



Climate and Ocean - Variability, Predictability, and Change



Sonya Legg & Wenju Cai: SSG Co-chairs
Gokhan Danabasoglu: SSG member
Jose Santos: ICPO Executive Director

USCLIVAR Summit, March 2022



**International
Science Council**



CLIVAR Mission and Scientific Priorities

CLIVAR is one of the 6 Core Projects of the World Climate Research Program (WCRP)



CLIVAR's **mission** is to understand the dynamics, interaction, and predictability of the climate system with emphasis on ocean-atmosphere interactions.

Scientific priorities of CLIVAR:

1. Mechanisms of climate variability and change that require further investigation with the ultimate goal of better constraining the fluxes of energy and carbon in the climate system;
2. Ocean processes that modulate climate variability and change for which open questions remain;
3. Climate predictability challenges over a broad range of space and time scales.

CLIVAR Organization Chart

CLIVAR Organization

Scientific Steering Group

ICPO

Core Panel

Research Foci

Ocean Model Development Panel

Global Synthesis and
Observations Panel

Climate Dynamics Panel

Monsoons Panel

Atlantic Region Panel

Pacific Region Panel

Indian Ocean Region Panel

Southern Ocean Region Panel

Northern Ocean Region Panel

Eastern Boundary
Upwelling Systems
(Ended December 2021)

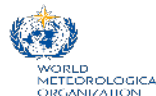
Tropical Basin
Interaction (March
2020 – December 2024)

Regional sea-level
change & coastal
impacts

The **CLIVAR SSG** provides overall guidance for CLIVAR activities, in concert with WCRP objectives, and establishes CLIVAR Panels (and Working Groups) and their terms of reference.

Research Foci address urgent and actionable research challenges. RFs have a limited life-time (3-5 yrs)

The Sea Level Grand Challenge is cross-cutting between CLIVAR & WCRP, and includes modeling & observations: ending 2022



International
Science Council



New WCRP Structure and Lighthouse Activities

WCRP Structure

Joint Scientific Committee (JSC)

WCRP Secretariat

Lighthouse Activities

International Offices

Core Projects and Research Communities

- Climate and Cryosphere (CliC)
- Global Energy and Water Exchanges (GEWEX)
- Climate and Ocean Variability, Predictability and Change (CLIVAR)
- Stratosphere-troposphere Processes And their Role in Climate (SPARC)
- Earth System Modelling and Observations (ESMO)
- Regional Information for Society (RIFS)

Ongoing Activities and Fora

- Fixed-term projects
- Reference datasets, evaluations and benchmarking
- Rapid updates, syntheses, assessments, gap analysis
- Conferences and workshops
- Diversity and capacity building: ECRs, regions
- Communications and outreach



CLIVAR representatives at the WCRP Lighthouse Activities

LHAs	CLIVAR Rep.	Activities involved with CLIVAR
Explaining and Predicting Earth System Change	Shoshiro Minobe (CDP)	<ul style="list-style-type: none"> <u>Workshop on 'Attribution of multi-annual to decadal changes in the climate system'</u>. 22-24 September 2021 (Online) (Report).
	Lijing Cheng (GSOP)	
My Climate Risk	Mat Collins (SSG)	<ul style="list-style-type: none"> AGU 2022 Fall Meeting: WCRP <u>'My Climate Risk' Lighthouse Activity: Inverting the construction of climate information for local-to-regional climate risk</u>. 15 December 2021. 21:30 - 23:00 CET. SRI Congress 2021. Session: <u>My Climate Risk</u>. 13 June 2021.
	Regina Rodriguez (ARP) – co-chair	
Safe Landing Climates	Paulo Nobre (Former WGSIP and ARP)	<ul style="list-style-type: none"> Tipping Elements Discussion Series
	Kevin Reed (US CLIVAR SSC)	
Digital Earths	Aneesh Subramanian (GSOP)	
	Svetlana Jevrejeva (SLGC)	
WCRP Academy	Angela Maharaj (nominated by Andrea Taschetto from TBI RF)	<u>Climate Training Stocktake Survey 2021</u>
	Antonietta Capotondi (PRP)	

