

Atlantic Region Panel

Sabrina Speich, sabrina.speich@lmd.ipsl.fr
Paquita Zuidema, pzuidema@rsmas.miami.edu

Panel overview

The CLIVAR Atlantic Region Panel (ARP) is in charge of implementing the CLIVAR science plan in the Atlantic section. ARP works closely with the other CLIVAR panels, regional and global programs. In the last year, we have been involved in a major review of Tropical Atlantic Observing Systems (TAOS) and in the promotion of interdisciplinary multinational field work.

Achievements for 2019-2020

1. The Tropical Atlantic Observing System (TAOS) Review (Speich & Rodrigues)

ARP co-chair Sabrina Speich is a lead author on the TAOS review, the first draft of the TAOS Review report was produced and solicited comments from the TAOS Review Committee, CLIVAR panels and SSG, OOPC, PIRATA, and etc from July to September 2020. ARP members participated in the review of the document. A current deadline of late November is in place for finalizing the review.

2. AtlantOS the Program (de Young, Chidichimo, Lamont)

ARP members are present within the AtlantOS Program was formally announced at the First International AtlantOS Symposium (March, 2019) supporting an All-Atlantic Ocean Observing System to address the challenges and realize opportunities for society, the economy, and the environment. The AtlantOS Program (<http://www.atlantos-ocean.org/contact.html>) has the vision to support the implementation of an All-Atlantic Ocean Observing System that benefits all of us living, working and relying on the ocean. The approach being followed in the program is to advance the implementation of joint observational elements in the Atlantic to improve the basin-scale system and in particular to ensure that information meets societal needs. There is also activity around five case studies that are meant to both demonstrate and realize the benefits of basin-scale coordination. The five case studies are on:

- Providing Basin-Scale Climate Services: Atlantic Meridional Overturning Circulation
- Carbon Uptake: Identifying Sinks and Sources
- Mitigating Impacts of Sargassum on Coastal Communities in the Tropical Atlantic
- Supporting Ecosystem Based Management for Fisheries in the Atlantic Upwelling Regions
- Networks to Predict and Explain Marine Animal Movements in a Changing Environment

A white paper was written (deYoung et al. 2020) and presented at the OceanObs'19 meeting at which several side-events around the AtlantOS program were also held. The AtlantOS program has applied for project status within GOOS and the GEO Blue Planet as it moves forward to implement its basin-scale program activities. The first case study, with its focus on AMOC, also complements the ARP focus on providing continuity on AMOC studies, described further under 5.

3. The EUREC4A/ATOMIC field experiment (Foltz, Zuidema, Speich)

The Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC, U.S.) and Elucidating the Role of Clouds-Circulation Coupling in Climate (EUREC4A, Europe) took place during six weeks in January-February 2020 to address Northwest Tropical Atlantic ocean-atmosphere interactions at the mesoscale and submesoscale and their relationships with the regional oceanic boundary layer and atmospheric shallow convection. The field work involved four research vessels, four research aircraft, land-based observations from Barbados, and a unique panoply of robotic platforms combined with a comprehensive modeling program (www.eurec4a.eu). Particular emphases of ATOMIC and EUREC4A-OA, the ocean-atmosphere component of EUREC4A, were the interaction between shallow convection and the ocean's surface layers, especially in the context of small-scale (100m–10km) SST fronts and oceanic barrier layers. CLIVAR's endorsement of the ATOMIC/EUREC4A-OA activity (<http://www.clivar.org/news/atomic-and-eurec4a-oa-have-been-endorsed-clivar>) was important for promoting the visibility and significance of these projects. Sabrina is co-PI of EUREC4A-OA; while Paquita and Greg were active participants in the ATOMIC.

In the northern “Tradewind Alley” portion of the study area, mainly between Barbados and the Northwest Tropical Atlantic Station for air-sea flux measurements buoy (NTAS), the R/V Meteor and R/V Ron Brown extensively measured the atmosphere and ocean in coordination with observations from the NOAA P3 aircraft. Many semi-autonomous and autonomous platforms were deployed from the ships, including six SWIFT (Surface Wave Instrument Floats with Tracking) buoys to measure surface waves and air-sea fluxes; a Sairdrone and an AutoNaut to measure the near-surface ocean and atmosphere, including profiles of ocean velocity; and four ocean gliders. More than 450 CTD casts were conducted from the ships.

In the “Boulevard des Tourbillons” region south of Tradewind Alley (~6°N-13°N), the R/V MS-Merian and R/V Atalante collected close to 5000 profiles of the upper ocean from many different instruments, including underway CTDs, Moving Vessel Profilers, XBTs, XCTDs, and microstructure profilers. The ships also deployed numerous radiosondes, 22 surface drifters, two air-sea flux observing prototypes (OCARINA and PICCOLO), and five Argo floats with dissolved oxygen sensors. Four saildrones and three ocean gliders in the region substantially augmented the ship's measurements. Throughout the MS-Merian and Atalante cruises, there was continuous monitoring of existing and predicted ocean-atmosphere conditions using real-time satellite data and ocean model output, and the ship was directed to regions of scientific interest. This coordination allowed for extensive sampling within mesoscale eddies and across strong submesoscale surface temperature and salinity fronts and filaments.

Work is currently underway to analyze the wealth of data collected during EUREC4A-OA and ATOMIC. Examples of initial results include very strong surface density gradients ($> 0.05 \text{ kg m}^{-3} \text{ km}^{-1}$) at small spatial scales ($< 20 \text{ km}$) that are often associated with strong surface freshening, likely from intense rain showers. Subsurface measurements from the R/V Atalante show a large subsurface eddy centered at a depth of about 300 m and carrying low-salinity South Atlantic Water northward underneath the shallower northward transport of warmer, saltier North Atlantic tropical water. Off the coasts of French Guiana and Suriname (~ 6-7°N), a cool, fresh plume was sampled by shipboard measurements and drifters as it detached from the continental shelf. These plumes, originating from the Amazon River to the south, are important sources of near-surface freshwater for the open ocean and can impact SST and local air-sea interaction. Initial results show the importance of both geostrophic and wind-driven currents for the offshore dispersal of the plumes (Reverdin et al., *JGR-Oceans*, to be submitted). A more thorough summary of the atmospheric

and oceanic measurements made during EUREC4A-OA/ATOMIC and preliminary analyses can be found in an overview paper by Stevens et al. that has been submitted to *AGU Advances*.

4. Living Action plan post–OceanObs’19 Conference (Speich)

There were supposed to be many activities in 2020 to build on the Living Action plan post–OceanObs’19 Conference. Apart from a physical meeting at the Ocean Sciences conference in San Diego in February 2020, other activities have been impeded or delayed by the Covid-19 pandemic. In particular, a dedicated meeting in Cape Town in March 2020 led by OOPC-GOOS and hosting all the major networks and Observing Systems in place has been canceled. Plans are to organize a webinar in early 2021 and consecutive virtual meetings. ARP members are actively contributing to the organization and agenda.

5. The Atlantic Meridional Overturning – Activities update (Frajka-Williams & Chidichimo)

The US AMOC project is sunsetting this year, ending an intensive 10-year period of work, with US agencies expected to support further work at a lower level of funding. At the same time funding for many of the observational programs, such as OSNAP, have been extended. ARP has been in discussion with both the US CLIVAR AMOC Science team and the CLIVAR SSG on how best to further monitoring efforts of the Atlantic Meridional Overturning Circulation and the associated science. There has also been discussion about alignment with the AMOC case study of AtlantOS. At the time of this writing, the terms of reference and initial configuration for a CLIVAR AMOC Task Team were being finalized.

6. Planning of Joint CLIVAR/FIO 2020 Summer School (Robinson)

The Summer School on Ocean Macroturbulence and its role in Earth’s Climate, led by Walter Robinson and originally planned for summer 2020, has been delayed for the summer of 2021. Plans for the summer school will be revisited in January of 2021; the lead organizer expresses a wish to delay further to summer of 2022 as opposed to holding the summer school virtually in 2021.

7. CLIVAR Research Foci update (Richter)

ARP supported the proposal to develop the Tropical Basin Interaction (TBI) Research Focus group, led by Ingo Richter and Noel Keenlyside. The tropical Atlantic has been shown to influence not only the adjacent continents but also the tropical Pacific and Indian Oceans. TBI will further investigate the linkages of the tropical Atlantic and thus bring further attention to the role of the Atlantic in global climate variability. This group is now organizing its first workshop, to be held virtually in February 2021. Ingo Richter, Regina Rodrigues and Susan Bates are members of both TBI and ARP. They will ensure coordination between the two groups. [WCRP-CLIVAR Workshop on Climate Interactions among the Tropical Basins](#) will be organised by TBI RF from 24 to 26 Feb 2021.

8. SCIENTIFIC and OPERATIONAL IMPACT of the COVID-19 pandemic (Everyone with Eleanor, Tarron and Greg to find/gather information?)

