Brazilian Modeling and Observational Projects

Edmo Campos & Mauricio Mata

2008-2009 Special for Brazilian Oceanography

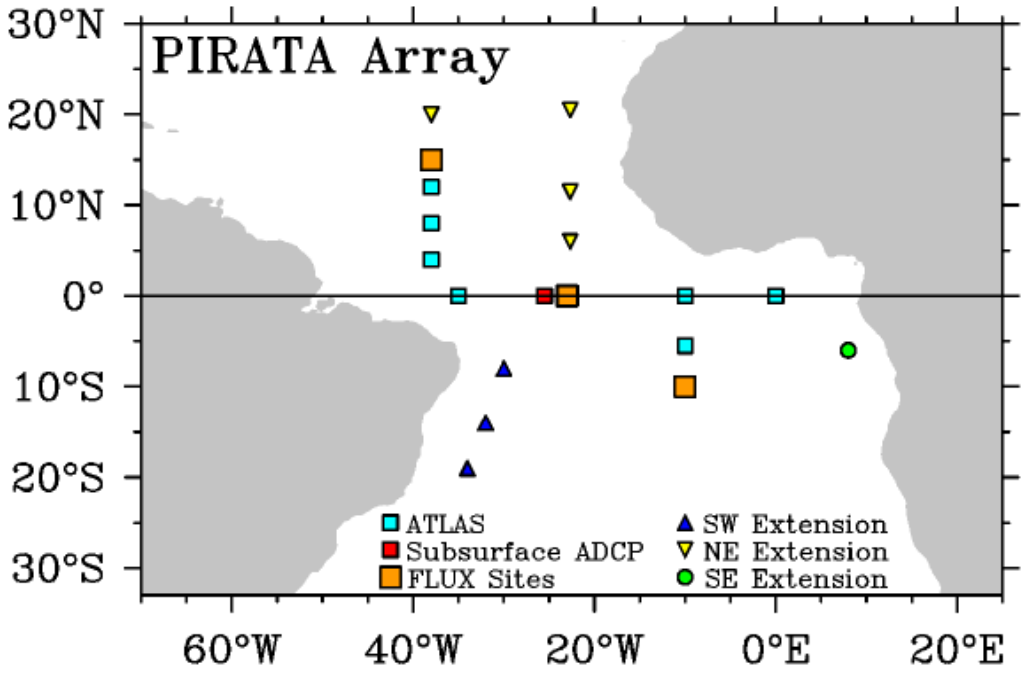
- Brazilian Government had several “Calls for Proposals” including oceanography&climate:
  - 2008:
    - National Institutes for S&T (INCT) : There were born two “virtual” institutes networks funded by the brazilian government including ocean studies.
      - The Climate Change INCT, including tropical ocean measurements and modelling (funded in approx. R$8.5M)
      - The Cryosphere INCT, including studies of the Brazil/Malvinas confluence and the Southern Ocean. (funded in approximately R$ 4.8M)

- 2009:

  - CNPq call for “PROANTAR” Research including the South Atlantic and Southern Ocean (ed 23/2009): 19 proposals funded up to R$1M each
  - CNPq call for “Oceanic Islands” research (ed 26/2009) : 31 proposals funded up to R$100K each
  - CNPq call for “South Atlantic and Climate” research (ed 38/2009): 16 proposals funded up to R$500K each

South Atlantic ongoing Projects

- The PIRATA-Array



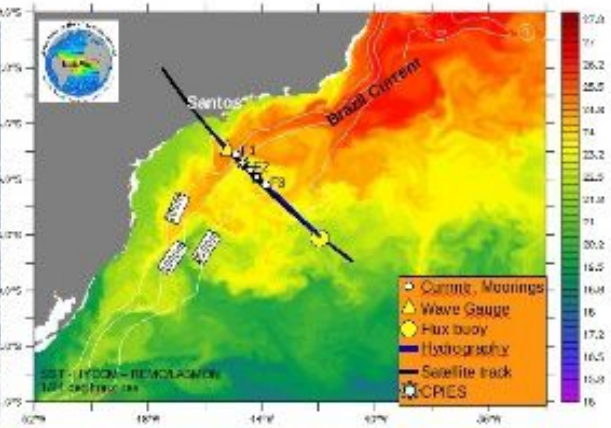
The Atlas-B Project

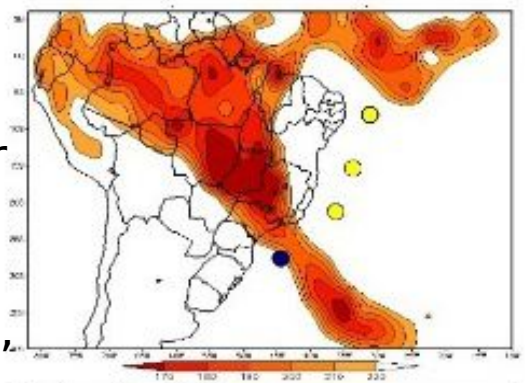
E. Campos / IO-USP

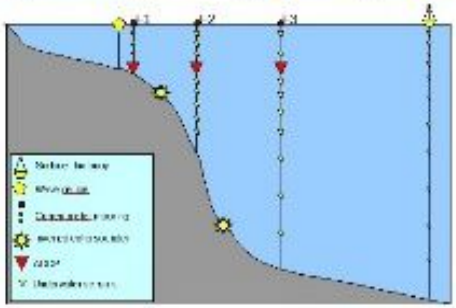
This project, already funded, is constructing a Brazilian Prototype of the Atlas Buoy (ATLAS-B) for monitoring the SACZ and the mixed layer heath content.

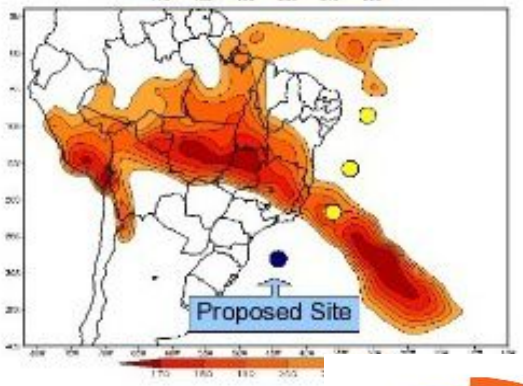
The deployment is planned for June/July 2011, at 28ºS, 42ºW.

A repeat hydrographic section, together will be carried across the Brazil Current.







