WCRP REPORT

World Climate Research Programme

Report of the 34th Session of WCRP Joint Scientific Committee

Carlton Hotel, Brasília, Brazil, 27-31 May 2013

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1. Opening Ceremony

The JSC Chair, Tony Busalacchi opened the 34th JSC Session at the Hotel Carlton, Brasília, Brazil, at 0915 on 27 May 2013. He greeted the participants and passed the floor to Carlos Nobre, who addressed the participants on behalf of the Brazilian Ministry of Science, Technology and Innovations (MSTI) and on behalf of all Brazilian climate scientists.

Dr. Nobre, representing the Brazilian Ministry of Science, Technology and Innovation (MCTI), started his welcoming address by recalling that he used to be a member of JSC, and it was therefore a great pleasure for him to greet the JSC in Brazil for the first time and to see some old friends in the meeting room. He expressed appreciation to WCRP for making the capital of the country, Brasília, the venue of choice, which was indicative of the true wish of the JSC to stronger engage Brazilian climate science in the WCRP activities. Carlos Nobre emphasized the importance of the WCRP for the world and said that the local organisers felt very honoured to be able to host the JSC meeting in Brazil.

The highlights of developments in Brazil included the creation of the National Ocean Research Institute, expansion of the national observing networks, both in situ and in space, establishing a national policy to reduce carbon emissions (with ~38% actual reduction between 2005 – 2011), work on reducing deforestation, implementation of policies for low carbon economic growth, especially in agriculture and energy sectors, and many other positive developments.

Climate research is on the rise in the country. There is significant funding for adaptation research. Brazil is developing an Earth System Model. Progress has been achieved in seasonal prediction of droughts and understanding of the role of the Atlantic and Pacific Oceans in creating conditions favourable for droughts.

Dr. Nobre concluded his welcome address by wishing the JSC to have a very successful and productive meeting and an enjoyable stay in Brasília.

In response, Director of WCRP, Ghassem Asrar thanked Dr. Nobre and Brazilian hosts for inviting the JSC to Brazil and Brasília. He said that the progress achieved in Brazil on so many aspects of climate observations, research and climate risk management, as presented by Dr. Nobre, was very impressive. He thanked the local volunteers for their wish to help in conducting the meeting and thanked the meeting attendees for travelling from afar to take part in the JSC Session.

Dr. Busallacchi also thanked Carlos Nobre for his welcoming address and recalled his own first visit to Brazil more than 20 years ago, which foreshadowed the establishment of the International Research Institute for Climate and Society, the PIRATA array, both instrumental in expanding regional research on droughts. He recalled the leading role of the Center for Weather Forecasting and Climate Research (CPTEC) of the MCTI Institute for Space Research (INPE) in national and international climate research and the importance of leadership by Carlos Nobre in the numerous advances of climate-related activities in Brazil and in the world. Tony Busalacchi stressed that one of key objectives of the JSC Session was the development of the Grand Challenges (GCs) of climate science. Droughts are of critical importance for the region, and one of the WCRP GCs, on the water availability, is meant to address the science issues related to occurrence and prediction of droughts. In addition to the current JSC session, further progress in the climate research in the region will be the main topic of the Latin America and

Caribbean (LAC) Conference in Montevideo, Uruguay, which WCRP is organizing in March 2014.

Janice Trotte of MCTI, the local host of the JSC-34, also welcomed the attendees, introduced the local support team, invited the participants of the Session to attend a social event on Wednesday 29 May 2013, and wished the JSC a fruitful meeting and nice stay in Brasília. On this high note the Opening Ceremony was concluded.

2. Current status and directions of WCRP development

Tony Busalacchi set the stage for the JSC discussions with a strategic review of the current status and directions of WCRP development. The content of this introductory talk was as follows:

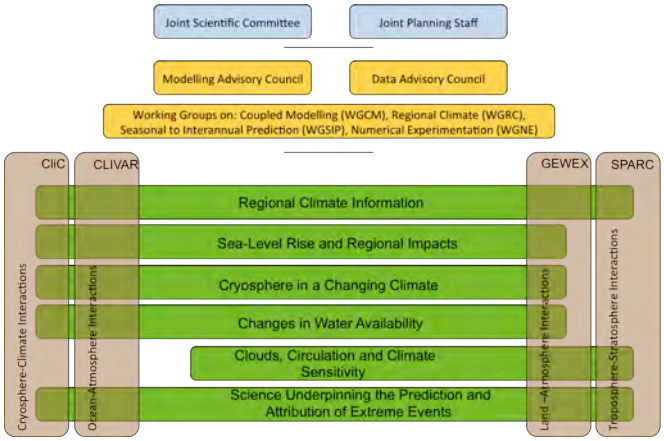
- WCRP mission and objectives,
- Introduction of new JSC members,
- Summary of JSC-33,
- Status of implementation of GCs,
- Outcomes of the WMO Executive Council-65,
- Interactions with Future Earth,
- Interactions with partners,
- Approach to membership of WCRP working bodies,
- Communication across WCRP, and
- Agenda and Chair's expectations for JSC-34.

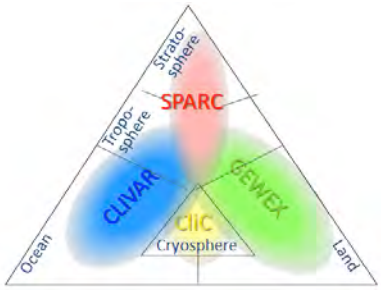
Dr. Busalacchi reminded to the participants that the mission and the main objectives of WCRP were to support climate-related decision making and planning adaptation to climate change by coordinating research required to understand the predictability of climate and of human influence on climate "for use in an increasing range of practical applications of direct relevance, benefit and value to society" (WCRP Strategic Framework 2005-2015).

The strategic development of WCRP is guided by the mandates of its Sponsors. The WMO, IOC of UNESCO, and ICSU, at the World Climate Conference-3, OceanObs '09 Conference, and in the course of the ICSU Review and Visioning acknowledged WCRP past contributions and identified future challenges and opportunities for the Programme. WCRP is expected to be flexible and agile in responding to constantly expanding users needs, particularly:

- at regional scale,
- for key sectors of global economy, and
- for adaptation, mitigation and climate-related risk management.

Dr. Busalacchi recalled the list of the GCs and how the WCRP structure was evolving to reflect the requirements of the society and natural boundaries between the main components of the climate system. The WCRP planning activities and its structure, which are shown in the two following figures, reflect the requirements for optimal coordination of climate studies.





Dr. Busalachi then introduced the new members of JSC, as follows:

- Stephen Belcher, MetOffice Hadley Centre, UK;
- Guy Brasseur, German Climate Service Center;
- Anny Cazenave, LEGOS, France;
- In-Sik Kang, Seoul National University, Republic of Korea;
- Rodney G. Martinez Guingla, CIIFEN, Ecuador;
- Mauricio M. Mata, FURG, Brazil;
- James Renwick, Victoria University of Wellington, New Zealand; and
- Soroosh Sorooshian, University of California, Irvine, USA.

The JSC-34 session in Brasília is expected to continue the scientific planning of WCRP activities and review progress on decisions made by JSC at its previous 33rd session. In Beijing, China, on 17-20 July 2012, the JSC-33:

- agreed to rollout the GCs;
- finalized the ToRs of WMAC and WDAC;
- agreed with projects on their main future directions and titles;
- initiated the WGRC;
- decided to conduct the African and Latin American and Caribbean climate conferences;
- reviewed main avenues to contributing to the GFCS, Future Earth and Framework for Ocean Observing; and
- revised approach on nominations and selection of WCRP working bodies.

These decisions shaped the agenda of JSC-34. After the dialogue with Sponsors, JSC will embark on considering the progress in planning of the WCRP GCs. Tony Busalacchi reminded to JSC the definition of a WCRP GC. A Grand Challenge is both highly specific and highly focused identifying a specific barrier preventing progress in a critical area of climate science. This focus enables the development of targeted research efforts with the likelihood of significant progress over 5-10 years, even if the ultimate success is uncertain. It should thus enable the implementation of effective and measurable performance metrics. By being transformative, a Grand Challenge should bring the best minds to the table, building and strengthening communities of innovators that are collaborative, perhaps also extending beyond "in-house expertise". It can capture the public's imagination: teams of world-leading scientists working to solve pressing challenges can offer compelling storylines to capture the interest of media and the public.

The view of the JSC Chair on the process of reviewing WCRP GCs was that the GCs need to transition to implementation mode. It is understood that overall a GC may

take 5-10 years to develop and that it may be subdivided into sub-initiatives. The JSC does not want to be prescriptive with respect to approach to GCs and recognizes that one approach may not fit all GCs. The JSC would therefore wish to see the following proposals from responsible projects:

- GC Leadership/PoC (e.g., chair, core project affiliated scientist, or new SSG member);
- Ideas on potential formation of a steering group or/and conducting a kick-off workshop or several workshops and on any other initial actions of the GC,
- Intra project assessment/alignment with regard to GC;
- Ideas on cross project coordination; and
- Well-defined Implementation Plan.

The position of JSC Chair was that the work of responsible project on a GC would not mean to come at expense of existing core project activities. He asked the designated leads to address progress to date, impediments, implementation schedules, cross-project interdependencies, and coordination. In addition, he asked the presenters to address issues raised at JSC-33 as documented in the JSC-33 report, both for GCs and projects.

Dr. Busalacchi then presented to the JSC the main outcomes of the WCRP's report to the the 65th Session of the WMO Executive Council, which took place In Geneva, Switzerland, one week before the JSC-34. The Council acknowledged with appreciation that the WCRP was organizing a series of regional projects, conferences, capacity development and training activities focusing on the role of science in climate services and risk management. The Council encouraged WMO Members to participate in the WCRP/ACPC Conference on the African Climate System - Addressing Priority Research Gaps to Inform Adaptation Decision-Making in Africa that will take place from 15-18 October 2013 in Arusha, Tanzania. The Council was also pleased to note that the WCRP was organizing a Conference on Climate and Society for Latin America and the Caribbean scheduled for March 2014 in Montevideo, Uruguay. The Council recognized the key contribution of the WCRP to the Global Framework for Climate Services in addressing the needs for science-based climate information at global and regional levels. The Council endorsed the recommendations of JSC-33 with respect of the six GCs and recognized that these grand science challenges were intended to integrate scientific activities across the four WCRP core projects and the various WCRP Working Groups and Panels to deliver "action-oriented" climate information for decision makers in support of the GFCS and Future Earth. The Council welcomed the establishment of a new WCRP Working Group on Regional Climate (WGRC), which will provide strategic advice on regional aspects of climate science, relevant aspects of climate services and vulnerability, climate variability and change, and climate impact and adaptation applications, and will as well contribute to the four near-time priorities of the GFCS and serve as the WCRP interface with the GFCS User Interface Platform.

Dr. Busalacchi then discussed the progress of the new Future Earth (FE) initiative. FE will build upon and integrate the existing Global Environmental Change (GEC) Programmes – WCRP, the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme for Global Environmental Change (IHDP), DIVERSITAS – biodiversity science, and the Earth System Partnership (ESSP). It will also have to expand significantly beyond the existing global networks and engage new institutions and researchers. It must ensure research excellence by being open and inclusive and by attracting the brightest minds from a broad range of disciplines and countries.

FE looks to WCRP to provide the research foundation for the physical climate system across observations, modelling and prediction, and interface to climate services, and the WCRP looks forward to supporting FE in this regard.

With respect to membership of the WCRP working bodies, Dr. Busalacchi reminded to the Session that at JSC-33, the Committee created a 'membership committee' within the JSC, comprised by the Officers and chaired by the JSC Vice-Chair. Their task is to work with each working group and steering group (on a suitable annual schedule) to fill a slate of candidates, one for each vacant position, but with serious attention to the gender, regional balance, and age issues. This committee is charged with ensuring that the process starts early, is completed in a timely manner, and that a well-considered slate of candidates is presented to the JSC along with all pertinent information, so that JSC could approve this slate being confident that it is the best achievable and that JSC guidance was well-considered.

Dr. Busalacchi also highlighted the importance of active and skillful communication across the WCRP. Since the JSC-33, the WCRP has prepared an Accomplishment Report, has been actively supporting the engagement of Early Career Scientists and developing core project outreach.

Chair's expectations for the week of JSC-34 session were to clearly understand where the Programme stands in planning and implementing the GCs, with respect to the progress of core project activities, in development of communication across the WCRP, in progress of WMAC and WDAC, in continued engagement with partners, especially with other GEC programs and FE during the transition period, and in further refinement of the new approach to working bodies membership.

Before concluding, Dr. Busalacchi warmly thanked three outstanding climate scientists - Martin Visbeck, Gerry Meehl, and Kevin Trenberth - who were expected to step down from their WCRP duties at the end of 2013 for their long and extremely productive service to WCRP and climate science.

The meeting agenda, as presented by the Chair, was then unanimously accepted. The list of JSC-34 attendees is given in Appendix A. The final agenda is available in Appendix B. Appendix D contains a list of actions agreed at JSC-33 and information on the status of their completion. Appendix F contains a list of used abbreviations. PDF versions of presentations made at JSC-34 are available for download at the JSC-34 webpage http://www.wcrp-climate.org/JSC34/index.html (follow the link to "Presentations").