CLIVAR's Contribution to WCRP Implementation

- Support preparation and organisation of **WCRP activities**:
 - ✓ Support to the WCRP Climate Research Forum in Eastern Asia and South America in 2021
 - ✓ WCRP 2022 Sea Level Conference (Jose and Jing on the Organising Committee)
 - ✓ SPARC General Assembly (Qian in coordination with FIO for the Qingdao Node)
- Contribute to the **WCRP LHA Science Plan** development
- Jose participated in the **WCRP leadership group** on behalf of ICPO
- Attended the **WCRP Secretariat and IPO regular teleconferences**
- Contributing to the **WCRP reports** to partners (e.g., WMO, SCOR, SOLAS) and the **WCRP Newsletter**
- **Advertising WCRP activities** through CLIVAR network



Science Highlights

1. Tropical Atlantic Observing System (TAOS) Review Report published

2. Tropical Pacific Decadal Variability (TPDV) – by PRP

- Decadal climate variability in the tropical Pacific: Characteristics, causes, predictability and prospects (Power et al., 2021, *Science*)
- TPDV Working Group launched by PRP in June 2021

3. New Working Groups for TBI RF

- WG1 - GCM Experiments
- WG2 - Conceptual and Intermediate Complexity Models and Statistical Approaches
- WG3 - Observations
- WG4 - Paleo Data

4. Future Directions in High-Resolution Ocean Modelling (Workshop by OMDP, October 2021).

<https://www.clivar.org/news/future-directions-basin-and-global-high-resolution-ocean-modelling-workshop-took-place-online>

5. Towards providing more reliable regional climate change projections (Workshop by CDP, online July 2021)

6. Freshwater in the Arctic Ocean 2010–2019 (Paper published by NORP cochair on Ocean Sci.)

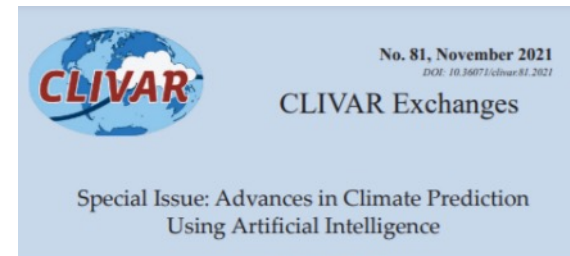
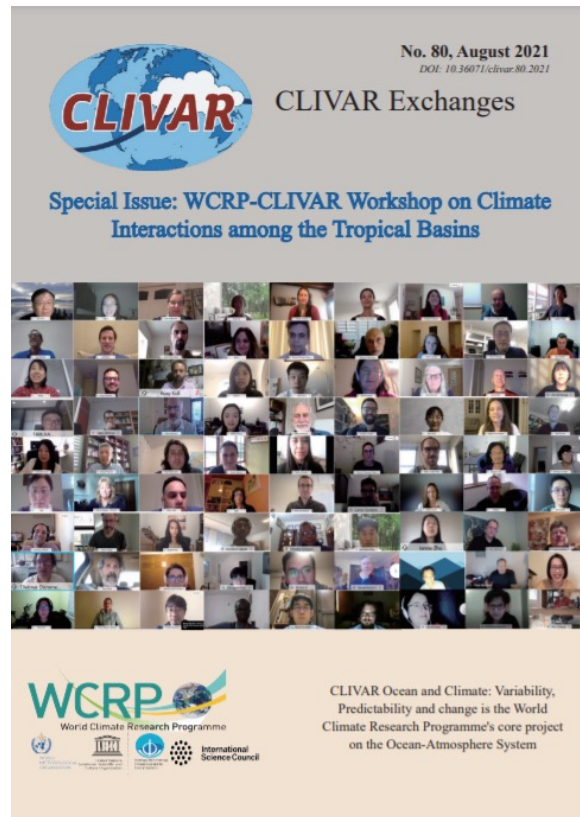


