipitation.