

Atlantic Region Panel

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Panel overview

The CLIVAR Atlantic Region panel has as its terms of reference (<https://www.clivar.org/clivar-panels/atlantic>) identifying and supporting research into climate variability in the Atlantic region, providing technical input to other panels, and monitoring progress of observing system implementation. This is a very broad remit, and so in 2021/22, the ARP decided to focus on three main areas of interest: the Atlantic meridional overturning circulation - linking to the new CLIVAR AMOC Task Team, coastal resilience/climate risk - linking to the WCRP Lighthouse activity on My Climate Risk, and tropical Atlantic - linking to the CLIVAR Tropical Basin Interactions Research Focus. This approach helped lend some focus to discussions and plans, while still being fairly broad. Achievements and forward-action have roughly aligned with these topics.

During the last SSG, it was also recommended that panels consider cross-panel activities, and we note that the CLIVAR AMOC Task Team has some former members of the ODMP, the Tropical Basin Interactions research focus serves as a link between panels for tropical processes, and the newly approved Marine Heatwaves summer school links between panels (Atlantic, Pacific and Indian Ocean) and also with the Lighthouse Activity on My Climate Risk.

Achievements for 2021-2022

1. Atlantic Meridional Overturning Circulation (AMOC): Task Team and updates

After the US CLIVAR AMOC Science Team final meeting in April 2022, the CLIVAR ARP - AMOC Task Team began work to support the international AMOC community of scientists. The TT held their second telecon on 7th September 2022 with the participation of Eleanor Frajka-Williams, Eric Chassignet, Gokhan Danabasoglu, Brad de Young, Helen Pillar, Rong Zhang, Maria Paz Chidichimo, Meric Srokosz, Paquita Zuidema, and Jose Santos and Jing Li from ICPO. Updates from recent AMOC meetings, overview of new AMOC projects, and plans for the future AMOC TT activities were mainly discussed during the telecon. More detailed info can be found in the [news](#) and [meeting notes](#). The main outcome was the decision to organise a workshop for 2023 on assessing AMOC observing (see Future plans).

In addition to the Task Team activities, a set of review articles was coordinated for the South Atlantic meridional overturning circulation (Regina Rodriguez), while a review of the North Atlantic MOC was published by Jackson et al. (2022).

2. Ocean Climate Risk Working Group and updates

As part of the new WCRP Strategic Plan to bridge climate science and society, a Lighthouse Activity called My Climate Risk was launched in 2021 with the objective of developing a 'bottom-up' approach to regional climate risk by implementing regional hubs. In addition, recognizing the need for more **interaction between the WCRP Core Projects and the new Lighthouse Activities**, the Ocean Climate Risk Working Group is liaising with members of the three CLIVAR

regional panels (Atlantic, Pacific and Indian Ocean) to create **Regional Hubs on Ocean Climate Risk**. Dr. Roxy Koll (IOPR), Dr. Susan Bates (ARP) and Dr. Jennifer Veicht (ARP) attended My Climate Risk General Assembly chaired by Dr. Regina R. Rodrigues in November 2022 to discuss the implementation of such regional hubs in 2023.

A **CLIVAR Research Foci Proposal on Marine Heatwave in the Global Ocean** was submitted jointly by members of three CLIVAR regional panels (Atlantic, Pacific and Indian Ocean) in October 2022 with the goal of achieving a better understanding of marine heatwaves globally, including detection, surface and subsurface characteristics, mechanisms, connection with climate change and biogeochemical extremes, in order to increase preparedness and promote efficient adaptation planning while contributing to the training of the next generation of scientists and providing input to observational programs. If approved, this research focus will be co-chair by Antonietta Capotondi (PRP) and Regina R. Rodrigues (ARP).

The ARP is working actively in the organization of the **WCRP Open Science Conference** to be held in Kigali, Rwanda, in October of 2023, with Dr. Regina R. Rodrigues being part of the Organizing Committee fostering many scientific sessions on climate risk. A proposal for a **Poster Cluster on “Marine heatwaves in the world oceans”** was successfully approved and will be organized by members of 3 CLIVAR regional panels (Atlantic, Pacific and Indian Ocean, <https://wcrp-osc2023.org/program/program-poster-clusters>).

