



Impact of the South Atlantic on the Global Overturning Circulation and Climate

SAMOC

Thematic Project FAPESP – Proc. 2011/50552-4

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LABORATORY FOR MODELING AND OBSERVATION OF THE OCEANS

LABMON

Oceanographic Institute of the University of Sao Paulo

Reunião de Projetos PPFMCG – FAPESP – 18-19 de Fevereiro, 2016

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[Physical Oceanography Division - Meridional Overturning ...](#)

www.aoml.noaa.gov/phod/research/moc/samoc/ ▾

Feb 12, 2014 - South Atlantic Meridional Overturning Circulation. While the North Atlantic is the sole provider of North Atlantic Deep Water (NADW) to the ...

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Jan 19, 2016 - South Atlantic Meridional Overturning Circulation (SAMOC).

Observations and models consistently indicate that variations in the Meridional ...

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Feb 2016: There will be a SAMOC session entitled "Observing and Modeling the Meridional Overturning Circulation in the South Atlantic: Causes of variability ...

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[Pioneering voyage | Revista Pesquisa FAPESP](#)

revistapesquisa.fapesp.br/en/2013/03/08/pioneering-voyage/ ▾

She is the former Director of the Physical Oceanography Division and current Chief ...

SAMOC includes research groups from France, Brazil, the United States, ...

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[\[PDF\] Large Scale, Climate-Related Oceanographic Research a...](#)

www.fapesp.br/eventos/2014/11/weekcalifornia/Campos.pdf ▾

Nov 18, 2014 - Research in the four areas of oceanography, ranging from coastal ...

SAMOC. The SAMOC-BR and the Atlas-B. Movar. Atlas-B. SAMOC ...

[SAMOC | Oceanography](#)

www.sea.uct.ac.za/sea-SAMOC-news ▾

Oct 14, 2013 - The Meridional Overturning Circulation (MOC) is a system of surface and deep ocean currents that extend across the globe. It is the main ...

[\[PDF\] Brazillian SAMOC Project - US CLIVAR](#)

https://usclivar.org/sites/default/files/meetings/Campos_SAMOC.pdf ▾

The Brazilian SAMOC Project. Edmo J. D. Campos. Oceanographic Institute of the University of São Paulo – edmo@usp.br. The South Atlantic Meridional ...

[Session: Observing and Modeling the Meridional ... - Confex](#)

What is SAMOC?



SAMOC I, B. Aires, Argentina, May, 8-10, 2007

○ **SAMOC Executive Committee: C. Meinen (USA); S. Speich (FR); A. Piola (ARG); S. Garzoli (USA) & E. Campos (BR)**



SAMOC II, Paris, France, May 2009



SAMOC III, Rio de Janeiro, Brazil, May 2010



SAMOC IV, Simons Town, S. Africa, September. 2011



SAMOC V, Buenos Aires, Argentina, December, 2014

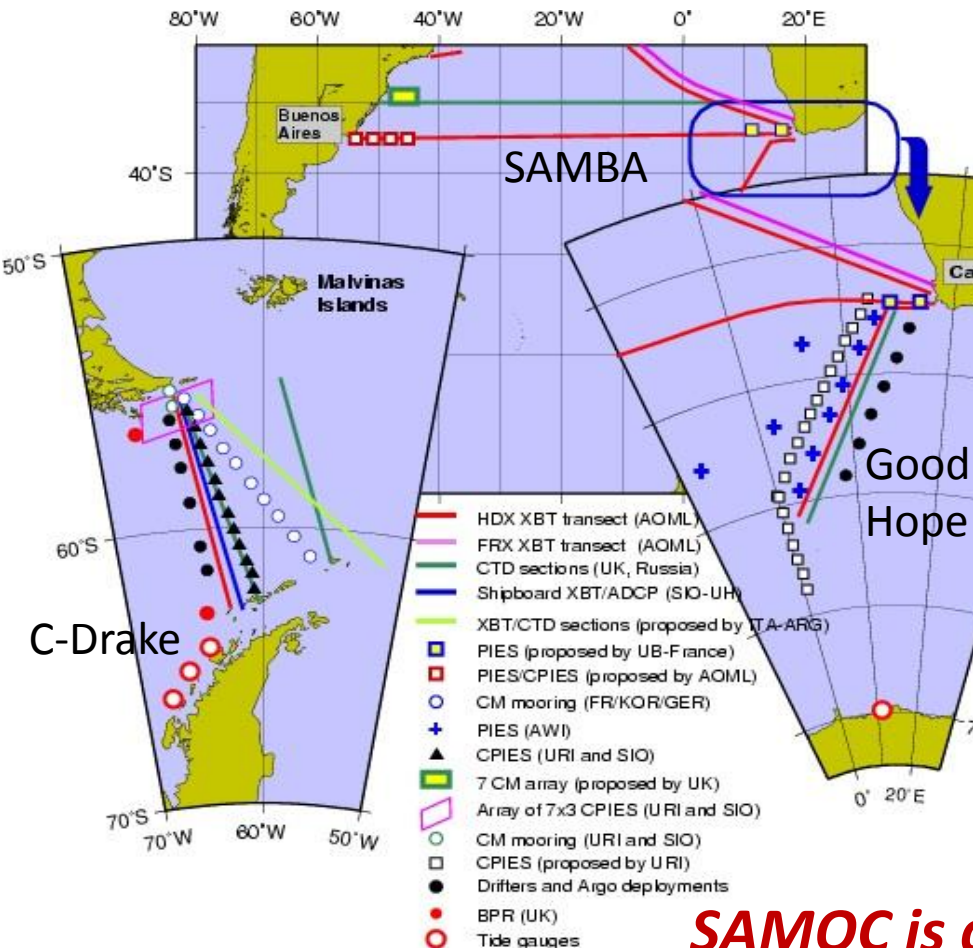
<p>2016 OCEAN SCIENCES MEETING</p>	<p>AGU • ASLO • THE OCEANOGRAPHY SOCIETY 21-26 February • New Orleans, Louisiana, USA</p>
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SAMOC VI will be held in Feb 21, in New Orleans, USA - back-to-back with the AGU OSM2016

