

Rough notes on the Brazil Current System in the ECCO2 hierarchy

CBR* & MMM

1 Introduction

How well does a state-of-art state estimate represents the Brazil Current (BC) System off south-east Brazil? An accurate answer to that question seems impossible today given that a characterization of the BC System is notably limited. To date most of what is known about that western boundary current system derives from few quasi-synoptic hydrographic and velocity observations and ever fewer current meter arrays (Rocha et al., 2014, and references therein). There are a few well-known characteristics of the BC System off Brazil that provide a testbed for state-estimates. In particular, the presence of an Intermediate Western Boundary Current (IWBC) over the continental north of $\sim 25^\circ$ and the downstream thickening of the BC are trademarks of the BC System off southeast Brazil (Rocha et al., 2014). Both the formation of the IWBC and the thickening of the BC are associated with the rather parochially named “Santos Bifurcation” (the bifurcation of the subtropical gyre at intermediate levels).

In these notes we analyze two outputs of the ECCO2 hierarchy: ECCOv4 and ECCOv4-LLC2160 (Forget et al., 2015). The base solution ECCOv4 consists of a 22-year synthesis (1992+) of millions of observations using a general circulation model; the interpolated resolution of the output is $1/2^\circ$. The ECCOv4-LLC2160 is a $1/24^\circ$ forward solution spun up from the ECCOv4 state-estimate. The LLC2160 output is available for 2 years starting March 2011. Figure 1 shows LLC2160 2-year time-average of surface and 800 m currents in the domain region. At the surface, the BC dominates the circulation over most of the continental slope and outer shelf; the currents largely follow the isobaths. At 800 m, the flow of the southward BC is depicted following south of 25.5° , whereas a the northward IWBC flows north of 25° over the continental slope; eastward of the IWBC there is a weak southward flow. The latter is not apparent in the 22-year average ECCOv4 data and may not survive a longer averaging.

2 Does the ECOOv4 and LLC2160 represent the BC thickening?

The ECCOv4 appears to represent the BC thickening rather satisfactorily. In particular, figure 2 shows two 2-year time-averaged velocity sections off Cabo Frio and Santos. The BC vertical extent and magnitude of horizontal velocity are consistent with observations (e.g., Rocha et al., 2014). The BC thickening is clearly depicted in a along-stream section of along-stream velocity (Figure 3). Consistent with the results of Rocha et al. (2014), most of the thickening of the BC occurs south of 25° .

Not surprisingly, the structure IWBC is not well represented in the coarse-resolution ECCOv4 output (the thin jet is replaced by a broad sluggish intermediate flow), though its transport may be well captured. The much finer resolution of the LLC2160 simulation, however, does allow for the representation of the IWBC jet (Figure 5). The outer shelf/upper continental slope LLC2160 off Cabo Frio is consistent with the classic BC-IWBC picture depicted by observations (Da Silveira et al., 2004). Because Santos is located at approximately the latitude of formation of the IWBC, the intermediate flow over the upper slope is notably weak.

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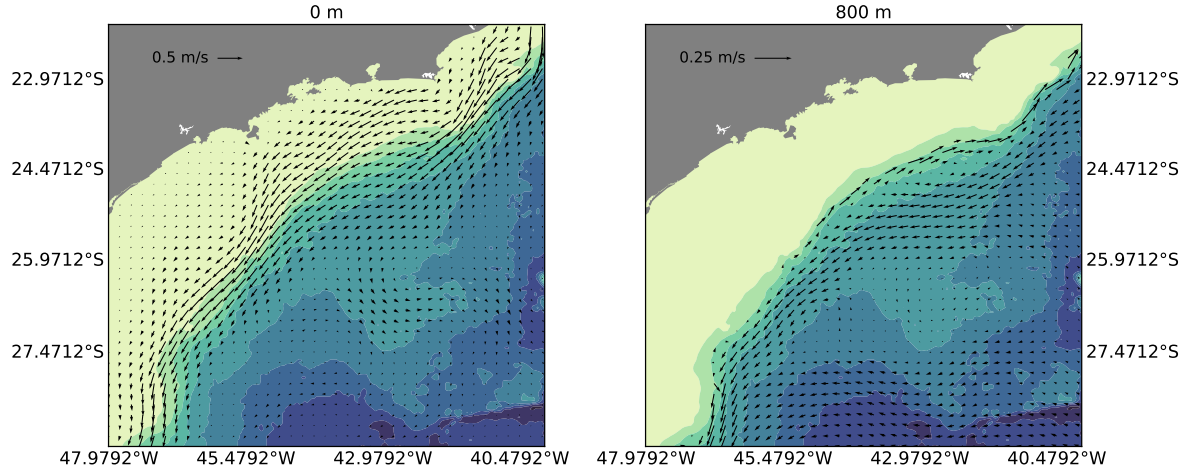


Figure 1: Horizontal velocity at the surface and 800 m from the LLC2140 ECCO2 simulation.

(It may also be crucial for the representation of the IWBC jet the use of a partial-cell formulation to properly account for the flow near topography. Need to think harder about this.)