Other CLIVAR panel activities

- **IORP**: RAMA-OMNI coordination (2021-), Indian Ocean Youth Ambassador (2021-), IndOOS-2 implementation progress report (2021-2022), WIO training workshop (June 2022)
- **SORP**: contributed to SOOS Science Plan & SO UN Ocean Decade; co-edited special issue in Frontiers in Marine Science on inter-basin exchange between the Southern Ocean and South Atlantic (2021), workshop (June 2022).
- **PRP**: ENSO metrics (ongoing), ENSO conceptual models WG (2020-2022), ENSO Summer School (July 2022), CLIVAR-PICES Joint WG on Climate Extremes and Coastal Impacts in the Pacific (under preparation)
- **ARP**: 3 focal areas (2021-): AMOC, Tropical Atlantic, risks and extreme events.
- **NORP**: Arctic Processes CMIP6 Bootcamp (5-15 October, 2022); review papers on seasonality of Arctic freshwater and Arctic Ocean heat flux (published in August 2021), NORP/SORP joint workshop (June 2022)
- **MP**: Regional working groups updated in 2021: Asian-Australian Monsoons (17 members), African Monsoons (19 members), American Monsoons (14 members)
- **GSOP**: Plan to focus on 2 topics: The Deep Argo role in the observing system and collaboration in SynObs (a Project under the UN Ocean Decade)
- **OMDP**: 1 new paper emanating from panel activities (JGR Oceans, Feb 2021); three workshops within OMDP (Feb, May, Oct, 2021); SWOT-Adopt-a-Crossover calibration and validation experiments (Aug 22-Sep 3, 2022)
- **CDP**: workshops: on “towards providing more reliable regional climate change projections” (June 21st - July 16th); and “Multi-annual to Decadal Climate Predictability in the North Atlantic-Arctic Sector” (20-22 Sep, 2021), 3 sessions on big conferences

CLIVAR Exchanges

Published in 2021



Upcoming issues in 2022



Coordination of US CLIVAR with CLIVAR Internationally



The research agendas are interactive and mutually supportive, with international CLIVAR providing a platform for US research thrusts to engage interests of others internationally, and with US CLIVAR's agenda influenced by international interests and collaborative opportunities.

- ◆ Coordination w/ Panels e.g., on observing system reviews, model experiments; w/ Atlantic Panel for CLIVAR AMOC Task Team
- ◆ Membership of current and former US SSC and Panel members on international SSG, Panels, and Research Foci Teams
- ◆ Promotion of CLIVAR activities and membership calls
- ◆ Report-outs at annual SSG/SSC meetings and US CLIVAR Summit
- ◆ Mutual sharing of panel, working group, and workshop reports
- ◆ Collaboration on joint reports and editions of Variations/Exchanges
- ◆ Co-sponsorship of CLIVAR meetings
 - Virtual Tropical Basin Interactions Workshop in Feb 2021; Sea Level Conference and ENSO Summer School in July 2022; CLIVAR-GOOS Workshop From Global to Coastal Ocean Obs in August 2022
 - 2022 Intl Panel Meetings when held in-person
 - Support travel of all US members
 - Hosting of meetings in US (e.g., 2020 and 2019 **SSG** Mtgs, 2019 **OMDP** Mtg, 2019 **Monsoon Panel** Mtg, 2019 **Sea Level GC** Mtg)
- ◆ Bi-monthly tag-ups of Project Office Directors

Purposeful and frequent interactions help ensure sustained and strong communication and coordination.



