# ***The World Climate Research Programme (WCRP): a short update to SCOR-2024***

## *The World Climate Research Programme*

*"The World Climate Research Programme (WCRP) coordinates and facilitates international climate research to develop, share and apply the climate knowledge that contributes to societal well-being."*

WCRP leads the way in addressing frontier scientific questions related to the coupled climate system — questions that are too large and too complex to be tackled by a single nation, agency or scientific discipline. Through international science coordination and partnerships, WCRP contributes to advancing our understanding of the multi-scale dynamic interactions between natural and social systems that affect climate. WCRP engages productively through these partnerships to inform the development of policies and services and to promote science education.

Like SCOR, WCRP does not fund science directly, but provides coordination and a platform for the exchange of ideas on specific high-priority research topics related to the climate system. Funds for WCRP activities come from its co-sponsors[1] as well as voluntary contributions from various countries and agencies. Since the COVID-19 pandemic, WCRP activities have been organised virtually or in hybrid format whenever possible, including meetings of the Joint Scientific Committee (JSC), the body responsible for providing scientific guidance to the Programme.

Currently, WCRP is in the process of implementing its new research strategy (WCRP Strategic Plan 2019-2028[2]). Major elements of the Science and Implementation Plan are to strengthen support for core research, ensure engagement of the next generation of scientists and improve the diversity of WCRP leaders (across nations, regions, and disciplines), deepen our interaction with partners at national and international levels, and ensure that society has the climate knowledge that it needs for decision-making.

WCRP has reoriented itself to ensure that there is the science, knowledge and understanding needed to target frontier problems, such as disaster risk reduction, climate adaptation, mitigation, and intervention strategies, that need to be solved together with partners for which WCRP's core research continues to be essential for developing answers. The integral role of WCRP in developing knowledge of the climate system will result in an increased understanding of the Earth system, including of the complex interactions between the physical environment and society.

These efforts culminated in the WCRP Open Science Conference (OSC; https://www.wcrp-climate.org/wcrp-osc23), 23-27 October 2023 in Kigali, Rwanda, which brought together nearly 1500 participants both virtually and on-site from diverse research communities, programmes and partners to discuss the latest developments in climate science, with an emphasis on science-based information for decision making. 50% of the participants were onsite with 32% of delegates from Africa and 26% from other regions in the Global South; one third were early career scientists. As the first official event in the lead-up to this fully hybrid once-in a-decade event, taking place at a very important moment of Earth's history, the virtual poster session opened on 9 October 2023. One major outcome of the OSC is the Kigali Declaration which served as an input to COP28. WCRP OSC Concept Papers are the other major outcomes from various OSC sessions.

[1] World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) and the International Council for Science (ISC)

[2] https://www.wcrp-climate.org/wcrp-sp-overview

***The WCRP Lighthouse Activities***

As of 2023, WCRP has six new 'Lighthouse Activities' (LHAs, two of which are just spinning up) that aim to make critical near-term progress towards meeting WCRP's Vision, Mission, and four Scientific Objectives, as outlined in the WCRP Strategic Plan 2019–2028. The WCRP Lighthouse Activities are designed to be ambitious and transdisciplinary (integrating across WCRP and collaborating with partners) so that they can rapidly advance some of the new science and technologies, and institutional frameworks, that are needed to manage climate risk and meet society's urgent need for robust and actionable climate information more effectively. WCRP's six LHAs are Digital Earths, Explaining and Predicting Earth System Change, My Climate Risk, Safe Landing Climates, and two new ones the Global Precipitation Experiment (GPEX) and Research of Climate Intervention. The WCRP Academy, which started as an LHA is now part of the more permanent structure of WCRP.

There are several connections to ocean research. For example, one theme of the Safe Landing Climates' Lighthouse Activity is sea level rise, which aims to quantify an "acceptable" rate of sea level rise and its irreversibility from multiple decades to millennia and study the impact of storm surges and cyclones on coastal communities to assess the potential for adaptation. Digital Earths will push the co-development of ultra-high-resolution modelling of the Earth-system and its components, including the ocean, as well aspects of data assimilation for a comprehensive and consistent description of the state of the system at any given time. They are launching a km-scale working group (with ESMO-WGNE) and a group in initializing/spinning up km-scale coupled models (with ESMO and CLIVAR OMDP). These LHAs will partner with Future Earth (Risk KAN, Ocean KAN, Coasts, Surface Ocean – Lower Atmosphere Study (SOLAS)), Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS), and others.

