



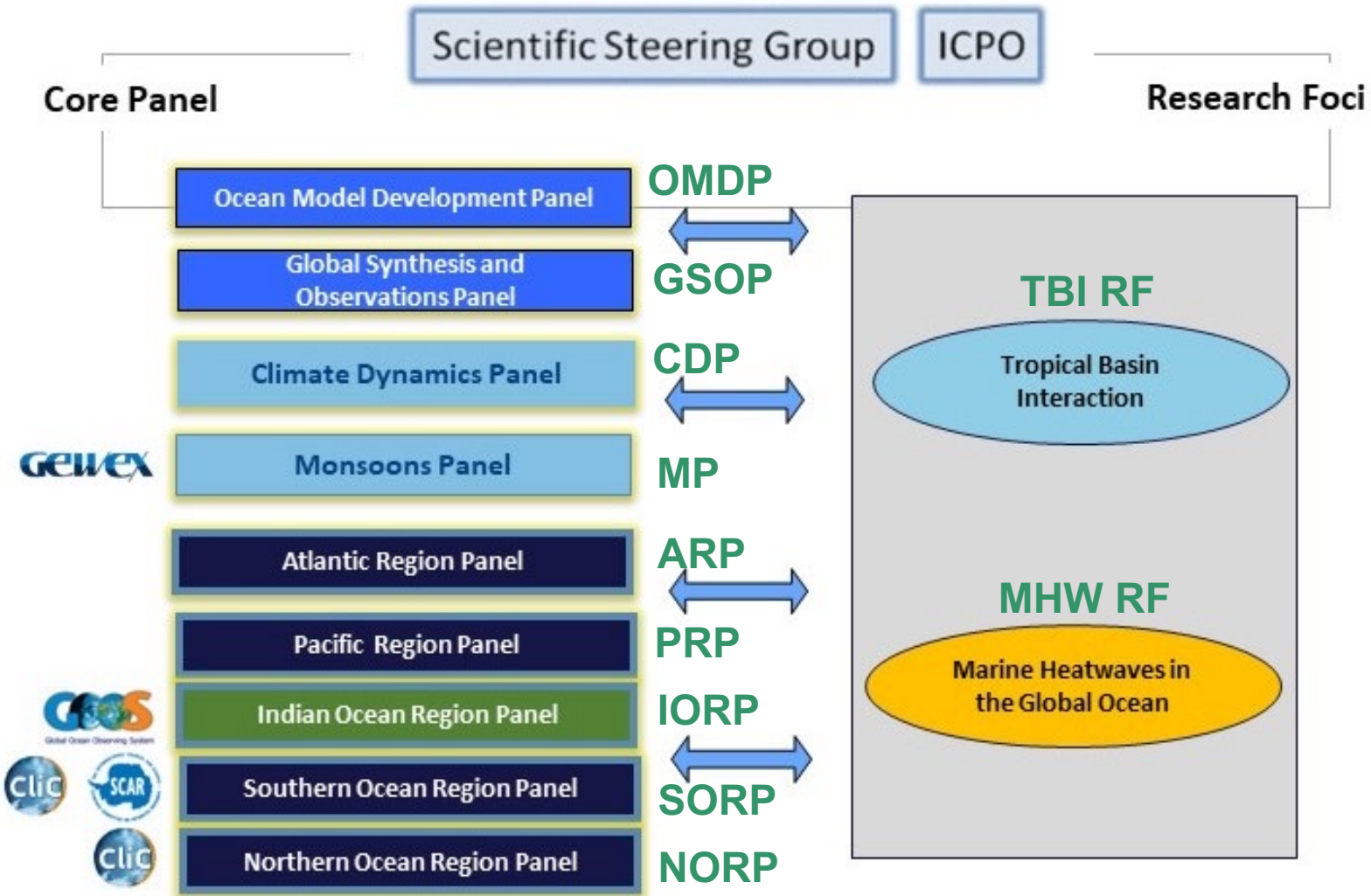
45th Session of the World Climate Research Programme
Joint Scientific Committee

