

SAMOC

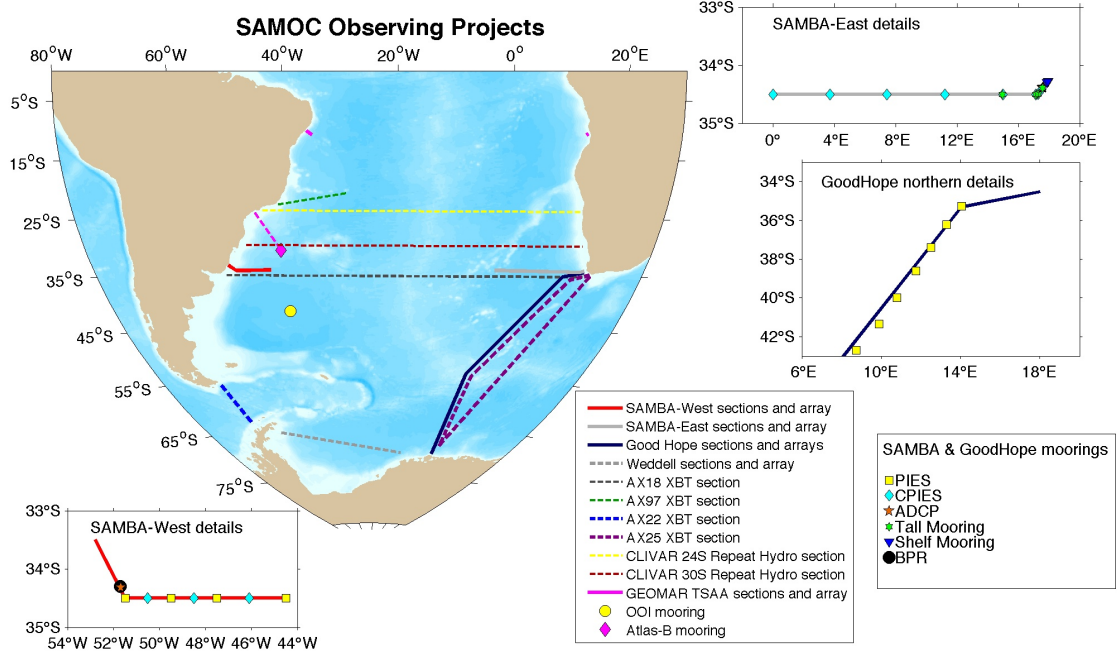
South Atlantic Meridional Overturning Circulation

SAMOC VII Workshop Report

Workshop date: Monday, September 4, 2017, 9:30am-3:00pm

Workshop venue: University of Cape Town, Cape Town, South Africa

Report prepared by: Christopher Meinen, Olga Sato and Isabelle Ansrorge



Executive Summary: South Atlantic Meridional Overturning Circulation VII workshop

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Improving global understanding of the South Atlantic Meridional Overturning Circulation (SAMOC) has been a major international science priority since the early 2000s (e.g. CLIVAR, 2003, www.clivar.org/node/355). The research community held the first SAMOC workshop in 2007, where existing and future observational plans were discussed. Key components of the global ocean observing system (GOOS) were already being used to make estimates of the Meridional Overturning Circulation (MOC) at that time, and several new MOC-related observing systems were started in the South Atlantic after that first 2007 workshop. In 2012, the SAMOC Initiative was endorsed as an important science activity by the International CLIVAR organization (see www.clivar.org/the-science/endorsed-projects/endorsed-projects). Over the past decade, the MOC observing systems in the South Atlantic have provided data that have led and will continue to lead to better understanding of crucial oceanic phenomenon, while numerous related modeling and analysis projects have sought to elucidate the complex physics that controls the spatial and temporal variability of the MOC in the region.