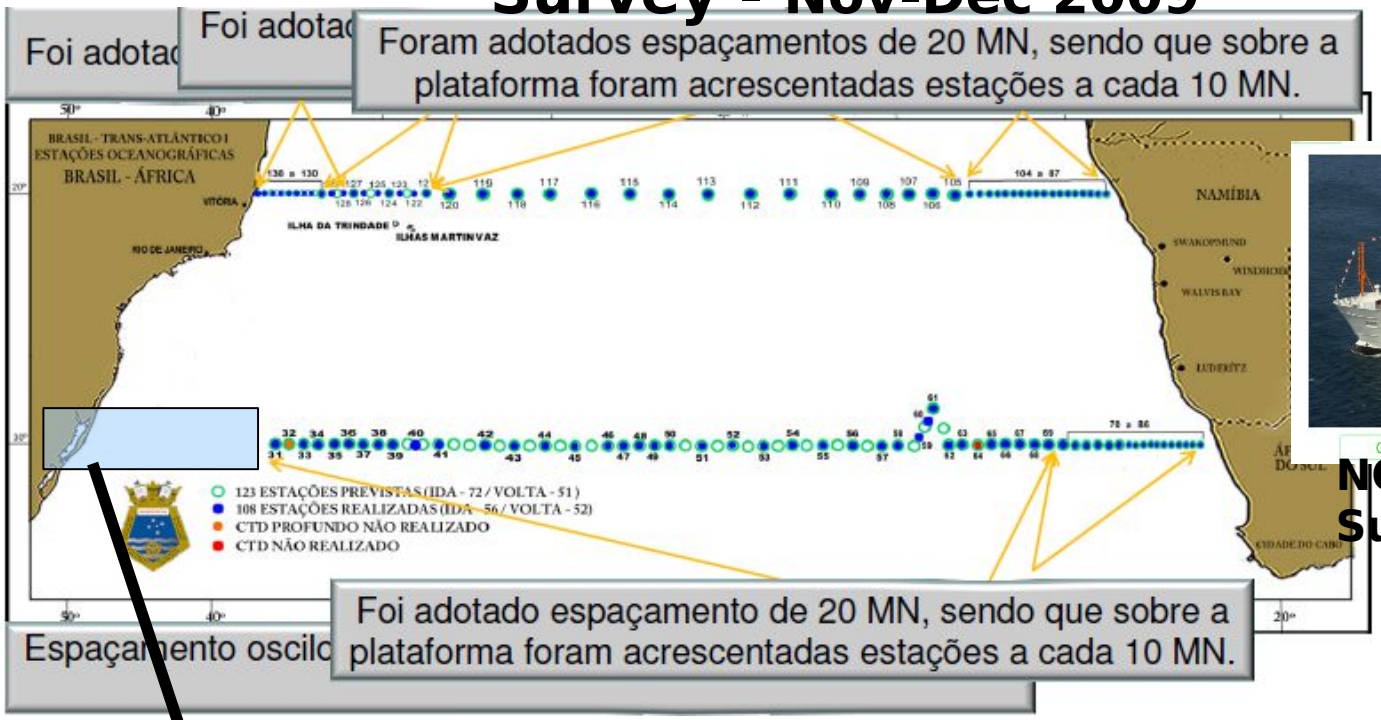


Noc. ANTARES

NHOc Cruzeiro do Sul

INCT

The “Antares/Cruzeiro do Sul” Trans-Atlantic Survey - Nov-Dec 2009



Comissão Trans-Atlântico I (19/OUT a 22/DEZ/09)

NOc Cruzeiro do Sul

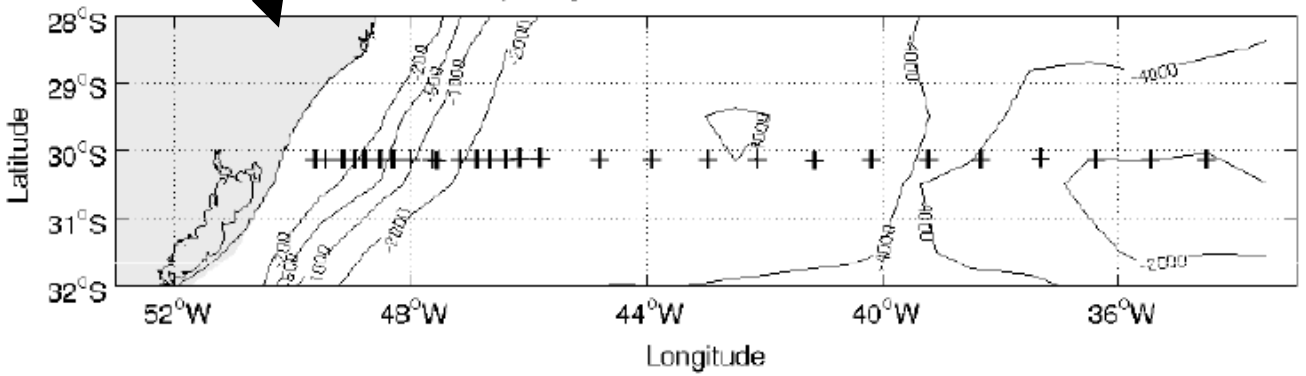
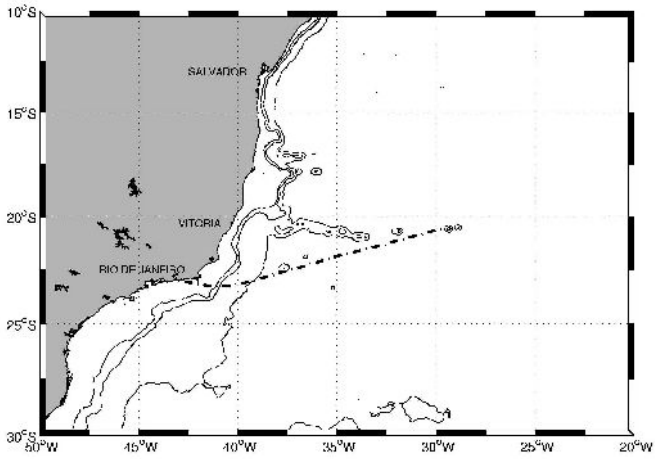
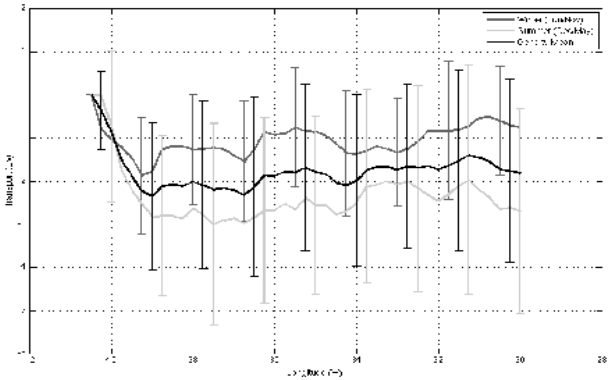


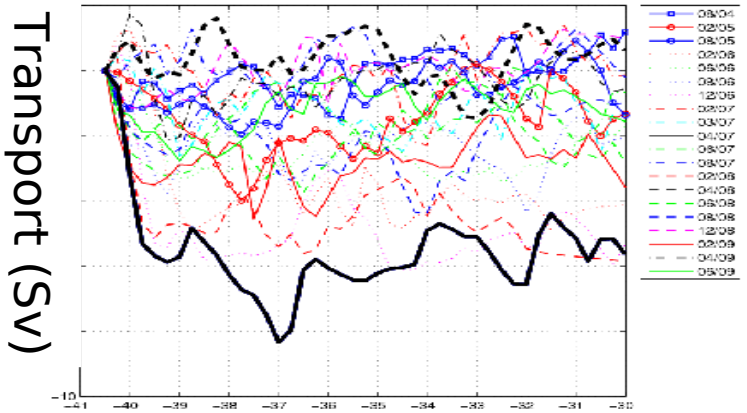
Figura 1. Estações oceanográficas ocupadas durante a realizada de 09 a 20 de Novembro de 2009 pelo Noc Antares da Marinha do Brasil.

Noc. ANTARES

- The MOVAR Proje

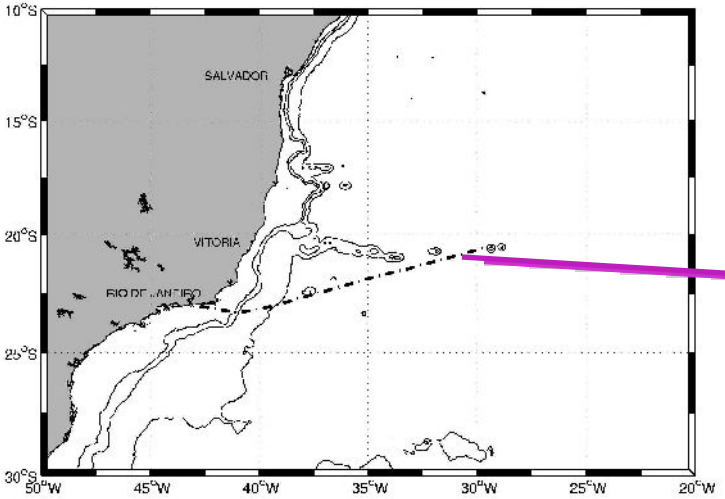


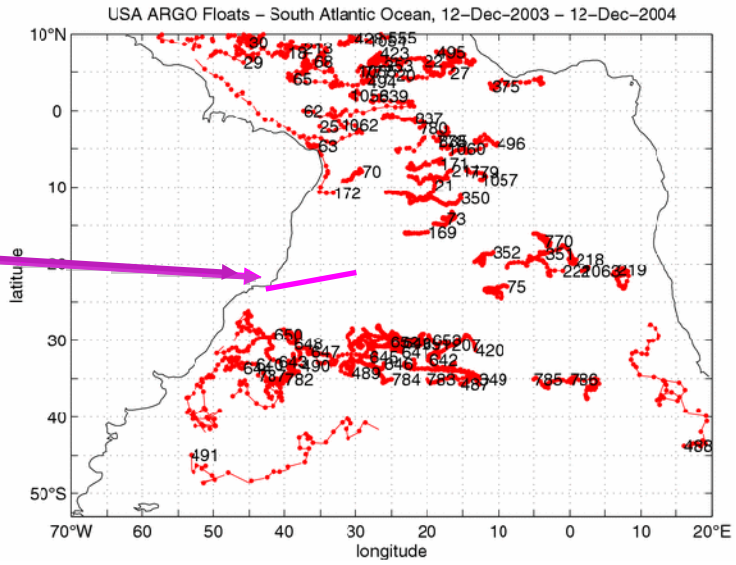




Volume transport means (after 20 repeats) with respect to 400 dbar.(left) and the individual AX97 transects with respect to same level (right). Note that the extreme transport situations (black and dashed-black lines on the right), are much larger that the summer/winter differences (left).

