Recent developments in global ocean data assimilation at the Met Office

Global ocean data assimilation at the Met Office is a crucial component of ocean reanalysis and ocean forecasting from short-range to seasonal time scales. We provide an overview of recent developments and areas of research in global ocean data assimilation at the Met Office. This includes a new version, GOSI9, of the Forecasting Ocean Assimilation Model (FOAM), the development of a hybrid ensemble/variational data assimilation approach and the application of the data assimilation on a 1/12th degree horizontal resolution grid. The GOSI9 version of FOAM comprises an upgrade to a more recent version of the ocean model with a new equation of state, a new sea ice model and updates to the data assimilation. Here we focus on the updates to the data assimilation which include changes to the observation and background error covariances, an increase in the number of minimisation iterations, the implementation of Brunt-Väisälä stability checks to reduce instability and changes to the Mean Dynamic Topography (MDT) used to assimilate altimeter sea level anomaly (SLA) data. We see a substantial improvement in performance relative to our previous system, particularly for sea surface height and subsurface temperature. An ensemble ocean forecasting system using a hybrid three-dimensional ensemble variational DA (3DEnVar) approach with 36 members has been developed at the Met Office. Each member is forced by a different atmospheric realisation from the Met Office atmospheric ensemble and the system includes stochastic model perturbations and a relaxation to prior spread inflation scheme. In addition, observation perturbations are made in each member. The system has been tested with different weights for the ensemble component of the hybrid background-error covariance matrix and different inflation factors. The 3DEnVar is shown to produce better short range forecast results than either a purely variational or purely ensemble approach. The current FOAM 1/12th degree system runs the model component at 1/12th degree and the data assimilation at the lower resolution of ¼ degree. Recent developments to improve the efficiency of the data assimilation component, NEMOVAR, have allowed the implementation of data assimilation at the full (1/12th degree) resolution. We have tested the implementation of the higher resolution data assimilation in FOAM and assessed the impact of the change.

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