PROJECT SUMMARY: NOAA contribution to the 34.5°S basin-wide MOC array

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Observations and models consistently indicate that variations in the Meridional Overturning Circulation (MOC) are strongly correlated to important climate changes such as variations in precipitation and surface air temperatures. To date, most MOC observations have been focused in the North Atlantic. However, model studies show that the South Atlantic is not just a passive conduit for water masses formed in other regions of the world ocean, but instead actively participates in their transformation. The South Atlantic also plays a significant role in the establishment of oceanic teleconnections: the Agulhas leakage 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 that in conjunction with modeling efforts would improve our understanding of the processes necessary to formulate long-term climate predictions.

The U.S. CLIVAR Atlantic MOC implementation strategy calls for a MOC and meridional heat transport (MHT) monitoring array across the South Atlantic. Three international South Atlantic MOC (SAMOC) workshops were held between 2007 and 2010 to bring together the scientific community to design an integrated observational system. Our hypothesis is that changes in the upper ocean return flow of the MOC in the South Atlantic could significantly impact the properties of the North Atlantic MOC waters over time. The goals of the program are (1) to characterize the time-mean and time-varying components of the MOC, as well as the heat and salt carried by the MOC, in the South Atlantic and (2) to provide a means to observe the changes in the ventilation characteristics and relative contributions of different water masses to the MOC.

This proposal seeks NOAA support for a key component of a moored trans-basin array along 34.5°S that will serve as the backbone for the SAMOC field program: four pressure-equipped inverted echo sounder (PIES) and four PIES equipped with the ABIISS data pod technology to be deployed in the interior (blue stars in Fig. 1). This NOAA project will complement the following existing observing systems:

- NOAA South Atlantic MOC (SAM) array (blue circles in Fig. 1)
- FRANCE-IFREMER pilot array (black circles in Fig. 1)

The full trans-basin array (Fig. 2) will consist of a balanced array of instruments also including four dynamic height moorings deployed near the coast on each boundary (proposed to NSF, red stars in Fig. 1). Inshore of the dynamic height moorings, the western boundary will be closed by an array of shallow moorings to be deployed by Brazilian scientists (Fig. 2b and Table 1). The eastern segment of the trans-basin array will be closed by an array of CPIES to be deployed by French scientists (Fig. 2b and Table 1).

Instrumentation sites will be strategically placed under JASON- and/or Envisat-like altimetry groundtracks whenever possible and appropriate. Blended data from bottom pressure observations and sea height anomalies will serve to evaluate the dynamic height estimates along 34.5°S and to produce continuous and unambiguous monitoring of the baroclinic and barotropic contributions to the MHT.

These data will be used to develop a technique to extend the time series of MOC and MHT back to the beginning of the altimetry record in late 1992.

The work proposed here to NOAA will be part of the overall integrated program, involving investigators from the U.S., France, South Africa, Brazil, Argentina, and Russia. The U.S., France, and Brazil will provide the major instrumentation for the moored array (Table 1). **At this time, we are not requesting ship time from NOAA**. UNOLS ship time requests have been submitted along with the NSF proposal for a trans-basin deployment and a trans-basin hydrography cruise. Brazil, Argentina, South Africa, and Russia will contribute ship time for the turn-around and recovery cruises (Table 1). Together with the existing field programs at 26.5°N in the North Atlantic and across the two Southern Ocean choke points south of South Africa and Drake Passage, the program proposed here will provide the measurements necessary to evaluate inter-gyre, inter-hemispheric, and inter-ocean connectivity of the MOC.

