Ensemble Bayesian filtering with Residual Nudging

Xiaodong Luo[a], and Ibrahim Hoteit[b]

[a] *IRIS, Norway, xiaodong.luo@iris.no,* [b] *AMCS, KAUST, Saudi Arabia.*

An auxiliary data assimilation technique, called residual nudging, is proposed in order to monitor and, if necessary, adjust the distance (residual norm) between the predicted observation and the true observation.

A rule for choosing the threshold of the residual norm is suggested, and two different methods are introduced in order to make the residual norm no larger than the specified threshold. In the first method, the objective of residual nudging is achieved by (potentially) introducing certain modification to the analysis mean after the observation is assimilated. Conceptually, this method is applicable to various data assimilation methods, including, for instance, the ensemble Kalman filter (EnKF) [3] and the particle filter [2].

The second method is specific for the EnKF. The objective of residual nudging is achieved by modifying the mean update formula before the information content of the observation is incorporated. Such a modification is equivalent to tuning the covariance inflation factor in the EnKF. It is shown that, in order for the residual norm to be bounded in a certain interval, the corresponding covariance inflation factor should be bounded in an interval as well. The bounds of the covariance inflation interval are explicitly derived, and some implications of the analytic results are highlighted [1].

References

[1] X. Luo and I. Hoteit. "Covariance inflation in the ensemble Kalman filter: a residual nudging perspective and some implications," *Mon. Wea. Rev.*, submitted.

[2] X. Luo and I. Hoteit. "Efficient particle filtering through residual nudging," *Quart. J. Roy. Meteor. Soc.*, in press (preprint http://arxiv.org/abs/1303.2698).

[3] X. Luo and I. Hoteit. "Ensemble Kalman filtering with residual nudging," *Tellus A*, vol. 64, 17130, 2012 (http://www.tellusa.net/index.php/tellusa/article/view/17130/html).