World Climate Research Programme
c/o World Meteorological Organization
7 bis, avenue de la Paix
Case postale N° 2300
CH-1211 Geneva 2 – Switzerland
wcrp@wmo.int

JSC-42
Submitted by: CLIVAR
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1. Highlights for JSC

- *Scientific highlights:*

CLIVAR's scientific priorities (CLIVAR Science Plan) include:

1. mechanisms of climate variability and change, with the goal of better constraining fluxes of energy and carbon in the climate system;
2. ocean processes that modulate climate variability and change; and
3. climate predictability challenges over a broad range of space and time scales.

- *Specific scientific activities of the past year include:*

  - Tropical Basins Interaction (TBI workshop and experiment studies) https://clivar.org/events/wcrp-clivar-workshop-climate-interactions-among-tropical-basins-online. (addresses scientific priorities 1,2,3);
  - Atlantic Meridional Ocean Circulation (AMOC Task Team and workshop) (scientific priorities 1,2,3);
  - Air-sea interaction from high latitude to tropics (scientific priority 2);
  - ocean heat and freshwater storage and transport (scientific priority 1);
  - Ocean's role in global ocean carbon cycling (SORP) (scientific priority 2);
  - Tropical Pacific Decadal Variability (TPDV) (scientific priority 1,3); and
  - Advancement in ENSO research: AGU100 Monograph on ENSO in a Changing Climate published; ENSO Metrics continued; ENSO Conceptual models being reviewed and prioritised; AI in ENSO forecasting; etc (PRP) (scientific priorities 1,2,3).
  - Monsoons climate change assessment;
  - Special Issue of CLIVAR Exchanges on "India's Monsoon Mission", showcasing key results including contributions from international monsoon research community;

- *Contributing to the scientific design and implementation of global observing system:*

  - Finalised review of Tropical Atlantic Observing System, with e-report published online (ARP);
  - COVID impact on observations (GSOP, IORP, ARP, etc);
  - Input to TPOS2020 final report (PRP);
  - Progress report on IndOOS-2 implementation (IORP, under preparation); and
  - CLIVAR-OOPC workshop on ocean observation and training workshop on observing the coastal and marginal seas in the Western Indian Ocean (IORP, under preparation).

- *Strengthened interaction with partners:*

  - **OOPC**: OOPC/WCRP-CLIVAR Joint session during OOPC-24; Pan-CLIVAR workshop on Ocean Observations; ocean heat and freshwater workshop;
  - **SOLAS**: Indian Ocean research;
  - **US CLIVAR**: AMOC Task Team; TBI workshop; etc., and
  - **IMBeR**: SIBER-IORP collaboration;
  - **WMO**: WWRP on monsoons (including through establishment of a joint International Monsoons Project Office in India) and S2S, Regional Climate Outlook Forums (RCOFs).

- *Strengthened cooperation with BGC communities (addressing scientific priority 1):*

  - CLIVAR contributed to the publication of Integrated Ocean Carbon Research Report;
  - PICES/CLIVAR joint working group on 'Climate and Ecosystem Predictability'; and Frontiers in Marine Science special issue on 'North Pacific Climate and Ecosystem Predictability on Seasonal to Decadal Timescales'(via PRP);
  - IORP-SIBER collaboration on IndOOS-2 implementation and knowledge sharing in Western Indian Ocean.

- *Enhancing ECS engagement through:*

  - recruiting ECS members in all CLIVAR panels (mandated);
  - promoting ECS networks in Eastern Asia (though WCRP CRF) and Indian Ocean-rim countries;
  - Involving ECS in contributing to the national reports (SORP); and
  - collaborating with the YESS community.