3. CLIVAR-GOOS Workshop

The CLIVAR/GOOS/ICTP workshop: '*From global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change*' was successfully organised from 15th to 17th August 2022 in Trieste, Italy and online. This workshop brought members across different CLIVAR panels, observing system scientists and leaders together with invited speakers from developing rim nations to discuss priorities and cross-cutting strategies as well as explore new partnerships for the expansion of the regional ocean observing systems. 21 onsite and 36 online participants from 29 countries attended the workshop, which was endorsed as an activity of the UN Decade of Ocean Science for Sustainable Development.

During the 3-day workshop, 15 plenary presentations were made on the global and regional ocean observing systems, success and innovations and the new technologies. In addition, 15 flash talks were made to reflect the perspectives from the developing rim-countries and small islands. During the breakout discussion sessions organized in each afternoon, participants were grouped around three thematic topics: 1) oceanographers' connection; 2) new technologies and 3) co-design stakeholders. Each group was asked to think about what the leading challenges are in maximising the use of ocean observations for applications and end-users, to provide possible solutions and partnerships that will enhance the global ocean observing system as well as to prioritize the recommendations by providing an implementable action plan with timeline, looking at both short term (1-3 yrs) and long term (3-5 yrs) goals, identifying the potential champions, partnerships and funding mechanisms. Some of the actions proposed by the thematic topics are: CLIVAR mentorship programme including policy training mentorship for early career professionals; pilot study to illustrate the value of new technologies like animal borne tags; development of products from available observations based on scientific data to be translated into information such as materials for teachers to be used in classes. The prioritized recommendations will be conveyed to CLIVAR, GOOS and/or OBPS (Ocean Best Practice System).

The recording and slides of the workshop are available at the [ICTP](#) and [CLIVAR](#) websites respectively.

4. Tropical Basin Interaction

A workshop on “Atlantic Variability and Tropical Basin Interactions at Interannual to Multi-decadal Timescales: Mechanisms, Drivers and Impacts” is being planned to be held in the summer of 2023 at ICTP in Trieste, Italy. This workshop will be held back-to-back with the ICTP summer school on the same theme. While these activities are led by the TBI RF and the CDP, ARP will be involved in their organization. Several ARP members are also involved in the TBI RF (Regina Rodrigues, Greg Foltz, Ingo Richter) and will ensure direct involvement of the ARP.

In early 2023, there will be a CLIVAR joint workshop on the tropical Pacific and its inter-basin interactions, with participation by the PRP, two of its working groups (TPDV and ENSO Conceptual Models), and the TBI RF. Ingo Richter will attend this workshop and this should help to strengthen interaction with the PRP. We will attempt to build on this momentum and organize an online cross-panel meeting in the first half of 2023.

5. EUREC⁴A-OA and ATOMIC - an ARP-endorsed project

EUREC⁴A-OA and ATOMIC were the European and American contributions respectively to an international observational campaign located mostly east and south of Barbados in Feb, 2020. The complex campaign included four planes and three boats. Because it ended just as the global pandemic was becoming recognized, the campaign itself suffered no setbacks. Analysis of the campaign datasets is continuing, with the datasets themselves described within a special Copernicus issue of ESSD (https://essd.copernicus.org/articles/special_issue1122.html). Dedicated sessions have most recently been held at AGU in 2021 and at EGU in 2022. Virtual data workshops have also been held, including a ‘Celebrosum’ in February, 2022.

