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Participants of the 40th Session of the World Climate Research Programme (WCRP) Joint Scientific Committee (JSC), Geneva, Switzerland. See Annex 1 for an annotated version.


WCRP
World Climate Research Programme

Contents

1. Introduction

The 40th Session of the World Climate Research Programme (WCRP) Joint Scientific Committee (JSC-40) was held from 6-10 May 2019 at WMO Headquarters in Geneva, Switzerland. There were over 80 attendees, which included the WCRP Joint Scientific Committee (JSC), the chairs and leaders of WCRP Core Projects and activities, international project office Directors and staff, WCRP Joint Planning Staff (JPS), WCRP sponsor representatives and selected partners and guests. Some attendees joined remotely.

One of the main tasks of JSC-40 was to seek community input into the implementation of the WCRP Strategic Plan 2019-2028 (WCRP Publication: 1/2019). A workshop to begin this process was held for two days immediately prior to JSC-40. The primary findings of the workshop are synthesized in the Implementation and Transition Meeting Report (WCRP Publication 8/2019), a summary of which is provided in Section 3.1 below.

2. Meeting overview

The official opening of JSC-40 was on 6 May 2019 at 10:00. There was a welcome by Detlef Stammer (JSC Chair), and by representatives of the WCRP Co-sponsors, Elena Manaenkova (Deputy Secretary-General, World Meteorological Organization, WMO), Vladimir Ryabinin (Executive Secretary, Intergovernmental Oceanographic Commission of UNESCO, IOC-UNESCO) (remotely), and Mathieu Denis (Science Director, International Science Council, ISC).

Elena Manaenkova highlighted the growing interest and expectation for more frequent assessments of the state of science (for example, to complement the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports in a 5- to 7-year cycle) to inform climate policy and noted that the WCRP community plays an important role in this. Vladimir Ryabinin stressed IOC's continued interest in sponsoring WCRP, noting especially the need for ocean science input into the upcoming UN Decade of Ocean Science for Sustainable Development (2021-2030). IOC called for an active role of WCRP in developing a decadal science plan within this framework. Mathieu Denis (ISC) emphasized that fundamental science is done in all disciplines, but ISC also strongly encouraged engagement with stakeholders and they offer help in connecting with communities. They, too, value the core mandate for basic research within WCRP.

The five days of JSC-40 included two days of consultation and discussion with the WCRP community (Councils, Core Projects, Working Groups and Grand Challenges) along with key strategic Partners and the three WCRP Sponsors on the *implementation* of the WCRP Strategic Plan 2019-2028 and on strategic issues. The latter included, for instance, how to sustain the important WCRP Coupled Model Intercomparison project (CMIP) into the future; WCRP regional activities; the future of the CCl/WCRP/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI); and the topics of machine learning and data mining. This was followed by two days of updates from WCRP Councils, Working Groups, Core Projects and activities and briefings from a number of WCRP's key partners. On Wednesday 8 May, there was also a WMO Public Science Lecture, co-organized by WCRP, which featured a lecture by Professor Thomas Stocker on "The Climate of Tomorrow: Building the Knowledge for Earth Stewardship." The final day of the Session was an internal JSC business meeting, which included the election of new JSC Officers. The full Session Agenda is available in Annex 2.

3. WCRP Strategic and Implementation plans

Detlef Stammer gave a brief overview of the WCRP Strategic Plan 2019-2028. The Plan takes into account the outcomes and recommendations of the WCRP Review (finalized in June 2018). It highlights the importance of fundamental science, a seamless approach (time, space, Earth system models, Research-Operations) and links to services and policy. The Plan includes four Scientific Objectives (Figure 1). At the time of the JSC40 session, the Plan still required formal endorsements by the three WCRP sponsors.

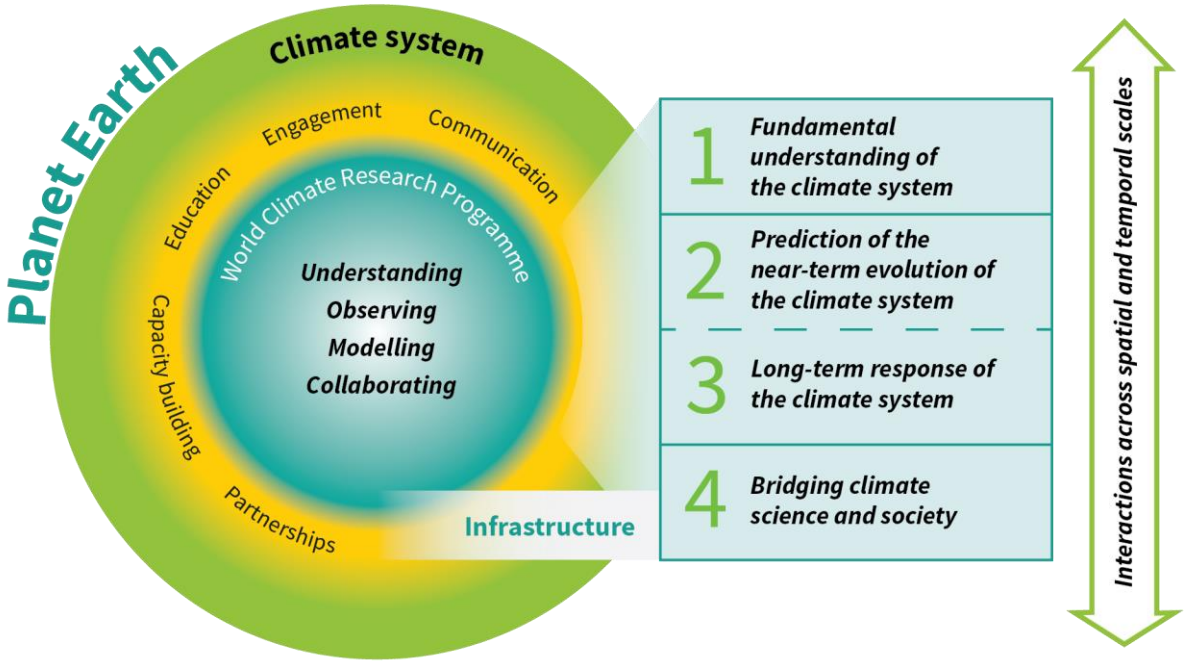

Figure 1: The four Scientific Objectives of the WCRP Strategic Plan 2019-2028 rely on the WCRP community working together to facilitate collaboration and advance understanding, observations, and modeling. WCRP research spans a range of spatial and temporal scales and depends on robust infrastructure to deliver its outcomes. WCRP connects with the wider science community and with a range of stakeholders through partnerships, capacity building, education, engagement, and communication.

3.1. Summary of the WCRP Implementation and Transition Meeting

The implementation of the Strategic Plan is the next task for WCRP. Development of a WCRP Implementation Plan process began at a two-day WCRP Implementation and Transition Meeting held immediately prior to JSC-40. Discussions also continued for the first two days of JSC-40.

The WCRP Implementation and Transition Meeting was the first meeting of the community to discuss how to implement the WCRP Strategic Plan. Participants from across the WCRP community worked together to determine an initial draft “Conceptual Framework” to deliver the new WCRP, a provisional timeline, an outline for the plans, and a series of discussion points.

Detlef Stammer and Helen Cleugh (JSC Vice-chair) summarized the outcomes of the Implementation and Transition Meeting. Detlef Stammer discussed how the Implementation Plan sets the Strategic Plan in motion and that it should naturally follow the logic of the

Strategic Plan. The WCRP Review highlighted the excellent science that WCRP is known for, but it also noted that the structure currently in place isn't ideal to address current and future WCRP priorities. Developing a new way of working must be transparent to the WCRP community and, indeed, must be developed in a "bottom-up" way by that community. The importance of consulting with the scientific community, funding agencies, academies, sponsors and other stakeholders as an integral part of the implementation of the WCRP Strategy was emphasized throughout the week.

Progress made during the Implementation and Transition Meeting included:

1. A draft initial Conceptual Framework for implementing the WCRP Strategic Plan
2. Initial draft of key science research areas (questions)
3. Key activities, approaches and modalities to address the scientific objectives of the WCRP Strategy
4. A number of core principles that underpin, and guide, implementation of the WCRP Strategy
5. A draft timeline for the implementation of the WCRP Strategy
6. A draft structure for the Implementation Plan

Helen Cleugh highlighted the need for an intrinsically integrated approach across WCRP. WCRP is tackling problems that require a global effort, bearing in mind that many of the questions are regional. She stepped the attendees of JSC-40 through the draft Conceptual Framework put together during the Implementation and Transition Meeting. The JSC members felt that the Conceptual Framework followed the logic of the Strategic Plan.

Helen Cleugh went on to emphasize the need to define research projects that connect people, models, and infrastructures, with an integrated focus to address critical questions. She spoke to the need to identify joint activities with partners that are project-oriented, as well as the more traditional approach of workshops and governance. The need for the WCRP to be more agile and nimble, so that it can respond to contemporary priorities, was also emphasized. The WCRP also has important roles of coordination and standard-setting, capacity building (early career researchers, developing world, etc.), and education. Discovery and innovation was identified as an important element that needed to be included in the draft Conceptual Framework.

A detailed outline of the summary presented can be found in the Implementation and Transition Meeting Report. Another important source of input to the discussions were the responses to Implementation and Transition Meeting Preparatory Questionnaire.

The charge to the larger JSC group was to review, revise and refine the outcomes from the weekend meeting, through a series of breakout groups focused on particular topics and ending with plenary discussions. Four parallel breakout groups were formed, each of which discussed the same topics in parallel. The topics were:

1. Priority research questions
2. Draft WCRP Conceptual Framework
3. (a) Infrastructure needs
   (b) Implementation Plan draft structure and timeline
4. Transition process

Each of these topics is expanded on below.

3.2. Meeting outcomes

3.2.1. Priority research questions

Meeting participants reviewed, discussed and refined the priority science questions and areas drafted during the Implementation and Transition Meeting to see if they resonated with the group, and aligned with the WCRP core mission and attributes. Breakout groups were asked to consider whether they could be aggregated into a smaller, sharper set of questions.

The 11 suggested questions were well received, with useful suggestions for additions or regrouping. Especially, the breakout groups proposed different approaches for grouping the science questions into higher-level themes, for example according to societally relevant topics (such as, extremes, mitigation, the food/water/energy nexus, and others) or by the primary end user of outcomes (such as, academies, the climate services community, or the mitigation and adaptation communities). The final list will ultimately need to ensure that the WCRP Strategic Plan portfolio of broad priorities is well covered.

3.2.2. Draft WCRP Conceptual Framework

Meeting participants also reviewed, discussed and refined the draft WCRP Conceptual Framework developed during the Implementation and Transition Meeting. They were asked to determine the clarity and logic of the wording, the functionality of the boxes (what activities, structure, people) and to consider how to bring in a regional focus (in a global context).

The proposed Conceptual Framework was very well received, with several suggested edits, such as stronger integration of partners and stakeholders; higher interactions with and between the elements of "Partnerships", "Critical Infrastructure", and "Integration"; stronger highlighting of fundamental research aspects; and recognition of existing groups already coordinating major activities in relevant areas.

3.2.3. Infrastructure needs

Meeting participants reviewed, discussed and refined the infrastructure needed for the next decade to deliver the WCRP Strategic Plan. This included the identification of critical infrastructure requirements and the process for infrastructure project development (project lifecycle).

Participants pointed strongly to community building as one crucial area of emphasis, including engagement of early career researchers and capacity building. Likewise, the important role of the WCRP International Project Offices (IPOs), both now and in the future, was mentioned. The availability of data and sustained observations, as well as leveraging the latest computing power, big data and machine learning algorithms was underlined. On the question of WCRP project life cycles, participants highlighted the need for both review criteria and an entity (e.g., the JSC) assessing progress and corresponding deliverables on those criteria. Some groups mentioned the potential need for different criteria for fast-track and longer-term projects, as well as the potential role model of the GEWEX Regional Hydroclimate Projects.

3.2.4. Implementation Plan structure and timeline

Meeting participants reviewed, discussed and refined the draft structure of the WCRP Implementation Plan, and especially considered missing elements and the proposed implementation timeline.

Participants advocated for capacity building to be included in the draft, both under "Partnerships" and "Measures of Success". They also highlighted that some agility is likely needed for short-term projects, e.g., through special JSC mechanisms or other.

3.2.5. Transition process

Meeting participants considered the transition process, from the current to a new WCRP. This included a discussion on how WCRP manages its business during the transition period, including the possibility to perform “Fast Track” initiatives, the feasibility of WCRP groups producing syntheses of their work and key tasks, as well as other activities and communications needed during this time.

Discussions emphasized both the relevance and importance of communication and consultation, both internally and with partners and stakeholders. Meeting participants also pointed out that the transition plan should be seen as part of the Implementation Plan and needed to clearly formulate goals and timelines (including key milestones). Importantly, the development of both should be inclusive and allow for co-design with partners.

