SAMOC

South Atlantic Meridional Overturning Circulation

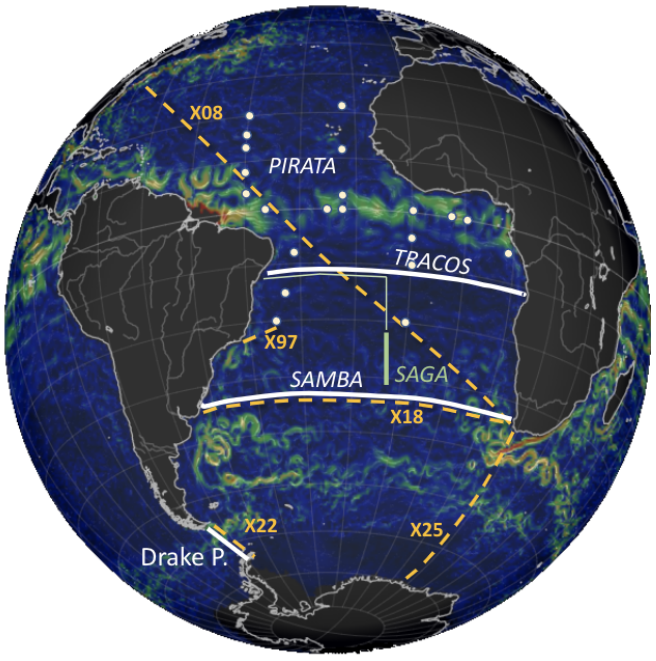
SAMOC IX Workshop Report

Dates: Tuesday, April 6th & Thursday, April 15th, 2021
Times: 9-11am EDT (+4 UTC)
Venue: Virtual

Organizing Committee: Isabelle Ansorge, Maria Paz Chidichimo, Rebecca Hummels, Renellys Perez, Olga Sato

Report prepared by: Isabelle Ansorge, Maria Paz Chidichimo, Rebecca Hummels, Renellys Perez, Olga Sato

SAMOC Observations 2021



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Adapted from Rühs et al., *Ocean Science*, 2019 and Aubone et al., *Progr. Oceanogr*, 2021 by Alberto Piola

Executive Summary

South Atlantic Meridional Overturning Circulation (SAMOC) Workshop IX

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The most well-known circulation feature in the ocean is the Meridional Overturning Circulation (MOC), which circulates heat, salt, dissolved oxygen, carbon, and nutrients between all of the global oceans. In the Atlantic ocean, the Atlantic MOC (AMOC) extends from the Southern Ocean to the northern part of the North Atlantic, transporting heat northwards through the South and North Atlantic Oceans. AMOC has important impacts on coastal sea levels, extreme weather events, marine heat waves, and shifts in regional surface temperature and precipitation patterns, all of which can directly impact agriculture, fisheries, infrastructure, and health around the globe. The South Atlantic Ocean is the gateway for remotely formed water masses to exchange, mix, and flow into the Atlantic Ocean, and it is the only ocean basin to transport heat equatorward. Recognition of the influence of the South Atlantic Ocean on the large-scale overturning circulation (e.g. CLIVAR, 2003), resulted in an international focus on improving South Atlantic Meridional Overturning Circulation (SAMOC) observing capabilities. The first international SAMOC workshop was held in 2007 to discuss existing observations and future implementation plans for new observations, and SAMOC workshops have been held approximately every 18 months since that first meeting. Data collected by the AMOC observing systems in the South Atlantic have, over the past two decades, resulted in significant improvements in our understanding of AMOC mean state, variability, structure, and meridional coherence, and the resulting data sets are highly valuable for validating and improving ocean and climate models.

The purpose of the virtual SAMOC IX logistics meeting, in 2021, was to exchange information about the plans, needs, and expectations regarding SAMOC field work during the various 2021 and 2022 field campaigns. Specifically, we wanted to bring together the SAMOC observational community to discuss how the cruise logistics have been (and continue to be) impacted by the Covid-19 pandemic amongst the different countries involved in SAMOC. The workshop also aimed to discuss data sharing plans, webpage improvements, ideas for future collaborations on papers and proposals, the need for funding mechanisms to sustain and grow the SAMOC observing network, and ideas for a SAMOC science meeting that could highlight the progress made by the community including the final US AMOC meeting in Woodshole, MA in 2022, the 2022 Ocean Sciences Meeting in Honolulu, Hawaii, and a virtual SAMOC science meeting either in late 2021 or early 2022.

Participants in the Virtual SAMOC IX Workshop. Photo courtesy Isabelle Ansorge.

Introduction

Analyses of ocean and climate models, as well as observations, have found that variations in the Atlantic Meridional Overturning Circulation (AMOC) are connected with changes in precipitation patterns, extreme weather phenomenon (e.g. droughts, land and marine 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; Domingues et al., 2018; Volkov et al., 2019). 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), and observational AMOC monitoring efforts have steadily grown (e.g., Frajka-Williams et al., 2019). 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; Smeed et al., 2018; Frajka-Williams et al., 2019; Lozier et al., 2019).

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”). Initial efforts for trans-basin in situ AMOC observing arrays have been initiated through the South Atlantic MOC Basinwide Array or SAMBA at 34.5°S (e.g., Meinen et al., 2013; Ansorge et al., 2014; Meinen et al., 2018; Kersalé et al., 2020; Kersalé et al., 2021) and the Tropical Atlantic Circulation and Overturning at 11°S or TRACOS (e.g., Hummels et al., 2015; Herrford et al., 2021). These observational efforts are steadily growing, and are

crucial for continuously monitoring AMOC variability, as well as tracking its projected decline in the next century (e.g., IPCC, 2013; Weijer et al., 2020).

The South Atlantic Meridional Overturning Circulation (SAMOC) workshops are a series of workshops aimed at improving scientific understanding of the SAMOC and interocean exchanges. These workshops have been ongoing for several years, dating back to the first workshop in 2007 in Buenos Aires, Argentina. SAMOC 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, and have been more focused on joint collaboration of research cruises and field work. Due to the Covid-19 pandemic, it was decided to hold the SAMOC Workshop IX virtually in April 2021.

On 6 and 15 April 2021, a group of 40-50 international scientists gathered virtually for the SAMOC IX Workshop. The focus of the SAMOC IX Workshop was on logistical progress and constraints within each of the projects contributing to the international SAMOC initiative, in particular to discuss upcoming cruises, challenges in fieldwork and impacts posed in the context of the Covid-19 pandemic. The discussions also included plans and opportunities for collaboration, as well as student and postdoctoral fellowship projects, and updates to the SAMOC NOAA-hosted website, and the Data Sharing Policy, among other important topics.