Seagoing science has been significantly impacted by the COVID-19 pandemic, with multiple cruises cut short, delayed or cancelled. Surveys of the impacts have been undertaken by GOOS and OceanSites, identifying areas of potential concern - particularly ship-based measurements

using expendable bathythermographs (XBTs), interdisciplinary moorings, repeat hydrographic transects, gliders and animal borne sensors (<http://www.ocean-ops.org/reportcard/>).

The RAPID array at 26N was impacted as the UK cruise to service moorings was underway when the UK went into lockdown, and the ship was recalled mid-cruise. Since that time, some instruments have run out of expected battery power, and a mooring was fished and floated away from its anchor (an increasing risk with increasing deployment duration). NOAA buoy-tending cruises were delayed but are continuing, and much of the OSNAP servicing cruises were delayed but undertaken prior to the end of 2021.

9. New WCRP Structure and Implementation Plan Regina Rodrigues, ARP member who is also the liaison, provided a presentation on the new WCRP structure on Oct. 29 to the panel. ARP discussed Lighthouse Activities the panel can contribute to and are contributing to the WCRP Questionnaire.

10. The Ocean Decade: Implications for ARP (Everyone)

There were several UN Decade Workshops relevant to the Atlantic held over the year for the South Atlantic (Rio de Janeiro) North Atlantic (Halifax) and the Caribbean (Mexico City and virtually) in which some of the panel members were involved to coordinate and animate the discussions. The results of these, and other regional works, contributed to the UN planning, led by the IOC in Paris, of the UN Decade activities which will begin in 2021. There have also been national discussions about contributions to the Decade with the guidelines for project, programs and activities released late in the summer of 2020. There will likely be many different opportunities for engagement by the ARP as plans for the Decade are developed.

11. Any Workshops in 2019/2020 as part of panel activities? (Everyone)

Panel member Ingo Richter convened a session on “Atlantic climate variability, and its global impacts and predictability” at the Japan Geophysical Union (JpGU) online meeting, July 12-16. Co-conveners were Hiroki Tokinaga, Andrea Taschetto, Noel S Keenlyside.

Ingo Richter was also co-convenor of a session on “Tropical & subtropical climate variability: ocean processes, air-sea interactions, climate modes, teleconnections and impacts” at the EGU General Assembly (May 4-8, online only). This session emphasized variability in the tropical Atlantic.

As part of the TBI activities Ingo Richter, Noel Keenlyside, Andrea Taschetto and Malte Stuecker are organizing a session at the 2020 AGU Fall Meeting entitled “Tropical Interbasin Interaction: Processes, Pathways, and Predictability”. This session will feature several presentations on the role of the tropical Atlantic in the global climate system.

Paquita Zuidema is co-convening a session at the 2020 AGU Fall Meeting entitled “Atmospheric and Oceanic Processes Governing the Trade Wind Regions” that is providing a presentation venue for the ATOMIC/EUREC4A community.

12. International projects (achieved and ongoing) involving the Atlantic Ocean in which the ARP community is involved

EU H2020 iAtlantic project - Integrated Assessment of Atlantic Marine Ecosystems in Space and Time (<http://www.iatlantic.eu/>). iAtlantic is a multidisciplinary research programme seeking to

assess the health of deep-sea and open-ocean ecosystems across the full span of the Atlantic Ocean launched in 2019. The multidisciplinary consortium of 33 partners is led by Prof. Murray Roberts at University of Edinburgh. Work will span the full scale of the Atlantic basin with partners from the US, Europe, Brazil, Argentina and Africa. In particular, iAtlantic will notably augment observing capacities in the South Atlantic including enhancements at the western and eastern side of the “South Atlantic MOC Basin-wide Array (SAMBA)” along 34.5°S.

EU H2020 TRIATLAS project – South And Tropical Atlantic Climate-based Marine Ecosystem Prediction For Sustainable Management (<https://triatlas.w.uib.no>). TRIATLAS goal is to contribute to the sustainable management of human activities affecting Atlantic marine ecosystems to maintain its health and to support the blue economy of the bordering countries. TRIATLAS is meant to deliver knowledge of the current state and future changes of the Atlantic marine ecosystems through a basin-wide approach that integrates research from the North and South, and that closes critical knowledge gaps in the Tropical and South Atlantic that impede an understanding of the entire basin.

iAtlantic and TRIATLAS projects are linked to the H2020 Coordinated Support Action: All Atlantic Cooperation for Ocean Research and innovation (AANCHOR). The main ambition of AANCHOR is to promote the implementation of the South Atlantic Research and Innovation Flagship initiative and the Belém Statement. The project runs from 2018-2022. (https://allatlanticocean.org/aanchor_csa)

EU H2020 EuroSea project – Improving and integrating the European Ocean Observing and Forecasting System. (<https://eurosea.eu>). EuroSea is a European Union Innovation Action funded through the European Commission research funding programme Horizon 2020 under a call supporting the G7 Future of Seas and Oceans Flagship Initiative. EuroSea brings together key European actors of ocean observing and forecasting with users of oceanographic products and services. The EuroSea innovation demonstrators are focused on operational services, ocean health, and climate in the Atlantic Ocean and Mediterranean and Baltic seas.

