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Contact information

All enquiries regarding this report should be directed to wcrp@wmo.int or:

World Climate Research Programme
c/o World Meteorological Organization
7 bis, Avenue de la Paix
Case Postale 2300
CH-1211 Geneva 2
Switzerland

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The Joint Scientific Committee and WCRP community remember

Larry Gates

1928 - 2022

and acknowledge his extraordinary contributions to climate science.

His legacy will live on.

Decisions and Action Items

To quote items please use the format: 22-JSC43-A00, where A refers to the decision (D) or action (A) and 00 refers to the sequential number.

A01: Explore with GCOS the approach, timing, and benefits of a joint WCRP-GCOS Workshop, and provide an update to JSC-43B (JSC, WCRP Leadership; JSC-43B)

A02: ESMO to provide a WCRP-wide strategy for reanalysis and data assimilation (ESMO; by JSC-44)

A03: CMIP Panel to establish closer connections with RfS and CORDEX community (development and users) at an early stage of the CMIP7 planning process (CMIP, RfS and CORDEX; JSC44)

A04: SPARC to enhance links with GCOS in relation to observations (SPARC; JSC-44)

A05: WCRP Core Projects and the Academy to work together to enhance the visibility of their training activities (Core Projects and the Academy; JSC-44)

A06: Digital Earths LHA to connect with CliC regarding the high-resolution modelling workshop to bring in the cryosphere aspect that is so far lacking (Digital Earths, CliC; October 2022)

A07: Digital Earths to enhance interactions with the coupled modelling community (Digital Earths; JSC-44)

A08: EPESC to consider further connections with the paleo community (including PAGES), looking at specific past extreme events (EPESC; JSC-44)

A09: WCRP activities, led by My Climate Risk, to explore joint webinars, perhaps using the MCR hubs as a way for further discussion and interaction with different regions (MCR and WCRP Secretariat; First discussions by December 2022)

A10: Safe Landing Climates to discuss with GEWEX and CliC the topics of water resources and permafrost (SLC, GEWEX and CliC; November 2022)

A11: WCRP Academy to make additional connections with other partners (e.g., Future Earth and ISC) and practitioners (Academy; JSC-44)

A12: Determine how sea level will fit within the WCRP structure and the topics that the various activities will cover (JSC, Core Projects, SLC, MCR; September 2022)

A13: WCRP to consider how best to enhance engagement with the Global South, through forums, activities or international research centers and how this should be set up within the WCRP structure (JSC and WCRP Leadership; JSC-44).

A14: Explore how to engage with the African Regional Focal Points regarding the possibility of a Climate Research Forum for Africa as a lead up to the WCRP Open Science Conference (RfS, MCR, Academy, JSC Chair and Vice-Chair, WCRP Secretariat; October 2022)

A15: Identify ways to better strengthen the linkages and engagement between the Core Projects and LHAs. This likely requires bespoke arrangements for each Core Project and LHA. A proposed WCRP Leadership meeting in 2022 would be an opportunity to discuss these mechanisms and also foster this engagement (JSC, WCRP leadership, WCRP Secretariat; October 2022).

A16: Investigate how WCRP can usefully engage with, and provide input to, the new Global Greenhouse Gas Carbon Budget monitoring system study (Head WCRP Secretariat; September 2022)

A17: (i) Send out Science and Implementation Plan templates to core activities and (ii) ask for additional input on Sections 6.3 (Capacity Building), Section 7 (Strategic Investment Strategy) and Section 8 (Timelines and Measures of Success) of the Plan (WCRP Secretariat and JSC Chairs; Send out in July 2022)

A18: Provide a guide to IPOs on current WMO procurement rules (WCRP Secretariat; October 2022).

A19: Compile and submit a short-list of JSC Membership candidates to the WCRP Co-Sponsors (JSC and WCRP Secretariat; October 2022)

A20: Investigate and decide on the time and location for the 44th Session of the JSC (April-May 2023) (JSC Chairs, WCRP Secretariat; September 2022)

D01: JSC approves WCRP Academy request for additional funding of CHF 42k for 2023; CliC to be allowed to use unspent 2022 funds for 2023 Grants and Fellowship scheme (up to CHF 30k).

A21: Form a JSC working group to provide recommendations on future WCRP fundraising and expenditure (JSC Chair, JSC Vice-Chair and Head of WCRP Secretariat; JSC-43B)

D02: All membership requests approved (details to be provided by WCRP Secretariat to activity leads)

A22: Send out letters of appointment and thank-you letters to Core Activity members (WCRP Secretariat; August 2022)

A23: Formalize JSC liaisons for CPs and LHAs once new JSC Members have been approved (JSC Chairs and Secretariat; JSC-43B)

A24: WCRP Membership of WCRP Bodies Guidelines to be updated and sent to JSC for final approval (WCRP Secretariat; September 2022)

D03: RfS and ESMO Science Plans approved in principle.

A25: JSC to provide written feedback to the RfS leadership on the Science Plan and follow this up with a meeting to discuss the way forward (JSC; November 2022)

A26: JSC to provide written feedback to the ESMO leadership on the Science Plan (JSC; November 2022)

A27: RfS and ESMO to consider how they can link, including links between ESMO and CORDEX (RfS, CORDEX and ESMO; JSC-44)

A28: Discuss and approve recommendations outlined in the Climate Research Forums report (JSC Vice-Chair, WCRP Secretariat; September 2022)

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1 Introduction and session opening

The 43rd Session of the World Climate Research Programme (WCRP) Joint Scientific Committee (JSC) was held online between June 27 and 8 July 2022. This included four three-hour open sessions (27-30 July 2022) and two three-hour closed (i.e., JSC and WCRP Secretariat only) sessions (6 and 8 July 2022). The agenda and participant list are provided as annexes to this report and all presentations and documents can be found on the [JSC-43 webpages](#).

To open the Session, Detlef Stammer (JSC Chair) and Helen Cleugh (JSC Vice-Chair) welcomed everyone and reflected on the journey made by WCRP in the last couple of years – a time period in which COVID deeply affected our community and during which there was an increasing demand on our science. They noted that we have made tremendous progress towards implementing the new WCRP strategy and they thanked the community for all their hard work that enabled this progress.

Detlef welcomed representatives of two of the three WCRP co-sponsors, Jürg Luterbacher (WMO) and Mathieu Denis (ISC), noting that Vladimir Ryabinin (IOC) sent his apologies. He explained that this meeting marks the end of the transition to a new WCRP structure that allows us to coordinate high-quality climate science from around the world, provide an authoritative voice in climate science, and address major climate challenges in an energetic, agile and dynamic way, with enhanced diversity and transparent communication and strong community engagement, relevance and profile. Detlef noted that the new WCRP is engaging with funding agencies around the world to ensure that critical climate research is advanced.

Detlef went on to discuss recent progress. He explained that the Lighthouse Activities (LHAs) are proceeding with their science planning and implementation and that there are bids for an International Project Office (IPO) for the Regional Information for Society (RIfS) Core Project, noting that proposals are also being developed for an IPO to support Earth System Modelling and Observations (ESMO).

Helen then highlighted the work that has been done in the last year (Figure 1), including implementing the WCRP Strategic Plan, reviewing and revision our core activities, looking at how to include missing science, and strengthening collaborations with partners. She noted that we are now getting to the stage of delivering exciting new science, which will culminate in the WCRP Open Science Conference (OSC) in October 2023. She reminded participants of the new [WCRP Structure](#), noting that the WCRP Grand Challenges are in the final process of sunseting (all but one has now ended). She explained that it is important that the communication and coordination between the Core Projects and LHAs is ensured, so that the LHAs can draw on the wider research communities.

Detlef and Helen outlined that the goals of the 43rd Session of the JSC are to hear back from the WCRP family on progress towards their new science and business plans, to discuss ways to improve interaction across WCRP, to think about how to facilitate strategic discussions, to finalize the WCRP Science and Implementation Plan, and to discuss aspects that will be required in the future. They noted that there needs to be a shift in how WCRP is viewed from the outside, with the science being showcased rather than the programmatic structure (Figure 2).

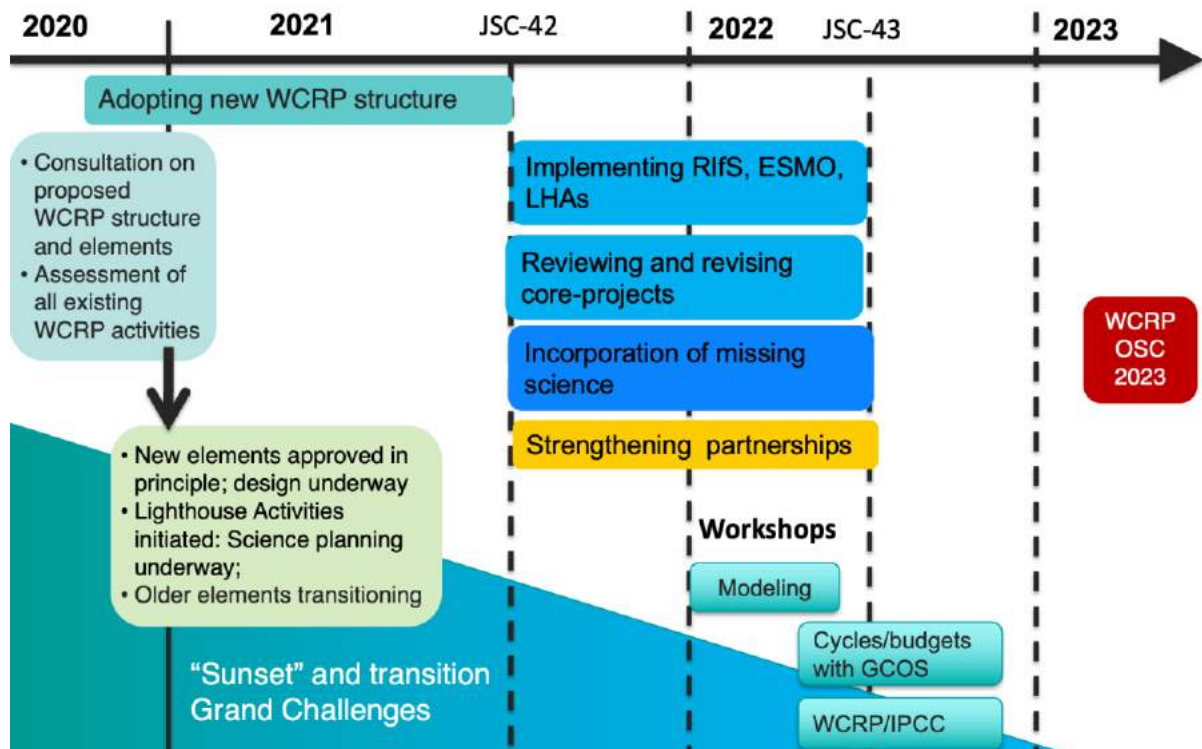


Figure 1: Timeline for the development of the new WCRP structure



Figure 2: WCRP science aims and accomplishments

The three WCRP co-sponsor representatives then gave brief interventions on behalf of WMO, ISC, and IOC-UNESCO.

Jürg welcomed participants on behalf of the Deputy Secretary-General of WMO, Elena Manaenkova, and noted that several of WCRP's new activities, in particular the LHAs, are closely aligned to the needs of WMO and WCRP's other co-sponsors. For example, the Explaining and Predicting Earth System Change Lighthouse has a particular focus on improving WMO's Annual to Decadal Outlook; and the WCRP Academy is working closely with the WMO Global Campus and education initiatives of the other co-sponsors. WCRP plays an important role in pushing the boundaries of the development of Earth System Models, for example with regards to its Digital Earths Lighthouse Activity, and consideration of Artificial Intelligence and Machine Learning. In addition, the Coordinated Regional Downscaling Experiment (CORDEX), working with WMO and the Green Climate Fund, has produced climate information that is being used extensively by countries for their National Adaptation Plans. WMO is pleased to see that WCRP will hold its OSC in Rwanda and is using this as a springboard to connect more closely with African scientists, activities, and research institutions. WCRP is continuing to work closely with the other research programmes in WMO, with the World Weather Research Programme (WWRP) with which WCRP already has several joint activities (e.g., S2S and the new monsoons office), as well as on topics such as stratospheric ozone, budgets and cycles with the Global Atmosphere Watch (GAW), which are crucial and relate strongly with WMO's Infrastructure and Services commissions.

