Mesoscale baroclinic flow patterns off the Tubarão Bight and Abrolhos Bank

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Introduction and Goal

The region adjacent to the Tubarão Bight and Abrolhos Bank is probably one of the less investigated of the Brazillian Continental Margin. Recently, the discovery of oil and gas on the pre-salt layer in the region brought the need for a better understanding of the local hydrodynamics. Studies focusing on the mesoscale activity and the seasonal variability of the circulation off the Brazillian eastern coast have reported complex flow patterns and raised the attention of the scientific community to the lack of knowledge of the local dynamics.

The documented features in the area are the Vitória Eddy and an anticyclonic feature off the Abrolhos Bank (Abrolhos Eddy) (Figure 1).

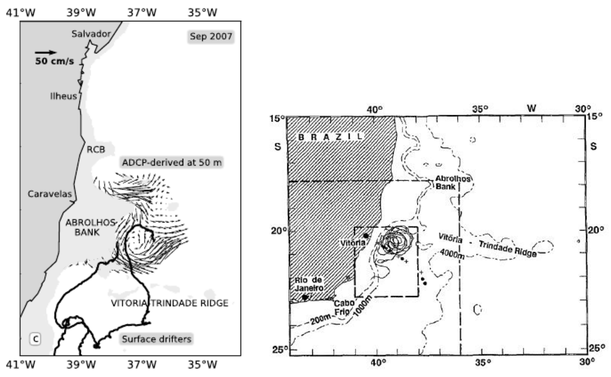

FIGURE 1: *Abrolhos (left) and Vitória (right) eddies from Soutelino et al. (2011) and Schmid et al. (1995), respectively.*

The goal of this work is to clarify some unsolved issues concerning the VE and characterize both eddies during summer and winter periods.

Data sets

- Abrolhos Project - provided by Petróleo Brasileiro S.A. The Abrolhos data were collected over winter 2004 (ABI) and summer 2005 (ABII) (Figure 2).
- Sea Surface Temperature (SST) from MODIS;
- Word Ocean Atlas 01 (WOA);

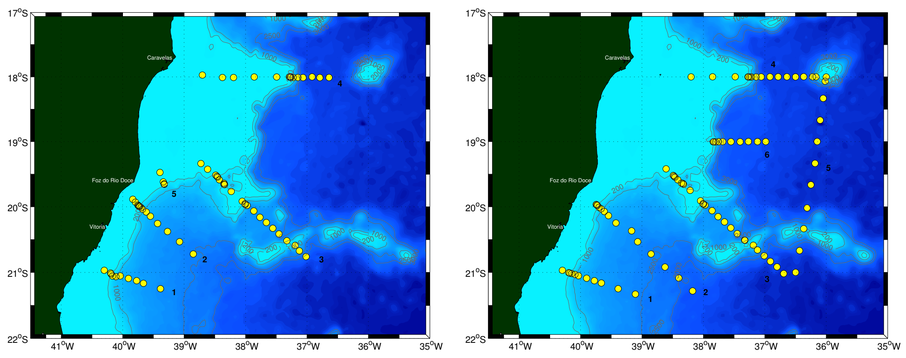

FIGURE 2: *Data sets for winter (left) and summer (right) scenarios with 66 and 88 hydrographic stations, respectively.*

Methodology

Based on concepts developed by Ezer & Mellor [1994], Gangopadhyay & Robinson [2002] and Calado et al. [2008] e [2010];

- Non-dimensionalization of temperature and salinity profiles (AB and WOA);

$$\phi(z) \; = \; \frac{T(z) - T_f}{T_s - T_f} \tag{1}$$

- Redimensionalization of the profiles with SST and synthetic salinity at the surface and climatology at the bottom;

