EDDY SYSTEM REPRESENTATION ON AN ASSIMILATIVE NUMERICAL MODEL FOR SANTOS BASIN REGION (BRAZIL)

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INTRODUCTION

The Santos Basin is located between Cabo Frio (23º S) and Florianópolis (28º S) within the South Brazilian Bight and under the influence of the western branch of the South Atlantic Gyre. It's one of the main oil basins in Brazil and, therefore, an economically important region. The upper 500 meters of the Santos Basin is occupied mostly by the Brazil Current (BC) which presents a strong baroclinic component associated to the shear with the Intermediate Western Boundary Current (IWBC), called BC-IWBC system which favors the formation of meanders and eddies. Campos (1995) linked the abrupt change on the coastline and the bottom topography to the main causes of BC's meanders and eddies in this region. One of them is the Cabo Frio Eddy (CFE), a transient cyclonic structure with approximately 600 m of depth that is frequently observed in the northern part of Santos Basin. Thus, the accurate representation of this system is extremely important for the local dynamics.

That way this work aims to evaluate the potential differences on the CFE system representation in two numerical simulations; one of them with data assimilation.

METHODOLOGY

To evaluate the CFE system representation, two distinguished numerical experiments were used on a Santos Basin region grid between 15°S-30°S and 25°W-50°W with resolution of 1/12° **(Fig. 1)**. Both experiments were conducted using *ROMS* (Regional Ocean Modelling System) within the *Projeto Azul* scope (SANTOS *et al.*, 2015). The initial and boundary conditions were taken from the global results of the *MyOcean* project and the atmospheric fields were taken from the *NCEP* (National Centers for Environmental Predictions) *Reanalysis 2*. The first experiment (*freerun*) comprised a non-data assimilative forward model simulation from 01/Jan/2013 to 28/Feb/2014, while the second experiment (*4dvar*) assimilated mapped SSH (Sea Surface Height) from *AVISO* (Archiving, Validation and Interpretation of Satellite Oceanographic data), SST (Sea Surface Temperature) from *AVHRR* (Advanced Very High Resolution Radiometer) - POES (Polar Operational Environmental Satellites) Project and *in situ* temperature and salinity data sets (UK Met Office EN3 project and *Projeto Azul*) from 01/Mar/2013 to 28/Feb/2014. The assimilative process was performed through the *IS4D-Var* (Incremental Strong constraint 4D Variational) data assimilation approach (MOORE *et al.*, 2011). To determine if the I*S4D-Var* approach efficiently represented this complex hydrodynamics area, the results obtained from both experiments were compared with *MUR* (Multi-scale Ultra-high Resolution) SST and *AVISO* SSH images and drifter trajectories from *Projeto Azul* dataset.

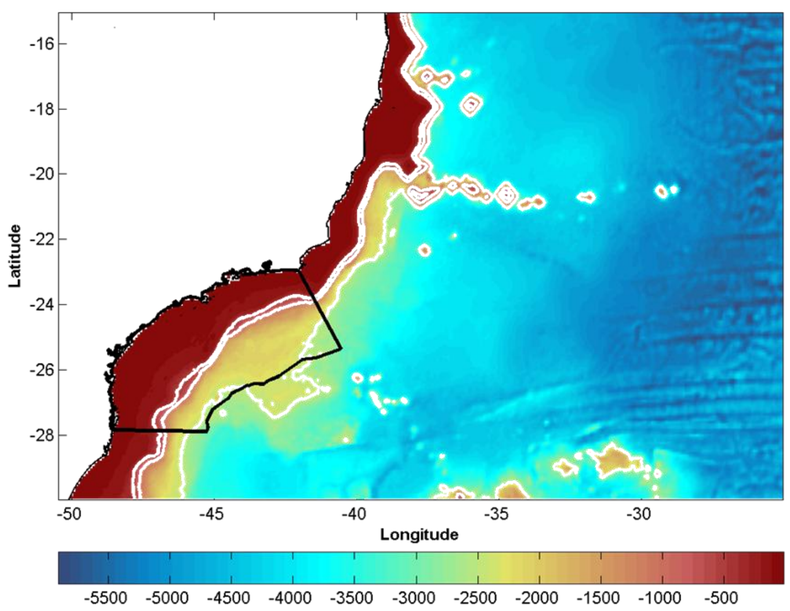

Fig.1: Representation of the bathymetry (m) for the simulation domain. The highlighted area corresponds to the Santos Basin.

RESULTS AND DISCUSSION

Among several eddies events, one well established was observed in May of 2013, which was possible to analyze its representativeness on the numerical models and database.

On day 14/May/2013 (Fig. 2) it's possible to identify a circular feature near Cabo Frio with colder temperatures on its interior through SST-MUR data, a subsidence core in SSH-AVISO image showing a cyclonic movement. Those characteristics are consistent with the CFE, which its presence was also confirmed through drifter data.

It is possible to observe, that the drifter floated in a cyclonic trajectory and its core were coincident with the eddy signature identified in TSM-MUR and in SSH-AVISO.

On the other hand, considering the numerical simulations these thermal and surface height signatures that characterize the CFE were only represented in the experiment with data assimilation (*4dvar*). In the other experiment, with no data assimilation (*freerun*), it was not possible to identify the feature associated with the referred eddy on computed SST, and even with the observation of a subsidence core near to its region, this core mismatch the position associated with this eddy event according to SSH from AVISO and the trajectory registered by the drifter released by *Projeto Azul*.

Considering the surface velocities, in both experiments (Fig. 3) a cyclonic movement was observed in the region expected to occur the CFE, nevertheless, greater velocity gradients were identified in 4dvar experiment results.

The CFE features were represented on the assimilated simulation (*4dvar*), both in thermic signature, elevation field and geographical position, but it's not represented on the non-assimilative simulation (*freerun*).