6. CLIVAR-FIO Summer School on Macroturbulence

Delayed by the global COVID-19 outbreak, the 2nd CLIVAR-FIO Summer School on ‘Ocean Macroturbulence and Its Role in Earth’s Climate’, which was originally planned for June 2020, was successfully organised from 15th to 20th August 2022 in Qingdao, China and online, back-to-back with the 11th Training Course of the UNESCO-IOC Regional Training and Research Center on Ocean Dynamics and Climate (ODC) on ‘Prediction and Projection of Climate’. 19 onsite trainees and over 100 online trainees from 33 countries attended the CLIVAR-FIO summer school. 14 leading experts from China, France, Germany, New Zealand, UK and USA made lectures addressing the observations, dynamics, modelling of the ocean meso- and sub-mesoscale motions, as well as their role in the earth’s climate. Activities consisted of lectures, problem-solving, discussions of recent journal articles, exercises with observational and model data sets provided by instructors for groups of participants to analyse. In addition, during the summer school, trainees were provided guidelines for proposal development and were grouped to develop a proposal for new research during the week, which was presented at the end of the summer school on August 20, receiving feedback from several of the instructors. The recordings, presentations and exercises were archived and are available on the [CLIVAR website](#). A post workshop survey was prepared to collect the feedback from the both lecturers and trainees.

7. CLIVAR Summer School on Marine Heatwaves

A proposal for holding an ICTP-CLIVAR Summer School in 2023 on “Marine Heatwaves: Global Phenomena with Regional Impacts” was successfully selected by the CLIVAR SSG and also approved by ICTP. It is a cross-panel hands-on training course for understanding and detecting marine heatwaves to be held in July 2023 at ICTP, Trieste, Italy. This is a cross-basin initiative, and the organizing committee consists of members of the three CLIVAR regional panels (Atlantic, Pacific and Indian Ocean) and the Lighthouse Activity My Climate Risk. To encourage participation from across the globe, it will be in a hybrid format. Leads of the GOOS Marine Heatwave exemplar group will be invited to participate in the school.

8. CLIVAR Special Issue on TAOS

Based on the decadal review of the Tropical Atlantic Observing System (TAOS), which was proposed and organized by ARP, in close collaboration with PIRATA, a *CLIVAR Exchanges* special issue on TAOS is being prepared, with an aim to disseminate the important findings from the TAOS Review Report (<https://doi.org/10.36071/clivar.rp.1.2021>) more widely and to highlight the societal relevance of TAOS. The special issue of *CLIVAR Exchanges* contains ten articles documenting the history and current status of TAOS, the key science and operational driver, as well as the recommendations for future TAOS development derived from the TAOS Review report. The Special Issue is expected to be published by the end of 2022.

9. ARP (Atlantic) Blog

The idea for an ARP (Atlantic) Blog was brought by Dr. Ingo Richter, which is similar to the [NOAA's ENSO Blog](#) or [JAMSTEC's Climate Watch Blog](#), and with an anticipated 1 post every 1-2 months. The Atlantic Blog will sit within the CLIVAR websites, with blog entries being classified with various topics by using different tags (e.g. AMOC, TAOS, TBI, Risks, and etc.). The draft frame of the Atlantic Blog has been prepared and the webpage is now being developed by the IT company who is servicing the CLIVAR website. The 1st draft design is expected to be ready by the end of 2022.

10. Conference session/workshops/collections

PIRATA + TRIATLAS Conference and General Assembly: A joint PIRATA + TRIATLAS Conference was held in Porto de Galinhas, Brazil, from October 3 to 5, while the TRIATLAS Consortium GA took place from October 6 to 7. During the conference, 30 talks (in-person and online) and over 60 posters were presented. Detailed information about the conference and its programme can be found at <https://triatlas.w.uib.no/triatlas-conference-and-general-assembly/>.

Open Science Conference on Eastern Boundary Upwelling Systems (EBUS): Past, Present and Future, September 19-23 2022, Lima, Peru. Jennifer Veitch gave a keynote address: ‘The Benguela System: a short review of what we think we know and what we need to fill the gaps’. More information can be found here: <https://www.ebus-lima2022.com/>

Royal Society AMOC meeting. A meeting at the Royal Society on “Atlantic overturning: new observations and challenges” is being held in December 2022. While it was not initiated by the

ARP, it is co-organised by AMOC TT member Meric Srokosz, with contributions from Eleanor Frajka-Williams, Laura Jackson and other TT members.