- The MOVAR Project contribution to ARGO
- During MOVAR cruises 12 Argo floats (donated by NOAA) have been released to increase float density in Southwestern Atlantic since 2005.





SOS-Climate / Interconf (R. Buss de Souza, L. Pezzi, PI's)

Objectives: To look at air-sea interactions processes in the vicinity of the BMC. Particularly interested in the feed'back modulation between the Marine and Atmospheric Boundary Layers.

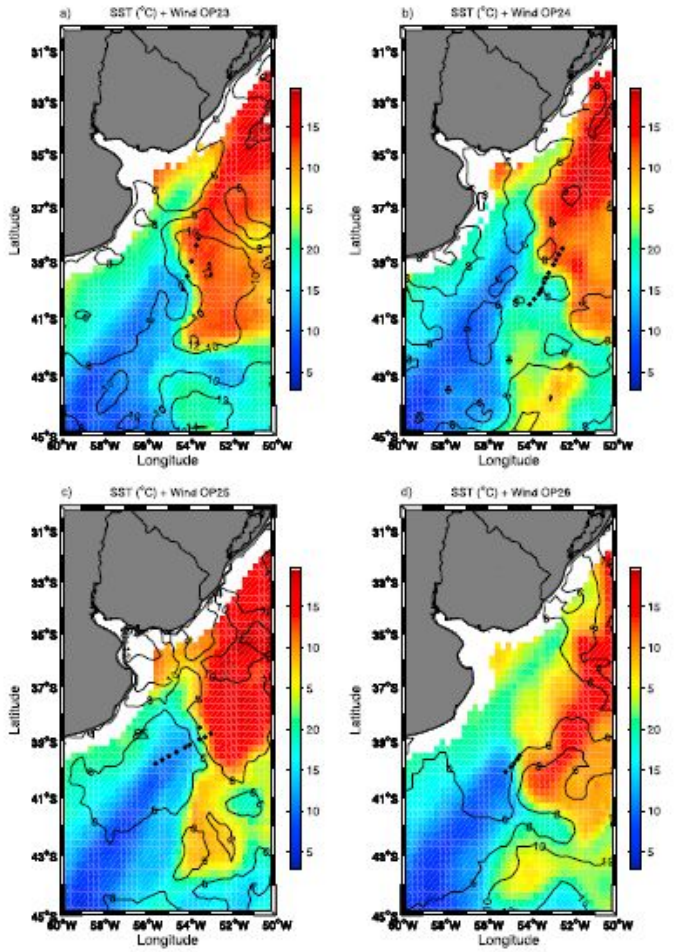


Figure 1. Brazil-Malvinas Confluence (BMC) study area with cruise routes, radiosonde ascent positions (black circles), and thermal front positions. QuikScat wind speeds (m s^{-1}) are the lines superimposed onto AMSR-E sea surface temperature (SST) images. All data are coincident in time with the experiments. The color bar denotes SST in °C. Experiments are from (a) OP23, (b) OP24, (c) OP25, and (d) OP26 routes.

D19103 PEZZI ET AL.: MABL AT THE BRAZIL-MALVINAS CONFLUENCE D19103

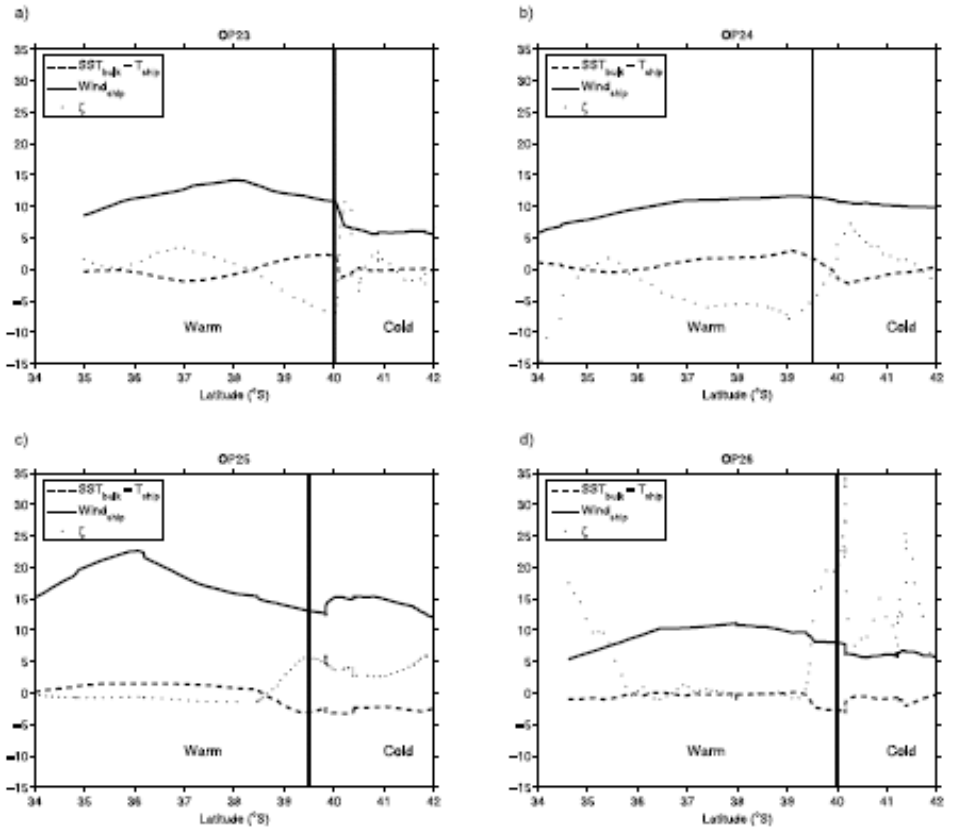


Figure 5. Synoptic, in situ measurements taken along OSS *Ary Rongel* routes for (a) OP23, (b) OP24, (c) OP25, and (d) OP26. ($Wind_{ship}$): wind speed measured at the vessel; ($SST_{bulk} - T_{ship}$) stability parameters (°C); Q_T: total heat fluxes (×10 W m^{-2}); ζ: atmospheric stability parameter (×10^2). All information is derived from the ship-borne meteorological data. The vertical lines denote approximately the Brazil Current (BC)/Malvinas (Falkland) Current (MC) front position.

South Atlantic Proposed Projects

Oceanographic Modeling and Observation Network (REMO)