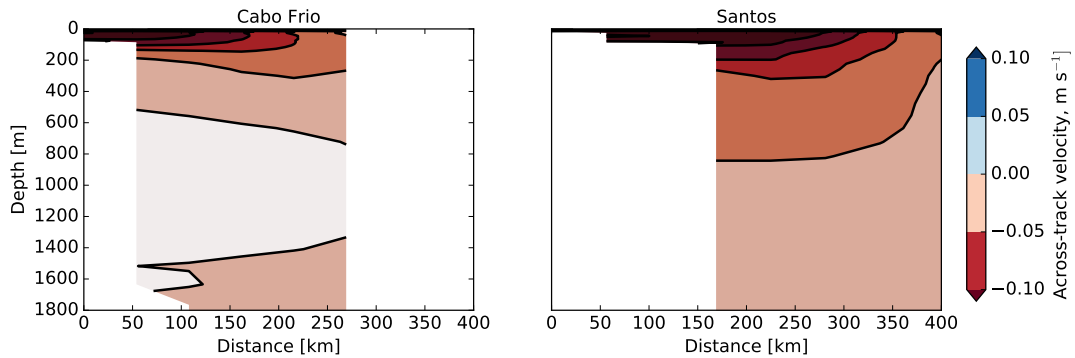


Figure 2: ECCOv4 vertical sections of velocity across-track off Cabo Frio (left) and Santos (right).

3 The Brazil Current System off Sao Sebastiao

The BC System circulation off Sao Sebastiao is something intermediate between Cabo Frio and Santos (Figure 6). The Brazil Current occupied the upper 400 m, spanning the outer shelf and part of the upper slope. The IWBC is well formed, but it is not as strong as off Cabo Frio.

4 Time-averaged current near the bottom

Figure 7 shows near-bottom current from 2-year time-averaged LLC2160 output.

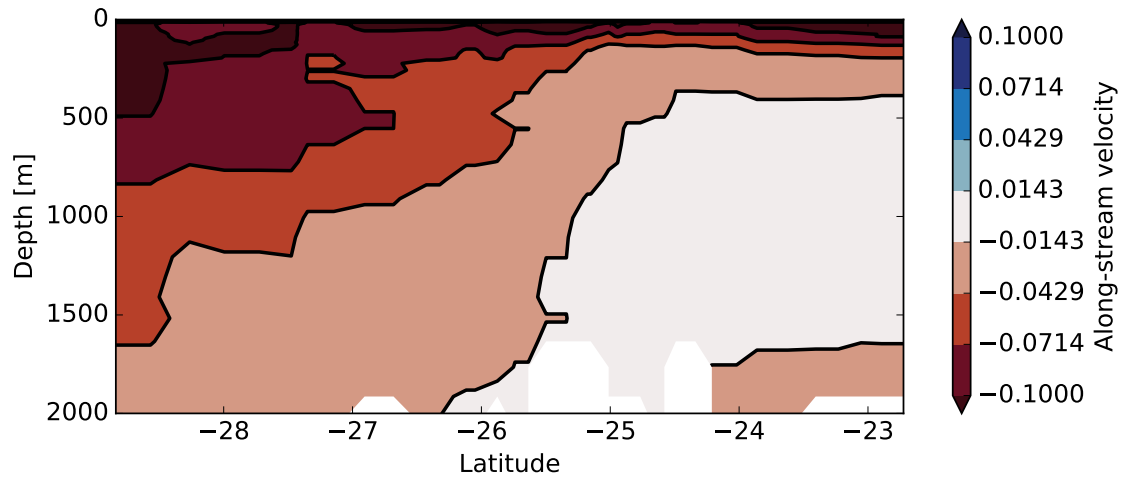


Figure 3: ECCOv4: vertical sections of approximate along-stream velocity along the 1750 isobath.

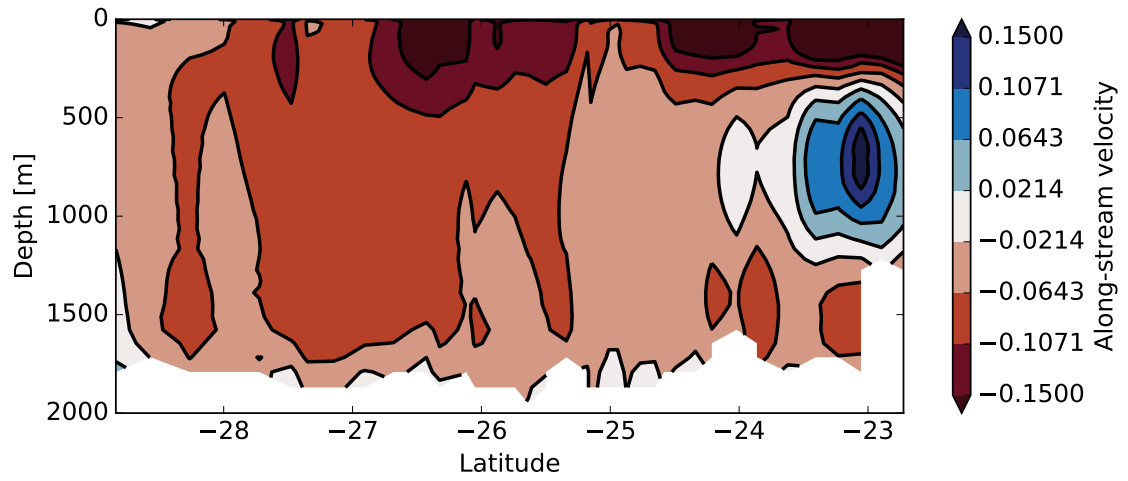


Figure 4: LLC2160: vertical sections of approximate along-stream velocity along the 1750 isobath.