As a member of Editorial Board Dr. Regina R. Rodrigues organized a **Special Collection “Ocean science in the South Atlantic”** to be published in ***Communications Earth & Environment*** (<https://www.nature.com/collections/aiaehtdjcb>) in January 2023 and will highlight a Review Paper on the “South Atlantic Meridional Overturning Circulation (SAMOC)” and a Comment on “Inclusive Science in the South Atlantic”, both pieces are co-authored by many former and current members of the ARP.

Plans for 2023 and beyond

In 2023, the ARP plans to support the AMOC Task Team workshop (July 2023 in Hamburg, Germany) and the CLIVAR/ICTP summer school on Marine Heatwaves (July 2023 in Trieste, Italy). In addition, a new research focus was proposed on Marine Heatwaves (including by ARP co-chair Regina Rodrigues) and a related session for the WCRP Open Science Conference in Kigali, Rwanda in Oct 2023. In conjunction with LHA My Climate Risk, the Ocean Climate Risk Working Group plans to create Regional Hubs on Ocean Climate Risk in 2023.

The AMOC task team is considering submitting a summer school proposal in 2023 for the summer of 2024.

AMOC Observation Workshop in 2023. We are proposing a workshop for July 2023 on the topic of “Assessing AMOC observing”. This will be held at Universität Hamburg immediately following the IAPSO sessions at IUGG (so July 17-19). The aim of the workshop is to bring the AMOC community together to discuss the observing system, review successes, review how it has been observed in the past, design new tests for the observing system and enumerate the uses of AMOC observations. Support has been requested from US CLIVAR for participation of scientists from the US, partial support will be provided by the Horizon Europe EPOC project (Explaining and Predicting the Ocean Conveyor) and is requested from CLIVAR. The scientific organising committee consists of AMOC Task Team members—Eleanor Frajka-Williams (UHH), Eric Chassignet (FSU), Gokhan Danabasoglu (NCAR), Helen Pillar (UTA) as well as Nick Foukal (WHOI) and Pete Brown (NOC).

In the lead-up to the workshop, we also propose ~monthly webinars to be arranged by the scientific organising committee, with technical support from CLIVAR.

Further future aims of the TT will be to follow-up on assessing the AMOC observing system through the workshop and individual projects, and to support the accessibility of observational AMOC products through existing channels (e.g. OceanSITES) or the creation of a data portal layer (e.g. GEOSS).

Atlantic blog. The blog for the Atlantic/ARP is now in draft stage and will be anticipated to begin in 2023.

Articles published in 2021/22 as part of panel activities (if any)

Jackson, L., A. Biastoch, M. Buckley, D. Desbruyeres, **E. Frajka-Williams**, B. Moat, J. Robson (2022): The evolution of the North Atlantic meridional overturning circulation since 1980. *Nature reviews*, 3:241-254. <https://doi.org/10.1038/s43017-022-00263-2>

Future recommendations are aligned with the objectives of the CLIVAR AMOC Task Team, including on strategies for future monitoring of the AMOC, and identifying key avenues where observations and models can/should work together.

Rodrigues, R.R. and Shepherd, T.G. (2022). Small is beautiful: climate-change science as if people mattered. *PNAS Nexus*, 1(1), pgac009.

Written in the context of the LHA My Climate Risk and the ARP working group on ocean climate risk.

Rodrigues, R.R. (2021). Downside up: Science matters equally to the Global South. *Nature Communications Earth & Environment*, 2(1), 1-2.

Written in the context of the new WCRP Strategic Plan goal of increasing diversity and inclusiveness, where WCRP is used as an example.

Ham, Y.G., H.J. Lee, H.S. Jo, S.G. Lee, W. Cai, **R.R. Rodrigues** (2021). Inter - basin interaction between variabilities in the South Atlantic Ocean and the El Niño/Southern Oscillation. *Geophysical Research Letters*, 48, e2021GL093338.

A product of the CLIVAR ARP Tropical Basin Interactions Foci.

