

Report to CLIVAR SSG-19

Panel or Working Group: Atlantic Panel

1. Contributions to developing CLIVAR science; fit to CLIVAR imperatives

Seasonal to Decadal Prediction:

- AIP will oversee the different programs to measure and monitor the Atlantic MOC (UK-RAPID, EU-THOR, US-AMOC, SAMOC, EU-NACLIM) by participating at the different existing AMOC meetings and briefings at panel meetings, pointing to gaps and possible improvements in the observing system. The panel is advocating for the implementation of a sustained network for all AMOC components.
- Some large projects are currently addressing the emerging science of decadal predictions (e.g. US AMOC, German MiKlip, EU-THOR, EU-COMBINE, EU-NACLIM (just accepted), EU-SPECS (submitted), it also includes the seasonal scale). There seems to be some predictability of the first kind associated to the North Atlantic in addition to the predictability linked to the external forcings. Initial results from CMIP5 decadal experiments suggest skill improvement up to 10-year lead time in surface temperature and upper ocean heat content due to ocean initialization.
- One objective of the "AIP/VAMOS Workshop on Coupled Ocean-Atmosphere-Land Processes in the Tropical Atlantic, Miami" was to assess the predictability of tropical Atlantic variability (TAV) at seasonal to decadal time scale. The TAV predictability is currently limited by the presence of a strong SST bias in the south-eastern tropical Atlantic in coupled ocean-atmosphere model simulations. Recent studies suggest moreover the role of weather noise as a potentially disrupting factor for the predictive skill in the tropical Atlantic. Other studies have pointed out the overestimation of the simulated SST-heat flux feedback (more negative in the models than in the observations) as a potential damping source of seasonal to interannual variability. The impact of Equatorial Atlantic SST variability on El Niño prediction was shown in different studies. It indicates a global importance of Equatorial Atlantic climate variability, and highlights the necessity to improve climate prediction in the Equatorial Atlantic. AIP participate in the CLIVAR Working Group on the 'Upper-Ocean Heat Budget Synthesis for the Eastern Equatorial Pacific and Atlantic Oceans' addressing the tropical SST bias issue.
- Sources of decadal variability and predictability: recent work coming from CMIP5 simulations suggests that aerosols (including a detailed representation of indirect effects) could be responsible for a larger fraction of North Atlantic climate variability at interannual to decadal time scale than previously thought. This does reopen the question of what has driven historical temperature variations in the North Atlantic and the role of the Atlantic multi-decadal Oscillation/Variability versus the forced response. A deeper understanding of the relative contributions of forced versus internal variability is needed to resolve this question. Use of the detection and attribution framework is suggested to make further progress as well as the always necessary work to improve the understanding and representation of aerosol effects in climate models. AIP is planning to play an active role in the coordination of attribution studies the multi decadal changes in North Atlantic SST.

Monsoons:

- AIP, together with VAMOS, is looking into coupled feedbacks in the tropical ocean which amplify the original bias from the underlying initial causes. It appears that the Bjerknes feedback (which is weaker in the Atlantic compared to the Pacific) is playing a dominant role in amplifying the equatorial spring biases in models. What is less clear (and seems to vary among models) is the original cause of the westerly wind spring bias. Various atmospheric causes have been suggested from analyses of

AMIP type simulations: displacement of the subtropical highs, bias in continental precipitation over the Amazon and West Africa, atmospheric convection over the ocean, stratus cloud representation. There are also suggestions for an oceanic role on the wind bias origin. Particularly, the coastal upwelling regions are identified as a region with substantial SST bias even in forced ocean-only simulations. A too diffuse thermocline in the coastal upwelling region that partly can be traced back to the equatorial region together with inadequate representation of upwelling and mixing processes at the shelf are possible sources of ocean model errors. There is a need to better document the different causes which can lead to the equatorial westerly wind bias in the western Atlantic (using both forced and coupled models). Improved predictions of Equatorial Atlantic SST variability is of particular importance for the prediction of the onset of the West African Monsoon and its interannual to decadal variability.

Hurricanes:

- Panel has been briefed on the activities being developed by the US CLIVAR WG on Hurricanes and it has decided to strengthen links with this group. It will look at CMIP5 simulations and tropical cyclones in a warming climate.

