The third workshop for the South Atlantic Meridional Overturning Circulation (SAMOC 3)

Workshop report

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with contribution of all the workshop participants

Rio de Janeiro/Niteroi, Brazil, May 11 - 13, 2010

The meeting was hosted by Edmo Campos (University of Sao Paulo) at the Brazilian Navy's Diretoria de Hidrografia e Navegação (DHN). It was chaired by Silvia L. Garzoli (AOML), Sabrina Speich (LPO, France), and Alberto Piola (SHN, Buenos Aires). The workshop was attended by scientists from Brazil, Argentina, Uruguay, South Africa, the Netherlands, France, UK, US, and Russia.

Funding for the workshop was provided by the NOAA CPO, US CLIVAR Office, Ifremer (France), the Brazilian Council for Scientific and Technological Development (CNPq) and the São Paulo State Foundation for the Support of Research (FAPESP), through the Project INCT-Mudanças Climáticas, and the Brazilian Navy.

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South Atlantic Meridional Overturning Circulation (SAMOC)

Workshop report

The main objective of SAMOC 3 was to design the basis for an observational program for the Meridional Overturning Circulation in the South Atlantic. Models and observations have shown that the northward heat transport across 35°S is significantly correlated with the strength of the AMOC, and hence the global climate system. The goal of the workshop was to discuss how the present observation systems may contribute to estimate the meridional and inter-basin fluxes of mass, heat and salt; how the present array ought to be upgraded to better capture these fluxes and their variability; and how to transition from the initial array to a long-term sustained program. The workshop discussions were aimed at determining **what** parameters should be observed, **how** to implement the best possible observation strategies, **where** are the observations needed, and **who** will be interested in carrying them out. The workshop also aimed to foster international cooperation and coordination, which is of crucial importance to fulfill these objectives.

The first part of the workshop was dedicated to a brief review of the current knowledge of the science and the observing elements in the region. Observations and models consistently indicate that the South Atlantic is not just a passive conduit for the passage of water masses formed in other regions of the world ocean but instead actively participates in their transformation. Water mass transformations occur across the entire basin, but are more intense in regions of high mesoscale variability, particularly the Brazil/Malvinas Confluence and the Agulhas Retroflection. Models and observations also show that the South Atlantic plays a significant role in the establishment of oceanic teleconnections. Anomalies generated in the Southern Ocean, for example, are transmitted through inter-ocean exchanges to the northern basins. The Agulhas leakage influence reaches the northern hemisphere and models suggest that changes occurring in the South Atlantic alter the global MOC. These results highlight the need for sustained observations in the South Atlantic and in the choke points in the Southern Ocean, which, in conjunction with modeling efforts, would improve our understanding of the processes necessary to formulate long-term climate predictions. After the review of the current knowledge in the region, a discussion followed in which theoretical results as well as the results from the analysis of general circulation models were discussed and analyzed to determine the optimal latitude to observe the MOC in the South Atlantic.

A brief review shows that the current observational array in the South Atlantic is quite modest, except perhaps for the region of Drake Passage, where a substantial number of research and monitoring programs are in place. The workshop participants shared the observational plans for 2011 and beyond. Results are summarized in Table 1 and in Figure 1.

Preliminary international agreements for the use of resources from countries at the margins, or cruising the South Atlantic were made during the Infrastructure session. In particular, ships from Argentina, Brazil, Russia and South Africa were made tentatively available for the program. A discussion followed on the need of establishing a data sharing and data management policy.

The remaining of the workshop consisted in plenary and groups discussions that, based on the current knowledge, addressed what parameters to observe, where, how and which groups might be interested in carrying out the observations. This was followed by a discussion on the possibility of submitting joint and individual proposals to international and national agencies.

In what follows, a summary of the group discussions is presented.
Long term sustained observations are needed to estimate the net meridional heat, salt and mass fluxes in the South Atlantic. Theoretical model results on the stability of the MOC as well as analysis of numerical models were used to determine the optimal latitude to observe the MOC in the South Atlantic. Based on these model results, it is proposed to instrument and sustain a zonal trans-basin line at nominally 35°S. Together with ongoing and proposed studies in the two Southern Ocean chock points (Drake Passage and the GoodHope line) this zonal line will allow for the observation, quantification and attribution of heat, salt and mass fluxes and their changes. The main *in situ* array will consist of short moorings on and inshore of the continental shelf break, and a mixed array of tall dynamic height moorings and pressure-equipped inverted echo sounders in the interior close to both boundaries. Existing estimates of the meridional hear transport close to the southern boundary of the South Atlantic indicate that a main source of error is the lack of information on the deep western boundary current.

Activity		Dates	Institution	POC
XBT line	AX18 35°S	Quarterly	AOML/SHN	Baringer, Troisi
	AX97 22°S	Quarterly	FURG/AOML	Mata, Goni
	AX25 GoodHope line	Dec 2010, Febr. 2011	UCT/AOML	Ansorge/Garzoli
	AX22 Drake Passage (includes SADCP) RV Gould	Bi-monthly	SIO	Sprintall
CTD line	CLIVAR repeat Hydro. 30°S. CTD/LDCP, CO_2. CfC, ph, He/Tr, nutrients.	March May 2011	AOML/PMEL	Baringer
	GoodHope line. RV Vavilov	Oct-10	Shirshov/IFREMER	Gladyshev, Speich
	Cape Town-Montevideo, 40°S. RRS Discovery	October-November 2010	NOCS	Mills
	Vema Channel Session and SAM region. CTD/LDCP. RV Akademik Ioffe	Nov-10		Zavialov
	Drake Passage	Nov-10	Shirshov	Gladyshev
	Drake Passage. cDrake	November 2010 and 2011	URI/SIO	Chereskin
	Drake Passage RRS J.C.Ross	Dec-10	NOCS	King
	DIMES (west of Drake) RV James Cook	12/1/2010 and Febr. 2012	NOCS/BAS	Meredith/Naveira Garabato
	Scotia Sea & Transits - Malvinas, S. Georgia, S. Orkney, and Antarctic Peninsula SADCP, TSG. RV Vavilov	Nov. 2010 and March 2011		Gladyshev
	Orkney Passage. RRS J.C. Ross	Apr-11	BAS	Abrahamsen
Transit lines Available for Argo and XBT sections	Cape Town to Gough Island	Sep-10	UCT	Ansorge
	Cape Town to Marion Island	Apr-11	UCT	Ansorge
	Drake Passage and Antarctica Peninsula. RV Puerto Deseado	Dec. 2010 and March 2011	SHN	Troisi
	Transit Brazil-Antarctica	October and March 2010	Brazil	Garcia
	CTD/LADCP/O2/nutrients	SAM cruises	SHN	Piola
Moored Instruments	SAM. CPIES/PIES. 34.5°S South Western Atlantic		AOML/SHN	Meinen, Troisi
	GoodHope. CPIES		Ifremer	Speich
	GoodHope line. Tall moorings		AWI	
	GoodHope line PIES		AWI	Boeble
	cDrake PIES/CPIES		URI/SIO	Chereskin
	OOI		WHOI/SIO	Send

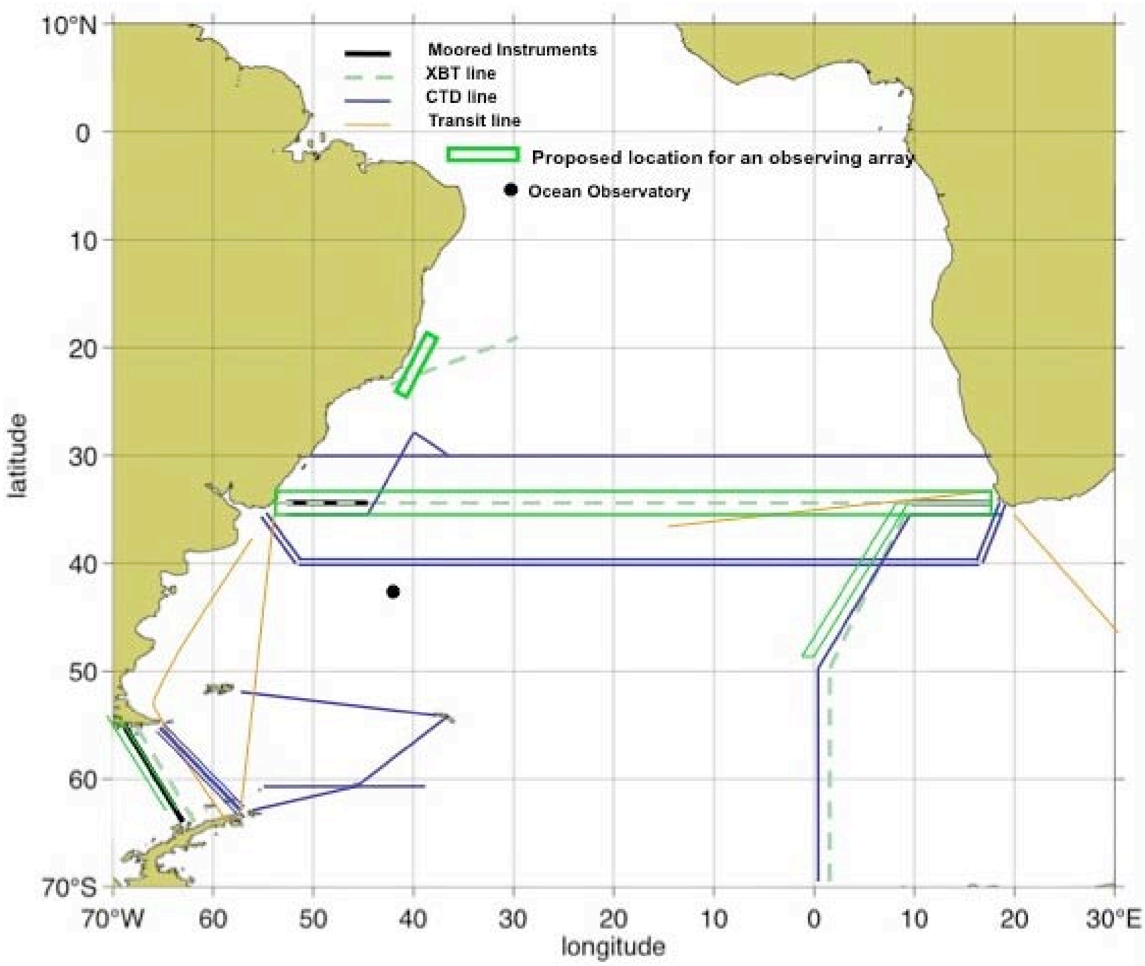

Figure: *Current plans for observations in 2010 and 2011. **Moored instruments are indicated by a solid black line** at: the Drake Passage, cDrake (US), off the South American coast, SAM (US/Argentina/Brazil), and off the coast of South Africa, GoodHope (France). Tall moorings are also deployed along the GoodHope line (Gemany). The black circle indicates the location of a planned Ocean Observatory (US).*

***Blue lines indicate CTD sections**. The line along 30°S will be occupied in 2011 as part of the CLIVAR CO_2 program. The lines along 40°S will be conducted by the UK and Brazil. CTD lines on the Drake Passage are from Russia, UK and US. The GoodHope line (Cape Town to Antarctica,), will be conducted by France and Russia, as well as the lines on the Vema channel, the SAM region, the Drake Passage, and the Scotia Sea and South Georgia. CTD sections will be also occupied twice a year on the mooring lines (Brazil, Agentina, US, Russia).**Dashed green lines indicate XBT sections**, are repeated quarterly with the exception of the GoodHope line (which is occupied twice a year during the southern Hemispheric summer) (US, Brazil, Argentina, South Africa). **Green rectangles** indicate the recommended observations: A CTD line nominally at 35°S; a line of moored instruments at the same nominal latitude; enhancement of observations PIES/CPIES along the GoodHope line up to the sub-Antarctic front; maintain an optimal distribution of instruments at cDrake. Transit lines (**Yellow lines**) are conducted every year and can be used for Argo float deployments or other observations.*

Moored instruments will be deployed with a higher spatial density near the boundaries to measure the deep water export in collaboration with existing arrays in the Drake and Good Hope passages. For the latter it is recommended to increase the number of moored observations off Cape Town and in the line towards Antarctica. Because the fate of Agulhas rings as they enter the Atlantic impacts the meridional salt transport, this component of the array should also monitor Agulhas ring shedding. Further model analysis will be used to further refine the precise number and distribution of instruments along the zonal and GoodHope lines where the existing mooring array is insufficiently dense for the monitoring purposes proposed herein. A reduced version of the C-Drake array will be deployed at the end of that program to assure the continuation of Drake Passage monitoring.

The working group on model evaluation and design studies is simulating mooring configurations, using different combinations of instruments and a variety of models, initially focusing on Ocean Circulation and Climate Advance Modeling project (OCAM) and OGCM For the Earth Simulator (OFES) and later including Estimating the Circulation and Climate of the Ocean, Phase II (ECCO2) and Nucleus for European Modeling of the Ocean (NEMO/DRAKKAR). Preliminary results from these studies based on OCCAM, POCM and OFES indicate that a nominal latitude of 35°S would be optimal (see Abstract from Perez eta al., of this report). Initially, the approach will be to determine how far into the ocean interior the boundary currents need to be measured, while the interior fluxes will be determined from thermal wind calculations. Along the boundaries attempts will be made to sub-sample the currents using density measurements, current meters, and CPIES. During the development of the virtual monitoring arrays, results will be shared with the observational group within SAMOC, to obtain feedback. To provide supporting evidence of implementing a monitoring array, we intend to publish the results in peer-reviewed journals, both for determining the optimal latitude of a monitoring array, and subsequently about simulated array designs.

