

The World Climate Research Programme (WCRP): a Short Update to SCOR-2020

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’s new Mission)

Like SCOR, WCRP does not fund science directly, but provides resources/platforms to hold meetings and workshops on specific high-priority research topics related to the climate system. Such funds come from its co-sponsors¹ as well as voluntary contributions from various countries and agencies. WCRP has gone almost wholly online since the start of the COVID-19 crisis. Major meeting such as the Joint Scientific Committee meeting were held with over 80 people attending remotely.

Currently, WCRP is putting significant effort into implementing its new research strategy (WCRP Strategic Plan 2019-2028²) by reviewing its entire structure and improving its functionality, including also its interaction with partners. Major elements of the implementation plan are to strengthen support for core research, and to extend and deepen our engagement with scientific partners at the national and international levels. The full implementation of a new WCRP structure is expected to be complete by the middle of 2022. However, WCRP has begun the process leading to a “soft launch” of its new foci and structure, the endpoint of which we expect will be beneficial to its co-sponsors and nations around the world.

Through its Strategic Plan 2019-2028 WCRP is reorienting itself to ensure that there is the science, knowledge and understanding 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 the complex interactions between the physical environment and human society.

A number of [Lighthouse Activities](#) (LHA, ambitious, exciting, and high-profile experiments, projects, and infrastructure building blocks) will be undertaken to advance WCRP’s mission and scientific objectives. The activities will be co-designed (with partners and users) and integrative (across the WCRP community) and require diversity. The LHAs are anticipated to start in 2021.

The four WCRP Core Projects will be internally assessed by their Scientific Steering Groups to determine how they might evolve to be fit for the future. They are called 'homes' in the proposed new structure of WCRP, as they are where WCRP’s enduring science capacity lives. Two new 'homes' are proposed. One for 'Earth System Modelling and Observational Capabilities' and one for 'Regional Climate Information for Societies'.

A series of regional consultations on the WCRP reform process are being organised, in order to engage communities from all regions of the world, so that the ongoing implementation of the WCRP Strategy and the way in which WCRP evolves lead to outcomes that are useful and useable across the world.

The WCRP Grand Challenges, including the Sea Level GC, will all sunset by the end of 2022. Other projects and activities may also sunset or be revised, as determined by their contributions to WCRP’s scientific objectives.

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 Grand Challenges

<http://wcrp-climate.org/grand-challenges>

The overarching WCRP Grand Science Challenges (GCs) represent major foci of scientific research, modelling, analysis and observations. Of the Grand Challenges, Regional Sea-Level Change and Coastal Impacts is of most relevant to SCOR, though many others (e.g. decadal climate, carbon feedbacks) have a significant ocean component. The Sea Level GC represents an integrated interdisciplinary program on sea level research reaching from the global to the regional and local scales. The [2019 meeting of the WCRP Grand Challenge on Regional Sea Level and Coastal Impacts](#) was held from 12-15 October 2019 in Orléans, France, with the first two days focused on the links between science and coastal climate services. The workshop, which was organized in association with IOC/GLOSS, WMO and CLIVAR focused on stimulating the uptake of coastal climate services, how they support present days and future coastal resilience, and making recommendations as to the best way forward. A specific research topic on '[Climate Services for Adaptation to Sea-Level Rise](#)' in *Frontiers in Marine Science* is being coordinated by the SL GC. The leadership of the GC has been updated by including the representativeness from user community. The 2nd Sea Level Conference is planned to be held in 2022 in Asia (Singapore), with a large representation from vulnerable Asian coastal areas, and including top world stakeholders, city planners, coastal developers and managers and other relevant stakeholders to focus on the flow of knowledge from sea-level science to strengthen climate change adaptation and disaster resilience in coastal zones. The SL GC will be come to an end after the 2nd SL Conference.