Speich, S. and **R.R. Rodrigues** (editors) (2022). Tropical Atlantic Observing System (TAOS), *CLIVAR Exchanges*, 82, doi.10.36071/clivar.82.2022.

A special issue coordinated by CLIVAR ARP, based on the outcomes of the TAOS decadal review.

Budget and other needs for 2023 (in CHF)

The ARP requests funding to support two linked activities:

- *In person meeting of the CLIVAR ARP - 5000 CHF (see Annex A)*
- *CLIVAR AMOC Task Team workshop - 5000 CHF*

We additionally request support for the CLIVAR AMOC Task Team workshop (See Annex B), to support travel of ECRs, scientists from developing countries and ARP members. We have also requested support from US CLIVAR but this is primarily to support scientists from the USA to attend/participate.

Annex A

Proforma for CLIVAR Panel requests for SSG approval for meetings

Note: If your group has approved funds in 2022 that were not used because of Covid19 and other unexpected issues, and you propose to use them in 2023, they should be included again in this request, in addition to any new request.

- 1. Panel name:** Atlantic Region Panel
- 2. Title of meeting or workshop:** 18th Session of Atlantic Region Panel meeting
- 3. Proposed venue (Or indicate if online):** Universität Hamburg, with hybrid possible
- 4. Proposed dates:** week of 17 July 2023
- 5. Proposed attendees, including likely number:** 13 ARP members

6. Rationale, motivation and justification, including:
The Atlantic Region Panel has not met in person since 2019, and while we have all become very experienced with online meetings, it was the wish of the panel members to meet in person to invigorate interactions and facilitate discussions for future endeavors. We polled the members and are tentatively planning to meet for 1-day in Hamburg, Germany (hosted by the Universität Hamburg), following the IAPSO meeting in Berlin (11-16 July 2023 for IAPSO sessions) and the AMOC Task Team Workshop (also hosted at Universität Hamburg, tentatively planned for 18-20 July 2023).

7. Specific objectives and key agenda items:

During the ARP-18 meeting, the panel is going to review the progress of the panel activities, especially around the three thematic working groups, i.e. AMOC, Ocean Climate Risk and Tropical Basin Interaction. Meanwhile, the future plans and activities of ARP are also to be discussed during the meeting, including the AMOC Observation workshop, the MHW summer school, the Atlantic Blog, future interaction with CLIVAR TBI RF and WCRP LHA, etc.

- 8. Anticipated outcomes (deliverables):** Meeting report including future plans
- 9. Format:** Hybrid meeting
- 10. Science Organizing Committee (if relevant):** CLIVAR ARP & ICPO
- 11. Local Organizing Committee (if relevant):** Eleanor Frajka-Williams
- 12. Proposed funding sources and anticipated funding requested from WCRP:**

Funding requested from WCRP for 5,000 CHF to support travel of ARP members. The travel of US members in ARP will be supported by the US CLIVAR.

Annex B

Proforma for CLIVAR Panel requests for SSG approval for meetings

Note: If your group has approved funds in 2022 that were not used because of Covid19 and other unexpected issues, and you propose to use them in 2023, they should be included again in this request, in addition to any new request.

- 1. Panel name:** Atlantic Region Panel: AMOC Task Team (<https://www.clivar.org/clivar-amoc-task-team>)
- 2. Title of meeting or workshop:** Assessing AMOC observing
- 3. Proposed venue (Or indicate if online):** Universität Hamburg, with hybrid possible
- 4. Proposed dates:** week of 17 July 2023
- 5. Proposed attendees, including likely number:** 60-70 attendees
- 6. Rationale, motivation and justification, including:**

The Atlantic Meridional Overturning Circulation (AMOC) plays an important role in modulating air-sea interactions and redistributing heat, freshwater, and biological and chemical properties throughout the Atlantic basin. The need to monitor this redistribution has led to the deployment of numerous intensive observing networks, most notably the AMOC arrays providing continuous transport estimates at different latitudes including 34.5°S (SAMBA), 16°N (MOVE), 26°N (RAPID) and ~55°N (OSNAP). Continuous long-term monitoring at the arrays has provided rich insights into overturning variability, valuable constraints for model assessment and forecast initialization, and raised new questions regarding fundamental aspects of AMOC dynamics.