Mathieu gave an overview of recent developments in the ISC and noted that they are happy and proud of how WCRP is evolving. He congratulated the community on the recent developments including the promising and continued development of the Science and Implementation Plan and the Lighthouse Activities. He noted that the way that WCRP has opened its doors to social scientists is to be commended and the OSC in Rwanda is truly exciting and is being widely talked about. He confirmed ongoing strong support from ISC. Mathieu further highlighted that ISC are currently grappling with the idea of whether we are going to see the same kind of resolve to address climate change as we have seen in response to COVID and in response to the war in Ukraine. We have robust evidence of climate change, and that work must continue (thanks to WCRP), but we should also focus on more pressing issues such as how we can move the policy community to take serious action.

Vladimir (via pre-recorded message) sent his greetings and best wishes from IOC-UNESCO and apologized for being unable to attend the JSC due to it coinciding with the UN Ocean Conference. The Ocean Conference will adopt a high-level political declaration and there will be new programs starting on mitigation and prediction of climate change in relation to the ocean-climate nexus, and he invited WCRP to look at those programs to see what we can do together. He noted that there are enormous opportunities for co-designing the climate aspect of ocean science, with IOC looking to this as a value chain including data, observations, digital twins, ocean policy and management. He expressed that WCRP needs to be part of this effort. He wished participants a very successful session.

Mike Sparrow (Head, WCRP Secretariat) welcomed everyone on behalf of the WCRP Secretariat. He explained that the Secretariat consists of WMO staff, support personnel from the Institute Pierre-Simon Laplace and the Bjerknes Centre for Climate Research, and consultants supporting the WCRP Open Science Conference and the WCRP Academy. He noted that three interns should join the Secretariat later in the year and the WCRP Junior Professional Officer, Wenchao Cao, will be leaving the Secretariat in October 2022. He also thanked host institutes and nations for the invaluable support of the international project offices.

2 Strategic initiatives and issues

2.1 New and emerging science issues

Detlef highlighted that the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) has now been published and demonstrates the challenge of staying below 2 degrees Celsius, let alone 1.5 degrees. Scientific assessments seem to point to emissions continuing to grow. Particularly, post-COVID emissions seem to have bounced back to pre-COVID emission levels. The world continues to see accelerating warming and associated impacts, such as weather and climate extremes. The past six years have been the warmest years on record and temperatures continue to rise. Associated climate variations show strong regional patterns and variations. The trend in sea-level rise is accelerating, ocean heat storage and acidification are increasing and there are significant impacts on the ocean's capacity to moderate climate change.

Detlef explained that increased greenhouse gas emissions from human activity are already causing climate change impacts that are harming people and nature. Further rapid reductions in emissions, adaptation to climate risks, and widespread adoption of new technologies and behaviors are needed to reach net-zero emissions and mitigate the worst climate impacts. Impacts from floods, droughts and extreme weather will threaten millions of people around the world. The pathway that we take will matter and WCRP needs to provide this information.

Detlef noted that risks will evolve further under progressively greater warming, and the extent of these impacts depends on our success in meeting our emissions targets. Climate information is needed at a regional level to allow action at the scale required for adaptation and understanding at the scale required to assess ecosystem and human impacts. To address this, WCRP created several new science initiatives, which we will outline the progress of in this meeting.

2.2 Task Team on Climate Intervention

Jim Hurrell (JSC Member) introduced and outlined the progress of the Task Team on Climate Intervention. He explained that there has been advances in terms of climate mitigation, but much more work is needed as the real solution to deal with climate change is mitigation. Adaptation is important, as we are committed to a certain amount of climate change, but mitigation will be needed to keep global warming below 1.5 degrees. This raises the question of whether we should be considering climate intervention technologies, noting the inherent risks this involves. Given the urgent and growing risks of climate change, it is important to understand the feasibility, efficacy, risks, and benefits of Carbon Dioxide Removal (CDR) and Solar Radiation Modification (SRM) as possible response strategies in addition to emission reductions and climate adaptation. The current state of understanding of CDR and SRM is not sufficient for supporting informed decisions. Research programs should focus on developing policy-relevant knowledge, rather than advancing a path for deployment, and operate under robust research governance. Research should be transdisciplinary and coordinated internationally. This is a role for WCRP.

Jim outlined that the role of the task team will be to document current research efforts in CDR and SRM – internal and external to WCRP – and those in which it makes most sense for WCRP to engage, to determine the value WCRP could add to existing research efforts and to identify research gaps that WCRP could help fill.

The task team will identify partners, including the other international research programs required for transdisciplinary research, and determine how CDR and SRM research efforts best fit within the new WCRP organizational structure. Jim noted that many of these activities are currently uncoordinated. WCRP could establish an inventory of efforts and gaps, coordinate activities and support the need for climate intervention research.

Jan Polcher (GEWEX Co-Chair) asked if social science would have a role in this task team. Jim said that ultimately it should, but at this stage the team is looking at how we can best address

this within WCRP as a first order of priority. Pierre Friedlingstein (JSC Member) noted that CDR and SRM are not the same thing and should not be considered on the same level. CDR is already part of all high mitigation scenarios – part of the solution to get to a 1.5 degrees Celsius limit. He also noted that SRM will affect all elements of the global climate system whereas CDR has little risk to the global climate response. Jim responded that even with CDR there are risky strategies and noted that WCRP has something to say in both cases.

2.3 Tiger Team on a Global Precipitation Experiment (GPEX)

Xubin Zeng (GEWEX Co-Chair) outlined that the Tiger Team on a Global Precipitation Experiment (GPEX) is charged with working out a strategy for how WCRP will address major science gaps in the field of precipitation. This strategy should include options for the most effective and efficient enabling structure within WCRP to advance this research, including how WCRP will engage with other activities happening internationally. The strategy will be presented at one of the next JSC meetings and the initiative will evolve from there. WCRP also intends to spin up an African component of GPEX with the goal to launch this at the time of the WCRP OSC in 2023. Xubin also noted that GPEX may become a project or a lighthouse activity, with the aim of preparing a science and implementation plan in one year. How it will be supported (existing IPO or new office) is yet to be decided. It will be important to leverage and coordinate with existing activities, so that GPEX can carry out a variety of activities with user engagement throughout the entire process. He noted that an international year of precipitation was proposed to coordinate field experiments in different regions and promote and coordinate related research.

Detlef noted that he is very impressed by this activity. He stated WCRP will be a key partner and that WCRP will need to be involved early in upcoming satellite missions.

2.4 Task Team on Cycles and Budgets

Jan Polcher outlined that the objective of the Task Team on Cycles and Budgets revolves around the continuity equation – you need to define a closed system, then identify all fluxes and reservoir changes. Except for some cases, the equality cannot be established. Thus, everything hinges on the error estimation for the fluxes and reservoirs. He explained that GEWEX's experience is closure studies have limitations but advance our understanding.

The task team proposal is to poll all core activities of WCRP to see where their knowledge of cycles and budget closure stands. They expect that this will build an Earth system wide view on the energy and water cycle, assess observations and models available for all components, and evaluate the possibility (relative to the errors) to detect and quantify imbalances of Earth's energy and water cycles. This should also improve our ability to monitor the energy, water, and biogeochemical cycles, and to identify regions which are either easier to analyze or critical because of large trends. It will also identify the time and space scale which could be covered with current observations and models. Jan outlined that the next steps of the task team are to send a questionnaire to WCRP core activities to see if it corresponds to their view on such studies and to determine if it fulfills LHA needs. Responses would then be evaluated, and a workshop organized to process the gathered information. The process should allow us to draw some conclusions on what is possible and identify where any roadblocks are.

Oksana Tarasova (Head, GAW) asked about the connection of this effort to the new WMO initiative on Carbon/Greenhouse Gas Monitoring. Jan noted that such connections are important, but it is too early for WCRP to make them now. There was a lot of discussion about the interactions between cycles. Pierre noted that the questionnaire seems to be tailored more towards the water and energy cycles than for the carbon cycle. It was agreed that this may be the first step, but that the importance of the carbon cycle should not be forgotten.

2.5 GCOS/WCRP collaborations

Han Dolman (Chair of the Global Climate Observing System (GCOS)) gave a presentation on GCOS/WCRP interactions. GCOS's core business is to define ECVs (Essential Climate Variables) to monitor Earth's water, energy, and carbon cycles. They are now grouping ECVs and looking at the cycles, which also helps to identify elements that are missing. The 2022 GCOS Implementation Plan will be presented to the United Framework Convention on Climate Change (UNFCCC) before the 27th Conference of the Parties (COP27). It provides guidance to the component observing systems that contribute to global climate monitoring. Han gave examples from key publications over the last few years.

Han explained that WCRP and GCOS are, by and large, complementary programs, noting that we have a lot in common and we should try to reinforce each other's messages and increase our impact by working together. He proposed that WCRP and GCOS have a joint workshop later in 2022. Detlef responded that he valued this collaboration and supported the idea of a workshop later in the year to identify some joint work. Sabrina Speich (Ocean Observations Physics and Climate Panel (OOPC) Chair) noted that they have been asked by UNFCCC to work on adaptation in the extremes space.

A01: Explore with GCOS the approach, timing, and benefits of a joint WCRP-GCOS Workshop, and provide an update to JSC-43B (JSC, WCRP Leadership; JSC-43B)

2.6 Future of Climate Modelling Workshop

Vaishali Naik (National Oceanic and Atmospheric Administration (NOAA) Geophysical Fluid Dynamics Laboratory) and Piers Forster (University of Leeds) presented the outcomes of the WCRP Future of Climate Modelling Workshop. The goal of the workshop was to identify the key contemporary challenges for climate modelling and create a roadmap for reliable, accessible, and useful climate model systems that will allow us to rise to major new challenges for climate research by exploring opportunities for climate modelling that exist now and into the coming decades.

Vaishali noted that we need detailed, improved, and actionable climate change information for society and decision-makers to help transition to net-zero emissions and to make informed adaptation, mitigation, and CDR decisions now as well as to adequately insure against climate related losses. To do this we need advancements in climate science, including improved process understanding and enhanced model developments.

A suggested solution is global km-scale climate models for reliable climate prediction. However, investment in a bigger computer does not necessarily guarantee reliable climate prediction. There are persistent biases in large scale circulation, climate sensitivity, aerosol-cloud interactions, and parameterizations are still needed and are error-prone. Advances in Earth system processes and interactions using very high-resolution models are challenging, e.g., for slowly evolving processes. Investments in computing alone may not help constrain projections or lead to capacity-building or a diverse workforce.

Piers then outlined the outcomes of the workshop. There was a great deal of consensus that while Digital Earths are an exciting new development, we can't rely on them to do everything. We need a diverse modelling landscape, "A multiverse of climate models (with associated infrastructure and a skilled workforce) that are fit for purpose to advance the societally relevant and actionable science needed for a sustainable present and future." This will require innovation and new talent. They came up with eight "dimensions of change" (principles for change):

1. Enhance scientific fidelity and model evaluation - use of observations, parameterization development, Turing / "Carlsaw" tests, improved process modelling, uncertainty identification and reduction

2. Become flexible, responsive, and innovative - Develop a multiverse of approaches; Agile suites of modelling tools; flexibility over who does what: national centres, international collaborative efforts, universities, private sector. Ensure partnerships.
3. Grow the diversity of workforce - Agile and diverse workforce; meaningful partnerships with the Global South that will lead to co-design and modelling capabilities, novel careers, skills, etc.
4. Move from collaboration to coordination - WCRP can play a coordination role to focus efforts and improve efficiencies; new partnerships could maximize science and societal benefits; better harness the private sector
5. Improve accessibility and usability - data protocols and model analysis tools working across suites of models, easy entry points, how-to guides, health warnings, outreach, etc.
6. Establish co-design - ensuring we address societal relevant questions, timing of IPCC WGs, include human systems in modelling efforts, more coordination with Future Earth/impact modelers etc.
7. Professionalize operational aspects and ensure that climate services are better supported, longer timescale development cycle, increase transparency, improve emulators/downscaling, improve feedback into research, co-design
8. Achieve net zero climate resilient modelling - Set a leading example: monitor, report, pathway for modelling centres and researcher activities

They provided the following recommendations to WCRP:

1. Play a coordinating role to broaden the global climate modeling effort and enhance the diversity of approaches for climate modeling
2. Capacity-build the Global South climate scientists as future leaders
3. Launch and coordinate a process understanding campaign with obs4MIPs to design and improve climate model fidelity
4. Coordinate uniform and interoperable model evaluation tools and metrics for model-obs and model-model comparisons
5. WCRP can lead on interacting with funders to support a wider set of climate modelling approaches, including private funders.
6. Promote co-design and wider stakeholder input by linking with other programs more effectively.
7. Launch a World Climate Operational Programme
8. Take the lead in developing a climate resilient net-zero emission pathway for the global climate modelling community.