CLIVAR

Climate and Ocean: Variability, Predictability, and Change



CLIVAR Organization



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

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

Highlights for Joint Scientific Committee

- CLIVAR has produced several publications in 2023 and 2024 associated with activities in 2023, and four reports.
 - Capotondi, A., et al. 2023: Mechanisms of tropical Pacific decadal variability. *Nat Rev Earth Environ.*, 4, 754–769.
 - Swart, N. C., et al., 2023: The Southern Ocean Freshwater Input from Antarctica (SOFIA) Initiative: scientific objectives and experimental design. *Geosci. Model Dev.*, 16, 7289-7309
 - Chen, J.-J., et al., 2023: Reduced Deep Convection and Bottom Water Formation Due to Antarctic Meltwater in a Multi-Model Ensemble, *Geophysical Research Letters*, doi:10.1029/2023GL106492.
 - Singh, S., et al., 2024: First International Summer School on Marine Heatwaves, *Bull. Amer. Meteor. Soc.*, doi: 10.1175/BAMS-D-23-0046.1.
 - Sprintall, J., et al., 2024: COVID Impacts Cause Critical Gaps in the Indian Ocean Observing System. *Bull. Amer. Meteor. Soc.*, doi:10.1175/BAMS-D-22-0270.1
 - Watanabe, M., et al., 2024: Possible Shift in Controls of the Tropical Pacific Surface Warming Pattern. *Nature*, in press.

- The CLIVAR Research Focus on Tropical Basin Interaction (TBI) has been extended until the end of 2025
- 4 New RF/Working Groups/Task Team
 - CLIVAR Research Focus (RF) on Marine Heatwave in the Global Ocean
 - “TROPICS” working group
 - RAMA Task Team
 - *Pacific Atmospheric Teleconnections in a wArming Climate (PATAC)*

Research Focus on Marine Heatwave in the Global Ocean

- Launched in Feb 2023. A cross-panel activity to achieve a better understanding of marine heatwaves globally, including detection, surface and subsurface characteristics, mechanisms, and connection with climate change and biogeochemical extremes. They are currently planning a review paper for one of Nature journals.
- AGU Ocean Sciences, New Orleans, Feb 2024: Led a session on “Marine heatwaves in a changing world”, with 5 oral sessions and a large poster session.
- Marine Heatwave RF and other CLIVAR panels (Indian Ocean, Pacific, and Atlantic Region Panels) organized a Summer School on “*Marine Heatwaves: Global Phenomena with Regional Impacts*” held at ICTP in Trieste, Italy, July 24-29, 2023.

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The summer school implemented SDA2 (Skill Development, Awareness & Application) that provided a framework to help the early career researchers (ECRs) build long lasting and fruitful collaborations both among themselves and with their mentors. A Summer School report has been published in *BAMS* (***Singh et al. 2024***).

Singh, S., J. Sprintall, A. Capotondi, and R. Rodrigues, 2024: First International Summer School on Marine Heatwaves. *Bull. Amer. Meteor. Soc.*, <https://doi.org/10.1175/BAMS-D-23-0288.1>

ICTP-CLIVAR Summer School on Marine Heatwaves: Global Phenomena with Regional Impacts

What: Graduate students and other early career scientists from 13 countries came together at a summer school to learn about detection, mechanisms, attribution, future projections and societal impacts of marine heat waves.

When: 24–29 July 2023

Where: Trieste, Italy

ICTP-CLIVAR Summer School on Marine Heatwaves: Global Phenomena with Regional Impacts



24 - 29 July 2023
An ICTP Hybrid Meeting
Trieste, Italy



Leading ocean scientists assess the latest impacts of a warming ocean

Published: 05 September 2023



There has been a lot of discussion recently about the [record warming trends](#) that have been observed globally in recent months. This includes an observed basin-wide warming of the ocean and an increase in marine heatwaves. Marine heatwaves occur when ocean temperatures in a given region are well above average for an extended period of time. Warmer ocean temperatures impact

Marine Heatwave RF and some members of the Atlantic Region Panel issued a [statement on ocean warming](#) which was published simultaneously by WCRP and WMO in September 2023.

