Inter-comparison of static and flow-dependent estimates of background error covariances

Amal El Akkraoui[ab], and Ricardo Todling[b]

[a] *Science System and Applications, Inc., USA,amal.elakkraoui@nasa.gov,* [b] *Global Modeling and Assimilation Office, NASA, USA.*

Variational data assimilation techniques rely on a good estimate of the background error covariance matrix (B) to provide reliable atmospheric analyses. The so-called NMC method is traditionally used to estimate a climatological B from the statistics of different-length differences of forecasts verified at the same time. This approach parameterizes the background error covariance as homogeneous and isotropic, and requires explicit tuning of its covariance coefficients. Recently, introduction of hybrid assimilation methodologies combines the static structure of B with flow-dependent estimates derived from an available ensemble of forecasts running in parallel with the data assimilation system. Ensemble estimates of B have the additional advantage of implicitly obtaining correlations among all control variables, but suffer from being low-rank due to limited size of the typical ensemble. Localization is normally applied to remedy this issue so long as the scales are adequately tuned. This work plans to examine the structure of B derived in these two ways when using forecasts from the Global Modeling and Assimilation Office (GMAO) hybrid three-dimensional variational (3D-Var) data assimilation system.

Motivated by a possible reformulation of the Incremental Analysis Update procedure of Bloom et al. (1996) more consistent with extensions of 3D-Var to weak-constraint 4D-Var, this work also plans to derive error covariance estimates from model forecasts tendency differences (e.g. Trémolet 2007). Both the NMC- and ensemble-based error covariance estimation methodologies mentioned above will be used to characterize climatological and flow-dependent components of tendency-based error covariance matrices to aid the GMAO variational assimilation procedures.

Preliminary inter-comparison results will be shown for these four error covariance estimates. The correlation lengths and structures will be evaluated, and analysis increments of corresponding twin experiments will be examined in the context of the Grid-point Statistical Interpolation system used at GMAO. Results from cycling experiments will be the subject of a companion work also presented at this Symposium (see Todling et al.).

References

[1] Bloom, S. C., L. L. Takacs, A. M. da Silva, and D. Ledvina, 1996: Data assimilation using incremental analysis updates. Mon. Wea. Rev., 124, 1256-1271.

[2] Trémolet, Y., 2007: Model error estimation in 4D-Var, Q. J. R. Meteorol. Soc., 133, 1267-1280.