3. Dialogue with Sponsors and Stakeholders

This part of meeting agenda was aimed towards receiving guidance from WCRP Sponsors and included briefings on main initiatives, to which the Sponsors were assigning the highest priority.

3.1 WMO and the Global Framework for Climate Services

The presentation by Jerry Lengoasa, the Deputy Secretary-General of WMO, was given by videoconferencing. Jerry Lengoasa reaffirmed to WCRP the support of WMO as a Sponsor. He informed the JSC that the WMO Executive Council (EC)

reviewed the status of WCRP at its recently finished 65th Session and that the EC has endorsed several WCRP initiatives.

WMO is an observer in the Science and Technology Alliance for Global Sustainability that leads the development of the FE initiative. The WMO EC-65 noted with appreciation the significant progress on development of the plan for the Initiative and noted that linkages between GFCS and the Future Earth Initiative would be mutually beneficial to both ICSU and the WMO and would strengthen the existing partnerships as well as create opportunities for the advancement of research in the Earth System science, as well as climate services.

Mr. Lengoasa briefly reviewed the GFCS status and related developments. The main vision of the Framework is to enable better management of the risks of climate variability and change and adaptation to climate change through the development and incorporation of science-based climate information and prediction into planning, policy and practice at the global, regional and national scale. This was the main statement of requirements given by the international community at the WCC-3 in 2009. Accordingly, the Framework intends to close the gap between those that need to know the climate and those that have such knowledge, thus empowering in particular the vulnerable. Nearly 70 countries around the world (according to a WMO 2010 survey), mostly least developed countries, do not have the capabilities to generate and apply climate information. In most developing countries, the observations, which are critical for understanding climate, its variability and changing patters and for producing predictions and projections into the future, are decreasing.

The WCRP Open Science Conference (OSC) made it clear that what was needed was not just good science, but also what we now refer to as "action-oriented" science. WCRP has taken this on board in its planning and has created a Working Group on Regional Climate (WGRC) to provide the interface between researchers and the GFCS delivery of services.

Mr. Lengoasa attached big importance to WCRP commitment to lead the GFCS implementation in all aspects related to research, modelling, prediction and research – based observations. He recalled the following main objectives of the GFCS Research Pillar:

- Improve understanding of Earth's Climate and assess impacts of climate variability and change on people, ecosystems and infrastructure;
- Enhance interaction and cooperation between researchers and climate information users;
- Target research towards developing and improving practical applications and information products in the four priority areas; and
- Enhance science readiness level for production of climate projections, predictions and user-tailored climate information products.

Main points raised during discussions:

WCRP should engage JSC and WCRP constituencies in implementation of the Research, Modelling and Prediction component of GFCS, for which WCRP has the lead, involve in this work the National Hydrometeorological Services (NMHSs) and academic/university science, and make an effort on achieving successful outcomes during the initial stage of GFCS implementation, particularly with regard to the activities listed in the GFCS Compendium with WCRP as the lead agency, focussing on GFCS initial priorities: water resource management, food security and agriculture, disaster risk reduction, and human health protection.

All WCRP Core Projects were encouraged to consider involving NMHS, as appropriate, in their GC activities and in WCRP and projects' regional and topical science conferences. Continued strengthening of cooperation between WCRP and the WMO Technical Commission for Climatology (CCl) was highlighted as a requirement.

3.2 ICSU and Future Earth

Steven Wilson introduced to the JSC the main ideas behind the new major research initiative, the "Future Earth" (FE), the current status of its planning and corresponding changes in the Global Environmental Change (GEC) Programs. FE is intended to provide the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability in the époque of anthropocene. FE is led by the Science and Technology Alliance for Global Sustainability. In 2013-2015 FE will replace the GEC Programs and the Earth System Science Partnership. It will operate as a global platform that

- augments earth system science with the one of impacts of environmental change on people, adaptation and transformation;
- delivers interdisciplinary research on GEC for sustainable development; and
- strengthens partnership between researchers, funders, and users using the principle of co-design.

Dr. Wilson introduced the conceptual framework of FE, which will include such considerations as human and natural drivers of change, human wellbeing, environmental changes and use them to seek pathways to sustainability. Its three main research themes will be the "Dynamic Planet", "Global Sustainability", and "Transformations toward sustainability". Cross-cutting capabilities in science and outreach will facilitate integration across research themes. The following categories of activities will be largely delivered through partnerships:

- Observing systems;
- Data Systems;
- Earth System Modelling;
- Theory Development;
- Synthesis and Assessments;
- Capacity development and education;
- Communication; and
- Science-policy interface and interactions.

Dr. Wilson then introduced the current status of the FE preparation, initiation of the FE Science and Engagement Committees and establishment of the Governing Council. An interim director and secretariat are being put in place and a process is starting to arrive at permanent arrangements. DIVERSITAS, IGBP, IHDP will merge into FE from mid-2014 onwards. GEC projects are invited to become part of Future Earth through phased approach and asked to consider their scientific readiness, benefits, and stability. The next projects conference will be organized in July – September 2013.

Main points raised during discussions:

The discussions of the FE had started at JSC-34 already after the presentations by Tony Busalacchi and Jerry Lengoasa. The additional points raised after the speech

by Steven Wilson were as follows. There are many joint activities of between WCRP and IGBP. Their continuity is important for successful continuation of the global change research. WCRP projects and constituencies engaged in joint activities with IGBP (such as IGAC, iLEAPS, AIMES, IMBER, PAGES, SOLAS) were therefore encouraged to monitor their status and continuity. There must be readiness for some rearrangement of joint activities.

3.3 IOC and Integrated Framework for Sustained Ocean Observations

Captain Frederico Antonio Saraiva Nogueira started the IOC presentation by a short introduction into the role and the history of the Commission and listed the IOC's four high-level objectives (HLOs):

- Preventing and reducing impacts of natural marine hazards,
- Mitigating impacts and adapting to climate change,
- Safeguarding health of ocean ecosystems, and
- Promoting policies for sustainability.

The pillars for achieving these objectives are:

- Ocean research,
- Observing system and data management,
- Early warning services,
- Assessment and provision of information to policy,
- Support to sustainable management and effective governance, and
- Overarching capacity development.

WCRP is an essential element for achieving the IOC goals in HLO 2 and a key linkage between the IOC and the UNFCCC and IPCC. Together with GOOS and GCOS, WCRP sponsors the Ocean Observations Panel for Climate (OOPC). WCRP develops research that serves as the basis for ocean observations and is therefore a key partner for GOOS. The most successful component of GOOS over the past decade has been its climate module. The growth of a number of observing networks (particularly Argo, surface drifters, and tide gauges) has led to a strong rise over the last decade in the assessed level of implementation of this system, but other components have not grown to the requirements expressed by climate science. Implementation of many elements of GOOS will be invariably funded on the local or national level and reflect the local and national priorities. Promotion of global standards and data sharing will allow for global research and regional and global assessments of the marine environment that will be key to better stewardship of the oceans and sustained benefit from the ecosystem services they provide.

The implementation of the "Framework for Ocean Observing" (FOO) will constitute a strength factor for improving GOOS as a global sustained observation network. Its genesis comes from the OceanObs'09 conference, which took place 21-25 September 2009 in Venice, Italy, and was co-sponsored by WCRP. The conference identified tremendous opportunities to expand ocean observing capabilities and noted significant challenges. The conference, among other things, called for the development of a Framework for planning and moving forward with an enhanced global sustained ocean observing system over the next decade, integrating new physical, biogeochemical, and biological observations while sustaining present observations.

The FOO high-level objectives are to:

- Take lessons learned from successes of existing observing efforts (best practices);
- Guide observing community as a whole to sustain and expand the capabilities of the ocean observing system;
- Deliver and observing system that is fit-for-purpose; and
- Promote collaborative alignment of independent groups, communities and networks, building on existing structures as much as possible.

A key idea in the Framework is the definition of Essential Ocean Variables, which have some overlap with other types of essential variables that have been defined, such as Essential Climate Variables defined by GOOS and GCOS, Essential Variables defined by WMO for weather forecasting, and Essential Biodiversity Variables that are being defined by GEO Biodiversity Observation Network (GEO BON, although largely focused on terrestrial variables). Essential Ocean Variables should respond to high-level requirements related to climate, understanding and managing ecosystem services, conserving biodiversity, managing living marine resources, and to safety and protection of life and property at sea and on the coasts. Aligning the coordination processes of the observing system by variables, rather than by platforms or observing techniques, stays truer to the natural system which we are trying to observe, while allowing for innovation of observing techniques over time as technology and capability develop. Different observing units or networks measure different Essential Ocean Variables and contribute to different data streams and products. Argo is an important one. These products then help inform climate research and societal decisions about climate. The current model helped feed our vision for moving forward from 2010.

FOO should try to respond to different scientific questions and societal benefits that require sustained ocean observations, including biodiversity, regional seas and regional fisheries management organizations, global fisheries agreements, global marine assessments, and the development of ecosystem-based approaches to management of the ocean environment. Many of these will be impacted by ocean acidification and will need such observations, as well as physical and other biogeochemical and biological sustained observations. A central concept of the Framework is that the nations of the world cannot afford multiple ocean observing systems each responding to different expressed requirements and that one integrated system that responds to many different requirements will be far more fruitful.

WCRP has played an important role in the ocean research coordination function of IOC and contributed to many important assessments informing the policy. WCRP has played a strong role in the observing system function as well. IOC hopes that WCRP can play a growing role in developing climate services, as well as in capacity development. These are areas of effort that are needed to provide the maximum benefit of climate research to society.

<u>Main points raised during discussions:</u>

The following comments were made on the IOC presentation. The renewed CLIVAR priorities are closely matching IOC objectives and interests. Stronger interactions with the IOC regional structures could serve well both the development of observing systems, research and services. The WCRP, through activities of CLIVAR, responds to the proposal from IOC to initiate some research work on upwelling systems, together with the IGBP IMBER project, which would include not only physical

processes but also some biogeochemical issues. JSC was pleased to note the IOC's appreciation for WCRP support and sponsorship of OOPC and Indian Ocean Panel. WCRP contributions to IOC priorities also include research in favor of GOOS and ocean reanalyses. WCRP is stepping up its activities in capacity development and oceanographic contributions to climate services.

4. JPS developments, program, personnel, and budget

Ghassem Asrar reported on the status and activities of the Joint Planning Staff – the WCRP Secretariat, on major activities since JSC-33, such as conferences, meetings, other events, and major publications. He also presented to the JSC the WCRP budget for 2012 and 2013 and the future activities that WCRP is planning to support.

The JPS is at present fully staffed. The Geneva JPS office is complemented by Ms. Catherine Michaut working at the French WCRP Support Unit located in Paris.

The Climate and Cryosphere project has the new SSG Chair, Gregory Flato, and the CliC International Project Office (IPO), headed by Jenny Baeseman, has acquired an administrative officer, Heidi Isaksen.

Martin Visbeck and Lisa Goddard are Co-chairs of the CLIVAR SSG, and the distributed International CLIVAR Project Office (ICPO) has a new director, Roger Barry; project scientist Anna Pirani, located in Trieste, Italy; Nico Caltabiano, Tim Waterfield, and Jennifer Riley in Southamption, UK; Carlos Ereno in Buenos Aires and Xiaohui Tand in Quingdao, China. The move of ICPO from Southampton and planning for establishment of a distributed office in China, India, and Italy is underway.

Kevin Trenberth is the Chair of GEWEX SSG. Howard Wheater is the Vice-chair of GEWEX SSG. The International GEWEX Project Office in Columbia, Maryland, USA is headed by Peter van Oevelen and includes Sam Benedict, Dawn Erlich, and Shannon Macken.

Joan Alexander and Gregory Bodeker are the SPARC Co-Chairs. The SPARC IPO is located in Zurich, Switzerland. Johannes Staehelin is the Director, and the staff includes Carolin Arndt, Fiona Tummon, and Anke Witten. Diane Pendlebury is the SPARC Project scientist based in Toronto, Canada.

Dr. Asrar continued his presentation by showing several examples of the events that were supported by WCRP in 2012-2013. WCRP conducts a significant number of events per year and their scope is sufficiently wide embracing all aspects of climate science and research-based observations and applications. WCRP working bodies meet regularly. WCRP is committed to sponsor participation of students and early career scientists (ECSs) in its meetings.

The WCRP budget is stable due to the sponsors' contributions and national contributions (26 countries) under ICSU, despite the reduction of the IOC's financial support due to UNESCO financial limitations. Dr. Asrar provided an overview of key meetings that WCRP will be supporting in 2013-2014 in response to priorities identified by core projects, and other WCRP working bodies, including events identified as needed to support the work on GCs. He concluded by stating that

- WCRP support for high priority climate science activities continues to grow;

- Focus on WCRP Regional Climate Science and GCs was gaining momentum;
- Future plans and priorities of core Projects were emerging with excellent support by their respective networks of scientists and sponsors; and
- WCRP financial status remained sound.