During the OSM2016 there will be also an entire Session on SAMOC

The International SAMOC

SAMOC is an international effort to study the Meridional Overturning Circulation in the South Atlantic and to understand its role on climate



Partner Institutions & Contacts

Argentina: Serv. Hidrografia Naval (A. Triosi) & Universidad de Buenos Aires (A. Piola)

Brazil: USP (E. Campos and O. Sato) & FURG (M. Mata)

France: Lab. de Phys. des Oceans, Univ. Paris IV & U. of Brest (S. Speich, C. Maes, N. Kolodziejczk)

Germany: AWI (O. Boebel); IFM-GEOMAR, (P. Brandt)

Russia: Shirshov Instit. of Oceanology (S. Gladyshev and P. Zavialov)

South Africa: Department of Environmental Affairs & University of Cape Town (I. Ansong, C. Reason, and M. Roberts)

Spain: Institut de Ciencies del Mar, CSIC (J. Pelegri and A. Olivares)

UK: National Oceanography Centre, Southampton (E. McDonagh, B. King)

USA: NOAA/AOML (S. Garzoli, G. Goni, C. Meinen, and M. Baringer) UCSD/Scripps Institute of Oceanography (J. Sprintal Univ. of Miami/RSMAS (S. Dong, R. Perez, and R. Fine); Massachusetts Institute of Technology (S. Baker-Yeboah and G. Flierl)

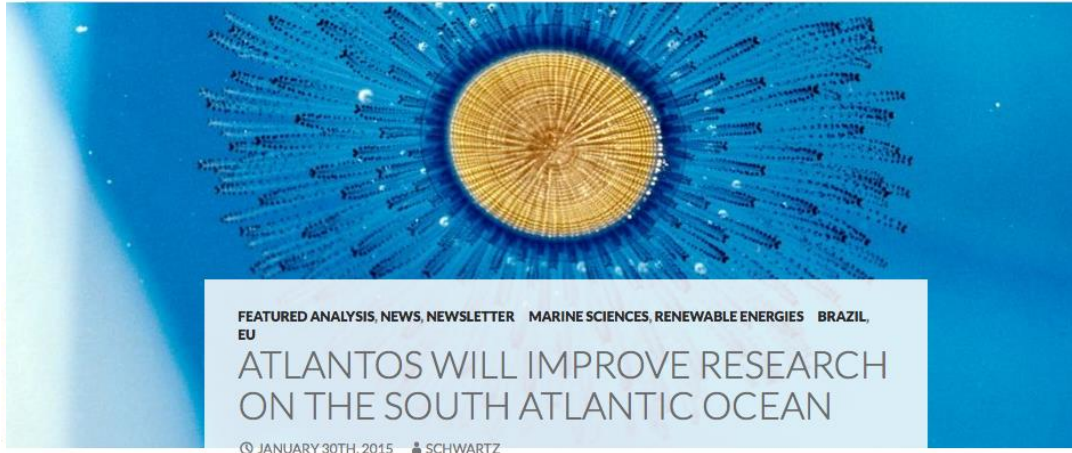
SAMOC is an initiative endorsed by CLIVAR

The Pandora Box is open ...!