Piers said that he and Vaishali would be interested to stay involved in these efforts. Detlef noted that this would be important for ESMO science planning, and so welcomed Piers' and Vaishali's offer to stay involved. Ted Shepherd (My Climate Risk Co-Chair) supported this initiative, as it is important that the modelling community should not 'put all its eggs in one basket'. Cath Senior (ESMO Co-Chair) noted that there is already a lot of overlap with what was talked about at the workshop and what is in the ESMO science plan. Rowan Sutton (EPESC Co-Chair) said that we need some concrete examples as to why the 1 km resolution model is not what we need in every situation. This was agreed to be a great suggestion.

Pierre said that this discussion should be considered in the development of CMIP7. This was agreed to be important. Xubin noted that there are limited resources. How do we do all of the things we talk about here. Would we put some of the CMIP7 resources in modelling centres into model improvement? Piers confirmed that this was discussed. We will need to look at how to

allocate resources and see how these efforts will talk together. It is an exciting opportunity to look at the entire landscape to see how to design this.

2.7 Engagement with the IPCC climate science assessment processes

Valerie Masson-Delmotte (IPCC WGI Co-Chair) gave an overview of the IPCC WG1 AR6 process. She explained that the IPCC WGI report was restructured to include multiple lines of evidence and a user-orientated framing. A survey of WGI authors showed that the report structure was suitable but highlighted some coordination challenges. Building from that, many authors have asked for AR7 to be even more integrated and to rethink the chapter structure across the working groups. She thanked WCRP for the key role it played in coordinating the science activities that underpin the IPCC process.

Valery explained that as we move from CMIP6 to CMIP7 it is important to establish a dialogue between IPCC authors, WGI Technical Support Unit (TSU) bureau and CMIP coordinators to inform the planning of CMIP7. She highlighted that the timing, access, scenario choices, engagement of Global South scientists and authors and data needs must be considered. The divergence of timelines for AR7 and CMIP7 was noted, but it was recognized that CMIP should be scientifically driven even if alignment would not be optimal.

Key issues and gaps in the assessment that were identified in the authors survey included regionally relevant information (including the urban scale), compound extremes and event attribution, overshoot, distillation of regional information, tipping points, climate velocity and ecosystems, biological processes, and air quality benefits of mitigation. Valerie provided some suggestions for regional coordinated activities, noting that the WCRP LHAs may invigorate and focus the community's efforts. She noted that it will be important to train young people in preparation for AR7, have regular workshops and networking, promote discussion and exchange on good practices in distilling regional climate information and for there to be systematic regional literature reviews.

Anna Pirani (Head of IPCC TSU) noted that some topics for the planned IPCC WGI – WCRP discussion could include diversity and renewal in authorship, addressing knowledge gaps, coordination challenges, and support for authors and the assessment process, data access and documentation, and planning and timelines.

Xubin noted that the number of pages of the AR reports have increased but the impact was the same. He asked if there was ever a discussion about keeping to a page limit. Valerie said that they didn't limit the pages, but they did provide summary material, such as two-page regional fact sheets.

Helen confirmed that a joint workshop is planned at the end of 2022 or beginning of 2023. It would intend to support the IPCC process by identifying emerging science needs and opportunities, exploring the value of rapid updates and mini assessments, discussing lessons learned through best practice approaches to conducting assessment, and discussing the importance of improved coordination between IPCC WGs.

3 WCRP Core Project Updates¹

3.1 The Climate and Cryosphere (CliC)

Edward Hanna (CliC Co-Chair) explained that CliC has now launched the new CliC Strategic Plan for 2022-2031. He explained that the goal of this plan is to have a more integrated system understanding of the cryosphere and its services with emphasis on social sciences as well as

¹ Note that the Core Projects presented on days most convenient to the time zone of the speaker. Here they are presented in alphabetical order.

physical climate and cryosphere aspects. Various strategic areas and ongoing activities were outlined, and emphasis was given to continuing workshops and trainings. A key element for CliC has been synthesizing knowledge with indigenous stakeholders and local communities and facilitating a two-way dialogue. The new fellowship and grant scheme has been extremely successful. Four projects were funded as a part of the scheme, demonstrating a good range of geographical coverage, topics and involving Early Career Researchers (ECRs) from under or less well represented geographic regions for a relatively small financial cost. A brief synthesis on the various science achievements of CliC was then provided with special mention of activities that fed into CMIP6 and the IPCC AR6 reports. Edward explained that CliC has been working towards a Scientific Steering Group (SSG) membership that includes various career stages and that has better gender and regional diversity than in the past and noted that they currently lack SSG representation from Africa.

In terms of future plans, Edward explained that CliC will spend the next few years implementing the new strategic plan and noted that 50 percent of CliC funding will be allotted to new projects targeting interdisciplinary research that bridges physical, social and ecosystem aspects of the climate-cryosphere and that involves ECRs and scientists from Global South. CliC will also work on promoting workshops and co-sponsored activities to address knowledge gaps, scientific reviews, capacity building activities, and more. CliC will leverage partnerships, such as with the Scientific Committee on Antarctic Research (SCAR) and the Association of Polar Early Career Scientists (APECS) for mutual benefit since it operates on a limited budget. It will also promote strong linkages within WCRP such as with ANDEX (GEWEX), the Monsoons Panel, ESMO, RfS, the LHAs and other WCRP activities. Edward also mentioned the current CliC IPO in Bergen will finish at the end of 2022 and that a proposal for hosting the office at the University of Massachusetts is under review.

Christian Jacob mentioned that the Digital Earths LHA would get in touch with CliC regarding the high-resolution modelling workshop that is currently being planned as the cryosphere aspect is currently lacking in that activity. This was welcomed.

3.2 Climate and Ocean Variability, Predictability and Change (CLIVAR)

Sonya Legg (CLIVAR SSG Co-Chair) reported on CLIVAR activities, progress, achievements, and plans. Several scientific articles have been published and many new initiatives and working groups formed. CLIVAR has also provided a significant contribution to the global and regional ocean observing system development. With regards to the UN Ocean Decade, CLIVAR is a partner and has had an active involvement with the UN Decade endorsed activities Digital Twin of the Ocean (DITTO) and the Ocean Observing Co-design programs.

Several workshops, conferences and summer schools are being organized, which will bring opportunities for engagement with other WCRP activities. Building strong connections, particularly with the LHAs, is a key objective for CLIVAR in the coming year. It will also look at strengthening partnerships with groups outside WCRP, such as the Global Ocean Observing System (GOOS), the Integrated Marine Biosphere Research (IMBeR) and the Scientific Committee on Oceanic Research (SCOR). In addition, there are plans for a call for proposals for new Research Foci.

Jose (CLIVAR IPO Executive Director) mentioned that CLIVAR-GCOS-OOPC have been cooperating more on specific activities, such as joint workshops and capacity building events, and that better links were necessary. Sonya suggested having a teleconference between CLIVAR and GCOS to explore better links and communication.

The JSC was impressed with the number of successful workshops that CLIVAR has organized in a virtual environment. One point for further discussion was about CLIVAR's plans for sea level research in the future. Sonya noted that many CLIVAR panels have activities related to sea level, but no coordination mechanism exists among them. Also, she highlighted that it is important not to overlap with some activities on this topic that are being developed by the LHAs. Further

discussions will take place with the Sea Level Grand Challenge after the Sea Level Conference to be held in Singapore 12-16 July.

3.3 Earth System Modelling and Observation (ESMO)

Cath Senior (ESMO Co-Chair) presented the steps that the ESMO Interim Scientific Steering Group (SSG) took on the development of ESMO's Strategic Plan. The plan's vision is that ESMO will provide an overall coordination mechanism across all modelling, data, and observation activities within WCRP, and make strategic links with groups outside WCRP. Four writing teams (on observations, modelling, data assimilation, and the carbon cycle) were set up with the task of addressing key scientific questions. The final document presents three scientific objectives that will underpin and integrate the next decade of climate science modelling, data assimilation and observational activities:

- Advancing predictions and projections of the Earth system
- Improve monitoring, understanding and attribution of climate system changes
- Advancing and harnessing emerging technologies in modelling and observations

These objectives are informed by the most pressing shortcomings in our ability for monitoring, predicting, and projecting the climate system from days to centuries and from local to global spatial scales. Cath noted that ESMO recognizes that there is overlap with objectives and activities of other WCRP groups and explained that the leadership will work on coordination of specific priorities. It will also draw on existing expertise from the modelling working groups (e.g., WGCM, WGSIP) but sees the need for other groups/panels to be set up, particularly related to observations.

The JSC thanked the ESMO leadership for the development of the ESMO Strategic Plan. Detlef noted that it is important that discussions and recommendations from the "Future of Climate Modelling Workshop" are considered and incorporated in the Plan. Also, there is a need to strengthen collaborations with GCOS, perhaps via cross-membership with GCOS panels. In addition, it is important that ESMO leads a discussion on the best framework to coordinate activities related to data assimilation and reanalysis. It was agreed that many groups should be involved, and Susann Tegtmeier (ESMO-Co-Chair) suggested that there may be an opportunity to broaden the role of the Task Team for Intercomparison of ReAnalyses (TIRA).

A02: ESMO to provide a WCRP-wide strategy for reanalysis and data assimilation (ESMO; by JSC-44)

3.3.1 Coupled Modelling Intercomparison Project (CMIP)

Jean-François Lamarque (CMIP Panel Chair) updated the JSC and other attendees on the progress and planning for the next phase of CMIP. A CMIP survey was carried out at the beginning of 2022 with questions about CMIP6 and how to improve some aspects for CMIP7. Preliminary analysis of the responses to the survey shows that no big structural change from CMIP6 should take place, although the process should reduce the burden on modelling centers. Some critical elements (e.g., forcings) may need to be operationalized. Clear communication with modelling groups is needed to make fast progress and entrain the community. It is expected that the delivery of the defined structure of CMIP7 will be done by end of 2023. Several task teams are being set up and an open call for membership will be issued soon by the CMIP IPO.

The JSC was pleased with progress of the CMIP panel and raised the issue that strong coordination is needed between CMIP and CORDEX. Although there are discussions already taking place, further involvement, particularly from the CORDEX users' community, should be encouraged. A key point is that users need to be able to use a structure which is robust but at

the same time flexible and agile. Further frameworks need to be defined for the creation of MIPs to ensure easy accessibility.

The JSC also inquired about how to overcome some issues that were identified during CMIP6, particularly on how the timing of AR6 created a bottleneck. It is important to identify how CMIP could achieve what is of most importance to IPCC and then define limited sets in addition to the DECK (Diagnostic, Evaluation and Characterization of Klima). It was also suggested to have a subset of MIPs and a well-defined package that aligns CMIP7 with the AR7 process. In parallel, or perhaps even on a different timeline, additional simulations and other MIPs could take place. One other key aspect for the further success of CMIP is more representation of researchers from the Global South to identify the interests and needs from those communities.