The role that hydrographic observations in the region can play in support of these moored observations was also discussed. It is proposed to conduct an east-west transatlantic hydrographic survey encompassing the western and eastern boundary current array (nominally at 35°S) The analysis should include measuring heat and salt fluxes, using hydrography from ARGO floats and CTD/XBT sections, as well as from moored instruments. Cold and fresh waters enter the South Atlantic through the Drake Passage while warm and salty subtropical waters enter through the Agulhas leakage route. Both fluxes are potential contributors to the MOC upper layer return route. Full depth hydrography across the South Atlantic together with ongoing hydrographic lines south of Africa and across the Drake Passage will provide detailed information on the baroclinic meridional fluxes between the warm (Agulhas) and the cold (Drake) routes. The zonal hydrographic section will provide an assessment of the basin-wide MOC while time series will be built on the observations along the boundaries. Geochemical and biogeochemical observations (i.e. CFCs and SF6) will also be collected along the hydrographic sections on the CTD cruises that service moorings and the cross basin section to look at coherence of MOC components between source regions and SW Atlantic. The hydrographic section combined with ARGO profiles will provide the two-dimensional temperature and salinity distribution across the South Atlantic, necessary for calculating the meridional heat and salinity fluxes (MOV). It is expected that combining these observations with those obtained at the choke points will aid in the evaluation of the contribution from each route and their associated variability. Furthermore, this newly collected data will provide an opportunity to understand the role of biogeochemical processes across the South Atlantic and their importance in a changing climate. Currently observations of this region are very limited and this program seeks to address this gap.

A SAMOC Data Management Plan will be developed that describes the management of data and metadata data within the SAMOC Program. The Data Management Plan will include best practice policy that assures data quality and perpetual archive availability. In addition, a data exchange policy will be implemented. This policy embodies the principles expressed in the IOC Oceanographic Data Exchange Policy, similar policies of the World Meteorological Organization, and yet assures that scientist's rights to their own data are protected. The primary aim of the SAMOC data policy is to enable access to SAMOC data in order to maximize their exploitation. The data management plan will include mechanisms to ensure that the data distributed are of uniformly high quality, distributed to enable applications that require data on short and long timescales, and is archived to enable ready access to the data. The data management plan will include all the data, and associated metadata, collected within the program and will include the disposition of the data into a Data Center that is expected to require funding for the archival and distribution of the data.

Abstracts of the presentations

The Indian Atlantic connection. Results from the GoodHope (France, South Africa, Russia, US)

Results from the GoodHope International Project

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The overturning circulation and horizontal fluxes of heat and freshwater in the South Atlantic Ocean are fundamental controls on planetary climate. They are potentially at least as important on a global scale as those in the North Atlantic, to which they are strongly coupled. The South Atlantic Ocean is unique in its role as a nexus for water masses formed elsewhere and en-route to remote regions of the global ocean.

In particular, South of Africa, the Southern Ocean (SO) provides the export channel for North Atlantic Deep Water (NADW) to the global ocean and the passage for heat and salt from the Indian and Pacific oceans. This region is influenced by the largest turbulence observed in the ocean. The eastward flowing ACC, the South Atlantic Current and NADW meet with the westward flow of Indian waters carried by the Agulhas Current, leading to water masses exchanges through jets, meanders, vortices, and filaments interactions. These local mesoscale and submesoscale interactions and the derived meridional fluxes might constitute the major link between the Southern Ocean and the Meridional Overturning Circulation (MOC). At the same time, mixing and air-sea interactions are responsible for significant water masses properties modifications. Mounting evidence from palaeoceanographic and modelling studies suggest that interocean exchanges south of Africa are drivers of global climate change. For example, through their southern influence on the AMOC, changes in the flux of warm, salty waters from the Indian Ocean may have triggered the end of ice ages, as well as effecting shorter-term climate variability. Yet, owing to the relative isolation of the region from the US and Europe, few modern observations time series existed in this sector of the global ocean before 2004. This was the main reason to foster an international cooperation to monitor regularly this oceanic sector. The project has been named GoodHope by the Cape of Good Hope. The international partnership is gathering together means (in terms of human, observing platforms, ship time and general financial support) from 11 different institutions and six countries (France, South Africa, United States, Germany, Russia and Spain). The project has been approved in 2003 by the International CLIVAR panel and endorsed by SCAR[1] and CliC[2].

The GoodHope experiment includes conductivity– temperature–depth (CTD) measurements (five realizations performed by the Shirshov Institute of Moscow, and a French multidisciplinary one, BONUS-GoodHope, achieved in early 2008 in the framework of the International Polar Year), geochemical tracer samplings, and expendable bathythermograph (XBT) measurements on the same and separate cruises. A part of the GoodHope section was designed to follow a groundtrack of the JASON satellite, with the aim of joining hydrographic and altimetric data analyses. ARGO floats launched during these cruises furthermore provide year-round hydrographic information on the region. A first description of water masses and full depth transport observations along the GoodHope transect in late 2004 can be found in Gladyshev et al. (2008). Since it starts, GoodHope has been one of the major projects in improving the data coverage of the Southern Ocean in terms of number of available monthly profiles.

With the relatively important number of full-depth hydrographic cruises, of high resolution XBT sampling, of deployed profiling floats and satellite altimetry in complement with numerical simulation analyses we have been able improve quantitatively the knowledge on regional dynamics and water properties exchanged south of Africa. In particular we have been able to characterize the regional mesoscale dynamics that has a major role in zonal and meridional exchanges. We have redefined the route undertaken by Indian waters to the South Atlantic (Speich et al. 2006; 2007; Speich and Arhan 2007; Doglioli et al. 2006; 2007; Dencausse et al. 2010 a, b and c); we were able to quantify the regional dynamics and variability of the ACC for the upper 2500 layers (Ansorge et al. 2004; Legeais et al. 2005; Swart et al. 2008; 2010 and Swart and Speich 2010) as well as refine the mesoscale structure of deep and bottoms waters

[1] SCAR : Scientific Committee on Antarctic Research (http://www.scar.org/)
[2] CliC : Climate and Cryosphere (CliC) Project (http://clic.npolar.no/)

flows (Gladyshev et al. 2008; Chever et al. 2010). Ongoing analyses of *in situ* and satellite data and of numerical simulations are coming up with better estimates of air-sea exchanges, the regional mixing layer dynamics and intermediate waters ventilation. The data collected during the 6 years of the GoodHope project and their analyses have led not only to an unprecedented qualification and quantification of regional dynamical processes. They have also concretized the first portion of (we hope) a long regional time-series that is used for monitoring variability and changes.

With the improved knowledge on the regional ocean dynamics we are now able to improve the monitoring design of GoodHope. In particular we suggest the deployment of a relatively dense network of bottom moorings such as the Current Pressure Inverted Echo Sounders (C-PIES) along the subtropical-subantarctic portion of the GoodHope line and, if possible, to extend it to the AX21 zonal line. Two of such moorings have been deployed in 2008 by Ifremer (France). Two additional ones will be deployed end 2011. The optimal number of additional moorings required to fulfil the monitoring objectives will be evaluated from combined analyses of high resolution models outputs and observations. Funding for the additional moorings will be seeked at national level within a coupled NSF (USA) and ANR (France) proposal. This network will be able to improve the regional deep and bottom layers sampling as well as that of the upper to intermediate layers whose properties structure is by far more complex in the subtropics and subantarctic portion of the GoodHope line than in the ACC. This way, by a coordination of the observing efforts within Drake Passage, the improved GoodHope monitoring effort and the zonal nominal line at 34°S in the South Atlantic with the related bottom moorings networks such as proposed within the South Atlantic MOC consortium (Garzoli et al. 2008; Speich et al 2010).

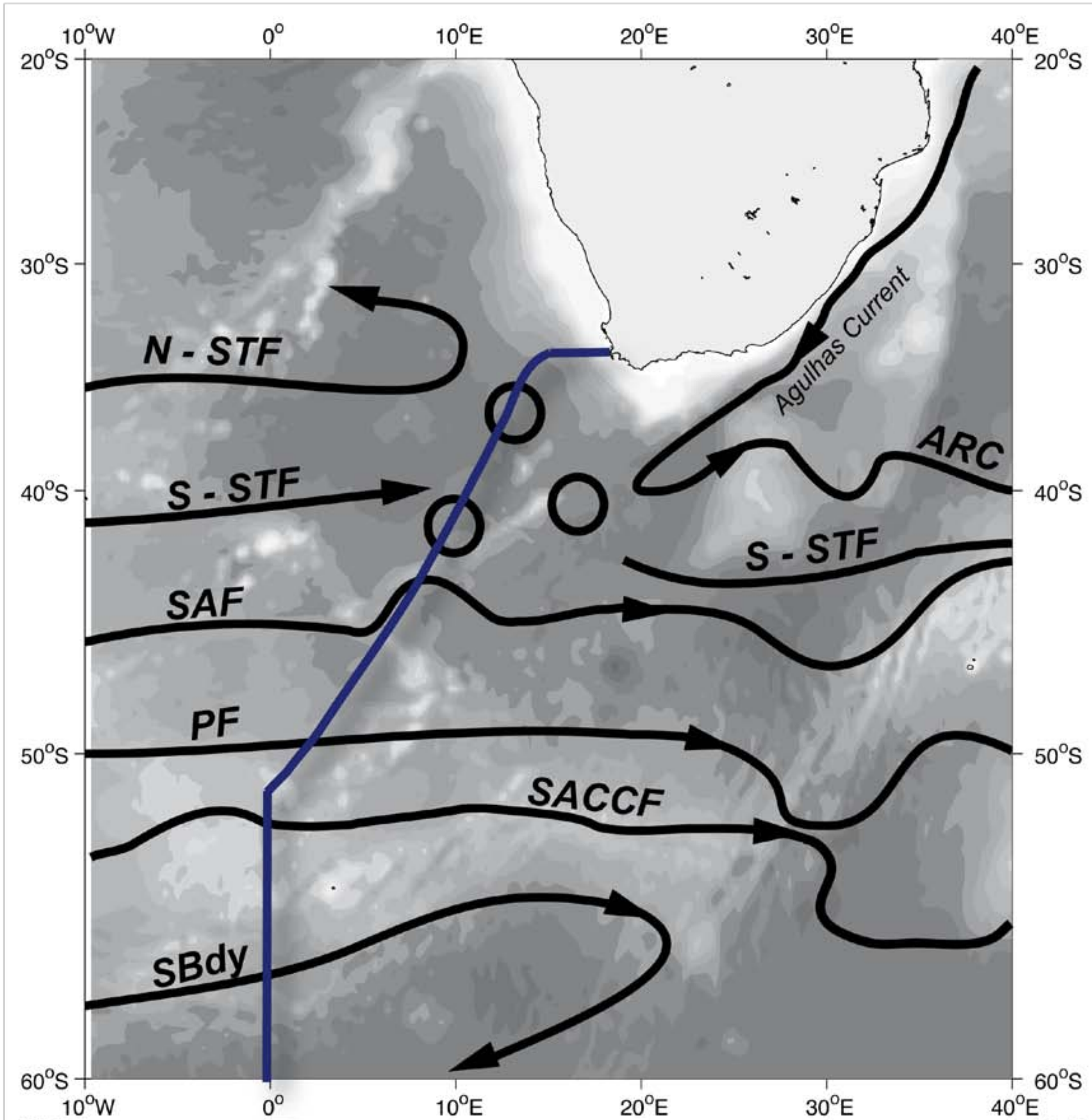


Figure: ***GoodHope figure caption:*** *Map showing the GoodHope cruise track, bathymetry, and the regional dynamics represented by the South Indian Western Boundary Current system, the Agulhas Current, its Retroflection and the Agulhas Return Current (ARC) as well as the Antarctic Circumpolar Current (ACC) fronts. The latter are referenced as N-STF (Northern Subtropical Front), S-STF (Southern Subtropical Front), SAF (Subantarctic Front), PF (Polar Front), SACCF (Southern ACC Front), and Southern Boundary of the ACC (SBdy). In the figure the locations of these fronts as determined from the criteria summarized in Orsi et al. (1995) and the satellite altimetry.*

Pacific-Atlantic InterOcean Exchanges: Drake Passage Programs

Janet Sprintall, Scripps Institution of Oceanography, UCSD

Drake Passage provides the Pacific-Atlantic connection for the Antarctic Circumpolar Current (ACC) that forms the "cold water" route for the thermohaline circulation. The ACC transports large quantities of mass, heat, and salt through the Drake into the South Atlantic where upper-ocean processes and air-sea fluxes transform the ACC surface water by changing its density, thus shaping the characteristic properties of water masses that contribute to the meridional overturning circulation. The Drake Passage has long provided a convenient chokepoint to observe and study the ACC in the Southern Ocean. Over the past decade or so, underway *in situ* measurements within Drake Passage from XBT, XCTD and ADCP instrumentation, along with concurrent shipboard meteorological and pCO2 sampling, have been relatively routinely acquired aboard the U.S. Antarctic Supply and Research Vessel, the R/V *Laurence M. Gould* (LMG). The LMG is the principal supply ship for the U.S. base of Palmer Station, Antarctica, and crosses Drake Passage on average twice a month, thus providing concurrent air-sea along-track measurements at high temporal and spatial resolution on a near year-round basis. There are significant benefits and synergy of air-sea observations when they are measured at similar time and space scales from the same platform. The multi-year high-resolution measurements have been used to examine seasonal and spatial variability in upper ocean eddy heat and momentum fluxes, diapycnal eddy diffusivities, mixed layer depth, and variability in the Polar Front location. Long-term trends in Drake Passage observations of upper ocean temperature, CO2 concentration, winds, and shifts in the Polar Front are related to large-scale climate phenomena such as the Southern Annular Mode. The comprehensive suite of air-sea LMG measurements have enabled one of the few data-based evaluations of the air-sea heat fluxes in the Southern Ocean. Improving model uncertainty of the Pacific-Atlantic interocean exchange through Drake Passage by validation with the shipboard upper ocean observations should enhance our physical understanding of the circulation and water mass transformation in the South Atlantic, and ultimately its role in the meridional overturning circulation and global climate.