$$T(z) \; = \; [T_s - T_f]\phi(z) + T_f \tag{2}$$

- Radiational and sponge boundary conditions;
- Barotropic model off NDTFAST=0

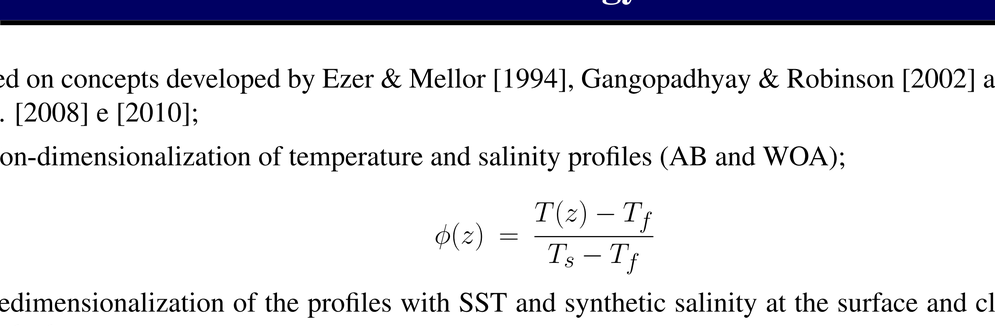

FIGURE 3: *Left - Steps prior to modelling and main configurations of the experiments. Right - Rectangular structured grid used on the simulation with ≈7 km resolution at x and y.*

Model Validation

The validation was qualitative. The model results show an essentially baroclinic section (Figure 4a) without the contamination of higher frequency phenomena, which can be observed in the ADCP section (Figure 4c) and at the same time without the limitations from the mathematical approximations, mainly on the region close to the continetal slope, presents on the Dynamic Method (DM) section (Figure 4b).

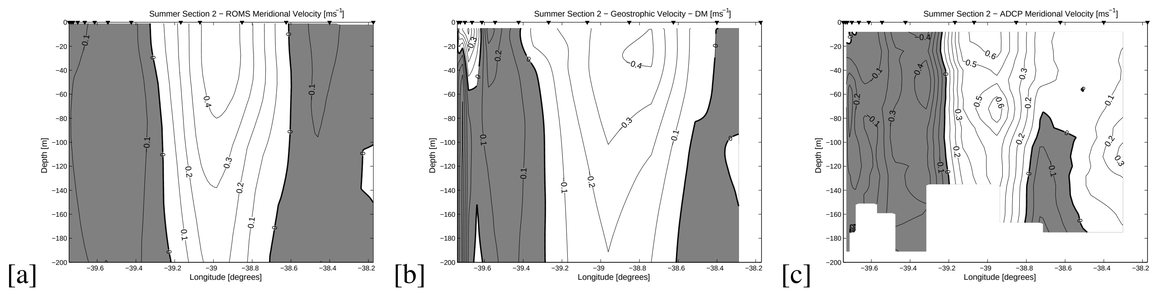

FIGURE 4: *Velocity Section from (a) ROMS model, (b) Dynamic Method (DM) and (c) ADCP.*

Results and Conclusions

- VE is present during summer and absent during winter;
- Anticyclone inside the Tubarão Bight (Tubarão Eddy);
- AE present during summer, no information during winter;
- Anticyclone associated to the VE during summer (dipole)

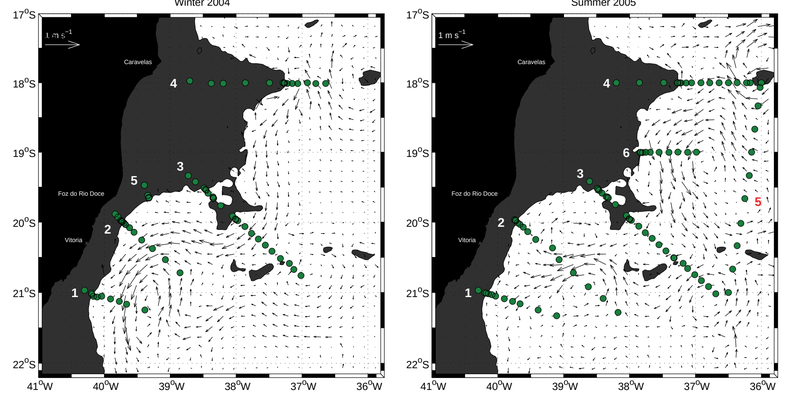

FIGURE 5: *Velocity vectors in the Eastern Brazil Continental Shelf on winter (left) and summer (right) scenarios at 200 meters depth.*