CLIVAR AMOC Task Team

CLIVAR AMOC Task Team

The objective of establishing the international AMOC Task Team under CLIVAR is to facilitate communication, promote international cooperation, and support continuing AMOC research and infrastructures, towards addressing ongoing, pressing science priorities. These have already been defined by the international community (i.e., US AMOC Science Team, UK RAPID_AMOC, OSNAP, SAMOC, AtlantOS, TAOS, etc.).

Terms of References

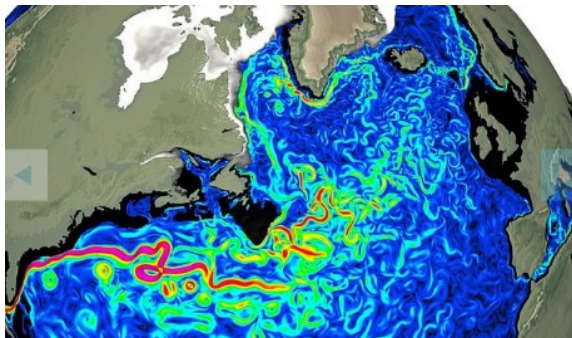
1. To promote and coordinate international collaborations amongst observational and modeling studies
2. To coordinate international workshops on AMOC science & impact topics (2023?)
3. To produce a summary report with identified priorities of the AMOC community.
4. To improve data and product distribution from AMOC programs
5. To develop strategies for cost-effective, sustained monitoring of the AMOC (through an assessment of the observing system using Observation System Simulation Experiments (OSSEs))

Membership

Name	Affiliation	Country	Role
Eleanor Frajka-Williams	National Oceanography Centre (NOC)	UK	Co-chair
Eric Chassignet	Florida State University	USA	Co-chair
Maria Paz Chidichimo	Argentine Scientific Research Council (CONICET)	Argentina	Member
Gokhan Danabasoglu	National Center For Atmospheric Research (NCAR)	USA	Member
Brad deYoung	Memorial University	Canada	Member
Rebecca Hummels	GEOMAR	Germany	Member
Laura Jackson	Met Office	UK	Member
Johannes Karstensen	GEOMAR	Germany	Member
Helen Pillar	The University of Texas at Austin	USA	Member
Sabrina Speich	Laboratoire de Météorologie Dynamique/Institut Pierre-Simon Laplace (LMD/IPSL) OOPC	France	Member
Rong Zhang	NOAA GFDL	USA	Member
Paquita Zuidema	University of Miami	USA	Member
Mike Patterson	US CLIVAR Project Office	USA	
Meric Srokosz	National Oceanography Centre (NOC)	UK	

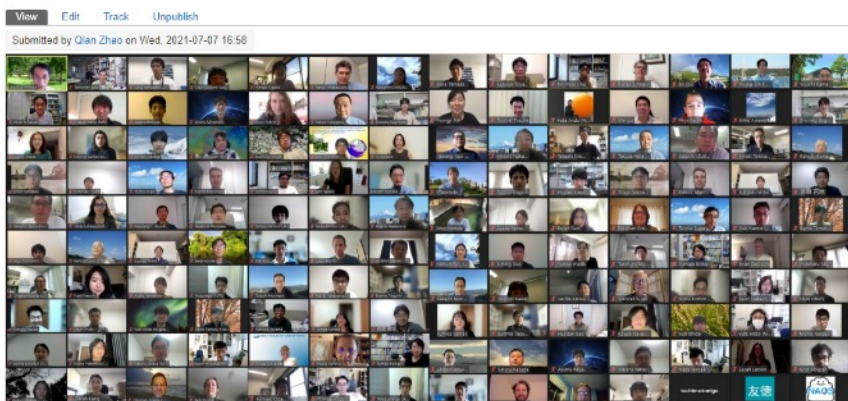
CLIVAR Endorsed activities

Future Directions in Basin and Global High-resolution Ocean Modelling



- October 2021. Supported by OMDP, More than 150 participants
- The low-res design of the virtual conference center was a nice contrast to the high-res models discussed at the conference

The International workshop for mid-latitude air-sea interaction took place successfully



- June 2021. Supported by CDP
- 20+ invited speakers, 50+ posters (by abstract sub. Deadline)
- Five sessions covering daily to centennial timescales, including extremes and teleconnections

The East Asian Workshop on A Predicted Ocean was held successfully online



- September 2021. Endorsed by OMDP
- More than 120 participants from the world
- 12 invited speakers
- Focus on prediction on key processes, prediction on extreme air-sea interaction.