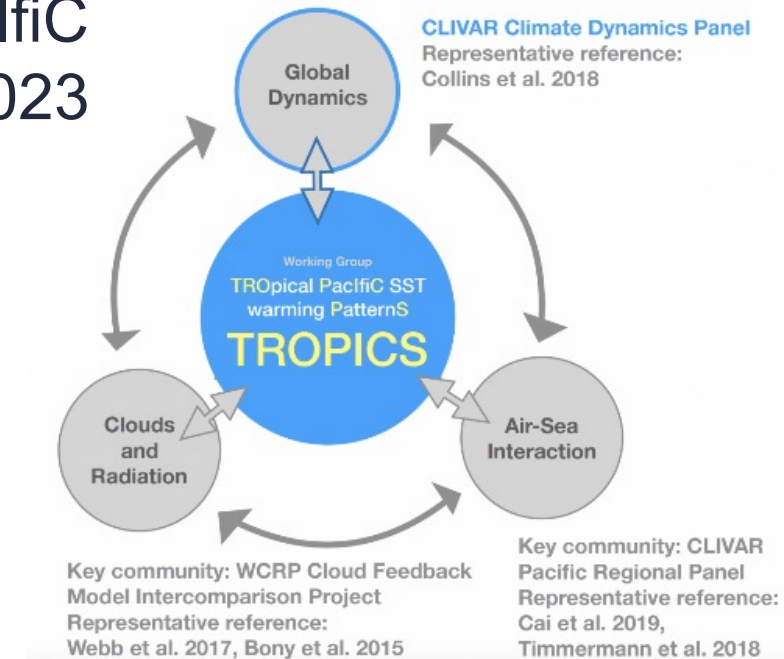
The statement outlined the potential reasons for the severe warming of the global ocean in 2023, particularly in the North Atlantic, and provided more accurate information amid speculations in the media.

New working group



A CLIVAR/CFMIP Joint Working Group on TROpical PacIfiC SST warming PatternS (**TROPICS**) launched in March 2023 (CDP/PRP).

- The [“TROPICS” working group](#) aims to bring communities together to resolve the important issue of model-observation discrepancy in the tropical Pacific sea surface temperature trend pattern.
 - The WG submitted a perspective paper to *Nature* on the recent tropical Pacific warming pattern (**Watanabe et al. 2024**).



Watanabe, M., et al., 2024: Possible Shift in Controls of the Tropical Pacific Surface Warming Pattern. *Nature*, in press

The CLIVAR Indian Ocean Region Panel led an article in *BAMS* documenting the challenges in sustaining IndOOS in the face of the ongoing pandemic and provided insights on the way forward.

