

## Climate Dynamics

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### Panel overview

The main aim of the Climate Dynamics Panel is to advance our basic understanding of atmosphere-ocean climate dynamics using observations and models and to determine the role of climate dynamics in shaping climate variability and change on seasonal to centennial time scales. Our work to date has been organized around three areas; (i) the organisation of storms, blocks and jet streams on seasonal and longer time scales, (ii) ocean basin to ocean basin and tropical-extratropical teleconnections and (iii) the development of predictive theories of climate dynamics involving non-linear interactions between the dynamics and physics of the atmosphere and ocean.

The panel has now been in existence for 4 years and many of the original members, including the co-chairs, are due to end their terms. In discussion with the CLIVAR SSG, it has been decided that one co-chair and some members will be extended for a further one year in order to provide continuity. It has also been decided that, as DCVP Research Focus is sun-setting, the CDP should pick up some aspects of the focus of that group.

### Achievements for 2018-19

#### Workshops and Meetings

- The panel meeting was held at the beginning of October at the Saint John Hotel, Mykonos, Greece, in conjunction with the CFMIP meeting. Minobe gave a talk to CFMIP introducing the activities of the panel. Kang was on the CFMIP organizing committee
- The panel was involved in the organization of three sessions at IUGG 2019; M18 Natural Climate Variability and Predictability on all Time Scales (Collins), M19 Role of Ocean-Atmosphere Interactions in Constraining Regional Climate Change (Collins, Keenlyside, Minobe, Xie), and P06 Oceanic Boundary Current Systems (Minobe, with US-CLIVAR air-sea interaction working group co-chair, Hyodae Seo).
- Keenlyside co-organized a workshop on Climate Prediction in the Arctic and North Atlantic sector, *5-7th June 2019, Bergen, Norway*. It was jointly organized by the Bjerknes Climate Prediction Unit and the EU Modelling. There were 50+ participants (including Manzini) from the Europe, America, and Asia.
- Barreiro co-organized the 2<sup>nd</sup> Advanced School on Regional Climate Modeling and Extreme Events in South America, ICTP, November 2018.
- Minobe and Hu gave posters at the US CLIVAR Large Ensemble workshop in Boulder, USA, July 2019, on “Forced atmospheric modes on decadal timescales

in a large AGCM ensemble dataset” and “Role of perturbing ocean initial condition in simulated regional sea level change”

- Bordoni co-convened a session at the Fall AGU - A53M: The Dynamics of the Large-Scale Atmospheric Circulation in Present and Future Climates: Jet Streams, Storm Tracks, Stationary Waves, and Monsoons and Xie/Zolina/Collins/Miobe convened A51E: Role of Ocean–Atmosphere Interaction in Regional Climate Variability and Change
- Manzini co-chaired the workshop “Atmospheric Circulation in a Changing Climate A joint DynVarMIP/CMIP6 and SPARC DynVar & SNAP Workshop”, 22-25 October 2019, Universidad Complutense de Madrid.
- Minobe attended PRIMAVERA, EU HighResMIP project, meeting in Barcelona, Spain, March, 2019, as an external board member representing CLIVAR
- Minobe co-convened a session at PICES 2019 S15: “Advances in North Pacific marine ecosystem prediction” associated with PICES-CLIVAR working group

### **Scientific Results from Activities**

- Cai et al., 2019 Pantropical climate interactions. *Science*, Vol. 363, Issue 6430, DOI: 10.1126/science.aav4236 (Keenlyside, Xie, Kang co-authors)
- IPCC Special Report on Oceans and Cryosphere in a Changing Climate (Collins CLA of Chapter 6 on extremes and abrupt events)
- The DCVP pacemaker experiments are appearing on the ESGF (Msadek)
- Minobe becomes an international member of US-CLIVAR working group for air-sea interaction, which has been established in September, 2019, and continue being a member of US-CLIVAR large ensembles working group.

### **Scientific Capacity Building and Career Support**

- Minobe and Xie gave a series of lectures at the Qingdao summer school on climate dynamics and air sea interactions in June 2019
- Bordoni gave three lectures as part of the 2<sup>nd</sup> ICTP Summer School on Theory, Mechanisms and Hierarchical modelling of Climate Dynamics: Convective organization and climate sensitivity in July 2019.
- Barreiro gave a lecture in the Advanced School and Workshop on American Monsoons: progress and future plans. ICTP-SAIFR, Brazil, August 19-23, 2019.
- Barreiro gave a lecture in the 2<sup>nd</sup> Workshop on Regional Climate Modeling and extremes over South America, ICTP, Brazil, November 5-9, 2018.
- Keenlyside co-chaired and lectured at the *Observing and Modelling the Arctic Environment - Climate processes, prediction and projection* Summer School at Nansen International Environmental and Remote Sensing Center (NIERSC), St. Petersburg, Russia, 8th – 13th September 2019

### **Plans for end of 2019 and beyond**

- Minobe will co-convene a session on “Extratropical air-sea interactions and extreme events” and Keenlyside will co-convene a session on “Impacts of Inter-Basin Interaction on Climate Variability and Extreme Events” at the Ocean Sciences Meeting 2020.
- Town Hall meeting and Ocean Sciences on the IPCC SROCC (Collins)

