Scale-dependent background-error covariance modelling for ensemble-variational data assimilation, with application to ECMWF's Ocean ReAnalysis (ORA) system

Anthony Weaver[1]
and
Marcin Chrust[2]

[1] *CERFACS, Toulouse, France*
[2] *ECMWF, Reading, UK*

Abstract

An important feature of ECMWF's latest ocean reanalysis system ORAS6 is a revised formulation of the background error covariance matrix **B**, in which parameters of the diffusion-based covariance model are calibrated using an Ensemble of Data Assimilations. In this presentation, we describe a new variant of this covariance model that enables the representation of ensemble-based covariances at multiple spatial scales. The revised **B** model incorporates key features from scale-dependent localization but, in contrast, does not require constructing a (localized) sample covariance matrix. Through a series of five-year cycled data assimilation experiments, the performance of a two-scale version of the new **B** model is compared with that of the single-scale **B** formulation used in ORAS6. Results show that the two-scale **B** provides a robust improvement in temperature and salinity in terms of observation-minus-background statistics. This improvement is attributed to the more effective spreading of information from sparse profile observations. Results for sea surface height (SSH) show a mixture of improvement (e.g., in boundary current regions) and degradation, the latter being especially apparent in the Southern Oceans. We attribute the degradation in SSH to biases in the mean dynamic topography and altimeter sea-level anomalies, whose influence is amplified by the large-scale component of **B**. Future developments to the multi-scale **B** formulation are discussed.