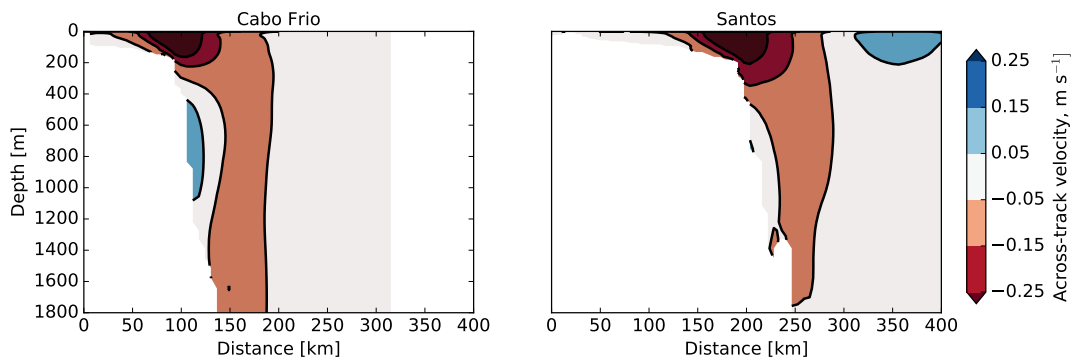


Figure 5: LLC2160 vertical sections of velocity across-track off Cabo Frio (left) and Santos (right).

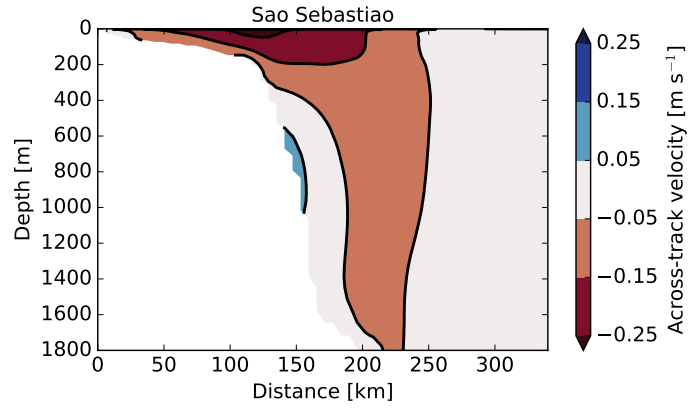


Figure 6: LLC2160 vertical section of velocity across-track off Sao Sebastiao.

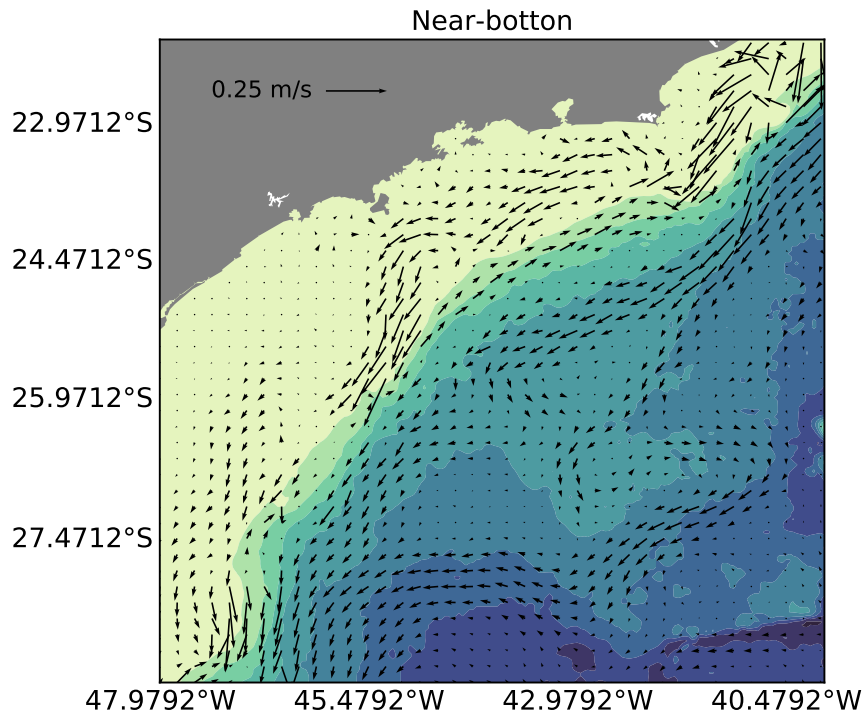


Figure 7: LLC2160 time-averaged near-bottom current off southeast Brazil.

References

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