Main points raised during discussions:

The JSC discussed the report of D/WCRP and noted:

- Successful WCRP accomplishment report published in 2013;
- Increased support that WCRP provides to ECS;
- Strong support by JPS to all WCRP activities and full staffing of JPS;
- Successful follow-up on JSC-33 recommendation to seek funding support from development banks;
- 25% increase in national contributions to JCRF since 2010; and
- Fruitful cooperation of WCRP and support from APN and START.

5. Agency Updates

Updates on WCRP-relevant activities were presented to JSC-34 by NOAA; CEOS, CGMS, and EUMETSAT; and ECMWF.

5.1 NOAA

Richard Rosen started his presentation by noting the rising demand for climate science and services. This demand is reflected in the NOAA Strategic Plan, which identifies the following "Climate Goal Objectives":

- Improved scientific understanding of the changing climate system and its impacts;
- Assessments of current and future states of the climate system that identify potential impacts and inform science, service, and stewardship decisions;
- Mitigation and adaptation efforts supported by sustained, reliable, and timely climate services; and
- A climate-literate public that understands its vulnerabilities to a changing climate and makes informed decisions.

All five NOAA line offices will be contributing to climate research and development of corresponding services. The scope of research will include several societal challenge projects focusing on sustainability of marine ecosystems, coasts and climate resilience, climate impacts on water resources, and weather and climate extremes.

Main points raised during discussions:

The JSC noted productive cooperation between WCRP and NOAA, strong alignment of the WCRP GCs with NOAA priorities, and the high demand for climate services and science support to them. JSC found it logical and beneficial both for weather and climate services to strengthen the interface between the weather- and climate-related research and operational activities. It highlighted the urgent need to achieve progress in attribution and prediction of extreme events. The considerations of the US Global Change Research Program on organizing an interagency group on climate aspects of water resources management could be a valuable contribution to the WCRP Water Availability GC.

In conclusion of this agenda item, D/WCRP warmly thanked NOAA for many years of supporting WCRP, especially the CLIVAR and GEWEX office activities.

5.2 CEOS, CGMS, and EUMETSAT

Joerg Schulz gave a series of presentations on CEOS, GCMS, and EUMETSAT.

The CEOS presentation co-authored with Mark Dowell and John Bates was on the activities of the CEOS Working Group on Climate (WGClimate). The Working Group mission is to facilitate the implementation and exploitation of Essential Climate Variable (ECV) time-series through improved coordination of activities. The group was endorsed by CEOS as a full CEOS Working Group (WG) to coordinate and encourage collaborative activities between the world's major space agencies in the area of climate monitoring. The Group addresses 47 different Actions of the GCOS Implementation Plan and the Satellite Supplement to it. The overall idea of the group functioning is to develop stewardship and metrics and ECV inventories and assessments to further develop and optimize the architecture for climate monitoring from space. The monitoring requirements, principles, and guidelines, current state-of-the-art, a roadmap and specific recommendations for further development are summarized in the Strategy Report on Climate Monitoring Architecture. It also serves as a basis for the GFCS Monitoring and Observation Pillar and is used to develop a coordinated action plan to address identified gaps and shortfalls.

WGClimate and CGMS initiated a web-based ECV Inventory Questionnaire on usage, stewardship, properties of ECVs and issues related to access to them, such as formats. The Questionnaire addresses ECVs at the level of individual datasets and contains two separate parts for existing/past and future/planned missions. Approximately 220 responses have been received with good breakdown across domains. This active response offers a possibility to conduct a gap analysis and to understand what is observed but not used. This ECV Inventory will remain continuously open for submissions and analysis. There are multiple ideas on the further use of this inventory. Two of them are to cluster climate observation applications with respect of GFCS priorities and WCRP GCs. Combining polar and geostationary missions can help to produce optimized products for a number of ECVs.

The WGClimate activities can strongly contribute to the climate data stewardship proposed by GCOS and WCRP in 2010 and help to ensure transparency, traceability and sound scientific judgment in generation of climate datasets. The consistency of GCOS/WCRP questionnaire with the ECV Inventory of WGClimate needs therefore to be checked and then the CGMS, WCRP and GCOS will be able to work together to identify expert groups producing and capable of assessing datasets, define best practices in this work, establish assessment teams that have adequate resources and nominate appropriate bodies to review these assessments. The feasibility of extending this work to in-situ data should be evaluated as well. CEOS and CGMS could provide the infrastructure/database for this work, and GCOS, WCRP, and WMO would solicit in-situ contributions.

The CGMS high-level priority plan (HLPP) has been endorsed by the 40th CGMS plenary meeting in November 2012. This rolling 5-year (2013-2017) plan is seen as part of a longer-term perspective with regard to the new challenges for climate monitoring raised in the context of the GFCS. It will be reviewed on an annual basis, considering in particular new requirements and perspectives arising from interactions with the user and scientific communities, the development of applications, and

relevant research activities. One of the HLPP top-level priorities is "Advancing the architecture for climate monitoring from space". The plans include an extension of the Global Space-based Inter Calibration System (GSICS) and the Sustained, Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM). A call for SCOPE-CM projects was issued in December 2012. 10 letters of intent were received and accepted, and implementation of the projects will start in January 2014.

Dr. Schulz also gave an update on the EUMETSAT climate activities. The EUMETSAT Council in November 2012 endorsed its Climate Monitoring Implementation Plan that contains the EUMETSAT Data Set Generation Plan and details all records to be produced by the Central Facility and all SAFs until 2017. This plan also covers needs for NWP model-based reanalysis and supports generation of data records contributing to 17 ECVs (10 atmospheric, 2 oceanic, and 5 terrestrial). The Central Facility in Darmstadt has the main responsibility to create FCDRs for all EUMETSAT instruments. This plans supports the European Re-Analysis of Global Climate Observations. The EU FP-7 ERA-CLIM 2 project (2014-2016) is under negotiation. If endorsed, it has the potential to consolidate the ERA CLIM data records with further improvements in calibration and algorithms and lead to temporal extensions and further homogenization of data records, product definitions and formats. The EUMETSAT plan contains some flexibility to accommodate data needs from other activities.

WCRP and EUMETSAT, in partnership with GCOS, CEOS and CGMS, organize a conference "Climate Research and Earth Observations from Space: Climate Information for Decision Making" (Darmstadt, Germany, 13-17 October 2014). Its main goal is to provide a forum for discussion of the state of the science and observations in order to evaluate achievements from and critical issues with satellite-derived climate information. A further priority is to identify gaps in the current space-based climate observing system. The reference for this discussion is the current Architecture for Climate Monitoring from Space. In the science area the conference will initiate a process for creating a post-IPCC-AR5 joint action plan for development of observing systems, with a focus on the space component. The conference will be an important step towards turning requirements, achievements and future priorities into true drivers for cooperation in the development of an efficient and sustained international space-based Earth observing system.

The following Conference outcomes are anticipated:

- Recognition of recent scientific achievements related to the production and use of high-quality and innovative science-based observational datasets;
- Recommendations for additional research and observations needed to increase the value and improve sustainability of high-impact science-based climate information obtained from satellites. The focus is on Climate Data Records, including ones resulting from reprocessing of historical observations, innovative use of multiple streams of observations for study of complex processes and phenomena such as modes of variability in the oceans, atmosphere and interactions within the Earth system;
- Identified pathways for productive collaborative work on the development of satellite-based climate observations in support of climate prediction;
- Update on stock of relevant methods applied to satellite data with a view to provide better science-based applications supporting climate discussions at all levels; and
- Discussion of the inherent uncertainties associated with satellite observations and best methods to account them in climate modelling and reanalyses.

Main points raised during discussions:

JSC expressed its deep gratitude to J. Schulz for the important presentations and his active and very productive involvement in WCRP activities over many years.

The JSC concluded that WCRP needed to consider ways of participating in and contributing to the CEOS Strategy Report on Climate Monitoring Architecture and provide to CEOS WGClimate a list of working groups that are in position to contribute to inventory of data and data products such as FCDRs and assessment of ECVs. An effort to include data and products based both on Earth observations from space and in-situ should be encouraged. In partnership with EUMETSAT, GCOS, CEOS, and CGMS, WCRP should continue preparations of the conference "Climate Research and Earth Observations from Space: Climate Information for Decision Making" with a view of contributing to co-design of an effective future space architecture for climate monitoring.

5.3 ECMWF

Adrian Simmons updated the JSC on the developments at the ECMWF foccusin on issues of great significance for climate research.

ECMWF has a continuing focus on a more seamless approach to its global prediction and has supported the proposal of WWRP to initiate the programme "Predicting Weather and Climate Extremes" to replace THORPEX in 2014. The timescale of predictions under this programme would be out to one year and therefore a link between WWRP and WCRP would be critical to the success of this programme. The THORPEX Data Assimilation and Observing Systems working group would continue and support the programme and a role for WGNE is also foreseen. If successful, the Programme will provide a key opportunity for modelling of events that have to be both forecast and represented in climate models. The scope of the Programme corresponds to the time range for which the growth of systematic model errors may be the largest and most susceptible to diagnosis and where lessons may be learnt from models used in data assimilation.

The medium- and monthly-range prediction systems at ECMWF move towards the use of coupled ocean model from day 0 (rather than day 10), with developmental emphasis on the resolution and mixed-layer representation of the ocean model and incorporation of a sea-ice model from the EC-Earth. The seasonal-range prediction system will be further developed with blending of products with those from monthly-range forecasting, and investigation of capabilities of the two systems for drought forecasting and disease prevention. The system will include the sea-ice model and will undergo other developmental activities for snow-cover, vegetation, volcanic aerosol and stratospheric representation, predominantly through external project funding. The development of the data assimilation includes a move to longer time windows and better, more dynamic representation of the background and analysis uncertainty.

ECMWF is actively continuing the development of the EU "Copernicus" (previously GMES) services, which include:

- coordinated development of core Atmosphere Service (GEMS/MACC) since 2005;

- global reanalysis efforts in Europe for twenty years, with intermittent support from the European Union through FP3, FP5 and FP7 (twice); and
- involvement in other climate monitoring projects and core Marine Service project.

The ECMWF reanalysis is an essential component of climate services. In 2011-2013 ECMWF was involved in the ERA-CLIM, in which nine partners were preparing input observations, model data, and data assimilation systems for a global atmospheric reanalysis of the 20th century. This activity includes

- Data rescue efforts (in situ, upper-air and satellite observations);
- Incremental development of new reanalysis products;
- Use of reanalysis feedback to improve the data record; and
- Access to reanalysis data and information on observation quality.

Various outputs of this effort are at different stages of completion. The ensemble model integrations for 1900-2010 have been completed. Updates on reanalyses using improved surface observations and climate forcing outputs for the same period will be completed in 2013. A new reanalysis to replace ERA-interim for the satellite era will be available in 2015.

The next step will be production of a consistent 20th-century reanalysis for major components of the earth system: atmosphere, land surface, ocean, sea-ice, and the carbon cycle. This ERA-CLIM2 Project (2014-2016) will be built on ERA-CLIM and parallel development of ocean and carbon-cycle reanalysis. Its main components will be

- Production of coupled reanalyses CERA-20C and CERA-SAT;
- Research and development in coupled data assimilation;
- Earth system observations for extended climate reanalysis; and
- Quantifying and reducing uncertainties.

Main points raised during discussions:

The JSC was very impressed with the scope and pace of developments at ECMWF and noted with interest the expanding contribution of ECMWF to the emerging climate services. It also noted that the ECMWF proposal for a new Prediction of Weather and Climate Extremes Programme to replace THORPEX would likely lead to overlaps with S2S and PCPI and may result in overlapping communities of participants. It indicated that S2S already had a demonstration subproject on extremes.

6. WCRP Grand Science Challenges

Development of implementation considerations and plans for GCs constituted a key component of JSC-34 agenda. The discussions started in the afternoon of the first day of the meeting and were finished on the second day, which was concluded by reports by the two WCRP Councils. All six GCs were discussed in detail starting with the Regional GC.

6.1 Regional climate information

This agenda item included a report on the status and developments with WGRC, CORDEX, an update on forthcoming WCRP regional events, an update from APN, and a detailed presentation by CLIVAR on the implementation considerations for this GC.

6.1.1 WGRC

Ghassem Asrar presented the WGRC report to JSC on behalf of the WGRC Co-chairs, Clare Goodess and Bruce Hewitson. The 1st Session of WGRC took place on 6-7 April 2013 in Vienna, Austria and was hosted by the Austrian Central Institute for Meteorology and Geodynamic (ZAMG). This inaugural meeting was largely devoted to defining WGRC capabilities, responsibilities, and future activities. In the result, the Group proposed some changes in its ToRs, which JSC-34 was asked to review and endorse.