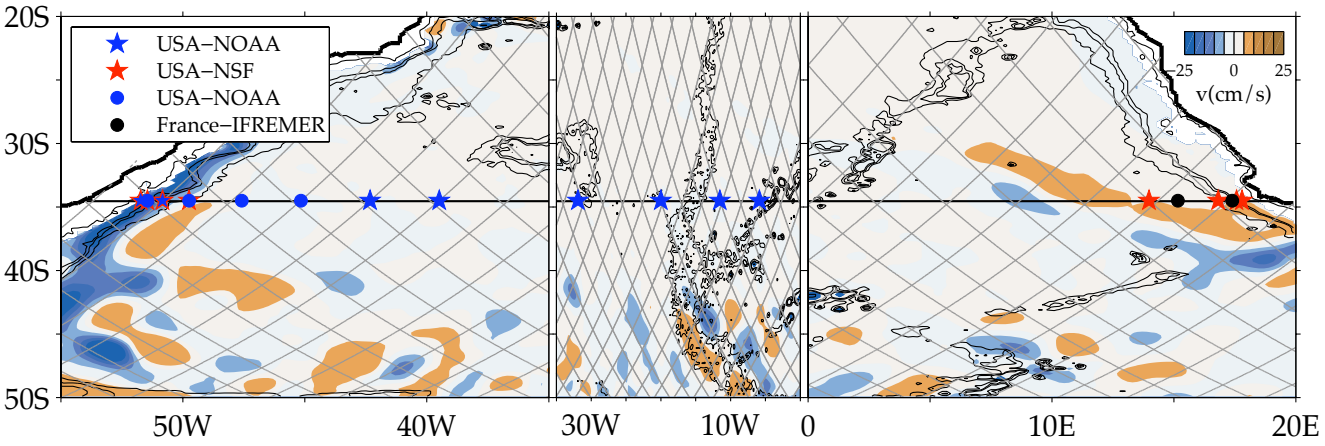

Figure 1. Schematic of the existing and proposed trans-basin array along 34.5°S. Note the x-axis scale is stretched over western and eastern boundaries. Circles indicate funded components of the array: western boundary PIES/CPIES funded by NOAA (blue circles) and eastern boundary PIES funded by France-IFREMER (black circles). Stars indicate the different components of the array that have been submitted to U.S. funding agencies: **western boundary PIES/CPIES and interior PIES-with datapods to NOAA (this proposal, blue stars)** and dynamic height moorings to NSF (red stars). Color contours are of 27-year mean OGCM for the Earth Simulator (OFES) meridional velocity at 200m depth. JASON ground-tracks are overlaid as gray lines.

