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

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At Deutscher Wetterdienst (DWD), the pilot project SINFONY has been set up to develop a seamless ensemble prediction system for convective-scale forecasting with forecast ranges of up to 12 hours. It integrates Nowcasting techniques with numerical weather prediction (NWP) in a seamless way. 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 from Nowcasting systems currently outperform NWP systems for very-short range weather forecasts. On the other hand, NWP forecasts are superior to Nowcasting predictions after a few hours of forecast lead time. Therefore, the goal is to optimally integrate both approaches in a seamless prediction system.
Objects based on radar reflectivities are operationally used in Nowcasting at DWD. We propose to consider object-based methods for the assimilation of radar reflectivities in NWP. Such methods potentially help to circumvent the well-known double-penalty problem. Additionally, they can provide a means to exchange information between the Nowcasting and the NWP side of a seamless forecasting system. Furthermore, the assimilation of 3D radar data is investigated as a reference for the object-based strategy. For this project we use the KENDA system (Kilometre-scale Ensemble Data Assimilation), which has been developed for the Consortium for Small-scale Modeling (COSMO) model and is operational at DWD since March 2017. This system includes a local ensemble transform Kalman filter (LETKF) and a deterministic analysis based on the Kalman gain for the analysis ensemble mean. Since KENDA gives the possibility to assimilate any type of observation, given a corresponding forward operator for the model, investigations based on 3D radar data and derived objects are possible using the Efficient Modular Volume Radar Operator (EMVORADO), potentially combined with tools to generate objects. We examine the assimilation of associated/derived quantities of objects obtained by thresholding radar reflectivities as well as objects based on Nowcasting products. Currently we explore the assimilation of “coarse”-gridded objects and their properties in the spirit of the Fraction Skill Score. For comparison we investigate at the same time the assimilation of full 3D radar data. Additionally, we perform experiments for the combined assimilation of cell objects and 3D radar data to not loose the information on “stratiform” (non-cell) events while emphasizing the convective cell objects.