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Observation impact in a convective-scale localized ensemble transform Kalman filter

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In operational weather forecasting, knowledge about observation impact, i.e. the contribution of specific observations to forecast error reduction, is crucial to refine the observing and data assimilation system. However, assessing this quantity by direct computation (data denial experiments) is usually not feasible because of the high computational cost. This has motivated the derivation of approximated forms of observation impact. If an adjoint model is available, established methods exist that give a reliable estimate. On the other hand, in an ensemble-based environment, a recently developed algorithm [1] uses the analysis and forecast deviations to approximate observation impact. This has now for the first time been implemented in the convective-scale limited-area model COSMO and has been thoroughly verified with data-denial experiments [2]. It has been found that the difference to data denial is not significant (less than 10%) and accuracy can be expected to improve further when considering longer test periods. The peculiarities for an application on this scale include a strongly non-linear behavior and a typically small localization length. While the former can be expected to be reasonably addressed by the ensemble algorithm, the latter imposes constraints for an appropriate choice of lead time. It could also be shown that valuable information, such as the detection of disadvantageous observations can be gained. This presentation shows the feasibility and distinctive features of the method for a convective-scale setup, gives examples from a pre-operational application at Deutscher Wetterdienst, and discusses the sensitivity to lead time, localization and verification norm.

References:

[1] E. Kalnay, Y. Ota, T. Miyoshi, and J. Liu. A simpler formulation of forecast sensitivity to observations: application to ensemble Kalman filters. Tellus A 64, 2012.

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