Assessing the new Met Office high resolution global ocean ensemble hybrid-3DEnVar system

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Abstract

We describe an updated global ocean and sea-ice ensemble data assimilation (DA) system based on the latest version of the FOAM (Forecasting Ocean Assimilation Model) system run at the Met Office. This system is planned to be run operationally at the Met Office in 2027. The ocean model is now NEMO (version 4) and the SI3 sea-ice model, both run at 1/12 degree resolution. The system assimilates data using NEMOVAR at 1/4 degree resolution. A 36 member ensemble of hybrid-ensemble-variational assimilation systems with perturbed observations (values and locations) is run. Running an ensemble of data assimilations can be expensive (despite the DA already being at a lower resolution than the model) we have done work to make this more affordable, including for example running the ensemble localisation on a coarser grid.

Each ensemble member is forced at the surface by a separate member of the Met Office Global-Regional Ensemble Prediction System (MOGREPS-G). The unperturbed member is forced by atmospheric fields from the Met Office operational Numerical Weather Prediction (NWP) deterministic system. The system includes stochastic ocean model perturbations and a Relaxation to Prior Spread (RTPS) inflation scheme.

We demonstrate the ensemble to be reliable for sea level anomaly (SLA), temperature and salinity (whereby the ensemble spread is a good representation of the uncertainty in the ensemble mean). Using hybrid three-dimensional ensemble variational DA (3DEnVar) along with the RTPS inflation scheme leads to a reduction of 20% (5%) in the unperturbed member, and the ensemble mean SLA (profile temperature and salinity) RMS error compared with the non-ensemble 3DVar system.