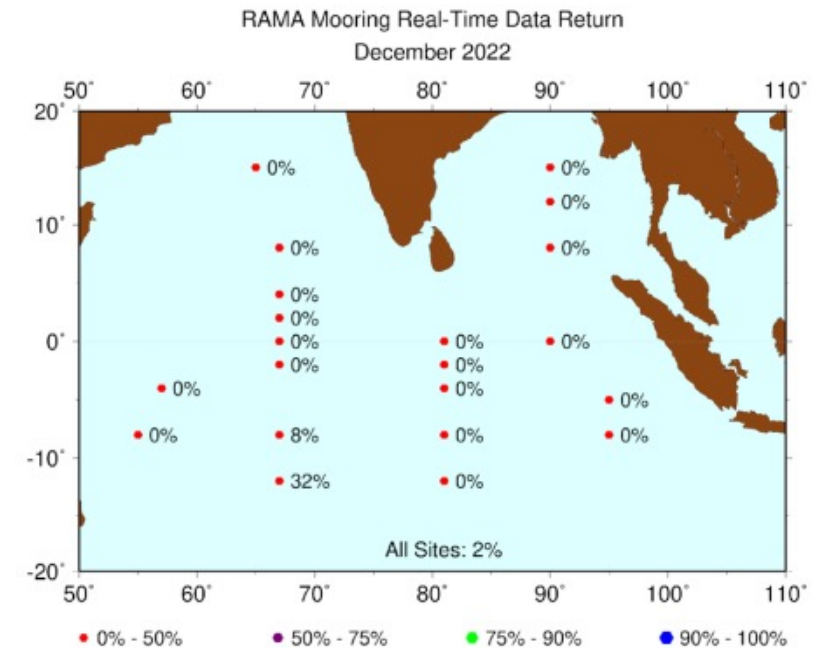
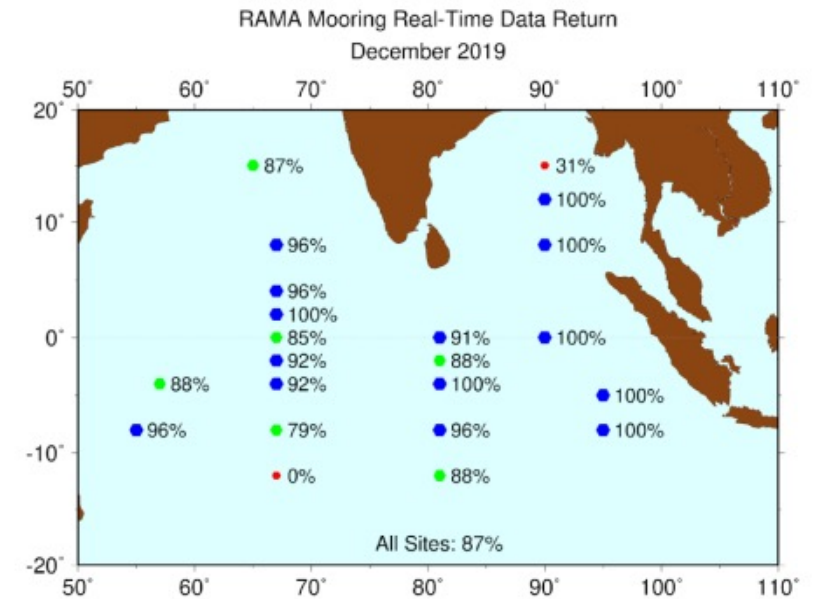
New Task Team formed to quantitatively evaluate the impacts and consequences of significantly reduced data return from RAMA since 2019 due to the COVID pandemic.

COVID Impacts Cause Critical Gaps in the Indian Ocean Observing System

Janet Sprintall, Motoki Nagura, Juliet Hermes, M. K. Roxy, Michael J. McPhaden, E. Pattabhi Rama Rao, Srinivasa Kumar Tummala, Sidney Thurston, Jing Li, Mathieu Belbeoch, and Victor Turpin

Online Publication: 15 Feb 2024

DOI: <https://doi.org/10.1175/BAMS-D-22-0270.1>



New Working Group

[Pacific Atmospheric Teleconnections in a wArming Climate](#) (PATAAC)

The working group, hosted by the CLIVAR Pacific Regional Panel, aims to consolidate current knowledge of atmospheric teleconnections and enhance our understanding of their potential changes in a warming future. The group will investigate interactions across spatial-time scales, ranging from large-scale interannual variability to regional synoptic patterns and extremes with societal impacts. The focus will be on the mechanisms of atmospheric teleconnections associated with Pacific variability and their effects over land through extreme events such as heatwaves, floods, and droughts.

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Tropical Basin Interactions RF has been extended to 2025

- ✓ **Working Group 1: Coordinated GCM Experiments (CoEx).** Protocols and test simulations for CoEx finalised with a paper being prepared for Geophysical Model Development. Work is ongoing.
- ✓ **Working Group 2: Theory and ICMs.** idealized GCM experiments to be made available; interbasin Linear Inverse Model (LIM) and interbasin recharge oscillator developed with codes to be made available to community
- ✓ **Working Group 3: Observations.** review article on pantropical observing system; potential joint activity with the Ocean Observations Physics and Climate Panel (OOPC) on a pantropical observation system; joint satellite event at Ocean Decade Conference in Barcelona; two synthesis reports prepared
- ✓ **Working Group 4: Paleo proxies.**