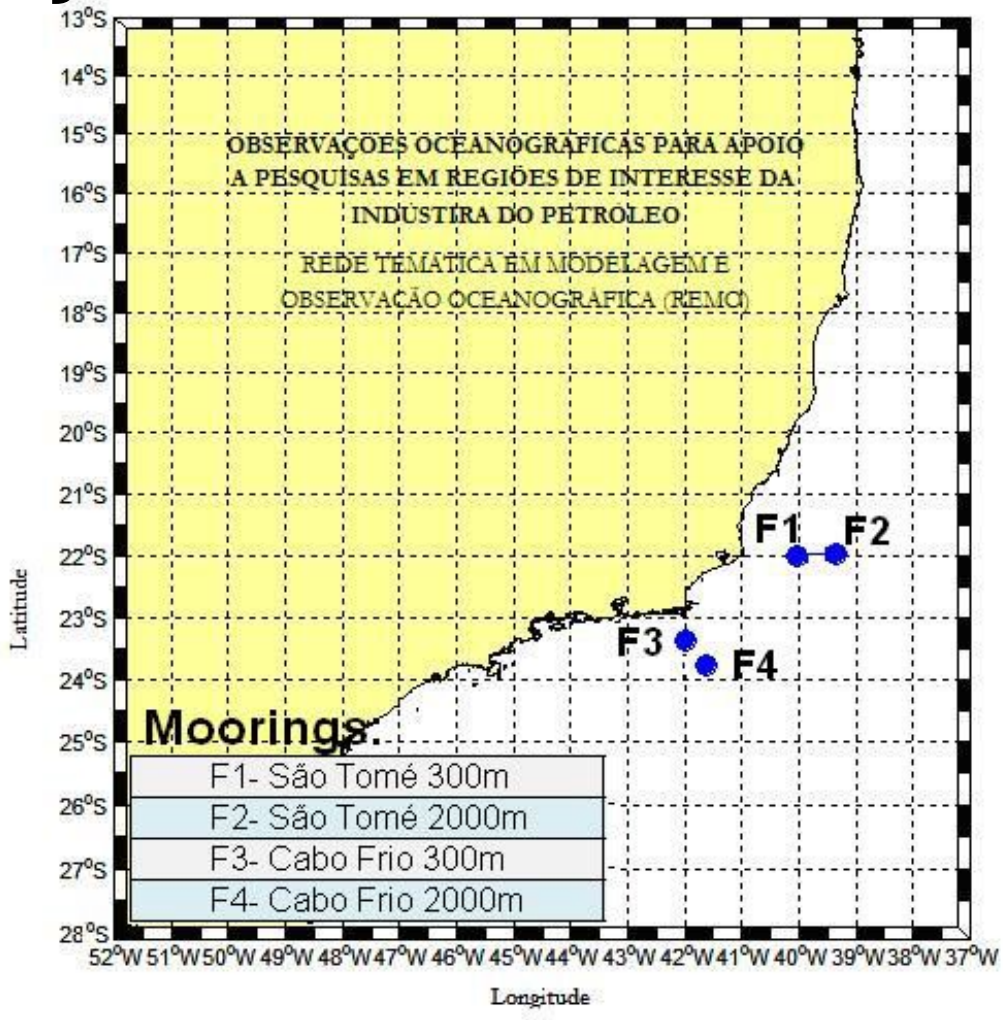
Mooring line sites

(R&D Phase 2)

Proposed execution:

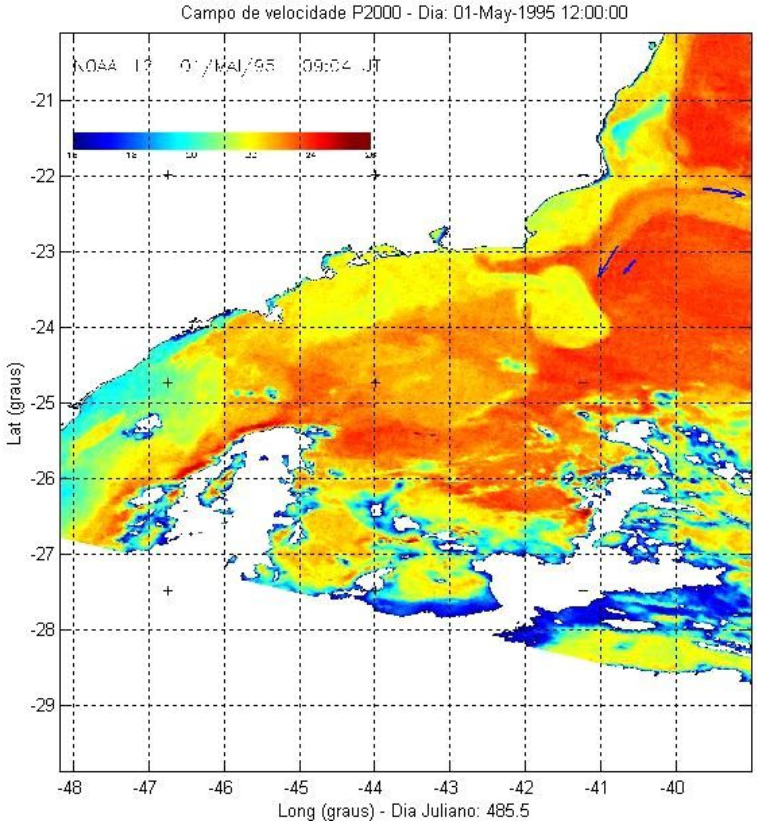
- UFRJ/COPPE/PENO

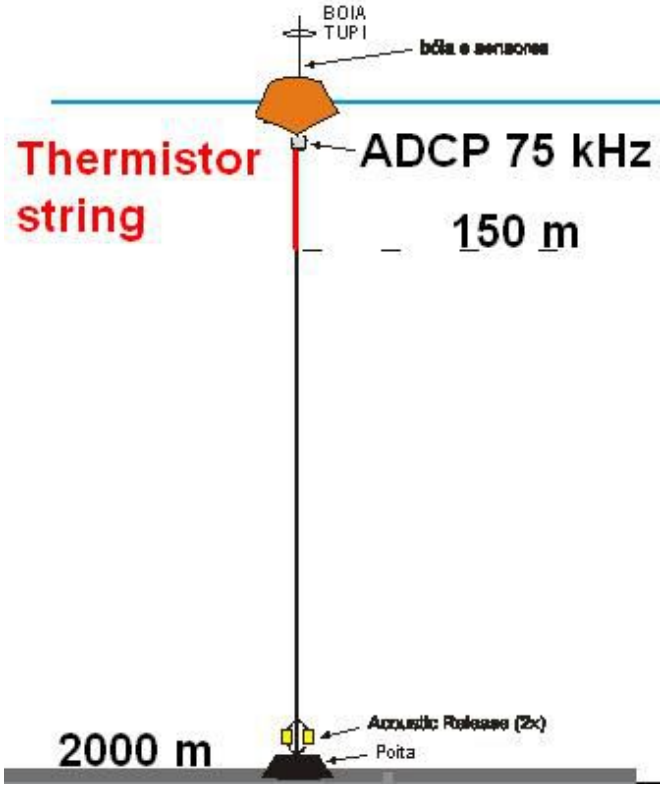
- Ship of opportunity (DHN/GNHO or IEAPM)



Oceanographic Modeling and Observation Network (REMO)

Mooring locations are proposed to evaluate and predict instabilities of the Brazil Current system. Some wavelengths have scales with a distance of Cabo de São Tomé (F1,F2) and Cabo Frio (F3,F4).





Source: Sartori Neto, A. (Ph.D. dissertation, 2004)

Mooring Layout

Marine Ecosystem Dynamics and Implications to Carbon Sequestration (DEMI-SeC)

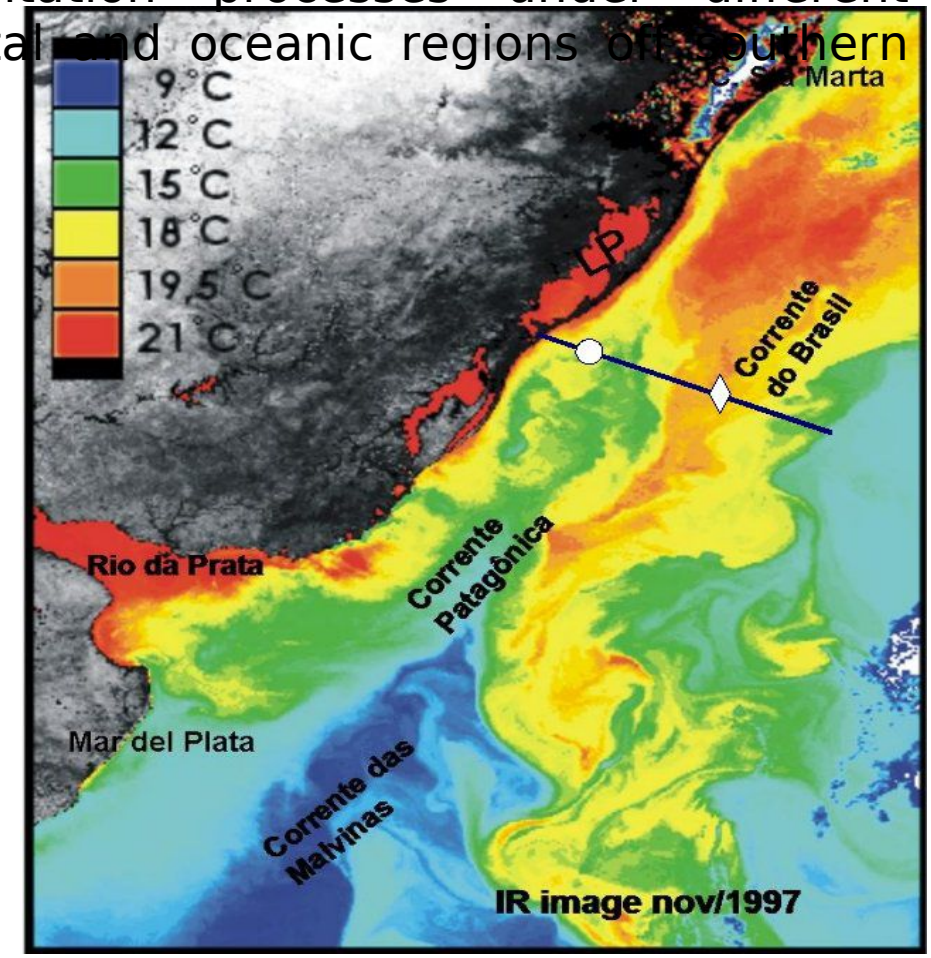
PI: J. Muelbert (FURG)

Objective:

To evaluate CO2 intake by primary producers and its use and transfer by secondary producers or sedimentation processes under different oceanographyc setting in the coastal and oceanic regions off southern Brazil.