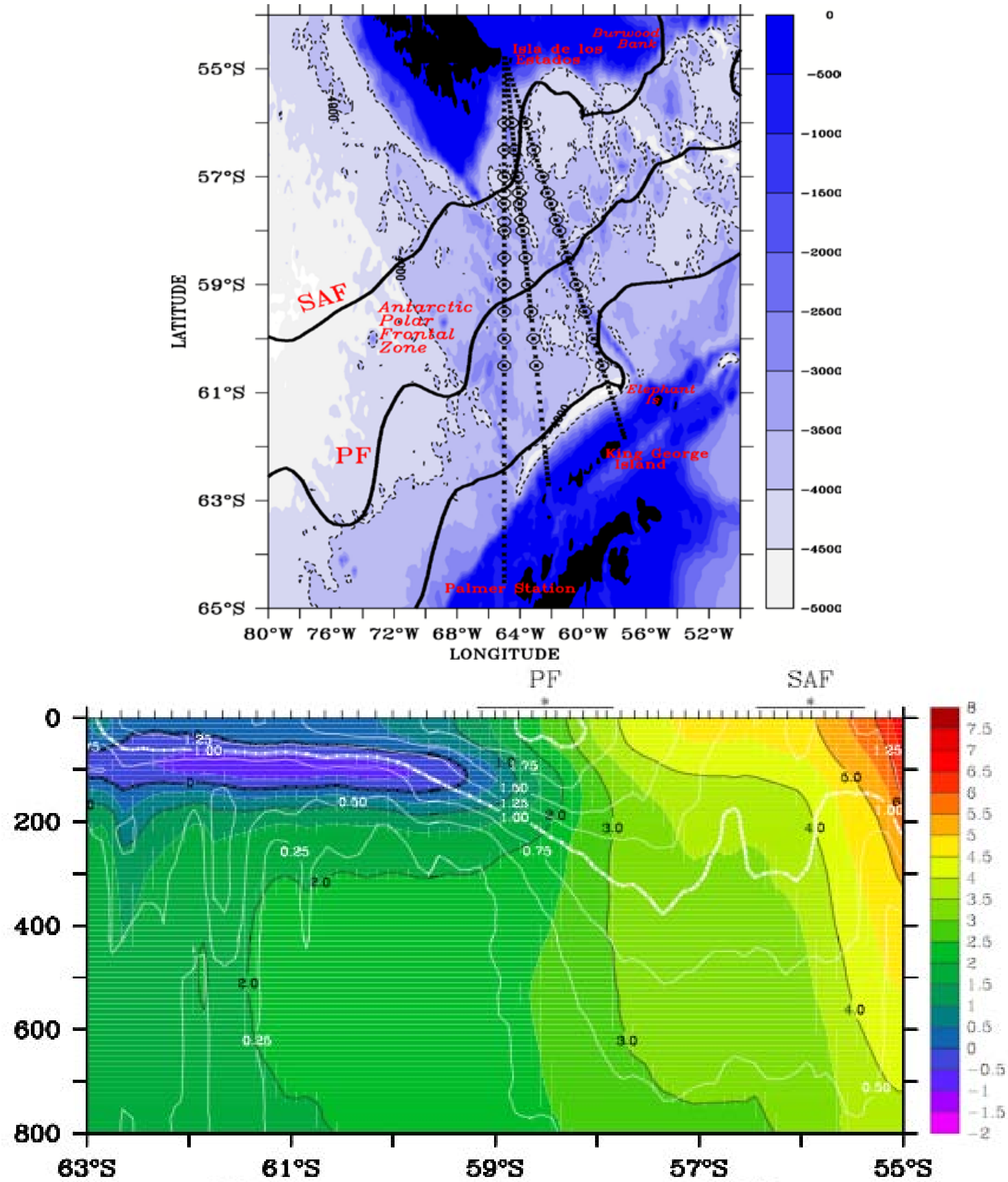


Figure: *Bathymetry and frontal locations (Orsi et al., 1995) in Drake Passage, indicating the location of the XBT (crosses) and XCTD (circles) casts on the three main tracks that the LMG follows when crossing Drake Passage (top panel). Mean (colors) and standard deviation (white contours) of temperature from 14 years of XBT measurements in Drake Passage (bottom panel). The mean and standard deviation of the Polar Front (PF) and Subantarctic Front (SAF) are also indicated on the top axis*

The Atlantic Meridional Overturning Circulation: Heat Transport, Variability and Watermass Transformations in the South Atlantic

Molly Baringer (AOML) Shenfu Dong (CIMAS, AOML) Silvia Garzoli (AOML) Gustavo Goni (AOML) Christopher Meinen (AOML) Ricardo Matano (OSU) Alberto Piola (SHN) Sabrina Speich (LBO, UBO) Ariel Troisi (SHN)

This presentation outlined ongoing work at AOML to study the heat transport and water mass conversions in the South Atlantic and the resulting associated strength of the meridional overturning circulation. Studies have shown that there are quantitatively significant water mass conversions within the SA and that these conversions are mostly concentrated in regions of intense mesoscale variability such as the southwestern Atlantic or the Cape Basin; conversion from surface and deep waters into intermediate waters in the southwestern Atlantic and from intermediate into surface waters in the Cape Basin region (Sloyan and Rintoul,2001, Piola et al). Near the tropics there is a net conversion of intermediate into surface waters.

The South Atlantic is the pulse for the SO; analysis of SSH and wind stress curl shows that the variability in the SA is related to the forcing in the Pacific and Indian Ocean. This is the component of the variability that is related to AMOC.

Ongojng studies at AOML on the heat budget and the role of inter-ocean exchanges in northward heat transport and air-sea heat flux has shown that the strength of the AMOC is significantly correlated with the northward heat transport across AX18 (~35S). A one Sverdrup increase in the AMOC would give a 0.06 PW increase in the northward heat transport. The heat transport is largely controlled by the geostrophic transport variability. Ekman transport contributes only 9% of the on average, however, it accounts for 22% of the total northward heat transport. Both the heat transport and AMOC contain Ekman and geostrophic components with large annual cycles. The annual cyrcles are out of phase and hence lead to a relatively reduced overall annual cycle. The seasonal cycles in geostrophic and Ekman components are consistent with the seasonal variations in wind stress curl and zonal wind stress, respectively.

Considering the enclosed “box” of the South Atlantic, we found that since the 1980’s the Surface Hest Fluxes decreasing, while the heat tendency in the “box” has remained constant. The OFES model suggests an increase in the northward heat transport across 35°S from 1980 to 2006. The increasing trend in the northward heat transport is likely due to the increase in Agulhas leakage into the South Atlantic. One possible explanation for the increase in the transport of the Antarctic Circumpolar Current is the increase in wind stress, as the Southern Annual Mode strengthens and shifts southward. Data such as the surface velocity from drifters and altimetry illustrates the strengthening Brazil Current moving southward and the complicated circulation south of 40°S, confirming this gyre redistribution.

Baringer and Garzoli (2007) demonstrated the critical need for DWBC observations to reduce uncertainties in meridional heat transport estimates at 35°S. Western boundary observations are a collaboration between the USA, Argentina, and Brazil. A parallel project is going on at the eastern boundary (Good Hope) as a collaboration between France and South Africa (see Speich et al presentation IT53D-06 on Friday afternoon). The initial deployment of three pressure-equipped inverted echo sounders (PIES) and one current and pressure equipped inverted echo sounder (CPIES) took place in March 2009 from the Brazilian Navy research vessel Cruzeiro do Sul. Hydrographic data was collected on both cruises. The first download of data from the PIES and CPIES was done in August 2009 via the Argentine research vessel Puerto Deseado. Previous studies have been ambiguous regarding how much of the Deep Western Boundary Current (DWBC) exists along the coast at this latitude versus having shifted offshore to the North. Results from the first 3-5 months of data from the SAM array suggest that there is a mean southward flow along the coast, however the time variability is quite strong and it is too early to say for certain that a mean DWBC is observed here. The data has shown: mean absolute southward flow across whole array just over -2 Sv, large variability with a minimum value just over -40 Sv. and baroclinic transport relative to 800 dbar has a factor of 3 smaller variability than the absolute transport.

The larger variance of the absolute transports compared to the transports relative to an assumed level of no motion confirms the importance of barotropic variations on the western boundary when calculating meridional heat fluxes basin-wide. Preliminary analysis of the PIES/CPIES data from March-August 2009 suggests that there is a non-trivial mean southward flow of around 6 Sv at 34.5°S potentially associated with the Deep Western Boundary Current.

MOC related activities at National Oceanography Centre Southampton

Joel Hirschi, Elaine McDonagh, Gerard McCarthy, Adam Blaker, Steve Alderson, Andrew Coward, Beverly de Cuevas.

The idea of the first part of the talk is to spark a discussion about why we actually want an observing system in the South Atlantic, i.e. what are the main science questions that such a system would help to answer? An example could be the tropical/subtropical Atlantic heat budget that could be better constrained by having continuous observations from both the RAPID array at 26°N and the new system at 25°S/32°S.

Brian's and Gerard McCarthy's hydrography results based on Argo observations in the South Atlantic highlight the presence of a large interannual variability. This variability is in fact as large as the differences found between hydrographic sections taken almost 10 years apart. This illustrates that, as in the North Atlantic, continuous observations are needed if we want to understand the spatial and temporal variability structure in the South Atlantic.

One question relevant to SAMOC is to understand to what extent MOC observations at different latitudes in the South Atlantic are likely to be effected by eddy activity. Especially at 32°S, which is one of the proposed latitudes for the SAMOC observing system eddy activity is high. The potential imprint of eddies on the MOC has been assessed by using output from an eddy-permitting 1/4° global ocean model forced with realistic surface fluxes for the 1958 to 2001 period. The model run consists of two passes through the 1958 to 2001 forcing. After an initial model adjustment with strong drifts in the beginning of the first pass the model reaches a quasi steady-state. The 1976 to 2001 period of each pass is used to extract the imprint of internal waves and eddies on the meridional overturning circulation (MOC). The surface forcing being identical the main difference between both passes is the state of the eddy and internal wave field. The exact formation time of eddies and to a lesser extent also of internal waves is determined by the initial conditions which are different in the two passes of the model run. Therefore, the instantaneous differences between passes 1 and 2 are largely due to different eddy and internal wave fields. These project onto the MOC and lead to differences of several Sv between the subannual to interannual MOC variability with an amplitude of about one third of the total MOC variability. The model results suggest that amplitude of the eddy/internal wave imprint on the MOC is similar at 25°S and 32°S, despite the higher eddy activity for the latter latitude (Figure 1).

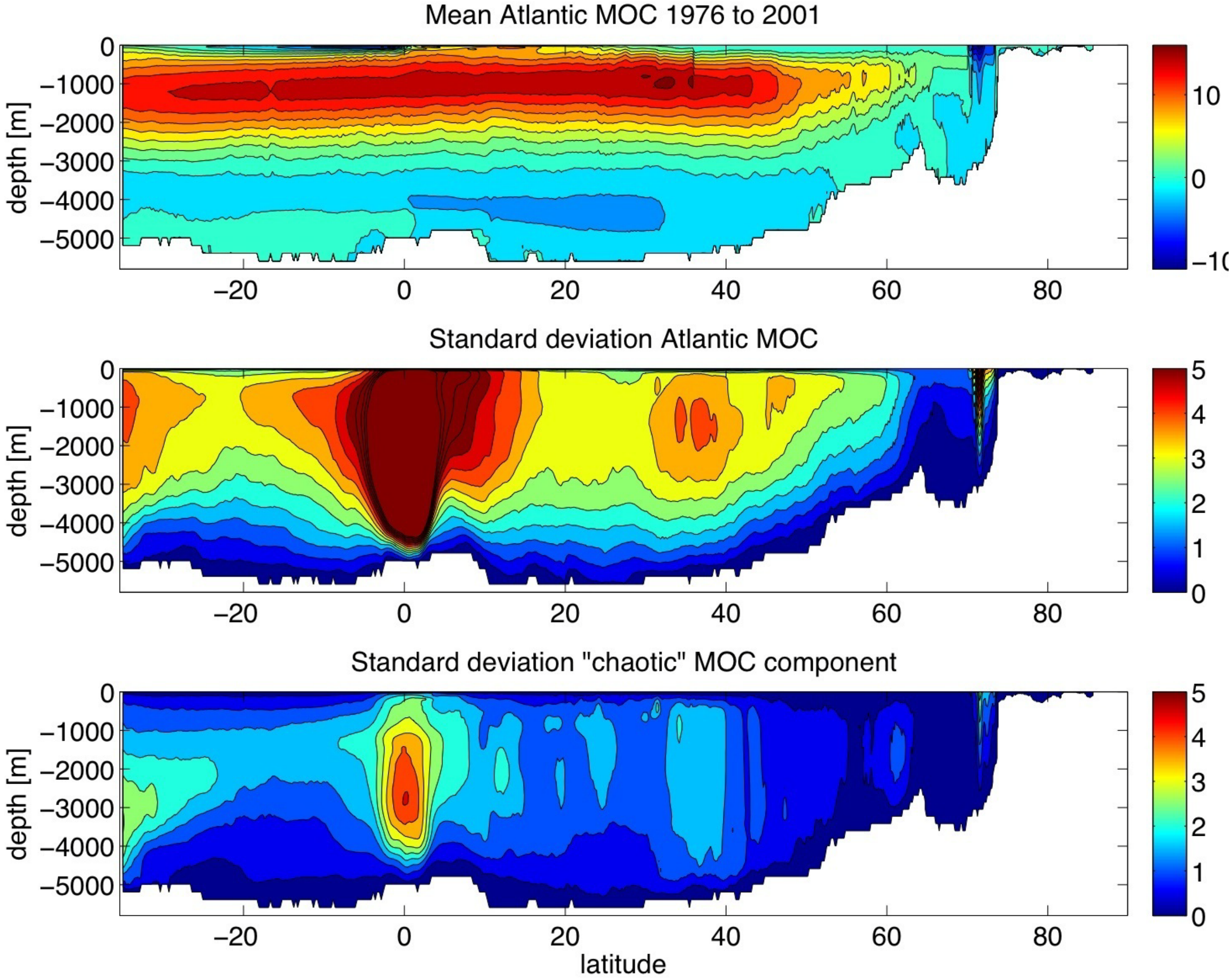
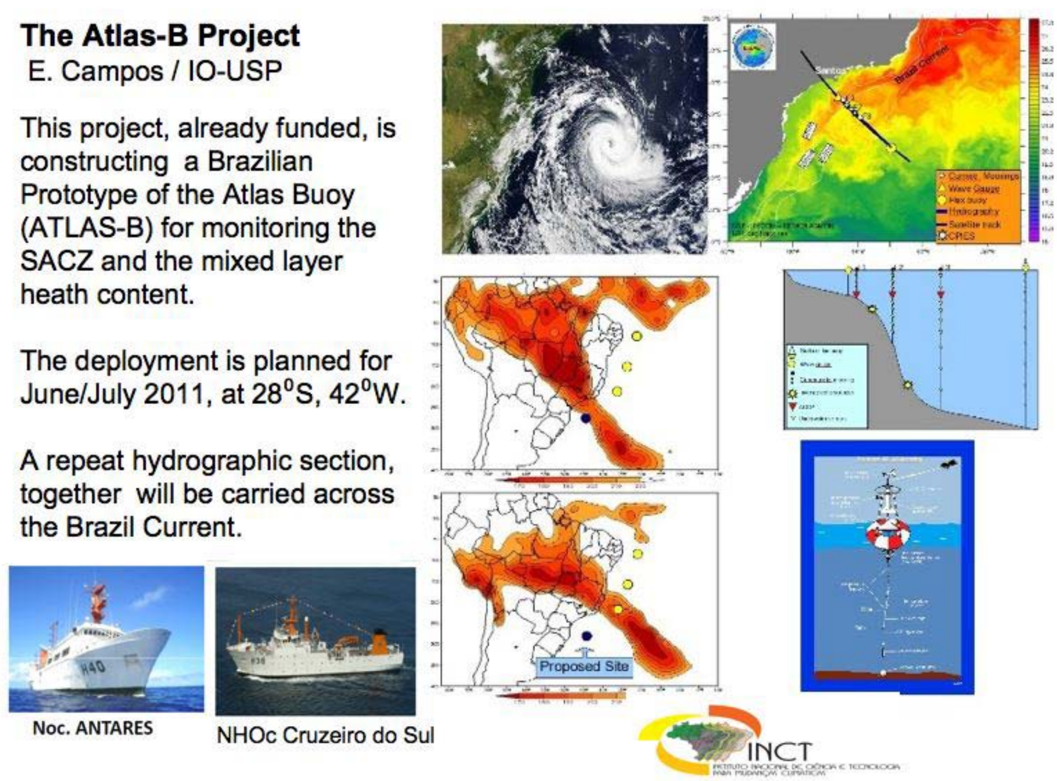