Current status of TBIMIP

Model	Center	Type of experiment	Status
CESM2	NCAR	pmaker hindcast	completed
CESM2	NCAR	standard pmaker	ongoing
CESM2	SCSIO, China	Tier 2 expmnts	ongoing
NorCPM	U. of Bergen	standard pmaker	ongoing
SINTEX-F2	JAMSTEC	pmaker hindcast	in preparation
MIROC6	JAMSTEC	hindcast+standard	in preparation
ACCESS-CM2	CSIRO, Australia	standard pmaker	in preparation
ACCESS-CM2	CSIRO, Australia	Tier3 expmnts	completed

Southern Ocean Freshwater release model experiments Initiative (SOFIA) has been registered as a Community MIP under CMIP (“SOFIAMIP”) as of November 15, 2023.

SOFIA was officially launched in October 2021 as a task team of CLIVAR/CliC/SCAR Southern Ocean Region Panel, to reconcile the growing number of Southern Ocean model studies on Antarctic meltwater impacts.

To date, SOFIA has 11 different participating models. Tier 1 model experiments have been completed to understand model uncertainty in freshwater release of 0.1 Sv from Antarctica under pre-industrial climate. Tier 2 experiments will cover historical period and future scenarios.

SOFIA experiment protocol paper (Swart et al. 2023) and a first science paper (Chen et al. 2023) were published.

Swart, N. C., et al., 2023: *The Southern Ocean Freshwater Input from Antarctica (SOFIA) Initiative: scientific objectives and experimental design*. **Geosci. Model Dev.**, 16, 7289-7309

Chen, J.-J., et al., 2023: *Reduced Deep Convection and Bottom Water Formation Due to Antarctic Meltwater in a Multi-Model Ensemble*, **Geophysical Research Letters**, doi:10.1029/2023GL106492.

Training schools

- [Summer School on “Marine Heatwaves: Global Phenomena with Regional Impacts”](#) (Trieste, 24-29 July 2023)
- [The 4th Summer School on Theory, Mechanisms and Hierarchical Modeling of Climate Dynamics: Atlantic Variability and Tropical Basin Interactions at Interannual to Multi-decadal Timescales](#) (Trieste, Italy, 31 July-11 August 2023)
- [CLIVAR-FIO Summer School on Biogeochemical processes in Earth System Models](#) (Qingdao, China, 15-20 July 2024)
- [ICTP-SORP-NORP Summer School and Workshop on Polar Climates: Theoretical, Observational and Modelling Advances](#) (Trieste, 22-31 July 2024)

Workshops

- [*CLIVAR workshop on the tropical Pacific and its interbasin interactions*](#) (Melbourne, Australia, 14-17 Feb 2023)
- [*Workshop on Meeting AMOC Observation Needs in a Changing Climate*](#) (Hamburg, Germany, 18-20 July 2023)
- [*Workshop on Atlantic Variability and Tropical Basin Interactions at Interannual to Multi-decadal Timescales: Mechanisms, Drivers, and Impacts*](#) (Trieste, Italy, 9-11 August 2023)
- [*The 2024 CFMIP Meeting and CLIVAR Climate Dynamics Panel 3rd Annual Workshop*](#) (Boston, USA, 3-6 June 2024) on Clouds, Precipitation, Circulation, and Climate Sensitivity, with additional theme on tropical warming pattern formation mechanisms
- [*Workshop on "Interaction among the tropical basins: observations and simulation"*](#) (Seoul, Korea, 22-23 June 2024)
- [*OMDP-COMMODORE Workshop 2024*](#) (Boulder, USA, 9-13 September 2024)
- [*Workshop on Improving Modelling of the AMOC*](#) (Exeter, UK, 23-25 September 2024)