Approach:

- Combined ship and mouring observations.
- Seasonal transect from coastal to oceanic waters with continous measure of temperature, salinity, fluorescence, LOPC.
- Selected stations for process oriented studies and ecosystem carbon dynamics.
- Bouys with fluorescence, CO2, O2, and meteocean sensors, and



Other recent Proposed Projects for the South Atlantic

- pCO2, Ocean Optics research during the next Brazil-Africa cruise 2011 (PI: C. Garcia, FURG)
- pCO2, momentum and heat fluxes in the SW Atlantic – The Atlantic Ocean Carbon Experiment-ACEx(PI: L. Pezzi, INPE)

Numerical simulation of the South Atlantic and Indian Ocean circulation forced with monthly means of NCEP Reanalysis since 1948

(PO31E-05)

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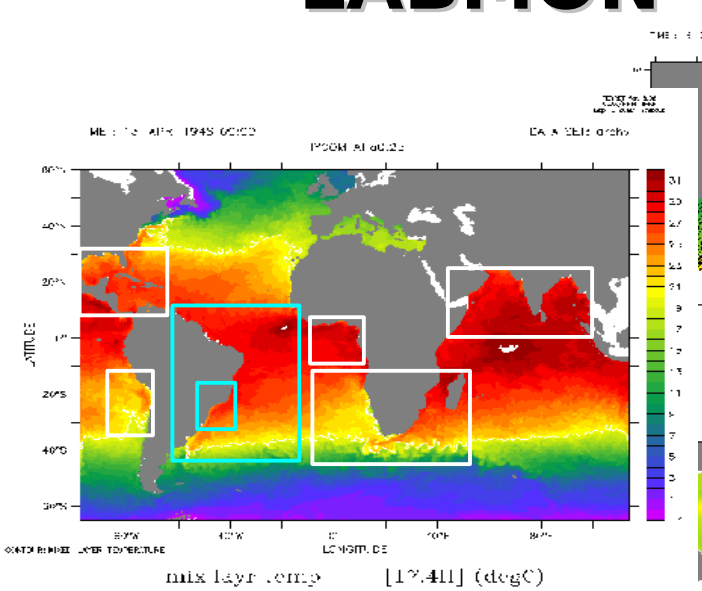
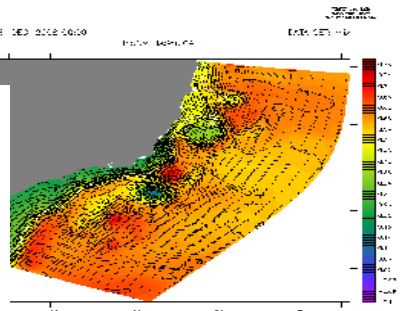
(*) Graduate Student at IOUSP

Ocean Sciences Meeting – Am. Geophysical Union, 22-26/Feb/2010

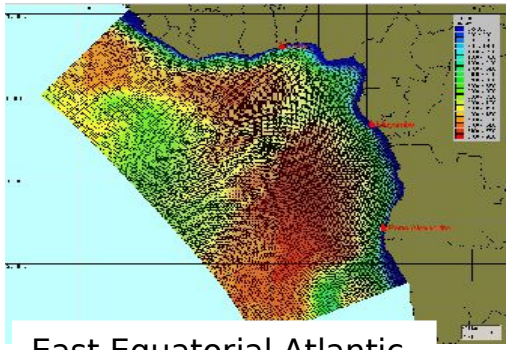
Portland – Oregon - U.S.A.