3.3. Summary and actions

Helen Cleugh summarized the outcomes of the discussion on implementation of the WCRP Strategic Plan, in which meeting participants:

- Discussed key science questions and the process to consult with, and get input from, the broader WCRP community
- Tested the logic and utility of the draft WCRP Conceptual Framework
- Identified the critical infrastructure needs of WCRP
- Considered “how” implementation can proceed, with key activities such as projects
- Considered key principles and activities to guide the transition

During the meeting the draft Conceptual Framework for implementing the WCRP Strategic Plan was updated several times, with the final end-of-meeting version given in Figure 2.

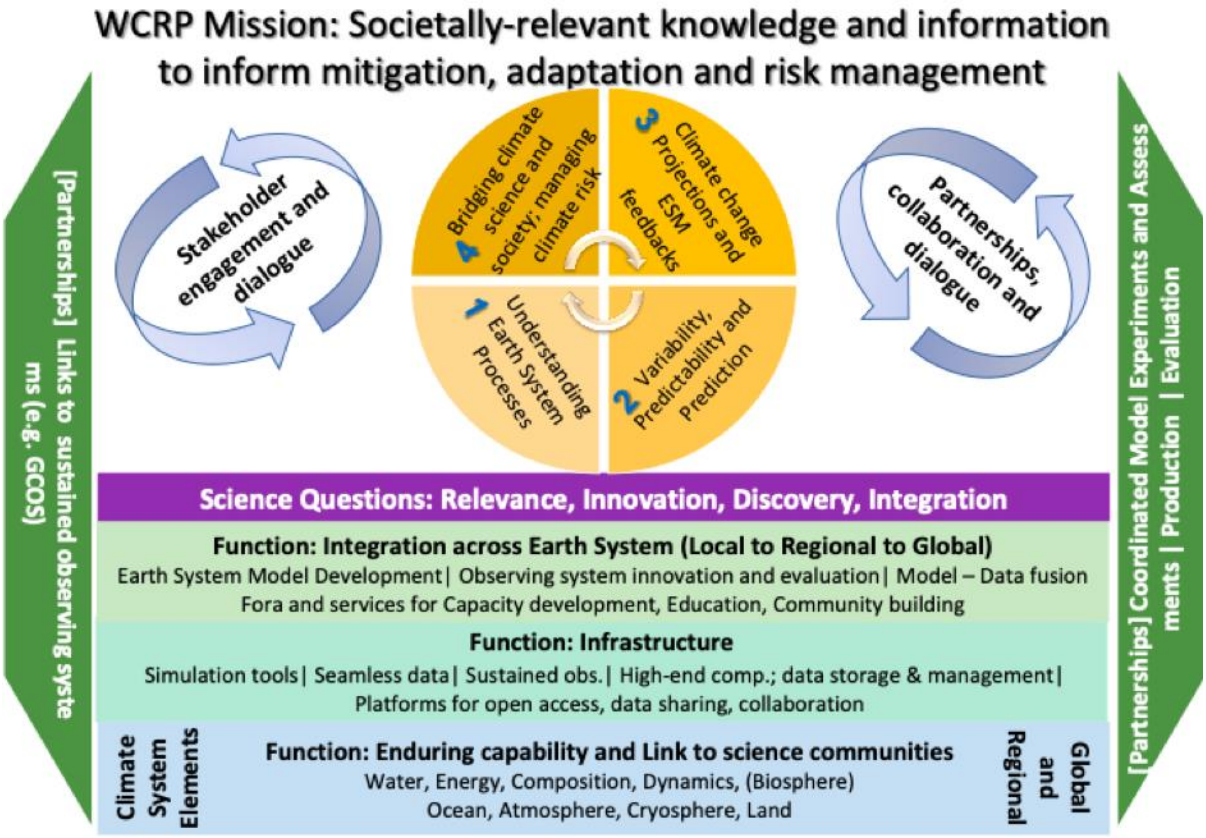

Figure 2: Draft WCRP Conceptual Framework

The key science question areas identified during the Implementation and Transition Meeting were updated at this meeting to:

1. How to improve the modeling of processes, including:
   - Revisiting aggregation and scaling; processes on molecular scale?
   - Process understanding and parameterization
   - Aggregation and scaling - long-term simulations
   - Risk assessment
2. Society's needs for prediction: what needs to be done to improve it?
3. Climate sensitivity: both the fundamental science and communicating the uncertainty
4. Geoengineering: assess impact of any response action; prediction and attribution
5. Prediction, attribution and evolution of extremes
6. Reservoir changes (heat/carbon/water)
7. Regional hotspots (e.g. what happens in high latitudes, Pacific Islands?)
8. Interaction of climate with overall development trends, including urbanization
9. Impact of different forcings (aerosols)
10. Model/data fusion and new/disruptive technology
11. Effect of humans e.g. land use change

It was recognized that these questions need to be further updated and refined via consultation with or via:

- Science Plans of the WCRP Core Projects
- Horizon scanning done by partners (IPCC) and aligned projects/groups (e.g. the Scientific Committee on Antarctic Research (SCAR))

- Other gaps and needs assessments – Academies and others
- Consultation and co-design with partners

It was decided that the timeline for an implementation and transition (updated from that of the Implementation and Transition Meeting) will consist of the following elements:

From now to April 2020 (41st Session of the JSC, JSC-41)
- Consultation with the WCRP community, partner and funding agencies and sponsors
- Refine science questions and conceptual framework
- Refine key elements for delivery and engagement
- Continue to identify science, funding and infrastructure needs
- Produce the first version of the Implementation Plan

Beginning of 2020 (Jan-Feb) – pre JSC-42
- An "elements" Workshop

From now to April 2022 (JSC-43) - 3 years to evolve, specifically:
- Further Consultation with all involved parties
- Development of a structure and governance
- Update or Supplement to the Implementation Plan (draft structure in Annex 3, updated from the Implementation and Transition Meeting)
- Consider the future key roles of the Core Projects and Project Offices
- Initiation of new, joint activities
- Nurture and leverage partnerships for mutually beneficial outcomes

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In order to move ahead, we need to ensure:

1. Consultation with the broader WCRP community, sponsors, partners, funders (the WCRP Climate Science Week at the fall 2019 AGU meeting is one important opportunity for this).
2. Identification of key partners and stakeholders, such as climate services, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (biodiversity and ecosystems), and others.
3. Movement from a general timeline to a specific schedule of milestones.
4. Design and development of an internal structure.
5. Design of effective governance (with a focus on internal governance).
6. Resources, budgets, and finance management are included.

The following key tasks/actions were identified:

ACTION Items:

1. Update Gantt chart (timeline) to reflect the agreed timeline for production of the Implementation Plan, including the consultation process (Narelle, Mike; June 2019)
2. Determine Task Teams to take forward implementation activities, including on:
   a. WCRP structures, needs, gaps and coordination, including:
      - Model development and infrastructure
      - Seamless data, data management
      - Regional activities

      (Task Team, report February 2020; Regional activities by December 2019)
   b. WCRP Implementation engagement and consultation process (Task Team; report February 2020). Task Team to co-design a "landscape" map and schematic with Future Earth (Task Team; April 2020).
   c. Task Team to develop a process for exploring and exploiting shared opportunities with partners, esp. Belmont Forum, Future Earth, GCOS, WWRP (Task Team; Feb 2020)
3. Conduct an inventory, provide a nomenclature, and suggestions for streamlining and clarifying definitions for WCRP activities (JPS; April 2020).
4. WCRP activities (CPs, GCs, WGs) to map to the draft Conceptual Framework – following the approach taken by S2S (WCRP activities, led by JPS; December 2019)
5. WCRP Core Projects to consider the utility (or not) of a Synthesis (an overview of their key achievements, possibly in a form that could be published) and associated timing (CPs; April 2020)
6. By AGU 2019 Fall Meeting ensure that the key elements of the Implementation Plan are ready in a format useful for discussion and input (Detlef, Helen, Mike, Mich, Narelle; November 2019)
7. By April 2020 have a draft of the first elements of the Implementation Plan, including:
   a. Refined science questions and conceptual framework
   b. Refined key elements for delivery and engagement (e.g. inclusion of capacity building)
   c. Science, funding and infrastructure needs

   (Detlef, Helen, Mike, Narelle; April 2020)
8. By April 2022 (JSC-43) have a drafted second set of elements of the Implementation Plan, including consultation and the development of a new structure and governance (Detlef, Helen, Mike, Narelle; April 2022)
9. In parallel to the development of the Implementation Plan, by November 2019, summarize the transition process discussions to date as well as ensuring additional refinement (including consultation as needed), which should include:
   a. How we manage our business during this transition time
   b. The process to initiate and deliver "Fast Track Initiatives"
   c. The feasibility of the idea of syntheses of our core activities and the best timing for this
   d. An outline of the key tasks, activities and communications during this time, and who has responsibility for these.

   (Detlef, Helen, Mike, Narelle; November 2019)

4. Strategic discussions

Strategic discussions included:

- The future of the Coupled Model Intercomparison Project (CMIP)
- WCRP regional activities, including the WCRP Coordination Office for Regional Activities (CORA) and the Working Group on Regional Climate (WGRC)
- Next steps after the Expert Team on Climate Change Detection and Indices (ETCCDI)
- The emerging topics of machine learning and big data mining

4.1. The future of the Coupled Model Intercomparison Project (CMIP)

Cath Senior (Working Group on Coupled Modelling (WGCM) Co-chair) introduced the current status of CMIP, future plans and current resourcing issues in the context of an ever-increasing expectation on delivery. She stressed that the CMIP and the CMIP Panel is well situated within the WCRP structure at the moment. CMIP produces some of the most visible and influential outcomes of WCRP and leverages a huge investment by many countries. Future plans must maintain (ideally improve) the visibility and effectiveness of CMIP within the WGCM of WCRP. WGCM has played a crucial role in both fundamental model development and coordinated intercomparison projects, providing high-profile input to climate assessments and policy development. These activities should remain core features of the new WCRP Strategic Plan, the Implementation Plan, and any revision to the WCRP structure.

The essential infrastructure for CMIP is currently delivered by the volunteer efforts of WGCM members, the CMIP Panel, and individual scientists. This infrastructure includes:

- 'Forcing data' for climate model simulations
- Development of data formats and standards
- Documentation and software to contribute model output to the Earth System Grid Federation (ESGF) and allow users from around the world to access this massive multi-model dataset.

WGCM is asking WMO for financial and project support for CMIP infrastructure and to put (at least) parts of CMIP on a more "operational" footing.

It is clear that the infrastructure supporting CMIP needs to be sustained to ensure its ongoing success. In doing so, we must not undermine the role of the modelling centers who fund and deliver all of the data for CMIP – there would be no CMIP without them. The infrastructure includes hardware, software, data, models, verification, people, etc. This also requires continued engagement of new countries building model capability, engaging scientists and their governments, and a careful sensitive approach that does not 'take control' of nationally funded efforts or force an 'operational standard'. The goal must be to improve the efficiency of the essential multi-model datasets.

The ensuing discussion noted the need for caution in using the terminology 'operational', as WCRP remains a research program, yet could benefit from a stronger research-operational approach. CMIP is a flagship project of WCRP, which requires strong model development — the research element of CMIP. CMIP has produced climate scenarios, on which IPCC and UNFCCC, as well as several national climate assessments, now rely. There is hence a corporate responsibility in supporting CMIP to fulfill the international agenda. IPCC deadlines

are putting a lot of pressure on the research community, with little time for proper Q&A, and increased risk on the delivery side. No one else is currently delivering climate scenarios, which in CMIP are mainly developed on research grants. Yet National Adaptation Plans are being developed on those outputs.

The role of WCRP in supporting policy and services needs to be properly acknowledged. A respective proposed WMO resolution tabled at the 18th session of the World Meteorological Congress recommends a mechanism (i.e., a Task Team) to look into a solution by June 2020. Data infrastructure should be a top priority in this context, recognizing the role of modeling centers, adopting a distributed approach, and bringing the code to the data to overcome bandwidth issues. The governance might be adjusted as well, possibly bringing the United Nations Environment Programme (UNEP) onboard.

In terms of resourcing, countries have varied approaches. In some cases, funding is consolidated in a single center, in others it is distributed in various ministries and/or research entities. The separation of DECK, Scenarios and MIP simulations already points to a possible further distinction between 'operational' and 'research' elements of CMIP, which could be further adjusted in future CMIP cycles.

Delays on CMIP delivery can also pose serious challenges for regional downscaling. Reliability and liability need to be considered in this context. CMIP is a huge community effort, and the work of individuals has to be acknowledged as well.

Based on the CMIP request to seek WMO support through Members, the JSC endorsed the process to proceed with the draft WMO Congress Resolution. If approved, WCRP will be part of the proposed Task Team with additional representation from WMO, IPCC, GFCS, UNEP, and others to develop a future solution for CMIP infrastructure support, realizing that CMIP will remain a strong WCRP effort. This mechanism will also recognize the role of WCRP and CMIP to WMO Members during the WMO Congress.

For further information see the JSC-40 CMIP presentation, the Draft Resolution for WMO Congress 18 - WMO scientific and technological support to climate policy and the Draft Information document WMO Congress 18 on CMIP.