Several atmospheric field campaigns are being planned for the sub-Arctic to examine air-mass modification between the Arctic and mid-latitudes. This includes the NSF Cold Air outbreak Experiment in the Sub-Arctic Region (CAESAR) campaign, for early 2022, with corresponding activities in the UK and Europe. These currently lack an oceanic component and would benefit from such a complement.

Plans for 2021 and beyond

1. Launching the CLIVAR AMOC Task Team

Due to the sunsetting of the US CLIVAR AMOC Science Team (initially anticipated for December 2020, after a decade of operation), the CLIVAR ARP looked into setting up a new working group or task team to support the AMOC community and its coordination. Conversations have been ongoing since mid-2020, with draft terms of reference now agreed, and plans to launch the CLIVAR AMOC Task Team in 2021. Task Team co-chair Eleanor Frajka-Williams, proposed as the new co-chair for ARP, which will help streamline this activity.

2. Finalise and publish the TAOS Review Report

The second draft of the TAOS Review Report has been provided for a large scientific community review to which ARP has participated. The report has received many constructive comments and now is being revised. We foresee a final draft published in January 2021.

3. Mapping in to the new WCRP structure and participating in the co-design and implementation of the WCRP Lighthouse Activities (LHAs)

ARP has constituted a specific working group, led by Regina Rodriguez (co-chair of the WCRP LHA on 'My Climate Risks'), to work on mapping ARP actual and future activities onto LHAs.

4. Actions contributing to the UN Ocean Decade
5. Any workshop as part of the panel activities planning for 2021 and beyond (Everyone)?

Joint CLIVAR/GOOS workshop: 'From global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change' (ICTP, Trieste, 2022?). See <http://www.clivar.org/news/teleconference-clivargoos-observation-workshop-organizing-committee>

Articles published in 2019/20 as part of panel activities (if any)

- de Young, B., Visbeck, M., Araujo Filho, M. C. D., Baringer, M. O. N., Black, C. A., Buch, E., ... & Fischer, A. S. (2019). An integrated all-atlantic ocean observing system in 2030. *Frontiers in Marine Science*, 6, 428.
- Kersalé, M., Meinen, C. S., Perez, R. C., Le Hénaff, M., Valla, D., Lamont, T., Sato, O. T., Dong, S., Terre, T., van Caspel, M., Chidichimo, M. P., van den Berg, M., Speich, S., Piola, A. R., Campos, E. J. D., Ansorge, I., Volkov, D. L., Lumpkin, R., Garzoli, S., Highly Variable Upper and Abyssal Overturning Cells in the South Atlantic, *Science Advances*, Vol. 6, no. 32, eaba7573, doi: 10.1126/sciadv.aba7573, 2020.
- Moat, B. I., Smeed, D. A., Frajka-Williams, E., Desbruyeres, D. G., Beaulieu, C., Johns, W. E., Rayner, D., Sanchez-Franks, A., Baringer, M. O., Volkov, D., Jackson, L. C., Bryden, H. L. Pending recovery in the strength of the meridional overturning circulation at 26N. *Ocean Science*, Vol. 16, 863-874, doi: 10.5194/os-16-863-2020, 2020.

Many manuscripts are currently in preparation emanating from the ATOMIC/EUREC4A project, including an ATOMIC overview paper within BAMS. Data papers are being prepared for a Copernicus ESSD special issue.

Budget and other needs for 2021

We are not anticipating strong budget needs for 2021, with all meetings held virtually.

Aim for a total length of ~2 pages, more is fine, but not necessary

Annex A

Proforma for CLIVAR Panel requests for SSG approval for meetings

Note: If your group has approved funds in 2020 that were not used because of Covid19, and you propose to use them in 2021, they should be included again in this request, in addition to any new request.

1. Panel name:
2. Title of meeting or workshop:
3. Proposed venue (Or indicate if online):
4. Proposed dates:
5. Proposed attendees, including likely number:
6. Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:
7. Specific objectives and key agenda items:
8. Anticipated outcomes (deliverables):
9. Format:
10. Science Organizing Committee (if relevant)
11. Local Organizing Committee (if relevant)
12. Proposed funding sources and anticipated funding requested from WCRP: