Validation of Numerical Model (ROMS) in equatorial region between Ecuadorian coast and Galapagos Islands

Escobar M. G (1); Santos J. (2); Muñoz A. (3)

Escuela Superior Politécnica del Litoral (ESPOL) (1) (2), Guayaquil - Ecuador

Centro de Modelado Científico (CMC), Universidad de Zulia (LUZ) (3) , Zulia - Venezuela

Contact details: magaemge@gmail.com (1), jlsantos@espol.edu.ec (2) ,agmunoz@cmc.org.ve (3)

ABSTRACT

The Regional Ocean Modeling System (ROMS) model has been implemented in the Equatorial Oriental Pacific Ocean (EOPO) to produce a hindcast of its thermohaline structure, with the purpose of investigating the accuracy of its prediction on temperature and salinity variables in the EOPO region.

Thus the validation of the forecast is necessary to determine the areas with the better and worse bias. This analysis was done from the continental coast of Ecuador to the Galapagos Islands, and from the surface to 75m in the water column.

The model has the capability to predict salinity with better accuracy than water temperature, and the bias increased as we leave the surface towards deeper waters, it's due to the time of spin up. And the least bias was for the cruise that made more oceanographic stations, It means that the number of measurements of temperature and salinity influence the hindcast analysis.

The preliminary results show the potential of using the ROMS model in this area of the Tropical Pacific for a series of applications at the seasonal time scales.

STUDY AREA

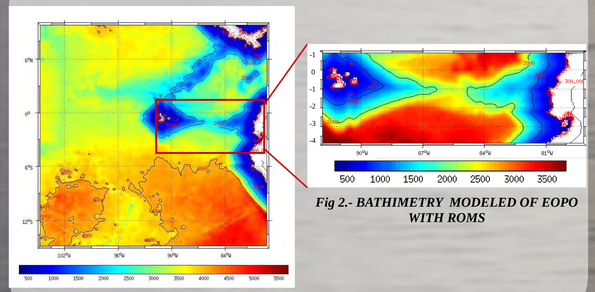


Fig 1.- BATHIMETRY MODELED OF ORIENTAL PACIFIC OCEAN WIRH ROMS

Fig 2.- BATHIMETRY MODELED OF EOPO WITH ROMS

METHODOLOGY

OCEANOGRAPHIC DATA

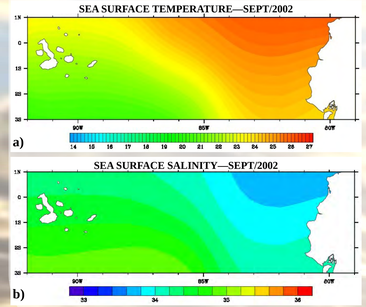


Fig 3.- HOMOGENIZATION OF IN-SITU MEAUREMENTS OF TEMPERATURE AND SALINITY

We have validated the model in base of three periods (September/2002, October/2005, October/2009) corresponding to oceanographic cruisers (CO) made by the Navy Oceanographic Institute of Ecuador. These data have passed a quality control in the standards level (0, 10, 20, 30, 50, 75m).

The temperature (fig. 3-a) and salinity (fig. 3-b) have been interpolated and homogenized by the Cressman-Poisson technique for regridding to the same resolution of ROMS output (fig. 5-a,b).

IMPLEMENTATION OF ROMS

Roms is a three-dimensional, free Surface and terrain-following numerical model.

- We have used ROMSTOOLS from the Institut de recherche pour le Développement (IRD) version.
- The simulated an area: 10°N to 15°S and 79°W to 179°W.
- The topography: ETOPO2 dataset.
- Resolution: 0.09°x0.09°.
- A vertical stretched: 32 levels (sigma coordinates)
- Grid parameters: theta_s=6 and theta_b=0 and rtarget=0.045.
- Atmospheric surface forcing dataset: NCEP
- Oceanic boundary and initial dataset: ECCO
- Spin up (estabilization): after 30 days of run (fig. 4)
- Interannual simulations: three months.

