Local Ensemble Transform Kalman Filter Assimilation of Precipitation with the NCEP Global Forecasting System

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Precipitation has long been one of the most important meteorological observations. Although many in-situ and satellite based precipitation observations have been made available, the nonlinear observation operator and the non-Gaussianity of the precipitation variable pose difficulties in its assimilation. It is relatively easy to force the model precipitation to be close to the observed values; however, since this is not an efficient way to modify the potential vorticity field that the model would remember, model forecasts tend to lose their additional skill after few forecast hours.

We propose to use a local ensemble transform Kalman filter (LETKF) to assimilate precipitation observations. The ensemble based data assimilation features the flow-dependent background error covariance, which is able to relate the precipitation variable to other "master" dynamical variables based on the original nonlinear moist physical parameterization in the model. In addition, we also propose two changes in the precipitation assimilation process: a) transform precipitation into a variable with a Gaussian distribution used in the assimilation, and b) only assimilate precipitation at the locations where at least some ensemble members have positive precipitation. In observing system simulation experiments (OSSEs) using a simplified but still realistic general circulation model, we have seen promising improvement by precipitation assimilation [1]. The model background based observation selection criterion plays an essential role in improving the analyses, and the Gaussian transformation of precipitation variables is particularly useful in the case of large observation errors. Based on the experience obtained using the OSSEs, we are going to conduct real precipitation assimilation experiments using the National Centers for Environmental Prediction (NCEP) Global Forecasting System (GFS) model. The TRMM Multisatellite Precipitation Analysis (TMPA) will be assimilated into the model with a newly developed GFS-LETKF data assimilation system. Preliminary results will be shown in this presentation.

References

[1] G.-Y. Lien, E. Kalnay, T. Miyoshi, "Effective Assimilation of Global Precipitation: Simulation Experiments," Submitted to *Tellus*, 2013.