Endorsed project and activities (Archived)

- Multi-Annual to Decadal Climate Predictability in the North Atlantic-Arctic Sector Workshop (Online, 20-22 September 2021), supported by CDP

Newly endorsed project and activities

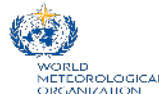
- Ocean to climate Seamless Forecasting system: An update of the Ocean Forecasting System (OSF) programme (Jan 2022)
- Ocean Heat and Freshwater Storage and Transports in Observations and Climate Models Workshop (Exeter, UK), 2021, supported by NORP
- Ocean Salinity Conference (New York, USA), 6-9 June, 2022

CLIVAR and the UN Ocean Decade

- **Digital Twin of the Ocean (DITTO) Programme**
 - ✓ Assisted in the preparation of the 1st International Digital Twins of the Ocean Summit at G7 (4-5 May 2022, London), and coordinate for virtual satellite activities to be organized alongside the Summit
 - ✓ Opportunity to register as a partner for DITTO
- **Ocean Observing Co-design Programme**
 - ✓ Attended Ocean Observing Co-design Programme meeting (Feb. 4, 2022, online)
 - ✓ To link the CLIVAR/GOOS Workshop more closely with the programme
 - ✓ Co-design for a testbed in the Indian Ocean
- Supported the CLIVAR contributions to the Southern Ocean UN Decade
- To seek the UN Ocean Decade Endorsement for the CLIVAR-GOOS Workshop
- Participated in the development of UN Ocean Decade China's national strategy, actions and contribution

Upcoming Events

1. **WCRP 2022 Sea Level Conference** (12-16 July 2022, hybrid with in-person participation in Singapore)
2. **CLIVAR-FIO Summer School on Ocean Macroturbulence and its role in Earth Climate** (August 14-20, 2022, two nodes in Qingdao and Guayaquil, with virtual participation available) - by ARP
3. **Third Summer School on Theory, Mechanisms and Hierarchical Modelling of Climate Dynamics: Tropical Oceans, ENSO and their Teleconnections** (18 – 29 July 2022, originally planned 2020) – by PRP
4. **CLIVAR-GOOS Workshop: From global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change** (15-19 August 2022, Trieste, Italy)
5. **Regional training workshop on observing the coastal and marginal seas in the western Indian Ocean** (7-9 June 2022, hybrid with in-person participation in Maputo, Mozambique)
6. **Arctic Processes in CMIP6 Boot Camp** (5-21 October 2022, Helgoland, Germany)
7. **“From filaments to climate” workshop co-convened with the SWOT Science Team** (late summer/early fall of 2022, hybrid with 3 nodes in USA, France and China)
8. **SORP-NORP Joint Workshop on polar freshwater** (June 2022)
9. **CDP workshop: Understanding the contributions of external and internal variability in climate** (July 2022)
10. **WCRP/CLIVAR workshop on interaction among the tropical basins: observations, numerical experiments and paleo-proxies** (3-7 October 2022, Norway)