***The WCRP Core Projects***

Until 2021 WCRP had four Core Projects (Research Communities), CLIVAR (Climate and Ocean Variability, Predictability and Change - www.clivar.org), CliC (Climate and Cryosphere- www.climate-cryosphere.org), GEWEX (Global Energy and Water Exchanges- www.gewex.org) and APARC (Atmospheric Processes And their Role in Climate - www.aparc-climate.org). Two new Core Projects have been established: Earth System Modelling and Observations (ESMO) and Regional Information for Society (RifS). ESMO is working on advancing predictions and projections of the Earth system on time scales from weeks to centuries via a model-observation integrating framework, as well as improving monitoring, understanding, and attribution of climate system changes and impacts. RIfS facilitates and catalyses new targeted research related to the provision of actionable information about climate variability and change in support of adaptation and mitigation. Both CLIVAR and CliC endorse of the SCAR/SCOR Southern Ocean Observing System (SOOS). Of these Core Projects, the work of CLIVAR is of particular relevance to SCOR.

***The CLIVAR Core Project of WCRP***

CLIVAR aims to understand the dynamics, the interaction, and the predictability of the climate system with emphasis on ocean-atmosphere interactions. Many scientific activities carried out by CLIVAR panels and Research Foci groups are of strong relevance to other WCRP core projects, Lighthouse Activities, and other emerging initiatives (e.g., a joint activity on Cycle and Budgets, jointly with GCOS). CLIVAR has also helped identify ocean hubs for My Climate Risk Lighthouse Activity. CLIVAR Research Foci on Marine Heatwaves in the Global Ocean which was launched in Feb. 2023, aims to achieve a better understanding of MHWs globally, including detection, surface and subsurface characteristics, mechanisms, connection with climate change and biogeochemical extremes. The group issued a statement on ocean warming which was published simultaneously

by WCRP and WMO (September 2023), outlining the potential reasons for the severe warming of the global ocean in 2023, particularly in the North Atlantic.

The CLIVAR Research Focus on Tropical Basin Interaction (TBI) that is due to conclude in 2024 has been granted an extension to the end of 2025, to complete important activities of its four working groups (WG) that were delayed during the pandemic and for them to collectively write a synthesis review paper. TBI WG1 is completing coordinated model experiments with output to be published on ESGF. WG3 is writing a review article on pantropical observing system. The TBI research foci is expected to be replaced with a new Research Foci with a call expected to be launched soon.

CLIVAR has produced several publications in 2023-2024. For instance, a working group of the CLIVAR Pacific Region Panel published a review paper in *Nature Reviews Earth & Environment*, that evaluates our understanding of the governing processes behind tropical Pacific decadal variability involving the ocean, which has important ramifications on climate and environment across the globe. The CLIVAR/IOC-GOOS Indian Ocean Region Panel (IORP) led an article in *BAMS* documenting how huge losses in the implementation of the observing arrays during the global COVID pandemic have left a permanent gap in the observation record that is critical to future climate predictions; and provides insights on the way forward. To address how these gaps impact forecasting and data-assimilation systems, the IORP has initiated a new Task Team to understand and quantify the impact of COVID-induced degraded observing systems over the Indian Ocean on simulations and forecasts of tropical climate variability. This task team will provide an opportunity for a closer partnership with SCOR.

CLIVAR has organised several workshops in 2024 which include: *Workshop on "Interaction among the tropical basins: observations and simulation"* held at Yonsei University in Seoul, Korea (22-23 June 2024) which provided a forum for presenting the latest research on tropical basin interactions using models and observations; the *OMDP-COMMODORE Workshop 2024* at NSF NCAR Mesa Laboratory in Boulder, USA (9-13 September 2024) by the CLIVAR Ocean Model Development Panel (OMDP) and the European Community for the Numerical Modeling of the Global, Regional, and Coastal Ocean (COMMODORE) aims to improve dynamical cores and parameterisations in numerical ocean models used for a wide range of scales from coastal applications to millennial global climate change. CLIVAR had two training schools this year: *CLIVAR-FIO Summer School on Biogeochemical processes in Earth System Models* (Qingdao, China, 15-20 July 2024), and *ICTP-SORP-NORP Summer School and Workshop on Polar Climates: Theoretical, Observational and Modelling Advances* (Trieste, 22-31 July 2024). Participants and experts in the latter event released an urgent call for international action and commitment for Antarctica InSync programme, a year-round observational campaign as Antarctic sea ice is on track to a second winter of extreme sea-ice deficit.

CLIVAR has also been involved with synergistic activities with external partners, including at two satellite events of the 2024 Ocean Decade Conference in Barcelona: 1) Co-designing ocean observing system for better societal services – Pan tropics and basin use areas; 2) Ocean-based solutions to mitigate climate change impacts with Africa as a demonstration.

WCRP and CLIVAR look forward to further exploring collaborations in ocean related activities with SCOR in the future. Please contact Hindumathi Palanisamy (WCRP - hpalanisamy@wmo.int), Agus Santoso (CLIVAR - agus.santoso@clivar.org).