An investigation of ocean model uncertainty through ensemble forecast and data assimilation experiments in the Southwest Atlantic Ocean

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Abstract

Numerical ocean models incorporate errors originating from different sources (e.g. atmospheric forcing, physics parameterizations, boundary conditions, bathymetry, numerical error). Data assimilation provides an important tool for correcting the numerical representation generated by the ocean model itself. In this study, ensemble experiments were performed by using the Regional Ocean Modeling System (ROMS) in the Southwest Atlantic Ocean (55^oS - 5^oS; 70^oW - 20^oW), with the aim to investigate uncertainties in the ocean state that derived from perturbations in atmospheric forcing and ocean bathymetry. Ensemble experiments that incorporated different atmospheric perturbations exhibited the main qualitative differences between the members during the first months of integration. The wind component perturbations dominated and provoked the greatest impact in the ocean ensemble spread as compared with other atmospheric variables. Even though as a terrain-following vertical coordinate model, ROMS proved to be more sensitive to perturbations in bathymetry, particularly in shallow waters. Next, the Local Ensemble Transform Kalman Filter (LETKF) was applied to ROMS to examine the impact of observed temperature and salinity (TS) profiles on a regional ocean analysis. The assimilation of TS profiles improved the thermohaline representation. For example, the area-averaged root mean square deviation of temperature was 3.80^oC for the free model run and was reduced to 2.45^oC for the LETKF analyses. The next step will be to assimilate the Sea Surface Temperature (SST) and Sea Level Anomaly (SLA) observation data to provide further constraints on the ocean mesoscale in the study region.

Keywords: oceanic data assimilation, EnKF, Brazil-Malvinas confluence, oceanic regional model.

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