On September 4th, 2017, a group of about 25 international scientists gathered at the University of Cape Town, South Africa, for the SAMOC VII workshop. Most of the participants had attended the 2017 IAPSO-IAMAS-IAGA meeting the previous week, which had included a scientific session titled “The Meridional Overturning Circulation: Mean State and Variability”, wherein many presentations had discussed recent scientific progress on SAMOC topics. The purpose of the SAMOC VII workshop was, therefore, to focus on logistical progress in projects that are contributing to the SAMOC initiative and on future opportunities for collaboration. The group discussions included plans for future student and postdoctoral fellow projects, the SAMOC Data Sharing Policy, and other important items. A review presentation on recent results from researchers in South Africa kicked off the workshop, after which discussions covered existing SAMOC observing systems, including the western and eastern portions of the South Atlantic MOC Basin-wide Array at 34.5°S (“SAMBA”), the RACE-SACUS Array at 11°S, observations in Drake Passage, observations from long-term global systems (e.g. Argo, XBT, satellite), and related observations being made in the subtropical and subpolar North Atlantic. Following the discussions on the existing observing systems, the group moved on to talk about future observing plans, how the existing SAMOC data sharing policy is working, and what plans the various groups had for future joint analyses, proposals and research cruises.



Introduction

Analyses of numerical models of the climate system have found that variations in the Atlantic Meridional Overturning Circulation (AMOC) are connected with changes in precipitation patterns, extreme weather phenomenon (e.g. droughts, heat waves, hurricane intensification), and sea level changes (e.g., Broecker, 1995; Enfield et al., 2001; Vellinga and Wood, 2002; Stouffer et al., 2006; Zhang and Delworth, 2006; IPCC, 2013; McCarthy et al., 2015; Buckley and Marshall, 2016; Delworth and Zeng, 2016; Lopez et al., 2016). The international science community has been researching the structure and variability of the AMOC for several decades now (e.g. Stommel, 1958; and many papers since), but observational and modeling studies of the AMOC have experienced a quantum leap in the new millennium as the aforementioned connections to critical climate quantities like sea level came into focus. Improving understanding of AMOC was designated a key near-term science priority for several countries in the Atlantic region – and new and/or improved AMOC observation programs began being put in place in the North Atlantic in the early 2000s (e.g. Cunningham et al., 2007; Send et al., 2011). In the South Atlantic, the development of similar observing systems has lagged somewhat behind the North Atlantic, mainly as a result of logistical and funding issues as opposed to being a question of scientific importance. The need for better AMOC observations in the South Atlantic has been widely acknowledged, however, and in 2012 the international CLIVAR organization endorsed a broad framework for AMOC observation and study in the South Atlantic (the “SAMOC initiative”). The measurement program for SAMOC is also one of the two Atlantic regional observing systems being assessed as part of the European AtlantOS effort to integrate the Atlantic observing system under *WP5: Integrated Regional Observing Systems*. Initial efforts for trans-basin *in situ* AMOC observing arrays have been initiated at 34.5°S (e.g. Meinen et al., 2013; Ansrorge et al., 2014) and at 11°S (e.g., Hummels et al., 2015).

A series of workshops aimed at improving scientific understanding of the SAMOC have been ongoing for several years, dating back to the first workshop in 2007 in Buenos Aires, Argentina (www.aoml.noaa.gov/phod/SAMOC/index_SAMOC1.html). Workshops have been held roughly every 18 months to provide opportunities to review the scientific advances in SAMOC research, identify significant observational gaps, and to develop plans for collaborations for joint research cruises, observing arrays, publications, and student and postdoctoral researcher opportunities. For the last few meetings, the SAMOC workshops have been held adjacent to major international science meetings to reduce travel expenses for the participants. On September 4th, 2017, an international group of roughly 25 scientists met at the University of Cape Town, Cape Town, South Africa, to progress for the SAMOC initiative – this was the seventh SAMOC workshop. Scientific progress on SAMOC understanding had been a major focus of one of the symposia at the IAPSO-IAMAS-IAGA Joint Assembly there in Cape Town the previous week. The focus of the SAMOC VII workshop was primarily on logistical issues as a result. This report provides a brief overview of the discussions during the one-day SAMOC VII workshop; the agenda for the workshop is presented in Appendix 1 at the end of this report.