Figure: *Top) Mean Atlantic MOC in the 1/4° NEMO model. Units are Sv and the contour interval is 2 Sv. Middle) Standard deviation obtained from 5-day Atlantic MOC averages for the 1976 to 2001 period. The contour interval is 0.5 Sv. Bottom) Standard deviation of the "chaotic" Atlantic MOC variabilty (mainly due to eddies and internal waves). The contour interval is 0.5 Sv.*

Brazilian Modeling and Observational Projects

Edmo Campos, IO-USP

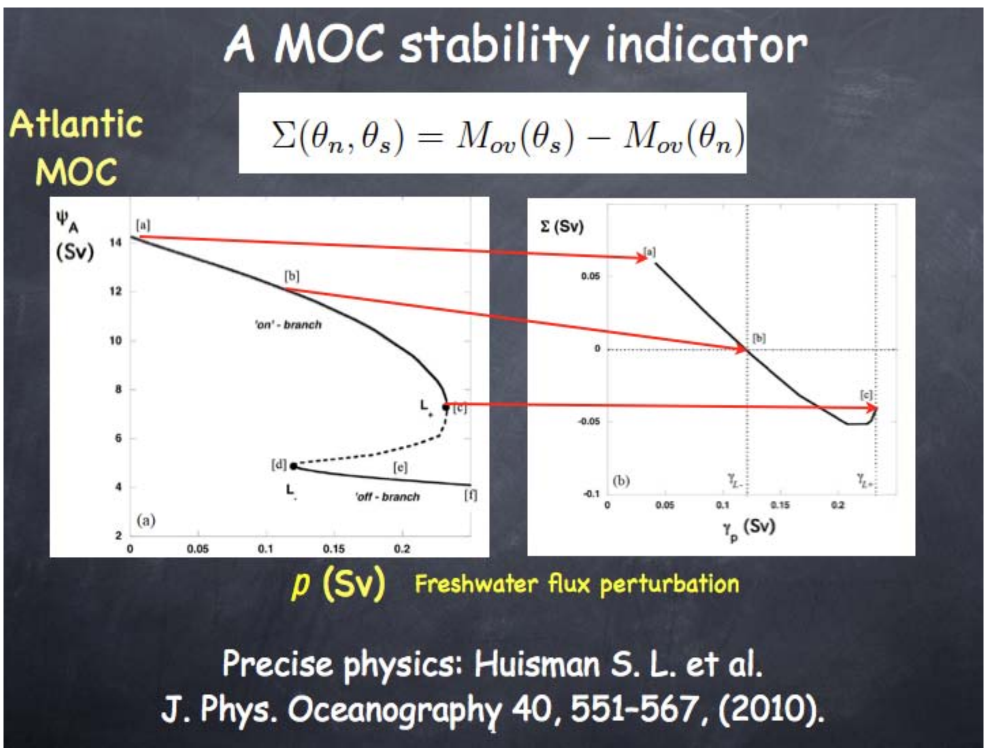
The South Atlantic Covergence Zone (SACZ) plays a key role in South American climate, its variability and change. Model experiments show a consistent air-sea coupling associated with the SACZ variability, although the lack of observations of both ocean and atmospheric conditions over the southwestern Atlantic has limited the understanding of such interaction. It is therefore expected that a moored platform for observation of the air and surface and subsurface ocean conditions over the SW Atlantic will help validate and improve climate models, provide data required for prediction purposes, and for climate variability and climate change monitoring. The PIRATA backbone and its southwest extension, off Brazil, are located to the north of the region of high precipitation associated to the SACZ. Thus, as part of a Brazilian funded project, an ATLAS-type buoy is being built, in cooperation with NOAA/PMEL, for deployment near 28S,43W. The new site will complement the PIRATA southwestern extension and provide the much needed information necessary to better understand the role of sea-air interactions and vertical mixing at the base of the ocean mixed layer.



A scalar indicator of the stability of the Atlantic Meridional Overturning Circulation

H.A. Dijkstra

Recent model results (Huisman et al. J. Phys. Oceanography, 40, 551-567, 2010) have suggested that there may exist a scalar indicator Σ monitoring whether the Atlantic meridional overturning circulation (MOC) is in a multiple equilibrium regime or not. The indicator Σ is based on the net freshwater transport by the MOC into the Atlantic basin, which is dominated by the contribution at 35 S. Σ changes sign as soon as the steady Atlantic MOC enters the multiple equilibrium regime due to an increased freshwater input in the northern North Atlantic. Changes in the Atlantic freshwater budget over a complete bifurcation diagram and in finite amplitude perturbation experiments are presented for a global ocean circulation model. We show that the net anomalous freshwater transport into/out of the Atlantic due to the interactions of the velocity perturbations and salinity background field is coupled to the background (steady-state) state freshwater budget. The sign of Σ precisely shows whether this net anomalous freshwater transport is stabilizing or destabilizing the MOC and therefore indicates whether the MOC is in a single or multiple equilibrium regime.



Why 35S is the best location to monitor the stability of the thermohaline circulation

Sybren Drijfhout

The convergence of the salt transport by the Meridional Overturning Circulation (MOC) in the Atlantic basin, or Mov, determines the sign of the salt advection feedback that operates on the Thermohaline Circulation (THC). Convergence amplifies a salinity anomaly when excess freshwater acts to reduce convection and the MOC/THC. Divergence damps such anomalies. In many parts of the Atlantic Mov is divergent, but south of the deep convection sites, between 40N and 60N, it is strongly convergent. At first sight it seems natural the monitor Mov in this region. But despite the strongly amplifying feedback on salinity anomalies by this, the stability of the THC is not affected by Mov at these latitudes, as the resulting salt advection feedback is coupled to a lagging damping feedback, leading to oscillations. The damping feedback is provided by either the Zonal Overturning Circulation, or the subpolar gyre, or transport from the Arctic. A second region of convergent Mov occurs near the southern boundary of the Atlantic, but the feedback associated with the local convergence is again counteracted by a lagged response of the gyre. The much weaker, basin-scale divergence/convergence of Mov, however, is not associated with a lagged response of opposite sign. Therefore, a basin-scale convergence of Mov may lead to amplification of subpolar freshwater anomalies. Its convergence controls the strength of the more local feedbacks associated with oscillations. Because Mov in the very north is weak, the basin-scale convergence of Mov is approximately equal to its sign at the southern boundary of the Atlantic, say 35S. If salt transport is northward there, the THC has multiple equilibria, if it is southward only the thermally driven branch (on-state) exists.

A second argument to monitor the THC at 35S stems from the existence of a monitoring array at 26N, and the fact that shorter timescale MOC-variability is uncorrelated at 35S and 26N, while the Atlantic Multidecadal Oscillation and anthropogenic trends do correlate over the whole basin, leading to a significantly increased signal-to-noise ratio when having two monitoring arrays situated in two different hemispheres, being beneficial for decadal prediction initialization and detecting abrupt change.

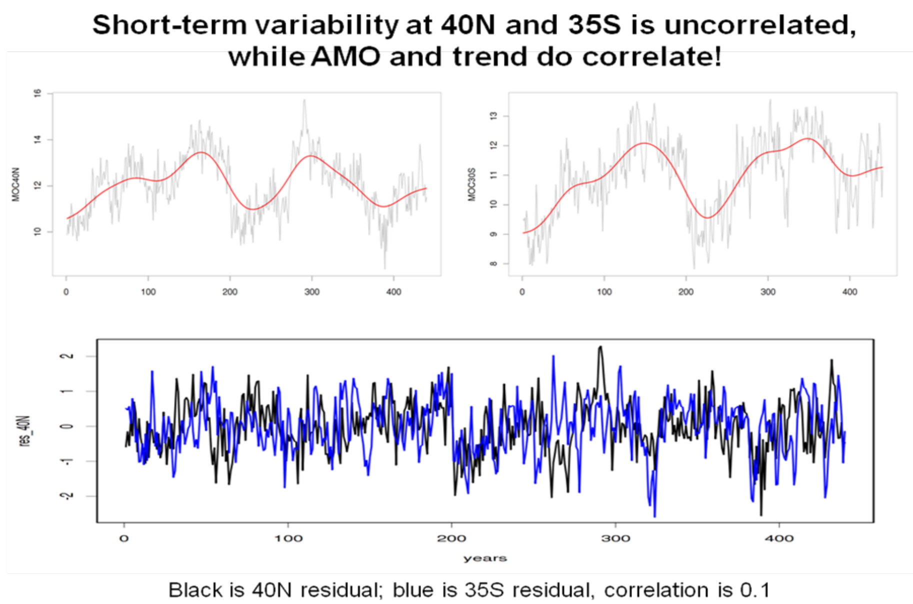


Figure: *The figure shows that the short-term variability at 40N and 35S is uncorrelated, while AMO and trend do correlate. Black is 40N residual, blue is 35S residual, correlation is 0.1*

Design and testing of a monitoring array of the Meridional Overturning Circulation (MOC) in the South Atlantic

Renellys C. Perez (UM/CIMAS), Silvia L. Garzoli (NOAA/AOML), Ricardo P. Matano (OSU/COAS), Christopher S. Meinen (NOAA/AOML)

A multi-model analysis was conducted to determine the optimal location and minimum requirements for a monitoring system designed to measure components of the MOC in the South Atlantic Ocean. The work evaluated the MOC as reproduced in two high-resolution (eddy permitting to eddy resolving) ocean general circulation models chosen for their skill at simulating boundary currents in the South Atlantic. The ocean models analyzed are the Parallel Ocean Circulation Model (POCM), and the Ocean general circulation model For the Earth Simulator (OFES). The ability to reconstruct the MOC signal from an array of density profiles (either from direct temperature and salinity measurements or estimated from inverted echo sounders), bottom current measurements, and Ekman transports was evaluated at five latitudes, 15S, 20S, 25S, 30S, and 34.5S. The two types of arrays are referred to as T, S array and CPIES array. Preliminary analysis was presented at the SAMOC3 workshop in Niteroi, Rio de Janeiro, Brazil on May 11-13, 2010.

We found that a T, S array can be effectively used to reconstruct the MOC at all five latitudes with a slight preference towards high latitudes (blue lines in Figure 1). The skill of the CPIES array was modest from 15S to 25S, but increased significantly towards high latitudes (red lines in Figure 1). Meridional heat transport was strongly correlated with the MOC in these simulations consistent with previous observations by Dong et al. (2009). As a result, these geostrophic-type arrays were also successful at reconstructing meridional heat transport. Based on our analysis (and analysis by modeling groups in UK/Southampton and KNMI), a nominal latitude of 34.5S was selected for the main in situ array. A reduced T, S array or CPIES array with approximately 20 instruments deployed along 34.5S can reproduce the temporal evolution of the MOC and the time-mean of vertically-integrated volume transport within the two simulations. Hence, some components of the pilot array deployed along 34.5S can be effectively incorporated into a South Atlantic MOC monitoring array.

