Abstract View

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Assimilation of Altimeter Eddy Fields in a Limited-Area Quasi-Geostrophic Model

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ABSTRACT

Techniques for the synoptic analysis, vertical inference, dynamical adjustment, and forecast of altimetric and deeper in situ data are presented as a first step towards the design of continuous assimilation schemes in limited-area oceanic domains. A year-long time series of streamfunction maps, denoted Mark 2, drawn in the POLYMODE area of the western North Atlantic is used as a benchmark for various tests and simulations. An original projection/extension scheme using empirical modes of density and/or pressure anomalies is used to obtain a first guess of the three-dimensional structure of the currents, starting from surface topography only. In the Mark 2 domain, this technique works well, since the first empirical mode is surface intensified and largely dominant. An alternative approach is to incorporate deeper data, e.g., float trajectories below the main thermocline. The first-guess currents are specified as initial and boundary condition of the Harvard 6-level quasi-geostrophic open ocean model. When surface data only are assimilated, the model makes the deep currents converge dramatically towards Mark 2. The fastest adjustment occurs in 9 days and involves nonlinear mode-mode interactions. The sensitivity of the assimilation scheme to different dynamical regimes, to bottom topography, and to the modal assumptions of the empirical extension is investigated. It is found the results are extremely robust. The presence of bottom topography further increases the rate of convergence of the deep levels. Finally, we use a simple orbital model to generate realistic altimeter track sequences. Mark 2 is sampled, and linear optimal estimation is applied to restore the surface topography. The deep adjustment still occurs. It is also found to be rather insensitive to the choice of sampling strategy and to the horizontal correlation scale.

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