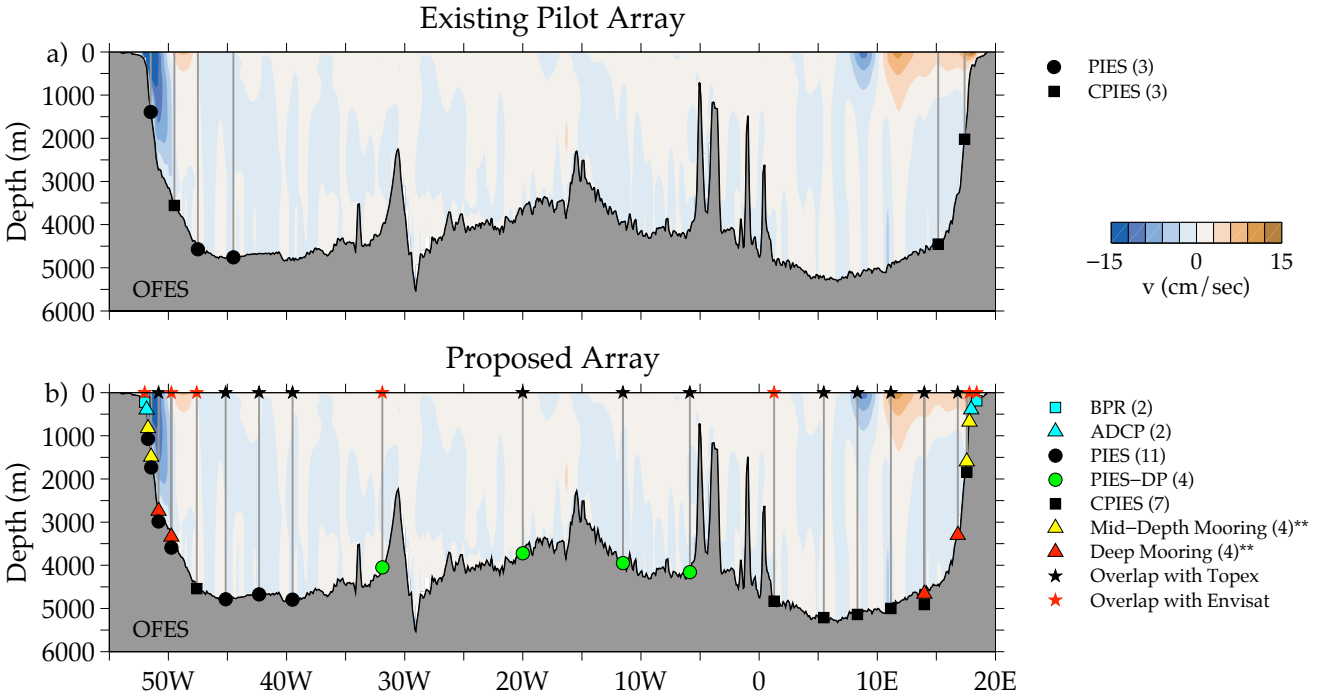

Figure 2: Schematic of the (a) existing pilot measurement systems as of November 2010, and (b) the proposed trans-basin array along 34.5°S. The proposed array consists of bottom pressure gauges (cyan squares), upward-looking ADCPs, mid-depth and deep dynamic height moorings (yellow and red triangles, respectively), PIES (black circles), PIES-with datapods (green circles), and CPIES (black squares). **Funds for PIES/PIES-with datapods on western boundary and in the interior west of 5°W are requested in this proposal to NOAA**. Black and red asterisks denote instrumentation sites that overlap with JASON and Envisat altimetry groundtracks, respectively. Color contours show the 27-year mean OFES meridional velocity along 34.5°S.

Table 1. Summary of components and resources for the SAMOC field program along 34.5°S. Existing measurements are highlighted in gray. **Those components requested as part of this proposal are highlighted in yellow.**

Component	Funding Agency	Principal Investigators	Country	Status
Western boundary pilot measurements (3 PIES/1 CPIES)	NOAA	C. Meinen, S. Garzoli, M. Baringer, G. Goni	USA	Funded
Eastern boundary pilot measurements (2 CPIES)	IFREMER	S. Speich	France	Funded
Eastern boundary ADCP (1)	IFREMER	S. Speich	France	Funded
Eastern boundary pilot measurement augmentation (2 CPIES)	CPER	S. Speich	France	Funded
Quarterly AX18 XBT transect	NOAA	G. Goni, M. Baringer, S. Garzoli	USA	Funded
Western boundary PIES (4), interior PIES-DP (4)	**NOAA**	**R. Perez, S. Dong, C. Meinen, G. Goni, S. Garzoli, M. Baringer**	**USA**	**This proposal**
(1) Dynamic height moorings (8) (2) Deployment cruise and trans-basin hydrographic cruise	NSF	S. Dong, R. Perez, J. Sprintall, R. Fine, G. Flierl, S. Baker-Yeboah	USA	Proposed
(1) Eastern boundary CPIES(6), (2) Goodhope PIES (7), (3) Marisonde buoys (5)	ANR	S. Speich	France	Proposed
Ship time, western boundary ADCP (1) and bottom pressure recorder (1)	FAPESP	E. Campos	Brazil	Proposed
Ship time, CPIES (3)	FACEPE	A. Fetter	Brazil	Proposed
Instrumentation to augment western boundary moorings and hydrography	Argentina	A. Piola	Argentina	To be proposed
Ship time for the GoodHope hydrography transects, deployment, and recovery cruise	Russian Academy of Science	S. Gladyshev, A. Sokov	Russia	Proposed
Ship time for eastern boundary turn-around and recovery cruise and bottom pressure recorder (1)	SANAP	I. Ansorge, C. Reason	South Africa	To be proposed