Improving Ensemble-based Observation Impact Estimate using a Group Filter Technique

Nicholas A. Gasperoni[a,b,c] and Xuguang Wang[a,b]

[a] *School of Meteorology, University of Oklahoma, Norman, OK 73072, USA*
[b]*Center for Analysis and Prediction of Storms, Norman, OK 73072, USA*
[c] *ngaspero@ou.edu*

An ensemble-based observation impact estimate [3] is straightforward to be applied for ensemble data assimilation systems. However, due to relatively small ensemble sizes compared to the large number of degrees of freedom in models, it is necessary to apply localization techniques to obtain accurate estimates. Fixed localization techniques do not guarantee accurate impact estimates, because as forecast time increases the error correlation structures evolve and move with the flow. For longer lead times, we should expect the optimal localization function to be shifted downstream from the observation and be spread by various model flow dependencies. Kalnay et al. [3] showed improvements in the accuracy of the impact estimate by employing a time-dependent displacement term to a Gaspari-Cohn localization function.

The goal of this study is to explore methods to improve the observation impact estimate by improving the method of localization. Our experiments use the LETKF together with a two-layer primitive equation model and simulated observations as in Holland and Wang [2]. We employ a Monte Carlo "group filter" technique developed by Anderson [1] to limit the effects of sampling error. For each group of ensemble members, a regression coefficient, β, is calculated between the analysis and a forecast of some length. Then a *regression confidence factor* (RCF) is computed to minimize expected RMS differences between sample β's. An envelope of RCF values is then applied to the observation impact estimate. Our results have shown that the shape, location, time-dependency and variable-dependency of the localization function is consistent with underlying dynamical process of the model. Results of applying the RCF on observation impact estimate will be presented in the symposium.

References

[1] Anderson, J. "Exploring the need for localization in ensemble data assimilation using a hierarchical ensemble filter." *Physica D*, vol. 230, pp. 99-111, June 2007. Available at: <http://dx.doi.org/10.1016/j.physd.2006.02.011>.

[2] Holland, B. and Wang, X. "Effects of sequential or simultaneous assimilation of observations and localization methods on the performance of the ensemble Kalman filter." *Q.J.R. Meteorol. Soc.*, vol. 139, no. 672, pp. 758-770, Apr. 2013. Available at: <http://dx.doi.org/10.1002/qj.2006>.

[3] Kalnay, E., Ota, Y., Miyoshi, T., and Liu, J. "A simpler formulation of forecast sensitivity to observations: application to ensemble Kalman filters." *Tellus A*, vol. 64, Oct. 2012. Available at: <http://dx.doi.org/10.3402/tellusa.v64i0.18462>.