Winter

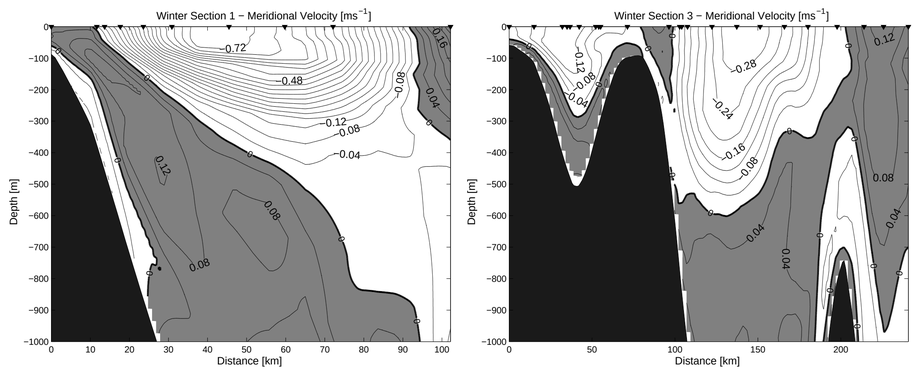

FIGURE 6: *Meridional velocity sections on the winter scenario. Positive (negative) values indicate northward (southward) velocities.*

- Section 1 (TE) - south max. velocity 0.78 m s^{-1}, north max. velocity 0.62 m s^{-1}, the transport was ≈ -8 Sv and 5 Sv over 500 meters;
- Section 3 - Brazil Current bifurcates;

Summer

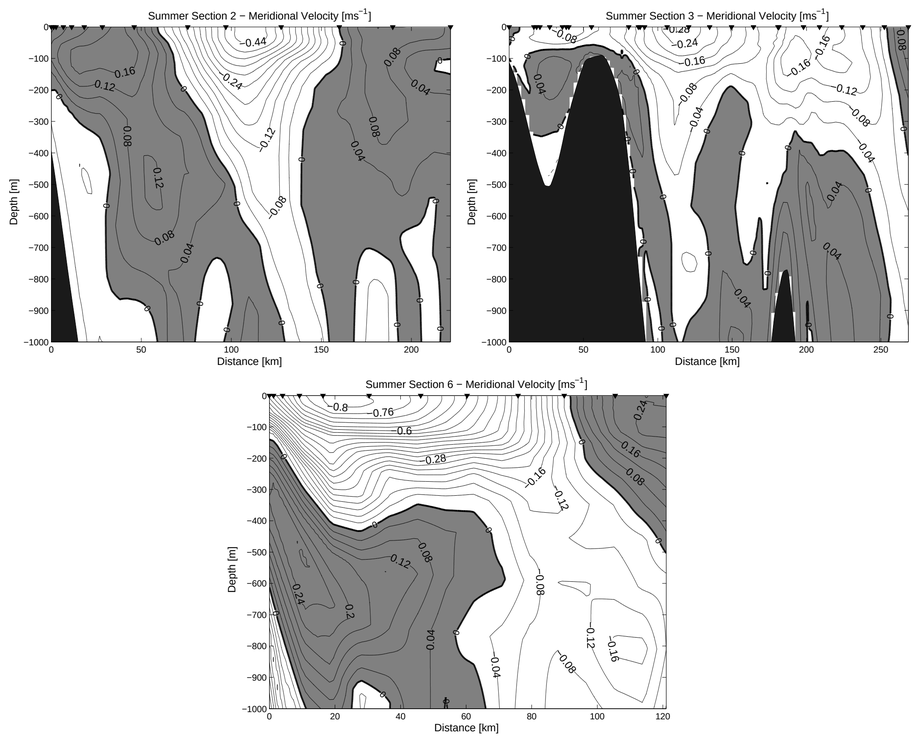

FIGURE 7: *Meridional velocity sections on the summer scenario. Positive (negative) values indicate northward (southward) velocities.*

- Section 2 (VE) - VE over ∼800m, the transport was -5.5 Sv, VE carries 4.2 (with IWBC) and antiVE 1.9 Sv;
- Section 3 - Brazil Current trifurcates;
- Section 6 (AE) - first mode eddy, south max. velocity 0.82 m s^{-1}, north max. velocity 0.25 m s^{-1}, the transport was ≈ -10.5 Sv and 1 Sv over 400 meters;

Acknowledgments

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