Summary presentations

The workshop began with a welcome from the local host, Prof. Isabelle Ansrorge (University of Cape Town, South Africa) and two summary presentations. On behalf of the host country, Dr. Tarron Lamont (Department of Environmental Affairs, South Africa) gave a presentation highlighting the observing systems that South Africa (tall dynamic height moorings; routine hydrography) and France (CPIES) have deployed on the eastern portion of the South Atlantic MOC Basin-wide Array (SAMBA) at 34.5°S. Dr. Lamont also presented details on several of the

ongoing research projects being led by the South African institutions. On behalf of the SAMOC Executive committee, Dr. Edmo Campos (University of Sao Paulo, Brazil) gave an overview of the history of SAMOC research and the SAMOC Initiative.

After the welcome and summary presentations, the workshop participants went through the agenda touching each topic in sequence. In the interest of brevity, the topics covered will be presented here as a bulleted list with the highlights of some of the main presenters crucial points. (Our apologies if we missed some of the speakers in our note taking!) The first several speakers gave updates on key components of the SAMOC observing system.

- Update on SAMBA-West (Dr. Christopher Meinen): The US and Brazilian PIES/CPIES moorings in the western array were recovered and redeployed in October 2016, bringing the length of the US NOAA records to just under eight years and the Brazilian instruments to just under four years. The next western boundary cruise was scheduled for September-October 2017 on the Argentine research vessel ARA Puerto Deseado and would be led by Dr. Alberto Piola (University of Buenos Aires, Argentina). Subsequent to that cruise, the following cruise was planned for March-April 2018 on a Brazilian vessel (led by Drs. Edmo Campos and/or Olga Sato).
- Update on SAMBA-East – previously covered by Dr. Lamont in her summary talk.
- Update on the recent trans-basin cruise along 34.5°S (Dr. Sabrina Speich): A complete trans-basin hydrographic cruise conducted during January-February 2017 onboard the German research vessel Maria S. Merian. During this cruise, led by Drs. Johannes Karstensen and Sabrina Speich, 130 full-depth CTD/LADCP casts were taken with additional water samples collected to measure biogeochemical tracers including dissolved oxygen, nutrients, carbon, et cetera. Additional observations were collected during the cruise, including XBT profiles, and Argo profilers were deployed. Dr. Speich indicated that processing of the cruise data was nearly completed, and that a publication on the data was planned for submission prior to the end of 2017.
- Update on the 11°S trans-basin MOC array (Dr. Peter Brandt): The array has been in place since 2013 and is continuing to make measurements on both boundaries. Recent results have found that at 11°S the flow calculations are highly sensitive to the Ekman product selected – and efforts are underway to determine the best course of action. Plans are underway for a trans-basin CTD section along 11°S between Brazil and Africa in May 2018. A collaboration is also being pursued with Dr. Moacyr Araujo (Federal University of Pernambuco, Brazil) to get additional observations in the western boundary region during PIRATA servicing cruises.
- Update on observations in Drake Passage (Dr. Yvonne Firing, Steve Piotrowicz): Repeat XBT and ADCP sections continue, and there are plans for the deployment of deep Argo floats with topography sensors. It was mentioned that there may be opportunities for students and/or piggy-back researchers to participate in these cruises.
- Update on XBT observations in the region (Dr. Molly Baringer): The high density XBT project continues with the “Good Hope line” (AX25) done twice per year, the AX18 line between Cape Town and Buenos Aires done four times per year, and the AX32 line done between Cape Town and New York done several times each year. It was noted that there are cruise participation opportunities with these cruises as well.
- Update on hydrographic cruises in the region (Drs. Elaine McDonagh, Molly Baringer, Josep Pelegri, and Sabrina Speich): The UK plans to do a trans-basin, full depth, hydrographic cruise (“JC159”) from Rio de Janeiro, Brazil to Cape Town, South Africa, along 24°S in February-April 2018. Subsequent to the January 2017 cruise along 34.5°S, it was mentioned that planning needed to be undertaken for future repeats along this line; researchers in Spain have submitted proposals to lead trans-basin hydrographic cruises along 34.5°S and are waiting for the results. Future NOAA plans include: the 13.5°W line from