A03: CMIP Panel to establish closer connections with RfS and CORDEX community (development and users) at an early stage of the CMIP7 planning process (CMIP, RfS and CORDEX; JSC44)

Anna mentioned that the WGI author survey included some similar questions to the CMIP survey. She noted that they are currently in the process of analyzing that survey and will be able to share the results with the CMIP Panel. Some relevant issues that have been identified already are the need of a more regional focus in AR7, stronger alignment with WGII (including use of regional and impacts orientated emulators), aligning the IPCC timeline with scenario MIP and DECK, and the need for server-side analysis, documentation, and analysis tools.

3.4 Global Energy and Water Exchanges (GEWEX)

Jan Polcher (GEWEX Co-Chair) presented some recent progress in GEWEX, touching on the three goals of the new GEWEX Strategic Plan:

- Determine the extent to which Earth's water cycle can be predicted
- Quantify the inter-relationships between Earth's energy, water, and carbon cycles to advance our understanding of the system and our ability to predict it across scales
- Quantify anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle.

Jan explained that the main avenue to achieving these goals is via GEWEX's four panels. Jan presented several science highlights, including a recent precipitation assessment activity. In that activity he noted that the estimation of mountain precipitation, though both observations and modelling, remains unresolved. He explained that mountain hydrology is an important research area, and has strong links between CliC, GPEX and GEWEX. Several other GEWEX projects such as ANDEX, TeamX, International Network for Alpine Research Catchment Hydrology (INARCH) 2, Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE), Coupling of Land and Atmospheric Subgrid Parameterizations (CLASP) (funded by three US agencies) were also briefly summarized. Jan stressed the importance of water cycle and budget studies and note that the question of how GEWEX can work towards improving our understanding of energy and water cycles on a regional scale is being discussed. The importance of km-scale models was also addressed in the context of understanding water and energy cycles.

Jan then presented the emerging scientific challenges within GEWEX that will be discussed at the Pan-GEWEX meeting in July 2022. Three topics have been identified: the energy and water cycle at regional scales, km-scale observation and modelling of the Earth System, and mesoscale organization of convection over land.

Krishnan Raghavan (JSC Member) mentioned the AsiaPEX projects and its relevance for hydroclimate and mountain regions, also for mesoscale convective systems and asked if this would be incorporated within GEWEX. Jan responded that AsiaPEX is a Regional Hydroclimate Project (RHP) of GEWEX and that GEWEX has been encouraging their regional experts to be

actively engaged in this. In addition, he also mentioned the Third Pole Experiment that will be relevant to this research area.

Detlef asked if soil moisture is a topic within GEWEX activities. Jan responded that this is indeed a part of their activities along with aquifer movement. On the question of how GEWEX maintains links with other WCRP activities and if they are happy with those so far, Jan mentioned that he believes that the LHAs are an important mechanism by which we can connect various activities. GEWEX has been trying to interact with the LHAs regularly, but after two years he feels that face-to-face interactions will be crucial. Jack Kaye (National Aeronautics and Space Administration (NASA)) mentioned that the NASA Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ArcSIX) campaign may be of interest to GEWEX (study of atmospheric radiation and associated composition over Arctic Ocean). Xubin noted that a connection with this campaign would be very much valued by GEWEX.

3.5 Regional Information for Society (RfS)

Bruce Hewitson (RfS Co-Chair) updated JSC attendees on the evolution and the status of the RfS Science Plan. The current document, which has been submitted to the JSC for approval, contains the RfS Mission and Vision, Governance and Science Plan, and has been prepared by the RfS Interim Coordination Group (ICG).

The Science Plan is a living document with three overarching challenges that focus on the regional/decision scale. There is certainly overlap with other activities, with the aim of strengthening collaborations and building activities together. The science plan was built around four clusters of research questions. These clusters are not silos and will interact and learn from each other. RfS will play a key role in intra-WCRP communication. However, for that to happen successfully, strong communication mechanisms between groups need to be in place.

Silvina Solman, (RfS Co-Chair, Coordinated Regional Downscaling Experiment (CORDEX) Co-Chair) continued the presentation and gave an update on the Global Extremes Platform (GEP). An agreement between WCRP and the Nanjing University of Information Science and Technology (NUIST) has been approved for setting up the GEP Support Unit at NUIST, which will provide staff and logistics in support to GEP activities. The GEP leadership will now move forward with implementation plans and with the nomination of a steering group.

Silvina provided information on the yearly activities and progress of CORDEX. With the use of climate model downscaling products, several studies have been done by members of the CORDEX community on impacts in many areas of the world, particularly related to health and agriculture. CORDEX has also finalized the experimental design for the dynamical downscaling of CMIP6 and released the CORDEX-CMIP6 Atmosphere Variable List. Several Flagship Pilot Studies (FPS) are progressing with their activities. Many workshops have also been organized (mainly online) with a couple of hybrid events. CORDEX has made information available regarding the status of CORDEX simulations. As for future plans, one major activity is the CORDEX Conference that will take place at ICTP in Trieste in September 2023, which will also provide input for discussions for the WCRP Open Science Conference. Some emerging issues brought to the attention of the JSC and wider WCRP community were related to the timing for CORDEX simulations delivery to the IPCC AR cycle and the perceived loss of CORDEX visibility within the new WCRP structure.

The JSC thanked both Bruce and Silvina on the progress made in RfS, particularly on the development of the Science Plan. The JSC also assured them that CORDEX has always been and will continue to be a very important part of WCRP and plays a key role in engaging with the regions alongside their role in coordinating regional climate model experiments. The JSC also sees a great opportunity for CORDEX Africa to strongly engage with the planning ahead of, and activities during, the WCRP OSC.

3.6 Stratosphere-troposphere Processes and their Role in Climate (SPARC)

Seok-Woo Son (SPARC Co-Chair) presented the latest developments associated with the new SPARC strategy as well as the progress and achievements of SPARC. SPARC science provided a strong contribution to the IPCC AR6 through WGI, particularly in atmospheric temperature trends. SPARC has also been involved in the 2022 Ozone Assessment, with updated trends of the stratospheric ozone vertical distribution (LOTUS activity), and community chemistry-climate simulations that provide updated ozone recovery projections (CCMI). Several activities, including webinars, field campaigns, scientific articles, and the SPARC Reanalysis Intercomparison Project (S-RIP), have been finalized.

The new SPARC strategy is also being developed and will provide a foundation of knowledge to better understand the role of the atmosphere in the global climate system. The new structure of the core project will focus on new science projects and collaborations. These collaborations will be supported by a 'Partnership Advisory Panel' which will take strategic leadership of the connections between SPARC and other groups, focusing on opportunities, synergies, and co-benefits. SPARC is also organizing its 7th General Assembly on 24-28 October 2022, with a multi-hub approach (3 hubs plus online).

In the discussion it was noted that SPARC science is highly relevant for regional aspects of climate change, and some focus should be placed in regional activities. Connections, however, in some regions (especially Africa) are difficult for many reasons. Perhaps these connections could be supported via WMO Regional Associations. It was also noted that it is necessary to develop better links with GCOS on observations. SPARC will also liaise with the WCRP Academy on trainings and will look to have a SPARC representative within the Academy.

A04: SPARC to enhance links with GCOS in relation to observations (SPARC; JSC-44)

A05: WCRP Core Projects and the Academy to work together to enhance the visibility of their training activities (Core Projects and the Academy; JSC-44)

4 WCRP Lighthouse Activity Updates²

4.1 Digital Earths

Christian Jacob (Digital Earth LHA Co-Chair) acknowledged the contributions of Peter Bauer, former Co-chair of the Lighthouse Activity, and several other members in drafting the Digital Earths Science Plan. He detailed that the main objectives of this LHA are to support and coordinate the research underpinning the establishment of integrated interactive digital information systems that provide global and regional information on the past, present, and future of our planet and our human systems. Digital Earths wants to be a group that helps the community to build digital twin systems. To be able to do this, three main components have been identified: (1) very high resolution fully coupled km-scale regional and global models; (2) data assimilation for climate; and (3) research that moves beyond the physical Earth System, that will incorporate human interactions and impacts to human systems in the information system workflow.

To address component 1, Christian outlined that a hybrid workshop on km-scale modelling is being planned for October 2022, jointly with ESMO, which will result in a white paper. Christian mentioned that the main but challenging objective of the workshop is to engage all the high-resolution modelling communities that are involved with coupled global and regional models – atmosphere, ocean, hydrology, and cryosphere. The objective is to bring everybody together to learn from each other, identify the big challenges and discuss ways to address those challenges.

² Note that the Lighthouse Activities presented on days most convenient to the time zone of the speaker. Here they are presented in alphabetical order.

In relation to component 2, a workshop on data assimilation took place in May 2022 jointly with EPESC LHA, the outcome of which is a white paper currently in preparation.

For the component 3, discussions have started on human hydrology – irrigation and other human-related hydrological systems that change the water cycle. The closest links for this are with US agencies that want to design a Regional Hydroclimate Project in collaboration GEWEX. This is not funded yet but is a great initiative. Links are also being established with ISMIP under this component. Further, this component is also aiming to establish one or more demonstration project(s) on how we could integrate human systems in our Earth System models where necessary.

Christian mentioned that one of the greatest opportunities for WCRP in the km-scale-modelling space would be to bring global and regional modelers together through an alliance. A way forward may be to define a few projects that the modelers could work on, especially around regional models such as in ANDEX. Other ideas, in the longer term, would be to think about regional Digital Earths and to find ways to use WCRP's capabilities to connect user communities.

Christian mentioned that the greatest challenge has been to engage the community, especially with a modelling community that is very diverse. To address at least some of these challenges, Digital Earths proposes to restructure the LHA leadership by inviting active Centres/Groups to nominate a representative so that the Lighthouse Activity can directly engage with them.

Pascale Braconnot (JSC Member) stressed that with high-resolution activities we need to understand km-scale interactions with respect to what's needed. Sometimes the question being asked does not require such high-resolution models. Christian responded by saying that the km scale was not picked randomly. It was picked because it resolves one of the biggest issues in climate modelling, i.e., convection in the atmosphere. He also mentioned that GEWEX showed what the fundamental shift in the ability to model things in the atmosphere is at this scale. How this connects with the other Earth system spheres is something that still needs to be understood, with coupling being at the forefront of the minds of the modelers.

Ted commented that there is not much opposition to km-scale modelling. He also affirmed that there is often a disconnection between global and regional modelers and this activity is a huge opportunity to work with regional models with a targeted component in mind.

Sonya inquired about the role of ocean modelers in this LHA and encouraged Digital Earths to connect with members of the Ocean Model Development Panel (OMDP) for modelling and GSOP for data assimilation. She noted that the Ocean Decade's DITTO (Digital Twins of the Ocean) program, with which CLIVAR is involved, will also be a good platform for Digital Earths to be involved in. Christian responded that oceanographers are involved and the whole point of the upcoming workshop is to ensure all these connections are made. Jan noted that the LIAISE (Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment) project in Spain aims to perform a km-scale intercomparison of land surface models to highlight the different assumptions when running at these resolutions and highlighted that Digital Earths could be a player in that respect as well. Jing Li (CLIVAR International Project Office) noted that there is a workshop co-organized by CLIVAR OMDP that is also relevant to this: FilaChange, an international conference on ocean processes linking filaments and finescales (1-100 km) with climate change (29 August - 2 September 2022).

Detlef and Helen asked whether observations would be within the scope of Digital Earths and if advances in machine learning would be a part of this? Christian responded that the role of Digital Earths is to bring observations and modelling closer together under the data assimilation component of the activity. In this sense, Digital Earths can inform on needs and apply observations in the data assimilation system – merging observations with models. As for machine learning, it can be anywhere and everywhere within WCRP and therefore should be much more cross-cutting and not under one activity. Cath mentioned that machine learning is included in the ESMO science plan.

