Effect of variable-dependent localization and static B in the hybrid-3DEnVar configuration using MPAS-JEDI

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The background error covariance (B) is one of the important elements to any data assimilation (DA) system, which determines how observed information is spread to the model, both spatially and across other variables/quantities. In this presentation, we has examined the effects of static B parameters and variable-dependent localization in the Joint Effort for Data Assimilation Integration (JEDI) software interface with NCAR's Model for Prediction Across Scales (MPAS-JEDI). Both static B and ensemble B covariances of hybrid B utilizes the Background error on an Unstructured Mesh Package (BUMP) from System-Agnostic Background Error Representation (SABER) repository, which is one of generic components available in the JEDI framework.

The reference experiment uses the static B parameters trained from 366 samples of National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) forecast differences with different forecast lead times (48 hour and 24 hours). For the ensemble B, the pre-generated 80-member EDA ensemble samples are used with a 1200 km (6 km) horizontal (vertical) localization length. In the hybrid B, 25 % and 75 % weights are specified to static and ensemble Bs for zonal and meridional winds, temperature, specific humidity, and surface pressure fields, while 0 % and 100 % weights are specified for cloud hydrometeor variables (i.e., cloud water, cloud ice, rain water, snow, and graupel).

To represent the MPAS's own forecast characteristics, the static B parameters are trained from 364 samples of MPAS's own forecast differences. The overall correlation lengths are similar between two samples, but one noticeable difference is relatively larger background error standard deviation in the stratosphere for MPAS-trained B. One beneficial aspect of MPAS-trained B is that it provides the B parameters for cloud hydrometeor variables, which enables all-sky 3dvar DA.

Then, to explore the variable-dependent localization, a smaller horizontal localization length, 600 km is applied to cloud hydrometeor variables. For the other variables, 1200 km horizontal length is kept. Also, 6 km vertical localization is kept for all variables.

A set of one-month Hybrid-3DEnVar cycling experiments were performed from 00 UTC April 15 to 18 UTC May 14, 2018 at 30 km (state) – 60 km (increment) global quasi uniform mesh. Overall, both static B trained from MPAS's own forecast difference samples and variable-dependent localization were shown to be beneficial in the model-space verification scores, verified with respect to GFS analysis.