2. Briefly list any specific areas of your panel's activities that you think would contribute to the WCRP Grand Challenges as identified by the JSC at its most recent meeting¹

- Provision of skillful future climate information on regional scales
 - Causes of interannual to interdecadal North Atlantic climate variability: relative roles of the external forcings and internal variability
 - Improvement of the observing system for the North Atlantic Ocean: AMOC, and the South Atlantic: SAMOC
 - Identifying required observing system to address the tropical Atlantic bias: TACE, contribution to the CLIVAR Working Group on the 'Upper-Ocean Heat Budget Synthesis for the Eastern Equatorial Pacific and Atlantic Oceans'
 - Improvement of the deep ocean observing system
- Improved understanding of air-sea interactions; their connections to clouds, aerosols, precipitation, and radiation; and their contributions to climate sensitivity
 - Investigation of the causes of the coupled model biases in the tropical Atlantic.
 - Investigation of the causes of the spread in West African Monsoon CMIP5 projections

3. Key science questions that you anticipate your community would want to tackle in the next 5-10 years within the context of a more ocean-atmosphere orientated CLIVAR (1-3 suggestions)

1. What are the causes of observed North Atlantic climate variability at interannual to interdecadal time scales and reasons for Atlantic biases (e.g., SST) in coupled-model simulations?

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1. Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
2. Regional sea-level rise
3. Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
4. Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
5. Past and future changes in water availability (with connections to water security and hydrological cycle)
6. Science underpinning the prediction and attribution of extreme events

2. What is the impact of small-scale processes on the mean climate state and on seasonal to interannual climate variability?

3. What are the causes of African Climate Variability and Benguela Ninos? What are their impacts on regional scales? What is their role in the variability of equatorial and coastal upwelling productivity?

4. What are the causes in ocean deoxygenation? How respond ocean ventilation to climate variability and change?

4. Cooperation with other WCRP projects, outside bodies (e.g. IGBP) and links to applications

- CLIVAR TACE has a strong relationship with the German SFB 754 research project, which addresses climate-biogeochemistry interactions in the tropical oceans, with a focus on ocean deoxygenation and tropical oxygen minimum zones (OMZ) in the Atlantic and Pacific, and implications for the global marine biogeochemical system. Annual TACE/PIRATA meetings include always a session Physical-Biogeochemical Interactions. However, biogeochemical community is often not well represented.
- Another topic that is well in the scope of AIP is the effect of climate variability and change on the coastal upwelling of the eastern tropics and subtropics. These regions are particularly impacted by a combination of different stressors: increasing temperatures, acidification and deoxygenation, the understanding of this impact requires a close cooperation between CLIVAR, IMBER and others.

5. Workshops/meetings held

- RAPID – US AMOC International Science Meeting, held in Bristol, UK 12 – 15 July, 2011 Past, Present and Future Change in the Atlantic Meridional Overturning Circulation. This meeting was very successful in highlighting the various aspects of AMOC from monitoring to dynamics to impacts. It also contributed to bring the paleoclimate community closer to the modeling and present observational research. The planning is to strengthen this aspect within US AMOC in the future.
- The U.S. CLIVAR Hurricane working group had a workshop in New Orleans, LA (27-28 January 2012). The various modeling groups (from U.S., Europe, Australia and Japan) discussed the status of the simulations that are being done for this working group. The first preliminary model intercomparison results were discussed, as well as plans for group publications and a journal special issue by members of the working group exploring various aspects of the hurricane activity in the simulations of the various working groups.

6. New activities being planned, including timeline

- Provide international platform for the scientific coordination of AMOC components. It will seek to bring together PIs of projects involved with the AMOC components in order to identify commonalities and gaps in the system, whilst advocating for a sustained network. Synthesis of data and information is also an activity that the panel is promoting, although it appreciates that it will depend on individual research groups to seek funding and support to perform it.
- Develop and provide some observed oceanic metrics for the Atlantic and apply them to the CMIP5 data sets when they will become available, particularly related to AMOC.

7. Workshops / meetings planned

- AMMA: fourth international conference, Toulouse, France, 2-6 July

- Tropical Atlantic Variability Meeting/ PIRATA-17 Meeting, Kiel, Germany, 10th-14th September 2012, together with the 12th AIP meeting, Kiel, Germany, 10-11 September 2012
- U.S. AMOC PI Meeting, scheduled for August 15-17 2012 in Boulder, Colorado.

8. Issues for the SSG

Annex A

Proforma for CLIVAR Panel and Working Group requests for SSG approval for meetings

Requests should be made through D/ICPO (Catherine.beswick@noc.ac.uk), against the following headings:

- 1. Panel or Working Group:**
- 2. Title of meeting or workshop:**
- 3. Proposed venue:**
- 4. Proposed dates:**
- 5. Proposed attendees, including likely number:**
- 6. Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:**
- 7. Specific objectives and key agenda items:**
- 8. Anticipated outcomes (deliverables):**
- 9. Format:**
- 10. Science Organising Committee (if relevant)**
- 11. Local Organising Committee (if relevant)**
- 12. Proposed funding sources and anticipated funding requested from WCRP:**