4.2. WCRP regional activities

Daniela Jacob (Director, Climate Service Center Germany (GERICS), Germany) and Tore Furevik (Director, Bjerknes Centre for Climate Research (BCCR), Norway) informed the JSC about the establishment and progress of the WCRP joint WCRP Coordination Office for Regional Activities (CORA). They recalled the WCRP Review, which stated: "WCRP's approach to regional climate issues and the links to applications require further and careful thought. Although WCRP should continue to focus on the fundamental, underpinning science that increasingly addresses regional and local climate on all timescales, it is essential that it formalizes and improves its links to applications and user needs, which involves more interdisciplinary approaches."

Resulting from a JSC ad hoc team's work summarized in the "Scoping a framework for WCRP regional activities" report (WCRP Publication: 23/2016), GERICS in Hamburg and BCCR in Norway established a joint CORA office, initially for a period of 3 years, from January 2019 to December 2021, with the possibility of extension. Funding of the CORA office is provided by both hosts. The JSC welcomed and expressed appreciation to GERICS and BCCR for prospective and timely engagement and contributions.

The JSC also welcomed the enthusiasm, focus and potential resources that the CORA office and initiative brings to the WCRP's regional science and activities. However, given that many of the WCRP activities have a regional focus, the JSC noted the need to clarify the future role of CORA within WCRP, its detailed activities and how it intersects with other WCRP initiatives – especially WGRC and CORDEX.

Clare Goodess (WGRC Co-chair) reported on the status of the Working Group on Regional Climate (WGRC). She reviewed the current terms of reference, pointing out that the scope and expectations are extensive and complicated, and noted the scarce activities in recent years due to the lack of resources.

While the JSC recalled the repeated discussions on scope and responsibilities of WGRC since its initiation, they considered that past and proposed activities of WGRC (e.g. FOCI) would be valuable within the concept and framework for the new Implementation Plan. The JSC, considering that respective roles or implementing modalities of a group would be shaped in line with the new Implementation Plan deliberation, advised that WGRC participate in the consultation on integrative regional activities.

For further information see the WCRP Working Group on Regional Climate (WGRC): Input to Implementation and Transition Meeting and the JSC-40 CORA presentation.

ACTION Item:

10. CORA with WGRC, CORDEX and ETCCDI to form a task team to co-develop a concrete plan of work for the next two years in support of WCRP regional activities and to report this back to the JSC by September 2019. Core-projects should be consulted and engaged in this planning process.

4.3. Next steps after the Expert Team on Climate Change Detection and Indices (ETCCDI)

Lisa Alexander (JSC, Leader of The Grand Challenge on Weather and Extremes - GC Extremes) presented a verbal report describing the status of ETCCDI and its sponsorship. She noted that WCRP remains the only sponsor left. At the JSC session in 2018 (Nanjing), GC Extremes informed the JSC of the discontinuation of the joint CCl/WCRP/JCOMM ETCCDI, which could dissolve so-far-successful research activities on extreme data, analyses, development of indices and relevant attribution studies. Lisa Alexander and GC Extremes leaders proposed a light-weight core-project-type activity on extremes (tentatively called the Global weather and climate Extremes Project: GEP) to offer a central hub to coordinate and integrate across all extreme-related activities toward and within the new WCRP. It would also provide internal science capability in formulating the WCRP position on extreme-relevant and policy-relevant issues such as attribution and prediction/projection of weather and climate extremes. There was some early indication of volunteer support to provide coordinating facilities, for consideration of the JSC.

The Grand Challenge on Weather and Extremes (GC Extremes) has presented continuous success in advancing scientific understanding, for example, leading the IPCC Sixth Assessment Report (AR6) chapter on weather and climate extremes. Lisa Alexander (JSC, Leader GC Extremes) pointed out that there are remaining questions to pursue and a need to provide guidance for applications and services (e.g. guidance documents on the use of extreme datasets and on future projections of extremes). Lisa stressed that interaction with

other WCRP groups needs to be well organized to ensure cross-fertilization and coordinated approaches.

ACTION Item:

11. GC Extremes and ETCCDI leaders to submit a proposal to JSC and inform on the further development of community support for coordination (GC Extremes, ETCCDI; April 2020)

4.4. Fast-emerging topics: machine learning and data mining

Pavel Kabat (WMO Chief Scientist and Director Research) in his capacity as head of the WCRP JPS made a presentation on machine learning algorithms as a fast emerging topic, which may reduce the huge computational burden in climate modeling by constructing implicit (learned) representations rather than explicit, parameter-rich representations. He asked whether WCRP is ahead of the science in this field. The JSC attendants' replies mainly took one of two different stances: some attendees, such as Martin Visbeck (JSC), noted that their groups were already launching and conducting studies jointly with experts on (deep) learning and that in their view this was already ongoing in many other institutes. Other panel or working group representatives confirmed that their activities already engage with the topics. Generally, attendees agreed with the relevance of this topic, while perhaps holding varied views on how to proceed in addressing it within WCRP.

5. WCRP activity reports

The following section includes a summary of WCRP projects/groups presentations during JSC-40 proceedings. Reports/presentations from all groups are available on the JSC-40 webpage: www.wcrp-climate.org/jsc40-documents. Each core-activity was asked ahead of the meeting to report on progress but also on the relevance of their planned work to the new WCRP strategy. Presentations were submitted ahead of time but had the opportunity to be adjusted so as to reflect the discussion on the future WCRP implementation.

5.1. Climate and Cryosphere (CliC)

Including the WCRP GC on Melting Ice and Global Consequences (GC Melting Ice)

James Renwick (CliC Co-chair) highlighted the number of workshops, meetings and activities that CliC and the GC Melting Ice had been involved in over the last year (17 workshops, 5 conferences and over 80 GoTo online project meetings).

The GC Melting Ice is structured around three themes:

1. The shrinking of mountain glaciers and large ice sheets with consequent sea-level rise and impacts on water resources;
2. Thawing permafrost and the potential for enhanced natural emissions of carbon dioxide and methane to the atmosphere;
3. Declining coverage of sea ice and snow, which will affect marine and ground transportation across the Arctic.

Progress with the many activities of both CliC and GC Melting Ice were highlighted, including the MIPs and CliC targeted activities and groups. In particular the alignment with the new SCAR Scientific Research Programme "Antarctic Ice Sheet Dynamics and Global Sea Level" was discussed and the new Northern Ocean Region Panel that is joint with CLIVAR.

In term of the links to the WCRP Strategic and Implementation Plans, James Renwick outlined how CliC can deliver on the Scientific Objectives of the Strategic Plan along the themes of “Fundamental understanding” e.g. the understanding of linkages between cryosphere components and between the cryosphere and other climate system components (including the biosphere), “Near-term prediction” e.g. seasonal sea ice, snow cover, glacier mass balance, and similar, “Future evolution (longer term)” e.g. ice sheet behavior and future sea level, including tipping points, and “Bridging climate science and society” e.g. impacts and vulnerability: Glaciers and water availability, ice sheets and sea level rise. James Renwick also commented that the work of CliC links to regional policy needs, such as the Arctic Council and Antarctic Treaty requirements.

James Renwick highlighted growing infrastructure issues. The cryosphere community has expanded rapidly, with CliC’s network expanding across all cryosphere domains and geographically throughout the polar regions and high mountain areas. It is important that CliC continues to partner and work with the wider community, as many complimentary research activities are led from other organizations. CliC will remain focused on leading climate and cryosphere research and also will find synergies with other related programs, both within and outside of WCRP to avoid duplicating effort.

Ken Takahashi (JSC) commented that CliC and GEWEX have been involved in advising on science questions for the WMO High Mountain Summit but noted that more can be done. Pascale Braconnot (JSC) suggested that perhaps there could be closer interactions with the paleoclimate community. James Renwick responded that those connections are there, though of course can be improved.

For further information please see the JSC-40 CliC Presentation.

5.2. Climate and Ocean Variability, Predictability and Change (CLIVAR)

Including the WCRP Grand Challenge on Sea-level Change and Coastal Impacts (GC Sea Level)

Wenju Cai (CLIVAR Co-chair) began by highlighting the progress and achievements of CLIVAR since the last JSC. This included key science papers and input to the design of observing systems, such as the Tropical Atlantic Observing System and Tropical Pacific Observing System 2020 (TPOS2020). CLIVAR also carries out a number of capacity-building activities, including several workshops around the world, for example, ENSO in a Warmer Climate (October 2018, Guayaquil, Ecuador). CLIVAR has a number of upcoming events, including regular early career workshops over the next year or so.

Wenju Cai gave some highlights from the new CLIVAR Science Plan and Implementation Strategy with the overarching goal of "building a society resilient to environmental changes". Key emerging issues were highlighted including the need to transition from scientific guidance to advocating for resources to implement global/regional observing systems and the importance of ensuring involvement in the United Nations (UN) Decade of Ocean Science for Sustainable Development by strengthening the cooperation with IOC-UNESCO and other key regional and national partners in support of adaptation strategies and science-informed policy responses to global ocean changes.

Wenju Cai then moved on to discuss the GC on Regional Sea Level and Coastal Impacts. Highlights included a proposed workshop (in November 2019) on "Sea Level Science for Services" (see presentation for details). Details of the future work priorities of the GC were

given, including the need to provide sea level Information that is useful and appropriate for coastal management; downscaling sea level variability and uncertainty from regional to local; sea level rise and changes in extremes; mega city, delta and island states (linking closely with decision makers).

With regards to the links to the WCRP Strategic and Implementation Plans, the GC Sea Level aims for close interaction with relevant coastal stakeholders to make sure that results of the proposed scientific researches are most useful for coastal zone management and impacts and adaptation efforts. It will provide salient and credible information on current and future states of sea level rise across different time and space scales and focuses on both the 'downstream' and 'upstream' sides of climate services.

James (Jim) Hurrell (JSC) recognized risk assessment as a future need and asked if the CP and GC were thinking more on broad needs or specific activities that quantify the risks. Annalisa Bracco (CLIVAR Co-chair) replied that it is both, but that one needs to understand what is going on before one can adapt and mitigate.

For further information please see the JSC-40 CLIVAR Presentation and Report.

5.3. Global Energy and Water Exchanges (GEWEX)

Including the WCRP Grand Challenge on Water for the Food Baskets of the World (GC Water) and the WCRP Grand Challenge on Weather and Climate Extremes (GC Extremes)

The co-chairs of the GEWEX Scientific Steering Group (SSG), Jan Polcher and Graeme Stephens, reported on the progress of GEWEX activities. They emphasized integrative and multi-disciplinary nature of GEWEX's Earth system studies with focus on processes and feedbacks, as well as the coupling between land and atmosphere. The GEWEX Co-chairs called for the JSC attention to the Earth Energy Imbalance (EEI) initiative, which is brought forward as the collective effort of all WCRP Core-projects and related groups, with the objectives to conduct quantitative uncertainty assessment of the energy budget and imbalances. They noted that, as a forward-looking scientific theme, a broader energy balance integrative theme could be implemented through regular update and assessments of water and energy syntheses, including regional assessments.

The JSC noted the ongoing development of the GEWEX strategies that trace specifically to the WCRP strategic plan. The GEWEX co-chairs highlighted that a number of key topics touched on in Section 3.3 of this report are addressed explicitly in the GEWEX strategies, such as climate processes that define climate sensitivity involving water cycle related feedbacks, climate forcing uncertainties, model development and assessment, regional climate impacts (RHPs), among other topics central to the strategic plan.

The GEWEX co-chairs highlighted a strong regional aspect within the scientific focus of GEWEX, noting the coordinating capabilities to implement scientific activities such as process-oriented observations, sharing/exchange of research in all regions, etc. On the related subject, the Water for Food baskets Grand Challenge is well connected to the GEWEX activities, which is built upon the ongoing and planned Regional Hydroclimate Projects (RHPs) around dense agricultural areas; has progressed particularly to deepen its science plans and engaging the relevant communities across the discipline. This GC has reached out to other core projects for expertise on the Earth system.

Note: See also section 4.3. for the summary of the discussion on the WCRP Grand Challenge on Weather and Climate Extremes.

For further information please see the JSC-40 GEWEX Presentation.

5.4. Stratosphere-troposphere Processes And their Role in Climate (SPARC)

The co-chairs of the SPARC Scientific Steering Group (SSG), Neil Harris and Judith Perlwitz, presented on recent progress within the various activities. A focus was placed on the large number of partnerships and collaborations between SPARC activities and on their effort in reaching out to the WCRP community and beyond, leading to many initiatives from within the activities. A notable activity in 2018 was the successful SPARC General Assembly in Kyoto, demonstrating strong community engagement, and the recent and ongoing scientific deliberation on the unexpected increase in emissions of ozone-depleting CFC-11, which SPARC has been co-leading in collaboration with the UNEP Ozone Secretariat, WMO and other partners. A recent symposium (March 2019) in Vienna explored the potential causes of the increased CFC-11 emissions and considered ways to produce a scientific foundation for discussions amongst the Parties of the Montreal Protocol in the coming years.