A review paper on Tropical Pacific Decadal Variability (TPDV) has been published in October 2023 as a major outcome of TPDV WG (PRP):

nature reviews earth & environment

<https://doi.org/10.1038/s43017-023-00486-x>

Review article

 Check for updates

Mechanisms of tropical Pacific decadal variability

Antonietta Capotondi ^{1,2}✉, Shayne McGregor ^{3,4}, Michael J. McPhaden ⁵, Sophie Cravatte ^{6,7}, Neil J. Holbrook ^{8,9}, Yukiko Imada¹⁰, Sara C. Sanchez ¹¹, Janet Sprintall ¹², Malte F. Stuecker ^{13,14}, Caroline C. Ummenhofer ^{15,16}, Mathias Zeller¹⁷, Riccardo Farneti ¹⁸, Giorgio Graffino ¹⁹, Shijian Hu ²⁰, Kristopher B. Karnauskas¹, Yu Kosaka ²¹, Fred Kucharski ¹⁸, Michael Mayer^{22,23}, Bo Qiu¹³, Agus Santoso ^{16,24}, Andréa S. Taschetto ^{16,24}, Fan Wang ²⁰, Xuebin Zhang ²⁵, Ryan M. Holmes ²⁶, Jing-Jia Luo ²⁷, Nicola Maher ^{1,11,28,29}, Cristian Martinez-Villalobos ^{30,31}, Gerald A. Meehl ³², Rajashree Naha³, Niklas Schneider^{13,14}, Samantha Stevenson³³, Arnold Sullivan³⁴, Peter van Rensch ³ & Tongtong Xu ^{1,2}

Sections

Introduction

Observed tropical Pacific decadal changes

TPDV as an ENSO residual

The $\bar{v}T'$ hypothesis and wave processes

The $v'\bar{T}$ hypothesis

Influences from Pacific extratropical atmospheric forcing

Winds of tropical origin

Influences from other ocean basins

Summary and future perspectives

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Webinars

- “PROS4SORP” – a seminar series organized by CLIVAR/CliC/SCAR Southern Ocean Region Panel

*The third of a quarterly series of presentations by invited speakers will be presented by **Dr. Steve Rintoul (CSIRO, Australia): How vulnerable is the East Antarctic Ice Sheet and deep overturning circulation? May 29th at 04.00 UTC***

- WCRP/WWRP Webinar Series organized by the CLIVAR/GEWEX Monsoons Panel

More seminar series are planned

WCRP Open Science Conference

Held several activities, including the SSG's 28th session, CLIVAR/GEWEX Monsoons Panel's 5th session, with many panel members actively involved at the conference. There were also Poster Clusters ("Marine heatwaves in the world oceans", "Changes in sea surface temperature patterns in the Tropics").



Ocean Decade Conference Satellite Events, Barcelona

Co-Designing Ocean observing system for better societal services - pan tropics and basin use areas

Location: CCIB

Date: 11 April 2024

Time: 1:15 pm to 2:45 pm

Building a transformative and solutions-oriented ocean observing system is critical to the success of the Ocean Decade. The design of such systems should follow the principles of co-design, working with stakeholders across the value chain and integrating their needs into the process. We will discuss these principles and observational needs of (a) a pan-tropical observing system; (b) a suite of “exemplars” including boundary currents, tropical cyclones, and marine carbon. Our event will commence with a short presentation followed by a “speed-dating” session. Attendees will meet with focus-area leadership to discuss regional involvement and collaborations from across the value-chain.

Partners

CLIVAR, WMO; South African Environmental Observation Network; Ecole Normale Supérieure, France; DCC-OCC, China; Sun Yat-Sen University, China; IOC-UNESCO; Mercator Ocean International; Japan Meteorological Agency/ Meteorological Research Institute; Ocean Frontiers Institute; CMCC, NOAA

Ocean-based solutions to mitigate climate change impacts with Africa as a demonstration