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EVENTS EU TOUR OF BRAZIL

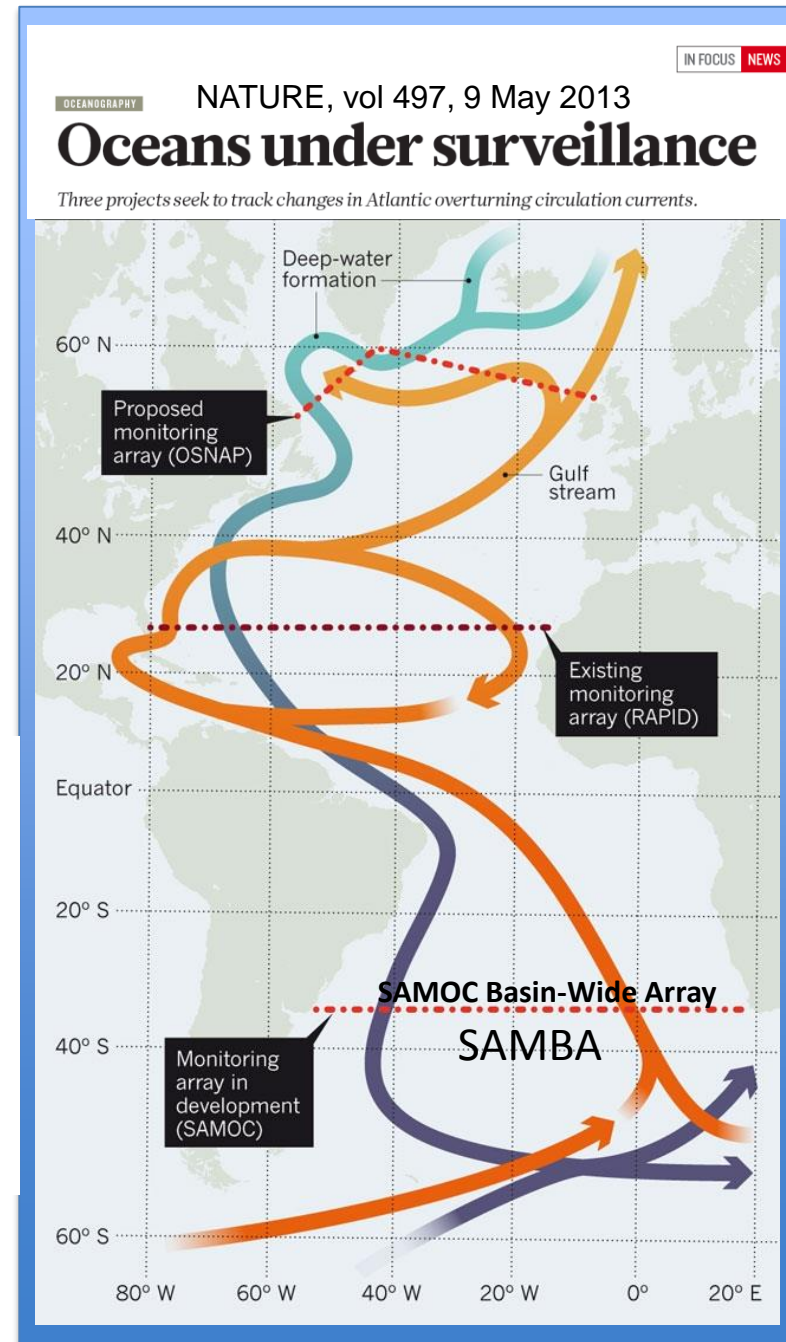
PROMOTING RESEARCH AND INNOVATION BETWEEN EUROPE AND BRAZIL



AtlantOS will address current fragmented Atlantic Ocean monitoring activities in Europe, Brazil, Canada and USA and seek to develop a more efficient, complete and lower cost information delivery system.

One of the initiatives that should be incorporated by AtlantOS is the SAMOC Programme (South Atlantic Meridional Overturning Circulation)

"The role of the oceans in the climate system must be carried out globally"



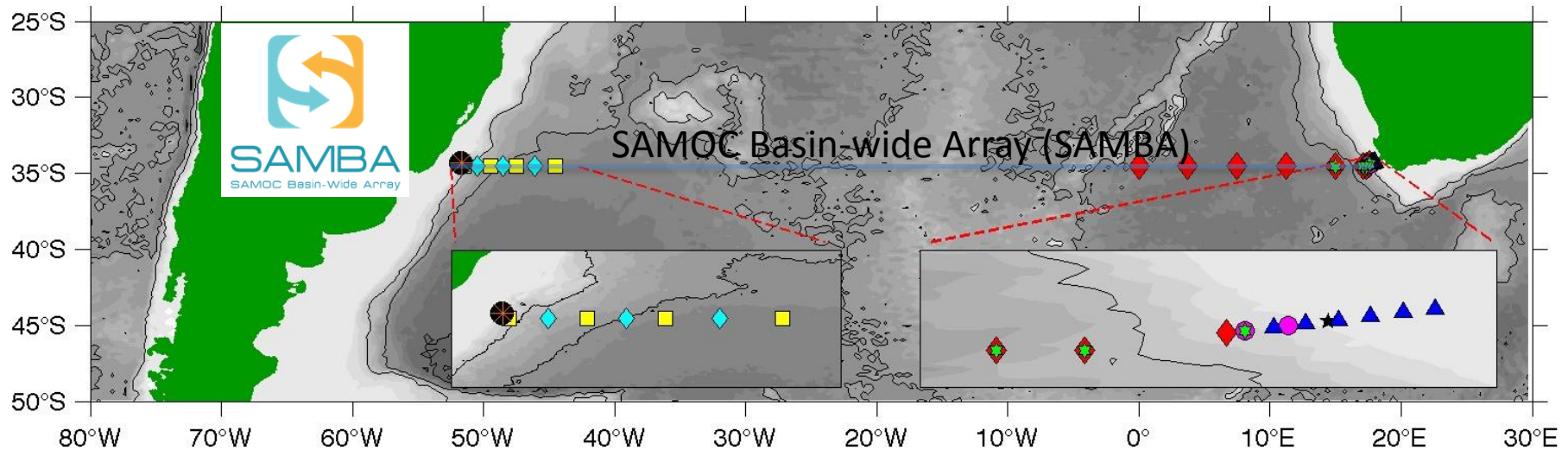
The SAMBA Experiment



The component of SAMOC funded by FAPESP extends till November 2016.

A proposal for a new project is in development

- PIES - NOAA - In place since March 2009
- ◆ CPIES - Brazil - In place since December 2012
- Bottom pressure - Brazil - In place since December 2013
- * Bottom ADCP - Brazil - In place since December 2013
- ◆ CPIES - France - In place since September 2013
- Bottom ADCP - France - In place since September 2013
- ▲ Short mooring - South Africa - To be deployed in mid 2014
- ★ Thermister mooring - South Africa - To be deployed in mid 2014
- ★ Tall mooring - South Africa - To be deployed in mid 2014



- In both 2012 and 2013, **SAMBA doubled** in size!
- 2012-2013: 3 CPIES, 1 ADCP, 1 BPR deployed on **western boundary**
- 2013: 8 CPIES, 2 ADCPs deployed on the **eastern boundary**
- Oct 2014: 10 short/tall moorings were deployed on the **eastern boundary**
- **April 2016: a cruise is scheduled for the first turnaround of the Brazilian C-PIES**

Since 2008, near 30 SAMOC related research cruises have been conducted in the South Atlantic

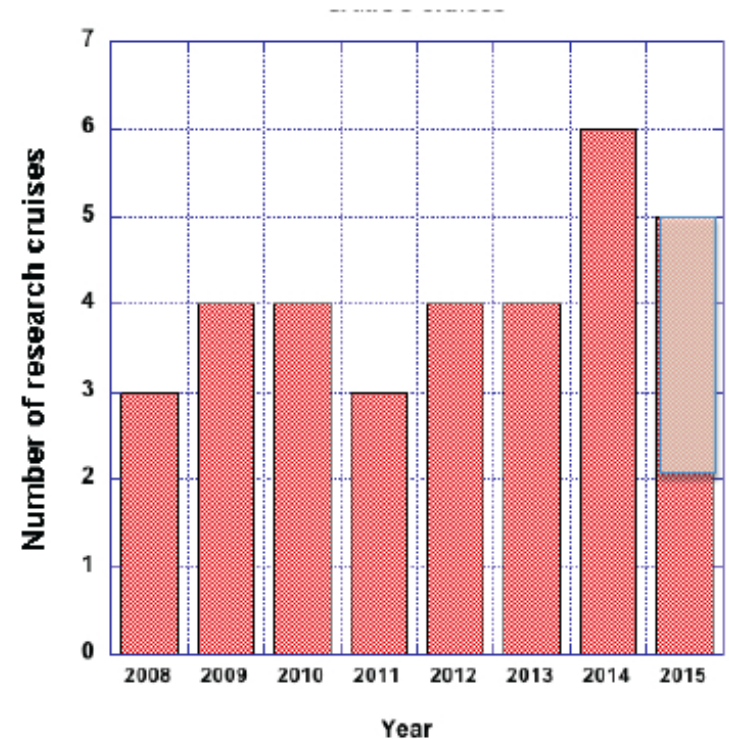
The field activities of SAMOC **depend heavily on the use of oceanographic ships.**

To estimate meridional fluxes an array of Current-Pressure Inverted Echo Sounders (C-PIES) were deployed along the SAMBA line.