The SPARC Co-chairs emphasized the need for clarity on WCRP's way forward, as the current discussions on the internal structure of WCRP have had significant impact on the current implementation and future planning for the community's scientific and institutional activities. As was shown in the Core Projects' proposal on integrative projects (see Section 8.3), SPARC and all the core projects, including CORDEX, agreed enthusiastically on constructive collaborations across the whole program and on identifying tangible ways to implement joint and/or integrated activities. The structure of the initially identified projects will be developed, with a proposal presented to the JSC in 2020, taking into account the gaps and priorities identified in major scientific assessments such as IPCC AR6. The regional activities/projects therein will be coordinated and supported by the CORA.

For further information please see the JSC-40 SPARC Presentation.

5.5. Coordinated Regional Climate Downscaling Experiment (CORDEX)

William (Bill) Gutowski (CORDEX Co-chair) presented on behalf of the CORDEX Science Advisory Team (SAT). The core business of CORDEX is focused on the added-value question and there is numerous evidence of successful examples where downscaling proves beneficial. Recent activities include a number of science and training workshops in the regions (Africa, Europe, Asia, South and Central America and North America) to also promote publication data on the ESGF, contributions to IPCC reports and atlases and science papers in peer-reviewed literature. Regional expertise is essential to develop this information.

The CORDEX SAT has developed a white paper to outline future challenges for regional climate downscaling, including convection permitting simulations in collaboration with the CMIP HighResMIP, Earth system modeling and exascale computing, and delivery of regional climate information in collaboration with CORA. Emerging issues include uneven development and resourcing across regions, data dissemination and capacity building.

Future activities include the International Conference on Regional Climate-CORDEX 2019 (ICRC-CORDEX 2019) conference to be held in Beijing, China, 14-18 October 2019.

The progress in CORDEX was acknowledged by JSC members who encourage the CORDEX SAT to coordinate very closely with CMIP and HighResMIP, in particular, as they also provide regional climate information.

For further information please see the JSC-40 CORDEX Presentation.

5.6. WCRP Data Advisory Council (WDAC)

The WCRP presentation was given by Susann Tegtmeier (WDAC co-chair). WDAC serves as a focal point for observations and observational data across the WCRP. Current activities include work on Essential Climate Variables, open data policies, reanalysis, fluxes, adequacy of observing networks, the WCRP-GCOS International Data prize and the Polar Challenge.

WDAC progress and achievements included that obs4MIPs has already published over 80 data sets on the Earth Syste Grid Federation (ESGF) in CMIP compliant format, with many additional data in the pipeline and a possible expansion into non-gridded and in-situ data sets as well in the future. In addition, the Surface Flux Task Team has developed a white paper, which is almost in the final stage to be published as a WCRP report and which includes recommendations on a way ahead to organize surface flux observations and data in the Programme.

The WCRP Task Team for Intercomparison of ReAnalyses (TIRA) supported the organization of a major International Reanalysis Conference in Rome in 2017 and proposes a more coordinated effort 'ESRIE' around the Earth System Reanalysis Intercomparison Effort within WCRP.

WDAC made recommendations to the JSC about future plans for observations and data coordination in WCRP, all of which are cross-cutting. There are needs:

- To fill gaps on observations for process understanding, sustained reference data sets and data sets inventory
- For data reanalysis and assimilation, possibly coordinated with WWRP/DAOS/PDEF
- For data science/management: the new topic of data science/mining and a need for knowledge transfer

WDAC also noted the emerging challenges around fluxes which touch upon all observations, data and modeling and will become increasingly important in an Earth system approach, requiring also solid partnerships beyond WCRP (e.g. SOLAS).

The need to maintain and revive a solid cooperation and close interactions between WCRP/WDAC and GCOS was highlighted, to assess the maturity of new observations, also for mitigation and adaptation. Reanalysis will become increasingly important also in the Earth system context, requiring bio-geochemistry/carbon/atmospheric composition elements to support WCRP research. Guidance is required by users on how to use the various data available.

WDAC called on the JSC to advise on how to best coordinate observations and data issues across the Programme.

For further information see the JSC-40 WDAC Presentation. Note also the WCRP Surface Flux White Paper and the proposed organizational structure for a WCRP intercomparison project for reanalyses (Task Team for Intercomparison of Reanalyses, TIRA).

ACTION Item:

12. JSC to advise on future WCRP structure and where observations/data coordination would sit, including the WDAC elements on observations/reanalysis/fluxes/data science; and concretely also on the WCRP Task Team for Intercomparison of Reanalyses (TIRA) proposal (JSC; April 2020).

5.7. WCRP Modelling Advisory Council (WMAC)

The WMAC update was presented by Francisco Doblas Reyes (WMAC Co-chair). Recent activities of WMAC include the CMIP6 Model Analysis workshop held in Barcelona (25-28 March 2019), the 2nd WCRP Summer School on Climate Model Development held at Centro de Previsão de Tempo e Estudos Climáticos (CPTEC), Brazil (22-31 January 2018), the Pan-WCRP Modeling Group Meeting held at the UK Met Office in Exeter (9‑ 13 October 2017) and the regular WCRP/WWRP International Prizes on Model Development. A third modeling summer school is currently planned for 2020.

WMAC made the following observations and recommendations on modeling activities in the context of the WCRP Implementation Plan:

- Manage change carefully and gradually
- Do not harm it when it works
- Changes need to be justified and require engagement
- It is a timely opportunity to adjust WCRP's structure
- Further integrate activities within and outside WCRP (e.g. with the World Weather Research Programme (WWRP), Global Atmospheric Watch (GAW))
- Model coordination role could fall under a subset of JSC members
- Maintain a modeling coordination mechanism in any future WCRP structure

The future structure could form an Earth system model development working group with atmosphere, ocean, land surface, sea and land ice, chemistry, aerosols, biogeochemistry (AIMES), etc. with proper internal 2-way communications to leverage fundamental ‘process’ and/or ‘disciplinary’ work (e.g. from core projects). Initialized simulations present an opportunity to consolidate existing efforts on climate prediction across time scales (i.e. S2S, WGSIP and DCPP), also possibly in closer connection to Numerical Weather Prediction/WWRP towards more ‘seamlessness’. The need to acknowledge respective roles and contributions of operational and research centers, as well as academia, in this landscape was noted.

With regards to WGCM, there is an opportunity to evolve into a “Working Group on Climate Change (WGCC)" with a focus on longer term, uninitialized, historical and future climate change simulations and scenarios and support to assessments with an interface with Integrated Assessment Modeling because of the growing importance of societal dimension.

The existence of a sustainability/resourcing and ‘operationalization’ of (parts) of CMIP was stressed. However, CMIP, as an established, and high priority WCRP activity needs to remain deeply rooted in modeling centers and requires also a close coordination with corresponding regional modeling.

It was commented that model development activities in WCRP need to connect to observations as well and are to be distinct from activities around the use of models, which could all benefit from a common infrastructure for model intercomparison efforts.

For further information see the JSC-40 WMAC Presentation.

ACTION Item:

13. JSC to advise on future of WMAC and where coordination of modeling activities should be located (JSC; April 2020).

5.8. Working Group on Coupled Modelling (WGCM)

Including the WCRP Grand Challenge on Clouds, Circulation and Climate Sensitivity (GC Clouds) and the WCRP Grand Challenge on Carbon Feedbacks in the Climate System (GC Carbon)

The WGCM update was presented by Cath Senior (WGCM Co-chair) remotely. WGCM coordinates CMIP which is organized and coordinated by a dedicated CMIP panel (chaired by Veronika Eyring). Models from 42 worldwide institutions are participating in 23 CMIP6-endorsed MIPs. Model simulations for CMIP6 are now progressing with rapid activity over the next few months as the AR6 timelines approach. Model outputs are now being served by ESGF from 14 institutions (19 models) and more will be made available over the coming months.

The CMIP6 Analysis Workshop held in Barcelona (24-28 March 2019), was attended by 249 participants from 26 countries, amongst which 40 percent were early career scientists and which included representatives from over 20 CMIP6-Endorsed Model Intercomparison Projects (MIPs) and 25 modelling groups. Routine evaluation in CMIP6 is building on new simulations, well established analysis practices and sharing of diagnostic code. Modelling centres will continue to run CMIP6 experiments into 2020 and MIP analysis will continue over many years. Many papers will be aimed at AR6. The distributed CMIP organization is proving successful with separation of development and delivery timescales. There are enough experiments and research questions in CMIP6 to fuel research over the next phase where discussions will engage all modeling centers.

Workshop attendees commented that the CMIP workshop was highly successful. New results on Equilibrium Climate Sensitivity (ECS) suggest a need to further increase research efforts on cloud feedback processes, aerosols, and microphysics. Not all models in the high sensitivity space reach the same conclusions. In terms of CMIP implementation, linkages with WGNE, CORDEX and HighResMIP need to be strengthened. WGCM ensures that CMIP is well connected to modeling centers and does valuable work on process understanding and, in particular, on climate sensitivity.

Progress and achievements for the GC on Clouds, Circulation and Climate Sensitivity was discussed. A workshop on storm tracks, monsoons and tropical rainbelts was held in 2018. Two assessments are currently underway, resp. on “Climate Sensitivity: synthesis across multiple lines of evidence; robust 5-95% ranges” and “Aerosol Radiative forcing: synthesizes lines of evidence for weak/strong forcing", both aiming to deliver review papers for AR6. Future activities include the “ICTP summer school: Convection organization and climate sensitivity (July 2019)” and the “EUREC4A field experiment (2020) and grey-zone project”.

GC Carbon, which focuses on the Carbon cycle feedback and predictability, also made progress, with workshops held in Bern in April 2018, in Boulder in October 2018 and Barcelona in March 2019. A new EU project “CCICC” coordinated by P. Friedlingstein (JSC, Co-chair GC Carbon) is aligned with this Grand Challenge and will focus on the contemporary carbon cycle, predicting of the carbon cycle and climate for the Global Stocktake and projections on required mitigation efforts.

WGCM and CMIP produce some of the most visible and influential outcomes of WCRP and leverage a huge investment by many countries. WGCM has played a crucial role in both fundamental model development and coordinated intercomparison projects, providing high-profile input to climate assessments and policy development. These activities should remain core features of the WCRP Strategic Plan, Implementation Plan, and any revision to the WCRP structure.

For further information see the JSC-40 WGCM presentation.
See also Section 4.1 for the discussion on the future of CMIP.

5.9. Working Group on Numerical Experimentation (WGNE)

Keith Williams (WGNE Co-chair) presented the update for WGNE. WGNE's role is to foster the development of atmospheric circulation models for use in weather prediction and climate studies on all time scales, and to diagnose and resolve shortcomings. These objectives are achieved through:

- Identifying systematic errors common to many models
- Sharing diagnostic tools and techniques to get to the root of the error
- Sharing knowledge around sensitivity of errors to model formulation (parameterizations, dynamical core, etc.)
- Working with other groups (e.g. GASS & GLASS) to develop solutions

Recent activities include work on the Madden-Julian Oscillation (MJO), dynamical cores and exascale computing, routine model verification, table of supercomputing development, metrics, drag/momentum and aerosol research and systematic errors.

The 5th Systematic Error workshop held in Montreal in 2017 made a number of recommendations, now published in a Bulletin of the American Meteorological Society (BAMS) paper, and was followed by a survey of the community to distill the future priorities for WGNE in developing research on convection, fluxes, uncertainty in models, and an extension of the drag and aerosol projects.

In the context of the new WCRP Strategic Plan and its implementation, WGNE needs to now encompass a broader Earth system approach to model development to tackle some of the long-standing issues in climate models.

It was commented that model development in WGNE is currently mainly concentrated on atmospheric models. Moving into a broader Earth system approach will require a balance across different disciplines but also dedicated modeling research on fluxes, aerosols and carbon, in particular. An expanded WGNE would coordinate those efforts and leverage model development in the various disciplinary areas which are also to be maintained.

For further information see the JSC-40 WGNE presentation. See also the WGNE Systematic Error Survey Results and the WGNE position paper on WCRP-CAS reform.

ACTION Item:

14. JSC to note the proposal from WGNE to evolve into an interdisciplinary model development group (JSC; April 2020).

5.10. Working Group on Subseasonal to Interdecadal Prediction (WGSIP)

Including the Decadal Climate Prediction Project (DCPP) and the WCRP Grand Challenge on Near-team Climate Prediction (GC NTCP)

The presentations on WGSIP, DCPP and GC NTCP were given remotely by Doug Smith (WGSIP Co-chair) and Adam Scaife GC NTCP Co-Chair). Recent activities and achievements of WGSIP include the International Conferences on Subseasonal to Decadal Prediction held in Boulder, USA (17-21 September 2018), the Climate Historical Forecast Project, progress in understanding teleconnections, shocks and drifts, diagnostics and snow initialization, and research-operations linkages and prediction of extremes statistics in decadal predictions led by the Decadal Prediction Project (DCPP). GC NTCP spearheaded the WMO Lead Center for Annual-to-Decadal Climate Prediction, now issuing pilot annual-to-decadal climate updates, and published also a paper in Nature Climate Change.

