



Square root ensemble filters for data assimilation

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Ensemble data assimilation system based on Kalman square root filters has been developed and tested for convective-scale version of the COAMPS model using twin experiments set-up. Ensemble data assimilation systems transform a forecast ensemble into an analysis ensemble with appropriate statistics. This can be done statistically treating the observations as random variables, or deterministically, requiring that the covariance of the updated ensemble satisfy the Kalman filter analysis error covariance equation. We implemented deterministic analysis ensemble update, which is Monte Carlo implementation of Kalman square root filters. Ensemble square root filters are not unique, since different ensembles can have the same covariance. This non-uniqueness had led to development of several different algorithms for updating the analysis ensemble. In our implementation of square root filter we used Whitaker and Hamil (2002) method. An additional processing of the ensemble covariances is introduced to avoid the filter divergence caused by sampling errors. The techniques commonly used (and implemented in our work) are distance dependent covariance localization and covariance inflation. Covariance localization is a filter that forces the ensemble covariances to go to zero at some horizontal distance L from the observation being assimilated. We also use a covariance localization in the vertical. Covariance inflation simply inflates the deviations from ensemble mean first guess by some factor greater than 1.0 for each member of the ensemble, before the computation of the background-error covariances and before any observations are assimilated.