The impact of assimilating SST, Argo and SLA data into an eddy-resolving tidally driven model for the Brazil Current region

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Introduction

- The Brazil Current (BC) has a well-marked mesoscale activity downstream Vitória-Trindade seamount chain (18°S). The BC intensely meanders and generates the Vitória (VE), Cape São Tomé (CSTE) and Cape Frio (CFE) eddies (Fig. 1).
- The realistic simulation of observed mesoscale features needs high-resolution modeling and data assimilation. The inclusion of tidal forcing may be important because it provides a significant fraction of available energy.
- The goal is to assess the impact of assimilating data into HYCOM with tidal forcing on the CSTE configuration.

Methods

- HYCOM tidal configuration has 1/24° of horizontal resolution and 21 vertical layers. The model was forced on the surface by the Climate Forecast System Reanalysis. On the lateral boundaries, the outputs of an assimilative non-tidal 1/12° HYCOM run were imposed.
- RODAS is the REMO Ocean Data Assimilation System - based on the EnOl scheme - assimilates SST, Argo (T/S) and SLA. The model tidal signal was filtered to enable the proper calculation of the innovations (Fig. 2).
- A set of 5 OSEs were performed to evaluate the system’s behavior. The OSEs assimilated: (i) only SST (A_SST); (ii) only T/S profiles from Argo (A_TS); (iii) only SLA (A_SLA); (iv) all aforementioned observations (A_ALL); and (v) all observations but without tides (A_ALL_NOTIDES).

Validation

- All assimilated observations contributed positively by reducing the T errors in the upper 500 m. However, the S deviations increased in the A_SST and A_SLA runs in the same layer. The A_ALL run demeaned the T and S errors by 34% and 17% respectively (Fig. 3 and 4), as well as raised in 77% (or reduced in 60%) the correlation (or deviation) between remote sensed observations of Sea Surface Height (or SST) in comparison to the Control run (not shown).

Results and Discussion

- An eddy tracking algorithm (Faghmous et al., 2014) was used to validate the simulated eddies in comparison to the observed in AVISO. The eddies from AVISO were taken as reference and a minimum distance of 50 km between the observed and simulated eddies was used to consider the model eddy as valid.
- A CSTE was formed on March 6th 2011, translated northeastward and increased its SLA amplitude on April 22nd 2011 (Mill et al., 2015). All the analyzed simulations captured the feature. However only the tidal simulations captured the increase in SLA amplitude. It is probably explained by the higher energetic level provided by the tides.

The CSTE lasted 117 days and was captured in 79%, 55% and 68% of the observation period by the A_ALL, A_SLA and A_ALL_NOTIDES, respectively, and the average distances were 27.7 km, 27.0 km and 26.3 km, accordingly (Fig. 7). In the 2 years of analysis (2010-2011) 6 eddies were observed and well simulated by the assimilative runs, however the A_ALL presented better results probably due to the most complete data set assimilated and the inclusion of tides.

The CSTE formed on March 6th of 2011.