On the data side, Detlef mentioned that some entities such as the European Space Agency (ESA) and NASA often ask WCRP about the requirements for high resolution observational datasets. He continued that Digital Earths is about this system and to focus only on the modelling aspect is not sufficient. Either observational data should be used within the data assimilation process or WCRP should suggest, through our activities, where high-resolution data are required. There could be a new parameter that has not been measured yet. Christian responded that the 'O' in ESMO corresponds to observations and therefore Digital Earths should not try to take that away from them. Jan also supported the idea that WCRP needs to be proactive in encouraging high resolution data. He further mentioned that EUMETSAT had asked him about our stand on private companies starting to have such high-resolution observations and how we can ensure that they are distributed fairly. He mentioned that this needs a discussion within and between communities.

Rowan conveyed his thoughts relating to the third Digital Earths component, beyond the physical Earth system, and highlighted the needs of the private sector in understanding climate risks – not only vulnerability and exposure but also catastrophe modelling. He mentioned that the whole financial system is trying to understand these risks and WCRP should somehow work on advancing WCRP's connections to the private sector. Rowan wanted to know if Digital Earths will address this. Christian responded that this has not been done so far and that it was challenging to find partners to do quantitative modelling. He suggested that it would be best to start small with one or two partners who are willing to engage. Rowan mentioned that small scale businesses, such as financial or investment industries, could be a possibility.

Paulo Ruti (EUMETSAT) mentioned that high resolution 1km modelling and data assimilation are still open questions. An ECMWF workshop/discussion will take place next year to address the key question of on what scale assimilation is taking place in models and what information are we able to assimilate. These are the big questions behind the Destination Earth activity.

A06: Digital Earths LHA to connect with CliC regarding the high-resolution modelling workshop to bring in the cryosphere aspect that is so far lacking (Digital Earths, CliC; October 2022)

A07: Digital Earths to enhance interactions with the coupled modelling community (Digital Earths; JSC-44)

4.2 Explaining and Predicting Earth System Change (EPESC)

Rowan Sutton (EPESC Co-Chair) highlighted the latest developments of EPESC. The overarching objective of EPESC is “to design, and take major steps toward delivery of, an integrated capability for quantitative observation, explanation, early warning and prediction of Earth system change on global and regional scales and multi-annual to decadal timescales”. To achieve this, three working groups (1. observing and modeling Earth system change, 2. integrated attribution, prediction, and projection (including early warning and the potential for abrupt change), and 3. assessment of current and future hazards) have identified activities that will start to be implemented after the full membership of those groups are in place. It is important to highlight that process understanding is fundamental for each of the three themes led by each of the working groups.

One activity being developed and worth noting is the Large Ensemble Single Forcing Model Intercomparison Project (LESFMIP), which is being led by the working group on integrated attribution. A journal article with the protocol is in review, and there are nine modelling groups that will take part initially. The initial analysis is to focus on explaining changes in sea surface temperature with a goal to provide attribution statements to the WMO State of Climate and the Global Annual to Decadal Climate Update reports in 2024. Future plans include providing advice to GCOS on observational requirements for explaining and predicting Earth system change.

The potential for further connection between the EPESC and My Climate Risk (MCR) was highlighted, noting that MCR hubs will be looking at the issues and hazards that are important

locally. To this end, it is essential to work on a common methodology and to connect with the paleoclimate community. Several studies have been looking at climate variability from the perspective of paleo records, and how these can help in understanding the changes seen today and the rate of those changes in the current climate. Although EPESC has plans to look at multi-annual to decadal timescales, it would be possible to have further discussions on these aspects with EPESC Working Groups 2 and 3.

A08: EPESC to consider further connections with the paleo community (including PAGES), looking at specific past extreme events (EPESC; JSC-44)

4.3 My Climate Risk

Regina Rodrigues (My Climate Risk Co-Chair) gave an overview of the progress, achievements and plans of the My Climate Risk Lighthouse Activity. My Climate Risk takes a bottom-up approach, looking at the complexity of local situations, how to simplify the messages to local stakeholders, particularly when dealing with uncertainties, and empowering local communities. Several successful online workshops, webinars, and meetings were organized in 2021. She explained that a new Scientific Steering Group (SSG) with excellent diversity is being formed, which includes some members of the previous Science Plan Development Team and with some new members who were selected from an open call for membership. Eight My Climate Risk regional hubs are in the process of being established, and the aim is to expand into regions not well represented within WCRP.

There are many challenges that need to be overcome, particularly related to building local capacity and the development of trust and good relationships. My Climate Risk expects most of the connections with international partners (both within WCRP, and externally) to occur with the hubs, with strong engagement from Core Projects and other Lighthouse Activities.

There is strong interest in establishing connections from the Explaining and Predicting Earth System Change LHA, particularly related to hazards and risk perception, and with the Academy, in relation to education and training. Engagement can be via the webinars that the My Climate Risk hubs will be organizing. This should also involve RfS and the CORDEX domains points of contact. There are also several points of common interest with CliC, especially in the Arctic and Himalayas. Regarding links with CLIVAR, some of the hubs will be dedicated to ocean activities, and these could become involved in the UN Ocean Decade.

A09: WCRP activities, led by My Climate Risk, to explore joint webinars, perhaps using the MCR hubs as a way for further discussion and interaction with different regions (MCR and WCRP Secretariat; First discussions by December 2022)

4.4 Safe Landing Climates

Gabi Hegerl (Safe Landing Climates Co-Chair) presented the Safe Landing Climates (SLC) LHA. She briefly introduced the five SLC working groups, which appointed 28 new members in late 2021:

- Understanding high risk events
- Perturbed carbon
- Water resources
- Sea level rise
- Safe landing pathways

The Working Groups are currently refining their goals and are determining future activities. Gabi outlined the various ongoing and proposed activities of each of the WGs, including the popular tipping elements, irreversibility, and abrupt change webinar series. Several workshops are proposed in 2023, including on the transient climate response to cumulative emissions and the

remaining carbon budget, global water cycle stability mechanisms, and a discussion series on future adaptation and mitigation pathways. Gabi also highlighted challenges that the LHA face in terms of achieving regional diversity and noted that they are searching for ways to better consolidate the many workshops and discussion series that they would like to have and to better engage with SLC affiliate members.

Jan asked how GEWEX could interact with the water resources WG to which Gabi replied that the WG is a work still in progress and that the members were trying to sort out their interests and themes. She proposed to have a discussion with GEWEX once the WG was more developed. Helen also suggested that potential connections with CliC on permafrost should be looked at.

Detlef asked where climate interventions would sit in SLC to which Gabi replied that this theme would be addressed by the Perturbed Carbon WG, as well as High Risk Events and Safe Landing Pathways WGs. Detlef ask what time scales of sea level rise that the SLC is looking at – shorter or longer time scales? Gabi responded that the WG is not particular interested in immediate changes and will focus on the next few decades to 100 years, but not out to very long-time scales. Pascale commented that it's important to acknowledge that understanding what is happening at all different time scales is important, as they are all connected.

A10: Safe Landing Climates to discuss with GEWEX and CliC the topics of water resources and permafrost (SLC, GEWEX and CliC; November 2022)

4.5 WCRP Academy

Angela Maharaj (WCRP Academy Co-Chair) briefly explained the structure of the Academy, which consists of three working groups – (1) Stocktake, (2) Identity and Portal, (3) Fundraising. The aim of the three working groups is to help build the training advisory arm of WCRP and to think about the sort of entity the WCRP Academy would be. The Stocktake WG conducted a Climate Training Stocktake Survey in 2021 to collect information on interest, availability, and gaps in training for climate science and research. In 2022 the Academy took on two consultants, who have been working on the outcomes of the survey and the next steps for the Academy. The survey analysis showed training gaps in Asia and across the Global South. The team is now investigating this through a series of targeted interviews. Angela highlighted that the survey had over 400 responses with a decent balance between the Global North and South and a good gender balance. She noted that WCRP's Climate Research Forums were a great opportunity to help propagate the survey. The Identity and Portal WG have been working on the branding of the Academy and are planning the web and portal development. As a first phase, a website is being developed to provide support and visibility to the training available, with priority to WCRP and partner training opportunities. The fundraising WG is looking at funding options, including philanthropic funding, and is addressing how the Academy can be funded so that it can be sustained long term.

Angela then presented the key outcomes of the Climate Training Stocktake Survey, including current training opportunities available and accessible, obstacles faced, trainings that are required but currently unavailable etc. Angela noted that content curation was a key requirement highlighted in the survey. She explained that the Academy will not develop its own training but will curate and vet good resources already available and provide advice on various trainings. To be able to do this, the Academy needs to develop criteria that will identify good material with sound quality control. The survey also identified a need for a repository to provide recordings of webinars, links to peer reviewed literature on the latest climate science as well as resources to help the community with training. Accessibility, i.e., the availability of material in multiple languages to provide global equity, was another requirement that was highlighted in the survey, but she noted that this may be a major challenge. Lastly, it was identified that maintaining relationships with clientele will also be important, both in terms of links to training providers and to those seeking training. The outcomes of the survey will be published in due course.

Angela highlighted that the Academy has been thinking about what success would look like for this activity and the timeline involved. It will rely on (1) a mechanism to regularly survey climate science training needs and communicate this information to training providers (commenced 2021), (2) a modern, well-developed platform that allows researchers globally to learn about and access training opportunities (phase 1 – 2022; phase 2 – 2023/4), (3) a funded, permanent Academy team that liaises with the climate science community, maintains and develops the platform, runs the surveying mechanism and maintains communications with potential students and training providers. This will rely on a sound business model and long-term support.

Angela highlighted that the Academy will soon be able to help provide resources for training, curation, and advertising WCRP trainings. It is also seeking ex-officio representatives for WCRP activities that don't have representation on Academy Steering Group. She highlighted three emerging issues: (1) recruitment – the Academy needs expertise and diversified skillsets that extend beyond research (and this is hard to find in the WCRP community), (2) quality control – sound processes will be needed for vetting resources from outside WCRP, (3) long-term stability – a business plan is needed to take the Academy forward and ensure continuity.

Linda Anne Stevenson (Asia-Pacific Network for Global Change Research (APN)) asked how the Academy will address open access issues of peer reviewed publications while collating information. Angela responded that the committee was working on principles that will be the guidance for policies to make things as open and equitable as possible. In terms of papers – the idea will be to provide references and interpretations of outcomes in papers that don't have open access rather than directly providing the papers. Sonya asked about the mechanism for WCRP activities to share their training materials (e.g., lectures from upcoming summer schools) with the Academy. Angela responded that right now the process is to email the Academy to start the conversation but that they hope to have a polished process later where potential providers will provide key information that can be used to start the vetting process.

Detlef mentioned that there is significant interest in the Academy shown by WCRP partners and that the Academy should look to these connections to grow its network. He asked Angela about current connections. Angela responded that the Academy is working on building such networks but highlighted that one of the dangers was that we will not necessarily know what is missing if we only reach out through people we know. It was agreed that the CRFs could help address this issue. In addition, Detlef raised the possibility of setting up a practitioners' interaction platform within the Academy. The comments were taken on board by the Academy leadership.

A11: WCRP Academy to make additional connections with other partners (e.g., Future Earth and ISC) and practitioners (Academy; JSC-44)

5 Grand Challenges

Only one Grand Challenge presented a report at JSC-43, with the others now closed or in the final stages of completing their work. The Grand Challenge on Regional Sea Level Change and Coastal Impacts (GC-Sea Level) will close after the July Singapore conference.

5.1 Grand Challenge on Regional Sea Level Change and Coastal Impacts

David Behar (Co-Chair, GC-Sea Level) presented an update of the GC-Sea Level, specifically the activities of the past year that have led to the WCRP Sea Level Conference in Singapore (12-16 July 2022). He briefly introduced the Grand Challenge (GC) Co-chairs and the six Work Packages (WPs) within the GC, followed by an update on the status of initiatives such as publications and workshops as a part of the GC activities. His presentation then primarily focused on WP5, which is the practitioner part of the GC-Sea Level. This included a practitioners' survey and analysis on sea level rise scenarios, the outcome (with approx. 300 participants) of which is currently in preparation for publication. David also provided a debrief on the practitioner led workshop that took place in February 2022 on leading practices and challenges to advance resilience to sea level rise. The workshop focused on various ways the practitioners can address

sea level rise issues especially by bridging across WCRP science. The major outcomes of the workshop will feed into Day 3 of the sea level conference, which will focus primarily on the practitioner perspective. Day 3 of the sea level conference will have practitioners at local, national, and international levels involved in their community resilience planning. What is being done to achieve resilience in their communities and how science can help in their work will be discussed. The objective is to promote interactions between sea level rise practitioners to form a community and to create a platform for interaction with WCRP scientists.