Ghana to Cape Town in 2019, the A10 line (30°S) in 2020 or 2021, the A7 line (which has not been done in 7 years), and the A16 line from Antarctica to Brazil along 40°W.

- Updates relating to Argo (Dr. Molly Baringer, Steve Piotrowicz and others): A new project to deploy about 25 deep Argo floats in the Brazil-Malvinas Confluence region was mentioned, as were plans to seed 60-80 floats in the Indian Ocean (which may come into the South Atlantic via the Agulhas Current).
- Updates relating to altimeter: No major updates were discussed, although it was briefly mentioned that efforts to estimate the MOC from merged altimeter and Argo and/or XBT observations were ongoing.
- Updates on the North Atlantic MOC projects (Drs. David Smeed, Elaine McDonagh, and Gerard McCarthy): For the 26°N array (RAPID/MOCHA/WBTS), a UK trans-basin cruise occurred in March 2017 and a US cruise occurred in May 2017. The updated MOC time series was planned to be released a few weeks after the SAMOC VII workshop. UK and US cruises will continue through at least 2020 (when the UK-NERC and US-NSF present funding ends; US-NOAA funding is renewed annually and should continue indefinitely). The UK has plans for testing a new telemetry method in January 2018. The “ABC” project that piggy-backs on the 26°N array and collects additional biogeochemical measurements is ongoing and is successfully collecting nutrients and carbon observations in the Florida Straits and moored dissolved oxygen data on several of the trans-basin moorings. For the OSNAP array, the project will continue under present funding to 2020, with the first time series results made public tentatively by the end of 2017.

After the updates on the various projects and components of the SAMOC observing system, the participants in the workshop moved on to discuss future plans and other related topics. Again, for brevity, the topics and main points raised will be presented here as a bulleted list.

- Future proposal plans and opportunities: Dr. Josep Pelegri described plans for a proposal for the “South Atlantic Gateway Array (SAGA)” led by Spain. Implementation of the array, which would stretch near 10°W between 24°S and 27°S with possibly additional moorings on the northern edge of the subtropical gyre, by the end of 2018. The project is a collaboration between the Institut de Ciències del Mar, CSIC, in Barcelona, and the University of Las Palmas, and would take place between 2018 and 2020. The project would also include hydrographic sections along 10°W between 11°S and 34.5°S and a trans-basin section between South Africa and Brazil. Drs. Elaine McDonagh and Sabrina Speich discussed the ongoing European call for proposals for which the South Atlantic region is one of the main foci. The call includes a broad range of topics including the deep ocean, the coastal environment, fisheries, and ecosystem studies. Dr. McDonagh suggested that she would be a good point of contact for interested parties. She also suggested that for this call there is a strong need for coordination between the groups planning to submit proposals.
- Future cruise plans: Prof. Isabelle Ansorge mentioned that there will be numerous cruises led by South Africa in the SAMBA-East region. Dr. Christopher Meinen mentioned that cruise opportunities are listed on the SAMOC International web page (www.aoml.noaa.gov/phod/SAMOC_international/) whenever the scientists leading the cruise provide that information either to him or to Dr. Renellys Perez (who maintains the SAMOC International web page).
- Existing and future publication plans: Dr. Christopher Meinen mentioned that an updated SAMBA MOC time series is presently being written up, led by Dr. Sabrina Speich. Dr. Marion Kersale mentioned she is leading a study of MOC calculations based on the tall moorings in the eastern portion of the SAMBA. Dr. Maria Paz Chidichimo mentioned she is leading a paper on the Brazil Current volume transport using data from the western end of SAMBA. Daniel Valla mentioned that he had just submitted the revised version of a paper analyzing the water masses captured on hydrographic sections supporting the western part of

SAMBA. Dr. Edmo Campos mentioned that he is working on a paper about the MOC using the HYCOM model.