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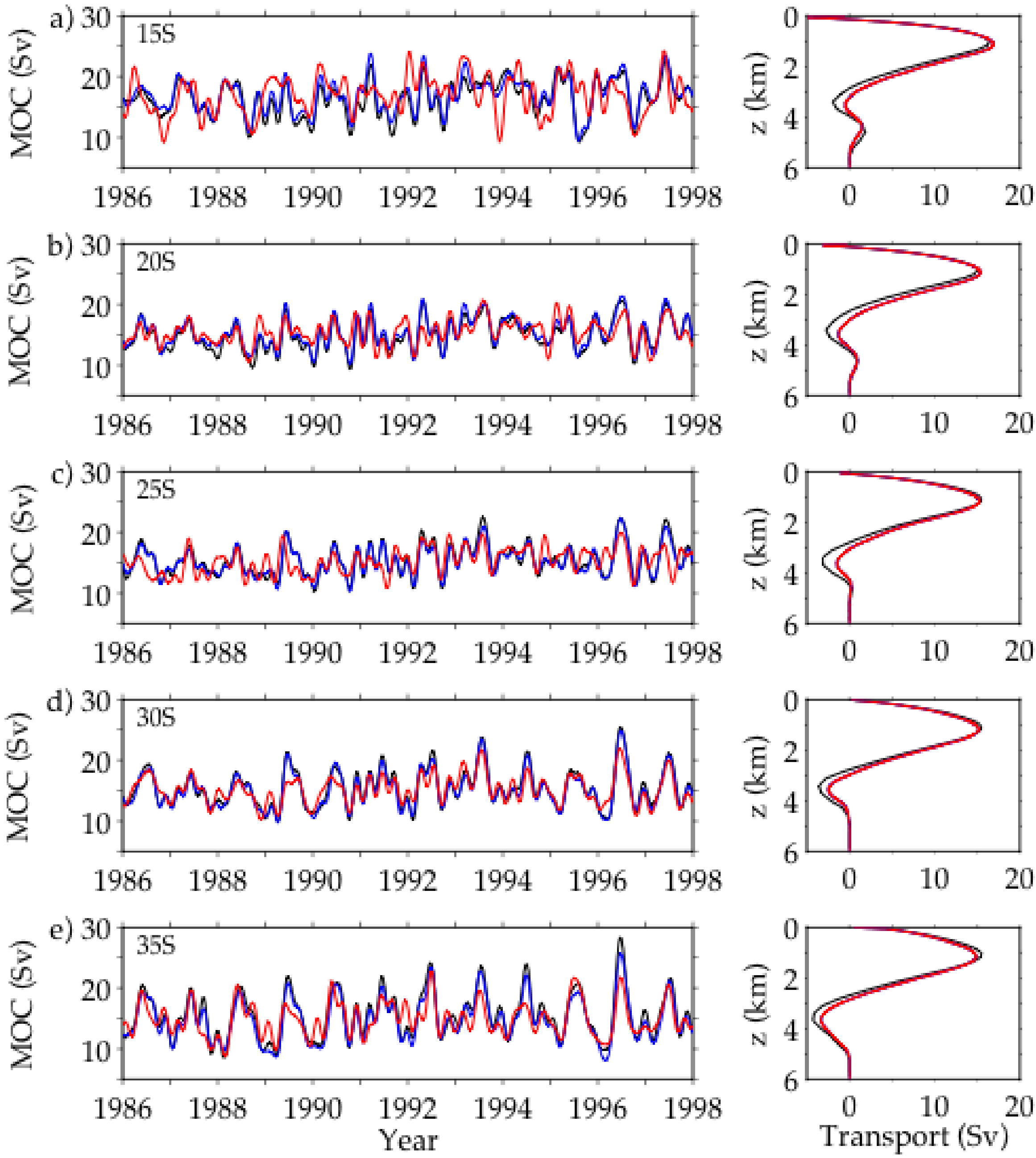


Figure: *Right panels: Reconstruction of the OFES MOC signal (black) with a perfect array of direct T, S measurements (blue) vs. a perfect array of CPIES (red) at 15S, 20S, 25S, 30S, 35S. Left panels: time-mean of vertically-integrated volume transport.*

Measuring the South Atlantic MOC - in the OCCAM ocean model

Povl Abrahamsen (BAS), Joel Hirschi (NOCS), Emily Shuckburgh (BAS), Elaine McDonagh (NOCS), Mike Meredith (BAS), Bob Marsh (NOCS)

We used output from the OCCAM ocean model at both 1/4-degree and 1/12-degree resolution, to attempt to reconstruct the MOC in the South Atlantic Ocean at latitudes ranging from 15 to 35 degrees S. We extracted densities from the model output fields to simulate having temperature/salinity measurements on moorings on a zonal section, and calculated geostrophic currents as well as Ekman currents from the wind stress, corrected to ensure there is no net flow through the section. The resulting time series of maximum overturning was compared with values calculated directly from the model velocities. When filtered to remove fluctuations on timescales shorter than 1 year, the reconstructions reproduced the variability in the original time series well, with an offset close to the external mode (the baroclinic residual current from barotropic currents, resulting from variations in bottom depth across the section). Excellent correlations were found at 15 deg. S, where much of the variability can be reconstructed from measurements near the western boundary, indicating that a relatively small mooring array may be able to monitor much of the MOC variability at this latitude. However, at the higher latitudes that are more of interest to us, the best correlations were found at 32 deg. S. Our next steps will be to reduce the number of profiles used for our calculations, to more accurately reflect a viable mooring array in the South Atlantic, and investigate the importance of including directly measured currents in the western boundary to help improve our results.

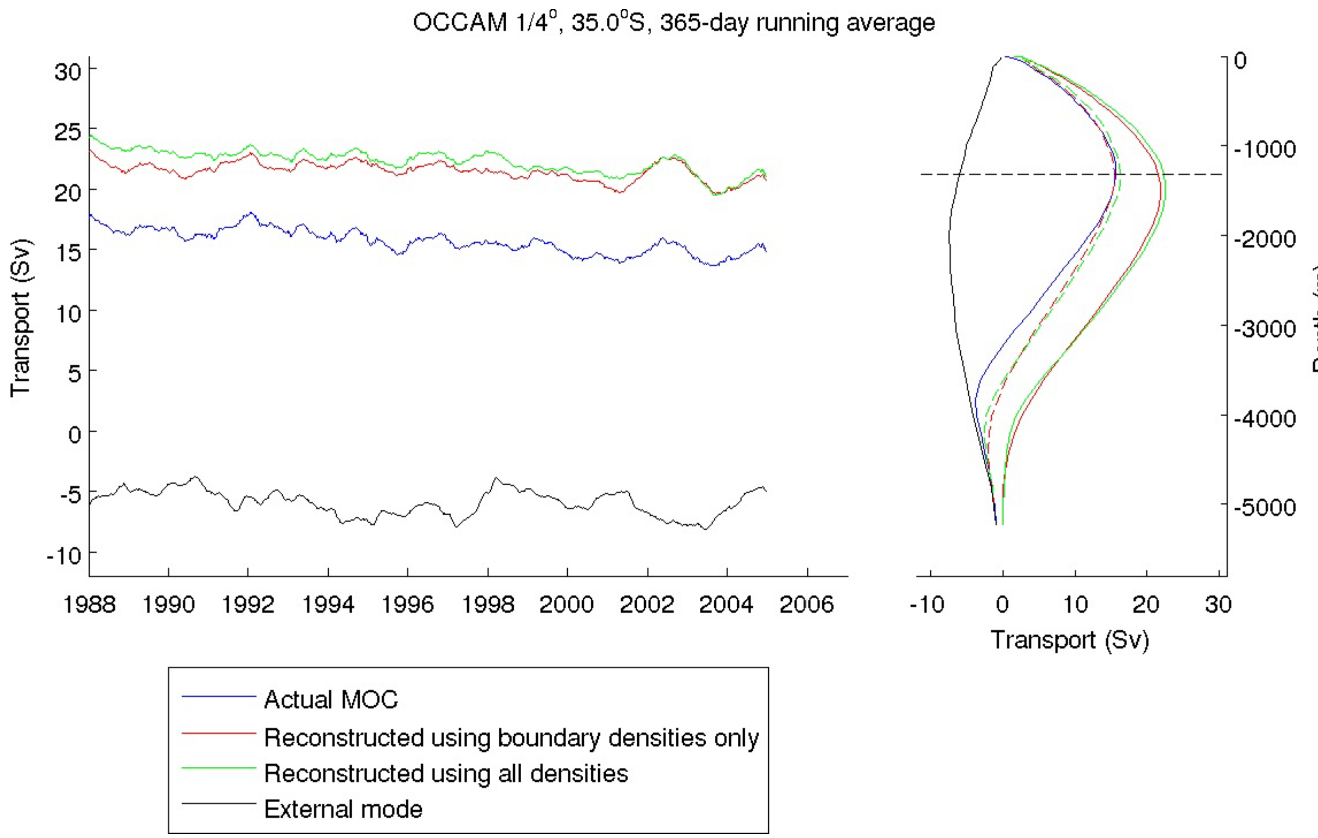


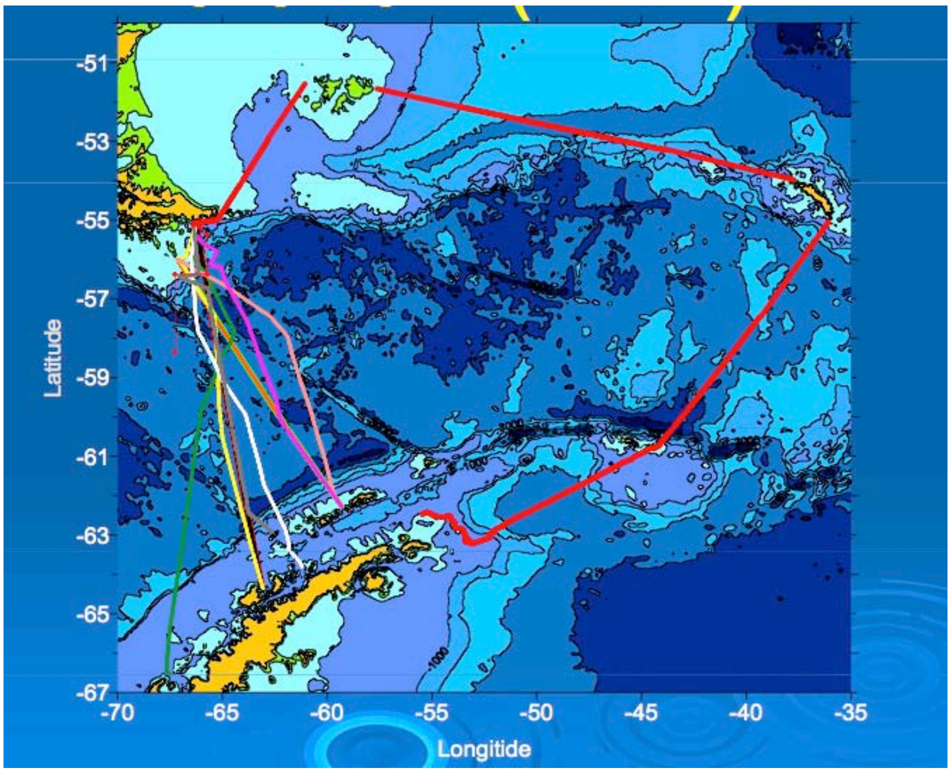
Figure: *MOC measured at 35 deg. S, from the 1/4-degree OCCAM model. Here the computed MOC time series from the velocity field (blue) is compared with reconstructions computed from densities at all interior points (green) and from the extreme eastern and western boundaries only (red). The external mode (baroclinic residual from barotropic currents) is plotted in black.*

Russian field program in the South Atlantic in 2009 – 2010

Sergey Gladyshev
Shirshov Institute of Oceanology, Russian Academy of Sciences

The main component of the Russian program is to conduct repeat hydrographic sections with the objective to monitor the Antarctic Circumpolar Current, to estimate long-term trends in it's staus and heat and fresh water fluxes. During the cruises we conduct CTD/LADCP casts, pCO2 measure primary production, zooplankton sampling as well as oxygen, silicate and phosphate. The main vessel used for these cruises is the Akademic Sergey Vavilov and the Akademic Msrislav Keldysh, both from the Shirshov Institute of Oceanography, Russian Academy of Science.

Plans for 2010-2011 includes: 1) A section South of Africa (October 2010), 2) A section in the Drake Passage (November 2010), 3) Twenty to thirty crossings of the Drake Passage (November-March 2010-2011), and 4) Three ACC crossings in the Scotia Sea (November-January 2010-2011)



Observational plans for 2010-2011 at the eastern side of the basin

Physical Oceanography at Shirshov Institute, and Selected Results on South Atlantic

Presented by Peter O. Zavialov, Shirshov Institute of Oceanology, Russian Academy of Sciences

(SIORAS), is one of the World's largest oceanographic institutes, counting about 1600 employees, and operating a fleet of 6 research vessels. The Physical Oceanography Division (POD) of SIORAS employs 161 scientists and engineers, as well as about 20 graduate students. The POD encompasses 13 departments, dedicated to particular areas of physical oceanography, ranging from turbulence and microscale processes to global ocean circulation and climate change. Much of the recent research activities of POD were focused on the seas surrounding Russia. However, the SIORAS fleet maintains regular missions to the South Atlantic, normally, carried out twice a year. In the second part of this introductory presentation, I give an overview of some recent results on the South Atlantic obtained by SIORAS scientists. Eugene Morozov and his co-workers have conducted repeated CTD and LADCP measurements in the abyssal channels of the South Atlantic, which are the major pathways for the Antarctic Bottom Water (AABW). As a result, they were able to estimate the total transports through these channels, as well as quantify some important details of the deep water flow pattern. Mikhail Koshlyakov, Roman Tarakanov, and other members of their group have estimated transports of the principal water masses through the Drake passage. They also suggested some new pathways for individual water masses, such as the Weddel Sea Deep Water (see the attached figure). Peter Zavialov and his co-workers have invstigated the response of the currents at the Southwestern Atlantic shelf to the wind forcing, as well as the quantitative details of the freshwater assimilation in the Plata River discharge influence area.

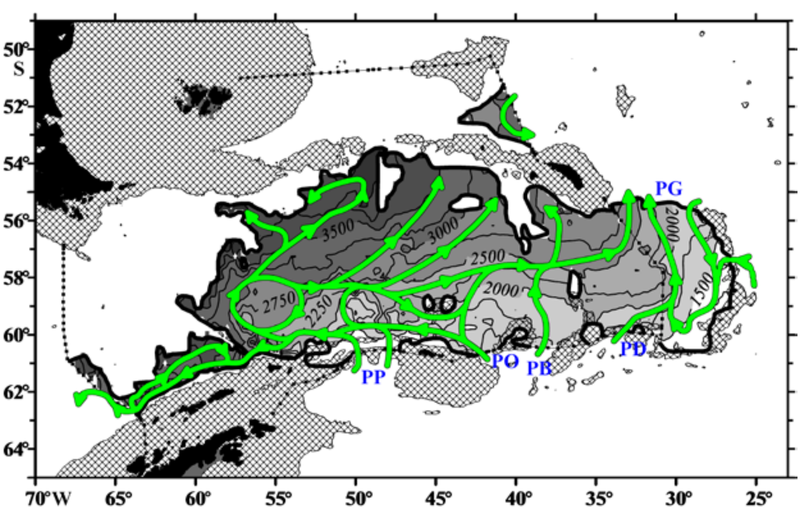


Figure: *Upper boundary surface and circulation of Weddel Sea Deep Water in the Scotia Sea and Drake Passage based on the recent hydrographic data collected by SIO RAS [Tarakanov et al., 2010].*

How satellite observations can be used to monitor AMOC components

Shenfu *Dong, Gustavo Goni*

The South Atlantic Covergence Zone (SACZ) plays a key role in South American climate, its variability and change. Model experiments show a consistent air-sea coupling associated with the SACZ variability, although the lack of observations of both ocean and atmospheric conditions over the southwestern Atlantic has limited the understanding of such interaction. It is therefore expected that a moored platform for observation of the air and surface and subsurface ocean conditions over the SW Atlantic will help validate and improve climate models, provide data required for prediction purposes, and for climate variability and climate change monitoring. The PIRATA backbone and its southwest extension, off Brazil, are located to the north of the region of high precipitation associated to the SACZ. Thus, as part of a Brazilian funded project, an ATLAS-type buoy is being built, in cooperation with NOAA/PMEL, for deployment near 28S,43W. The new site will complement the PIRATA southwestern extension and provide the much needed information necessary to better understand the role of sea-air interactions and vertical mixing at the base of the ocean mixed layer.