Location: PRBB

Date: 9 April 2024

Time: 11:30 am - 2:00 pm

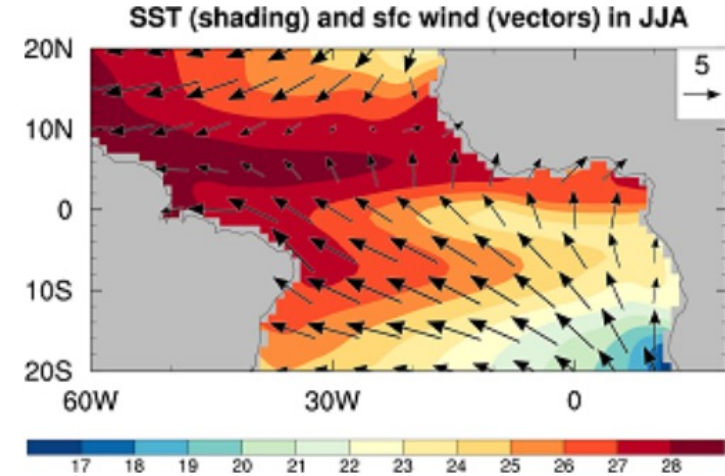
The workshop will be hosted by the Ocean to climate Seamless Forecasting system (OSF) Programme together with its partners, harnessing the collaborative efforts within the framework of the Ocean Decade to advance understanding and prediction of the ocean-climate nexus. It seeks to showcase main achievements from 2021 to 2024, build capacity, foster dialogue and promote cooperation among diverse stakeholders in the pursuit of ocean-based solutions for climate change, by highlighting cutting-edge advancements such as low-cost ocean and climate observation technology and new generation ocean and climate models.

Partners

CLIVAR, SOLAS, IOCAFRICA, the Decade Collaborative Centre on Ocean-climate Nexus and Coordination, the National Institute of Oceanography and Fisheries of Egypt, the Organization of African Academic Doctors



Atlantic Niños aren't what they used to be



The great ocean conveyor - what has it been doing lately?

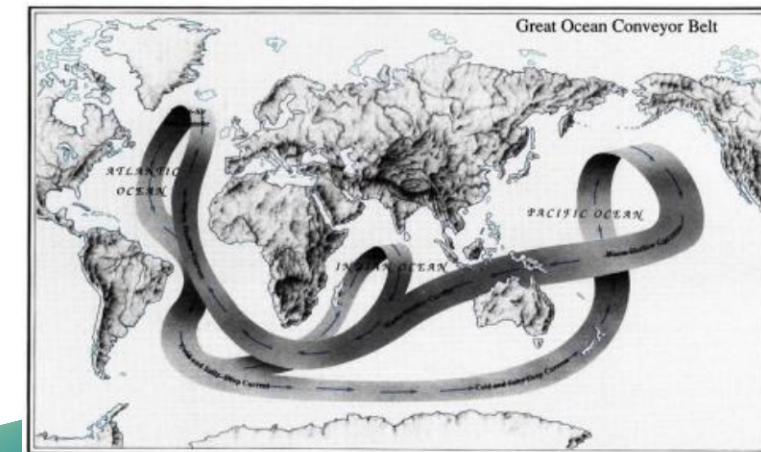


Fig. 1: The great ocean conveyor logo (Broecker, 1987). (Illustration by Joe Le Monnier, Natural History Magazine.)

Planned science initiatives and major events

Science initiatives:

- High-resolution modeling
- Biogeochemistry
- Understanding the impact of COVID-induced degraded observing systems over the Indian Ocean
- Arctic Ocean science and community outreach
- Metrics for assessing synthesis products
- CMIP7 ocean diagnostics
- Development of intermediate complexity model of TBI

Planned major events:

- Pan-CLIVAR Meeting
- The Wyrтки Symposium and ENSO Winter School
- CDP 4th Annual Workshop: Weather & Climate Interactions – observations, theory, and modelling
- NORP-SORP-OMDP Workshop on ocean heat in polar regions and connections to lower latitudes

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Pan-CLIVAR Meeting 2025

- A 5-day meeting to include all members of CLIVAR panels, research foci, and the scientific steering group.
- The venue is to be located in the Global South, to encourage attendees from developing countries (considered venue: Indonesia, October 2025)
- Aims: 1) foster cross-panel interactions through facilitating internal coordination among activities across different CLIVAR panels and research foci; 2) evaluate progress, formulate future priorities, and enhance members cohesion within each panel and research focus group; 3) develop ideas and input for new CLIVAR science and implementation plans for the next 5 to 10 years.
- The first Pan-CLIVAR meeting was held in 2014; over 130 members of CLIVAR panels and guests gathered in The Hague over a week (14-19 July 2014). The meeting was held jointly with the GEWEX conference “Trending Now: Water”.