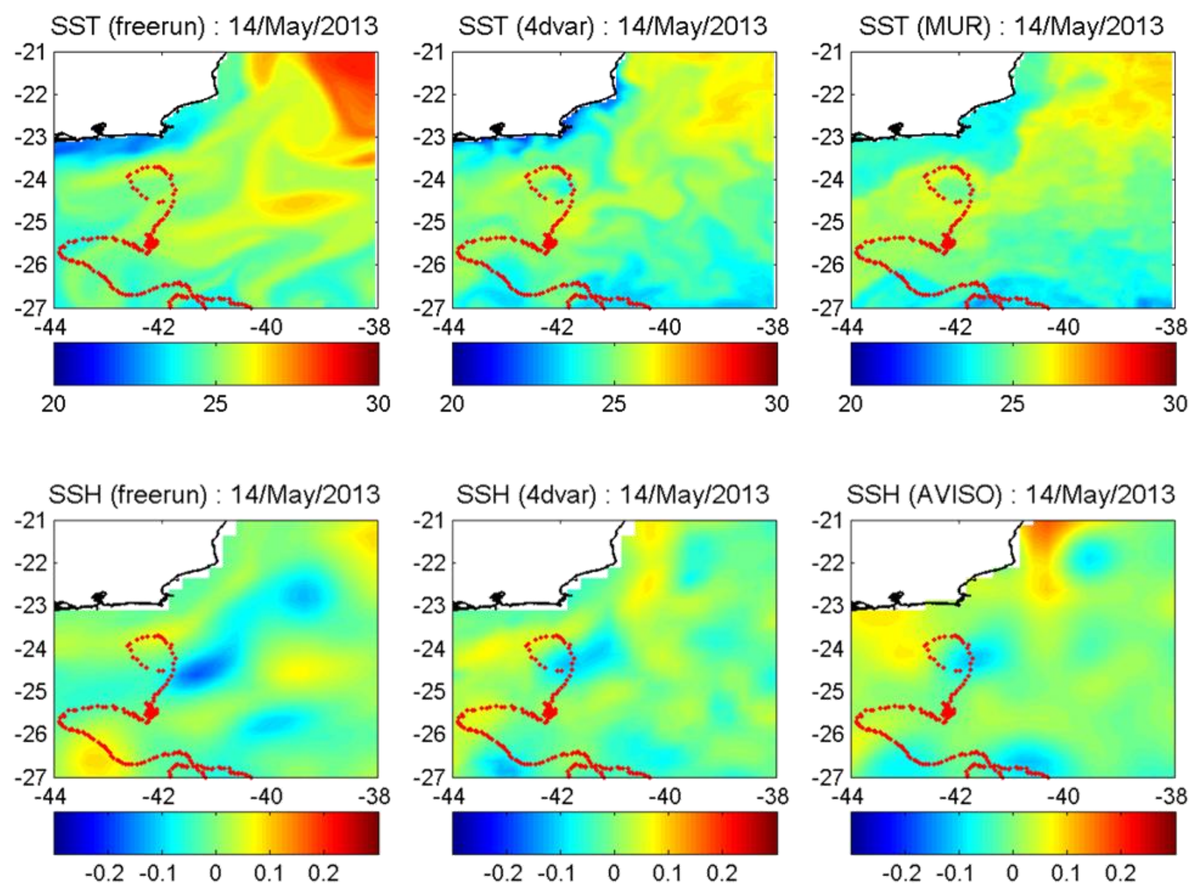

Fig.2: SST and SSH fields with drifter path for 14/May/2013. SST field from *freerun* simulation (top left), from *4dvar* simulation (top middle) and SST-*MUR* (top right). SSH field from *freerun* simulation (bottom left), from *4dvar* simulation (bottom middle) and *AVISO* (bottom right).

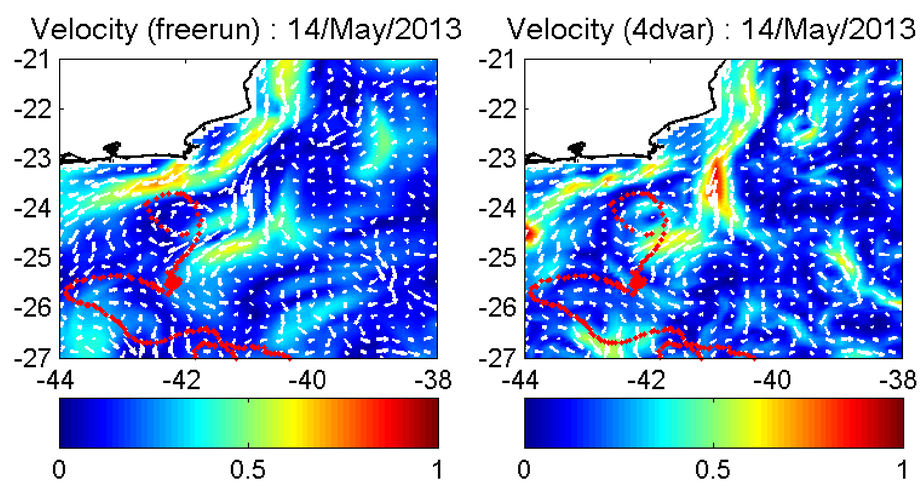

Fig.3: Vectors and velocity magnitude fields with drifter path for 14/May/2013 from *freerun* simulation (left) and *4dvar* simulation (right)

CONCLUSIONS

✓Through the present work, it was possible to observe the successful of the numerical experiment with data assimilation. In this experiment, the CFE was represented through the SST, velocity and SSH parameters.

✓These results show that the data assimilation may improve the simulation, with gain in more accurate hydrodynamics representation.

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