- *Upcoming CLIVAR events:*

  - 2nd Sea Level Conference (Singapore, July 2022);
  - CLIVAR-GOOS Workshop (from global to coastal: Cultivating new solutions and partnerships for an enhanced Ocean Observing System in a decade of accelerating change; Trieste, Italy, 2022);
  - CLIVAR-FIO Summer School on Ocean Macroturbulence and its role in Earth Climate (Qindao, China, 19-25 June 2022);
  - Workshop on Advancing Predictive Understanding of Regional Climate Variability and Change across Timescales (hybrid, Sapporo, Japan, 8-9 and 12-14 June 2021);
  - Workshop on Multi-annual to Decadal Climate Predictability in the North Atlantic-Arctic Sector (online or hybrid, tbc, 20-22 September 2021);
  - International Workshop on Future Directions in High-resolution Ocean Modelling (online, 29 September – 1 October 2021);
  - Workshop on Ocean Heat and Freshwater Storage and Transports in Observations and Climate Models (Exeter, UK, TBD);
  - Training workshop on observing the coastal and marginal seas in the western Indian Ocean (Hybrid, Mozambique & Kuwait, Winter 2021 or Spring 2022);
  - Workshop on fluxes in the sea-ice zone (TBC); and
  - Online Training Workshop on S2S Prediction of Monsoons, with WWRP (1-12 November 2021), in conjunction with the Seventh International Workshop on Monsoons (IWM-7) to be held in India in 2022.

- *Support to the WCRP activities:*

  - Climate Research Forum in Eastern Asia, South America and Southern Asia;
  - LHAs science plan development;
  - RifS and Model/data homes science plan development and Backbone groups; and
  - SPARC 2022 General Assembly Asia node.

2. Primary science issues (ahead, 3 to 5 years)

Our scientific priorities remain unchanged from those listed in the CLIVAR science plan. Specifically, we will focus on:

1. mechanisms of climate variability and change, with the goal of better constraining fluxes of energy and carbon in the climate system, including
   - ocean heat and freshwater storage and transport (NORP, SORP);
   - constrain the Southern Ocean's role in global carbon cycling (SORP);
   - the role of the Southern Ocean in the planet's heat and freshwater balance (SORP); and
   - Tropical Basins Interaction (TBI RF).

2. ocean processes that modulate climate variability and change, such as:
    - air-sea interaction from the high-latitudes to the tropics (CDP & ARP);
    - ice-ocean interaction, e.g. progression of warm water into ice-shelf cavities (SORP); and
    - identification of priorities of Eastern Boundary Upwelling System (EBUS) research (EBUS RF), to be summarized in a perspective paper.

3. climate predictability challenges over a broad range of space and time scales. Specific activities through:
    - coordinating Atlantic Meridional Ocean Circulation (AMOC) research and infrastructures (ARP in cooperation with other CLIVAR panels, and US CLIVAR);
    - studying organisation of storms, blocks and jet streams on seasonal and longer time scales (CDP);
    - examination of inter-basin and tropical-extratropical teleconnections (CDP & TBI);
    - Constructing ENSO Metrics (PRP);
    - understanding of nature and predictability of Tropical Pacific Decadal Variability (TPDV), its representation in climate models, and its projected changes (PRP TPDV WG); and
    - examining regional impacts of climate variability and change, e.g., sea level, ecosystems, extreme events, monsoons, etc (all region panels, Monsoons Panel and SL GC and EBUS RF).

To achieve these scientific goals, CLIVAR will continue to coordinate development of necessary modeling and observational infrastructure for ocean-climate research, particularly in the following areas.

- Ocean only or coupled climate model improvement, including
    a. JRA55-do vs. CORE II (OMDP);
    b. OMIP study: phase 2 (OMDP);
    c. Development of predictive theories of climate dynamics (CDP); and
    d. ENSO conceptual models to more fully account for ENSO complexity (PRP ENSO Conceptual Model WG).
- Scientific design and implementation of global observing systems (e.g., IndOOS, TAOS, AtlantOS, TPOS2020, SOOP, etc.) (IORP, ARP, PRP, SORP, GSOP & GOOS).
- Explicitly connecting observation/modelling, such as
    a. thematic workshops/summer schools/topical task teams;
    b. linkage of OMDP with region panels, e.g., for model bias investigations, modelling of regional phenomena; and
    c. communication by regional panels communicate regarding their modelling needs to OMDP.

