Workshop
A monitoring system for heat and mass transports in the South Atlantic as a component of the Meridional Overturning Circulation

Estancia San Ceferino, Buenos Aires, Argentina
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The main objective of the workshop was to gather scientists with current or proposed programs in the South Atlantic to foster collaborations leading to the establishment of a monitoring system for meridional heat and mass transports in the South Atlantic and inter-ocean exchanges that contribute to the Meridional Overturning Circulation (MOC). The importance of the measurements themselves in the South Atlantic had already been thoroughly described in the South Atlantic Clivar meeting that took place in 2003 (see http://www.clivar.org/organization/atlantic/SACOS.pdf). The urgency to build upon models and observations already in place and to form international partnerships to augment the capabilities and accelerate research in the area was recently augmented by the recommendation of the Joint Subcommittee of Ocean Science and Technology (JSOST) to include "Assessing Meridional Overturning Circulation Variability" as a near-term priority for national research in ocean sciences. The workshop received financial support from the NOAA Climate Program Office and from the US CLIVAR office. Participants from Argentina, Brazil, France, Germany, Italy, Russia, Uruguay, United Kingdom, and the United States attended the event (Appendix I).

The discussion started with a review of the current knowledge of the region both from previous observations and results from theoretical and numerical models. A summary of existent and proposed observations is given schematically in Appendix II. Several speakers commented on the justification for a study of the South Atlantic noting its role as the connection with the Southern Ocean and the North Atlantic, and the global nature of the MOC. Observations and models suggest that the South Atlantic is not a passive conduit for remotely formed water masses, but that it actively creates them through dynamic and thermodynamic processes occurring within the basin. Furthermore, MOC variability can be linked to the equatorward heat transport at mid latitudes within the basin that operates over longer time scales than surface fluxes and hence, could potentially provide some predictability for climate. For example, discernable changes in tropical SST appear to be strongly linked to the eastern boundary circulation in the South Atlantic and in fact global SST is linked to the South Atlantic Subtropical heat transport. Presentations pointed to the critical importance of observing accurately and monitoring the subtropical boundary currents in order to estimate the MOC mass, heat and freshwater transports.

The Drake Passage and the region south of South Africa are key chokepoints for the world's largest current, the Antarctic Circumpolar Current (ACC). Heat, salt, mass, freshwater, nutrients and other oceanic properties are transported between the Atlantic, Pacific and Indian Oceans, with consequences for global climate. Presentations highlighted the dynamically challenging nature of the ACC flows, and the added complexity of propagating signals along the adjacent topography, including transient

waves remotely forced in the Pacific. The Agulhas leakage region is also of critical influence. It is not only the gateway for the upper limb of the MOC return flow, but through the shedding of Agulhas rings is one of the major sources of salinity increase of the South Atlantic. The variability of the leakage observed in paleo-times appears to be linked with the Atlantic MOC intensity. Thus it was concluded that a better understanding and quantification of the circumpolar variability and the Agulhas leakage on a range of timescales, and how these changes impact the lower latitudes was sorely needed, in particular to design a monitoring system that might be capable of measuring heat and salt fluxes.

Plans were established to coordinate existing and future observations in the Drake Passage, in the region between South Africa and Antarctica, and on a zonal line nominally at 35°S to be able to estimate the fluxes in a closed box. It was agreed that very little is currently in place or even proposed that is capable of capturing the complete MOC as a sustained observing system. Therefore, discussions were directed towards the design of a monitoring system for the Atlantic MOC in the South Atlantic. The need for new developments in the present data collection system was discussed as well as the need to collect data at climate time scales (e.g. a sustained commitment for a decade and more of observations in near real time). Modeling results were presented that indicate the need to increase observations not only in the choke points but also in the interior of the South Atlantic basin where water mass transformations occur and large discrepancies exist in numerical models and between numerical models and observations.

Strong endorsement was made in support of sustaining the Argo Program currently the only global source of subsurface data in the open ocean away from the tropics. Observations collected by tagging marine mammals with CTD sensors (e.g. MEOP), were also considered. Most monitoring projects already underway or in the planning stages, place instruments along altimetry ground-tracks to supplement the observations. Therefore, the group strongly endorsed the continuation of the satellite altimetric missions with spatial resolution sufficient to resolve mesoscale features. The group also considered important the success of, and collaboration with the Aquarius-SAC D program that will provide remote observations of salinity at the basin scale.

The main recommendations from the workshop can be summarized as follows. First, it is imperative to sustain the existing observations in the three key regions mentioned above and to further enhance the observing system. Second, there is a strong need to develop new cost effective technology to allow near real-time full water column observation. Third, it is critically important to collaborate in the instrument deployment to reduce operational costs, and to collaboratively analyze the different data sets and model products presently available and soon to be obtained, as well as to conduct process modeling studies to determine the most cost effective monitoring system for the MOC in the South Atlantic for climate time-scales. The group proposed to reconvene in a year.

For further information, please visit the Workshop website:
http://www.aoml.noaa.gov/phod/SAW/

Appendix I: List of Participants

Name	Country	Institution
Baringer, Molly	USA	NOAA/AOML
Barreiro, Marcelo	Uruguay	Univ. De LA Republica/Uruguay
Byrne, Deirdre	USA	Univ. of Maine
Campos, Edmo	Brazil	IOUSP/Brazil
Chereskin, Teri	USA	SIO/.UCSD USA
Donohue, Kathleen	USA	URI
*Garzoli, Silvia	USA	NOAA/AOML
Gladyshev, Sergey	Russia	SIO, Moscow
Goni, Gustavo	USA	NOAA/AOML
Guerrero, Raúl	Argentina	INIDEP
Lagerloef, Gary (only day 1)	USA	ESR
Lindstrom, Eric (only day 1)	USA	NASA/HQ
Macrander, Andreas	Germany	AWI, Bremerhaven
Mata, Mauricio M.	Brazil	FURG/Brazil
Matano, Ricardo P.	USA	OSU
McDonagh, Elaine	England	NOC, Southampton
Meinen, Christopher	USA	NOAA/AOML
Meredith, Mike	England	British Antarctic Survey
Nof, Doron	USA	Florida State Univ.
Owens, Breck	USA	WHOI
*Piola, Alberto	Argentina	SHN/UBA
Piotrowicz, Steve	USA	NOAA/OAR
Provost, Christine	France	CNRS/LOCEAN
Rupolo, Volfango	Italy	ENEA
Sokov, Alexey	Russia	SIO, Moscow
*Speich, Sabrina	France	LPO, Univ. of Brest
Troisi, Ariel Hernan	Argentina	SHN
Watts, Randy	USA	Univ. Rhode Island
Wimbush, Mark	USA	GSO, Univ. of R.I.

* The Organizing Committee

Appendix II: Figure showing current and planned observations.