Updates on the SAMOC Observing System (Tuesday, April 6th)
Co-chairs: Dr. Maria Paz Chidichimo and Dr. Isabelle Ansorge
Rapporteur: Dr. Renellys Perez

The Workshop welcome, overview and goals were presented by Dr. Renellys Perez Afterwards an overview and history of the SAMOC initiative was presented by Prof. Alberto Piola. This was followed by several presentations providing updates on the observing systems forming part of the international SAMOC initiative. Dr. Tarron Lamont presented updates on the status and plans for the SAMBA-East array at 34.5°S, and Dr. Olga Sato presented an update on the status of the SAMBA-West array at 34.5°S. Dr. Maria Paz Chidichimo and Dr. Isabelle Ansorge presented an update of the new tall mooring plans under the recently funded iAtlantic & TRIATLAS at SAMBA-West and SAMBA-East programmes. Prof. Dr. Peter Brandt presented updates on the TRACOS array at 11°S. Dr. Pedro Vélez Belchi presented an update on the South Atlantic Gateway Array (SAGA) in the interior South Atlantic. Dr. Janet Sprintall presented updates on the Drake Passage array and shipboard datasets. Lastly, Dr. Shenfu Dong presented updates on the repeat CTD and XBT sections and on the in-situ/altimetry/Argo synthesis products.

The SAMOC overview and observing systems updates are briefly described in the list below.

SAMOC overview (Prof. Alberto Piola)

This talk highlighted the great results emerging from the SAMOC efforts over the past two decades, and provided an overview of the history of SAMOC development. This history includes the CLIVAR Planning meeting in France in 1996 and associated “South Atlantic Climate Change” white paper led by Silvia Garzoli, the OceanObs’99 conference in France where the community articulated the need for a South Atlantic observing system, a white paper led by Edmo Campos in 2001, and activities of the CLIVAR Atlantic Implementation Panel and the GOOS/GCOS Ocean Observations Panel for Climate, among others. A series of eight previous SAMOC meetings have been held between 2007 - 2019 and this is the ninth meeting. During his talk, Alberto presented a map of the observational networks built from all of the programs (including tall moorings, PIES, ADCP moorings, bottom pressure recorders, XBTs, and hydrographic transects), and highlighted the large number of countries involved. The building of theSAMBA at 34.5°S was part of this effort. At 11°S, observations at the western boundary happened earlier than the SAMOC effort. Since then, the 11°S array has evolved into a trans basin TRACOS array. Afterwards, Alberto gave a quick overview of some recent results from the SAMOC observing systems at 11°S and 34.5°S. We are ready to start doing model/data comparisons in the South Atlantic, and a SAMOC observational synthesis is now called for. Dr. Gokhan Danabasoglu mentioned that his team is starting to look at SAMOC observations in detail as part of his AMOC metrics project.

Update on SAMBA-East 34.5°S (Dr. Tarron Lamont)

This section provided an update form the South Africa involvement in SAMOC. Dr. Lamont’s presentation confirmed that funding had been secured through the South African National Antarctic Programme (SANAP) for another three years. However, of concern is that the funding amount has been cut and this reduction will drastically impact the implementation of the full array on SAMBA-East. Discussing achievements in 2020, Tarron confirmed that moorings at Sites C1-C4 had been redeployed in October 2020, and this cruise was largely a success despite issues with the shallower (1000 m) C1 mooring. The issues with C1 were as a result of geological instabilities in

the area which resulted in a shift in the mooring location perhaps due to sediment slippage. As a result, the scientists were unable to communicate with the C1 acoustic release during the cruise. Tarron's team are looking into a possible plan to communicate with the mooring later this year (in September - October 2021). In 2021, it is planned for the IFREMER PIES/CPIES moorings to be turned over and to refurbish several of the NOAA PIES in the mid-Atlantic basin. *Note, a PIES is a pressure-equipped inverted echo sounder attached to the seafloor, and a CPIES is a PIES with the augmentation of a current meter 50 m above the seafloor.* IFREMER will also sign an agreement to keep their PIES/CPIES on the eastern boundary in order to reoccupy Sites C7 and C6 and enhance resolution if possible with other PIES (i.e., the 11 PIES that were recently transferred to NOAA from MIT/WHOI and refurbished by South Africa and France).

One of these 11 PIES was recently deployed along the SAGA transect along a North/South orientation near ~9°W, 34.2°S. This mooring (SN049) connects SAGA to the SAMBA line and combined with the efforts of the Brazilian array (Sites E & F, and most offshore SAMBA-east mooring), the SAMOC community is delighted to announce that SAMBA moorings now extend from the interior on both sides of all of the major ridges to the boundary regions. As part of the international SAMOC partnership, a new BGC Argo float with a UVP camera is planned to be deployed within an Agulhas Ring in the Cape Basin from the German R/V Sonne.

Finally, as with all countries the standard covid requirements on South African research vessels require a 7-day quarantine period prior to cruise (with negative COVID tests) which understandably puts strain on the science team to prepare everything well in advance.

Update on SAMBA-West 34.5°S (Dr. Olga Sato)

The initial PIES moorings, provided by NOAA and supported with ship's time from Argentina and Brazil, have been recovered and redeployed several times since March 2009. The same four sites, the 'Southwest Atlantic MOC' (SAM) Array, have been continuously occupied since 2009. Beginning in 2012, several additional sites have been instrumented within the array with funding from Brazil, and more deployments are planned in future. Two cruises are conducted per year (dates may vary): typically in March-May on a Brazilian vessel (N. Oc. Alpha-Crucis) and September-October on an Argentine vessel (ARA Puerto Deseado). The cruises included CTD/LADCP casts from the continental shelf, along the array, out to PIES Site D (44.5°W), as well as maintenance of the mooring array (e.g., telemetry, recovery, deployment). Additional cruises were conducted for special operations, such as the January 2019 cruise (N. Oc. Alpha-Crucis) to deploy new CPIES in the interior at Sites E and F.