The instruments **record internally the data**, which are then retrieved either by **acoustic telemetry** or when the **C-PIES are recovered for being serviced and redeployed.**

Data recovery and turnaround operations can only be realized during research cruises.

During the cruises, several other type of activities are conducted, such as **CTD Stations, ADCP Profiling and the collection of water samples** for biogeochemical analyses.



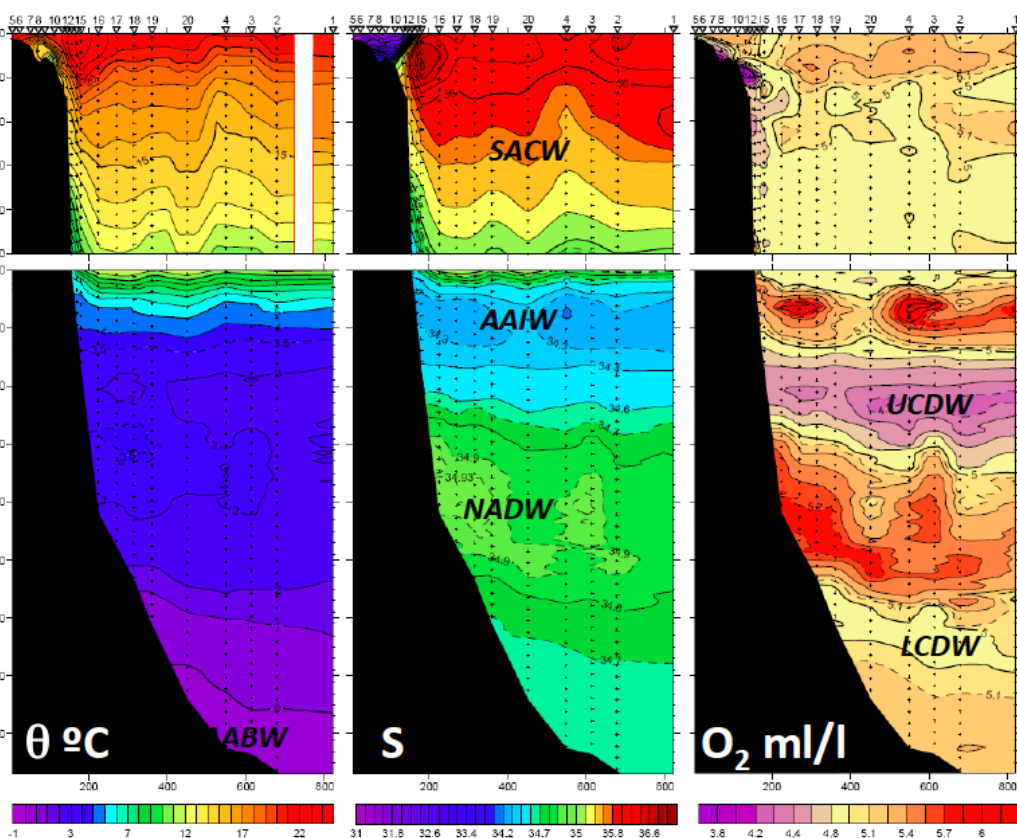
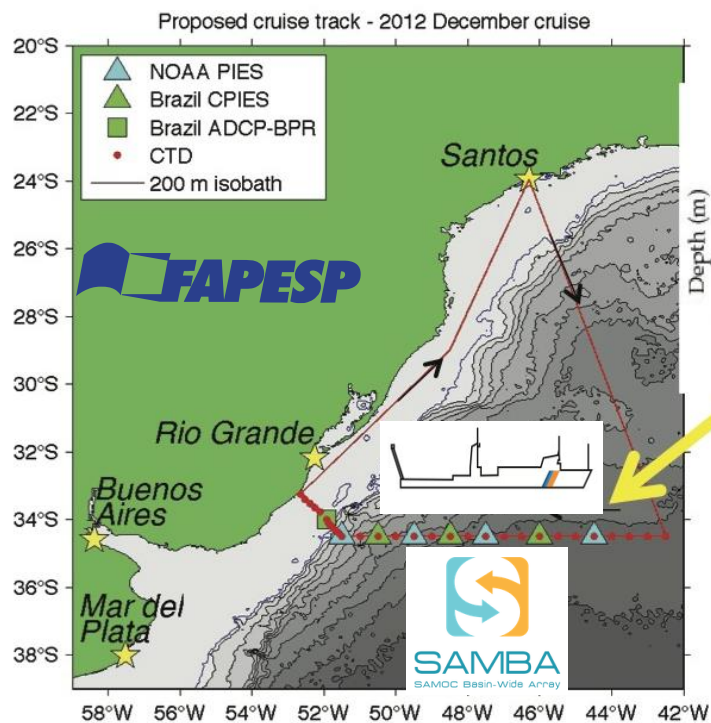
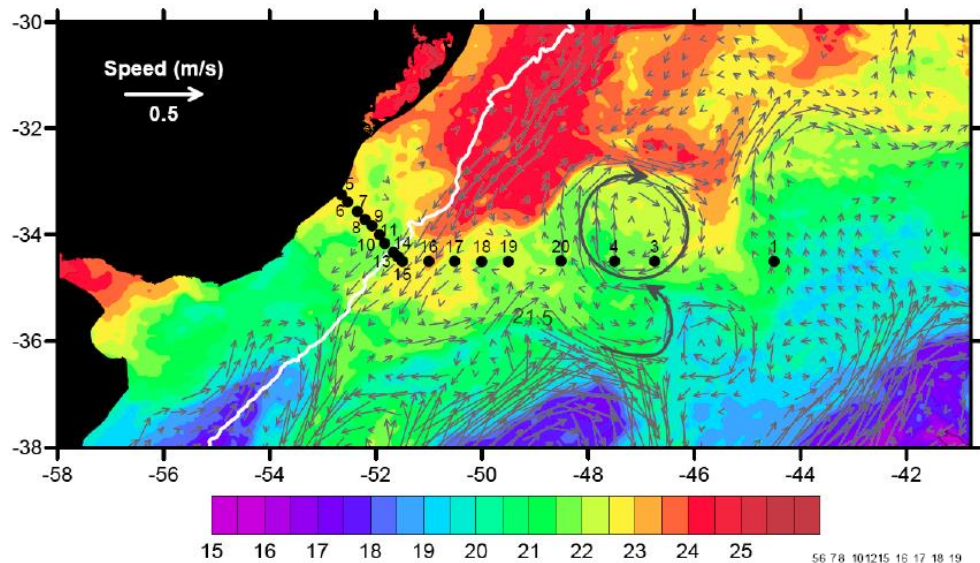
142 High Density XBT transects 2007-2015:
AX18: **26**; AX22: **43**; AX25: **24**; AX97: **50**