3. Issues and challenges

- *Changes to the Core Project*
    - Future Research Foci: proposals for future research foci will be solicited once LHA draft science plans are finalized. This will allow RFs to contribute to ocean-specific areas related to LHA science plans (if warranted), while avoiding duplication of LHA efforts.
    - Future meetings: encouraging virtual meetings where possible, prioritizing travel for ECS-focused activities.
    - Encourage more cross-panel activities, and model-observation fusions
- *Working with the new "Core Projects"*
    - GSOP and OMDP are more relevant to the 'Model-data' new core project, there is a potential to organise joint activities together; members of these panels are involving in planning for the Model-data core project, helping to make these connections.

- CLIVAR region panels can link more closely to RifS;
- Some SL GC legacy activities may be integrated into the new core projects (and LHAs), with discussions ongoing.

- *Working with the Lighthouse activities*
  - **LHA1 (EPESC):** CLIVAR panels bring detailed understanding of processes and phenomena of climate specific to different regions, and observational and modelling requirements necessary to understand and predict them. The importance of ocean as well as monsoons should be emphasized in the description of this LHA. Some SL GC legacy activities may contribute to EPESC, with discussions ongoing.
  - **LHA2 (My Climate Risk):** Coastal risks, sea-level rise, risks associated with coupled interactions as well as the ocean health risk are identified as areas relevant to CLIVAR panels. This LHA is co-chaired by a CLIVAR representative (Regina Rodrigues), who can help build strong connections with CLIVAR, in particular to integrate part of the legacy of SL GC, and link to the effort in extreme events prediction;
  - **LHA3 (Safe Landing Climate):** Importance of ocean, monitoring, coupled climate phenomena, sea-level rise, heat and carbon sequestration should be highlighted in this LHA. The future link can be established via integrating part of the legacy of SL GC (e.g. WP5 on SL science and coastal zone management and WP6 SL budget) and the upcoming sea level conference; ocean heat and freshwater transport and storage workshop; coastal resilience effort prioritised by ARP, and etc.
  - **LH4 (Digital Earth):** Region panels of CLIVAR connect to the observation datasets, and coordinate model and data management. The expertise in the CLIVAR panels needs to be connected to this LHA. GSOP is particularly relevant to this LHA, e.g. observation impact studies.
  - **LH5 (WCRP Academy):** Summer schools and workshops are regularly organised by CLIVAR, and the materials need to be maintained, archived, and made available to a broader community. Regional knowledge is crucial for understanding the needs from different countries/communities, in terms of capacity building, particularly a stronger involvement in ECS, regional connections for capacity building and connection to user communities.

- *Additional elements to see in the new WCRP*
  - Enhanced communication among core projects, LHAs and other components within WCRP.
  - Continued engagement with regional stakeholders and ECS communities after Climate Research Forums.
  - Greater linkages with the operational community on sub-seasonal to seasonal prediction, including through linkages with WMO Regional Climate Outlook Forums.
  - Recommend all WCRP components have targets for gender, career stage, and geographic diversity; in particular for new activities, a diverse team from the start is recommended from the start, not an afterthought.

- *How do you see your community evolving e.g., new activities or activities coming to an end?*
  - AMOC Task Team launched in 2022, with an online workshop being prepared;
  - New working group on Tropical Pacific Decadal Variability (TPDV) launched in 2022;
  - EBUS RF will come to an end in 2022, with a perspective paper on EBUS priorities being prepared and a session being proposed to 2022 OSM;
  - SL GC will sunset in 2022 with the 2nd Sea Level Conference being proposed, and integration with CLIVAR, RifS and LHAs (EPESC and My climate risk) are being explored;
  - CLIVAR CDP may have some connection with the Decadal Climate Prediction Project (DCPP).