Dr. Sato presented the amazing progress that has been made on the western boundary array of SAMBA since its initial deployment. Recently the array has been extended with three new Brazilian CPIES (Sites 0A, E, and F) deployed in 2019. The CPIES at Sites E and F deployed in January 2019 have Popeyes Data Shuttles (PDS). CPIES 0A was deployed in June 2019 at the shelf break between the ADCP on the upper slope and Site A (at the 1300 isobath) to account for a missing fraction of the Brazil Current contribution to the western boundary transport in that region. During the same cruise, telemetry was conducted at all sites and the four Brazilian CPIES and two of the US PIES were recovered and redeployed. Dr. Sato noted that it was not possible to retrieve the data from the Bottom Pressure gauge at the shelf and apparently the instrument was lost. The Vema Channel moorings were successfully retrieved in June 2020, and they will be deployed again during the next cruise. Olga remarked that during the 2019 cruise it was the first time in a while that everything was in place and

working well (with the one exception of the bottom pressure gauge that was not responding). During her presentation, Olga shared a map of the hydrographic transits that are planned during the next Brazilian cruise, scheduled for October - November 2021. An Argentine cruise is on hold for 2021-2022. Brazil and Argentina cruises are currently on hold due to Covid-19 associated restrictions.

After Olga's presentation, Dr. Maria Paz Chidichimo gave a brief update of the planned tall mooring deployments at SAMBA-West. Two new tall mooring deployments are planned along the array, with funding from the European Union, Argentina, and Brazil. A tall dynamic height mooring with additional biogeochemical sensors, current meters, and an upward-looking ADCP at 200m, is planned to be deployed near the 700m isobaths, through the iAtlantic project. This project will also fund augmentations of SAMBA-West iAtlantic mooring & SAMBA-East tall moorings with oxygen sensors. A tall dynamic height mooring with additional current meters (exact number and deployment depths to be determined) will be deployed near the 3500m isobaths, through the TRIATLAS project. The iAtlantic mooring instrumentation is ready, the initial deployment is planned for one year (deployment plans are halted due to the Covid-19 pandemic).

Update on TRACOS 11°S (Prof. Dr. Peter Brandt)

The TRACOS array at 11°S provides observations on both boundaries of the basin since 2013. The previous array at this latitude, which was maintained between 2000-2004 only provided observations at the western boundary. At the western boundary, the current array setup includes four tall moorings covering the NBUC and DWBC flow and the boundary section (SADCP/CTD) was occupied in total twelve times. As TRACOS is in close proximity to the southern moorings of PIRATA in the interior, the Brazilian PIRATA cruises now also occupy the western boundary section at 11°S providing even more hydrographic section data in addition to the regular maintenance cruises which help resolve water mass variations. For example, the comparison of all hydrographic data obtained on the western boundary shows that salinity is changing on 25.0 isobath in the NBUC region, mostly due to enhanced Indian ocean inflow. The last maintenance cruise of the array at the western boundary took place in October - November 2019 and also serviced the 35°W section, which has not been occupied since 2003.

At the eastern boundary, the Angola current flow was observed with ADCP(s) from July 2013 - July 2019 between 45 m and 450 m depth. The mooring came to the surface early during the last deployment period, but was redeployed in September 2019, so there was only a few months data gap. In general, on the Angolan side there is a lot of fishing activity, and at the moment there is only one mooring at the 1,200 m isobath instead of the two moorings that were deployed at the beginning of the record at shallower depths. The heavy fishing activity has also made it hard to get BPR measurements on the eastern side. Instead, now at the 1200 m isobath mooring microcat measurements are being made higher up in the water column, instead of the two BPR recorders at 300 and 500m depth. Previously, the BPRs at 300 and 500m on both sides of the boundaries were used to get geostrophic velocity anomalies, paired with SSHA from altimetry. The first results on the derived AMOC anomaly time series from these observations are published in Herrford et al. (2021, Ocean Sciences). Despite the changes in the instrumentation configuration, they hope to continue producing these AMOC estimates in the future. The last maintenance cruise at the eastern boundary was just before the pandemic in 2019.

The next maintenance cruises under pandemic conditions will take place during March - May 2021 to do the Angolan mooring servicing and other work in SE Atlantic, and

from June - August 2021 to do the moorings at the western boundary at 11°S as well as other work including the equatorial mooring at 23°W, which is also part of TRIATLAS. The 2021 cruises are planned with a 10-day quarantine before leaving the port and have to start and end in Emden, Germany. So far there are no limitations on cruises to 11°S due to Covid-19 except that the cruises are exceptionally long, because they have to start and end in Germany.

Things to consider for the future: heavy fishing issues on the eastern boundary, additional CPIES could enhance measurements there. The next maintenance cruises will be proposed for 2023. GEOMAR is working on making NBUC/AMOC estimates using Argo data, and also looking at flow pathways near 11°S also from Argo data. For the SAMOC-West array, the TRIATLAS mooring is ready to deploy (see SAMBA-West update above), but the Covid challenge for a deployment of the mooring is that at the moment it is not possible to send scientists and or technicians to Argentina and Brazil, given the restrictions for international travel, and it is not clear when this will change.

Update on SAGA array (Dr. Pedro Velez Belchi)

The South Atlantic Gateway Array (SAGA) is a newly-funded project which aims to measure the zonal flows in the mid-latitude central South Atlantic Ocean. The project is a collaboration between multiple institutions in Spain and Mexico and aims to deploy four PIES and three tall moorings nominally along 9°W, just east of the Mid-Atlantic Ridge. SAGA will measure the upper ocean westward flow in central South Atlantic via the Benguela Current and Agulhas rings following studies by Arhan et al. (2003) and Hernandez-Guerra et al. (2019), and the underlying NADW interior pathway from the west to east South Atlantic. These different water masses and current pathways determined the locations of where they are deploying the moorings. The SAGA team produced the GEM fields using Argo and CTD observations in the area. The tall moorings will sample from 4000m to 2000m depth and are deployed in between pairs of PIES moorings. A geological survey was done prior to deployment to find the best location to deploy the PIES/moorings. The tall moorings are also equipped with deep sediment traps. Additionally, deep Argo floats and 5 standard floats from France were deployed in the Zapiola gyre in the Argentine Basin. The first SAGA cruise took place from 7 March 2021 (Punta Arenas; 15 day mandatory quarantine prior to the cruise due to Covid-19 regulations) to 13 April 2021 (Las Palmas). One of the PIES (SN049) was supplied from University of Cape Town/NOAA (previously owned by MIT/WHOI) and this instrument is the link between SAGA and SAMBA at ~9°W, 34.2°S. The other 3 Spanish PIES were deployed with data pod technology. The last hydrographic station of the SAGA cruise was completed April 4, 2021. One of the planned Spanish cruises in 2021 (section along 9°W, A14) was cancelled. The recovery cruise for the tall moorings will take place in May 2022. The PIES were deployed for 4 years, and the data from PIES data pods is expected on the following dates: July 2022, November 2023, May 2025. Dr. Belchi and Dr. Alonso Hernandez Guerra mentioned their interest in accessing the data from the transbasin MSM60 cruise in 2017. Dr. Sabrina Speich mentions that the data can be found in the global hydrological data center (CCHDO). In a recent publication, Manta et al. (2021) analyzed the MSM60 hydrographic section in detail, and provides more details on data availability. Later comments indicated that the data can also be found on pangaea.