Argo floats
Altimeter

The first (and so far the last) SAMOC cruise on board the R/V Alpha Crucis.

The Univ. of Sao Paulo's ship has been out of service since early December 2013.

In this period, three "partial" expeditions have been realized, one on board an Argentine vessel and two with the Alpha Delphini, a coastal research boat not appropriated for deep ocean operations.



SAMOC's Numerical Modeling Component

Title: South Atlantic Circulation and Salinity: An Integrated Observational and Modeling Investigation

Source of Support: Arg: Comision Nacional de Actividades Espaciales and Ministerio de Ciencia y Tecnologia, USA: NASA

PIs: Arg: Piola, Palma, Saraceno, USA: Matano, Strub, Chao.

Title: Variability of Ocean Ecosystems Around South America (VOCES)

Source of Support: Inter-American Institute for Global Change Research

PIs: Arg: Piola, Acha, Campagna, Brazil: Campos, Moller, Muelbert, Chile: Pizarro, Peru: Purca, Uruguay: Defeo, USA: Brink, Matano

Title: Role of the South Atlantic on the Meridional Overturning Circulation and Climate (SAMOC)

Source of Support: FAPESP, as part of the SAMOC/BR Thematic Project

PIs: Edmo Campos, Olga Sato, (Brazil); R. Matno (USA); Shenfu Dong (USA) Sabrina Speich (France)

Title: South Atlantic Meridional Overturning Circulation: Pathways and Modes of Variability

Source of Support: National Oceanic and Atmospheric Administration

PIs: R. Perez, S. Garzoli, R. Matano

Collaborator: R. Msadek

Title: Variability of the South Atlantic Subtropical Gyre

Source of Support: National Aeronautics and Space Administration

PIs: R. Perez

Collaborator: R. Msadek

Title: Transport in the upper branch of the South Atlantic Meridional Overturning Circulation.

Source of Support: National Oceanic and Atmospheric Administration

PIs: Claudia Schmid and George Halliwell

Collaborators: Christopher Meinen and Silvia L. Garzoli

Title: Transport in the upper branch of the South Atlantic Meridional Overturning Circulation.

Source of Support: NASA

PIs: G. Goni, S. Dong

Global experiment with HYCOM

HYCOM 1/12-deg, 32 hybrid layers, sigma2, global domain.