Modelagem Oceânica no LABMON

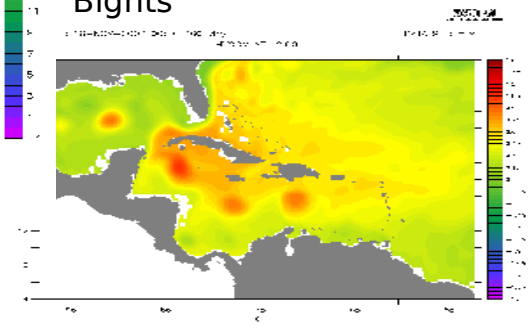




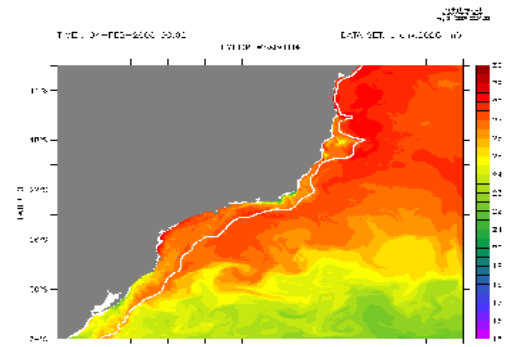
Campos and Santos Bights



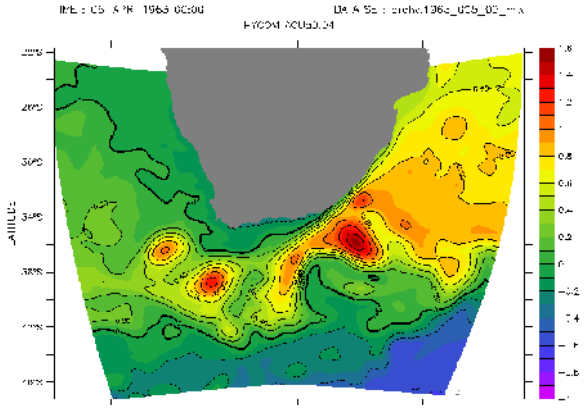
East Equatorial Atlantic



Gulf of Mexico and



Southwest Atlantic

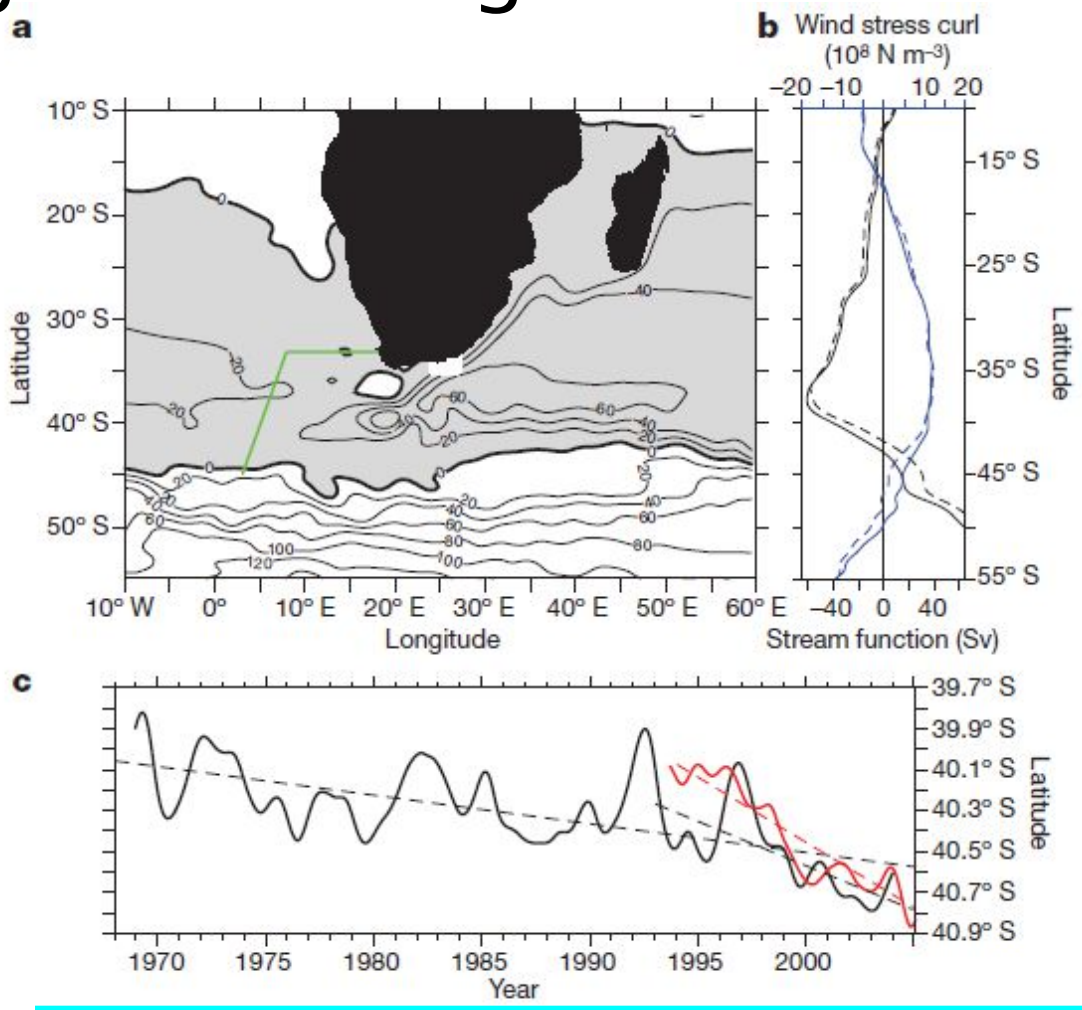


O **LABMON** é hoje, no Brasil, um dos centros com maior experiência no uso de modelos numéricos de última geração, tanto em pesquisa básica quanto em sistemas operacionais para previsão do estado do mar.

Motivation: The Agulhas Leakage is increasing

Recent studies show the leakage of warmer and saltier Indian Ocean waters into the South Atlantic has been Increasing in the paste few decades.

This is due to poleward shif of the souhtern hemisphere westerlies.

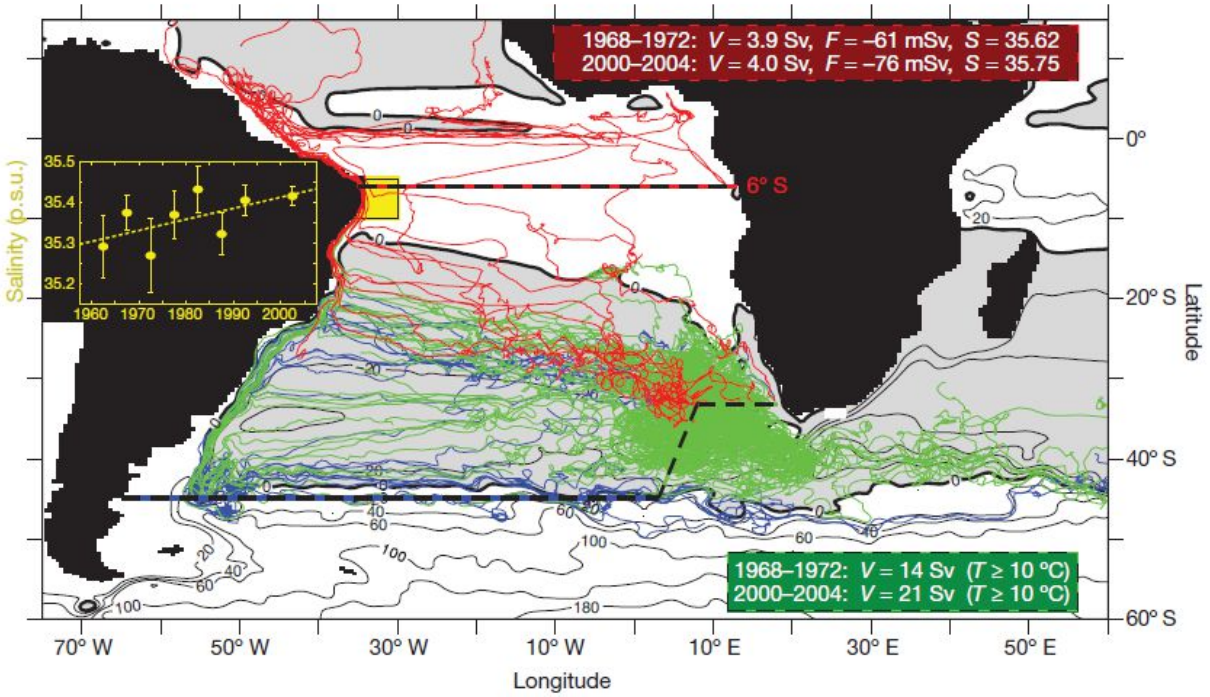


Biastoch et al. 2009: Increase in Agulhas leakage due to poleward shift of Southern Hemisphere westerlies. *Nature 462, 495-498.*

Impacts of the increased leakage

Part of the modified water masses due to the increased Agulhas reaches the northern hemisphere and affect the MOC.

Another part circulates in the subtropical gyre and reaches the Brazil-Malvinas Confluence.



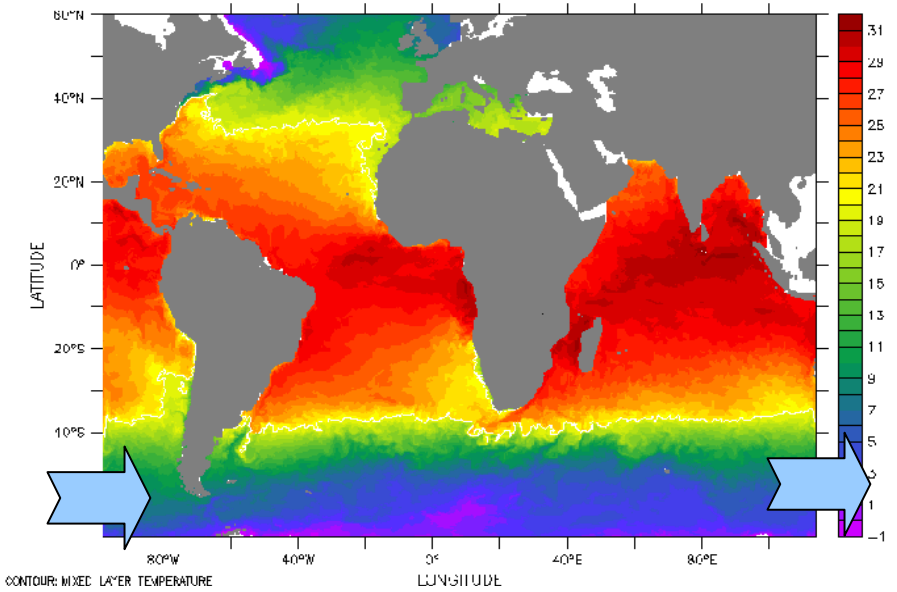
Biastoch et al. 2009: Increase in Agulhas leakage due to poleward shift of Southern Hemisphere westerlies. *Nature 462, 495-498.*

Experiment with HYCOM

in order to assess the impacts of increased Agulhas Leakage in the Southwest Atlantic (SWA), an implementation of HYCOM, forced with monthly means of NCEP/Reanalysis products since 1948 is being run.