The WCRP Core Projects

WCRP carries out a major part of its activities through its four core projects, CLIVAR (oceans and climate - www.clivar.org), CliC (cryosphere and climate - www.climate-cryosphere.org), GEWEX (water and climate www.gewex.org) and SPARC (upper atmosphere and climate - <http://www.sparc-climate.org>). Both CLIVAR and CliC are endorsers 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 (Climate and Ocean: Variability, Predictability and Change) is one of the four core projects of the WCRP, which is to understand the dynamics, the interaction, and the predictability of the climate system with emphasis on ocean-atmosphere interactions. Many CLIVAR panel and Research Foci members are taking part in the planning for [WCRP Lighthouse Activities](#) and the WCRP [regional consultation process](#). Meanwhile, in response to the rapid pace of scientific advances and recognizing the need for the project to be flexible and responsive to new ideas and challenges, a new research foci on Tropical Basin Interactions has been approved by the CLIVAR SSG. COVID-19 has hindered many activities organised by CLIVAR in 2019, however, the CLIVAR community is adapting to the new normality at a fast pace. The planned CLIVAR/FIO summer and ENSO summer schools are postponed to 2021. With the emphasis on connecting observation-modeling-prediction, a pan-CLIVAR workshop on 'From global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change' will be organised in May 2021 at ICTP, Italy, in cooperation with IOC-UNESCO, GOOS, and other international partners. CLIVAR is also trying to increase its relevance and contribution to the [UN Decade of Ocean Science for Sustainable Development](#), initiated by IOC-UNESCO. CLIVAR puts emphasis on the regional and gender balance of the membership. In 2020, the ratio of female and male members is about 1:2.

- **Northern Ocean Region Panel (NORP)**

The panel has been putting great emphasis on the freshwater storage and exchange. A review paper on Arctic freshwater budget is finished, identifying progress and knowledge gaps on Arctic freshwater distribution, source/sinks, and reanalysis. NORP is planning for a GOOS/GCOS workshop on heat and freshwater transport and storage in models and observations planned for October 2021. Another workshop on Arctic freshwater will be organized by NORP alongside ASSW2021 in March 2021. The panel is planning on the NORP Bootcamp Summer School tentatively to be held in Helgoland, Germany in Summer 2021.

- **Ocean Model Development Panel (OMDP)**

Despite the development of ocean (coupled) models, there are still knowledge and technical gaps to be resolved. OMDP has been enhancing the development of an ocean circulation model through identifying the challenges and prospects in ocean circulation models, organizing the Co-ordinated Ocean-Ice Reference Experiments (CORE-I and CORE-II) and the newest variants, the Ocean Model Intercomparison Projects (OMIP-1 and OMIP-2). The panel was involved through the coordinated development of forcing datasets: CORE-I, CORE-II, and now JRA55-do. Since last year, OMDP has built protocols for comparison and comparing ocean-sea ice models at high-resolution and low resolution, and protocols for comparison and comparing ocean model parameterizations. Based on these protocols and previous successes, OMDP will continue leading the role of ocean model community to engage in the model intercomparison on resolution and parameterizations, and other aspects of ocean models. To recognize the role of the ocean on ocean eddies, OMDP organized a workshop on Sources and Sinks of Ocean Mesoscale Eddy Energy in March, 2019 at Florida State University, USA. In January 2020, a CLIVAR/US CLIVAR joint exchanges: A joint special edition on Sources and Sinks of Ocean Mesoscale Eddy Energy was issued. OMDP is planning to organize a workshop on Future Directions in High-resolution Ocean Modelling, postponed to late September.

- **Southern Ocean Regional Panel (SORP)**

SORP serves as a forum for the discussion and communication of scientific advances in the understanding of climate variability and change in the Southern Ocean. SORP successfully organized a session at IGS Sea Ice Symposium in August, 2019 at Winnipeg, Canada. The panel seeks qualified scientists to be the national representatives of Southern Ocean, and asks them to submit the national report to seek the knowledge gaps and cooperation opportunities. In the past three years, representatives from 17 countries submitted the national report. The co-chairs are now working to synthesize them, the impacts of COVID-19 on the Southern Ocean projects of the countries will be included. Due to COVID-19 and the cancellation of SCAR OSC 2020 and associated business meetings, the planned WAMC/YOPP-SH/SOOS/ASPeCt joint workshop was cancelled, the panel is looking for other ways to reorganize it.