WGRC also discussed its future work. It agreed to develop an action plan to guide activities of the WGRC and to mobilize community interest and required resources to implement it. WGRC will also prepare a short contribution for the WCRP website introducing the Group perspectives on caveats associated with the available regional climate information products, some future products under development, and user perspectives on CORDEX. The Group will review the Annexes and Exemplars of GFCS implementation plan and provide comments to the WCRP JPS for integration and inclusion in the plan as well as input to further discussion during the next WGRC meeting. The WGRC is also planning to participate in the FE webinars and future events. Reviewing the GFCS documentation and FE plans will help WGRC to start drafting a commentary document describing its role vis-a-vis these initiatives. WGRC agreed to establish links with relevant WCRP working bodies and to start this by communicating with WGCM and WGSIP.

WGRC agreed that since its main charge is to mainstream the use of and improve regional climate information, it has to develop a skeleton (including scope) of a guidance document on use of climate information. Also, they will prepare a short concept note, brochure, and slides as a communication package on science-based regional climate information.

The Group recommended William Gutowski to replace Colin Jones as a CORDEX Co-chair and also agreed to recommend to CORDEX Co-chairs additional names as possible candidates for SAT.

Main points raised during discussions:

JSC thanked Claire Goodess, Bruce Hewitson, and the whole group for excellent and thoughtful start of their activities. The JSC guidance for WGRC was as follows. WGRC should keep under review all sources of science-based regional climate information. While modelling was the main focus for CORDEX, WGRC should also keep under review the regional climate information based on observations and consider observations requirements for regional climate services. The Climate Service Partnership could be a useful contact for WGRC work in support of climate services. However, given richness of all possible user requirements and diversity of users, desired focus of WGRC should be more on science support rather than on judgements about user requirements. For example, WGRC can be very instrumental in identifying and recommending to WCRP regional scientific issues that WCRP

could address. JSC did not see a big advantage in having a very long set of WGRC ToRs, particularly because the WGRC, like all WCRP groups, is based on the voluntary membership. JSC reiterated in this regard that WGRC is expected to be instrumental in helping CLIVAR to develop an Implementation Plan for the Regional GC. For that WGRC may be asked to develop position papers on various aspects of such a Plan. There was a clear consensus in the audience that WGRC in particular and WCRP as a whole should continue to focus primarily on science that underpins climate services.

The Committee considered the proposed ToRs in detail and approved them with some minor modifications. The endorsed ToRs are given in Appendix D to this report. One strong recommendation from JSC to WGRC was to ensure that members of WGRC representing projects should not only work within WGRC but also serve as active liaisons between WGRC and project regional activities. This is especially true for GEWEX and CLIVAR who have active regional constituencies such as GEWEX GHPs and CLIVAR regional projects. It is therefore important that such WGRC project liasions participate in corresponding project meetings such as SSGs. WGRC proposal on membership issues were taken up by JSC-34 under the corresponding agenda item.

6.1.2 CORDEX

Filippo Giorgi presented CORDEX to JSC-34. This modelling framework was designed to:

- evaluate and improve RCD models and techniques;
- provide a coordinated set of RCD-based projections and predictions for regions worldwide; and
- facilitate the communication with the impacts, adaptation and vulnerability community and involvement of the research communities from developing countries in climate research.

The original Task Force on Regional Climate Downscaling (TFRCD) was terminated after successfully completing its mandate. CORDEX activities are now a major part of the scope of work of the newly formed WGRC. The CORDEX Science Advisory Team (SAT) was established and co-chaired by Filippo Giorgi and Colin Jones. CORDEX needs another Co-chair because Colin Jones had to step down, after several years of excellent work, due to a job change. Michel Rixen is supporting SAT coordination from WCRP JPS.

CORDEX has been active in promoting and expanding the Framework, taking advantage of large meetings such as EGU and AGU sessions. Many groups and modelling communities (e.g. WRF, RegCM, PRECIS) are completing ensembles of simulations over various domains. Many articles are appearing in leading research journals referring to the Framework. As an example, Filippo Giorgi demonstrated CORDEX activities of the RegCM model community, which conducted 34 scenario simulations for 1970-2100 over 5 CORDEX domains using RegCM4 model driven by three GCMs, forced by 2 representative concentration pathway scenarios (RCP4.5/8.5), and using several packages of physical parameterizations. The volume of the produced data is about 200 TBs.

Regional activities of CORDEX are growing rapidly. In Africa, 10 groups completed the first ERA-Interim driven runs and 14 groups completed different scenario runs. The Africa – CORDEX formed a diagnostic – metrics team under the leadership of Bruce Hewitson and his team at the University of Cape Town, South Africa. Support

to this work comes from START, WCRP, SMHI, ICTP and several NGOs. The team met in Cape Town in April 2010 and conducted the following workshops:

- training workshop in Trieste, March 2011,
- training workshop in Cape Town, November 2011, and
- paper writing workshop in Trieste, April 2012 (three papers produced).

27 modelling groups participate in Euro-CORDEX coordinated by A. Gobiet (http://www.euro-cordex.net). Participants had three meetings in November 2011 (Hamburg) and at the EGU Sessions in 2012 and 2013. The Euro – CORDEX simulations are made at 50 km and 12 km horizontal grid spacing, and the data is stored at DKRZ, SMHI, BADC, and DMI.

MED-CORDEX coordinators are S. Somot and P.Ruti. 11 modelling groups are participating. Meetings were held in March 2012 in Toulouse and at EGU 2013. The modelling using coupled and atmosphere-only models is underway or planned at the 50 km, 25-30 km (coupled), and 12 km horizontal grid spacing. The output is stored at ENEA.

The CORDEX – East Asia coordinator is W.T. Kwon. 9 modelling groups are participating. A regional meeting was in September 2012 on the Jeju Island followed by an APCC training workshop in Busan, South Korea in August 2013. Regional simulations are under way or planned at 50 km and 12 km horizontal (for some sub-regions) grid spacing. The data is stored at KMA.

The CORDEX – South Asia coordinator is K. Krishnan. 10 modelling groups are participating. A planning meeting in February 2012 and a training meeting in October 2012 were held in Pune. Three training workshops are planned, with the first in Kathmandu in August 2013. Model output data will be hosted at IITM.

The CORDEX Central and South America coordinator is S. Solman (CIMA). A joint VAMOS/CORDEX training workshop is being organized in Lima, September 2013, and a training workshop is planned in Encenada, Mexico, in October 2014.

There is no formal CORDEX activity in North America, and the regional activities are largely associated with NARCCAP.

Emerging CORDEX activities include analysis of change in tropical cyclones, development of regional activity in the Middle East and polar regions, especially in the Arctic. CORDEX includes not only dynamical RCD but also keep under review statistical downscaling methods. A major workshop is being organized on statistical downscaling under the sponsorship of U.S. National Science Foundation (NSF) in Trieste, Italy, in August 2013.

A significant change is occurring in the CORDEX data management. CORDEX data will be saved and distributed through the Earth System Grid (ESG) as it is done for CMIP and re-analyses activities. The system will include a file/format compliancy checker prior to the data upload. CORDEX nodes are planned at BADC, DKRZ, DMI, SMHI, ENEA, UCT, IITN, and KMA. A virtual node is being tested at SMHI.

A major event, not only for CORDEX but also for the whole WCRP, is the International Conference on Regional Climate – CORDEX that is being organized by WCRP on 4-7 November 2013 in Brussels, in partnership with the European Commission and IPCC. The Conference will bring together the international

community of regional climate scientists to present and discuss results from WCRP regional climate studies, with a particular emphasis on the CORDEX initiative.

On 4 November 2013 the high-level session of the conference will discuss key findings from the IPCC AR5 WG I with respect to the physical science basis, and a stakeholder dialogue on regional climate information for decision-makers will be held. The science segment on 5-7 November 2013 will be dedicated to key results of regional climate research and the Phase I of CORDEX. More than 500 participants are expected.

Filippo Giorgi highlighted several issues that are of significance for future successful development of the project. There are needs for:

- a mechanism for improved coordination across activities in the different CORDEX domains and, more generally, across the wider CORDEX community;
- better communication across the CORDEX community;
- improvements to the CORDEX web-site management;
- a mechanism for approving new CORDEX domains and activities; and
- core funding beyond the current CORDEX activities that are conducted primarily on voluntary basis.

Main points raised during discussions:

JSC warmly thanked both Filipo Giorgi and Colin Jones for their very important contribution to CORDEX at the initial stage of its development.

The JSC noted that there were proposals for new domains, for example Middle East and North Africa and also Antarctica that would need improved coordination and a focal point. The Arctic CORDEX is planning to meet at the CORDEX Conference in Brussels. The JSC highlighted the need for CORDEX to focus not only on interpretation of higher resolution runs but also on development of physics and research on predictability aspects of regional climate that can be linked to regional processes, for example, such as land-atmosphere interactions. The capacity development needs should always be a priority. One possible method of evaluating regional models and understanding the causes of biases in them is the use of CORDEX models in a Transpose-AMIP-like mode, for example for seasonal predictions. JSC also recommended to CORDEX to document the framework for CORDEX model intercomparisons done in retrospective mode. CORDEX SAT was asked to prepare and present to JSC a mechanism for proposing and endorsing new CORDEX domains and for evaluating a need for such domains. CORDEX was invited to report on status and advances of activities in its major domains and lessons learnt at JSC-35.

6.1.3 The Latin America and Caribbean Conference

Celeste Saulo spoke via videoconferencing on the WCRP “Conference on Climate and Society for Latin America and the Caribbean (LAC): Developing, linking, and applying climate knowledge”. The Conference is going to be held at the Republican University, Montevideo, Uruguay, on 17-21 March 2014.

The WCRP Open Science Conference made it clear that the climate research community was facing a complex challenge to improve the knowledge of the climate system, the interactions among its components and the limits of predictability but also enhance the ability to interact with other disciplines, particularly decision makers

and social scientists in order to translate basic climate knowledge into useful and action – oriented information. It was in this context that JSC recommended to VAMOS, in partnership with CLIVAR, GEWEX and the JSC, to organize a Latin American and Caribbean Conference on Climate with the objective of identifying new priorities of climate research for the region.

The plan for this Conference preparation is now being actively implemented. The following are the main objectives for Conference:

- Identify gaps and ways to overcome limitations in the chain of knowledge going from basic to applied climate science and to informing policy and decisions that are particularly relevant for LAC.
- Build interdisciplinary capacity, fostering the participation of decision and policy makers, climate and social scientists and key intermediary institutions.
- Contribute to the discussion on the emerging provision of regional climate services.

The Conference website is at http://www.cima.fcen.uba.ar/WCRP. Celeste Saulo and Walter Baethgen are the Co-chairs of the Scientific Steering Committee (SSC). Carlos Ereño is the coordinator. Fernanda Zermoglio is the liaison to WGRC. Hugo Berbery is the liaison to CLIVAR and René Garreaud is the liaison to GEWEX. Marcelo Barreiro leads the Local Organizing Committee.

Defining the research agenda that is needed to contribute to the provision of effective, problem-oriented and demand-driven climate services necessarily requires a balance between

- research focused on improving climate monitoring and predictions at regional and local scales;
- research oriented to demands of socio-economic sectors sensitive to climate, and
- research on the process of informing policy and decision-making in the different socioeconomic sectors.

Specific science objectives of the Conference are to:

- Identify research themes critical to improve our understanding of sources and intrinsic levels of predictability on intraseasonal, interannual, decadal and longer time scales;
- Improve overall understanding and assess predictability of climate extreme events and their impacts on key environmental services and on society
- Identify strategies to narrow the gap between current predictive capabilities in the region and estimated limits of predictability;
- Discuss how to establish a research framework oriented to identify climate-related information, products, and tools needed in the different socioeconomic sectors, and to explore communication strategies to improve the flow of knowledge throughout the information chains;
- Promote discussions across WCRP emerging initiatives relevant to LAC such as grand challenge on regional climate, grand challenge on water availability, and CLIVAR monsoon activities; and
- Contribute to the identification of knowledge needed to establish relevant regional climate services.

The kick-off Meeting of the SSC was held on 4-5 March 2013 in Buenos Aires, Argentina, under the WCRP sponsorship. It proposed five themes for the conference:

- "Water and Energy",
- "Agriculture and Ecosystems",
- "Human Health",
- "Coastal zones",
- "Urban environments", and
- the general theme of "Climate monitoring, prediction and predictability in LAC".

The Conference program will include oral presentations, poster sessions, and round-table discussions involving social scientist(s), stakeholder(s), and climate scientist(s). This round table will be coordinated by a member of the SSC and its discussion will be guided by a position-paper contributed by all the participants in the round table, including the coordinator. It will be followed by an open discussion. A group of SSC members is developing a strategy for the Conference funding. A request to get the permission to conduct the Conference in the MERCOSUR Building was presented to the Uruguayan Government through the Secretary of Environment.

A preliminary announcement of the date and place of the Conference will be distributed in June 2013. The call for abstracts will be distributed by the end of June 2013. After SSC review, nominations of keynote speakers and invited talks for each of the sectors, SSC members and keynote speakers will prepare short white papers on each conference theme/subject. A document including the keynote presentations and white papers will be developed in advance of the conference. This document will be reviewed after the conference to include the recommendations and conclusions resulting from the conference. A Conference report will be prepared with suggested future actions for publication in the open literature. This report should help WCRP to define Programme priorities for the region.

