Development of a new seamless integrated forecasting system (SINFONY) at DWD

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1. Deutscher Wetterdienst

At Deutscher Wetterdienst (DWD), the pilot project SINFONY has been set up in 2017 to develop a seamless ensemble prediction system for convective-scale forecasting with forecast ranges of up to 12 hours, which integrates nowcasting techniques with numerical model prediction (NWP) in a more or less seamless way. The focus is on severe summertime convective events with associated hazards such as heavy precipitation, hail and wind gusts.

So far, the storm-scale forecasting for the first 2 hours and warning rely mostly on observation-based nowcasting products with frequent updates (typically with 5-min intervals) that are available within a few minutes. New NWP forecasts with the convection-permitting ensemble system COSMO-D2-EPS are started only every 3 h and can outperform the quality of nowcasting only at later forecast times. Moreover, nowcasting and ensemble NWP are treated as two separate and independent methods, and there are only few common products available for the forecasters.

The goal of SINFONY is to narrow down this gap and to provide new products for the forecasters from observation time up to +12 h, combining nowcasting and NWP. Therefore, efforts are undertaken on the one hand by enhancements to both nowcasting and NWP separately and on the other hand by mutual information exchange and combination between these two methods.

The nowcasting system, which is currently purely deterministic, is expanded to an ensemble approach. In terms of radar-derived reflectivity fields, the scale-dependence of predictability of precipitation is exploited, following the concept of the Short-Term Ensemble Prediction System (STEPS). Regarding cell objects, the cell detection, tracking and forecasting system KONRAD3D is extended by the incorporation of statistical cell life-cycle information using Ensemble Transform Kalman Filter technique.

For the NWP system, a rapid update cycle (RUC) is under development, with hourly ensemble forecast on the km-scale using the new limited area version of the ICON model (ICON-LAM). Efforts are done to further improve the model physics (2-moment microphysics). Additional high-resolution observational data including 3D-radar-data, Meteosat SEVIRI satellite data and lightning densities are added to the existing LETKF based assimilation system, as well as the assimilation of cell objects detected with nowcasting techniques.

The combined forecast products for reflectivity fields and for cell objects should provide seamless condensed information combining the individual strengths of the nowcasting system and the NWP in an optimal way. For the reflectivity fields, blending techniques using weighting functions based on comparative verification of nowcasting and NWP are used. The Bayesian combination of both systems based on the ensemble spread is another option that is under development. The optimal combination of cell objects presupposes the same cell detection technique in nowcasting and NWP. This can be realized

with the model forward operator EMVORADO (Efficient Modular VOlume scanning RADar Operator) providing synthetic radar data as basis for cell detection. The combined product is generated by comparing simulated and observed cells and merging this information with clustering-techniques. The focus on a thorough verification of the nowcasting ensemble, the NWP ensemble as well as the combined products is a prerequisite for a seamless integrated forecasting system.

The presentation will give an overview of the goal and the concept of the SINFONY project and its progress during its first 2 years through case studies of convective events in Germany during May and June 2016.