WGSIP is now developing a new cycle of candidate projects on unprecedented extremes, Asian monsoons and ocean climate forecasting, as well as engagement in CMIP with sub-annual predictions building on the CMIP6 DCPP, support to TPOS2020, Earth System decadal predictions and contributions to the Global Stocktake, to cite a few and all in line with the WCRP Strategic Plan.

Attendees commented that predictability on decadal time scales is still low, although significantly better in the Atlantic as compared to the Pacific, and that long-term forcing seems to be the dominant factor. The risk assessment framework of S2S could apply on decadal time scales as well. There are pros and cons of different methods for initializing models and this should be further investigated. Achieving consistent energy and water cycles in those models also remains a challenge.

For further information please see the JSC-40 WGSIP presentation. Also see the background paper "Suggestions for potential future directions for the GC NTCP."

ACTION Item:
15. Follow-up on proposed future work areas of GC NTCP (WGSIP, April 2020).

5.11. Subseasonal-to-seasonal (S2S) Prediction Project

Andrew Robertson (S2S Co-chair) presented the update for S2S. The S2S mission is to:

- Improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events
- Promote the initiative's uptake by operational centres and exploitation by the applications community
- Capitalize on the expertise of the weather and climate research communities to address issues of importance to the Global Framework for Climate Services, calibrated forecast products

Research achievements during the first phase of the project include the establishment of the S2S database hosted at ECMWF and mirrored at the China Meteorological Administration

(CMA), progress in MJO predictions and teleconnections, and improved skill from the representation of the stratosphere.

Following a gap analysis, the project has now entered into its 2nd phase, and will focus on S2S database enhancement (ocean variables, more surface variables 4xdaily and additional models), new research foci (sub-projects on MJO prediction and teleconnections; roles of ocean and sea ice, land surface, stratosphere, atmospheric composition and ensemble generation), and enhancing operational infrastructure, user applications and real-time pilot experiments, involving broad collaborations with e.g. WGSIP, SPARC, WGNE, WCRP Grand Challenges and WMO Lead Centers.

Attendees congratulated S2S as an exemplary collaborative science to inspire other WCRP activities and for encouraging and supporting some seamless work across weather and climate research communities. The project incorporates risk assessment thinking and bridges science and society nicely. Forecast probabilities are still hard to interpret for end-users and the real-time pilot experiments in Phase II can address this. Some additional connections with GC Extremes and CLIVAR were suggested. It was commented that the draft Conceptual Framework, developed as part of the WCRP Implementation Plan process, should recognize the leadership role of S2S and other modeling groups in the overarching objectives.

For further information see the JSC-40 S2S presentation.

6. Sponsor reports

The three WCRP Co-sponsors; WMO, IOC-UNESCO and ISC provided updates.

6.1. World Meteorological Organization (WMO)

Pavel Kabat (Chief Scientist and Director of Research, WMO) informed of the emerging priorities in the research-relevant parts of the WMO Strategy and Implementation Plan. These included an integrated and seamless approach across weather, climate, water and environment; as well as pursuing a full chain of science to service delivery. It was also notable that the global agenda have gradually increased the expectation and requirements for input from WMO and its Members (National Meteorological and Hydrological Services), which have been shown in the outcome of the climate negotiations (e.g. Conference of Parties), UN General Assembly and Security Council, and the plan for a UN Climate Action Summit (September 2019).

In line with the ongoing governance reform of WMO, and foreseen changes in the structure, WMO plans to renew its organizations for research; aiming for wider engagement of all stakeholders (public-private-academia) and to closely respond to the needs and requirements of the Members and furthermore of the society. A new Research Board and a Scientific Advisory Panel would be established upon the approval at the WMO Congress (June 2019), where the research communities' leadership are expected to play the key role.

6.2. Intergovernmental Oceanographic Commission (IOC-UNESCO)

Salvatore Arico (Head of the Ocean Science Section, IOC-UNESCO) discussed the implementation of the WCRP Strategic Plan. He stressed that the process should start now, as the transitioning and planning process presents some challenges. He stressed the importance of the consultation process and stated that the new Strategic Plan should be operationalized because there is a strong demand out there on societal needs. From an ocean perspective,

better observations, models, data services, etc. are needed (he referred to OceanObs09 and the upcoming OceanObs19). He noted that the strength of WCRP is with model intercomparison frameworks.

IOC believes in a strong ocean element in the future WCRP, including contributions to the upcoming UN Decade of Ocean Science. In the policy arena there is a certain fatigue in relation to assessments, and the system is showing some limitations. This may result in increasing demand on WCRP and may imply that WCRP should increase its efforts not only in bedrock science but also in stronger societally relevant work. Polar and Artic issues are also a strong IOC interest.

IOC-UNESCO would value regular discuss with the WCRP JSC, in particular with regard on the science plan on UN Ocean Decade.

Detlef Stammer responded to Salvatore's closing remark with a confirmation that the JSC wants to strengthen linkages with the WCRP Sponsors and noted that the JSC will discuss how to do this. Thomas Peter (JSC) was interested in Salvatore's reference to fatigue in the policy realm. Salvatore responded that science has a lot to contribute to policy making and that WCRP should remain a strong science-driven Programme that also tackles societal aspirations. Martin Visbeck (JSC) asked about the WCRP contribution in the context of the UN Ocean Decade for Sustainable Development. Salvatore responded that it is an “UN Ocean Science decade”, and that it will produce a body of knowledge that can inform services and policy on issues such as hazards and biodiversity.

6.3. International Science Council (ISC)

Mathieu Denis (Science Officer, ISC) stated that ISC welcomes the ambition of the WCRP Strategic Plan, with an approach that is more nimble and seamless. He is confident that the Strategic Plan will be approved quickly.

In terms of the WCRP Implementation Plan, Mathieu reflected that there is now a crowded research landscape. In the Implementation Plan there will be an opportunity to work also with other communities and identify synergies, as that was the spirit of both the Strategic and Implementation Plans. To facilitate this, ISC is ready to help in reaching out to its communities. ISC is well equipped to connect also to social sciences groups, such as those working on the ‘Arctic'. ISC can strongly support the building of synergies as well as in making WCRP more visible, as more could be done in this regard.

ISC will work with WCRP in the development of the new governance, including the possible inclusion of more social sciences with whom ISC can facilitate contact for fundraising.
Mathieu applauded the willingness of the JSC to have a more coordinating role of WCRP sponsors and noted that ISC is ready to help. It would be a good idea to convene regular meetings of the WCRP co-sponsors with the JSC and maybe also with other programmes.

In response to the presentation Detlef Stammer strongly supported the need for more regular meetings with the WCRP Co-sponsors. Helen Cleugh echoed Detlef Stammer and encouraged interventions by ISC and IOC, with the goal of working together to achieve the WCRP Strategic Plan goals. Pavel Kabat responded from a WMO perspective, that he recognizes that there may be an impression that parts of the WCRP Strategic Plan are more attractive to specific sponsors. He noted that this is not the case and stated that WMO is committed to the full chain (societal benefits, ocean, etc.). Martin Visbeck noted that as part of the WMO reorganization research will become more prominent and will contribute to the constructive discussions surrounding the IOC-UNESCO Ocean Science Decade. At the same time ISC is developing its

action plan. This makes the timing for the WCRP Implementation Plan very good and allows for an alignment of WCRP's sponsors to fine tune WCRP's governance.

7. Partner reports

A number of WCRP partners were invited to participate on Wednesday 8 and Thursday 9 May 2019. This section is summarizing their reporting, beginning with statements from WCRP sister Programmes, the World Weather Research Programme (WWRP) and the Global Atmosphere Watch (GAW), and then moving to presentations from other key partners.

7.1. World Weather Research Programme (WWRP)

Paolo Ruti (Chief, WWRP), gave a presentation on "Catalyzing Innovation in Weather Science: the World Weather Research Programme." Paolo outlined how seamless prediction in the WWRP context considers all compartments of the Earth system as well as disciplines of the weather enterprise value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision-making, end-user products) to deliver tailor made weather information from minutes to months and from local to global.

WWRP focuses on Science for Services; a value approach bringing research and operations together (Figure 3).

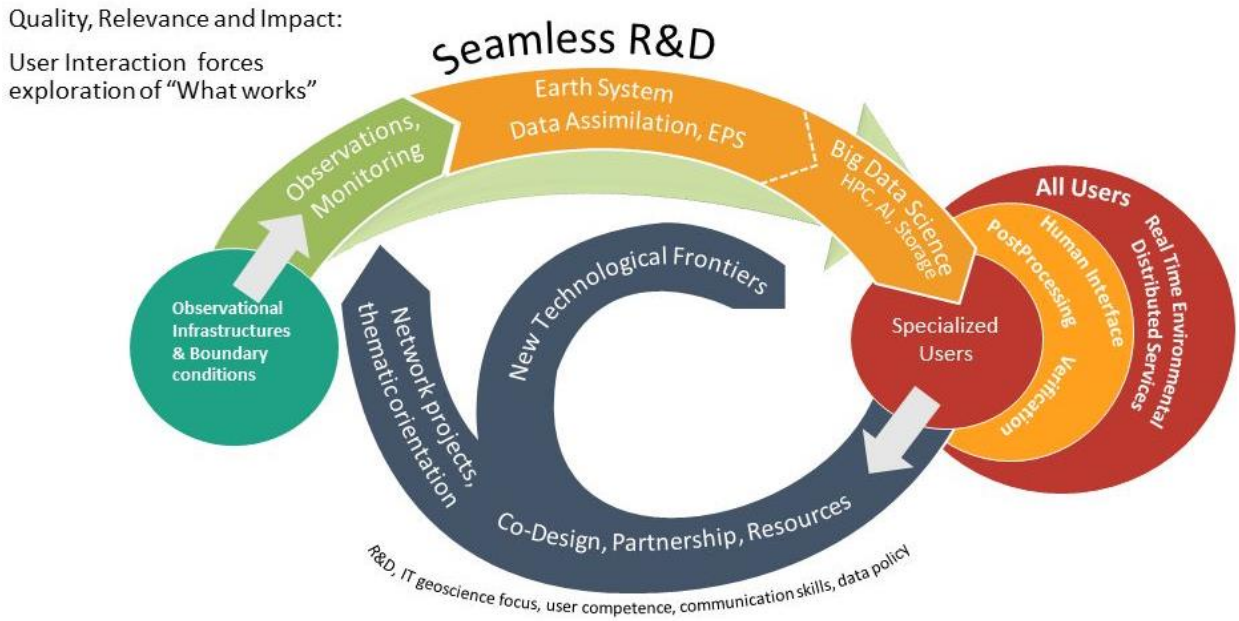

Figure 3: WWRP Science for Services framework.

WWRP activities focus on four challenges: High impact weather, water, urbanization and evolving technologies. WWRP's Implementation Plan 2016-2023 includes a structure formed around working groups and projects, often in partnership with WCRP.

WWRP and WCRP already have joint responsibility for:

- Further development of subseasonal-to-seasonal prediction.

- Enhancing resilience to weather-related risk in the context of a changing climate.
- Developing the models used for weather and climate research, prediction and projection.
- Contributing to development of observing system for weather and climate research and applications.
- Developing future infrastructure for extreme computing and data handling.
- Strengthening regional research and innovation.
- Nurturing early career scientists.

Paolo highlighted that there is the potential for mutual benefit from collaboration related to:

- Process understanding across time-and-space scales; translation to predictive skill.
- Coupled data assimilation and reanalysis.
- Organized tropical convection.
- Vulnerability, risk, communication.
- Comprehensive intensive field programmes to enhance process understanding and support model development in critical processes.

WWRP is looking forward to seeing more details of the WCRP Implementation Plan in order to identify concrete opportunities for collaboration. The Programme welcomes the WCRP invitation to do so, in particular in the context of the Global Data Processing and Forecasting System (GDPFS) to strengthen Research-Operations linkages. Some concerns were expressed as to the WCRP implementation timeline, which seems rather long but fast-track initiatives may indeed cover some emerging and urgent topics to be developed. Both programmes can work with the WMO Permanent Representatives to communicate those opportunities.

7.2. Global Atmosphere Watch (GAW)

GAW provides international leadership in research and capacity development in atmospheric composition observations and analysis. The GAW Implementation Plan builds upon the premise that atmospheric composition matters - to climate, weather forecasting, human health, terrestrial and aquatic ecosystems, agricultural productivity, aeronautical operations, renewable energy production, and more. The vision for the next decade of GAW is to grow the international network of high-quality atmospheric observations across local to global scales to drive high quality and impact science while co-producing a new generation of research enabled products and services. GAW supports a number of international conventions and applications/services and cross-cutting activities such as the Integrated Global Greenhouse Gas Information System (IG3IS).