- Student and postdoc plans: Prof. Isabelle Ansrorge mentioned that she has a South African student working on a biological and Lagrangian study comparing moored data with Argo float observations. Dr. Olga Sato mentioned that she has a graduate student working on estimates of the Deep Western Boundary current using the SAMBA-west CPIES data. Daniel Valla mentioned he is finishing his PhD using data from SAMBA-west and the associated hydrographic cruises, and that upon completion he will be continuing to work on these topics as a postdoc in Argentina working with Dr. Alberto Piola. Dr. Meinen reiterated that Dr. Marion Kersale was working as a postdoc in Miami together with himself and Drs. Renellys Perez and Matthieu Le Henaff on MOC calculations from the SAMBA and the RAPID/MOCHA/WBTS array.
- Data analysis issues – are there bottlenecks: Overall there was agreement that this was working okay – but there was encouragement for future initiatives like the COCOA meeting that was led by researchers at NOC-Southampton to aid new groups working with dynamic height moorings et cetera. Dr. David Smeed pointed out there is a continuing need for deep mooring data for validation purposes.
- Data sharing – policy, issues and future plans: Dr. Christopher Meinen mentioned that there is a SAMOC data sharing policy that is available on the SAMOC international web page (www.aoml.noaa.gov/phod/SAMOC_international/) and that for projects to be considered part of SAMOC, they should be following that data sharing policy. It was also noted that NOAA is posting its data and the Argentine hydrographic data via the NOAA web pages, and that other SAMOC related data sets should be obtained by request from the individual project investigators. The SAMOC Data Sharing policy is reproduced at the end of this report as Appendix 2 for the convenience of the reader.
- SAMOC web page updates and information: It was mentioned that the SAMOC web page (www.aoml.noaa.gov/phod/SAMOC_international/) is updated roughly every month by Dr. Renellys Perez when she receives updates – but that it can only be updated when SAMOC researchers send the appropriate updates.
- New technology ideas: Dr. Christopher Meinen gave a brief update of several versions of ‘data pod technologies’ that are being developed somewhat independently by NOAA-AOML, the Univ. of Rhode Island, the National Oceanography Centre in Southampton, and by IFREMER.
- Memorandum of Understanding (MOU): There was some discussion, prompted by Dr. Edmo Campos, about the possible need for a formal or informal MOU to aid in joint work by researchers in various countries. There have been institution-level agreements between some agencies, and agency-level agreements between select countries (e.g. France and Brazil). For a many-country agreement involving Argentina, Brazil, France, Germany, South Africa, the UK, and the US, there was general consensus that an informal institution-level agreement would be far more practical given the difficulties that would be involved in the formal agency-level or government-level agreements. Dr. Campos volunteered to work on developing a draft.

The final brief discussion item at the workshop was planning for the time of the next workshop. Attaching the workshop to a major international meeting to reduce travel costs for SAMOC workshop participants seems to be popular, and the ~18 month frequency also seems to be reasonable for those participants who spoke up. Tentatively it was thought that the next SAMOC workshop might be planned to be adjacent to the April 2018 EGU meeting in Vienna – and Dr. Karen Heywood, the EGU Ocean Sciences Division President, strongly encouraged that possibility and suggested it would be possible to have a science session related to SAMOC during the EGU meeting. The SAMOC Executive Committee will discuss this in the future and will look for a ‘local’ organizer in Europe who can help facilitate this if this plan goes forward.

