9.16 DEVELOPMENT OF A PROBABILISTIC PRECIPITATION-NOWCASTING APPROACH

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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 aim of the project is a novel combination of probabilistic nowcasting techniques and numerical weather prediction (NWP) ensembles to achieve improved and seamless forecasts of hazardous summerly deep convective events from observation time up to +6h/+12h. Up to now both methods are mostly treated independently of each other.

The operational radar-based precipitation nowcasting at DWD employs the so-called optical flow technique. It uses composites of 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 linearly extrapolated into the future. Deterministic predictions are provided in time steps of 5 minutes with forecast periods of 2 hours. The forecasts are updated every 5 minutes according to new radar measurements. To account for the limited predictability of precipitation, especially in convective situations, a transition from deterministic to probabilistic nowcast is necessary. To enable probabilistic precipitation nowcasting, the aforementioned algorithm is extended to an ensemble approach. The precipitation prediction depends on the choice of various parameters within the algorithm; the most important are the following: (a) the weighting of the motion of individual pixels in comparison to the large-scale motion, (b) the length of the considered history of the track, (c) the spatial smoothness of the predicted precipitation field. These none-analytical algorithm parameters are subject to a wide uncertainty range. Consequently, as a first step, a nowcasting ensemble can be generated by varying the parameters in their valid ranges. This is comparable to the method of varying parameters in physical parametrizations within NWP ensemble prediction systems. An additional way of estimating nowcasting 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.

In addition to the described pure-advective approach, an estimation of the likelihood for strengthening and weakening of precipitation during the forecast time is desired. This can be addressed by different approaches: One possibility is the incorporation of statistical information on the life-cycle of convective cells. Another option is the consideration of environmental conditions similar to the ingredients-based method applied in operational forecasting. It uses atmospheric stability, moisture content, lifting and vertical wind shear to estimate the likelihood and strength of convection. To consider environmental conditions in the nowcasting ensemble the relevant parameters could be taken form NWP simulations.

Considering the use of NWP results to improve nowcasting ensemble (both for information of wind vectors and environmental conditions) relies on the experience that the synoptic-scale structures are much better captured in NWP simulations compared to precipitation itself.

Results of case studies during May and June 2016 are presented. Also, conceptual ideas for a multi-modal approach and a blending of nowcast ensemble and NWP ensemble for a seamless probabilistic prediction across different forecast times will be discussed.