Mike acknowledged the important role of practitioners in GC-Sea Level and asked if David felt that WCRP adequately covers sea level rise issues in its new structure. David was concerned about the fragmentation of sea level issues and insisted that opportunities for collaboration that bring together practitioners and scientists need to be created. He suggested that more practitioners must be brought in to build the bridge, noting that if WCRP wants to do this there are many practitioners interested in getting involved. He explained that practitioners not only want to talk with each other in their community but would also love to interact with the science community. David also suggested an adjunct to the My Climate Risk Lighthouse (science and society oriented) to organize practitioner interactions.

Detlef mentioned that the WCRP OSC in Kigali will celebrate the success of WCRP GCs. He recalled the New York Sea Level Conference Statement that suggested the generation of a sea level information office for practitioners' use and asked if there was any update on it. David mentioned that he wasn't aware of this, but that something like it might come out of the practitioners' event at the conference in Singapore. Detlef said that the success of this practitioner experiment in Singapore will help inform the OSC in Kigali.

Thomas Peter (JSC Member) asked if the practitioners were looking into future adaptation strategies with a feeling that this can be managed, or do they fear what we are approaching. David responded that while some places have been overwhelmed, many have the money to deal with it. He explained that science is not the only factor in decision-making. The process will remain chaotic, but science can stimulate how we think about things. To tackle the issues well, we need good science-practitioner connections. Marie-France Loutre (PAGES) noted that PAGES has two working groups on sea-ice related issues, C-SIDE (Cycles of Sea-Ice Dynamics in the Earth system) and ACME (Arctic Cryosphere Change and Coastal Marine Ecosystems). She noted that it may be interesting to connect more to these.

A12: Determine how sea level will fit within the WCRP structure and the topics that the various activities will cover (JSC, Core Projects, SLC, MCR; September 2022)

6 Connections, partnerships and collaboration

6.1 Climate Research Forums

Helen reported on the status and future of the WCRP Climate Research Forums (CRFs). She briefly recalled the reason for starting the forums, which was a decision that came out of the 41st Session of the JSC. The forums were aimed at informing the community about the new WCRP and seeking their feedback, especially on the Lighthouse Activities; exchanging ideas and discussing new activities and opportunities; and exploring ways that our community of scientists, partner programs, funders and end users of climate science can better engage. Seven forums were delivered in 2021 and Helen discussed the key findings based on the response of participants to questions on e.g., their awareness of WCRP, and how well WCRP is addressing critical science questions. Many of the participants wanted to know more about the WCRP LHAs and, when asked where WCRP can make a difference in their regions, more than 80% of participants responded that better coordination of climate related activities is an area where WCRP can really make a difference.

Helen proceeded to discuss the various options for future CRFs. If the CRFs are to be continued, they should be for very clear purpose, and we need to ensure that they have adequate support.

We developed a successful method for delivering the forums and now have a template that can be passed to groups interested in taking over. She also mentioned that regionally based forums need a structural home – most likely in RfS. In addition, alignment with the Lighthouses, especially My Climate Risk and the Academy, may be of interest. In terms of resources, dedicated staff will be needed as well as funding/sponsorships.

The plan now is to share the CRF report with the JSC and WCRP core science activities and explore with the OSC Science Organizing Committee what role the Regional Focal Points might have in the lead-up to OSC-2023. We will also follow-up with the Regional Focal Point groups to review the feedback received, explore interest in an event in Oceania, and reactivate engagement in Africa. Detlef stressed the importance of organizing something for the African region in preparation for the OSC in Rwanda. This can also be connected to the spinning up of an African Alliance. Jens Hesselbjerg Christensen (JSC Member) discussed the concept of leadership and how this would vary culturally and geographically. Regions should be made aware that WCRP wants to inform as well as be informed. Ted showed interest in carrying this forward as a part of RfS, MCR and the Academy, as it's crucial for WCRP to get established in places where it is currently underrepresented. Christian proposed the idea of establishing international centres and noted that WCRP should work towards pushing those ideas forward.

A13: WCRP to consider how best to enhance engagement with the Global South, through forums, activities or international research centers and how this should be set up within the WCRP structure (JSC and WCRP Leadership; JSC-44).

A14: Explore how to engage with the African Regional Focal Points regarding the possibility of a Climate Research Forum for Africa as a lead up to the WCRP Open Science Conference (RfS, MCR, Academy, JSC Chair and Vice-Chair, WCRP Secretariat; October 2022)

6.2 Ensuring Connections between Core Projects and Lighthouse Activities

Jens Hesselbjerg Christensen (JSC Member) opened a discussion on the connections between the Core Projects and Lighthouse Activities by highlighting the great work that has taken place across WCRP during COVID times. Collaborations between activities are taking place, but there is room for further interactions and stronger involvements of CPs in the LHAs activities. He noted that the Lighthouse Activities (LHAs) have only ever had online meetings and that we likely need people to meet face-to-face.

Pascale asked whether the structure of the LHAs is simple enough. She explained that people need to understand how they should work together. Jens agreed that we should see where things need to fit together and facilitate that.

Sonya said that relying on in-person meetings to advance the Lighthouse Activities is not going to work, as that will not be sustainable and meetings would only be once a year in any case. She outlined that an ongoing communication structure, such as a monthly email from each LHA or regular posts on an internal webpage would be useful. Jens replied that a communication strategy that addresses all of these things would be useful.

Roberto Sánchez-Rodríguez (JSC Member) noted that the first step is to know what the other projects are doing. We could have a matrix that shows what we are doing and lists how to interact with each group in order to identify the capabilities and where value can be added. Xubin noted that it is better to do a few things well than many things not so well. He outlined three categories: review and assessment; capacity building; and science. Different strategies or modes may be needed for each category.

Gabi said that she doesn't share the concern regarding Core Project and LHA interactions to the same extent. She said that Safe Landing Climates mapped all the links to the Core Projects and they are aware of them and they are just trying to find their way forward in an innovative way. The WCRP Open Science Conference would be a good time to expand the work as needed and

to add value. Pierre supported doing the LHA reporting virtually, to lessen the impact on our carbon footprint. He noted that there could be more visibility of the LHAs but more meetings, especially in person, is not the answer. Detlef noted that leadership meetings could be a very important platform. Jens said that this could be addressed with good communication between the leadership of the different core activities. Bruce said the opaqueness of WCRP is the issue. We want fuzzy boundaries. How do we gain awareness of what is going on? The IPOs could maintain a database that would be searchable and could provide the information that we need. Detlef proposed asking all activities how we can better work together across WCRP. He reiterated that a leadership meeting might be an immediate way forward. Pascale noted that the Science and Implementation Plan will also be a place to work on this further.

A15: Identify ways to better strengthen the linkages and engagement between the Core Projects and LHAs. This likely requires bespoke arrangements for each Core Project and LHA. A proposed WCRP Leadership meeting in 2022 would be an opportunity to discuss these mechanisms and also foster this engagement (JSC, WCRP leadership, WCRP Secretariat; October 2022).

6.3 World Weather Research Programme (WWRP)

Chris Davis (WWRP Chair) presented an update from WWRP, explaining that they are currently in the middle of developing a new implementation plan. A lot of the initiatives that they want to advance require partnerships, including with WCRP. The new WWRP has an umbrella concept, ensuring that there is awareness of weather research to reduce risk on all levels. He outlined current and future projects of WWRP:

Current Projects:

- HIWeather Core Project (through 2024)
- Paris Olympics 2024 RDP (through 2024)
- Aviation RDP-2 (through 2025)
- Tropical Cyclones-Probabilistic Forecast Products (through 2025)

New Projects (starting in 2023-2026):

- Polar Research (coupled atmosphere-ocean-ice prediction and inclusion of indigenous communities)
- Sub-seasonal (and longer) predictability related to agriculture, energy and water resources (coupled atmosphere-land-ocean) applications
- Urban Prediction
- Integrated hydrology and precipitation (minutes to days)
- Satellite based nowcasting for Africa
- Public Engagement for Practitioners, Learners, and Educators (PEOPLE)

The new projects were chosen because they span the Earth system components (land, water, ice, atmosphere), include fundamental science that we need to advance, respond to climate and water drivers (priorities in WMO), maintain some continuity with current research efforts, demonstrate the relevance of WWRP and enhance visibility, inform and build trust with the broad community, and increase regional emphasis, including with Developing Countries, Least

Developed Countries and Small Island Developing States. He noted that there are many connections that can be made with WCRP activities.

Jim asked Chris whether he could see any relatively easy wins for WCRP/WWRP collaborations. Chris said that GPEX could provide an opportunity for valuable collaborations, further noting that while more may come out of the WWRP symposium in August, he could see Digital Earths, high resolution modelling, and improving coupled models (initialized prediction) are areas of common interest. He stated that he is not sure where the best entry point for this is. Estelle de Coning (Head, WWRP) said that the Polar Research (Antarctic Treaty, Arctic Council), observation and modelling efforts are potential areas of collaboration.

Xubin asked what WWRP's measures of success for projects are. Chris said that those metrics should be established up front. Generally, the transition of research into operations, where the research is transitioned into something that can be used, is a measure of success of the current core projects and there will be similar measures of success for the new core projects.

6.4 Global Atmosphere Watch (GAW)

Greg Carmichael (GAW Chair) presented an update from GAW, which is focused on atmospheric composition, with research and infrastructure components. Greg presented the organization of GAW and noted that a lot of activities are focused on observational research infrastructure, where some parts of the world still lack stations. GAW supports the Vienna Convention and the Montreal Protocol and a variety of sectoral services – including health and food security. There is a strong modelling component in GAW, including analysis, reanalysis, and inverse modelling. There are many important intersections between air quality and climate change.

He highlighted the activities of the WMO sand and dust storm warning advisory and assessment system, the vegetation fire and smoke pollution warning and advisory system, the Integrated Global Greenhouse Gas Information System (IG³IS), and urban related activities, which are critical for health and for greenhouse gas emissions at the urban scale. He noted that there could be more interaction between GAW, WCRP and WWRP at the urban scale. He mentioned the Global Greenhouse Gas Carbon Budget monitoring system, which was recently approved at WMO Executive Council, a study for which will take place over the next 6-8 months. He noted that GAW is just starting to develop a new Implementation Plan, aligned with the WMO implementation plan. Atmospheric composition and the climate interface will be a key component and he looks forward to more meaningful collaborations between GAW and WCRP.

Jim noted that WCRP is currently looking at climate intervention. Some parts of that investigation will include atmospheric composition. He asked if WCRP should coordinate with GAW regarding stratospheric baselines. Greg confirmed that this would be a useful conversation. Pierre asked about the activity on the Global Greenhouse Gas Carbon Budget monitoring system. Greg said that the infrastructure would support services, a combination of observations, modelling, inversion – proving oversight of services that would be both observations and fluxes. He said it was currently in an early concept phase, coming top-down from WMO. Detlef said that the WMO Executive Council approved a study to set this up, he asked if Greg could highlight how WCRP could get involved in this study and asked how we should contribute. Greg explained that the study team will be 10-15 people. He said that he hopes 3-4 people of those will be from GAW, and WCRP should also push for representatives. He likened it to the World Weather Watch in terms of a concept.

A16: Investigate how WCRP can usefully engage with, and provide input to, the new Global Greenhouse Gas Carbon Budget monitoring system study (Head WCRP Secretariat; September 2022)

6.5 Future Earth

Kristie Ebi (Future Earth) explained that WCRP and Future Earth have worked closely together for some time and in many areas, highlighting the [joint statement](#) agreed in 2020. She outlined

the Future Earth hub network and explained that the program recently restructured, and now has an assembly, a governing council and the secretariat (made up of the eight hubs). She highlighted the three pillars: facilitating research and innovation, build and mobilize networks, and share the narrative. She noted the success of the recent Sustainability Research & Innovation Congress 2022, the 10 New Insights in Climate Science series (with WCRP), and the Earth Commission (and TipMIP).