- Town Hall meeting at AGU Fall Meeting on *Predictions of the near term evolution of the climate system* (Msadek)
- Large Ensemble session at the Japan Geoscience Union May 2020 as a collaboration between US-CLIVAR Large Ensembles working group and CDP (Minobe)
- Chapman conference on the Evolution of the monsoon, biosphere and mountain building in Cenozoic Asia (Bordoni) January, Washington DC
- The 3<sup>rd</sup> ICTP Summer School on Theory, Mechanisms and Hierarchical Modeling of Climate Dynamics: Tropical Oceans, ENSO and their Teleconnections (Bordoni)
- The outline proposal for a Research Focus on Tropical Basin Interactions has proceeded to full bid stage (Keenlyside); Ingo Richter is co-chair, and proposal was prepared jointly with the Atlantic Region Panel
- 2019 AGU fall sessions “Decadal Climate Variability, Predictability, and Predictions” (Rym and Aixue), “Deep-Ocean Circulation Changes and Their Impacts” (Aixue, session chair and convener).
- The next panel meeting may be held in April 2021 in Japan, combined with a workshop of a Japanese recently funded project, hotspot2. The hotspot2 project is seeking the possibility of making the workshop a collaboration workshop between hotspot2 and CDP (Minobe)

**Articles published in 2018/19 as part of panel activities (if any – reported above)**

- Cai et al., 2019 Pantropical climate interactions. *Science*, Vol. 363, Issue 6430, DOI: 10.1126/science.aav4236 (Keenlyside, Xie, Kang co-authors)
- Roberts, M. et al., 2018: The Benefits of Global High Resolution for Climate Simulation: Process Understanding and the Enabling of Stakeholder Decisions at the Regional Scale. *Bulletin of the American Meteorological Society*, 99, 2341-2359, DOI: 10.1175/bams-d-15-00320.1 (Minobe)

**Budget and other needs for 2020**

*Please keep in mind that the overall budget of CLIVAR is limited and this needs to be distributed between all activities and the SSG meeting.*

## Annex A

### Proforma for CLIVAR Panel requests for SSG approval for meetings

1. **Panel name:** Climate Dynamics
2. **Title of meeting or workshop:** Changing Patterns of Climate: Understanding Uncertainties
3. **Proposed venue:** Fjordhotel Rosendal, Norway
4. **Proposed dates:** Tentatively 22-26 June 2020
5. **Proposed attendees, including likely number:** 30, mix of senior to early career researchers working on climate dynamic methods to understand and constrain regional climate change
6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:**

Adapting to climate change is a major imperative facing the planet. Sustainable development of our society critically depends on meeting this challenge. However, designing and implementing successful adaptation measures demands accurate information on how the climate is expected to change on continental and smaller scales. Although great progress to this end has been made, model-based projections of future climate remain highly uncertain at the regional level. Increasing the spatial resolution and complexity of climate models unfortunately does not automatically reduce this uncertainty.

The workshop will put forward a new vision – **understanding and reducing uncertainties in regional climate change requires a deeper understanding of the underlying “dynamics” of the climate system.**

In particular, uncertainties in regional climate change can be greatly reduced by understanding how the atmospheric circulation responds to changes in thermodynamic forcing, for example associated with the radiative impacts of clouds, and how it is further shaped through interaction with the ocean, land-surface, and sea ice on the regional level. With this enhanced understanding of climate dynamics, appropriate metrics, indices, emergent constraints, and storylines can be defined to best utilize the available multi-model climate projections and to target future model development. Furthermore, the approach provides a pathway to mechanistic-informed selection (weighting) and statistical-correction of climate model projections that can be used for regional downscaling and impacts modelling.

The following make the workshop particularly timely, mean it will have large impact on international research agenda, and lead to long term socio-economic benefit:

- Society urgently requires the development of appropriate adaptation measures
- Progress is needed to reduce uncertainties in regional climate change projections
- Governments and funding agencies are shifting focus towards adaptation research
- There will be a wealth of new climate change projection (CMIP6) data available for provision of climate services

The workshop clearly aligns with the CLIVAR science plan and the agenda of the its

Climate Dynamics Panel. It is relevant to the other three WCRP core projects (CliC, GEWEX, SPARC) and requires participation from these communities. It will contribute to the WCRP unifying theme on regional climate, and WCRP Coordination Office for Regional Activities (CORA) will help arrange the workshop. We will also seek involvement of the WCRP Grand Challenge on Clouds, Circulation, and Climate Sensitivity.

**7. Specific objectives and key agenda items:**

The main objective of the workshop is to high-light climate dynamics as an essential tool to understand and reduce uncertainties in regional climate change. Specific objectives are to synthesize current understanding of this research field and to identify the key gaps in our understanding climate dynamics, and pathways to address these gaps.

**8. Anticipated outcomes (deliverables):** High-profile publication to energize the community around climate dynamics approaches to understand and reduce uncertainties in regional climate change

**9. Format:** Workshop will focus on drafting a synthesis publication. A sketch of the publication will be prepared by the organizing committee. At the workshop there will be key plenary presentations, breakout writing groups, and plenary discussions. The organizing committee will lead the finalization of the paper following the workshop.

**10. Science Organizing Committee (if relevant):**

The initial committee consists of Noel Keenlyside, Matthew Collins, John Fyfe, Sarah Kang, Shang-Ping Xie

**11. Local Organizing Committee (if relevant):** Beatriz Baleno (CORA), Mahaut de Vareilles (University of Bergen)

**12. Proposed funding sources and anticipated funding requested from CLIVAR:**

Total costs and CLIVAR contribution TBD.