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The impact of assimilating novel observations on prediction of transport and eddies in Australia's Western Boundary Current System

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In the South Pacific's Western Boundary Current, the East Australian Current (EAC) System, we combine a high-resolution (2.5-6km) numerical ocean model with an unprecedented observational data set, using 4-dimensional variational data assimilation. In addition to the traditional data streams (satellite derived SSH and SST, Argo profiling floats and XBT lines) we exploit novel observations that were collected as part of Australia's Integrated Marine Observing System (IMOS, www.imos.org.au). These include velocity and hydrographic observations from a deep-water mooring array and several moorings on the continental shelf, radial surface velocities from a high-frequency (HF) radar array and hydrographic observations from a suite of ocean glider missions. The impact of the novel observations on estimates of the WBC System is assessed in two ways. Firstly, a comparison of experiments with and without the novel observations allows us assess their value in state estimation and prediction of WBC transport and eddy structure. Secondly, variational methods allow us to quantify how each observation contributes to the state-estimate solution directly. Using the reanalysis we calculate the impacts of observations from various platforms in informing model estimates of volume transport and eddy kinetic energy in the EAC. The most influential observations are, in this order, the satellite derived SST, the radials from an HF radar array midway along the coast, the satellite derived SSH, the ocean glider observations and data from a full-depth mooring array in the northern, upstream portion of the domain. Not only do the HF radar observations have high impact on transport estimates at the array location, they have significant impact both up and downstream. Likewise, the impact of the mooring array is far reaching, contributing to transport estimates hundreds of kilometres downstream of its location. The observation impact of deep gliders deployed into eddies is particularly high. Significantly, we find that observations taken in regions with greater natural variability contribute most to constraining the model estimates, and subsurface observations have a high impact relative to the number of observations. The challenge of correctly representing the depth structure of the current and its eddies upon data assimilation is discussed. This work provides new information on the value of specific observation platforms for prediction of the EAC and motivates further work into improving prediction of the current's separation and eddy shedding dynamics.

Which theme does your abstract refer to?

Assimilation of novel observations (i.e. under-utilized observations and upcoming missions)

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