Error Analysis and Adaptive Localization for Ensemble Methods in Data Assimilation

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Ensemble data assimilation systems are increasingly popular for a variety of applications, as they provide a flexible alternative to large-scale variational systems. A number of different versions of ensemble filters have been suggested and tested over the last two decades.

Even though Ensemble-DA has high potential, its theoretical justification is still under development, both on the application side, testing the operational setup for different data types, as well as on the mathematical analysis, looking into approximation properties with ensemble-size small compared to the number of degrees of freedom in the model.

Localization is often used to reduce the effect of spurious long-range correlations and to increase the effective size of the ensemble space. It is the goal of our work [1] to understand the basic properties of localization. We derive deterministic error estimates for the EnKF and study its dependence on localization both for the one-step analysis case and for the assimilation of two kind of observations. We also derive the formula for an optimal localization radius depending on the observation density and the observation error. The validity of the theory is demonstrated by numerical experiments for several simple models using LETKF [2].

References

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[2] Hunt B.R., Kalnay E., Kostelich E.J., Szunyogh I., "Efficient data assimilation for spatiotemporal chaos: A local ensemble transform Kalman filter", *Physica D*, vol. 230, pp 112-126, 2007