Planned products, high-level assessments or other key outputs/publications

- PRP working groups:
 - ENSO Metrics software package,
 - review paper on ENSO conceptual models,
 - Python reference version of the ENSO Recharge Oscillator
- OMDP: new dataset that will replace the JRA55-do datasets
- TBI RF working groups:
 - output of idealized GCM experiments;
 - Code for interbasin recharge oscillator and a Linear Inverse Model (LIM) to study interbasin interaction,
 - integrated review of the outcome of all research activities of their four WGs,
 - TBI Coordinated Experiments (CoEx): paper, model output, synthesis paper
 - Review article on pantropical observing systems

...continued

- MHW RF: a review/perspective paper as introduction to a special collection on MHWs by Nature journals
- Southern Ocean Region Panel has compiled 8 articles for the *CLIVAR Exchanges* on research highlighting emerging Southern Ocean and Antarctic programs, featuring programs developed in the Global South.
- Monsoons Panel: Guest Editors/Contributors for a special issue of *Advances in Atmospheric Sciences* on global monsoons, including Asian monsoon, American monsoon, African monsoon, and Australian monsoon
- ENSO Special Collection proposed to the *Journal of Climate* to focus on the unusual ENSO behavior observed in the past decade - a joint initiative from the CLIVAR Pacific Region Panel, MHW RF, TBI RF, and CLIVAR Scientific Steering Group

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Linkages with other WCRP activities

- CliC co-sponsors NORP and SORP; GEWEX co-sponsors the Monsoons Panel
- Cross-membership of CPs and CLIVAR panels (e.g., APARC chair in CDP, ARP chair in My Climate Risk LHA)
- [Regional Hubs on Ocean Climate Risk](#) is a collaboration between ARP Ocean Risk WG, My Climate Risk LHA, IORP, PRP
- Cataloguing training events in WCRP Academy
- Monsoons Panel: SPARC, CliC, My Climate Risk and Safe Landing Climates LHAs, will provide ideas/activities for GPEX LHA
- potential synergy with CORDEX and GEWEX: OMDP's plan on downscaling climate projections, CLIVAR's planned work on biogeochemistry
- Further potential interactions with LHA (various)

Partnerships with entities outside of WCRP

- IORP:

- co-sponsored by IOC-GOOS
- continued engagement with the scientific community and observational programmes, e.g., OOPC, GOOS, SIBER, SOLAS, IOCINDIO, TRIUMPH, EKAMSAT, RAMA, Ocean Decade activities, including at the [IIOSC-2024](#)
- ongoing interaction with SIBER on development of Coastal Observations Lab in a Box (COLaB)

- SORP:

- co-sponsored by SCAR (Scientific Committee on Antarctic Research); SCAR was a co-sponsor of NORP-SORP workshop on polar fresh water
- Interacts with Antarctic InSync, an endorsed UN Ocean Decade Action which is proposing synchronous observations of the Southern Ocean and Antarctica

...continued

- Partnership with OOPC: coordinated implementation strategy for observing systems; OOPC representatives to be entrained into TBI RF WG3 on Observations, involving NPOCE and TPOS via PRP.
- PICES: MHW RF co-chair – PRP ex-officio involved in PICES WG-49 on ‘Ocean extremes and coastal impacts’ and is organising a session on marine extremes (physical and biogeochemical) at the next PICES annual meeting in Honolulu, October 2024
- UN Decade project [SynObs](#): Monsoons Panel and IORP new task team
- Other potential partnerships: Ocean University of China (host of ICPO), [CLIVAR-endorsed programme OSF](#) (Ocean to Climate Seamless Forecasting System)

Suggestions, issues or challenges

- ICPO
 - underwent a transition in early 2023
 - No staff from August until 5th of December 2023 when a new director arrived
 - Interviews of 2 staff scientists and administrative assistant have recently been completed
- CLIVAR Global Synthesis and Observations Panel (GSOP)
 - has not been active since 2023
 - SSG met with the GSOP co-chairs on February 2024, offering feedback and advice
 - Panel finally met for the first time on 2nd of May 2024, and is currently in the process of sorting out their membership

Thank You



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www.wcrp-climate.org