- **Climate Dynamics Panel (CDP)**

The frontline problems and techniques described in Collins et al. (2018 NCC) constitute the science topics of the Climate Dynamics Panel, while the “Developing predictive theories of climate dynamics” topic may be considered as an overarching theme. In the past year, CDP (co)organized sessions at IUGG, fall AGU and PICES 2019. Members have organized or lectured at several summer schools to enhance the capability building. The planned workshop on Climate Prediction in the Arctic and North Atlantic sector (5-7th June 2020, Bergen, Norway) has been changed to an online meeting due to the COVID-19; as the main achievement of the workshop, a review paper on uncertainty of the climate prediction will be finished after the workshop. The panel is conceiving another workshop in 2021 for better understanding the climate dynamics.

- **Atlantic Region Panel (ARP)**

The [Tropical Atlantic Observing System \(TAOS\) Review](#) is being finalised by ARP in collaboration with PIRATA. The final draft including science drivers and Essential Ocean Variables (EOV) metrics is now being sought for comments from the TAOS Review Committee, ARP members, and relevant programmes. The final report will be released by the end of 2020. The [2nd CLIVAR-FIO Summer](#)

[School on Ocean Macroturbulence and Its Role in Earth's Climate](#) led by ARP originally planned in July 2020 in Qingdao, China, will be postponed to July 2021 due to COVID-19. The CLIVAR ARP endorsed Ocean-Atmosphere component of [EUREC⁴A](#) (EUREC⁴A-OA, Europe) and [Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign](#) (ATOMIC, US) experiment has been conducted in the northwest tropical Atlantic in January-February 2020 with the participation of more than 200 scientists. The team is now validating and calibrating the collected data, writing campaign overviews and data papers, and have started brainstorming collectively to address the scientific analyses of the observations and the parallel modelling effort. Meanwhile, with the [sunset of US AMOC Science Team](#), an AMOC Task Team is being proposed by ARP with prioritising the AMOC activities that can be taken over by the international CLIVAR, with close cooperation with other international partners on AMOC observation and researches.

- **Pacific Region Panel (PRP)**

ENSO remains the focus of researches for PRP. The main activities (e.g. ENSO metrics) of the former CLIVAR ENSO in a Changing Climate Research Foci (ENSO RF) have been integrated into PRP since 2018. A Working Group on ENSO Conceptual Model has been established within PRP and kicked off in July 2020. The WG is to bring experts of ENSO theory, modelling, and observations together to review knowledge on ENSO conceptual models and identify possible avenues for improved conceptual models that can more fully account for ENSO complexity. The PRP also contributed to the AGU monograph on ['ENSO in a Changing Climate'](#), which is to be published in November 2020. The [3rd Summer School on Theory, Mechanisms and Hierarchical Modeling of Climate Dynamics: Tropical Oceans, ENSO and their Teleconnections](#), co-organised by ICTP and CLIVAR PRP, has been postponed to 2021 due to COVID-19. Meanwhile, PRP continues its effort on Tropical Pacific Decadal Variability (TPDV), by leading the manuscript of 'A review of decadal climate variability in the tropical Pacific: characteristics, causes, predictability and prospects' which has been submitted to *Science*. A TPDV working group is being proposed within PRP to address the open questions identified in the TPDV article. Moreover, PRP intended to strengthen the cooperation with the biogeochemical groups by co-organising a workshop on 'Climate and Ecosystem Prediction in the North Pacific' alongside the 2019 PICES annual meeting, to synthesize the current state of knowledge on the physical drivers of marine ecosystems variations along the coasts of the North Pacific rim as well as sources of predictability arising from large-scale climate variability. The future work will be focusing on the mechanisms of formation of marine heat waves in the Pacific basin. PRP also actively involved in workshop on ['Atmospheric convection and air-sea interactions in the Tropical Oceans'](#), jointly organised by US and International CLIVAR on May 2019 in Boulder, USA.