There is a growing importance of atmospheric composition in weather and climate research programmes. The collaboration space between GAW and WCRP that exists or could be enhanced includes:

- Enhanced observing systems (Greenhouse Gases, Short-lived Climate Pollutants)
- Enhanced modeling capabilities
- Modern data science
- Capacity building
- Close interaction with SPARC, S2S and WGNE

Attendees noted the crucial GAW-SPARC collaboration. The interface with GAW would ideally happen at the WCRP level, but SPARC is maybe the most obvious candidate entry point for those partnerships.

7.3. Global Climate Observing System (GCOS)

Stephen Briggs (GCOS Co-chair) and Carolin Richter (Director, GCOS) presented an update from GCOS, focusing on the recommendations from the GCOS/WCRP meeting in Morocco (18-22 March 2019). The Morocco meeting covered the topics of adaptation, cycles (carbon, energy, water), and three topics: extreme events, fluxes, and coastal-land sea exchanges. The main recommendations were:

Recommendation 1:

- Consider the regional and temporal resolutions needed to improve the understanding of the carbon cycle.
- How information about carbon isotopes can be used and what is needed to improve monitoring of the carbon cycle?

Recommendation 2:

- Work with modelling and observational communities to establish a scientific basis for improving observations, i.e. how to capture the Earth's energy balance observationally and what is the needed accuracy of these observations to close the Energy balance sufficiently to resolve the radiative forcing.

Recommendation 3:

- Provide contribution of surface flux work as done under OceanObs/GCOS.
- Recommend and support that the community should submit a 'proposition of continuation' of CONCEPT-HEAT (Consistency between planetary heat balance and ocean heat storage).
- Encourage and support contributions to other scientific papers, for example on the Earth Energy Imbalance (EEI) inventory (e.g. added expertise from observations on atmospheric, land and cryosphere storage).
- Building on a previous workshop, improve links between model and observational communities.
- Recommend and support the continuation of Ocean Reanalysis Intercomparison Project. Support related reanalysis inter-comparison projects.
- Determine the time-scales needed to understand the global energy balance.
- Identify the regional scale that needs to be considered (e.g. including heat re-distribution: transport in the atmosphere and ocean, and regional budgets).
- Continue to increase scientific understanding, knowledge and tools through the physical budget constraint approach, and address implications of changes in the energy budget.

The comment was made that WCRP and others set the scientific requirements for the observing systems.

For further information please see the GCOS presentation.

7.4. Global Framework for Climate Services (GFCS)

Filipe Lucio (Director, GFCS) gave a brief oral intervention on GFCS. GFCS became operational in 2012. Up to now the focus has been on the proof of concept, which was reviewed recently. A climate coordination panel will guide the implementation of GFCS and will include a WCRP representative. WMO Congress will define the course of GFCS going forward.

7.5. Future Earth

Amy Luers (Executive Director, Future Earth), introduced a launch of the Earth Commission that aims to underpin the setting of science-based targets for a resilient planet, and an emerging effort to identify and facilitate the research on Global Systemic Challenges. She proposed that WCRP and Future Earth may deepen collaborations through the joint effort, particularly, in the areas of sustainability research, as well as through science responses to policy requests.

This is centered on:

- "Building the Field": transdisciplinary convenings, supporting funding for transdisciplinary Research, support of early career research etc.
- "Shaping the Narrative": Rapid Response to policy requests (see the Anthropocene magazine)
- "Facilitating Research": Grounded in 20+ global research projects and the Knowledge Action Networks (KANs).

Future Earth works to accelerate transformations to global sustainability, focused on global systematic challenges: Earth targets, societal transformations for climate action.

7.6. Belmont Forum

Erica Key (Executive Director, Belmont Forum), informed attendees that Belmont Forum calls on climate topics are open and coming up, and expressed an interest in developing closer ties in the future with the WCRP research community. She noted that the wording of the WCRP Strategy is well-chosen to resonate with possible future sponsors and partners and reaffirmed the support of Belmont Forum for the open data concept. The Belmont Forum encouraged the WCRP community to consider reaching out to the private sector, in which much is already happening for sustainability and resilience and proposed to share their 'lessons learned'.

Detlef asked how WCRP could connect or provide input needed? Erica responded that he could attend the scoping workshops and attend the anniversary meeting, where they will discuss gaps. Pavel clarified that the Belmont forum is the only currently existing consortium of funding agencies and noted that opportunities are huge, to address local to global challenges. WCRP could be part of a new scoping exercise beyond 2020.

Erica noted that the WCRP Strategic Plan resonated with the Belmont Forum and that there is a need to work on communication, such as working with journalists. Early career scientists are also important and pathways for change.

Pascale stated that it was unclear as to the mechanism to leverage funding. Erica briefly outlined the process and noted that they work with the resources that their funders bring to the table.

Jim stated that one issue that the WCRP Review raised is that there can be cultural differences between WCRP and its partners. Erica said that she believes that it is a coalition of the willing. WCRP does have its own culture but people are becoming much more open. Future Earth's Knowledge Action Networks are a good way of connecting with social scientists, for example.

Note that Maria Uhle, National Science Foundation (Belmont Forum), was unable to attend the JSC40 due to a delay with her flight. A one-to-one meeting with Pavel was arranged on the Friday.

8. WCRP future plans and outreach

8.1. Climate Science Year

Pavel Kabat discussed with JSC-40 participants some of WCRP's overarching plans for the remainder of 2019. These activities include:

- WCRP involvement in the Eighteenth World Meteorological Congress (Cg-18) (Geneva, 3-14 June 2019)
- WCRP contributions to the Climate Summit (New York, 23 September 2019)
- The WCRP Climate Science Week at the AGU Fall Meeting (San Francisco, 7-13 December 2019)

Pavel Kabat outlined the activities surrounding the first two of the points noted above. He also noted that he suggests to implement a series of regular Climate Science Updates, which would partly be a product of WCRP. Detlef Stammer raised a question around the Climate Science Updates. He asked if these would be more an opinion piece, as there would be some concern if it is presented to policy makers without going through an IPCC-like process. Martin Visbeck is in general supportive to engage with climate policy makers, potentially the JSC could form a small task force to give a fast turnaround answer for issues raised. Both Martin Visbeck and Helen Cleugh stated the importance of being very clear about the purpose of these proposed Climate Science Updates, and advised the JSC that WCRP should proceed with caution, especially given the parallel IPCC work program and activities. Pavel confirmed that IPCC are already fully on board. The discussion was not conclusive but did indicated that the JSC wanted more information on the purpose of these initiative, and how they would be done and the resources required before a decision to engage or not can be made.

ACTION Items:

16. Make Detlef/JSC aware of items during the Climate Science Year that need JSC input (JPS; August 2019)
17. Form a JSC task team to support JPS to answer request for information or engagement with climate policy makers and related stakeholders, Such a team would also determine the benefit and scope of climate science update initiative (JSC; April 2020)

8.2. WCRP Climate Science Week at the AGU Fall Meeting

Jens Hesselbjerg Christensen (JSC) presented (remotely) the latest information on the WCRP Climate Science Week, to be held as part of the American Geophysical Union (AGU) Fall Meeting in San Francisco (7-13 December 2019). The purpose of the week is primarily to celebrate the success of 40 years of WCRP climate science, but also to find ways to respond to the changing world around us, to solidify and grow new partnerships and to socialize the new framework for implementation of the WCRP Strategic Plan.

The week will include a WCRP 40 Anniversary Symposium, four WCRP town halls, a WCRP Union Session, an early career workshop and an exhibition booth. WCRP and AGU have developed an MoU (soon to be finalized) that secures a broad collaboration on these events.

For full details please see the Climate Science Week webpages.

The planning of the Climate Science Week is ongoing. Jens, on behalf of WCRP, participated in the AGU Fall Meeting Programme Committee meeting on 2-3 May 2019. Session proposals for AGU resulted in over 30 WCRP-branded sessions, with the possibility of more to come after all science sessions are confirmed. Abstract submission for these sessions will open in June with a deadline in August and a finalized meeting schedule in September. The early career workshop is under development with the Young Earth System Scientists (YESS), the Association of Polar Early Career Scientists (APECS) and the Young Hydrologic Society (YHS).

Michel Rixen (JPS) noted that the International Geosphere-Biosphere Programme (IGBP) held a similar event in 2015 and had 11 sessions, highlighting that securing 30 sessions is already an excellent result. There is an opportunity to extend this by connecting with the relevant AGU sections. Jim Hurrell, as one of the AGU Section Presidents, noted that there are a number of people coming to San Francisco on the weekend preceding AGU for specific events. We need to get the message out early to attract them to the Sunday Symposium. The weekend also has early career events, so it would be good to connect to them. In addition, there is also the AGU centennial celebration and it would be good to connect with that. AGU is encouraging oral histories - that could be an opportunity.

Jim Hurrell also discussed the structure of AGU science: 28 sections, with four “neighborhoods” (grouping of sections). He noted all are involved in planning for the AGU Centennial Celebration, which makes for a complex landscape but may also be an additional opportunity for a WCRP-themed event. At present AGU neighborhoods are brainstorming on the format of their Cenennial sessions (one each day of the week) and Jim noted that he would be happy to be an advocate for WCRP. Michel Rixen and Martin Visbeck asked if Jim would join the WCRP Climate Science Week Organizing Committee to advise on opportunities. This was organized further outside of the meeting.

For further information see the WCRP Climate Science Week presentation.

ACTION Items:

18. Liaise with Jim Hurrell on extra AGU-WCRP events at an AGU Section level (JPS; July 2019)
19. Teleconference with US GCRP regarding the WCRP Climate Science week (Pavel Kabat; July 2019)
20. Form a Task Team(s) to assist with WCRP Climate Science Week organization, including:
    - Consultation with the WCRP community
    - Identification of speakers
    - Logistics and collateral

    (Task Team; July 2019)

8.3. WCRP Core Project proposal

In the fringes of the JSC meeting the WCRP Core Project Co-chairs held discussions on how best to integrate their activities going forward in order to:

- Show 'we are open for business'
- Aim to identify joint initiatives in an evolving WCRP
- Determine what the Core Projects can contribute
- Investigate how the Core projects can help kick off the new WCRP

The emerging plans for WCRP encourage such initiatives, recognizing the value of cross-cutting research initiatives and to encourage new opportunities for early-mid career scientists.

A WCRP joint initiative should include:

- An international dimension
- Fundamental science
- Societal relevance
- Tractability

The discussions focused on possible initiatives that have global climate relevance, which could be coordinated by Core Projects, and where broad integration would be of use and could start immediately. Quite a few possibilities were discussed with the outcome settling on regional issues with global relevance in the:

- Himalayas
- Andes
- Arctic

Each region has existing research communities and existing initiatives, although of different sizes and complexity. It is important to identify what WCRP can add. It was recognized that many integrative projects will be on a similar scale (e.g. focused on a particular region) rather than grand, broad-brush ones (e.g. understanding global monsoon systems). Other topics (e.g. climate mitigation approaches, short-lived climate forcers) are likely to have a larger fraction of non-WCRP partners.

The activity of the core-projects to think about joint activities was much appreciated. It was suggested to use existing meetings to further develop these issues, to choose one to focus on over the coming 18 months and to organize a workshop on that topic in 2020. Each Core Project would provide some support for the workshop. It would also be important to look for partner involvement and support and ideally co-design these initiatives.

ACTION Items:

21. Core Projects, in coordination with CORA, CORDEX and other Working Groups, to build further on the initiative to look further into joint activities within their current structures as we move into a more integrative structure (CP Chairs; Ongoing)
22. Core Project Co-chairs, in consultation with Working Groups, are encouraged to take joint project idea forward, taking into consideration AR6 gaps and priorities, and to come back to the JSC in early 2020 with a plan (CP Chairs; Early 2020)

9. JSC business

9.1. Election of JSC Officers

During a JSC-only session on Friday morning, 10 May, an election for three remaining JSC Officers took place by paper ballot. The result of the election was as follows (in alphabetical order of last names):

- Pascale Braconnot
- Jens Hesselbjerg Christensen
- James Hurrell

The elected officers, together with the Chairperson and Vice-Chairperson, will serve a two-year term until the JSC Session in 2021, as stated in the 1993 Agreement of the WCRP co-sponsoring organizations.

The election was overseen by the JPS member (Boram Lee, assisted by Pepi Potter), and the Director of JPS / WMO Chief Scientist (Pavel Kabat) acted as scrutineer. All the records of the election including the ballots, counting results and the summary of the election, are maintained by the JPS as a confidential record. All JSC members congratulated the elected Officers and welcomed them in their new roles.

The election procedure was designed to ensure that the nomination and election of JSC Members is transparent and communicated to the community in full throughout the process.

ACTION Item:

23. Ensure the process to nominate and select new JSC members is transparent and communicated to the community in a timely manner (JPS, JSC, co-sponsors; ongoing and for the next nomination and reporting cycle in 2020).

9.2. JSC membership and social scientist representation

The JSC affirmed that they will welcome social scientist representatives as ex-officio members of the JSC. The JSC will submit a suggested list of names and alternatives to the ISC later this year, a process that will involve a community call. One focus of the respective call for membership will be for expertise on risk.