Update on Drake Passage (Dr. Janet Sprintall)

Drs. Janet Sprintall and Teresa Chereskin have been maintaining year-round near-repeat XBT and underway ADCP sampling sections across the Drake Passage

since 1996. The 147+ XBT sections (~6 XBT transects per year) collected thus far have a horizontal resolution of 5-10 km and a depth range of 0-850 m. The underway ADCP measurements (~20 Shipboard ADCP transects per year; NB150, 0-300 m, 415+ transects; OS38 0-1000 m 278+ transects) collected since 1999 use a 150kHz instrument, measuring the upper 300m, and since 2004 also use a 38kHz instrument, measuring between 0-1000 m. Since 2002, underway and discrete measurements of pCO2, DIC, nutrients, and other meteorological variables have also been made across the Drake Passage by Drs. David Munro, Colm Sweeney, and Nicole Lovenduski during ADCP transects, as well as discrete samples during CTD cruise stations (pH, fluorescence, salinity, temperature, silicate, nitrate, phosphate, etc.). See Freeman et al. (2019) for more details. These cruises produce a valuable research and educational data set which is available on NOAA's National Center for Environmental Information (NCEI). An analysis of the cDrake experiment data was conducted to study turbulent mixing from lee waves, eddy heat flux, and flow properties in a streamwise coordinate system (Gutierrez-Villanueva et al., 2020). From 2020 to the present, XBT/ADCP cruise sampling has ceased due to Covid-19, and NSF is not applying for EEZ clearance. A proposal to NSF-ANT was recently funded which will support the 2021-2024 field work once cruises are reestablished.

Update on XBT/CTD cruises and in-situ/altimetry syntheses (Dr. Shenfu Dong)

The high-density XBT transect (AX18) along 34.5°S has been occupied since 2002, with the overall objective of monitoring the upper limb of the South Atlantic MOC. A total of ~55 transects to date provide MOC and meridional heat transport (MHT) estimates on a quarterly basis, and the data have been used to evaluate performance of numerical models simulating the South Atlantic MOC and MHT. Due to the pandemic it was not possible to conduct AX18 cruises during 2020, nor was it possible to visit the ship to train the crews to deploy the XBTs. Results from XBT data collected thus far, continue to show a good correspondence (high correlation) between the MOC and MHT.

The MOC and MHT also are being estimated using using altimetry, Argo, and XBTs (Shenfu Dong's method) and real-time AVISO data and hydrographic data (method developed by Claudia Schmid; Majumder et al., 2016) at 4 latitudes in the South Atlantic 20°, 25°, 30°, 34.5°S, and the methods have been extended to the North Atlantic. Estimates of the MOC and MHT derived from these in situ/altimetry synthesis products were used to study heat buildup and deficits due to convergence and divergences, respectively, in heat transport in the South and North Atlantic, as well as link changes in the South Atlantic to remote forcing in the Pacific (Dong et al., 2020). These MOC and MHT time series are available at https://www.aoml.noaa.gov/phod/samoc_argo_altimetry/index.php. Dr. Claudia Schmid mentioned that she is looking forward to joint analysis opportunities for all time series she is producing. Some info can be found here https://www.aoml.noaa.gov/phod/samoc_argo_altimetry/bc_benc_index.php and https://www.aoml.noaa.gov/phod/samoc_argo_altimetry/index.php.

Although the MOC and MHT derived from the various methods agree well in the North Atlantic and at lower latitudes in the South Atlantic, at 34.5°S the methods don't seem to agree well. More work is needed to understand if these MOC and MHT differences are due to temporal and spatial sampling/coverage (i.e., representation of western boundary currents and/or mesoscale variability) or other aspects of the different observational methodologies.

Finally, Dr. Dong presented the results by Manta et al. (2021), where they analyzed the data from the first trans-basin hydrographic survey along the entire SAMBA transect

(34.5°S) conducted in January 2017, on board the R/V Maria S. Merian (cruise MSM60) through the GO-SHIP program. They found that meridional velocity along the transect is barotropic but eddy rich. In addition, it was mentioned that the AX25 XBT line between Cape Town and Antarctica along the GoodHope line has been able to continue with annual XBT deployments despite the pandemic. The GoodHope line started in 2003 and is in its 18th year!

After the presentations, Dr. Renellys Perez closed the session and presented the topics that will be discussed on Day 2. The group suggested discussing on day 2 the need to reconcile and understand the reason for the differences in the various MOC and MHT estimates along 34.5°S. A group photo was taken.

Logistics Discussion(Thursday, April 15th)
Co-chairs: Dr. Olga Sato and Dr. Rebecca Hummels
Rapporteur: Dr. Maria Paz Chidichimo

On day 2, all the topics listed in the agenda were discussed with all participants leading to an open discussion on various topics. Discussions during the workshop included issues and opportunities on existing and future proposal and cruise plans, student and postdoctoral project plans, data analysis and publication plans, as well as Data Sharing policies. The discussions also included necessary updates that need to be made to the SAMOC webpage, and new technology ideas for implementation as part of the monitoring arrays. The following key points and action items and were discussed by the community during the conversation:

Funding - Current projects and programs and upcoming proposals

The different running projects gave information about their running funding and plans for extending their funding:

- SAGA (Pedro Velez-Belchi): up to end 2021 (SAGA component to SAMOC); plan to ask for funding for next 3 years

- NOAA (Renellys Perez): proposal (abyssal temperature in the South and North Atlantic (follows up Meinen et al. 2020 study); will hear back from proposal mid May. Update: This proposal was funded in May 2021.