Forced with NCEP reanalysis

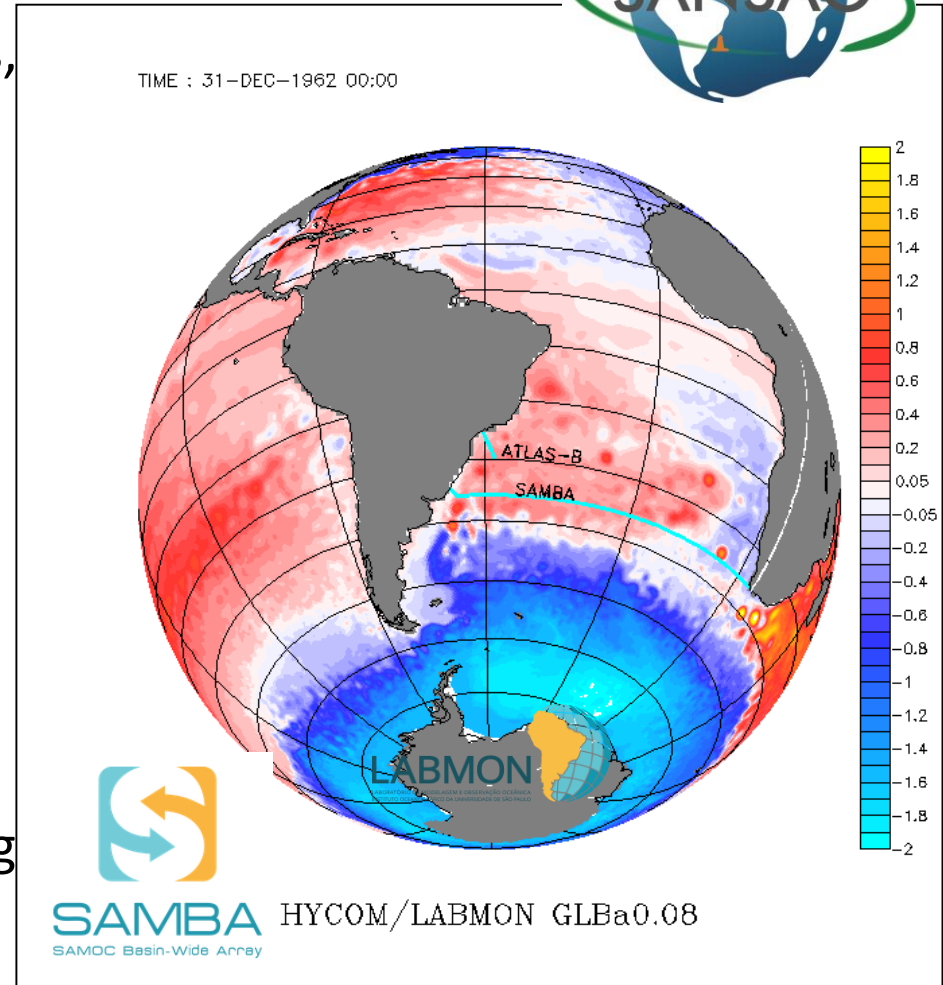
Exp1: Climatological forcing

Exp2: Forced with time-varying monthly means, from 1950 to present.

Main objective:

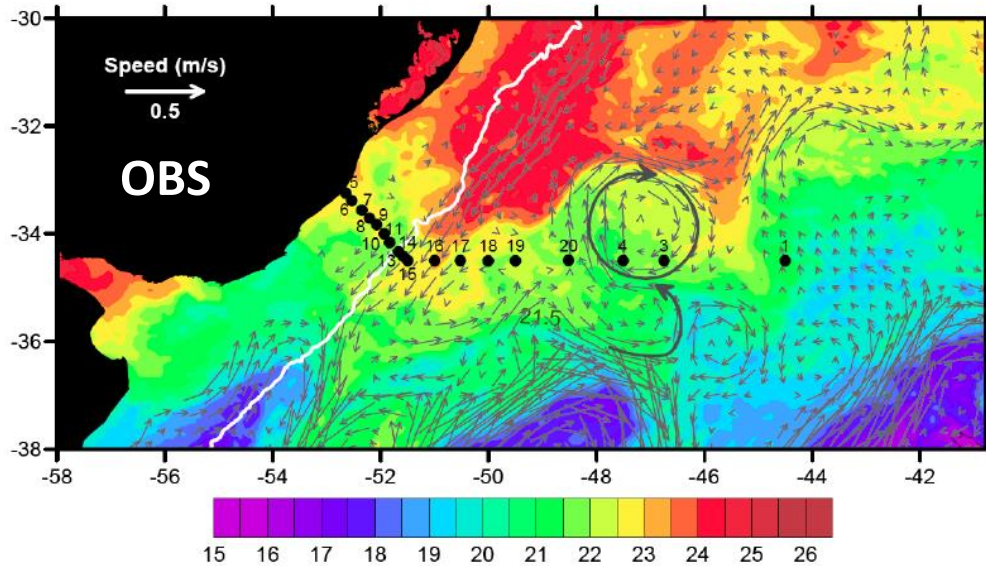
To evaluate ocean's response to changes in the atmospheric forcing in the past decades.

Also part of Thematic Project SANSÃO (T. Ambrizzi)



Experiments run at Tupã, the Cray Super-computer at INPE/CPTEC, with FAPESP's support

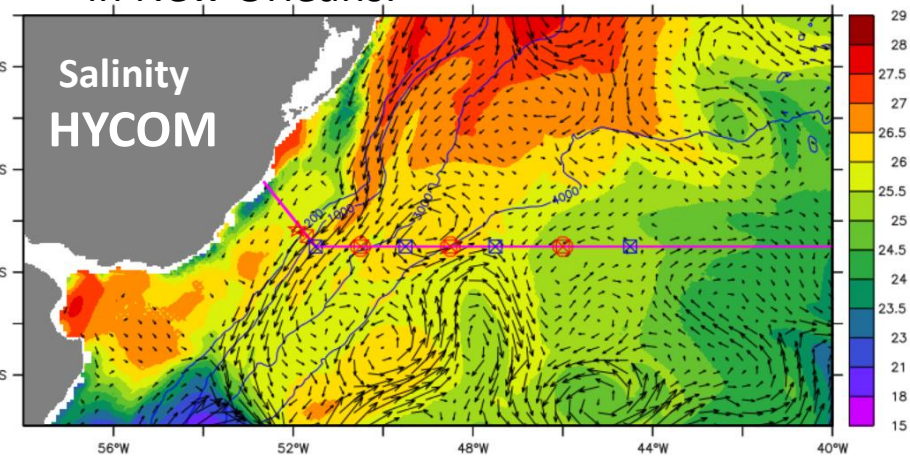
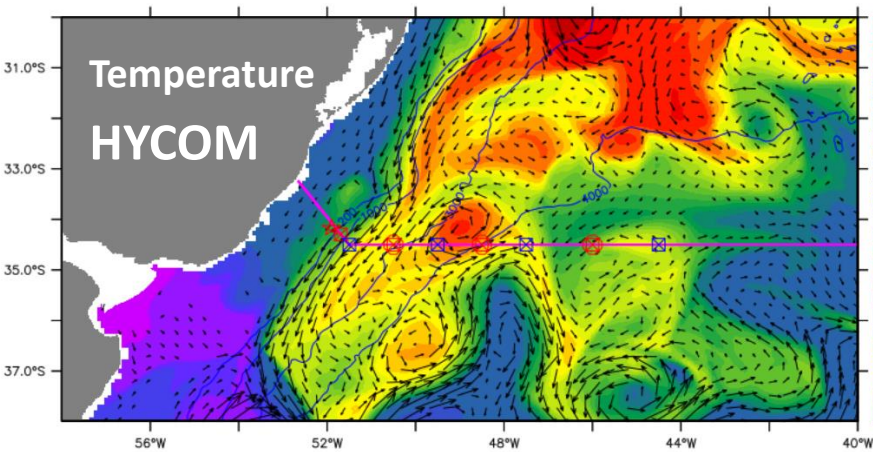
Model Validation



The results of the numerical experiments with HYCOM are being compared with observations, including data obtained during SAMOC cruises.