ACTION Item:

24. Issue a call for social scientist ex-officio members of the JSC and follow up on the call (JPS to issue the call to sponsors on behalf of JSC; September 2019)

9.3. JSC task teams

Detlef Stammer outlined his plan to form a number of task teams, to include JSC Members and other leaders in the WCRP community. Formation of these task teams will be reflected in the actions from this meeting and should allow for more rapid decision-making.

ACTION Item:

25. Assign particular tasks or portfolios to different JSC members and add to corresponding mailing list (JSC; September 2019).

9.4. WCRP budget

As part of a report by Pavel Kabat on the JPS he recalled the set arrangement for the financial operation of WCRP through the Joint Climate Research Funds (JCRF), a special account within WMO, as described in Annex B of the agreement WMO, ISC and IOC-UNESCO, signed in 1993. Kavel Kabat presented an outline of the budget for 2019, formulated based on the discussions and advice made at the 39th Session of the JSC (April 2018, Nanjing) and on the anticipation of required expenses to facilitate transition and implementation planning. In doing so, he noted that the WCRP-wide support for its Core Projects, working groups and other activities remain at the same level as the previous years to maintain community support of key scientific activities. He also suggested that, JCRF and other collective financial resources of WCRP are primarily for community support, providing the seed funding to initiate new scientific efforts for emerging issues as well as to bond and nurture the community — executed largely in the forms of travel support and/or the co-sponsoring of scientific workshops/summer schools — to underpin WCRP's convening power.

The detailed discussion of the 2019 and 2020 budgets were postponed until budget proposals were communicated to the JSC chair and further circulated by him among the JSC members.

ACTION Items:
26. To provided initial budget proposals to the JSC chair and to agree on those among JSC members electronically (Pavel Kabat, Detlef Stammer, JSC; August 2019).

9.5. WCRP group membership

The JSC reviewed all the nominations considering the required balance for the expertise, gender and geographic representation.

CliC: All recommendations were accepted. The fact that an open call for applications was done this time was noted as was the good gender balance. For next time consideration to include someone from the paleo community and from Africa would be desirable.

CLIVAR: All recommendations were accepted. Gender balance is just acceptable so asked to be careful to keep at least at this level going forward.

GEWEX: The JSC took note of and approved the membership extension for 3 members for 2 years (2020/2021), as recommended. Meanwhile, it found it concerning that there was no new nomination. A respective dialog will follow.

SPARC: The JSC approved the SSG membership extensions for 5 members and the new nominations as submitted. However, the gender balance should be improved in future years.

A call for self-nominations for Councils, Working Groups and the CORDEX SAT will be issued right after the JSC40 session with deadline 20 June, after which Co-Chairs of respective groups will forward their recommendations to the JSC in summer.

For further information see the Guidelines on Membership of WCRP Bodies.

9.6. WCRP communication and capacity building

There was insufficient time to discuss communication and capacity building in detail. The current WCRP Communication Strategy will end in 2020. A new communication plan must be developed as part the WCRP Implementation Plan if it is to be successful.

See the Recommendations for a new WCRP Communication Plan for more information.

9.7. WCRP carbon footprint

There was a brief discussion on how best to proceed with reducing the overall carbon footprint of WCRP. While some travel was thought necessary, it was also encourage to use electronic means as much as possible to reduce WCRP related travel.

ACTION Item:

27. Proposed options to reduce WCRP related travel (JPS; Ongoing)

9.8. Next meeting of the JSC

A number of proposals were received to host JSC sessions in the coming years:

- JSC-41 (2020) in Australia, maybe back to back with a Belmont Forum meeting in Brisbane in June (note a possible clash with WMO EC-72)
- JSC-42 (2021) in Peru - possibly back to back with the "Regional Conference: Science for Climate Services", organized by the Peruvian Meteorological and Hydrological Service - SENAMHI, co-sponsored by WMO Regional Association for South America (RAIII) and WCRP.
- JSC-43 (2022) in South Africa - Pedro Monteiro (JSC) will look into the details.

Annex 1 - List of Participants

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+ Was unable to attend due to an issue with her flight

Special Guests for the Public Science Lecture (Wednesday, 8 May):

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Luis Alfonso	de Alba	Special Envoy for the 2019 Climate Summit	

NB * indicates remote attendance

WorldClimateResearchProgramme

Majority of

Geneva

01 Huijun WANG, *JSC, CN*
02 Bo SUN, *support for 01, CN*
03 Wenju CAI, *CLIVAR, AU*
04 Thomas PETER, *JSC, CH*
05 Xuebin ZHANG, *ETCCDI, CA*
06 Keith WILLIAMS, *WGNE, UK*
07 Neil HARRIS, *SPARC, UK*
08 Ken TAKAHASHI, *JSC, PE*

09 Iréne LAKE, *CORDEX, SE*
10 Jan POLCHER, *GEWEX, FR*
11 Masahide KIMOTO, *JSC, JP*
12 Paul BOWYER, *CORA (GERICS) , DE*
13 Silvina SOLMAN, *CORDEX, AR*
14 Peter VAN OEVELEN, *GEWEX, US*
15 Timothy NAISH, *GC Melting Ice, NZ*
16 Susanna CORTI, *JSC, IT*

17 Tore FUREVIK, *CORA, NO*
18 Daniela JACOB, *CORA , DE*
19 Pascale BRACONNOT, *JSC, FR*
20 Mareike KENNTNER, *SPARC, DE*
21 Jose SANTOS, *CLIVAR, CN*
22 Pedro MONTEIRO, *JSC, ZA*
23 Pavel KABAT, *chief scientist, WMO*
24 Helen CLEUGH, *JSC (vice-chair), AU*

Legend: #, given & SUR-name, *unit/role, country code*

JointScientificCommittee – Session 40

of Participants

7 / 10 May 2019

25 Susann TEGTMEIER, *WDAC, DE*
26 Michael SPARROW, *JPS, WMO*
27 Michel RIXEN, *JPS, WMO*
28 William GUTOWSKI, *CORDEX, US*
29 Jean-Noël THÉPAUT, *WDAC/WMAC, ECMWF*
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41 Judith PERLWITZ, *SPARC, US*
42 Krishnan RAGHAVAN, *JSC, IN*
43 Martin VISBECK, *JSC, DE (10 May)*
44 Boram LEE, *JPS, WMO*
45 Josefa POTTER, *JPS, WMO*
46 Matthias TUMA, *JPS, WMO*
47 James HURRELL, *JSC, US (10 May)*
48 Detlef STAMMER, *JSC (chair), DE*

Photos, fusion: Josefa Potter, Oliver Lux; Annotation: Hans Volkert

The Joint Scientific Committee (JSC) – the guiding body of the World Climate Research Programme (WCRP) – held its 40th annual session since 1980 at WMO headquarters in Geneva from 6 to 10 May 2019. After lunch on 7 May, 46 persons assembled for their photo opportunity on the staircase in the lobby of the WMO building. Two further JSC members were photographed at not yet taken positions on 10 May in order to construct the enhanced group depicted above. The addition of metadata in two columns (number, given and sur-names, unit within WCRP [cf. www.wcrp-climate.org], country code of workplace) helps demonstrate the geographical distribution across all continents and the diversity of the personalities involved in WCRP. The annotated groupphoto prolongs the tradition of similar undertakings of voluntary cooperation as described in a recent article (cf. https://doi.org/10.1007/s00376-017-6329-6).

Annex 2 - WCRP JSC40 Agenda

6-10th May 2019, WMO Building, Geneva

Day 1 (6th May): 08:30-09:30
Attendance (by invitation): WCRP JSC-only

08:00 – 08:30 Registration for JSC members
08:30 – 09:30 1. Opening of JSC (internal)
- 1.1 Welcome to old and new members
- 1.2 Introduction: i) JSC responsibilities and role
- 1.3 Introduction: ii) JSC officer responsibilities and role
- 1.4 Introduction: ii) key agenda items for the week, including JSC Officers election process, etc.
- 1.5 AOB

Day 1 (6th May): 09:30-18:00
Attendance (by invitation): WCRP Sponsors, JSC, Chairs & Directors, JPS

09:30 – 10:00 Registration, coffee and refreshments
10:00 – 11:00 2. Opening of JSC-40
- 2.1 Welcome by JSC Chair
- 2.2 Welcome by Sponsors: WMO, IOC (by video), ISC
- 2.3 Participants' introductions
- 2.4 Objectives of meeting and tasks for the JSC
- 2.5 Approval of JSC-40 agenda

11:00 – 12:30 3. Strategic Plan, Implementation
- 3.1 Brief overview and status of draft Strategic Plan
- 3.2 Summary of outcome of Implementation and Transition Workshop
- 3.3 Charge to breakout groups

12:30 – 14:00 Lunch

14:00 – 15:30 4. Strategic Plan
Breakout Groups session 1: Task - to discuss details of Strategic Plan objectives (input from WCRP groups, four BoGs in parallel) (TBD: moderators, rapporteurs)

15:30 – 16:00 Coffee break

16:00 – 17:30 5. Implementation Plan
Breakout Groups session 2: Task - to discuss implementation of Strategic Plan objectives (inputs from WCRP groups, four BoGs in parallel) (TBD: moderators, rapporteurs)

17:30 – 18:00 6. Plenary
- 6.1 Summaries of Breakout Groups sessions 1 and 2
- 6.2 Wrap-up of the day by JSC Chair

Evening: No-host dinner

Day 2 (7th May): 09:00-18:00
Attendance (by invitation): WCRP Sponsors, JSC, Chairs & Directors, JPS

09:00 – 10:30 7. Implementation Plan
Breakout Groups session 3: Task - to discuss implementation of core WCRP activities and critical Infrastructures (four groups in parallel) (TBD: moderators, rapporteurs)

10:30 – 11:00 Coffee break

11:00 – 12:30 8. Transition Strategies
Breakout Groups session 4: Task - to discuss possible transition strategies of new core WCRP activities and critical Infrastructures (four groups in parallel) (TBD: moderators, rapporteurs)

12:30 – 14:00 Lunch

14:00 – 15:30 9. Plenary
- 9.1 Breakout Groups sessions 3 and 4 summaries on Implementation and Transition
- 9.2 Wrap-up by JSC Chair

15:30 – 16:00 Coffee break

16:00 – 18:30 10. Specific strategy discussion
- 10.1 Future of CMIP – C. Senior (remotely) and F. Doblas-Reyes (60 mins)
- 10.2 CORA and WGRC – G. Brasseur, D. Jacob, C. Goodess (remotely), B. Hewitson (remotely) (45 mins)
- 10.3 ETCCDI – L. Alexander (15 mins)
- 10.4 Fast emerging topics: machine learning, data mining – P. Kabat (15 mins)

Day 3 (8th May): 09:00-16:00
Attendance (by invitation): WCRP Sponsors, JSC, Chairs & Directors, JPS, and Partners

09:00 – 10:00 11. Opening & Briefings
- 11.1 Welcome to partners by JSC Chair and WMO Chief Scientist
- 11.2 Summary of Implementation and Transition Discussion – JSC Chair
- 11.3 WMO New Strategy and opportunities for WCRP – P. Kabat

10:00 – 10:30 12. Briefings of WCRP Groups (10+5 mins discussion each)
- 12.1 WDAC – S. Tegtmeier, J.-N. Thépaut
- 12.2 WMAC – F. Doblas-Reyes

10:30 – 11:00 Coffee break

11:00 – 12:30 12. Briefings of WCRP groups (cont'd, 15+5 mins each)
- 12.3 CLIVAR + GC Sea level – A. Bracco (remotely), W. Cai
- 12.4 GEWEX + GC Water and GC Extremes – G. Stephens, J. Polcher
- 12.5 CliC + GC Melting Ice – J. Renwick
- 12.6 SPARC – J. Perlwitz, N. Harris

Discussion (10 mins)

12:30 – 14:00 Lunch

14:00 – 15:30 12. Briefings of WCRP groups (cont'd, 15+5 mins each)
12.7 WGNE – K. Williams
12.8 WGCM + CMIP, GC Cloud and GC Carbon – C. Senior (remotely)
12.9 CORDEX – W. Gutowski
Discussion (20 mins)
WWRP Statement on Implementation and Transition (10 mins)

15:30 – 16:00 Coffee break

Day 3 (8th May): 16:00-19:00
Attendance: Public

16:00 – 18:00 Public Science lecture and panel discussion, co-hosted by WMO and WCRP
https://www.wcrp-climate.org/wmo-public-science-lecture

Evening Reception/Ice-breaker

Day 4 (9th May): 09:00-18:00
Attendance (by invitation): WCRP Sponsors, JSC, Chairs & Directors, JPS, Partners

09:00 – 10:00 12. Briefings of WCRP groups (cont'd, 15+5 mins each):
12.10 S2S – A. Robertson
12.11 WGSIP + DCPP, GC NTCP – D. Smith and A. Scaife (remotely)
Discussion (20 mins)
10:00 – 10:30 13. Statements on Implementation and Transition (10 mins each):
13.1 Sponsors (IOC - remotely, ISC, WMO)