- SAMBA-East array (Tarron Lamont) 02/2021 -12/2023 (proposal approved from National Research Foundation's SANAP Programme with further support from H2020 iAtlantic)

- iAtlantic (María Paz Chidichimo): already acquired all instruments for shelf mooring at SAMBA-West (the proposal includes attaching oxygen sensors to SAMBA-West and SAMBA-East moorings and to analyse connections with oxygen variability in the North Atlantic).

- Triatlas (Sabrina Speich): instruments in acquisition; microcats equipped with ODO sensors to attach to SAMBA-East moorings; Tall moorings for Triatlas and iAtlantic ready, but the Argentine cruise on hold due to the pandemic; Edmo Campos has Microcats for Triatlas moorings

- Sheekela Baker-Yeboah will work on the PIES-Altimeter ground track comparison in collaboration with Tarron & others.

- Peter Brandt: GEOMAR received funding for the TRACOS array via TRIATLAS

- Matthieu Le Henaff: NASA project to use along-track altimetry to estimate the shelf and shelf break transport, on both sides of the basin. The project ends in 2022. Sabrina mentioned that related efforts are underway under the EUREC4A project.

- Peter Brandt & Sabrina Speich: Upcoming EU/Horizon proposal call centered on AMOC Consortia are coming together. One proposal is led by Gerard McCarthy (with Sabrina Speich). This project call includes North Atlantic countries because the call is strongly connected with Arctic Ocean variability.

- Renellys Perez: Upcoming NSF Networked Blue Economy Funding Opportunity

- Edmo Campos: SAMBAR-Brazil is going up to 2022. The plan is to seek funding to continue the project. The concern was raised that agencies fund new research, not sustained programs. Tarron mentioned the same concern exists for SAMBA-East.

- Elaine McDonagh: More sustained funding is something that hopefully will come out of the OceanDecade and mentions the EU call related to ice sheets and impacts on the broader circulation and climate.

- Ann-Christine Zinkann (NOAA): UN Ocean Decade committee needs more time to release information about programmes that got funded; Upcoming Laboratories, they welcome proposals; Predicted Ocean Laboratory is in September 2021 (Maria Paz Chidichimo & Sabrina Speich are part of the expert team); Next call to submit proposal for projects will be in the fall 2021 or spring 2022.

- Sabrina Speich: GOOS is advancing programmes like Ocean Predict, Ocean Obs co-design for many purposes.

- Josep Pelegri: His institution is coordinating a proposal on Ocean Sites.

- Ocean Decade: It is just about endorsement: Ocean Decade will put pressure on the right level for sustained observations, but there is no funding attached to the Ocean Decade, research money has to come for individual countries. There will be Carbon and deep ocean observation proposals submitted to Ocean Decade.

The note was placed that further information on new/existing projects that aren't captured on the SAMOC international webpage (https://www.aoml.noaa.gov/phod/SAMOC_international/) should be sent to Renellys Perez after the meeting for inclusion on the webpage.

Data processing and archiving, and continuity plans

Many participants reported out on their individual ways of data archiving and sharing. It was agreed that people should always send their information in particular the links to the different data sources about where to find SAMOC related data to Renellys Perez and then it will be all placed on the SAMOC international webpage. This will enable users to find all the relevant data of the different groups, until a shared data repository is available.

Tarron Lamont mentions that Chris Meinen was overseeing all the processing of the CPIES data from the SAMBA-East array. Marion Kersalé started in South Africa and then moved to NOAA as a postdoc, and she helped a lot with the data processing. Marion Kersalé is now moving on to do different things. Tarron asks about continuation plans for data collection, calibration, etc., which is an important conversation that all projects should be having. SAMBA-east data is archived at the South African Marine Management System, which is a new system under development.

There is the open question still of having all of the SAMBA data at the same data center. This is a topic that needs to be revisited and discussed further. Renellys Perez mentions that Rigoberto Garcia processes the PIES/CPIES data for SAM and SAMBA-West, and that Renellys Perez and Shenfu Dong are taking over from Chris Meinen and Marion Kersalé.

Status and future of SAMBA-East instruments

Tarron Lamont: Brought up the importance of having spare instruments, and how funding limitations have limited their ability to have a redundancy of instruments. The 11 PIES that previously belonged to MIT/WHOI and were refurbished by South Africa and France, will hopefully help provide spares for reinstrumenting some of the SAMBA-East sites.

Renellys Perez: NOAA/GOMO provided one-time funds to purchase spare PIES for SAM. They should be available in September 2021, and will greatly help to have more spares available for SAM turnaround operations.

New field programs and datasets that are available for SAMOC-related studies

Here is the collection of all the upcoming cruises that were discussed during the meeting:

SAMBA-East:	September - October 2021
SAMBA-West (Brazil):	October - November 2021 cruise is on hold
SAMBA-West (Argentina):	2021 - 2022 Argentine cruise is on hold

SAMBA-West iAtlantic shelf mooring instrumentation is ready, as is SAMBA-West TRIATLAS mooring, but the deployment plans are on halt due to the pandemic.

TRACOS 11°S:	March - May 2021 (Eastern side);
	June - August 2021 (Western side);
SAGA	March - April 2021 (two cruises October - November 2021, 2022 have been proposed)
Drake Passage	Cruises on pause at the moment due to pandemic
XBT sections 34.5°S	Cruises on pause at the moment due to pandemic

- Deployment of tall moorings at SAMBA West (iAtlantic and TRIATLAS); Argentine cruise on hold in SAMBA west. Peter Brandt mentions that technicians can not travel from Germany due to restrictions associated with the pandemic.

Instrument autorelease dates:

- Two SAM PIES moorings were deployed in 2018 and they will autorelease in 2023. The remaining SAM PIES and Brazilian PIES/CPIES sites were deployed in June 2019, and have autorelease dates in 2024. We have some time for maintenance cruises, but not much. However, no telemetry has been done since June 2019 and this means that there is a high risk of major data gaps if we can't visit those sites in 2021 or 2022.

- ADCP mooring from Brazil has an autorelease date for 2021 (it is on the upper continental slope close to the coast, maybe there are other options to get there before the autorelease).