Despite this legacy, maintaining funding for the AMOC observing networks is challenging and complicated by the requirement for ocean observations to serve increasingly diverse end-user groups. Additionally, since the installation of the RAPID array in 2004, a number of technological advances in ocean observing have been realised: (a) the Argo float profiling array has been at full-strength since ~2007, (b) underwater gliders have become more widely used, (c) gravimetry measured from space is now available.

The success of the observing arrays, the new knowledge gained from observational and modelling efforts, and the new technological advances and the challenges faced by maintaining ocean observing underscore the need for collaboration and coordination across the interdisciplinary oceanographic community to

- 1. Quantify the value of AMOC observing.**
- 2. Define a collective set of observational priorities.**
- 3. Outline a roadmap for future AMOC observing.**

Finally, without extensive collaboration between observational and modelling communities, progress will be limited and slow. This includes exchanging existing data, information on proposed acquisitions, and insights regarding the practicalities of observing system implementation.

In summary, the primary goal of this workshop will be to inform the design of a future-focused AMOC observing system that can provide continuous measurements of key variables while also remaining sustainable over multiple decades. To accomplish this goal, the workshop will first provide a retrospective look at the value of the observational methods, what has been done to validate the approaches, and what questions (in method or scientific) have not yet been addressed. The workshop will focus on how models and observations can be used together, so that models that faithfully simulate key processes in the observed record can be used to provide a larger spatial perspective than the existing arrays (and potentially serve as ‘nature runs’ for further experiments). Finally, discussions at the workshop will focus on future plans to coordinate an international AMOC observational approach to monitor variability over multiple decades.

The objectives of the AMOC workshop are well-aligned to the terms of reference of the CLIVAR ARP, including “Define the tools required to assess and understand climate variability...within the Atlantic sector”, “Design a strategy to implement these methods, spanning observations, models, experiments and process studies” and “Monitor and evaluate progress of the implementation”. Additionally, AMOC research more generally is well-aligned with the WCRP Lighthouse Activity on “Explaining and Predicting Earth System Change” which focuses on multi-annual to decadal timescale observing, attribution, prediction and projection of Earth system change.

7. Specific objectives and key agenda items:

The objective of the meeting is to bring the AMOC community together to work towards consensus on

- the capabilities and shortcomings of current AMOC observing,
- the capabilities and shortcomings of model-based tools for AMOC observing system assessment/re-design,
- shortlisted suggestions for investigations/experiments to be run in support of AMOC observing re-design,
- a shortlist of priority quantities that should be constrained by a ‘fit-for-purpose’ AMOC observing system to serve science (across physics, biogeochemistry and ecosystems) and societal needs.

In advance of the hybrid, synchronous workshop in July 2023, we anticipate organising ~monthly webinars to give an overview of the current AMOC observing system and assessments of the observing system performed to-date.

8. Anticipated outcomes (deliverables):

The organizing committee will produce a report, or review paper in Oceanography or *BAMS*, to summarize these outcomes (see specific objectives) and provide a roadmap for the wider community to contribute to the co-design and implementation of a sustainable, fit-for-purpose AMOC observing system.

9. Format: Hybrid meeting

10. Science Organizing Committee (if relevant): Eleanor Frajka-Williams, Gokhan Danabasoglu, Helen Pillar, Nick Foukal, Eric Chassignet

11. Local Organizing Committee (if relevant): Eleanor Frajka-Williams

12. Proposed funding sources and anticipated funding requested from WCRP:

Funding requested from WCRP **5000 CHF** to support travel of ECRs, scientists from developing countries and ARP members.

In addition, we have requested funding from US CLIVAR to support attendance of scientists from US institutions, and we anticipate partial support from the Horizon Europe project EPOC (Explaining and Predicting the Ocean Conveyor) to support local hosting (e.g. catering). We may also look into funding by the Canadian OFI (Ocean Frontiers Institute) and possibly from registration revenue.