Main points raised during discussions:

The JSC thanked Celeste Saulo and the LAC SSC for the work done and congratulated them on significant progress and high enthusiasm. A comment was made that the science associated with the role of ocean in climate was not very visible in the presentation, except the theme of coastal zones. JSC Members were encouraged to send their thoughts, feedback and ideas to the LAC SSC (e.g. through Celeste Saulo). The JSC encouraged communication and sharing experience between the LAC and Africa Climate Conference (see below). Carolina Vera will be asked to continue to act as a JSC liaison to the LAC Conference.

6.1.4 Africa Climate Conference

Frederick Semazzi and Pius Yanda spoke on the Africa Climate Conference (ACC), which will be held at the Arusha International Conference Centre (AICC), in Tanzania on 15-18 October 2013. The objective of the Conference is to craft an Africa-wide agenda for climate research for sustainable development, linked to existing policy processes, partners and institutions (regional, national and sub-national) with a view of delivering as one on African priorities on climate research and addressing global research needs.

The Conference organizers are WCRP and its CLIVAR and GEWEX projects, the University Dar es Salaam, Tanzania, and the African Climate Policy Centre (ACPC), which is a part of the ClimDev-Africa (Climate for Development in Africa) programme, a joint initiative of the United Nations Economic Commission for Africa (UNECA), the African Union Commission (AUC), and the African Development Bank (AfDB). The President of Tanzania is expected to open the Conference.

The SSC of the Conference is co-chaired by Arame Tall and Seleshie Bekele. The CLIVAR contact is Anna Pirani, the GEWEX contact is Sam Benedict, the WCRP JPS contact is Valery Detemmerman, and the JSC contact is Pius Yanda.

The milestones for the ACC preparation include:

- Mapping climate scientists and institutions in Africa;
- SSC launch;
- Preparation of ACC Concept Note;
- Frontiers Paper (WCRP, AMMA, AfClix, CCDAII);
- Call for Abstracts;
- Review and selection of speakers and presenters;
- Fund raising;
- Agency participation; and
- Logistics.

Research priorities will be addressed in alignment with the critical information needs of African end-users, policy-developers, and vulnerable communities, to adapt to changing climate and manage risks in the 21st century. They include:

- Support to strategic ahead-of-season planning (1-month to 12- months outlook);
- Support to intra-seasonal risk monitoring and management to inform within-season operations (5- to 40- days range);
- Support to longer-term strategic planning and policy development (next 1-10 years);
- Support climate change adaptation policy development and planning (next 50 years);
- Assessing the current vulnerability due to recent climate events;
- Estimation of the impacts of climate variability and change;
- Decision making at local scales;
- Building credibility and confidence in predictions, across timescales; and
- Mainstreaming climate services into policy formulation and decision making at all timescales.

As of 24 May 2013 about 200 abstracts were received, 90% of them being from African researchers. Because most of prospective participants require travel support, successful fundraising for the Conference is very important.

Main points raised during discussions:

The JSC noted good progress of the Conference preparation and thanked the organisers and the University of Dar es Salaam. Potential attendance of the President of Tanzania was noted with appreciation. As in the case of the LAC Conference (see report for the previous agenda item), JSC encouraged communication and sharing experience between the LAC Conference and ACC. The JSC also noted that there was a proposal for a change of the ACC venue but agreed with organizers that this may be not practical due to the short time remaining before the Conference.

6.1.5 APN

Linda Anne Stevenson presented to JSC the Asia-Pacific Network for Global Change Research (APN, see www.apn-gcr.org). The vision of APN is to bridge disciplines and link science and policy for resilience and sustainability.

APN is both a funding agency with financial resources originating from Japan, USA, Republic of Korea, and New Zealand, and a network of 22 member countries with representation from policy and science communities.

The APN current strategic goals are:

- Supporting regional cooperation in global change research;
- Strengthening interactions among scientists and policy makers;
- Improving scientific and technical capabilities; and
- Cooperating with other global change networks and organizations

APN science agenda includes the following broad topics:

- Climate change and variability;
- Ecosystems, biodiversity, and land use;
- Changes in the atmospheric, terrestrial and marine domains; and
- Resources utilization and pathways for sustainable development.

Cooperation of APN and WCRP is strong and involves

- Professor Goswami who is a member of JSC and of the APN Science and Policy Group;
- WCRP was key to developing the APN Climate Adaptation Framework;
- WCRP was involved in the APN book on climate, security, society, and sustainability;
- WCRP participated in the APN inter-governmental meeting;
- APN support early career scientists' participation in the CORDEX Conference in Brussels on November 2013; and
- APN support developing CORDEX at sub-regional levels in Asia: in South Asia, Southeast Asia, and East Asia.

A Scoping Workshop to Enhance the Climate Adaptation Actions of APN Developing Countries (August 2012) recommended that from the financial year 2013 APN establish a multi-year strategic programme focusing on climate. The APN Climate Adaptation Framework (CAF) will support

- Development of high-resolution observational, model and downscaled data sets that can contribute to filling data gaps;
- Sharing of needs-oriented data;
- Calibration and validation of RCMs, analysis of projections, and assessment of uncertainties;
- Development and utilization of impact, vulnerability, risk and economic assessments;
- Improvement of communication skills of scientists and practitioners cooperating with stakeholders, including local government, community, private sector and civil society, for encouraging policy makers to formulate and implement adaptation plans based on the latest scientific knowledge; and
- Utilization of available information including climate data in applications for adaptation.

A series of new activities under CAF will be focussed on adaptation and reduction of disaster risks, loss, and damage.

Linda Anne Stevenson expressed special thanks to D/WCRP for writing the preface to the APN Book Climate in Asia and the Pacific: Security, Society and Sustainability. This book synthesized 56 climate-related projects in the region, explained the current status of climate change and climate variability in the Asia-Pacific region and presented future directions of research. The book expected to be published by mid-2013.

Another highlight among APN activities is the Science-Policy Dialogues (SPD). For example, in July 2012 APN became engaged in its first South East Asia SPD with START. The messages originating from such dialogues correspond to the outcomes of the WCRP Open Science Conference. They call for

- solution-oriented knowledge and information that can lead to useful action;
- risk management to deal with uncertainty;
- importance of local champions in the policy sector (linked to building trust);
- action-oriented research (moving away from traditional research);
- encouragement of risk-sharing through market-based mechanisms; and
- combination of local knowledge with scientific knowledge to shape policies.

The first Southeast Asia SPD in 2012 was deemed a success. The momentum will be sustained via the

- 2014 South Asia SPD in collaboration with South Asia START
- 2015 East Asia SPD in collaboration with Temperate East Asia
- 2016 Synthesis of 3 Sub-Regional SPDs

APN is closely following the development of FE because

- its focus is global environmental research,
- FE encompasses all existing (and former) GEC programmes,
- is multi-, trans-, interdisciplinary in nature, and
- has a strong focus on regional-based research (in a global context), policy-science interactions, and capacity development.

APN actively contributed to the first FE workshop through co-funding, participation in the organizing committee, selection of participants, co-chairing sessions, and participating in breakout sessions. APN remains interested in the development of FE in the region and is collaborating with the ICSU Regional Office for Asia and Pacific to ensure synergy and assist FE development in the Asia-Pacific region.

The Asia Pacific region has the ability to lead the move towards global sustainability under the FE programme. Its scientific community is ready to make the change to support integrated research that would build the knowledge and solutions necessary for the transition to sustainability. FE research in Asia and the Pacific should primarily focus on issues related to climate change, the rapidity of urbanization, food security, ecosystem services, the vulnerability of coastal communities and ecosystems, security of livelihoods especially of rural communities, the green economy, mountain ecosystems and water resources in Asia. Notwithstanding the interest in global sustainability, local issues should receive equal attention in FE research, and solutions developed need to be applicable at the scales where decisions are taken. Comparability across nations and regions would be required for integration of

knowledge in regional and global assessments of sustainability. Existing research networks should be strengthened to enable them to meet the needs of FE in Asia and the Pacific.

Linda Anne Stevenson concluded her presentation by announcement that the next APN Annual Call for Proposals would be launched in mid-June 2013.

Main points raised during discussions:

JSC warmly thanked APN for long-term fruitful cooperation, strong focus on climate research including support to climate services, support to ECSs, and for precious help in connecting WCRP to the Asia – Pacific Region. The Comittee noted with great appreciation the availability of APN support to ECSs for the CORDEX Conference in Brussels. JSC also expressed a view that regional cooperation of WCRP and APN is of significance to WGRC and that WGRC and APN could discuss how to further develop climate science and support climate services in Asia and the Pacific.

6.1.6 Implementation of the Regional GC

Lisa Goddard presented to JSC, on behalf of CLIVAR - as a project leading implementation of subthemes of this GC in WCRP - the implementation considerations for the Regional GC.

One approach, based on the existing experience and capabilities of CLIVAR, would be to consider whether recently identified CLIVAR global research opportunities in the areas of intraseasonal-to-interannual variability and predictability of monsoon systems and decadal variability and predictability could lead to results necessary to achieve the Regional GC objectives. Using several examples based on decomposition of variability and change into several major times scales, she presented to JSC the role of forced changes, understood as trends in temperature and precipitation, and estimates of their decadal and interannual variability on global and local scale. Her conclusion based on these examples was the global solution that fits all regions did not exist or was not known and that the only viable existing option for progress in the regional GC was to develop a plan that has regional specificity. Therefore, the approach to implementation of this GC might involve formulating a small number of specific research questions (preferably process-based), identifying what is known and unknown about them and evaluating readiness and momentum of scientific community, funding opportunities, the need for WCRP/CLIVAR coordination, and to start addressing these smaller but more specific science issues.

Monsoon systems, as a major mode of climate variability and supply of rainfall to vulnerable developing nations, could be considered as such smaller research theme. However, it is well known that prediction of monsoons faces several challenges. Key areas for progress in the next 5-10 years could be provisionally defined as:

- Improved model constraint on monsoon variability and change;
- Better model representation of the key processes involved in monsoon variability;
- Improved prediction of monsoon variability and change using land surface modelling and incorporation of land surface initialization; and
- Enhanced understanding of natural climate variability and anthropogenic change on monsoon systems.

In terms of process understanding the related scientific questions can be formulated as follows:

- Can we make links between different modes of variability? E.g., does ENSO affect the statistics of monsoon intraseasonal variability?
- Do scale interactions result in a cascade of predictability? E.g., is there a link from decadal variability (or mean state error) to ENSO teleconnections and to predictability of intraseasonal or even synoptic variability?

Decadal prediction experiments of CMIP5 can help to address these questions but their skill has still to be demonstrated. Another possibility is to investigate the role and predictability associated with the stratosphere – troposphere coupling, which is developing under SPARC through the DynVar and SOLARIS/HEPPA initiatives.

Dr. Goddard also identified some general issues that need to be addressed for the Regional GC. They include quality of observations and analyses, infrastructure for data sharing between models and observations, and means of effective communication to broader research community. Illustrations proving the existence of problems in these domains included demonstration of very large differences between various analysis products. Their differences were of the same order or exceeded the order of the useful signal.

Concluding her presentation, she reviewed the ways of delivering climate information to decision makers, for example in support of GFCS. Her opinion was that the role of WCRP should be focused on delivering scientific understanding, climate-quality observations, and models that represent relevant climate processes, and making all this accessible to the broader scientific and decision-maker community. Using an example of information network for agriculture, she illustrated the need to better understand the composition of such networks, define priorities, identify users, their goals, problems, and resulting requirements, and strengthen communication with them and key links. Another demonstrated example was the workings of the Climate Services Partnership, a network of more than 200 members aiming to improve development and provision of climate services worldwide in support of GFCS.

Dr. Goddard also recommended abolishing the use of word combinations like “actionable information” or “actionable science” in WCRP documentation because it can be understood not only as something that can be acted upon but also has some legal connotation. The proposal was to use formulations like ”action-oriented” or similar.

Main points raised during discussions:

The JSC strongly agreed with Lisa Goddard on the urgent need to develop science of predictability in the regions, e.g. for monsoons, which is consistent with the goals and objectives of CLIVAR. Also, the JSC was in favour of the proposal of CLIVAR to break down the predictability issue into tractable smaller problems, finding “champions”, developing plans for such smaller activities based on identified opportunities, with involvement of all projects and other relevant groupings, “co-design” being a part of approach. The predictability aspect of the Regional GC is very research intensive. Fast progress cannot be guaranteed. Therefore there is a need to focus on science and better understanding of processes and resulting predictability while provision of actual services should be dependent on the progress in science. Ability of models to reproduce decadal variability needs to be assessed and, where possible, improved. There is a need to facilitate regional and global climate information accessibility, e.g. via ESG. WCRP and this GC need a

mechanism to engage scientists working in the regions on this science problem, which will improve visibility of WCRP in the regions.