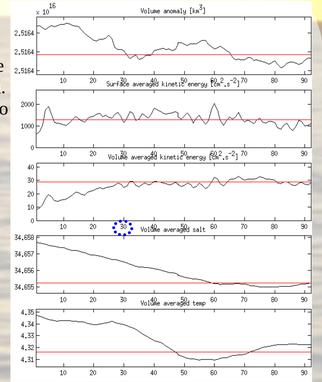


Fig. 4.- SPIN UP—ROMS

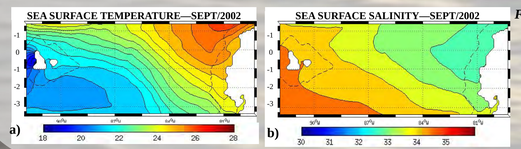


Fig 5.- TEMPERATURE AND SALINITY—ROMS OUTPUT

RESULTS

TEMPERATURE

The results show that the temperature forecasted by ROMS produces zonal mean biases of **less than +/- 1°C** at the surface level, **+/- 2ºC** from 10m to 30 m and a larger bias for deeper layers (50-75m). In general, the temperature is **overestimated** in all the CO and deep levels (fig. 6-a,b,c). By latitude, larger biases are found between 1°S and 1.5°S, where is located the Equatorial Front (fig. 6-d).

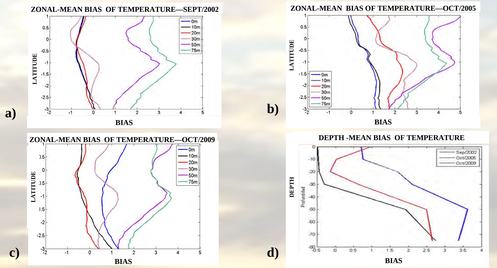
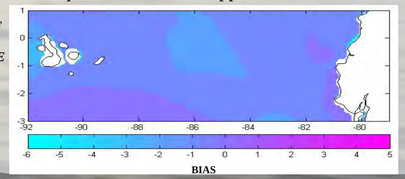


Fig 6.- ZONAL AND DEPTH MEAN BIAS OF TEMPERATURE

By longitude, a larger bias is found towards the Ecuadorian coast and west of Galápagos Islands (fig 7).

The better CO correlated was for **September/2002** with **0.9**, followed by **October/2005** with **0.7** and **October/2009** with **0.4** for the surface level. The root mean square is less in the upper levels.

Fig 7.- BIAS OF SEA SURFACE TEMPERATURE SEPT/2002



SALINITY

In contrast to temperature, salinity is **underestimated** in all CO and depths. The salinity forecasted by ROMS produces zonal mean biases of **less than 0.65ups** for the 30 first meters and less than **0.7ups** in deeper levels (fig. 8-a,b,c). By latitude, larger biases are found between 1°S and 1.5°S (fig. 8-d).

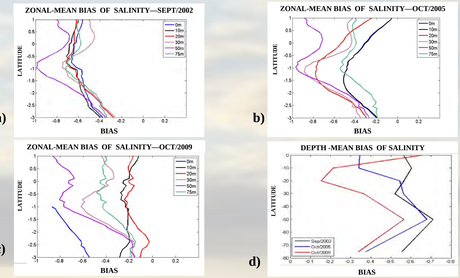
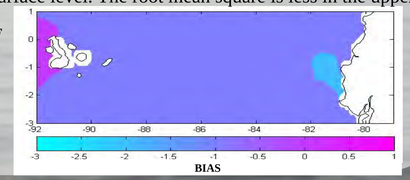


Fig 8.- ZONAL AND DEPTH MEAN BIAS OF SALINITY

By longitude, a larger bias is found towards the Ecuadorian coast and west of Galápagos Islands (fig. 9).

The better CO correlated was for **September/2002** with **0.9**, followed by **October/2005** with **0.8** and **October/2009** with **0.9** for the surface level. The root mean square is less in the upper levels.

Fig 9.- BIAS OF SEA SURFACE SALINITY SEPT/2002



CONCLUSION

Our results reveal the importance of using a numerical model and the need to have more density in the oceanographic cruisers for improving the interpolation.

.ROMS has the capability to forecast better the salinity than the temperature.
.ROMS overestimate the temperature with less than +/-1ºC in the upper layers and underestimate the salinity with at least –1ups.
.ROMS reach the stabilization after 30 days. Despite of larger bias are calculated in deeper layers, an inter-annual simulation of three months permit acceptable forecasts for the 30 first meters.
.The Cressman-Poisson Technique smoothes the isotherm and isohalines more than observed .

ACKNOWLEDGEMENTS

The autors would like to acknowledge Centro de Modelado Científico of Universidad de Zulia, the Permanent Comission for the South Pacific and the Escuela Superior Politécnica del Litoral for the support to this research.