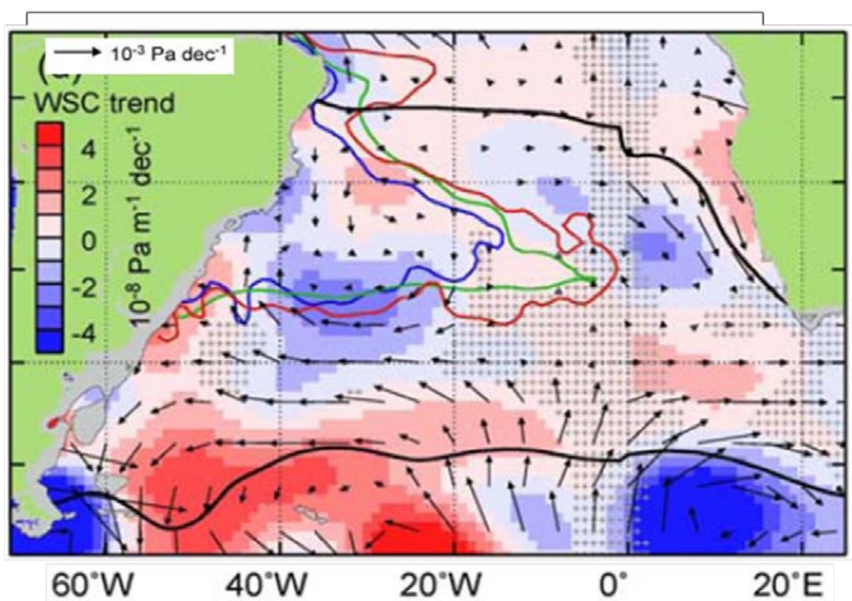


Figure: *Spatial distribution of wind stress (arrows) and wind stress curl (shading) trend for the period 1993-2006. The black curve denotes the climatological zero wind stress curl line, and the blue, green, and red lines are 135 cm dynamic height contour for June 1993, time-mean, and June 2006, respectively.*

Modeling the Earth System at INPE

Domingos Urbano & Paulo Nobre

National Institute for Space Research – INPE. Center for Weather Forecasting and Climate Studies – CPTEC. Center for Earth System Sciences – CCST

The Brazilian Programs on Climate Change Research (CCR) are mainly three: Rede CLIMA, INCT-MC, and FAPESP Program on CCR. They represent a collaborative work with more than 50 research groups acting on 10 different focal points, as well as many groups of 8 other countries then Brazil. The development of the Brazilian Model of Global Climate System is an important part of these effort, with components as atmosphere, ocean, land, and ice. Financial support has been given from different sources for short to long term (3 to 10 years) program schedules. Enhancements of seasonal and inter annual climate prediction are one of the main goals in this effort and are one ongoing work already been done at CPTEC/INPE in the last decade. The thermo-haline circulation is therefore a key process on global coupled models.

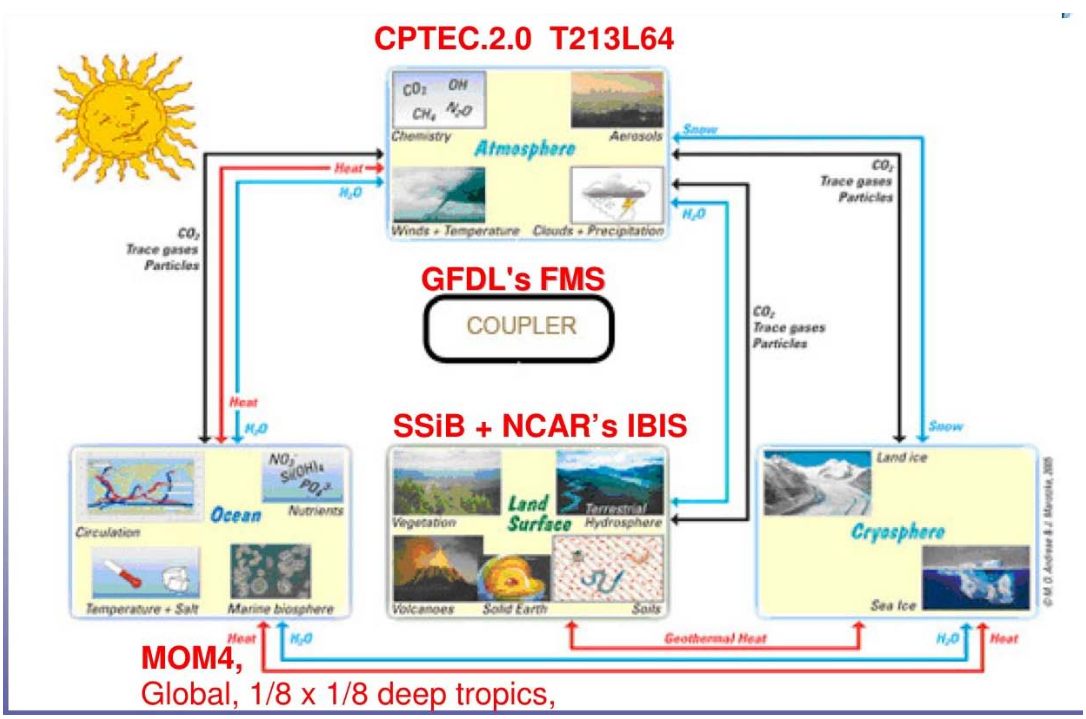


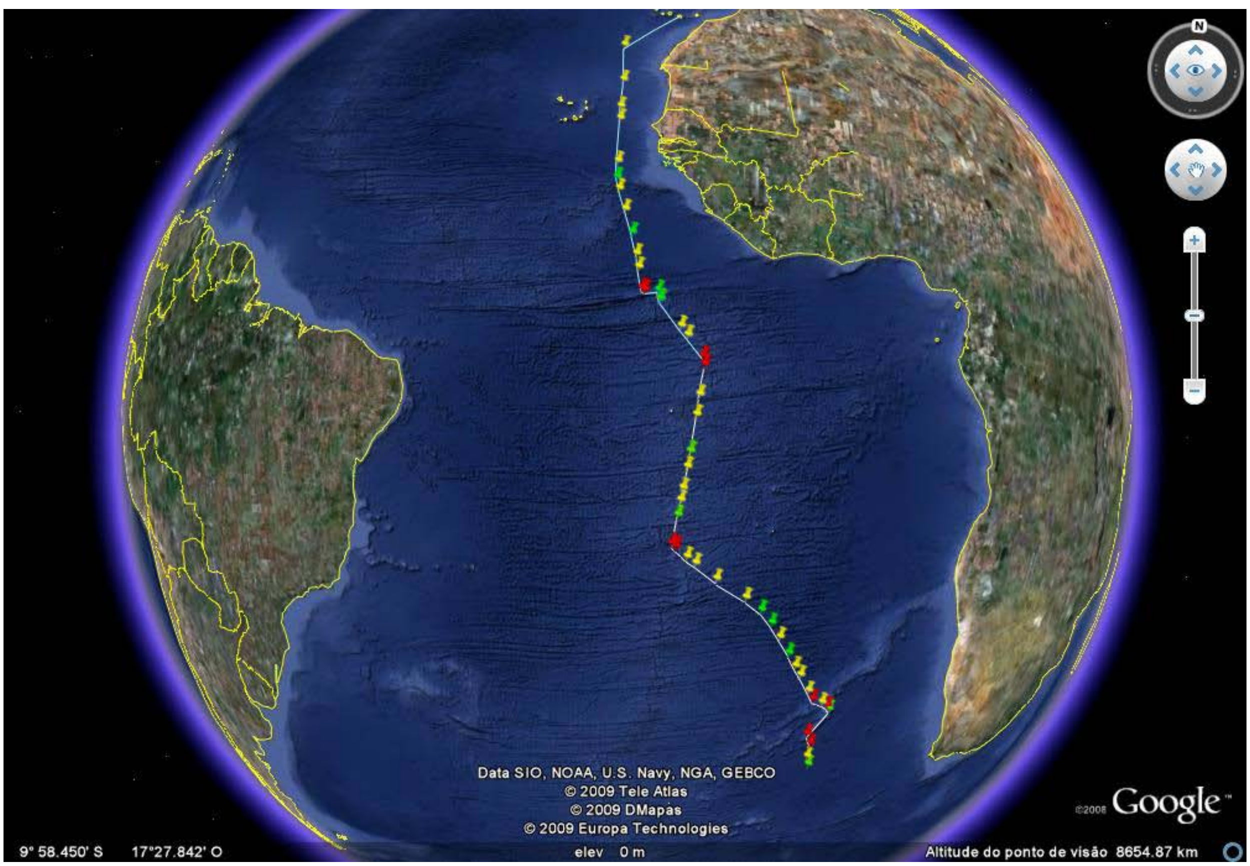
Figure: *The Global Climate System. A modified "Bretherton Diagram" highlighting linkages between biogeochemical and physical climate systems*

Results of the South Atlantic MAR-ECO cruise, 2009

Andre Barreto

Universidade do Vale do Itajaí

The South Atlantic MAR-ECO project is a multinational effort, aimed at describing and understanding the patterns of distribution, abundance and trophic relationships of the pelagic and benthic organisms inhabiting the mid-oceanic South Atlantic ridge and adjacent areas. Also it is exploring the role of mid-oceanic ridge and its adjacent morphological features in deep-water fauna dispersal processes between the coasts of Africa and South America and among the north Atlantic, Pacific, Indian and Antarctic oceans. It's a spin-off of the MARECO project, that had similar objectives for the North Atlantic Ridge, and is also part of the Census of Marine Life Programme (CoML).



MAR-ECO South Atlantic

www.univali.br/mar-eco

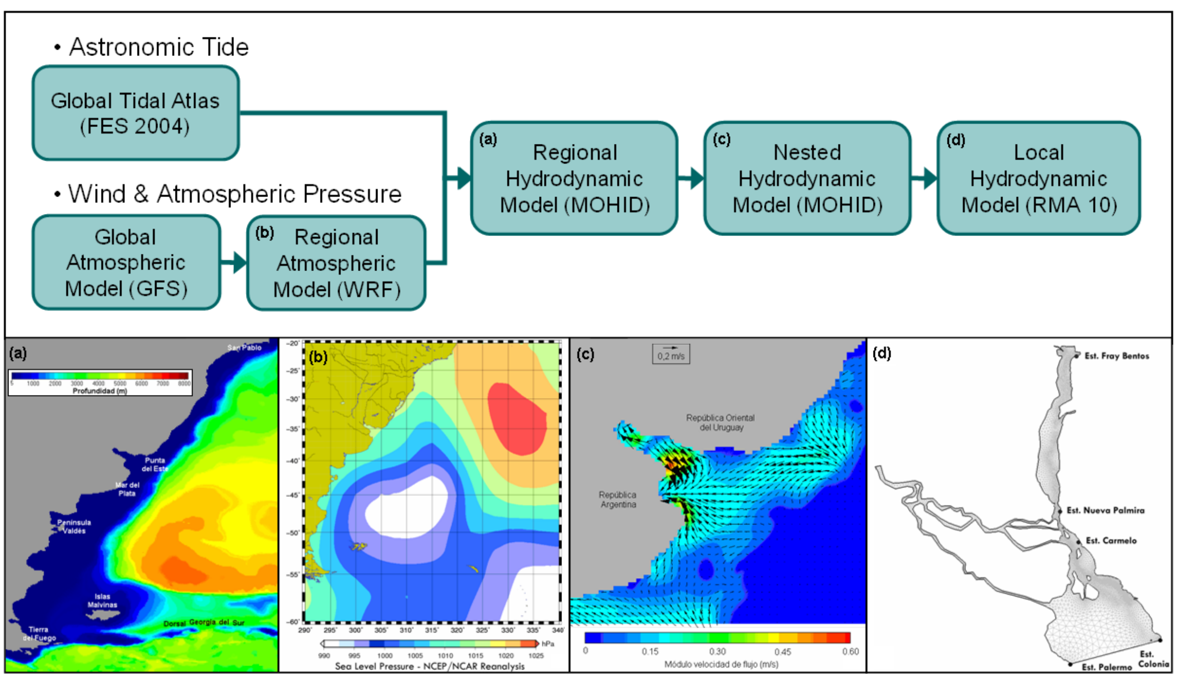
The first field phase of the SA-MARECO was conducted in November, 2009, on board the RV Akademik Ioffe, in a partnership with the Shirshov Institute of Oceanology (Academy of Sciences, Russia). During the cruise, biological samples were collected with mid-water and bottom trawls (IKMT net and Sigsbee trawl, respectively) and zooplankton nets. Microbiological samples were collected from geological cores and from deep water collected with Niskin bottles. Also, marine mammal and seabird sightings were recorded along the entire cruise. During the same cruise, a team of physical oceanographers collected CTD water column profiles that were very important to support the discussion of the biological patterns observed. This cruise exemplifies the advantage of integrated efforts when collecting data from oceanic regions. Due to the large costs involved, projects that aim at more than one field of research are extremely valuable in understanding the marine environment.