The JSC requested all projects, WGSIP, and WGCM, with CLIVAR in the lead, to prepare a more detailed white paper on the interannual – decadal predictability research that includes contribution from all WCRP Projects, with emphasis on more likely tractable regional predictability opportunities. The paper should include an analysis of opportunities to involve research on modes of climate variability as a contribution to the Regional GC. Brainstorming should continue on this problem, and particularly on the idea focusing on science versus services and on moving ahead in a series of smaller initiatives under the GC focus of the provision of climate information on regional scale. In view of the complexity of this GC, a need to optimize leadership of WCRP work on the research on provision of skilful/action-oriented regional climate information on interannual to decadal time scales was highlighted.

6.2 Clouds, Circulation and Climate Sensitivity

Sandrine Bony presented implementation considerations for the WCRP GC on Clouds, Circulation and Climate Sensitivity, for which she acts a lead coordinator together with Bjorn Stevens. This work was prepared under the leadership of WGCM, in co-authorship with several scientists from different WCRP constituencies such as GEWEX, WGNE and SPARC. The authors were very thankful to the WGCM members, GEWEX/GASS SSC, and to JSC for their support and encouragement and to several individual scientists for constructive comments and contributions.

The website for this GC is at http://www.wcrp-climate.org/index.php/gc-clouds.

Dr. Bony started her presentation by presenting the challenges that this GC is expected to overcome. The spread of climate sensitivity estimates in the CMIP5 models is unacceptably large, mostly as a result of treatment of clouds. The 'cloud problem' contributes to an inability to usefully constrain the estimates of climate sensitivity in models. Regional precipitation projections remain very uncertain, and most of this uncertainty stems from an inability to quantitatively predict how large-scale atmospheric circulation systems, especially in the tropics, will respond to climate change. Model development is hindered by a lack of understanding of how a poor representation of cloud scale processes and cloud scale dynamics contribute to model biases in the large-scale circulation.

Models have become more and more complex and moved from GCMs to fully coupled models and Earth System Models (with aerosols, interactive vegetation, carbon cycle, chemistry, etc), and this drive to complexity has greatly extended the scope of questions that can be addressed by modelling. However, it has not reduced key uncertainties that affect many aspects of climate projections including biogeochemical responses. The remaining uncertainties are still related to basic physical processes such as interactions between atmospheric water, temperature, and circulation.

The opportunities for the rapid progress are linked to

- CMIP5 and other Model Intercomparison Projects (or MIPs);
- Qualitatively new types of models;
- A golden age of Earth observations from space;

- Lessons from experience permitting to decompose the cloud problem into a series of more tractable questions and also permitting to efficiently address the role of the atmospheric aerosol; and
- A mature and interconnected research community.

The GC will be implemented through five major initiatives entitled as follows:

- Climate and hydrological sensitivity
- Coupling clouds to circulations
- Changing patterns
- Leveraging the past record
- Towards more reliable models

The initiative “Climate and Hydrological Sensitivity” will be led by Steven Sherwood and Mark Webb. Its aim is to design critical tests for climate models that will help assess the most reliable estimates of climate and hydrological sensitivity. The pathway to such test lies through identification of causes of inter-model differences in sensitivity, interpretation of their robust features, critical analysis of model extreme behaviours, unraveling uncertainties and proposing strategies to tackle them. This work will be done in connection with WGCM/CMIP5/CFMIP (e.g. CGILS project), GEWEX/GASS, PMIP, and GC on water availability.

The initiative “Coupling Clouds to Circulation” will be led by Pier Siebesma (KNMI, Netherlands) and another expert, still to be identified. Its aim is to tackle the parameterization problem through a better understanding the interaction between cloud, convective processes and circulation systems. The main idea here is to review lessons from observations and cloud-resolving modelling over large domains and study interaction between diabatic heating and large-scale dynamics. This initiative will involve WGCM/GEWEX/WGNE (e.g. CFMIP, Transpose-AMIP, global CRM/LES models), WWRP/GEWEX/CLIVAR (MJO-diabatic), and SPARC.

The initiative “Changing Patterns” is led by Ted Shepherd and Adam Sobel. Its aim is better anticipate how the large-scale atmospheric circulation will respond to anthropogenic forcing from greenhouse gases, aerosols, and ozone. The scope of work is to ascertain the role of local and large-scale or remotely forced changes in driving regional changes, identify robust responses; interpret uncertain components, and assess the impact of model biases or shortcomings on regional responses. This package will be worked on in cooperation with GEWEX/GASS (e.g. WTG), AEROCOM, and SPARC.

The initiative ”Leveraging Records of the Recent and Longer Past” will be led by Masa Kageyama and Robert Pincus. Its aim is to exploit observations of the recent past or proxies for longer-term changes to better constrain cloud processes and feedbacks. Activities will include an analysis of decadal/multi-decadal records from satellite and in-situ observations, improvement of paleo-climate reconstructions and syntheses and comparisons of past and future changes. They will be conducted together with GEWEX/GDAP and PMIP.

The initiative ”Towards more Reliable Models” will be lead by Christian Jakob and Masahiro Watanabe. Its aim is to interpret and reduce model errors to gain confidence in projections and predictions. It will focus on major long-standing model biases, understanding how model errors or shortcomings impact projections and predictions and improvement of understanding of the climate system through model

development. This work involves WGNE, WGCM, GEWEX/GASS, and SPARC.

The overall GC will be led by WGCM in close collaboration with GEWEX/GASS, WGNE and SPARC. Many of the initiatives will leverage on on-going or planned WCRP projects. The GC Steering Committee will be led by Sandrine Bony and Bjorn Stevens and will include all leaders of the five initiatives.

In 2013 the team is planning to sharpen each of the initiatives by highlighting key science questions and identifying opportunities (e.g. on-going projects) and gaps (e.g. missing connections). The next step will focus on motivating the community to work on GC initiatives, e.g. through high-profile papers and implement them through:

- on-going projects (e.g. CFMIP/GASS, WGNE, SPARC, PMIP, AEROCOM),
- workshops, summer schools,
- design of CMIP6, and
- identification of new projects.

Main points raised during discussions:

JSC thanked very much Sandrine Bony and Bjorn Stevens and the whole GC team for their productive efforts. A lot of work has gone into revising the white paper, integrating and engaging across the WCRP, and developing a well defined strategy for the years ahead. The JSC was of opinion that this GC and the approach of its leaders set the standard for planning of all WCRP GCs. The JSC commented on the scope of work that the interaction of radiation, aerosols and clouds could be further detailed in the scope of work under this GC, especially if the role of some regions in climate sensitivity is considered. With respect to the use of satellite data, a concern was expressed that the length of satellite observational record might be insufficient for the sensitivity analysis especially if the period of observations includes anomalous regimes. Nevertheless the use of ISCCP data and A-Train can help. The Conference on Climate Observations from Space in October 2014, Darmstadt, Germany, offers an opportunity for such discussions on the use of satellite data for this GC.

6.3 Cryosphere in a Changing Climate

Vladimir Kattsov presented this GC instead of Greg Flato, the Chair of CliC SSG who was unable to attend the meeting. There are many compelling motivations for this GC. They include:

- the prospects of an ice-free Arctic Ocean;
- the fate of mountain glaciers providing fresh water to hundreds of millions of people worldwide;
- the strength of positive feedbacks between the warming climate and natural emissions of GHGs from the thawing permafrost; and
- the role of ice-sheet dynamics in amplification of Greenland's contribution to the global SLR.

These issues are receiving increasing attention by the international scientific research community and relate directly to societal needs for information about climate change and its impacts. These and other processes, in which components of the cryosphere play a central role, remain an important source of uncertainty in projections of future climate change, and thus improved understanding of the cryosphere in a changing climate (CCC) is clearly a GC.

Successful implementation of this GC should result in

- Increased confidence in climate models and their predictions/projections of cryospheric changes including those on regional scale;
- Improved information regarding future changes in the cryosphere, with a specific focus on information relevant for impact assessment and adaptation decision-making, such as the expected timing of the Arctic multiyear sea ice disappearance, the fate of mountain glaciers, etc.;
- More comprehensive, quality-controlled observational, observationally-based, and proxy datasets of cryospheric variables suitable for a range of research and model evaluation activities; and
- Better quantitative understanding of processes involved in cryosphere - climate interactions and better representation of these processes in global and regional climate predictions from months to decades ahead, as well as longer-term projections, particularly with respect to the effect of the carbon sequestered in the terrestrial and sub-sea permafrost on the atmospheric composition, the role of ice sheet dynamics in SLR, etc.

Several specific research directions are ready to be addressed and can yield tangible progress in the 5-10 year perspective. They are:

- Research on seasonal, interannual, and longer-term predictions and projections of polar climate and the role of cryosphere in climate predictability;
- Analysis of model intercomparison results aimed specifically at understanding and attributing model biases and shortcomings related to the cryosphere;
- Improving the representation of permafrost and high-latitude land surface, including wetlands, in climate models, with specific emphasis on their role in the global carbon cycle; and
- Developing ice-sheet models with specific emphasis on ice-sheet dynamics and its impact on the rate of sea-level rise.

Each of these “sub-GCs” meets the GC criteria. CliC therefore suggests pursuing several scientifically important and societally relevant themes.

For example, at least four large national and international scientific projects are active in implementing the ideas on the role of permafrost and carbon that were developed by CliC through its CAPER initiative. They are:

- Vulnerability of Permafrost Carbon Research Coordination Network (RCN);
- Changing Permafrost in the Arctic and its Global Effects in the 21st Century (PAGE21);
- Centre for Permafrost dynamics in Greenland (CENPERM); and
- Next-Generation Ecosystem Experiments (NGEE Arctic).

A major role for CliC will be to coordinate interaction between these projects.

In terms of ice sheet contribution to sea level, there are several initiatives and groups, such as

- Ice sheet mass balance working group (ISMASS);
- Sea-level Response to Ice Sheet Evolution (SeaRISE); and
- Estimating the future contribution of continental ice to sea-level rise (Ice2Sea).

By coordinating the existing activities and proposing new ones that are essential, it will be possible to achieve progress on this GC. The development of implementation plan for this GC will be the subject of a dedicated workshop "Cryosphere in a Changing Climate" (16-18 October 2013, Tromsø, Norway).

Main points raised during discussions:

The JSC thanked V. Kattsov for standing in for Greg Flato. It noted that the science problems led by CliC and related to the cryosphere should be considered in design of CMIP6. The WWRP Polar Prediction Project may be instrumental in the aspects related to modelling and assimilating data on the state of cryosphere. The GC was advised to consider opportunities emerging in relation to the Year of Polar Prediction (2017-2018). The JSC, WGCM, WGSIP, and core Projects were requested to provide feedback to CliC on the structure, goals, and objectives of the Cryosphere GC workshop and facilitate participation in it of interested and relevant scientists. It was also noted in discussions that WCRP should not overlook opportunities to contribute to or strengthen the international research on the role or declining Arctic Ocean sea-ice in climate predictability and on its impact on the atmospheric circulation. CliC and WGSIP should discuss how to organise effective cooperation of research on the role of cryosphere, especially sea-ice and snow, in predictability on time scales of relevance for WGSIP. The JSC Chair requested an update on the structure, goals, and objectives of GC Cryosphere Workshop.

6.4 Attribution and prediction of extreme events

Kevin Trenberth presented the development of this GC on behalf of the GEWEX project, which is in the lead of its implementation in partnership with CLIVAR. He started the talk by illustrating the large variety of space- and time- scales on which meteorological extremes can occur. Extremes may or may not be rare. They often break records and reach values outside of previous experience. High significance should be attached not only to an extreme or rare event, but also to high-impact events.

An important milestone in defining the extremes theme was the WCRP-UNESCO (GEWEX/CLIVAR/IHP) Workshop on metrics and methodologies of estimation of extreme climate events (September 2010, Paris). It recommended to:

- enhance efforts to develop improved high temporal resolution (sub-daily) datasets that can be used to assess changes in extreme rainfall, drought, heat waves, floods, and storms;
- include in the agenda of model evaluation the focus on the model's ability to replicate extremes and to better compare model output with observations;
- assign a high priority to determining the main phenomena responsible for extremes and improving understanding of the relevant physical processes;
- develop robust statistical methods for assessing extremes and their uncertainties and make these tools available for wide-spread use; and
- plan and launch an activity on analysis of extremes utilizing CMIP5 data.

After the discussions at the GEWEX SSG Session in October 2012, the leadership of the GC started to be formed. Xuebin Zhang and Gabi Hegerl were invited to form a task team for the GC, review and update white paper, identify ongoing and planned events and activities, and recommend how best to interact/participate with the existing activities and what concrete steps WCRP can take to build on the ongoing activities or initiate new ones. This work is underway and one of the imminent tasks

is to finalize the GC white paper. The issues to be addressed include the nature of extremes, their scaling and predictability in future climate.

Dr. Trenberth identified some key science questions to be addressed by the GC, as follows:

- What data are needed (and how to obtain them) for properly characterizing extremes of different time and space scales and their changes, for characterizing the state of the oceans that are most relevant to extremes, and for the validation of models?
- What are the causes of changes in extremes that are both internal and external to climate system? How much of the changes can be attributed to forcing that is external to the climate system and to factors such as modes of variability?
- What is the relative importance of large-scale versus local processes affecting extremes (e.g., circulation including ocean-atmosphere and external drivers versus local conditions such as land use and local feedbacks)?
- What can we learn about underlying processes and physical mechanisms of rare events through event attribution?
- Can models adequately represent these processes and how to improve model capability of simulating them?
- What is predictability of statistical properties of extremes at annual and decadal scale?
- If and how will modes of variability change in the future? What are the resulting changes in extremes?