Suggestions for new scientific studies

This topic created a lively discussion and collection of new and exciting ideas about what could be studied next in the context of SAMOC. Some of these ideas are presented below:

- Reconciling the differences between various MOC and MHT results from different observing systems in the subtropical South Atlantic (e.g., 34.5°S)
- Understand the processes ventilating subtropical gyres, heat/freshwater fluxes, eddies, variability of boundary currents and how they contribute to MOC and MHT variability, add oxygen sensors to tall moorings (the latter is already being planned under iAtlantic at SAMBA-West and SAMBA-East).
- Move to include biogeochemistry (BGC) studies - new BGC Argo floats deployed, MSM60 cruise, new iATLANTIC, TRIATLAS moorings, co-benefit of having platforms to add multiple sensors.
- There is a consensus to increase research that shows the impact of what we are doing (i.e., examining how societal relevant phenomena are modulated by the MOC and MHT in the South Atlantic).
- Measurements link to to heat build up in the South Atlantic Dipole and its impact on coastal sea level anomalies
- Heather Furey (MIT/WHOI) mentions that so far there are no Lagrangian studies in the deep ocean in the South Atlantic, it would be great to do such a project in the South Atlantic and simultaneously do particle tracking experiments in models; Conversation with Edmo Campos to deploy floats to measure deep ocean eddies. Olga Sato suggests putting together models and observations; Tarron: also interested in this for SAMBA-East region (they have several cruises going on); Renellys Perez: suggests involving Josefina Olascoaga at the University of Miami in this discussion.
- Increase the number of model-observational studies using SAMOC observations.
- We need more coastal moorings, and to examine phenomena near the coasts, to link better to societal benefits.
- We need long SAMOC records to study connection of MHT to extreme weather precipitation (e.g., Lopez et al. 2016 with models and MOC reconstructions)
- Regina Rodrigues used RAFOS floats to extract information on South Atlantic currents and circulation.
- Study the impact of South Atlantic MHT to extreme weather (precipitation); link between MOC, boundary currents, coastal sea level/extremes.

Improvement/update content on the SAMOC International webpage

- Deadline for getting new information to Renellys Perez for inclusion on the webpage is April 30th.
- People should not be deleted from the webpage, but maybe should gradually move to the bottom or keep an alumni area.
- We should add a new page tracking all of the students/postdocs that have worked on SAMOC. It is part of the broader impacts/legacy of SAMOC.
- GoogleDoc information can be updated rather frequently.
- Opportunities for at-sea training for students could also be mentioned on the webpage.

Update on the newly formed international CLIVAR AMOC Task Team, UN Decade, and other international initiatives. Synergies with Belem Statement.

- CLIVAR AMOC Task Team (started in April 2021, co-chairs: Eleanor Frajka Williams and Eric Chassignet, includes Rebecca Hummels, Sabrina Speich and Maria Paz Chidichimo as members). Motivation: US CLIVAR AMOC Science Team is sunsetting in 2022; the new CLIVAR AMOC Task Team includes all international AMOC-related studies from north to south.
- Belem Statement: allowed for the BG8 EU Horizon 2020 call to include South Atlantic countries and for the North Atlantic countries to expand their research on different regions in the South Atlantic.

Ideas for a SAMOC Science meeting

- Propose a SAMOC session at the 2022 Ocean Sciences meeting (Shenfu Dong). The Deadline for Ocean Sciences Session Proposal 26th May 2021, it was not decided who is chairing/co-chairing, this will be discussed further by the SAMOC Executive Committee. Ocean Sciences will take place in Hawaii in February 2022, it will be difficult for people elsewhere to participate in person due to pandemic related travel limitations. Update: Session was proposed by Janet Sprintall, Siren Ruhs, Gaston Manta, and Manuel Gutierrez-Villanueva.
- Propose a virtual 3-5 day SAMOC science meeting (Sabrina Speich)
    - When could this take place? Perhaps after the 2021 cruises?
    - This could give more time for discussion and project development
    - The group suggested giving this virtual meeting a broader science perspective beyond SAMOC, and to cover South Atlantic studies in general.
- The final US AMOC meeting is scheduled for April 25-28, 2022 in WHOI/MIT. This meeting will involve a smaller gathering of scientists, and provides an opportunity to have a SAMOC focused day or two of meetings and will be a hybrid meeting.
- Sabrina Speich mentions a proposal submitted to AANCHOR for an “All Atlantic” Workshop (under review). It will be somewhere in the South Atlantic. The timeline is not clear.
- The need to involve the modelling and data assimilation community in such a science meeting was discussed.

Acknowledgements

The organizers of the SAMOC IX Workshop would like to thank all of the speakers and participants for joining us virtually, and all of the personnel that are conducting field operations in this challenging time. We hope to be able to meet soon in person for the next SAMOC Workshop.

Bibliography

Ansorge, I. J., M. O. Baringer, E. J. D. Campos, S. Dong, R. A. Fine, S. L. Garzoli, C. S. Meinen, R. C. Perez, A. R. Piola, M. J. Roberts, S. Speich, J. Sprintall, T. Terre, M. A. van den Berg, Basin-Wide Oceanographic Array Bridges the South Atlantic, EOS, 95, 53-54, doi:10.1002/2014EO060001, 2014.

Aubone, N., E. D. Palma, and A. Piola, The surface salinity maximum of the South Atlantic, Progress Oceanography, 191, 102499, doi:10.1016/j.pocean.2020.102499, 2021.

Broecker, W. S., Chaotic climate, Scientific American, 273, 62-68, 1995.

Buckley, M. W., and J. Marshall, Observations, inferences, and mechanisms of the Atlantic Meridional Overturning Circulation: A review, Reviews in Geophysics, 54, 5-63, doi:10.1002/2015RG000493, 2016.

Cunningham, S. A., T. Kanzow, D. Rayner, M. O. Baringer, W. E. Johns, J. Marotzke, H. R. Longworth, E. M. Grant, J. J-M. Hirschi, L. M. Beal, C. S. Meinen, and H. L. Bryden, Temporal Variability of the Atlantic Meridional Overturning Circulation at 26.5°N, Science, 317, 935, doi:10.1126/science.1141304, 2007.

Delworth, T. L., and F. Zeng, The Impact of the North Atlantic Oscillation on Climate through Its Influence on the Atlantic Meridional Overturning Circulation, Journal of Climate, 29, 941-962, doi:10.1175/JCLI-D-15-0396.1, 2016.

Domingues, R., G. Goni, M. Baringer, and D. Volkov, D, What caused the accelerated sea level changes along the U.S. East Coast during 2010–2015?, Geophysical Research Letters, 45, doi:10.1029/2018GL081183, 2018.