Pre-Operational Modeling of the Rio De LA Plata – Rio Uruguay System

Mariana Fernández[1], Pablo Santoro[2], Mónica Fossati[3], Gabriel Cazes, Rafael Terra, Ismael Piedra-Cueva

Institute of Fluid Mechanics and Environmental Engineering (IMFIA), School of Engineering, Universidad de la Repúbllica, Montevideo, Uruguay [1]mfernand@fing.edu.uy, [2]psantoro@fing.edu.uy, [3]mfossati@fing.edu.uy

Since 2007, IMFIA has been developing a pre-operational model based on the application of hydrodynamic and atmospheric circulation numerical models. This model is capable of predicting the main hydrodynamic variables in the Río de la Plata, and therefore constitutes a numerical tool of great value for the fluvial-maritime navigation and regional environmental management. A two-dimensional model (MOHID) with nested domains was used to simulate the hydrodynamics. This model was forced with a meso-scale atmospheric model (WRF) and a global tidal model (FES2004). Comparisons of modeled water levels with data have shown very good qualitative and quantitative agreement.



NSF Ocean Observatories Initiative, the Argentine Basin Global Node

Weller and Cowles Presented by Ariel Troisi Argentina, through the Consejo Nacional de Investigaciones Científicas y Técnicas – CONICET (National Scientific and Technological Research Council) and the Servicio de Hidrografía Naval – SHN

The SHN is in close contact with the NSF, WHOI and SIO regarding the deployment plan of a Global Node of the Ocean Observatories Initiative in the Argentine Basin (42ºS, 42ºW) in early 2013. The area is characterized by high winds, large waves, strong air-sea energy and gas exchange, important amounts of CO_2 sequestration, strong permanent mesocale variability, high productivity and subject to atmospheric dust impacts on biogeochemistry. The proposed Argentine Basin site is right at the edge of high nutrient and high chlorophyll waters, and within an energetic circulation variability area. The node will include; a surface buoy (bulk met, direct covariance fluxes, pCO_2, T/S, waves, ADCP, modem), surface mooring (2 stable pH, 12 T/S, fluorometer), shallow profiler (optical attenuation, fluorometer, spectral irradiance, T/S, O_2, pCO_2, nitrate, zooplankton sonar, modem), deep profiler (T/S, turbulent U/V, fluorescence, O_2), two flanking moorings (12 T/S, O_2, fluorometer, stable pH, ADCP, modem) and three gliders (T/S, O_2, fluorometer, modem). Servicing and supporting the node will provide additional ship opportunities in the region.

Monitoring the formation rate of NADW components using tracer inventories

Rana A. Fine rfine@rsmas.miami.edu RSMAS, University of Miami

Tracer Observations for the South Atlantic Meridional Overturning Circulation Recent studies show little to no coherence in the Meridional Overturning Circulation (MOC) across gyre boundaries. We can use the CFCs and SF_6 to look at variability in coherence for NADW from source into southwestern Atlantic. This is evident in looking at data from a section A22 from 1997 across the Deep Western Boundary Current (DWBC) along 8°N and 53°W with the A10 section at 30°S occupied in 1993. The 8°N section shows a well defined DWBC as regards cores of high CFCs in Upper North Atlantic Deep Water (UNADW) and LNADW. Along 30°S there are high CFCs observed in Brazil Basin along the western boundary, and what looks to be patchiness of elevated CFCs further seaward in the Brazil Basin. Is the DWBC re-constituted again at 30°S? What is the relationship of western boundary NADW in Brazil Basin to that upstream? Compensating the NADW export is the import of Antarctic Intermediate Water (AAIW). The AAIW undergoes considerable mixing and water mass transformation, and it has connections to the neighboring basins. The AAIW in the southwest Atlantic has several sources: it originates from a surface region at the Brazil Malvinas Confluence north of the Drake Passage possibly with some originating in the southeast Pacific, and it also receives an injection of water from the Indian Ocean as part of the Agulhas/Benguela current system. I am interested in measuring CFCs and SF_6 across the Brazil Basin every two years for the DWBC, and also looking at northward passage of AAIW. The CFCs and SF_6 are independent tracers that are sensitive indicators to be used to quantify formation rates and variations in the NADW and AAIW components. They can provide information on coherence between high latitude source regions and regions downstream - via western boundary and interior pathways. Though the total rate of formation of NADW may not have changed in past few decades, there maybe chan The A10 section of CFC-11 along 30°S occupied in 1993 below 1000 m, (CFC data originators W. Roether and B. Klein). Brazil Basin shows highest CFCs in NADW along western boundary (& Bottom Water), also patchiness of elevated CFCs in interior. I am proposing to measure CFCs & SF6 every other year on CTD cruises servicing IES etc over western boundary and when possible entire Brazil Basin.

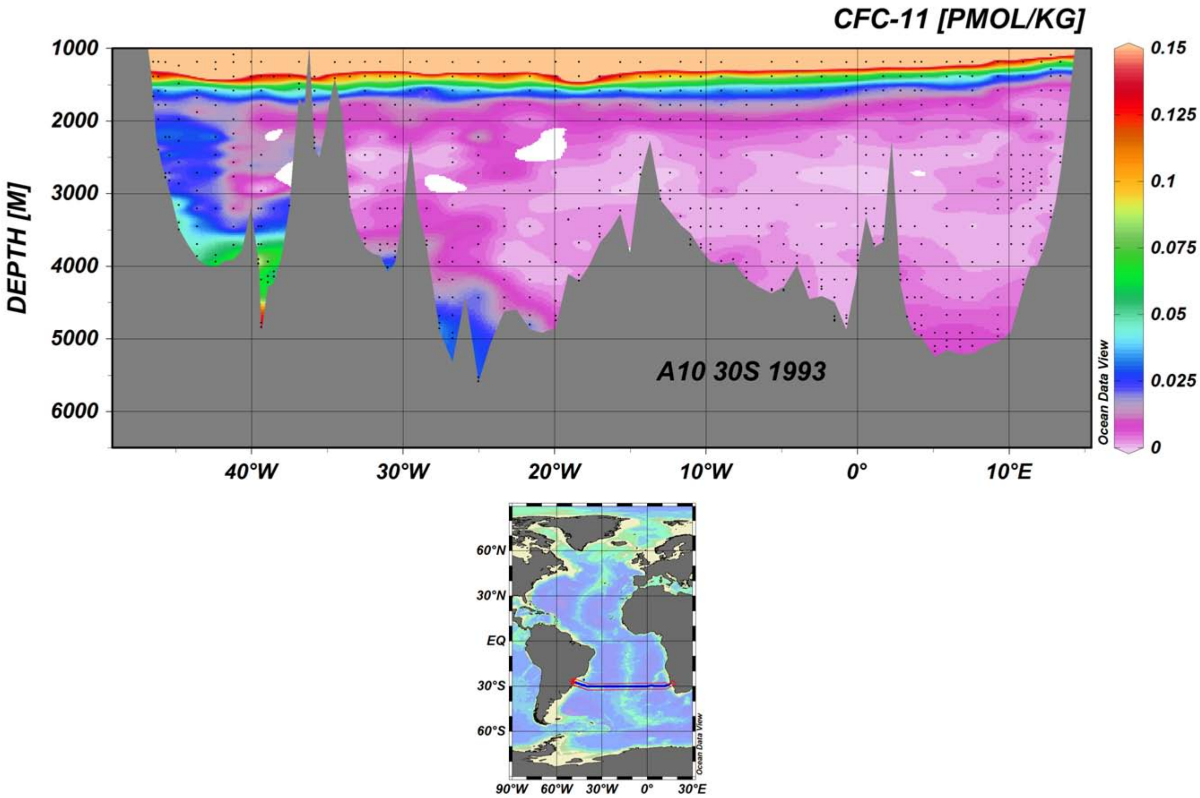


Figure: *The A10 section of CFC-11 along 30°S occupied in 1993 below 1000 m, (CFC data originators W. Roether and B. Klein). Brazil Basin shows highest CFCs in NADW along western boundary (& Bottom Water), also patchiness of elevated CFCs in interior. I am proposing to measure CFCs & SF6 every other year on CTD cruises servicing IES etc over western boundary and when possible entire Brazil Basin*

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Oceanographic Research in the Southern and South Atlantic Oceans by the Institute of Oceanography at Federal University of Rio Grande

Prof. Carlos Alberto Eiras Garcia
Institute of Oceanography
Federal University of Rio Grande

The Institute of Oceanography (IO-FURG) at Federal University of Rio Grande offers 2 (two) undergraduate (Oceanography and Environment Management) and 4 (four) graduate courses (Biological Oceanography; Physical, Chemical and Geological Oceanography; Aquaculture; and Coastal Management). Approximately 60 lecturers, 25 technicians, and 20 post-doc assistants are currently employed by IO-FURG. The IO-FURG owns the *RV Atlântico Sul*, a 35m-length research vessel for coastal research. The IO-FURG is part of a Brazilian education system in marine studies that has evolved considerable since the 1980's. While a single undergraduate graduate course was offered in 1980s, 12 (twelve) courses are expected to be functioning in 2012. Graduate courses in Marine Sciences are also offered in several institutions in Brazil.

The logistical support for oceanographic research in Open Ocean includes 4 (four) research vessels (RV), owned by the Brazilian Navy, which are available for field studies in the South Atlantic and Southern Oceans. Several research groups from different Brazilian universities and research institutions uses these Brazilian RVs. One of them is the High Latitude Oceanography Group (GOAL), which has conducted several scientific projects along the Southwestern Atlantic ocean (ex. PATagonia EXperiment, PATEX) and in the Southern Ocean (ex. Southern Ocean Studies for understanding global-CLIMATE issues, SOS-CLIMATE, during the International Polar Year).

In the Patagonian shelf, the PATagonia Experiment (PATEX) has the following objectives: to investigate the environmental factors that control the occurrence phytoplankton blooms; to determine the main nutrient levels; to characterize the phytoplankton assemblage and primary production rates, and ratios associated with the bloom waters; to determine their bio-optical characteristics; to quantify the CO_2 fluxes, and atmospheric aerosols and DMS concentration in the studied area.

In the Southern Ocean, the main research topics of GOAL focus in the understanding of (1) the formation and variability of dense bottom water close to the tip of the Antarctic Peninsula; (2) the variability of Bransfield and Gerlache Straits ecosystems; (3) the role played by the SO in the global carbon cycle using *in situ* and satellite ocean colour data; and (4) the upper layer circulation and 3D structure of eddies shed by the Brazil-Malvinas Confluence.

Several oceanographic cruises are expected to occur in the following years. For instance, a cruise along the 30 S from Brazil to Africa is expected to occur in October 2011. The main objective of this cruise is to measure and model carbon dioxide fluxes in the ocean-atmosphere interface, and increase our understanding on the physical and biogeochemical processes that control these fluxes in the South Atlantic Sub-Tropical and Southern Ocean.

In conclusion, the perspectives for observational oceanographic in open oceans have recently improved due to (a) an increase of number of Brazilian universities or institutions dedicated to Marine Sciences; (b) an increase in funding levels for marine and oceanographic research; (c) an increase in logistical support provided by Brazilian Navy (ex. recent acquisitions of *R.V. Cruzeiro do Sul* and *R.V. Alte Maximiano*); and (d) a possibility of two new Research Vessels, for coastal and oceanic research.

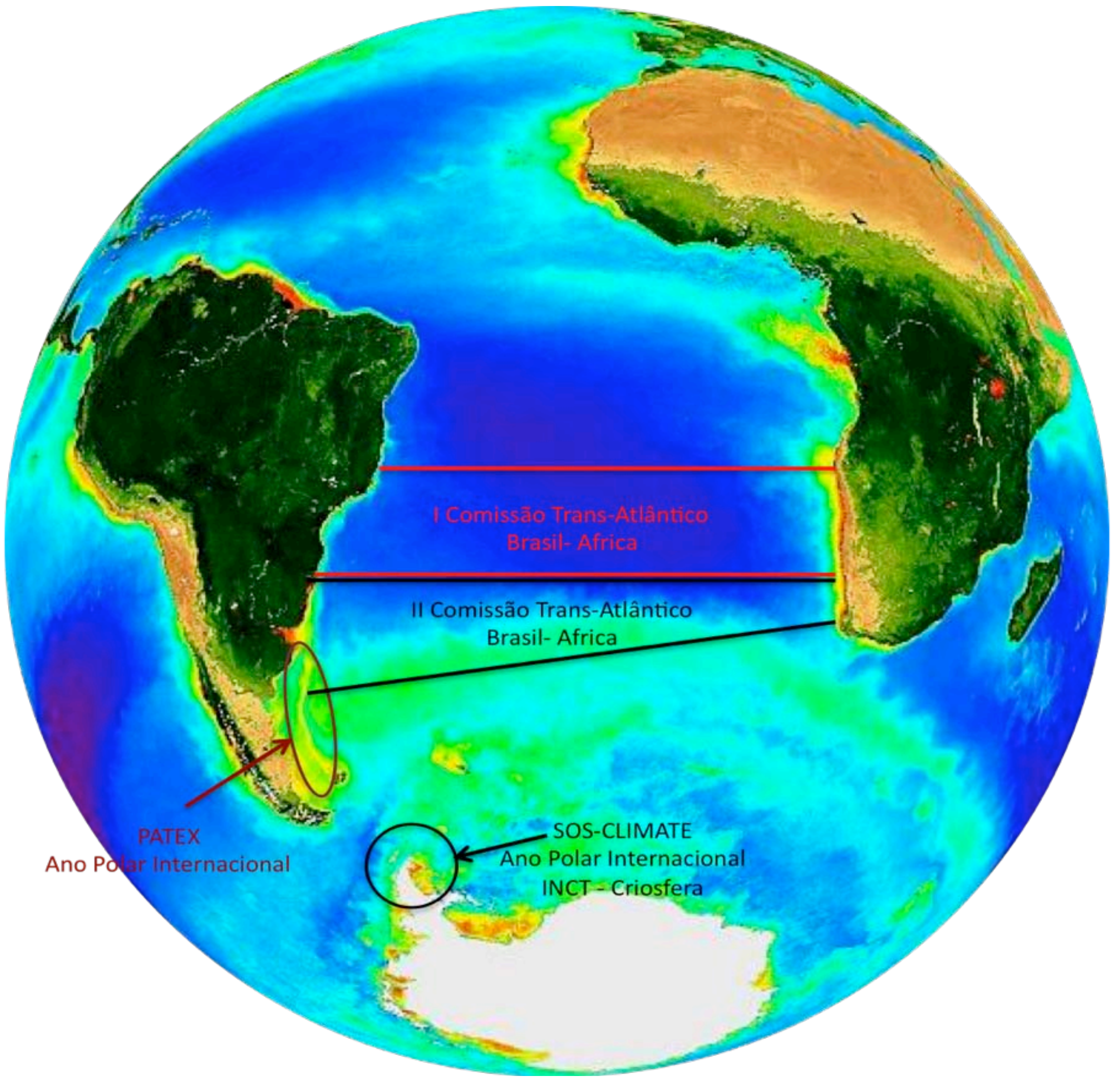
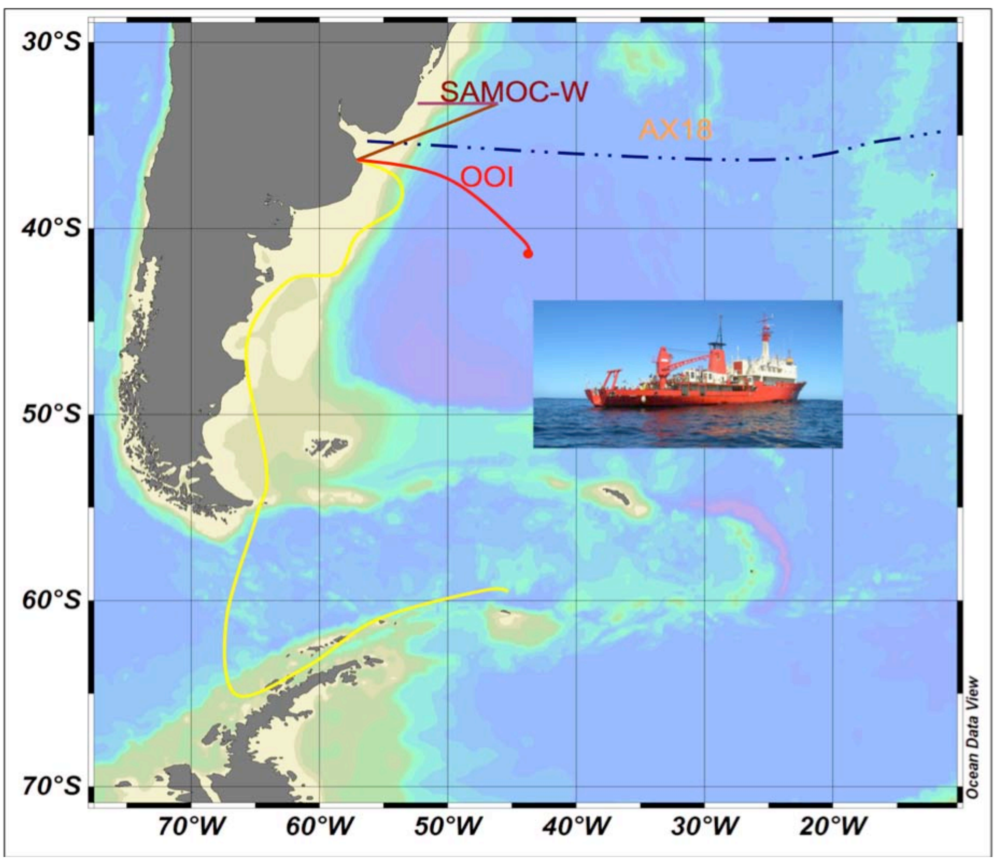