The main research directions of the GC, which can help to find answers to the above questions, were formulated as follows.

- *Improved observational data:* new initiatives are needed to improve the quality and availability of both historical and real-time in-situ observations for better characterization and quantification of weather and climate extremes and for better quantification of ocean states that influence weather and climate extremes. These include development of new and improvement of ongoing reanalyses, and continued homogenization and data rescue for in situ data, as well as development of new high resolution data sets that blend in-situ and remotely sensed data and spurring the advances in both;
- *Quantification of long-term changes in extremes and understanding the causes:* this includes continued improved understanding of causes both internal and external to climate system of changes in extremes, understanding causes of very rare events (such as extended heat wave and flooding) through event attribution to gain better understanding of physical mechanisms and processes underlying these events;
- *Processes and physical mechanisms through which modes of variability and air-ocean interactions and feedbacks influence the frequency and magnitude of extremes:* these include identification and characterization of these processes and mechanisms, evaluating model's capability in simulating such processes and improving model's representation of these processes, understanding if and how these modes of variability will change in the future and resulting changes in weather and climate extremes;
- *Extending operational seasonal prediction capabilities:* there exists potentially useful skill in predicting modes of ocean/atmosphere variability at seasonal and perhaps longer time scales, it is thus important to explore potential use of such predictions in forecasting the frequency and magnitude of extreme events; and

- *Harnessing advances in climate model development and initialization for decadal and long-term predictions for the prediction of changes in the likelihood of future extremes:* these include the development of best practices for the prediction or projection of frequency and magnitudes of extremes in the near term and in the future to address societal climate change adaption needs.

The implementation strategies for the GC are to

- Maintain international collaboration and coordination for the development of data set and for building capacity in needy regions;
- Make use of existing meetings as far as possible to build consensus and address questions, and use focused workshops, theme sessions at international meetings, to address one or more questions as needed;
- Exploit virtual institutes and web based meetings;
- Maintain close links among WCRP projects, among panels and working groups of WCRP projects, and between observation and modelling community for effective coordination and timely exchange of data, information, new advances in science;
- Work with other WCRP projects to build a cross-cutting implementation plan to guide funding agencies; and
- Establish a close link with user community (e.g. re-insurance and water management industries).

The following projects can be expected:

- Generation of high frequency (e.g., hourly) datasets;
- Promotion of data analysis;
- Understanding processes and phenomena;
- Confronting models with new observationally-based products;
- Developing new metrics of performance;
- Highlighting shortcomings and developmental needs; and
- Developing applications for improved tracking and warning systems, information for users, assessing changes in risk of drought, floods, riverflow, storms, coastal sea level surges, ocean waves, etc.

Main points raised during discussions:

JSC thanked Dr. Trenberth for leadership and involving X. Zhang and G. Hegerl in establishing a Task Team for this GC. It recognized the need to improve coordination of significant number of activities and related events, which may require an inventory of relevant activities. Outcomes of the 2010 WCRP workshop at UNESCO in Paris need to be taken into account in devising the GC strategy. One important avenue for development is introduction of standardized norms and normalization factors in analysis of extremes.

JSC has agreed that there is indeed an urgent need to sharpen the focus of the White Paper on Extremes with regard to the nature of extremes, their temporal (e.g. seasonal, decadal, etc.) scales, duration, spatial scales, and predictability. The focus on the current planning is on climate change but ability to predict extremes or favourable conditions for extremes on seasonal to interannual scales needs to be included as well, and this addition requires considering initialization of models. Similarly important is to continue to improve the model resolution, both in time and space, for attribution and prediction (or research on predictability) of extremes. It is possible that in order to practically predict the statistics of extremes, there may be a

need to resolve weather events in climate models. A paper on this issue could be prepared for the GEWEX Newsletter.

JSC recommended to the GC team to consider how potential outcomes of this GC can help CORDEX in providing useful climate information on regional scales and how CORDEX can help the Extreme GC.

Extreme events need always to be considered in the context of their impact on society and ecosystems. In this connection, the JSC recommended that the African and Latin America and Caribbean Climate Conferences include climate extremes in their agenda.

6.5 Changes in water availability

Kevin Trenberth presented this GC, which is led by GEWEX. The GC intends to better understand and predict precipitation variability and change and interpret changes in land surface and hydrology in terms of past and future changes in water availability.

In order to address the challenge, significant improvements are required in:

- data sets of precipitation, soil moisture, evapotranspiration, and related variables, such as water storage and sea surface salinity;
- analyses aimed at closing the water budget over land;
- modelling capabilities for a range of models from global climate models to regional hydro-climate models; and
- information related to water availability and quality for use in decision making and for initializing climate predictions from seasons to years ahead.

Water availability is a key issue for the four GEWEX Science Questions (GSQ), especially the first two of them that are related to observation and prediction of precipitation and research on global water resources. The talk by Dr. Trenberth was focused on these two GSQs.

<u>Observation and Prediction of Precipitation – GSQ 1</u>

The main questions to be asked in terms of quantitative description of precipitation are:

- How well various observing systems can describe precipitation, and what basic measurement deficiencies and model assumptions determine the uncertainty of estimates at various space and time scales?
- How do changes in climate affect the characteristics (distribution, amount, intensity, frequency, duration, type) of precipitation, especially extreme droughts and floods?
- How to improve models and how much confidence we can place in global and regional climate predictions of precipitation?

Dr. Trenberth presented to JSC an update on the state of research and scientific understanding in this area. In terms of the global precipitation over land there still are significant differences between various products, not only in means but also in trends, and these uncertainties cascade, for example, into discrepancies among drought indices. Equally, there is large spread of 22% in the mean precipitation simulated by CMIP5 models and, very likely, significant average bias. The GEWEX

Data and Assessments Panel estimates the GPCP global climatology bias being around 8%. There are some adjustments of the product, like corrections for wind loss, inclusion of snow, algorithm developments, regional comparisons, etc. The main hope for very significant improvement of the precipitation observations is associated with the Global Precipitation Mission (GPM) to be launched in 2014. GPM will ensure that more than 60% of observations are less than 1 hr and 80-90% are less than 3 hrs apart at all latitudes. This is a significant advance over the current situation. Some additional capabilities with regard to clouds and aerosols will be provided by the Cloudsat and Earthcare missions.

Model output can, in principle, be effectively assessed because the main simulated precipitation errors are in the tropics where TRMM provides good coverage and data quality. There are a large number of characteristics of modeled precipitation that can be evaluated (amount, distribution, frequency, intensity, runoff, recycling, diurnal cycle, moisture lifetime, etc.) and this can lead to more focused research on causes and related processes and biases, like double ITCZ, weak tropical transients, biases in tropical cyclones, representation of MJO, easterly waves, mesoscale convective systems, etc.

Progress and planning of research activities with regard to GSQ1 will be the theme of a dedicated workshop in Fort Collins, USA, on 27-28 June 2013. The topics to be covered by the workshop are as follows:

- How well can various observing systems describe precipitation probability distributions and accumulations, what defines the uncertainty estimates at various space and time scales, and how can it be improved in the future?
- How can observations of water and energy related quantities be used to better understand relationships among these variables and how they influence observed precipitation at various scales?
- How much confidence do we have in the physics of models used to predict long-term climate changes in precipitation and what metrics can be applied to track progress in the model representations of precipitation physics?
- What is the role of data assimilation in bridging the gap between observations and models and how can we advance diagnostic methods that can deal more directly with the physics and parameterization of convection – and what planned and new observing systems could improve knowledge going forward?

Four half-day sessions of the workshop will have two presentations for each topic and a moderated discussion. A rapporteur will summarize their outcomes. Then, the summaries will be considered at the joint GDAP/GHP meeting in Rio de Janeiro in September 2013 and feature as a topic at the GEWEX Science Conference in 2014. The final outcome of this preparatory work will be a written report with recommendations. The role of GEWEX Panels and WCRP working groups and a need to have an executive group will be determined.

Global Water Resource Systems – GSQ 2

The main questions to be asked for GSQ2 are as follows:

- How do changes in the land surface and hydrology influence past and future changes in water availability and security?
- How do changes in climate affect terrestrial ecosystems, hydrological processes, water resources and water quality, especially water temperature?
- How can new observations lead to improvements in water management?

Answering the first question requires progress in closing the terrestrial water budget estimates. The avenues leading to achieving more accurate representation of the budget are exploitation of new datasets, data assimilation, and improved physical understanding and hydrological modelling skill across all necessary scales. Comprehensive assessment of the budgets requires scaling up from catchments to regional and global scales for the entire hydrological cycle including hydrogeological aspects of ground water recharge. For that the hydrological and climate models and data processing schemes should include realistic land surface complexity with all aspects of global change: water management, land use change and urbanization; water quality and especially water temperature (which is affected by industrial and power plants use). The approach should also be inclusive of the ecosystem response to climate variability, responsive vegetation, and cryospheric changes such as permafrost thawing and changes in mountain glaciers. Feedbacks, tipping points, and extremes are of particular concern. The results should enhance the evaluation of the vulnerability of water systems, especially to extremes, which are vital for considerations of water security and can be used to increase resilience through good management and governance.

Dr. Trenberth then showed several examples of the current state of affairs in the assessment of water balance on various scales and illustrated approaches of leading research groups to this issue. He analysed the problem of closing the global balance and the existing datasets such as reanalyses. A critical constraint in this connection is the assessment of the transport of energy and water from the ocean to land. Then he described the balances for large regions and presented several approaches of evaluating them – largely using remotely sensed data. Still, the results obtained using coupled models, land surface models and remote sensing show large differences. Product validation for basin budgets is needed. Various GEWEX-related initiatives and projects such as LandFlux can help in this regard, for example in assessing individual components of the water balance such as precipitation and evapotranspiration, the latter remaning the biggest source of uncertainty.

Dr. Trenberth also presented several specific issues, approaches, and some initiatives available for assessing various water and energy cycle products and their uncertainty at the scales of the globe, oceans and continents, and at the basin and point level. He indicated new types of observations that will soon be available and perspectives for advanced diagnostics, downscaling using realistic land surface hydrology, land use and land management, cryosphere, and developing a drought information system.

Progress and planning of research activities with regard to GSQ2 will be the theme of a dedicated workshop in Saskatoon, Canada on 5-7 June 2013. The topics to be covered by the workshop are as follows:

- How do changes in land surface and hydrology influence past and future changes in water availability and security?
- How do changes in climate affect terrestrial ecosystems, hydrological processes, water resources and water quality, especially water temperature?
- How can new observations lead to improvements in water management?
- How do models become better and how much confidence do we have in global and regional climate predictions and projections of precipitation?
- How can better climate models lead to improvements in water management?
-

The speakers are expected to cover progress to date, knowledge gaps, pathways forward, metrics, how to track progress, planned activities, implementation, and

schedule. The path forward with respect to GSQ2 will be similar to the one described above for GSQ1.

The WCRP activities addressing the Water GC have the potential to provide useful and beneficial results for society and climate science including

- improved models leading to improved predictions at
  - all time scales (monthly, seasonal, decadal, centennial) and
  - space scales from regional to global;
- addressing of extremes;
- quantified uncertainties in climate and hydrological products;
- information for water managers, decision makers, users;
- a Drought Information System;
- positive effects of management decisions; and
- better interactions between communities of researchers and users.

Main points raised during discussions:

JSC expressed appreciation to Dr. Trenberth and GEWEX for responding to the needs of this important GC. JSC highlighted to GEWEX the need to involve all relevant GEWEX constituencies in the work in this GC and more strongly engage with research communities working on hydrological modelling, land use, and land surface change. There is a need also to consider issues associated with ground water changes. Like in other GCs, progress strongly depends on improvement of climate models, and one ubiquitous example of existing issues is the large spread in precipitation simulated by the ensemble of CMIP5 models.

With GEWEX being the lead of this GC in WCRP, GEWEX initiatives like GLASS and GASS need to be stronger involved. JSC noted the GEWEX plans to identify scientist(s) to lead this GC and to decide if a group is needed to coordinate the activities. It urged GEWEX to determine as soon as it becomes feasible the GC leadership and, in doing so, to take into account that, like in other GCs, there are significant regional requirements for the Water GC. JSC recognized that achieving the objectives of this GC should necessarily include development of datasets, identifying existing datasets, documenting them, assessing their limitations, promoting provision of metadata, etc. JSC stressed that this work would strongly benefit from and should involve CEOS and CGMS. Another important requirement for successful work on this GC is free and open availability of precipitation observations and data sets.

6.6 Regional sea-level

Martin Visbeck spoke on this agenda item on behalf of CLIVAR, the WCRP project leading the regional sea-level (SL and RSL) GC. The talk was based on input from Detlef Stammer, Catia Domingues, Claus Böning, and Jenny Baeseman.

