Prediction and Reanalysis from a Mesoscale Data Assimilation and Forecasting System for the Pacific Ocean

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Abstract

Oceanic mesoscale circulations, primarily manifesting as eddies, typically span around 100 km horizontally and persist for about a month. These circulations represent the main component of oceanic kinetic energy and are referred to as the "weather" of the ocean. Forecasting efforts, focused on periods from a day to a month, target these mesoscale circulations. Advances in eddy-resolving models, observing systems such as Argo floats and satellite altimeters, and data assimilation techniques have enabled systems like HYCOM in the United States and Mercator-Ocean in Europe to predict these features effectively. To further enhance mesoscale forecasting, the Pacific Regional Ocean Forecast System (RPOFS) was developed for the Pacific Ocean. RPOFS features a 6 km horizontal grid and 100 vertical levels, with a multi-scale three-dimensional variational data assimilation (MS-3DVAR) scheme implemented. This system assimilates data from various sources, including satellite sea surface height and temperature, as well as subsurface profiles. In particular, an enhanced altimeter data assimilation methodology allows explicitly constraining both barotropic and baroclinic components of sea surface height. RPOFS demonstrates reliable forecasting of mesoscale circulations, with five-day forecasts accurately predicting eddies larger than 150 km and capturing features of the Kuroshio large meander. Forecasting errors are compared and analyzed in comparison to those of HYCOM and Mercator-Ocean systems.