Judit Ungvari (Future Earth) noted that there may be some collaboration with Future Earth and WCRP on the WCRP Open Science Conference, noting that perhaps SRI (in Panama) could be a good lead up event in 2023. Detlef supported this collaboration and invited Future Earth to be present and work collectively on the conference – noting that WCRP is organizing this for the wider community. This was warmly supported by Kristie. Detlef asked if there was anything that Future Earth would like to see strengthened in the future. Kristie said that it would be good to strengthen the co-production and co-design. Judit highlighted that there are already very active collaborations. There is an opportunity to work closer with the knowledge action networks and she invited WCRP to get in touch to explore interactions.

7 WCRP Open Science Conference

Detlef gave an overview of the planning for the WCRP Open Science Conference (OSC). The OSC will take place in Kigali, Rwanda, 23-27 October 2023. He explained that it will be hosted by the Rwanda Environment Management Agency, with partners that include the Rwanda Meteorological Agency, African Institute for Mathematical Sciences, University of Rwanda and others. He outlined that the host was selected unanimously after an open call which attracted seven expressions of interest, four full proposals and a site visit in February 2022. He outlined that a WCRP OSC Science Organizing Committee (SOC), a WCRP OSC SOC Executive (EXESOC), and several sub-groups have been established to advance different elements of the conference. He outlined the draft conference themes and gave a broad overview of the logistic and communication plans. The call for abstracts and registrations will open in December 2022. So far 526 people have registered their interest on the website, from 85 different countries. Detlef finished by discussing activities that will aim to build interest and engagement in Africa and potential outputs of the conference (potential position papers will be discussed with the community and a conference statement as input into COP 28 will be produced).

8 WCRP Science and Implementation Plan

Helen outlined progress on the WCRP Science and Implementation Plan (previously called the WCRP Implementation Plan), which is designed to be a dynamic and living document that will be regularly reviewed and refreshed. She shared the outline of the draft plan, a draft version of which is available to session participants. Templates will be provided to the Core Projects and Lighthouse Activities for their input to the Science and Implementation Plan. These should be 5-10 pages of text per activity and the JSC liaisons and the Secretariat will support this endeavor. Detlef noted that the Science and Implementation Plan will be important for people to know what WCRP is doing, as a guide for the onboarding of new WCRP leaders and as a foundation document for funding agencies to understand what WCRP does. Detlef and Helen asked the core activities for their reactions to the templates and the timeline for their activities. There was general support.

A17: (i) Send out Science and Implementation Plan templates to core activities and (ii) ask for additional input on Sections 6.3 (Capacity Building), Section 7 (Strategic Investment Strategy) and Section 8 (Timelines and Measures of Success) of the Plan (WCRP Secretariat and JSC Chairs; Send out in July 2022)

9 WCRP Secretariat and finance

Mike gave a report on the WCRP Secretariat, listing the secretariat staff and thanking hosts of the IPOs worldwide for their support. He gave a summary of the finances, noting that only 17% of the allocated budget was spent in 2021 due to COVID impacts on travel. In 2022 voluntary contributions have so far (mid-June) been received from the United States, United Kingdom, New Zealand, Germany, and Canada and between CHF 150 and 200k is promised for the OSC. The 2023 draft budget was outlined, including additional funds expected from the U.S. Global Change Research Program (USGCRP) and he highlighted requests for additional funds from CliC and the Academy and to support two interns that will join WCRP in September 2022. He noted that it is important to realize that this does not include income that is expected from USGCRP, as that is yet to be confirmed. In the discussion that followed several core activities asked the Secretariat for a guide to what WMO can and cannot procure and the methods in given cases, as this changes often and remains unclear. Mike affirmed that the Secretariat could provide a basic guide but noted that they are constrained by what WMO procurement advise in any given case and that it is always best to check on a case-by-case basis regarding what is possible.

A18: Provide a guide to IPOs on current WMO procurement rules (WCRP Secretariat; October 2022).

10 JSC actions and decisions

Following usual practice, the JSC held a closed session (i.e., JSC members and WCRP Secretariat only) to discuss and approve memberships, budget requests etc. (see Annex 1 for details). During this session the following Actions and Decisions were agreed:

10.1 JSC membership

The JSC will review candidates for JSC membership beginning 1 January 2023 and submit a recommendation package to the WCRP co-sponsoring organizations.

A19: Compile and submit a short-list of JSC Membership candidates to the WCRP Co-Sponsors (JSC and WCRP Secretariat; October 2022)

10.2 Review of actions and future JSC meetings

The JSC decided that it would be necessary to meet face to face in 2023, probably in April or May, but that the carbon footprint of that meeting should be kept to a minimum. To that end, virtual participation should be made possible, and the location should take into consideration participant travel.

A20: Investigate and decide on the time and location for the 44th Session of the JSC (April-May 2023) (JSC Chairs, WCRP Secretariat; September 2022)

10.3 Budget 2023 approval and review of 2021/22 finances

The JSC reviewed WCRP finances for 2021 and 2022 and the budget for 2023. It also considered applications for additional funding in 2023 from CliC and the Academy. The Committee also discussed how WCRP should raise the funds necessary to advance its strategic plan and decided that a JSC working group should be established to make recommendations by the end of 2022.

D01: JSC approves WCRP Academy request for additional funding of CHF 42k for 2023; CliC to be allowed to use unspent 2022 funds for 2023 Grants and Fellowship scheme (up to CHF 30k).

A21: Form a JSC working group to provide recommendations on future WCRP fundraising and expenditure (JSC Chair, JSC Vice-Chair and Head of WCRP Secretariat; JSC-43B)

10.4 Core activity membership

New memberships and membership renewals of WCRP core activity SSGs (or equivalent) were reviewed by the JSC and decisions made.

D02: All membership requests approved (details to be provided by WCRP Secretariat to activity leads)

A22: Send out letters of appointment and thank-you letters to Core Activity members (WCRP Secretariat; August 2022)

A23: Formalize JSC liaisons for CPs and LHAs once new JSC Members have been approved (JSC Chairs and Secretariat; JSC-43B)

A24: WCRP Membership of WCRP Bodies Guidelines to be updated and sent to JSC for final approval (WCRP Secretariat; September 2022)

10.5 RfS and ESMO Science Plans

The JSC noted that they were very impressed with the science plans of both new Core Projects and both were approved in principle.

D03: RfS and ESMO Science Plans approved in principle.

The JSC noted the following actions:

A25: JSC to provide written feedback to the RfS leadership on the Science Plan and follow this up with a meeting to discuss the way forward (JSC; November 2022)

A26: JSC to provide written feedback to the ESMO leadership on the Science Plan (JSC; November 2022)

A27: RfS and ESMO to consider how they can link, including links between ESMO and CORDEX (RfS, CORDEX and ESMO; JSC-44)

10.6 Climate Research Forums

The JSC briefly reviewed the recommendations outlined in the Climate Research Forums report, but there was insufficient time to discuss and approve the recommendations. The JSC decided that this would be done by email after the Session.

A28: Discuss and approve recommendations outlined in the Climate Research Forums report (JSC Vice-Chair, WCRP Secretariat; September 2022)

Annex 1 – Agenda

Day 1 (27th June): 15:00-18:00, CEST [180 mins]

(Chairs D Stammer and H Cleugh; Rapporteur N Van Der Wel; Chat Moderator N Caltabiano)

1. JSC Opening Session [40 mins]

- Opening and Goal of JSC-43 from JSC Chair and Vice-Chair [15 mins] (*D. Stammer, H. Cleugh*)
- Welcome from Co-sponsors [3 mins each] *J. Luterbacher (WMO), Mathieu Denis (ISC), V. Ryabinin (IOC, by pre-recorded video)*
- Welcome on behalf of WCRP Secretariat [5 mins] (*M. Sparrow*)
- Approval of Agenda [5 mins] (*D. Stammer, H. Cleugh*)
- Guidelines for running JSC-43 via videoconference [6 mins] (*D. Stammer, H. Cleugh*)

2. Strategic initiatives and Issues: Update and Discussion [140 mins]

2.1 New and emerging science issues [15 mins] (*D Stammer and H Cleugh*)

2.2 New science - Task Team Updates [3 x 15 mins; 10 mins presentation and 5 mins discussion]

- Climate Intervention (*J Hurrell and M Ivanova*)
- Global Precipitation Experiment (GPEX) (*X Zeng*)
- Cycles and Budgets (*J Polcher*)

2.3 GCOS/WCRP collaborations [15 min presentation and 10 min discussion] (*H Dolman*)

[10 min break]

2.4 Future of Climate Modelling Workshop [10 +10 mins] (*V Naik/ P Forster*)

2.5 Engagement with the IPCC climate science assessment processes [15+10 mins] (*D Stammer, H Cleugh, V Masson-Delmotte/A Pirani*)

- IPCC WG1 – WCRP Collaborations (*V Masson-Delmotte/Panmao Zhai/ A Pirani*)
- update on planned WCRP-IPCC Workshop (*D Stammer, H Cleugh, R Sánchez Rodríguez*)

End of Day 1

Debrief for JSC Chair, Vice-Chair, Officers and Head WCRP Secretariat [30+ mins]

Day 2 (28th June): 06:00-09:00, CEST [180 mins]

(Chairs D Stammer and H Cleugh; Rapporteur H Palanisamy; Chat Moderator N Van der Wel)

Days two and three are focused on our Core Projects, Lighthouse Activities and other activities that the JSC and others should be aware of (<https://www.wcrp-climate.org/wcrp-ip-structure>).

3 WCRP Activity Updates and Discussion [180 + 180 mins]

3.1 Presentations and Discussion of WCRP core activities (Part 1)

- Grand Challenge on Regional Sea Level Change and Coastal Impacts [10 mins presentation + 10 mins discussion] (*D Behar*)
- Climate and Cryosphere (CliC) Core Project [10+10] (*E Hanna*)
- Global Energy and Water Exchanges (GEWEX) Core Project [10+10] (*J Polcher and X Zeng*)

[10 min break]

- WCRP Academy Lighthouse Activity [10+10] (*A Maharaj*)
- Digital Earths Lighthouse Activity [10+10] (*C Jakob*)

- Safe Landing Climates Lighthouse Activity [10+10] (*G Hegerl*)

3.2 Climate Research Forums [10+10] (*H Cleugh*)

Discussion [30 mins]

End of Day 2

Debrief for JSC Chair, Vice-Chair, Officers and Head WCRP Secretariat [30+ mins]

Day 3 (29th June): midday-15:30, CEST [180 mins]

(Chairs *D Stammer* and *H Cleugh*; Rapporteur *N Caltabiano*; Chat Moderator *H Palanisamy*)

3.3 Presentations and Discussion of WCRP core activities (Part 2)

- My Climate Risk Lighthouse Activity [10 mins presentation plus 10 mins discussion] (*T Shepherd* and *R Rodrigues*)
- Stratosphere-troposphere Processes and their Role in Climate (SPARC) Core Project [10+10] (*Seok-Woo Son*)
- Regional Information for Society (RIfS) Core Project (including CORDEX and Global Extremes Platform) [20+10] (*B Hewitson*, *S Solman*, and *S Pryor*)

[10 min break]

- Climate and Ocean Variability, Predictability and Change (CLIVAR) Core Project [10+10] (*S Legg*)
- Explaining and Predicting Earth System Change Lighthouse Activity [10+10] (*K Findell* and *R Sutton*)
- Earth System Modelling and Observation (ESMO) Core Project [10+10] (*S Tegtmeier* or *C Senior*)
- Coupled Modelling Intercomparison Project (CMIP) [10+10] (*J-F Lamarque*)

Discussion [20 mins]

End of Day 3

Debrief for JSC Chair, Vice-Chair, Officers and Head WCRP Secretariat [30+ mins]

Day 4 (30th June): 21:00-midnight, CEST [180 mins]

(Chairs *D Stammer* and *H Cleugh*; Rapporteur *N Van der Wel*; Chat Moderator *B Balino*)

4. Connections, Partnerships and Collaboration [95 mins]

4.1 Discussion: Ensuring Connections between Core Projects and Lighthouse Activities [20 mins] (*J Christensen* and *P Braconnot*)

4.2 Partnerships and collaboration (*J Hurrell* and *P Braconnot*) [75 mins]

Brief updates from partners including

- World Weather Research Programme (*C Davis*, *E De Coning*) [10+5]
- Global Atmosphere Watch (*G Carmichael*, *O Tarasova*) [10+5]
- Future Earth (speaker TBC) [10 + 5 mins]
- General short interventions from other partners [30 mins]

5. WCRP Open Science Conference [25 mins]

(*D Stammer*, *H Cleugh*, *V Detemmerman*, *N Caltabiano*)

<https://www.wcrp-climate.org/wcrp-osc23>

Including:

- Updates and discussion on programme, plenaries and sessions
- Comms, branding and marketing
- North-South Engagement and involvement of Early Career Scientists

- Fund raising and finances

6. WCRP Science and Implementation Plan [30 mins]

(D Stammer and H Cleugh)

Including

- Introduction and progress with regards to the WCRP Science and Implementation Plan
- Engagement of WCRP activities and partners
- The way forward, including timeline

7. WCRP Secretariat and Finance [30 mins]

- Secretariat Report [5 mins] *(M Sparrow)*
- Summary of Budgets and Finance [10 mins] *(M Sparrow)*

M Sparrow will briefly summarize the 2021/22 expenditure, and 2023 budget.

