
Integrated Hybrid Data Assimilation for an Ensemble Kalman Filter

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Abstract

Hybrid ensemble-variational assimilation methods have been widely applied for numerical weather predictions. The commonly used hybrid assimilation methods compute the hybrid analysis increment using a variational framework and update the ensemble perturbations by an EnKF. To avoid the inconsistency resulted from separated hybrid assimilation and EnKF systems, two integrated hybrid ensemble Kalman filters (EnKFs) that update both the ensemble mean and ensemble perturbations by a hybrid background error covariance in the framework of EnKF are proposed here. The integrated hybrid EnKFs approximate the static background error covariance by use of climatological perturbations through augmentation or additive approaches. The integrated hybrid EnKFs are investigated in the Lorenz (2005) models II and III with different magnitudes of model error. Results show that the static background error covariance can be sufficiently estimated by climatological perturbations within order of hundreds. The integrated hybrid EnKFs are superior to the traditional hybrid assimilation methods, which demonstrates the benefit to update ensemble perturbations by the hybrid background error covariance. Sensitivity results reveal that the advantages of the integrated hybrid EnKFs over traditional hybrid assimilation methods maintained with varying ensemble sizes, inflation values and localization length scales.

Keywords: ensemble Kalman filter, hybrid data assimilation, perturbation update

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