The model is reproducing quite well the water mass properties, the dynamics and variability.

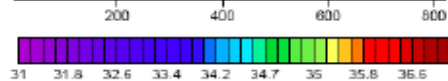
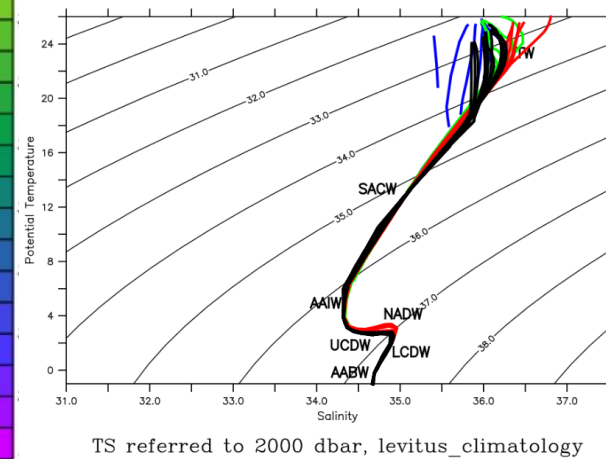
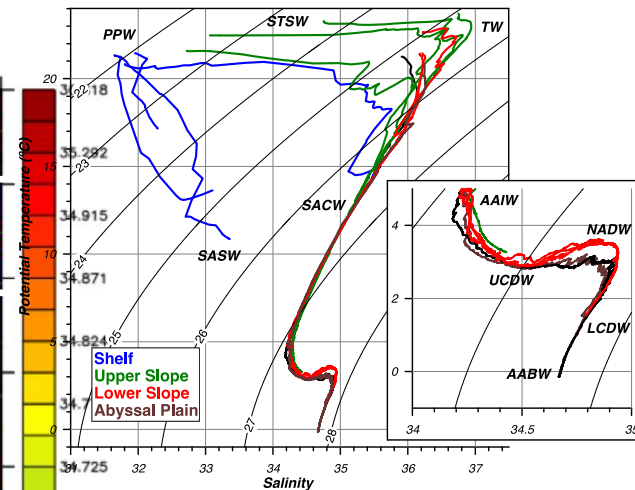
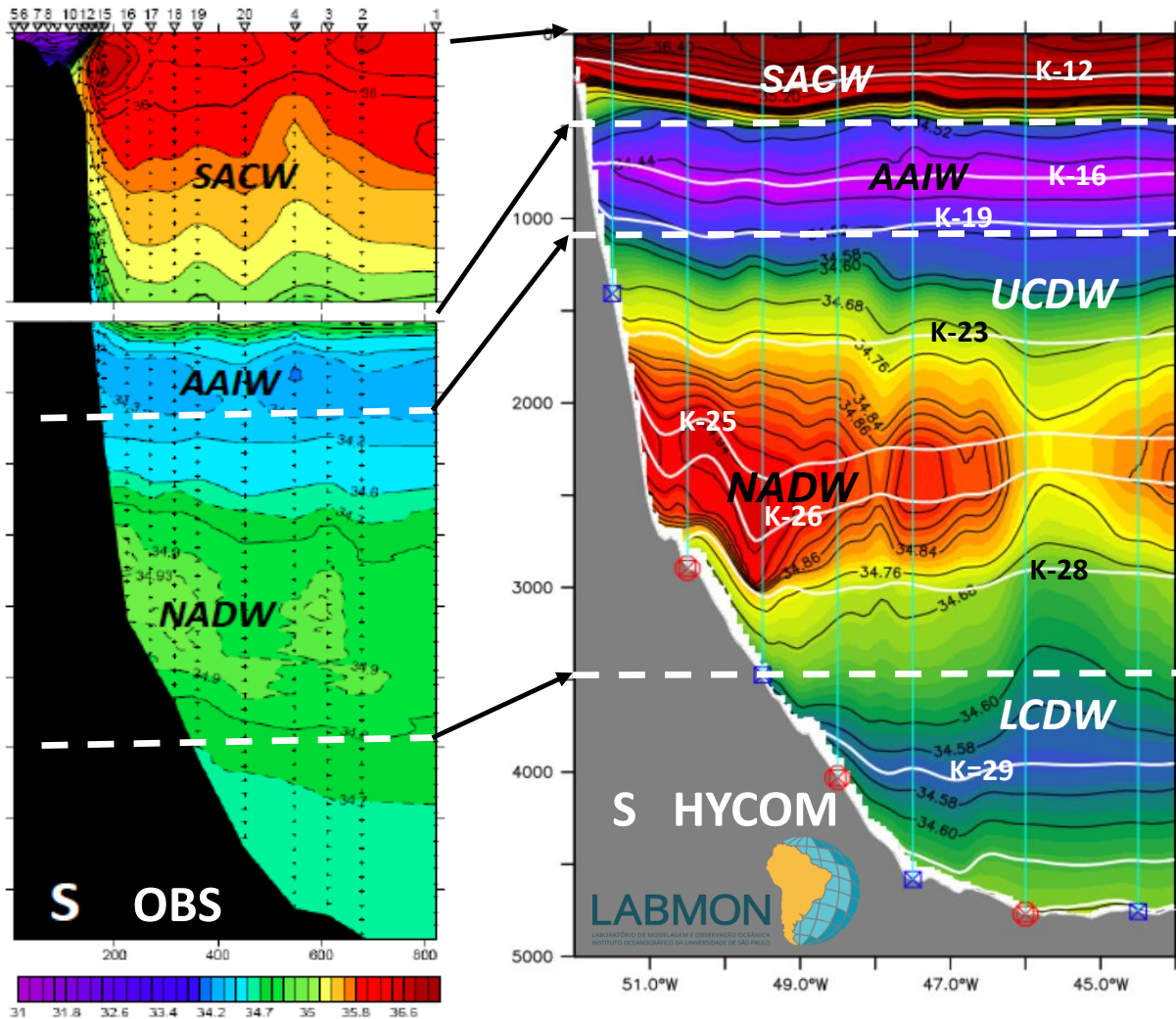
Results are being used in several scientific papers, some of which will be presented at the AGU-OSM2016 in New Orleans.