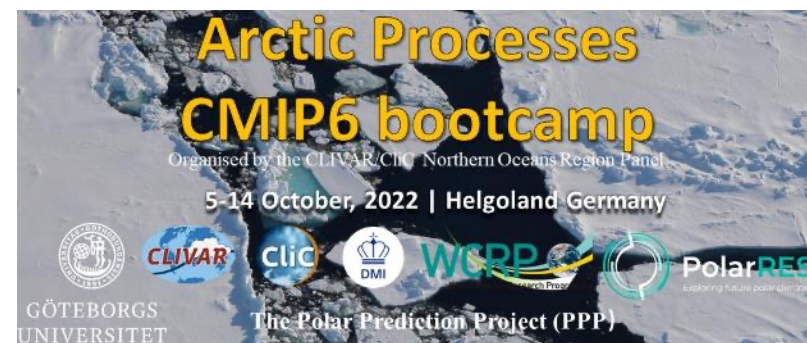
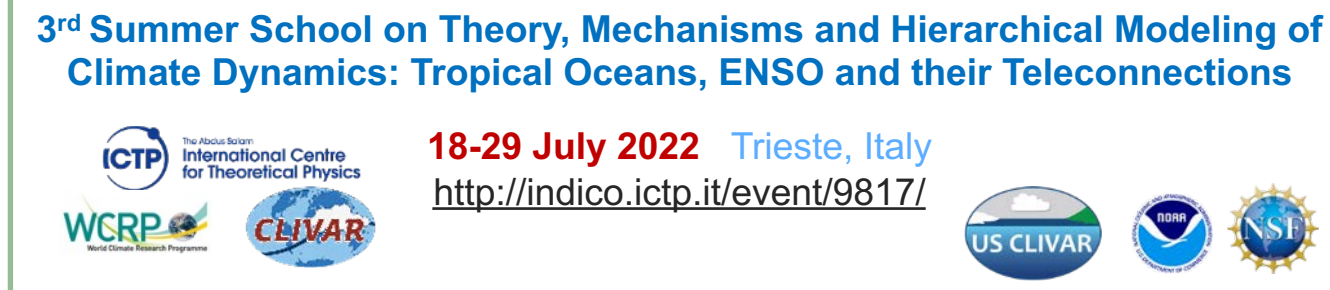


International
Science Council



Capacity building activities

*** Special thanks to US CLIVAR in providing tremendous support for CLIVAR activities**



International
Science Council



Pan-CLIVAR Workshop



Objectives

1. To bring the CLIVAR panels together with invited speakers from developing rim nations for an exchange of problems, ideas, and solutions, enriching the efforts of each and adding up to a global perspective worth more than the sum of its parts;
2. To discuss and develop opportunities for developing rim countries to increase their oceanographic capabilities and improve regional forecasting in partnership with the various regional ocean observing systems as well as to
3. To provide an opportunity to discuss how the efforts and priorities of regional and national observing systems combine and how the panels can prepare together for the UN's International Decade of Ocean Science for Sustainable Development, 2021-2030.

CLIVAR IORP, ARP, PRP, OMDP, GSOP are participating in the organizing committee.

Draft Programme	
Day 1: Societal and scientific drivers of regional ocean observing systems	
	Opening Session
Plenary talks	1. Global perspective talks 2. Flash talks from developing countries
Breakout	Sessions topics to be generated from the plenary talks
Day 2: Connect observation-modeling-prediction	
Plenary talks	To connect resources/philanthropy with countries/regions that need them! (Possible speakers: CoastPredict, Observing Together, INCOIS, ROMS, Google Ocean, Vulcan, etc.)
Breakout	Session-1: Coastal disaster reduction Session-2: Coastal ecosystem conservation and protection Session-3: Stakeholder engagement Session-4: Fisheries and aquaculture Session of opportunity
Day3: Multi-disciplinary and innovative observing system and expansion into coastal zones	
Plenary talks	Autonomous vehicle, Animal-borne sensors, Satellite observation, Coral reef with the environmental stresses + fisheries, Low-cost sensors and citizen science, New Players
Breakout	Session-1: Capacity building and pilot projects Session-2: Indigenous and local knowledge systems Session-3: Public awareness & citizen science Session-4: Demo-applications (*Policy and clearance issues)



International
Science Council



Thank You