Sensitivity Experiments with a LETKF Data Assimilation Scheme Employing the WRF Model

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Abstract

In this work the Local Ensemble Transform Kalman Filter [1] (LETKF) implemented in the Weather Research and Forecasting model (WRF) [2] is used to study the sensitivity of this algorithm to different error sources. The domain covers South America and its adjacent oceans. Our approach consists in performing different OSSE experiments where the truth is generated using the WRF model, forced with the FNL analysis. A set of observations is generated taking randomly perturbed values from this true state. LETKF analysis cycle experiments using 40 ensemble members and adaptive covariance inflation [3] were performed using these observations. The following experiments have been performed:

- Perfect model with perfect boundary conditions
- Imperfect model with perfect boundary conditions
- Perfect model with imperfect boundary conditions
- Imperfect model with imperfect boundary conditions

Where Perfect model / Perfect boundary refer to the same version of WRF and boundary conditions used to generate the "true state", while imperfect model includes changes in WRF cumulus and planetary boundary layer parameterizations and imperfect boundary conditions correspond to the utilization of the Reanalysis I dataset to force the model.

Each of these experiments employs the same boundary conditions for all the ensemble members, regardless whether they are perfect or not. The evolution of the ensemble spread under this constrain is analyzed. Results show that the errors in boundary conditions are particularly important in data assimilation problems with limited area domains. Moreover, they indicate that there is a need to perturb the boundary conditions in order to prevent the ensemble spread from collapsing. Nevertheless, adaptive inflation makes a good job in adjusting the ensemble spread in each of the experiments and helps in maintaining the spread under the constraint imposed by the boundary conditions.

References

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