LABMON

LABORATÓRIO DE MODELAGEM E OBSERVAÇÃO OCEÂNICA
INSTITUTO OCEANOGRÁFICO DA UNIVERSIDADE DE SÃO PAULO

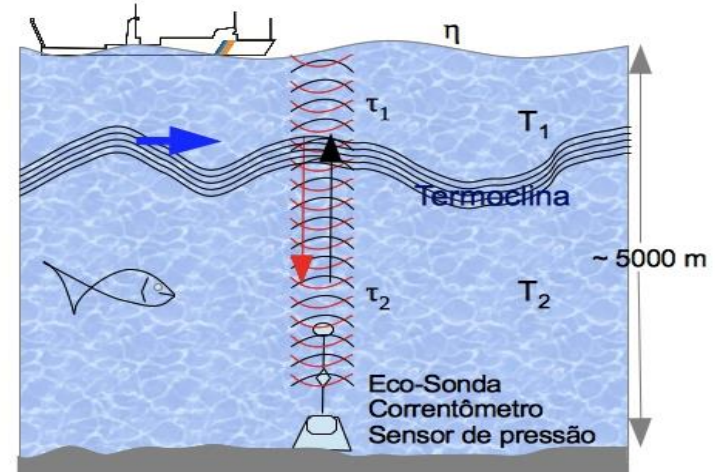




What Next?

- Publication of a number of scientific papers based on the results of the numerical modeling component;
- Conduction of research cruise with the Alpha Crucis, in April/2016.
- Preparation and publication of scientific papers with the data retrieved from the moored instruments;
- Submission of a proposal for the next phase of the project, in which a **new strategy, less dependent on ships, will be applied.**

Project depends crucially on oceanographic ships



C-PIES store data in solid state memory. Data is retrieved by acoustic telemetry during cruises, or when instruments are recovered for maintenance.

Datapod Technology

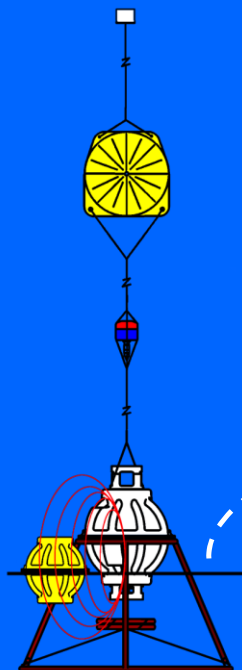
Because of the high cost of ship operations and the uncertain availability, there is a strong need to develop new, cost-effective technology to allow near real-time full water column observation.

Popeye: Commercial option available, made by the University of Rhode Island (US)



A Popeye Data Shuttle (PDS) has been developed and successfully field tested at the University of Rhode Island—Graduate School of Oceanography (URI-GSO). Several expendable PDS modules can be deployed with each PopLink-equipped C-PIES. Data are broadcast hourly to all PDS modules (range, 2 meters). On an individually programmed schedule, each PDS will self-release and float to the surface. The data in the PDS memory will be transmitted (LIFO) via the Iridium gateway to an email server ashore. The URI-GSO PDS module provides a reliable and cost effective tool to retrieve data from a deployed C-PIES measurement system without sending a ship.

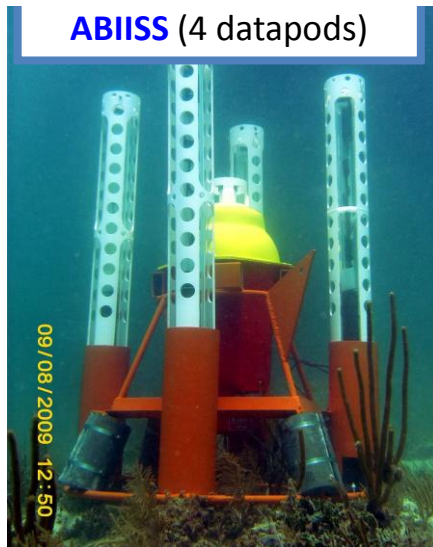
PopLink



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Datapod Technology

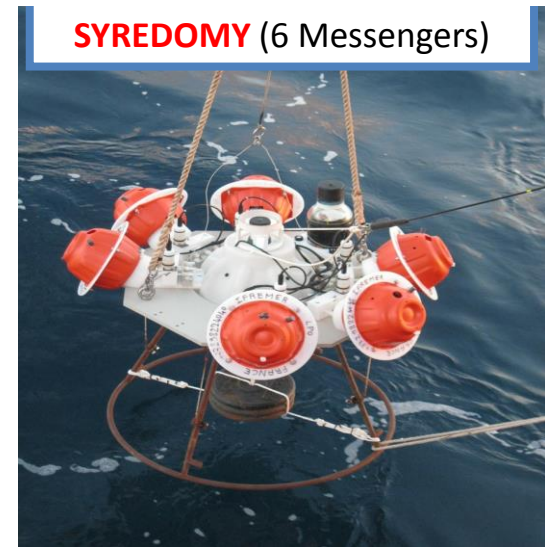
Other prototypes are being tested, with very promising results: ABISS (NOAA/AOML, USA) and SYREDOMY (LPO, Univ. Brest/France)



Being tested

ABISS (NOAA/US)

SYREDOMY (France)





Summary

- Despite the problem with the Alpha Crucis, the observational component is being conducted successfully.
- Numerical modeling component is generating a huge amount of most valuable information
- A number of scientific papers have been published or in review for publication in first class, peer-reviewed journals
- A new proposal is being discussed, in which new, cost-effective observational strategies will be attempted.