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Acknowledgements

The organizers of the workshop would like to the University of Cape Town for providing the meeting room for the SAMOC VII workshop and for graciously managing the coffee breaks and lunch. Thanks also go to the many international funding agencies around the world that fund the researchers studying SAMOC.

Appendix 1: Workshop agenda

South Atlantic Meridional Overturning Circulation (SAMOC) VII Workshop Cape Town – 4 September 2017

Date: Monday, 4 September, 9:30am-3:00pm

Venue: University of Cape Town

Agenda

- | | | |
|------------------------|---|---------------------|
| <i>9:30am-9:40am</i> | Welcome and overview of workshop goals | Isabelle Ansorge |
| <i>9:40am-10:00am</i> | Brief overview of SAMOC | Edmo Campos |
| <i>9:30am-10:30am</i> | Updates on Observing System status | Chair: Chris Meinen |
| | (incl. SAMBA-west, SAMBA-east, 11°S array, Drake Passage, XBT, CTD, Argo, Altimeter, N. Atlantic, etc.) | |
| <i>10:30am-11:00am</i> | Coffee break | |
| <i>11:00am-Noon</i> | Updates on Observing System status continued | |
| <i>Noon-1:30pm</i> | Lunch break | |
| <i>1:30pm-3:00pm</i> | Discussion of Logistics issues | Chair: Chris Meinen |
| | <ul style="list-style-type: none">• Future proposal plans and opportunities• Future cruise plans and opportunities• Existing and future publication plans• Student and postdoc project plans• Data analysis issues: Are there bottlenecks?• Data sharing: Policy, issues and future plans• SAMOC webpage, data serving, email list, etc.• New Technology ideas?• Memorandum of Understanding (MOU)? | |
| <i>3:00pm</i> | Coffee break and closing | |

Appendix 2: SAMOC Data Sharing Policy

The Data Sharing Policy agreed upon and approved as part of the earlier SAMOC V workshop is reproduced here. The participants in the South Atlantic Meridional Overturning Circulation (SAMOC) Initiative have agreed to the following sharing policy for data collected in projects that are part of SAMOC:

The overarching goal of this policy is to make high quality, fully calibrated, data available broadly to the science community and to the public as quickly as possible. Toward that end, we agree to the following:

- Data collectors are encouraged to publish data in journals that publish original data sets such as Earth System Science Data, Geoscience Data Journal, or CODATA Data Science Journal, etc. as soon as possible after collection with the objective of establishing the source institution(s) that funded the collection of the data sets.
- Data collected will be made available to other SAMOC participants, the science community, and the public immediately after collection and quality control are completed solely for the purpose of calibrating parallel observations and/or models. Users receiving data immediately agree to not use this data for publication or to include it in scientific presentations without the prior approval of the data collectors.
- Data will be made available to other SAMOC participants, the science community, and the public without restriction at the soonest possible time after collection, ideally within six months, and no longer than one year. Data will be made available through at least some of the major data centers including (but not limited to): the National Oceanographic Data Center, the British Oceanographic Data Centre, OceanSITES, etc. in addition to any individual project web pages.
- Within the SAMOC group, data recipients are encouraged to invite scientists involved in the data collection to participate in analyses and publications that depend significantly on the data they collected. This is not intended to force co-authorship; scientists who are invited to participate but who fail to significantly contribute to manuscript development will have no expectation of co-authorship. This practice of inviting participation of data collectors in analyses and publications is also encouraged with data users in the broader scientific community.

Users of SAMOC data are encouraged to keep the groups collecting data informed on how their data is being/will be used. Users are also strongly encouraged to make a good faith effort to inform others and to inform themselves about what graduate students are working on and the projects they are presently conducting in order to minimize duplication of effort to the extent possible and to protect the work of students that may require more extended development time.

This policy does not in any way prevent SAMOC data collectors from sharing their data in a less restrictive manner than is described here - this policy represents only a minimum requirement for inclusion in the SAMOC Initiative.