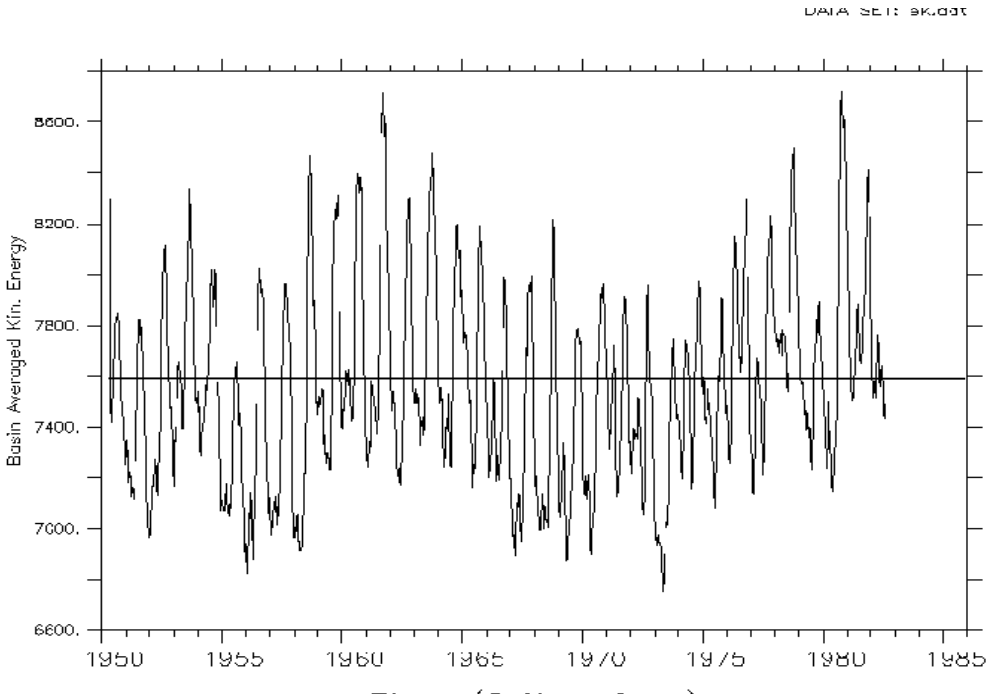
The model was first “warmed up” from rest, using Levitus T&S and forcing it with climatological winds. The results were then used as initial condition for the “dated” run.

As of Feb/16 the model was in mid 1984.

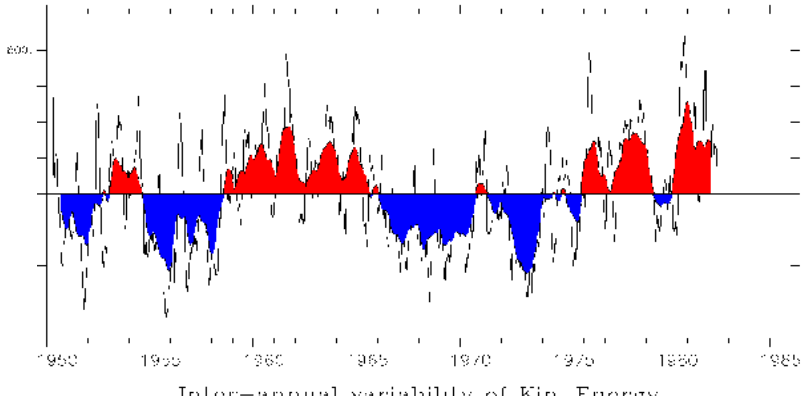


1/4-degree horizontal resolution; 22 hybdrid layers. On the open boudaries, T and S were relaxed to Levitus climatology and Barotropic fluxes of AACC imposed in the souther ocean, in such a way to yield a 148 Sverdrup transport across the Drake Passage.

Kinetic energy time-history suggests that the model reached an equilibrium after a couple of years.



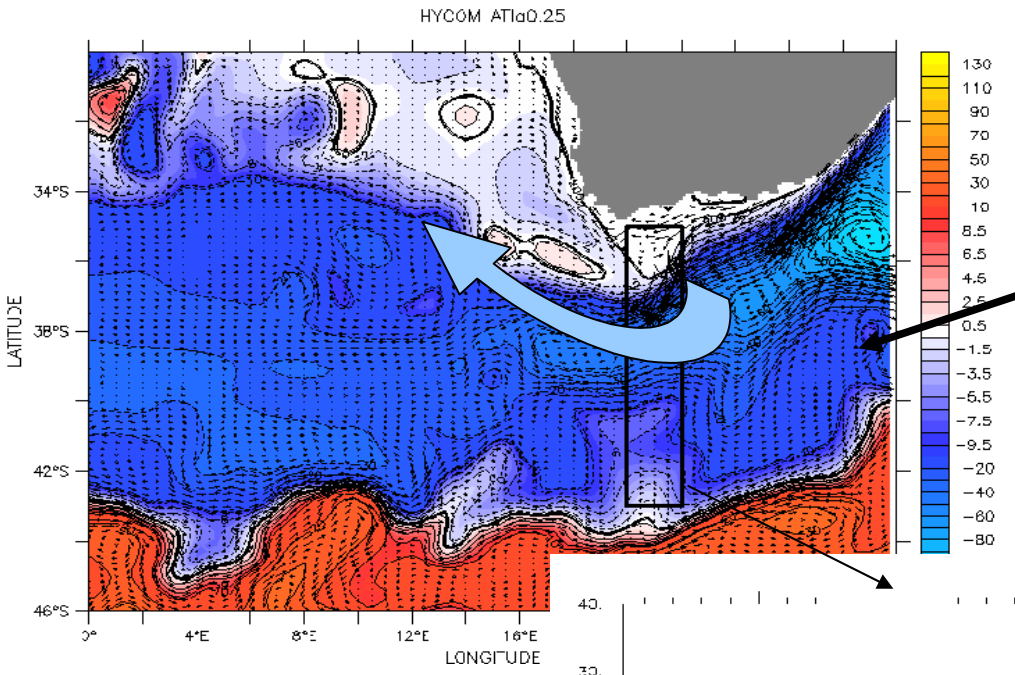
Time-series of the basin-averaged kinetic energy per unit mass, with the seasonal cycle.

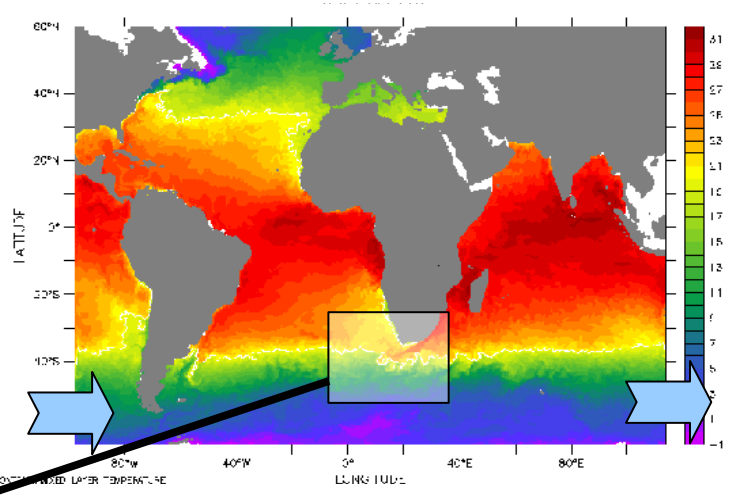


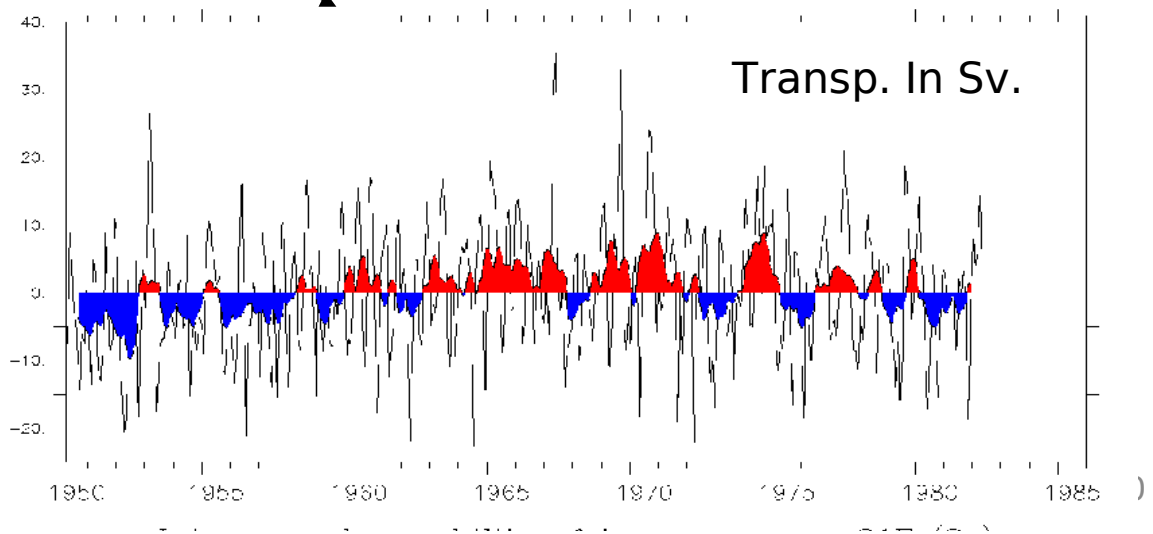
Time-series of the basin-averaged kinetic energy per unit mass, after romoval of the seasonal cycle. The colors represent the variability after a 2.5-year box-car filtering.