Enfield, D. B., A. M. Mestas-Nuñez, and P. J. Trimble, The Atlantic multidecadal oscillation and its relation to rainfall and river flows in the continental U.S., Geophysical Research Letters, 28 (10), 2077-2080, doi:10.1029/2000GL012745, 2001.

Frajka-Williams, E., I. J. Ansorge, J. Baehr, H. L. Bryden, M. P. Chidichimo, S. A. Cunningham, G. Danabasoglu, S. Dong, K. A. Donohue, S. Elipot, P. Heimbach, N. P. Holliday, R. Hummels, L. C. Jackson, J. Karstensen, M. Lankhorst, I. A. Le Bras, M. S. Lozier, E. L. McDonagh, C. S. Meinen, H. Mercier, B. I. Moat, R. C. Perez, C. G. Piecuch, M. Rhein, M. A. Srokosz, K. E. Trenberth, S. Bacon, G. Forget, G. Goni, D. Kieke D, J. Koelling, T. Lamont, G. D. McCarthy, C. Mertens, U. Send, D. A. Smeed, S. Speich, M. van den Berg, D. Volkov, and C. Wilson, Atlantic Meridional Overturning Circulation: Observed Transport and Variability, Frontiers Marine Science, 6:260, doi:10.3389/fmars.2019.00260, 2019.

Freeman, N. M., D. R. Munro, J. Sprintall, M. R. Mazloff, S. G. Purkey, I. Rosso, C. A. DeRanek, and C. Sweeney, The observed seasonal cycle of macronutrients in Drake Passage: Relationship to fronts and utility as a model metric. Journal of Geophysical Research: Oceans, 124, 4763– 4783, doi:10.1029/2019JC015052, 2019.

Gutierrez-Villanueva, M. O., T. K. Chereskin, and J. Sprintall, Upper-ocean eddy heat flux across the Antarctic Circumpolar Current in Drake Passage from observations: time-mean and seasonal variability, Journal of Physical Oceanography, 50(9), 2507-2527, doi:10.1175/JPO-D-19-0266.1, 2020.

Herrford, J., P. Brandt, T. Kanzow, R. Hummels, M. Araujo, and J. V. Durgadoo, Seasonal variability of the Atlantic Meridional Overturning Circulation at 11° S inferred from bottom pressure measurements, Ocean Science, 17, 265–284, https://doi.org/10.5194/os-17-265-2021, 2021.

Hummels, R., P. Brandt, M. Dengler, J. Fischer, M. Araujo, D. Veleda, and J. V. Durgadoo, Interannual to decadal changes in the western boundary circulation in the Atlantic at 11°S, Geophysical Research Letters, 42, 7615–7622, doi:10.1002/2015GL065254, 2015.

IPCC, Climate change 2013: The physical science basis. Contribution of Working Group I to the fifth assessment report of the Intergovernmental Panel on Climate Change, New York, NY, Cambridge University Press, 1535 pp., 2013.

Kersalé, M., C. S. Meinen, R. C. Perez, M. Le Hénaff, D. Valla, T. Lamont, O.T . Sato, S. Dong, T. Terre, M. van Caspel, M. P. Chidichimo, M. van den Berg, S. Speich, A. R. Piola, E. J.D. Campos, I. Ansorge, D. L. Volkov, R. Lumpkin, S. Garzoli, Highly Variable Upper and Abyssal Overturning Cells in the South Atlantic. Science Advances, Vol. 6, no. 32, eaba7573, doi:10.1126/sciadv.aba7573, 2020.

Kersale, M., C. S. Meinen, R. C. Perez, A. R. Piola, S. Speich, E. J. D. Campos, S. L. Garzoli, I. Ansorge, D. L. Volkov, M. Le Henaff, S. Dong, T. Lamont, O. T. Sato, and M. van den Berg, Multi-year estimates of Daily Heat Transport by the Atlantic Meridional Overturning Circulation at 34.5S, Journal of Geophysical Research Oceans, doi: 10.1029/2020JC016947, 2021.

Lopez, H., S. Dong, S.-K. Lee, and G. Goni, Decadal modulations of interhemispheric global atmospheric circulations and monsoons by the South Atlantic Meridional Overturning Circulation, Journal of Climate, doi:10.1175/JCLI-D-15-0491.1, 2016.

M. S. Lozier, F. Li, S. Bacon, F. Bahr, A. S. Bower, S. A. Cunningham, M. F. de Jong, L. de Steur, B. deYoung, J. Fischer, S. F. Gary, B. J. W. Greenan, N. P. Holliday, A. Houk, L. Houpert, M. E. Inall, W. E. Johns, H. L. Johnson, C. Johnson, J. Karstensen, G. Koman, I. A. Le Bras, X. Lin, N. Mackay, D. P. Marshall, H. Mercier, M. Oltmanns, R. S. Pickart, A. L. Ramsey, D. Rayner, F. Straneo, V. Thierry, D. J. Torres, R. G. Williams, C. Wilson, J. Yang, I. Yashayaev, J. Zhao, A sea change in our view of overturning in the subpolar North Atlantic, Science, 363, 516–521, 2019.

Majumder, S., C. Schmid, G. Halliwell, An Observations and Model Based Analysis of Meridional Transports in the South Atlantic. Journal of Geophysical Research, doi: 10.1002/2016JC011693, 2016.

Manta G., S. Speich, J. Karstensen, R. Hummels , M. Kersalé , R. Laxenaire, A. Piola, M. P. Chidichimo, O. T. Sato, L. Cotrim da Cunha, I. Ansorge, T. Lamont, M.A. van den Berg, U. Schuster, T. Tanhua , R. Kerr, R. Guerrero, E. Campos, and C. S. Meinen, The South Atlantic meridional overturning circulation and mesoscale eddies in the first GO-SHIP section at 34.5°S, Journal of Geophysical Research: Oceans, 126, e2020JC016962, doi:10.1029/2020JC016962, 2021.

McCarthy, G. D., I. D. Haigh, J. J. Hirschi, J. P. Grist, D. A. Smeed, Ocean impact on decadal Atlantic climate variability revealed by sea-level observations, Nature, 521, 508–510, doi:10.1038/nature14491, 2015.

Meinen, C. S., S. Speich, R. C. Perez, S. Dong, A. R. Piola, S. L. Garzoli, M. O. Baringer, S. Gladyshev, and E. J. D. Campos, Temporal variability of the Meridional Overturning Circulation at 34.5°S: Results from two pilot boundary arrays in the South Atlantic, Journal of Geophysical Research Oceans, 118 (12), 6461-6478, doi:10.1002/2013JC009228, 2013.

Meinen, C. S., S. Speich, A. R. Piola, I. Ansorge, E. Campos, M. Kersalé, T. Terre, M.-P. Chidichimo, T. Lamont, O. T. Sato, R. C. Perez, D. Valla, M. van den Berg, M. Le Henaff, S. Dong, and S. L. Garzoli, Meridional Overturning Circulation transport variability at 34.5°S during 2009-2017: Baroclinic and barotropic flows and the dueling influence of the boundaries, Geophysical Research Letters, 45(9), 4180-4188, doi: 10.1029/2018GL077408, 2018.

Meinen, C. S., R. C. Perez, S. Dong, A. R. Piola, and E. Campos, Observed ocean bottom temperature variability at four sites in the Argentine Basin: Evidence of decadal

deep/abyssal warming amidst hourly to interannual variability during 2009-2019, Geophysical Research Letters, 47, doi: 10.1029/2020GL089093, 2020.

Ruhs, S., F. U. Schwarzkopf, S. Speich, and A. Biastoch, Cold vs. warm water route - sources for the upper limb of the Atlantic Meridional Overturning Circulation revisited in a high-resolution ocean model, Ocean Science, 15, 489-512, doi: 10.5194/os-15-489-2019, 2019.

Send, U., M. Lankhorst, and T. Kanzow, Observation of decadal change in the Atlantic meridional overturning circulation using 10 years of continuous transport data, Geophysical Research Letters, 38, L24606, doi:10.1029/2011GL049801, 2011.

Smeed, D. A., S. A. Josey, C. Beaulieu, W. E. Johns, B. I. Moat, E. Frajka-Williams, and Coauthors, The North Atlantic Ocean is in a state of reduced overturning. Geophysical Research Letters, 45, 1527–1533. doi:10.1002/ 2017GL076350, 2018.

Stommel, H., The Abyssal Circulation, Deep-Sea Res., 5(1), 80-82, 1958.

Stouffer, R. J., J. Yin, and J. M. Gregory, Investigating the causes of the response of the thermohaline circulation to past and future climate changes, J. Clim., 19(8), 1365–1387, 2006.

Vellinga, M., and R. A. Wood, Global climatic impacts of a collapse of the Atlantic thermohaline circulation, Clim. Change, 54(3), 251–267, 2002.

Volkov, D. L., S. -K. Lee, R. Domingues, H. Zhang, and M. Goes, Interannual sea level variability along the southeastern seaboard of the United States in relation to the gyre-scale heat divergence in the North Atlantic, Geophysical Research Letters, 46, 7481–7490, doi:10.1029/2019GL083596, 2019.

Weijer, W., W. Cheng, O. A. Garuba, A. Hu, and B. T. Nadiga, CMIP6 models predict significant 21st century decline of the Atlantic Meridional Overturning Circulation. Geophysical Research Letters, 47, e2019GL086075, doi:10. 1029/2019GL086075, 2020.

Zhang, R., and T. L. Delworth, Impact of Atlantic multidecadal oscillations on India/Sahel rainfall and Atlantic hurricanes, Geophys. Res. Lett., 33, L17712, doi:10.1029/2006GL026267, 2006.

Appendix 1: SAMOC Logistics Meeting Agenda

DAY 1, Tuesday April 6th
Theme: Updates on the Observing System
Co-chairs: Maria Paz Chidichimo and Isabelle Ansorge
Rapporteur: Renellys Perez

1. Welcome (Renellys Perez, 5 minutes)
2. SAMOC overview (Alberto Piola, 15 minutes)
3. Updates on observing system, covid19 impacts, upcoming cruises (10-15 minutes each)
    a. SAMBA-East (Tarron Lamont)
    b. SAMBA-West (Olga Sato)
    c. TRACOS array at 11°S (Peter Brandt)
    d. iAtlantic & TRIATLAS (Isabelle Ansorge & Maria Paz Chidichimo, incorporated into other presentations)
    e. SAGA (Pedro Vélez Belchi)
    f. Drake Passage (Janet Sprintall)
    g. XBT cruises and in-situ/altimetry synthesis products (Shenfu Dong)
4. Q&A for all of the speakers
5. Closing and topics that will be discussed on Day 2

DAY 2, Thursday April 15th
Theme: Logistics discussion
Co-chairs: Olga Sato and Rebecca Hummels
Rapporteur: Maria Paz Chidichimo

To share information with the group on any of these topics, please send a slide to the co-chairs by Monday April 12th.

1. Funding - current projects/programs and upcoming proposals
2. Data processing & archiving - continuity plans
3. Status and future of SAMBA East instruments
4. New field programs and datasets that are available for SAMOC-related studies
    a. Coastal altimetry (Matthieu Le Henaff)
5. SAMOC study ideas
    a. Reconciling differences between various MOC/MHT results in the subtropical South Atlantic (e.g., 34.5S)
6. Improvement/update content on the SAMOC International webpage
    a. add a new page tracking all of the students/postdocs that have worked on SAMOC
7. Update on the newly formed international CLIVAR AMOC Task Team, UN Decade, and other international initiatives. Synergies with Belem Statement.
8. Ideas for a SAMOC Science meeting
    a. Propose a SAMOC session at the 2022 Ocean Sciences meeting (Shenfu Dong)
    b. Propose a virtual 3-5 day SAMOC science meeting (Sabrina Speich)

Appendix 2: List of Registered Participants

Adrian Rafael
Alberto Piola
Alonso Hernández Guerra
Andrew Stefanick
Ann-Christine Zinkann
Ariel Hernan Troisi
Claudia Schmid
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Edmo Campos
Elaine McDonagh
Gavin Louw
Gokhan Danabasoglu
Grant Rawson
Heather Furey
Isabelle Ansorge
James Todd
Janet Sprintall
Jose Luis Pelegri
Lina Sitz
Marcel van den Berg
Maria Paz Chidichimo
Marion Kersalé
Matthieu Le Henaff
María Dolores Pérez Hernández
Melania Cubas
Mike Patterson
Olga Sato
Pedro Pena
Pedro Vélez Belchí
Peter Brandt
Rebecca Hummels
Renellys Perez
Rigoberto Garcia
Ryan Smith
Sabrina Speich
Sheekela Baker-Yeboah
Shenfu Dong
Sabrina Speich
Tarron Lamont
Teresa Chereskin
Terry Schaefer
Ulises Rivero