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The WRFDA and different estimations of the background error: application in Catalonia for high-resolution precipitation nowcasting

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Over the last few years, very short range forecasts from numerical weather prediction models are being increasingly used for nowcasting purposes. Since the WRF Data Assimilation (WRFDA) system supports radar data, it is possible to run rapidly updated high-resolution (3 km grid spacing) WRF forecasts to assess the development and evolution of precipitation. Given that operational simulations must be completed in a timely fashion, a computationally cheap system is needed; for this reason we rely on three-dimensional variational (3DVAR) data assimilation techniques, as real time 4DVAR or Ensemble Kalman Filters (EnKF) are unfeasible for us.

One of the key components of any 3DVAR system is the background error covariance matrix (B), as it defines the weight given to the background and spreads the information spatially and across different variables. Commonly, the differences between consecutive pairs of 12 and 24 hours forecasts, valid at the same time, and for a month-long dataset, are used to estimate a climatological B matrix.

The aim of this work is to evaluate several approximations to this estimation when applied to the operational nowcasting system at the Meteorological Service of Catalonia (NE Spain). On one hand, the computation of seasonal matrices shows that the length-scale and the variance of the control variables change over the year. On the other hand, the values obtained for these parameters made us consider whether an appropriate tuning of them would be convenient for the assimilation of the high resolution data provided by our radar network. The impact, both in the analysis and forecast, of using tuned seasonal B matrices, is evaluated for a selection of cases from different seasons.

In addition to this, the background error statistics can include flow-dependency information through a hybrid approach combining the 3DVAR and the EnKF methodologies, such as the Hybrid-3DEnVar data assimilation technique available in WRFDA. In this study, it is also shown how a computationally cheap time-lagged ensemble can be used for this purpose in an operational high-resolution nowcasting system.