In spite of the inter-annual and decadal variability, it seems there is no long term trend in the model's kinetic energy.

Variability of the Agulhas Leakage in HYCOM simulation

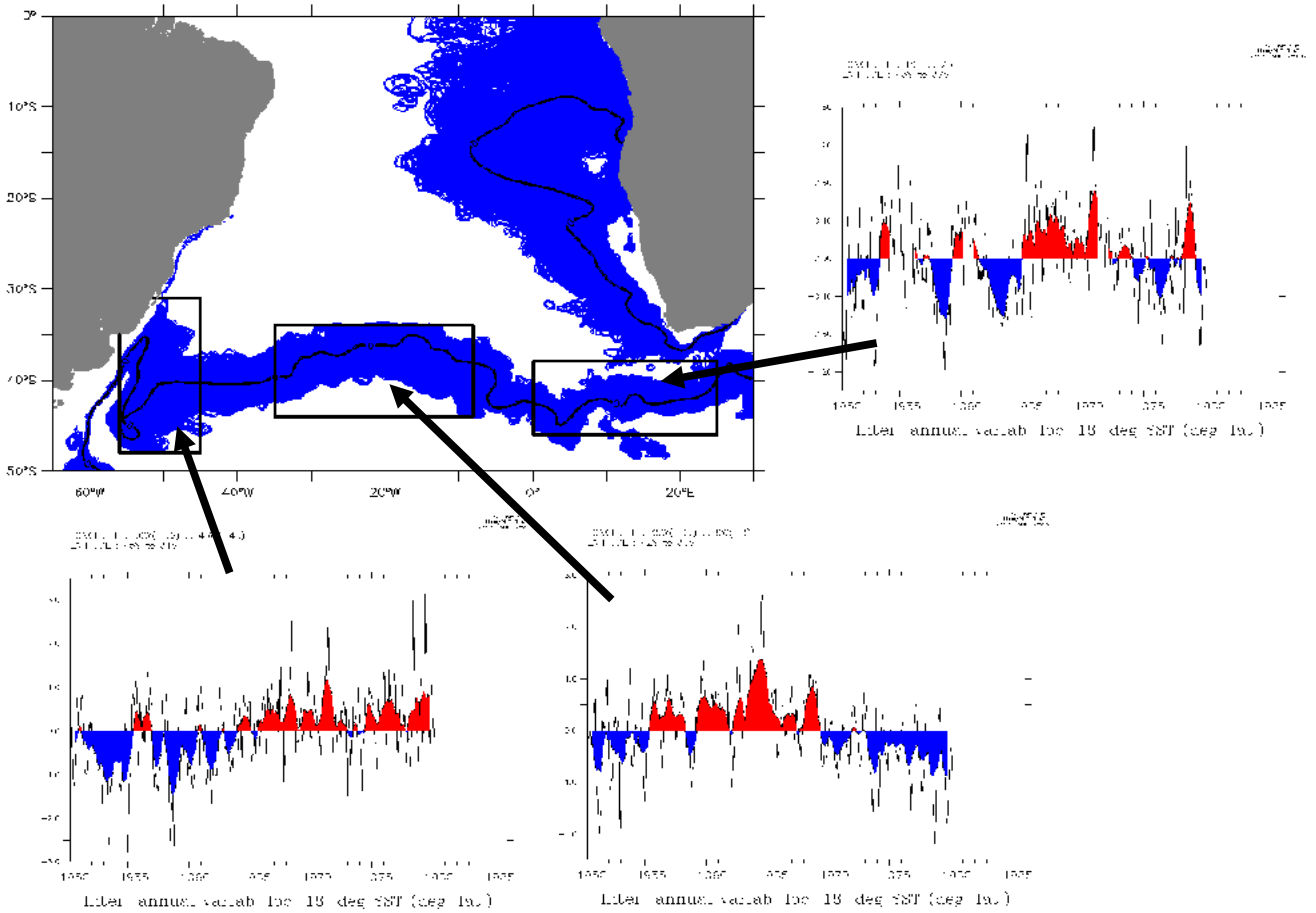






The barotropic transport averaged between 20 and 22ºE, in the Agulhas retroflection is changing, according in the numerical simulation.

Variability of the zero SSH line in the model simulation



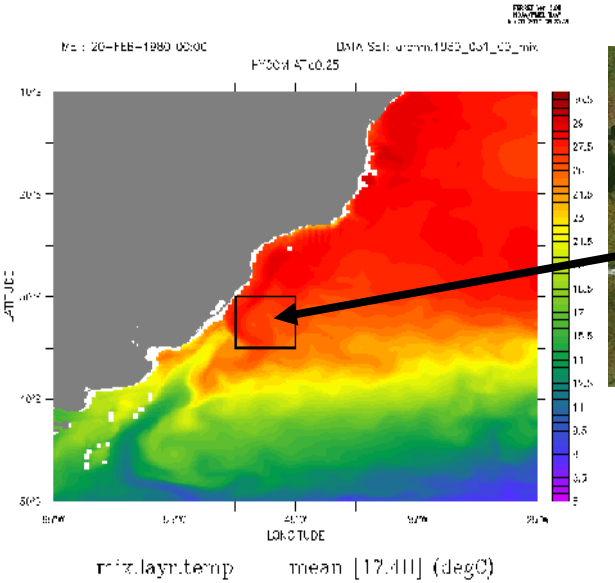
Variability in the SW Atlantic

The model shows interesing variability in the SW Atlantic.

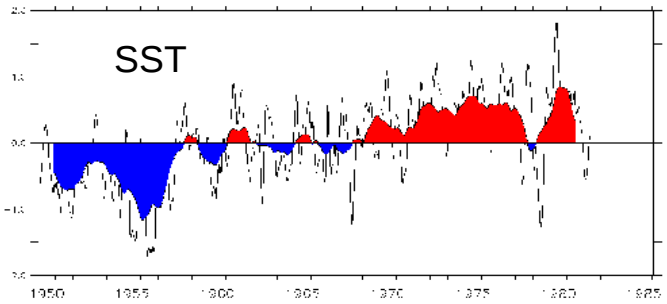
There is an increasing trend in SST and SSS, and a long term decrease in SSH.

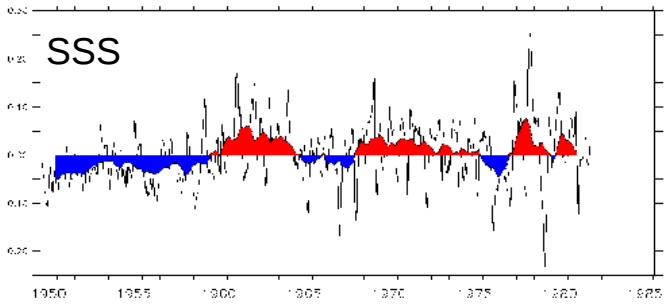
Are these changes due to the increase in the Agulhas Leakage or are they caused locally by the changes in the wind?

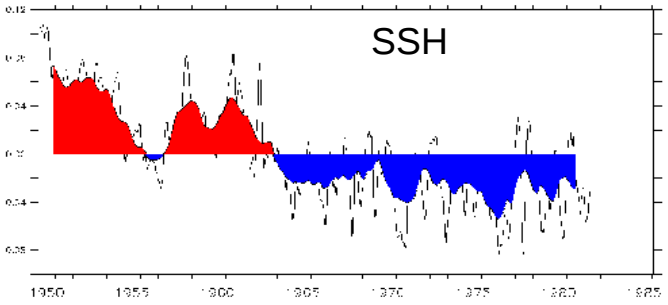
What are the feedbacks of these ocean properties changes?



Catarina, the first hurricane in the S. Atlantic







Final Remarks

- In our model results, the inter-ocean exchange associated with the Agulhas Current retroflection presents an increasing trend beginning in the early 1960's;
- There is a poleward shift of the zero SSH line near the retroflection region;
- In the Southwest Atlantic, the SST and SSS present increasing trends in the period from the early 60's to the end of 1980;
- In the same period, the área-averaged SSH in the SWA seems to be decreasing with time;
- The changes in the SWA could be associated with the increasing Agulhas leakage;