Figure: *The areas of intense oceanographic research conducted by the High Latitude Oceanography Group (GOAL). PATEX and SOS-CLIMATE were scientific contribution to the International Polar Year. An oceanographic cruise between Brazil and Africa was conducted in Oct-Dec 2010 period (red lines). A second Brazil-Africa cruise is expected to occur in 2011 in the same period (black lines).*

Infrastructure in Argentina – Plans and Possibilities

Ariel Troisi, SHN Argentina

Current ship infrastructure in Argentina consists of one oceanographic research vessel, R/V PUERTO DESEADO, operated by the Servicio de Hidrografía Naval – SHN, and three fisheries research vessels, R/V DR HOLMBERG, R/V CAPITAN OCA BALDA and CAPITAN CANEPA, operated by the Instituto Nacional de Investigación y Desarrollo Pesquero – INIDEP. SHN is cooperating closely with NOAA-AOML in servicing the AX18 line since 2002, as well as in periodically collecting the data of the PIES array deployed in the SAMOC-W line. Additional plans and possibilities of interest for SAMOC include the proposal by the NSF Ocean Observatories Inititative to establish a Global Node in the Argentine Basin (42ºS, 42ºW) which will be serviced periodically by a vessel, as well as national plans covering the Argentine shelf, slope and down to the Antarctica.



Overview of South African contribution to SAMOC

Isabelle Ansorge, University of Cape Town South africa

Currently there are 3 annual cruises onboard the RV SA Agulhas attached to relief voyages of South African year round scientific bases – Gough Island, Marion Island and the SANAE base. These cruises provide ideal opportunities to monitor changes in heat, salt, volume fluxes and physical/biogeochemical properties across these regions – in particular Gough and SANAE cross the "Agulhas Ring" corridor between the Indian and Atlantic oceans and the Marion Island relief voyage crosses both the Agulhas Current and its return flow. The most exciting news is that a new research vessel has been commissioned and will be launched in April 2012. The new polar vessel will take over from the 30 year old RV Agulhas and being modern it will have a full suite of laboratory space, new oceanographic equipment i.e. ADCP, titanium CTD, ability to measure iron, underway systems etc..In addition transect time will be decreased by 50%. It is hoped that the new ship will provide additional dedicated sea time so that future scientific cruises will no longer be "tied" to the relief voyages. In addition to the new polar vessel plans are currently in place to motivate to government for a dedicated research facility – similar to BAS or AWI - in short a one stop shop where research, logistics, technical support, public facilities/museum lie under one roof. It is hoped that the new Polar facility will open in 2014 or 2015 and be housed at Cape Town's Waterfront. A number of new centers have opened in the past 3 years including SAEON (South African Environmental Observing Network), which is responsible for data collection, management and dissemination and it is expected that SAEON would play an integral part in SAMOC, Nansen Tutu center aims to combine model, remotely sensed and in situ data to provide all year round observations and information on the state of the shelf seas around South Africa as well as improving our forecast capabilities. Finally, it is expected that a new call from the South African Department of Science and Technology for funding will open in 2011 and the SAMOC community will be well placed to submit an application for funding and logistical requirements by then. Cape Town will host the next SAMOC meeting in September/October 201.

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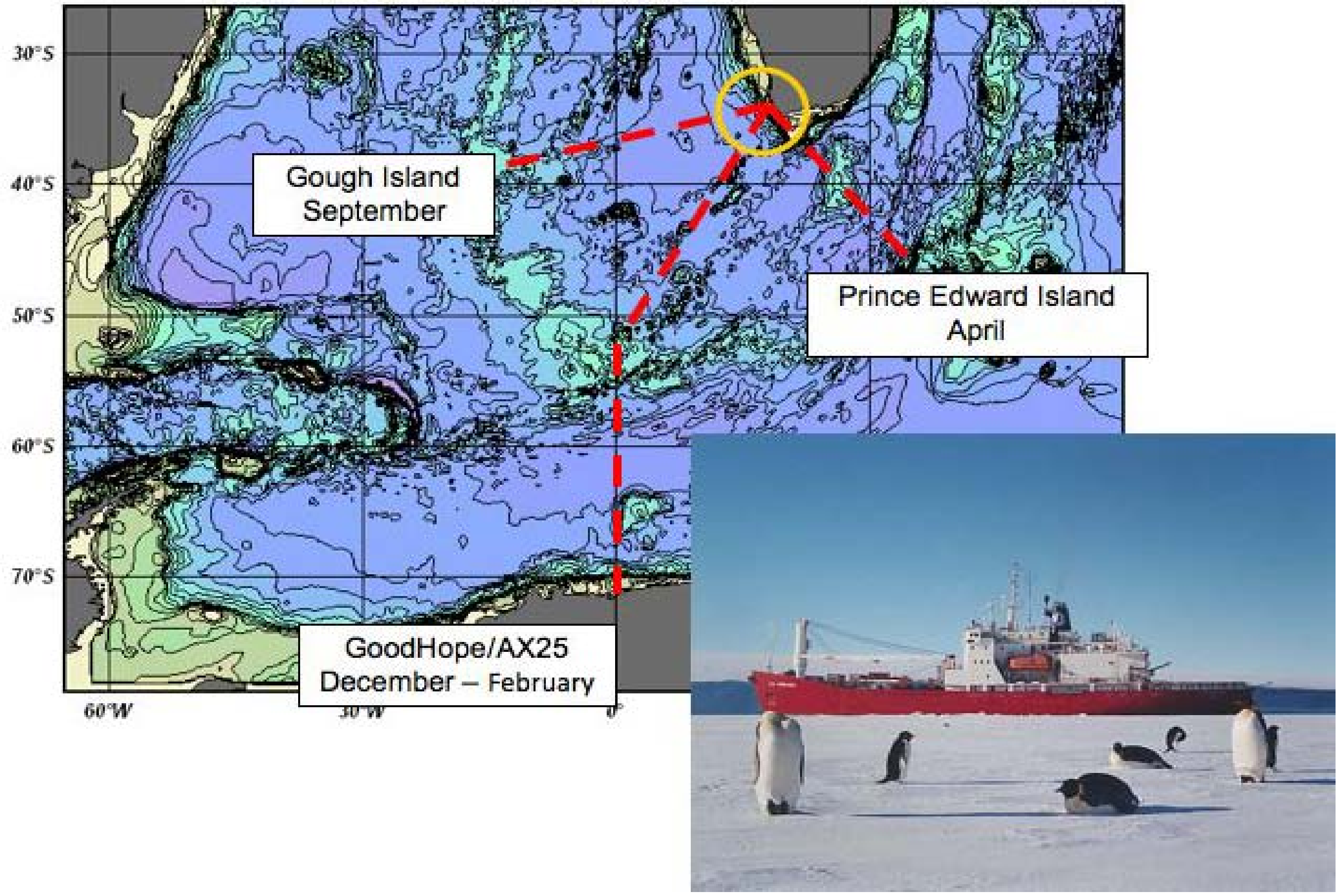

Figure: *The figure shows current opportunities for Argo float or other instrument deployments that can contribute to SAMO3.*

SAMOC3 - Agenda

Day 1: Tuesday May 11

8:00 departure by bus from Hotel Marina Palace (Leblon) to Niterói
Morning Session: 9:00 to 12:30

Welcome (DHN Director)
Edmo Campos: Logistics
Silvia Garzoli: Objectives of the meeting
Sabrina Speich: The Indian Atlantic connection. Results from the GoodHope (France, South Africa, Russia, US)
Janet Sprintall: The Pacific-Atlantic Connection: Drake Passage Measurement programs.

10:40 – 11:000 coffee-break

Molly Baringer: Meridional exchanges of fluxes. Observational studies and results from AOML and collaborators from Argentina and Brazil.
Joël Hirschi: MOC related activities at NOC (presented by Povl Abrahamsen):
Brian King: NOCS UK: initial results and future plans (presented by Povl Abrahamsen)
Edmo Campos: Brazilian Modeling and Observational Projects

12:30 – 13:30 Lunch break

Afternoon Session: 13:30 to 17:00

Henk Dijkstra: A scalar indicator of the stability of the Atlantic Meridional Overturning Circulation
Sybren Drijfhout: Why 30S is the best location to monitor the stability of the THC." KNMI models
Renellys Perez: Model analysis for experiment design in NOAA
Povl Abrahamsen: Model analysis for experiment design in UK

15:10 – 15:30 coffee-break

Sergey Gladyshev: Russian field program in the South Atlantic in 2009 – 2010
Peter Zavialov: "Physical Oceanography at Shirshov Institute, and selected results on South Atlantic".
Shenfu Dong: How satellites observations can be used to monitor AMOC components.
Domingos Urbano: Modeling the Earth System at INPE

18:00 – 19:30 Ice-breaker Cocktail (On board a the R/V Antares)

20:00 – Bus departs to Marina Palace Hotel

Day 2: Wednesday May 12

8:00 Bus departs from Marina Palace to DHN

Morning session: 9:00 to 12:30

Andre Barreto: Mar-Eco South Atlantic
Mariana Fernandez: Pre-operational modeling of the Rio de la Plata- Rio Uruguay system.
Presented by Ariel Troisi: Ocean Observatory Initiative by Weller and Cowles
Presented by Alberto Piola: Monitoring the formation rate of NADW components using tracer inventories by Rana Fine

Infrastructure availability in the South Atlantic:

Edmo Campos University of São Paulo
Carlos Garcia, Fund. Univ. Rio Grande
Ariel Troisi (SHN, Argentine Navy)
Isabelle Ansorge (Univ. Cape Town, South Africa)

10:40-11:00 Coffee-break

Plenary discussions on Infrastructure and Data sharing

Steve Piotrowicz: Data shearing policies

12:30 – 13:30 Lunch break

Afternoon Session: 13:30 to 17:00
Groups discussions to start the preparation of a Plan: What do we need to observe? Where? How? Who is interested in doing it?

Coffee-break from 15:10 to 15:30

17:30 Bus departs DHN to Marina Palace Hotel

20:00 Dinner at Porcao Churrascaria, in Ipanema (optional)

Day 3: Thursday May 13

8:00 Bus departs Hotel do DHN

9:00 to 12:30
Brief plenary
Groups resume

Coffee-break from 10:40 to 11:00
12:30 – 13:30 Lunch break

Afternoon: 13:30 to 17:00
Plenary session. Presentations of the different groups. General discussion. Proposal of a plan.
Closing on Thursday May 13 at 15:00.

15:30 Bus departs from DHN do Marina Palace Hotel

20:00 "Field trip" (an incursion to the Carioca nightlife, optional)

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Acronyms

AOML	Atlantic Oceanographic and Meteorological Laboratory. United States.
SHN	Servicio de Hidrografia Naval, Argentina.
FURG	Universidade Federal do Rio Grande. Brazil
UCT	University of Cape Town, South Africa.
SIO	Scripps Institution of Oceanography. United States.
PMEL	Pacific Marine Environmental Laboratory. United States
Shirshov	Shirshov Institute of Oceanology. Russia
URI	University of Rhode Island, United States
NOCS	National Oceanographic Center, Southampton, United Kingdom.
BAS	British Antarctic Survey, United Kingdom.
Ifremer	Institut français de recherche pour l'exploitation de la mer, France.
AWI	Alfred Wegener Institute for Polar and Marine Research. Germany

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