- **CLIVAR/IOC-GOOS Indian Ocean Region Panel (IORP),**

The decadal review for the Indian Ocean Observing System (IndOOS) was completed, (see: ['IndOOS-2: A Road map to Sustained Observations of the Indian Ocean for 2020-2030'](#)). This review was sponsored by the Ocean Observations Physics and Climate panel (OOPC), an expert panel of the Global Ocean Observing System (GOOS). It was conducted and written by a group of sixty international scientists, under the guidance of the IORP in partnership with Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) and under the scrutiny of an independent review board appointed through various partners of GOOS. Proactive actions have been taken by IORP, the writing team and partner programmes to advocate the outcomes and recommendations of the IndOOS review, trying to mobilise resources from a broader community to implement the IndOOS-2. The IndOOS Resource Forum (IRF) has been reactivated during 2019, and prioritised recommendations have been conveyed by IORP through the IRF, to national and international representatives of the forum. There were also discussions on how IORP and SIBER can be better coordinated and cooperated. The panel also planned to strengthen the linkage with 2nd International Indian Ocean Expedition (IIOE-2) in the future.

- **The Eastern Boundary Upwelling Systems (EBUS) Research Focus**

The [ICTP-CLIVAR Joint Summer School on Oceanic Eastern Boundary Upwelling System](#) was organised by EBUS RF and ICTP in Trieste, Italy from 15-19 July 2019. The school aimed at stimulating discussion and new ideas concerning the mechanisms that influence the responses of EBUSs to climate variability and change. 37 students and 11 lecturers from 22 countries participated

in the summer school. A two-day EBUS RF meeting was organised after the school, with the focused discussion on the cooperation with SCOR working group (WG) 155 on Eastern Boundary Upwelling Ecosystems (EBUE) for the [Summer School on 'Changes in coastal upwelling systems and their impact on marine resources'](#), which was originally scheduled from 4-12 May 2020 in Dakar, Senegal, and now postponed to early 2021 due to COVID-19. The structure for the manuscripts for EBUS perspective paper has also been drafted during the EBUS RF meeting in Trieste. EBUS RF is going to be sunset by 2021 after the publication of the EBUS perspective paper.

The GEWEX/CLIVAR Monsoons Panel (MP)

The scientific work of the MP can be summarized under the following topics:

- Observational/field studies work;
- Engagement with IPCC AR6/CMIP6 and MIPs;
- Stakeholder engagement/end users & Climate Services;
- Cross-group collaborations;
- Climate change detection & attribution (including CORDEX);
- Analysis of Sub-seasonal to Seasonal (S2S) simulations

Global Synthesis and Observations Panel (GSOP).

Some of the main activities implemented by the pane during 2019 are:

- Organization of a Session on Ocean modeling and data assimilation during OceanObs19
- Activities of GSOP were presented by Y. Fujii at OceanPredict
- Provision of position comments on the 2nd TPOS2020 report
- Participation and outreach of reanalysis inter-comparison activities (North Atlantic ORA-IP and Real-time ORA-IP)
- Participation as GSOP to ocean heat content assessment efforts led by K. von Schuckman for the next IPCC report
- Endorsement of synthetic profile data activities
- GSOP meeting held in WHOI, February 2019
- Participation to the IQuOD meetings representing reanalysis requirements and endorsement of IquOD activities

Plans for 2020 and beyond

- The panel aims at continuing the participation and dissemination of results regarding reanalysis assessment and in particular participating to the ocean heat content and energy budget studies coordinated by the former group of Clivar Energy budget RF.
- The panel aims at continuing supporting IQuOD and other observational activities and in particular representing the requirements from reanalyses.
- The panel plans to participate, endorse and promote other activities concerning inter-comparison and assessment of global ocean reanalyses as continuation of ORA-IP (NA ORA-IP, etc.).

Tropical Basin Interaction (TBI)

TBI has starting its activities by several teleconferences during the past 6 months, and plans to organize an online workshop: WCRP-CLIVAR Workshop on Climate Interactions Among The Tropical Basins in early February of 2021, a call for paper will be made in the next few weeks

WCRP and CLIVAR look forward to further exploring collaborations in ocean related activities with SCOR in the future. Please contact Mike Sparrow (WCRP - mssparrow@wmo.int) or Jose Santos (CLIVAR - jose.santos@clivar.org) to discuss further.