10:30 – 11:00 Coffee break

11:00 – 12:30 13. Statements on Implementation and Transition (cont'd, 10 mins each)
13.2 Partners (WWRP – NB moved to Wed, GAW, GCOS, GFCS, Future Earth)
13.3 Agencies (US GCRP – remotely, Belmont Forum)
Discussion (15 mins)

12:30 – 14:00 Lunch

14:00 – 15:30 14. WCRP Planning and Outreach
14.1 JPS report – P. Kabat
14.2 Climate Science Year (WMO Cg-18, Climate Summit NYC, AGU2019) - P. Kabat
14.3 Update on the AGU Fall Meeting Programme Committee Meeting – J. Christensen (remotely)

15:30 – 16:00 Coffee break
16:00 – 18:00 15. Wrap up

15.1 Next steps on TP/IP
15.2 Review of actions

Day 5 (10th May): 09:00-18:00
Attendance (by invitation): WCRP JSC and JPS

09:00 –10:30 **16. JSC only session**
16.1 Election of Officers
16.2 JSC membership and social scientist representation
16.3 AOB for JSC

10:30 – 11:00 Coffee break

11:00 – 12:30 **17. JSC and JPS session**
17.1 Budget
17.2 Response to Sponsors' review and EC-70 Resolution 30
17.3 Group memberships
17.4 Communication
17.5 Capacity Building
17.6 Next meeting
17.7 Review of actions

12:30 – 14:00 Meeting ends

14:00 – 15:30 JPS meets with JSC Chair and Vice-Chair

Rooms:
Plenaries: Conference Room (C1 Level -1): Monday to Friday (9:00-18:00)

Breakout groups:
Break out Room (6 Lake): Monday to Friday (9:00-18:00)
Break out Room (6 Jura): Monday to Friday (9:00-18:00)
Break out Room (7 Lake): Monday to Friday (9:00-18:00)
Break out Room (7 Jura): Monday to Friday (9:00-18:00)

JSC-only sessions: Break out Room (6 Lake): Monday to Friday (9:00-18:00)
Coffee breaks: Bar at ground level/level 0

Annex 3 - Draft structure of the WCRP Implementation Plan

Part 1: April 2020

1. Introduction
2. The WCRP Strategic Plan: Vision, Mission and Objectives
3. Engagement
4. WCRP Conceptual Framework
5. Partnerships
    - Identifying key partners
    - Co-designing science questions
    - Identifying common infrastructure
    - Clarifying the role of the Strategic Plan
    - Reaffirming current, and building new
6. Implementation
    - Transition Plan
    - Schedule: Gantt chart, milestones, deliverables
7. Measures of success
8. Risks and contingencies

Part 2: April 2022

10. Support functions (including support offices)
11. External governance: Sponsors, JSC, Governing Board, JPS
12. Internal structure and governance
13. Resources, budgets, finance management

Annex 4 - Acronyms

AGU	American Geophysical Union
AIMES	Analysis, Integration and Modelling of the Earth System
APECS	Association of Polar Early Career Scientists
AR6	Sixth Assessment Report (IPCC)
BAMS	Bulletin of the American Meteorological Society
BCCR	Bjerknes Centre for Climate Research
BoG	Breakout Group
CAS	WMO Commission for Atmospheric Sciences (WMO)
CCI	Commission for Climatology (WMO)
Cg-18	Eighteenth World Meteorological Congress (WMO)
CliC	Climate and Cryosphere (WCRP)
CLIVAR	Climate and Ocean Variability, Predictability and Change (WCRP)
CLW	Climate and Water Department (WMO)
CMA	China Meteorological Administration
CMIP	Coupled Model Intercomparison Project
CMIP6	CMIP Phase 6
COP21	Twenty-first Session of the Conference of the Parties (UNFCCC)
CORA	Coordination Office for Regional Activities (WCRP)
CORDEX	Coordinated Regional Climate Downscaling Experiment
CP	Core Project (WCRP)
CPTEC	Centro de Previsão de Tempo e Estudos Climáticos
DAOS	Working Group on Data Assimilation and Observing Systems (WWRP)
DCPP	Decadal Climate Prediction Project
DRA	Development and Regional Activities Department (WMO)
EC-70	Seventieth Session of the Executive Council (WMO)
EC-72	Seventy-second Session of the Executive Council (WMO)
ECS	Equilibrium Climate Sensitivity
EEI	Earth Energy Imbalance
ENSO	El Niño-Southern Oscillation
ESGF	Earth System Grid Federation
ESRIE	Earth System Reanalysis Intercomparison Effort
ETCCDI	Expert Team on Climate Change Detection and Indices (CCl/WCRP/JCOMM)
ETR	Education and Training (WMO)
GASS	Global Atmospheric System Studies (GEWEX)
GAW	Global Atmosphere Watch (WMO)
GC	Grand Challenge (WCRP)
GC Carbon	GC on Carbon Feedbacks in the Climate System (WCRP)
GC Clouds	GC on Clouds, Circulation and Climate Sensitivity (WCRP)
GC Extremes	GC on Weather and Climate Extremes (WCRP)
GC Melting Ice	GC on Melting Ice and Global Consequences (WCRP)
GC NTCP	GC on Near-term Climate Prediction (WCRP)
GC Sea Level	GC on Regional Sea-Level Change and Coastal Impacts (WCRP)
GC Water	GC on Water for the Food Baskets of the World (WCRP)
GCOS	Global Climate Observing System
GDPFS	Global Data Processing and Forecasting System
GERICS	Climate Service Center Germany
GEWEX	Global Energy and Water Exchanges (WCRP)
GFCS	Global Framework for Climate Services
GLASS	Global Land/Atmosphere System Study
ICRC	International Conference on Regional Climate (CORDEX)
IG3IS	Integrated Global Greenhouse Gas Information System (GAW)
IGBP	International Geosphere-Biosphere Programme

IOC-UNESCO	Intergovernmental Oceanographic Commission of UNESCO
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPO	International Project Office
ISC	International Science Council
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology (WMO/UNESCO-IOC)
JCRF	Joint Climate Research Fund (WCRP)
JPS	(WCRP) Joint Planning Staff
JSC	(WCRP) Joint Scientific Committee
JSC-40	40th Session of the JSC
JSC-41	41st Session of the JSC
JSC-42	42nd Session of the JSC
JSC-43	43rd Session of the JSC
JSC-45	45th Session of the JSC
KAN	Knowledge Action Network (Future Earth)
MIP	Model Intercomparison Project
MJO	Madden-Julian Oscillation
MOU	Memorandum of Understanding
OBS	Observing and Information Systems Department (WMO)
PDEF	Working Group for Predictability, Dynamics and Ensemble Forecasting
RAII	Regional Association II (Asia) (WMO)
RHPs	Regional Hydroclimate Projects
S2S	Subseasonal to Seasonal Prediction Project (WCRP, WWRP)
SAT	Science Advisory Team (CORDEX)
SCAR	Scientific Committee on Antarctic Research
SOLAS	Surface Ocean - Lower Atmosphere Study
SPARC	Stratosphere-troposphere Processes And their Role in Climate (WCRP)
SSG	Scientific Steering Group (WCRP)
TIRA	Task Team for Intercomparison of Reanalyses
TPOS2020	Tropical Atlantic Observing System and Tropical Pacific Observing System 2020
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization (UN)
UNFCCC	United Nations Framework Convention on Climate Change (UN)
WCRP	World Climate Research Programme
WDAC	WCRP Data Advisory Council (WCRP)
WGCC	Working Group on Climate Change
WGCM	Working Group on Coupled Modeling (WCRP)
WGNE	Working Group on Numerical Experimentation (WCRP,CAS)
WGRC	Working Group on Regional Climate (WCRP)
WGSIP	Working Group on Subseasonal to Interdecadal Prediction (WCRP)
WMAC	WCRP Modelling Advisory Council (WCRP)
WMO	World Meteorological Organization
WWRP	World Weather Research Programme
YESS	Young Earth System Scientists Community
YHS	Young Hydrologic Society

Annex 5 – Consolidated Action list

1. Update Gantt chart (timeline) to reflect the agreed timeline for production of the Implementation Plan, including the consultation process (Narelle, Mike; June 2019)
2. Determine Task Teams to take forward implementation activities, including on:
   a. WCRP structures, needs, gaps and coordination, including:
      - Model development and infrastructure
      - Seamless data, data management
      - Regional activities

      (Task Team, report February 2020; Regional activities by December 2019)
   b. WCRP Implementation engagement and consultation process (Task Team; report February 2020). Task Team to co-design a "landscape" map and schematic with Future Earth (Task Team; April 2020).
   c. Task Team to develop a process for exploring and exploiting shared opportunities with partners, esp. Belmont Forum, Future Earth, GCOS, WWRP (Task Team; Feb 2020)
3. Conduct an inventory, provide a nomenclature, and suggestions for streamlining and clarifying definitions for WCRP activities (JPS; April 2020).
4. WCRP activities (CPs, GCs, WGs) to map to the draft Conceptual Framework – following the approach taken by S2S (WCRP activities, led by JPS; December 2019)
5. WCRP Core Projects to consider the utility (or not) of a Synthesis (an overview of their key achievements, possibly in a form that could be published) and associated timing (CPs; April 2020)
6. By AGU 2019 Fall Meeting ensure that the key elements of the Implementation Plan are ready in a format useful for discussion and input (Detlef, Helen, Mike, Mich, Narelle; November 2019)
7. By April 2020 have a draft of the first elements of the Implementation Plan, including:
   d. Refined science questions and conceptual framework
   e. Refined key elements for delivery and engagement (e.g. inclusion of capacity building)
   f. Science, funding and infrastructure needs

   (Detlef, Helen, Mike, Narelle; April 2020)
8. By April 2022 (JSC-43) have a drafted second set of elements of the Implementation Plan, including consultation and the development of a new structure and governance (Detlef, Helen, Mike, Narelle; April 2022)
9. In parallel to the development of the Implementation Plan, by November 2019, summarize the transition process discussions to date as well as ensuring additional refinement (including consultation as needed), which should include:
   a. How we manage our business during this transition time
   b. The process to initiate and deliver "Fast Track Initiatives"
   c. The feasibility of the idea of syntheses of our core activities and the best timing for this
   d. An outline of the key tasks, activities and communications during this time, and who has responsibility for these.

(Detlef, Helen, Mike, Narelle; November 2019)

10. CORA with WGRC, CORDEX and ETCCDI to form a task team to co-develop a concrete plan of work for the next two years in support of WCRP regional activities and to report this back to the JSC by September 2019. Core-projects should be consulted and engaged in this planning process.
11. GC Extremes and ETCCDI leaders to submit a proposal to JSC and inform on the further development of community support for coordination (GC Extremes, ETCCDI; April 2020)
12. JSC to advise on future WCRP structure and where observations/data coordination would sit, including the WDAC elements on observations/reanalysis/fluxes/data science; and concretely also on the WCRP Task Team for Intercomparison of Reanalyses (TIRA) proposal (JSC; April 2020).
13. JSC to advise on future of WMAC and where coordination of modeling activities should be located (JSC; April 2020).
14. JSC to note the proposal from WGNE to evolve into an interdisciplinary model development group (JSC; April 2020).
15. Follow-up on proposed future work areas of GC NTCP (WGSIP, April 2020).
16. Make Detlef/JSC aware of items during the Climate Science Year that need JSC input (JPS; August 2019)
17. Form a JSC task team to support JPS to answer request for information or engagement with climate policy makers and related stakeholders, Such a team would also determine the benefit and scope of climate science update initiative (JSC; April 2020)
18. Liaise with Jim Hurrell on extra AGU-WCRP events at an AGU Section level (JPS; July 2019)
19. Teleconference with US GCRP regarding the WCRP Climate Science week (Pavel Kabat; July 2019)
20. Form a Task Team(s) to assist with WCRP Climate Science Week organization, including:
    - Consultation with the WCRP community
    - Identification of speakers
    - Logistics and collateral

    (Task Team; July 2019)
21. Core Projects, in coordination with CORA, CORDEX and other Working Groups, to build further on the initiative to look further into joint activities within their current structures as we move into a more integrative structure (CP Chairs; Ongoing)
22. Core Project Co-chairs, in consultation with Working Groups, are encouraged to take joint project idea forward, taking into consideration AR6 gaps and priorities, and to come back to the JSC in early 2020 with a plan (CP Chairs; Early 2020)
23. Ensure the process to nominate and select new JSC members is transparent and communicated to the community in a timely manner (JPS, JSC, co-sponsors; ongoing and for the next nomination and reporting cycle in 2020).
24. Issue a call for social scientist ex-officio members of the JSC and follow up on the call (JPS to issue the call to sponsors on behalf of JSC; September 2019)
25. Assign particular tasks or portfolios to different JSC members and add to corresponding mailing list (JSC; September 2019).
26. To provided initial budget proposals to the JSC chair and to agree on those among JSC members electronically (Pavel Kabat, Detlef Stammer, JSC; August 2019).
27. Proposed options to reduce WCRP related travel (JPS; Ongoing)

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.