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A Detailed and a Coarse Scheme for Convective Data Assimilation of Radar Observations using a Local Ensemble Kalman Filter

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The DWD is developing an implementation of the Local Ensemble Transform Kalman Filter (LETKF) for the cloud resolving COSMO model. This study shows in an idealized convective testbed that the LETKF is able to perform storm-scale Data Assimilation of simulated Doppler radar observations. Localizing the observation error covariances, the analysis quality appears comparable to assimilation systems that use algorithms like the EnSRF that localize the background error covariances.

It is investigated in perfect model experiments how the limited predictability of convective storms affects precipitation forecasts by comparing a fine scheme with low analysis error to a coarse scheme that allows variance regarding position, shape and occurence of storms in the ensemble. To get there, the coarse scheme uses averaged superobservations and a coarser evaluation of the analysis weights, a larger localization radius and a weaker Gaussian constraint on the analysis solution.

Performing 3-hour forecasts of convective systems with typical lifetimes exceeding 6 hours, forecasts from the detailed analyses of the fine scheme are found to be advantageous to those of the coarse scheme during the first 1-2 hours, regarding the predicted storm positions. After 3 hours in the convective regime used here, the forecast quality of the different schemes appears indiscernible, judging by RMSE and verification methods for rain-fields and objects.

It is concluded that, for operational assimilation systems, the analysis might not necessarily need to be detailed on the grid scale of the model. Depending on the forecast lead time, and on the presence of orographic or synoptic forcings that enhance the predictability of storm occurences, analyses from a coarser scheme might suffice. As a positive side-effect, the computational cost of the Kalman Filter solution can be reduced strongly.