- Discussion on future use of funds [15 mins] *(D Stammer, H Cleugh, M Sparrow)*

End of Day 4

Debrief for JSC Chair, Vice-Chair, Officers and Head WCRP Secretariat [30+ mins]

END OF OPEN SESSION

Debrief for JSC Chair, Vice-Chair, Officers and Head WCRP Secretariat [30+ mins]

JSC Only Session

Day 5 (6th July): 20:00 to 2230 CEST JSC-only meeting [up to 150 min]

(Chairs D Stammer and H Cleugh; Rapporteur N Caltabiano; Chat Moderator N Van der Wel)

- Internal JSC only (no secretariat) [up to 60 mins] *(D Stammer)*
- JSC future membership [60 mins] *(D Stammer and H Cleugh)*
- Review of previous Actions [15 mins] *(M Sparrow)*
- Budget 2023 approval and review of 2022/21 finances [15 mins] *(M Sparrow, D Stammer)*

Day 6 (8th July): 06:00-08:30 CEST [up to 150 mins]

(Chairs D Stammer and H Cleugh; Rapporteur N Van der Wel; Chat Moderator H Palanisamy)

- Future strategies for WCRP resources [30 mins] *(D Stammer, H Cleugh)*
- Core Activity membership [60 mins] *(M Sparrow & WCRP secretariat)*

Approvals of new membership for Core Projects and Lighthouse Activities

- Approval of membership guidelines [15 mins] *(H Cleugh)*
- IPOs and other support units [15 mins] *(D Stammer and H Cleugh)*
- AOB including

Annex 2 – List of participants

First Name	Last Name	Function/Affiliation
WCRP Joint Scientific Committee		
Detlef	Stammer	JSC Chair
Helen	Cleugh	JSC Vice-chair
Lisa	Alexander	JSC Member
Tercio	Ambrizzi	JSC Member
Pascale	Braconnot	JSC Officer
Jens Hesselbjerg	Christensen	JSC Officer
Susanna	Corti	JSC Member
Pierre	Friedlingstein	JSC Member
James (Jim)	Hurrell	JSC Officer
Thomas	Peter	JSC Member
Krishnan	Raghavan	JSC Member
Roberto	Sánchez-Rodríguez	JSC Member
Ken	Takahashi	JSC Member
Hui-Jun	Wang	JSC Member
WCRP Core Activities		
David	Behar	Regional Sea-Level Change and Coastal Impacts Lead
Wenju	Cai	CLIVAR Co-chair
Kirsten	Findell	Explaining and Predicting Earth System Change Co-Chair
Edward	Hanna	CliC Co-chair
Gabi	Hegerl	Safe Landing Climates Co-Chair
Bruce	Hewitson	RfS Co-chair
Christian	Jakob	Digital Earths Co-Chair
Jean-Francois	Lamarque	CMIP Panel Chair
Sonya	Legg	CLIVAR Co-chair
Christopher	Lennard	WCRP Academy Co-Chair
Angela	Maharaj	WCRP Academy Co-Chair
Amanda	Maycock	SPARC Co-chair
Tim	Naish	Melting Ice and Global Consequences
Jan	Polcher	GEWEX Co-chair
Regina	Rodrigues	My Climate Risk Co-Chair
Karen	Rosenlof	SPARC Co-chair
Cath	Senior	ESMO Co-chair
Ted	Sheherd	My Climate Risk Co-Chair

First Name	Last Name	Function/Affiliation
Silvina	Solman	RfS Co-chair
Seok-Woo	Son	SPARC Co-chair
Rowan	Sutton	Explaining and Predicting Earth System Change Co-Chair
Susann	Tegtmeier	ESMO Co-chair
Xubin	Zeng	GEWEX Co-chair
Invited participants		
Greg	Carmichael	GAW
Fei	Chen	UCAR
John	Claydon	IMBeR
Jim	Crawford	IGAC
Chris	Davis	WWRP
Estelle	de Coning	WWRP
Mathieu	Denis	ISC
Langley	DeWitt	IGAC
Han	Dolman	GCOS
Kristie	Ebi	Future Earth
Piers	Forster	University of Leeds
Garry	Hayman	iLEAPS
Jin	Huang	NOAA
Jack	Kaye	NASA
Katia	Kontar	USGCRP
Li	Li	SOLAS
Hannah	Liddy	AIMES
Marie-France	Loutre	PAGES
Jürg	Luterbacher	WMO
Valérie	Masson-Delmotte	IPCC WGI
Vaishali	Naik	NOAA Geophysical Fluid Dynamics Laboratory
Anna	Pirani	IPCC
Valentina	Rabanal	YESS
Yuhan (Douglas)	Rao	YESS
Rodrigo	Rudge	YESS
Paolo	Ruti	EUMETSAT
Sabrina	Speich	OOPC
Linda Anne	Stevenson	APN
Oksana	Tarasova	GAW
Yoichi	Toyama	APN
Judit	Ungvari	Future Earth

First Name	Last Name	Function/Affiliation
Panmao	Zhai	IPCC
International Offices		
Beatriz	Balino	Executive Director CliC IPO
Susmitha	Joseph	Officer-in-Charge IMPO
Stefanie	Kremser	Director SPARC IPO
Irene	Lake	Director CORDEX IPO
Jing	Li	Staff Scientist, CLIVAR IPO
Claire	Macintosh	CMIP IPO
Eleanor	O'Rourke	Director CMIP IPO
Jose Luis	Santos Davila	Director CLIVAR IPO
Peter J.	van Oevelen	Director GEWEX IPO
Sabrina	Zechlau	Acting Director SPARC IPO
WCRP Secretariat		
Michael (Mike)	Sparrow	WCRP Secretariat, Head
Beatriz	Balino	WCRP Support Unit, Bjerknes Centre for Climate Research
Nico	Caltabiano	WCRP Secretariat, Science Officer
Wenchao	Cao	WCRP Secretariat, JPO
Valery	Detemmerman	WCRP Secretariat, Consultant
Catherine	Michaut	WCRP Support Unit, IPSL
Hindumathi	Palanisamy	WCRP Secretariat, Science Officer
Narelle	van der Wel	WCRP Secretariat, Science and Communication Officer

Annex 3 – Main Acronyms

AIMES	Analysis, Integration and Modeling of the Earth System Project
APECS	Association of Polar Early Career Scientists
APN	Asia-Pacific Network for Global Change Research
ArcSIX	Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (NASA)
AR6	Sixth Assessment Report (IPCC)
CDR	Carbon Dioxide Removal
CEST	Central European Summer Time
CLASP	Coupling of Land and Atmospheric Subgrid Parameterizations
CliC	Climate and Cryosphere (WCRP)
CLIVAR	Climate and Ocean Variability, Predictability and Change (WCRP)
CMIP	Coupled Model Intercomparison Project
CMIP6	CMIP Phase 6
CMIP7	CMIP Phase 7
COP	Climate Change Conference of the Parties (UN)
COP- <i>n</i>	<i>n</i> th COP
CORDEX	Coordinated Regional Climate Downscaling Experiment
COVID	Coronavirus Disease
CRF	Climate Research Forum (WCRP)
ECR	Early Career Researcher
EPESC	Explaining and Predicting Earth System Change (WCRP)
ESA	European Space Agency
ESMO	Earth System Modelling and Observations (WCRP)
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EXESOC	OSC SOC Executive (WCRP)
GAW	Global Atmosphere Watch (WMO)
GC	Grand Challenge (WCRP)
GCOS	Global Climate Observing System (WMO)
GEP	Global Extremes Platform (WCRP)
GEWEX	Global Energy and Water Exchanges (WCRP)
GOOS	Global Ocean Observing System (IOC-UNESCO)
GPEX	Global Precipitation Experiment (WCRP)
GSOP	Global Synthesis and Observations Panel (CLIVAR)
IGAC	International Global Atmospheric Chemistry
IG ³ IS	Integrated Global Greenhouse Gas Information System (WMO)
iLEAPS	Integrated Land Ecosystem-Atmosphere Processes Study (Future Earth)

IMBeR	Integrated Marine Biosphere Research (Future Earth)
INARCH	International Network for Alpine Research Catchment Hydrology (GEWEX)
IOC-UNESCO	Intergovernmental Oceanographic Commission of UNESCO
IPCC	Intergovernmental Panel on Climate Change
IPO	International Project Office
ISC	International Science Council
JCRF	Joint Climate Research Fund (WCRP)
JSC	Joint Scientific Committee (WCRP)
JSC- <i>n</i>	<i>n</i> th Session of the JSC
LESFMIP	Large Ensemble Single Forcing Model Intercomparison Project
LHA	Lighthouse Activity
LIAISE	Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment
LLHI	Low Likelihood, High-Impact
MIP	Model Intercomparison Project
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NUIST	Nanjing University of Information Science and Technology
OMDP	Ocean Model Development Panel (CLIVAR)
OOPC	Ocean Observations Physics and Climate
OSC	Open Science Conference
PAGES	Past Global Changes
PEOPLE	Public Engagement for Practitioners, Learners, and Educators (WWRP)
RHPs	Regional Hydroclimate Projects
RIfS	Regional Information for Society (WCRP)
S2S	Subseasonal to Seasonal Prediction Project (WCRP, WWRP)
SCAR	Scientific Committee on Antarctic Research
SCOR	Scientific Committee on Oceanic Research
SOC	WCRP OSC Science Organizing Committee (WCRP)
SOLAS	Surface Ocean - Lower Atmosphere Study
SPARC	Stratosphere-troposphere Processes And their Role in Climate (WCRP)
SRM	Solar Radiation Modification
SSG	Scientific Steering Group (WCRP)
TIRA	Task Team for the Intercomparison of Re-Analysis
TSU	Technical Support Unit (IPCC)
UCAR	University Corporation for Atmospheric Research
UN	United Nations

UNESCO	United Nations Educational, Scientific, and Cultural Organization (UN)
UNFCCC	United Nations Framework Convention on Climate Change (UN)
USGCRP	U.S. Global Change Research Program
WCRP	World Climate Research Programme
WGCM	Working Group on Coupled Modeling (WCRP)
WGSIP	Working Group on Subseasonal to Interdecadal Prediction (WCRP)
WMO	World Meteorological Organization
WWRP	World Weather Research Programme
YESS	Young Earth System Scientists Community

**The
World Climate
Research Programme
(WCRP)**

*facilitates analysis and
prediction of Earth system change
for use in a range of practical
applications of direct relevance,
benefit and value to society.*

