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Assimilation of objects based on 3D radar reflectivities on the convective scale with an ensemble-based data assimilation system

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At Deutscher Wetterdienst a new internal project has been set up to develop a seamless ensemble prediction system for convective-scale forecasting with forecast ranges of 6 up to 12 hours. The focus is on severe summertime convective events with associated hazards such as heavy precipitation, hail and wind gusts.

On one hand, predictions of convective cells based on nowcasting systems, which are mostly based on radar reflectivities, currently outperform NWP models for very-short range weather forecasts. On the other hand, NWP forecasts are superior to nowcasting predictions after one to two hours of forecast lead time. Therefore, we aim at integrating both approaches in a seamless prediction system.

Objects based on radar reflectivities are operationally used in nowcasting. We propose to consider object-based methods for the data assimilation of 3D radar reflectivities in NWP. Object-based methods in NWP potentially have the advantage of avoiding the well-known double-penalty problem. Further, their assimilation might be much faster compared to the direct assimilation of the raw radar reflectivities due to a reduced amount of data. Additionally they can provide a means to exchange information between the Nowcasting and the NWP side of the forecasting system in a seamless sense.
In March 2017 the Kalman filter for convective-scale data assimilation (KENDA), which has been developed for the Consortium for Small-scale Modelling (COSMO) model, has become operational at DWD (Schraff2016). This system includes a local ensemble transform Kalman filter (LETKF) and a deterministic analysis based on the Kalman gain for the analysis ensemble mean. KENDA gives the possibility to assimilate any type of observation, given a corresponding forward operator for the model. Therefore KENDA allows us to also assimilate data in form of “objects” in a natural way.

In our investigation we examine various constructions of objects based on 3D radar reflectivities for the data assimilation system in NWP. We focus on selected case studies of days with strong convective activity in which small and large convective cells could be identified, and therefore give rise to the challenging question of how to define an “object”. Currently we explore the advantages and challenges of this novel type of observational data, and we will show our latest results in this poster.