A key milestone in the WCRP SL research remains the WCRP Workshop "Understanding Sea Level Rise and Variability" held at IOC in Paris in June 2006. The major output from the workshop was the report summarizing the current state of the SL science, an outline of future research requirements for improving our understanding of SL rise and variability, and a description of the observational requirements (both experimental and sustained systematic observations). The final outcome of the workshop was published in 2009 by Wiley-Blackwells as a monograph, which was available for purchase. This book contains sections on the

state-of-the-art and research requirements for improving present estimates and future projections of:

- SL rise and variability,
- ocean thermal expansion,
- non-polar glacier contributions,
- ice sheet contributions,
- vertical motion due to glacial isostatic adjustments and tectonic motions,
- terrestrial (including anthropogenic) water storage contributions, and
- changes in the frequency and intensity of extreme SL events and waves.

The quality of this publication is very high and it is of high significance for SL research and also for understanding the SL rise risk for developing countries such as SIDS. For that reason Prof. Visbeck's view was that such books should be made available for all at no charge.

In 2009, the WCRP and IOC established a WCRP-IOC Task Group on Sea-Level Variability and Change. The decision was made by the 30th Session of the WCRP Joint Scientific Committee (6-9 April 2009) and was endorsed by the 25th Assembly of IOC in June 2009. WCRP supported several meetings on SL and RSL including

- 2010 IPCC workshop on Sea-Level Rise and Ice Sheet Instabilities, Kuala-Lumpur, Malaysia;
- 2010 Conference on Deltas in Times of Climate Change, Rotterdam, The Netherlands; and
- February 2011 WCRP/IOC Workshop on Regional Sea-Level Change, Paris, France.

Further developments included a WCRP update on SL for the UNFCCC CoP in Copenhagen in 2009, a white paper for the WCRP Open Science Conference 2011 and a CLIVAR/CliC SL Workshop in Hobart in February 2013, which was organized by WGOMD. Prof. Visbeck presented the implementation considerations for this GC based on the outcomes of the previous events, input by his coauthors (see above), and his knowledge based on recent publications.

RSL is one of the climate parameters with immediate societal relevance. It is affected by all climate components. Its changes are an integral measure of climate change but RSL has also strong contributions not related to climate, and hence not covered by WCRP. This requires interaction with other communities.

There is a strong spatial inhomogeneity of SL variability and change. Available reconstructions suggest non-stationary character of spatial trend patterns and their linkage to natural climate modes such as ENSO, PDO, NAO, etc. In many regions the natural variability of SL can, at times, exceed the anthropogenic trend. However, existing assessments have a large degree of uncertainty.

Speaking about processes determining SL variability and change, Prof. Visbeck started with adiabatic re-distribution of upper-layer water, mostly by wind-driven currents associated with climate modes, which dominates the SL variability on interannual-decadal time scales. It leads to the dependence of SL on modes of atmospheric variability. On longer time scales changes in heat and fresh water uptake come into play, for example from glaciers and ice sheets. Ocean dynamics and gravitational effects strongly complicate the picture, for example, melting of ice sheets results in a level drop near their margins and an increase of the SL at large

distances from ice sheets. Abyssal warming is also important and different between various ocean basins. Vertical land motion (Glacial Isostatic Adjustment) affects RSL.

Prof. Visbeck identified the following challenges of assessing RSL changes for the 21st century:

- Scenario uncertainty, affecting both global mean SL and RSL;
- Inter-model spread reflecting strong differences in simulated ocean circulation changes; and
- Strong internal variability, e.g. on decadal time scales, which indicates that SL prediction on these time scales may be dependent on initial conditions in the ocean.

This led him to the following suggestions for disciplinary and interdisciplinary research activities on the RSL GC.

There is a need to better understand and assess the past RSL and reduce remaining uncertainties in its reconstructions. This can be achieved by

- complementing the tide gauge records with more (proxy) data,
- coordinated multi-model, multi-method data synthesis effort analogous to the CORE effort of WGOMD,
- Integration of ice sheet modelling, ocean modelling, sea level reconstructions, and land motion.

To improve understanding of present changes and underlying causes, it is necessary to

- identify forcing functions and separate natural and anthropogenic changes;
- observe temperature and salinity changes in the deep ocean;
- overcome spurious drifts in ocean models by experimenting with novel forcing strategies and analyzing atmospheric feedbacks;
- ensure adequate account of cryospheric contribution; and
- and test climate models against known present day changes and well-understood processes.

The inter-model differences in the 21st century projections reflect large uncertainties in future evolution of climate modes, lack of initialization (i.e. inability to predict internal variations), changes in regional ocean circulation, projection of glacier and ice sheet changes, and interaction of the ocean with ice sheets. Interaction between the modelling, glaciological, and geodetic research communities is needed to

- Reduce uncertainties in climate models with respect to SL;
- Add missing processes and components into climate models, e.g., ice-sheet dynamics and ice-sheet mass loss, changes in terrestrial hydrology; and
- Initiate a coordinated climate modelling effort with improved representation of regional ocean dynamics; ice sheet – ocean interactions; and changes in terrestrial hydrology.

There is also a need, in liaison with coastal, geodetic and social sciences communities, to systematically account in future projections for coastal effects such as shelf dynamics, impacts of storm surges and waves, and as well non-climate related effects of sediment redistribution and ground-water mining.

Prof. Visbeck also listed potential contributions by CliC, as follows:

- New targeted activity to better assess sea-level contributions from the West Antarctic Ice Sheet;
- New targeted activity looking at freshwater movement and changes in the Arctic that will likely to review all components of freshwater volume export to the Arctic Ocean;
- Ice Sheet Mass Balance and Sea Level (ISMASS) Working Group to be co-sponsored with SCAR/IASC to lead ice sheet model intercomparisons, establish an ice-sheet modelling forum, and contribute to workshops for ECSs, as well as help with online resources.

He also indicated that CliC and CLIVAR joined forces to generate SL rise educational resources, such as webinars, classroom activities for teachers, and graphics archive.

Main points raised during discussions:

JSC thanked Catia Domingues, and Detlef Stammer for agreeing to lead this GC and also thanked Martin Visbeck and his co-authors for the impressive presentation. JSC agreed that the required work on deep ocean hydrography would benefit strongly from support by OOPC and OceanSites. It considered desirable to include paleo research and SL reconstructions in the scope of GC activities. JSC noted that the contribution to planning of RSL GC of land-based contributions (water storage), glacial isostatic rebound and other tectonic influences was largely missing. In this connection JSC agreed that the GC requires involvement of at least the geodetic and gravimetric communities, which are normally outside the WCRP network.

JSC agreed that there might be a need for and a merit in a SL rise model intercomparison for time scales of 40-50 years, which may include a consideration of SL decadal prediction using initialized models. JSC supported the proposal on more extensive use of CORE II protocols for SL research and took note of the role of shelf dynamics in local SL change and its absence in climate change models. CLIVAR was to consider opportunities and benefits of a retrospective MIP for SL models, with a focus on regional SLR to benefit from continuing improvement in available datasets, especially SL observations from space and tide gauges.

6.7 Discussion of the WCRP Grand Science Challenges

After the presentation and discussion of all GCs, the JSC had a general discussion on GCs with the aims of identifying missing elements and consolidation the organization of the WCRP activities to speed up the implementation of all GCs. The following main points were made in this discussion:

- There is a need for proactive work on building commonly accepted quantitative metrics for useful climate information on regional scale.
- The GC on climate sensitivity focuses mostly on clouds. Other contributing processes such as aerosols (sulphur), biogeochemicals (iron, nitrogen, etc.) are not included while these effects are important in regard to human impacts on climate. Nevertheless, JSC was strongly supportive of the priorities identified in the GC on climate sensitivity and the main agreed aim for this GC – to improve some fundamental features in model physics. This indeed calls for staged approach starting with addressing the issues of clouds and sensitivity while effects of aerosols and other chemical constituencies on climate may be taken up in SPARC initiatives.
- Several GCs would benefit from wider and more intensive use of up-to-date ESMs.

- Leadership of all GCs was invited to consider the benefits of using the approach of U.S. Climate Process Teams (CPTs) in implementation of their respective GCs. The CPT approach favours proactive confrontation of model and data and employs some effective coordination and work distribution methods.
- Delivering outcomes through the Research Pillar of GFCS is an efficient way of contributing results of research on GCs to climate services. This topic will be discussed at the 1st meeting of the Intergovernmental Board on Climate Services (WMO, Geneva, 1-5 July 2013).
- JSC agreed to keep under review the longer-term development of WCRP GCs. When progress has been achieved in some of them, new important topics (challnges) may be identified and discussed.
- There is a need to keep under review the management of GCs. Leads of GCs should try to identify gaps, overlaps, and opportunities for cross-GC research linkages. All projects were asked to develop and articulate a strategy for implementation of the GC they lead for one year ahead. For GCs, in which the leads have not been found, the respective projects were asked to identify them as soon as this becomes feasible.

7. WCRP Councils

7.1 WMAC

John Mitchell and Christian Jakob presented the outcomes of the Second WMAC session, which took place on 27 May 2013 at the same hotel simultaneously with the 1st day of the JSC-34. Not all WMAC members came to the session, and it was recognized that the format of the meeting could be the main cause. One of the agenda items for the session was a discussion of GCs but it was difficult to discuss them before hearing the GC reports and based on the written input only. Nevertheless, WMAC agreed that achievement of many of the GC goals would require major improvements to models. At the moment there appears to be no strategy how to achieve this. Another concern is that additional tasks associated with GCs may cause even more work for an already stretched modelling community. Thus, more thought on coordination of modelling activities was required, which could be proposed as a topic for WMAC-3. WMAC-2 also had reservations with respect to the CMIP6, the preparations for which were expected to start in less than 3 months after JSC-34. The modelling community has barely recovered the major efforts associated with CMIP5, with results indicating some minor difference from the ones of CMIP3, for long-term climate projections. Like in the case of modelling to support GCs, there is a need for a strategy to significantly improve models and for more time to make it happen. With respect to CMIP6, WMAC endorses the proposal that CMIP6 Decadal Prediction activities are coordinated through WGSIP, WGCM, and CLIVAR.

WMAC reiterated earlier concerns with respect to the expertise and human power in the area of model *development*, as opposed to model *use*. Model developers are becoming ”endangered species”. There is therefore a need to promote model development, potentially with a focus on early career scientists. WMAC proposes the establishment of several prizes for significant contributions to model development, potentially with involvement of relevant partners such as National Hydrometeorological Services, WMO, AMS, RMS, AGU, EGU, EMS, etc. It formed a small WMAC task team to move this issue forward.

There is a need for summer schools on model *development*. Most summer schools on modelling are either focussed on running models or on numerical methods. Little to no training is at present available in details of model development. WMAC proposes to start organizing summer school(s) on model development that would focus on parameterization (e.g., like the ECMWF training seminar). A small task team has been formed that includes representation from GC on Sensitivity, WGOMD, GASS, and GLASS.

WMAC has some concerns about the Model Evaluation Framework in CORDEX and a suggestion on its possible improvement. The model evaluation framework in CORDEX relies almost exclusively on the use of reanalysis data in driving the regional models. There may be a strong merit in including experiments forced at the boundaries with historical GCM simulations in the model evaluation. Such dedicated evaluation should focus on model qualities and therefore it is best done under a science body, such as WGRC, rather than through a community of users.

WMAC sees ESGF as the main mechanism for exchanging data including model output, observations and datasets and (re-) analysis data in the WCRP in the next decade. This arrangement is seen as most efficient and promising despite not all implications of it are fully understood at present. Many WCRP activities such as CMIP, CHFP, CORDEX, OBS4MIPS, and ANA4MIPS agree to this approach while core project involvement requires some more thought. WMAC proposes to JSC to endorse ESGF as the recommended WCRP data exchange mechanism and discuss core project involvement in it. This needs to be done in consultation with ESGF. However, the internal structure of ESGF should be determined only by its community. WMAC further proposes to replace the ESGF Review Board by an Advisory Board with membership drawn from relevant partners, including WCRP.

WMAC recommends that WDAC lead the new effort on coordinating activities on surface fluxes that would include activities under GEWEX, SURFA, reanalyses, SOLAS, etc.

WMAC also proposes two workshops. A Workshop on model “tuning”, to be lead by WGCM, could cover all aspects of tuning – from process level to coupled models system adjustment. The workshop could discuss making documentation of tuning process a requirement for participation in CMIP6 - thus making the process more efficient and transparent. The other workshop would be on coupling of model dynamics and physics. The initial question would be “How do dynamical and physical process couple in the general circulation and how well is this coupling represented in models?” Answers to this question are key to regional climate prediction and are currently dealt with in separate communities, which increases a danger of fragmentation. Potential partners would include GC on climate sensitivity, GASS, and SPARC. WMAC recommends forming a small group to be led by GASS to define workshop goals and outline.

In terms of membership and its organization, WMAC proposes to keep current membership for one more year, and then include a representative from WGRC. A representative from WWRP is still considered desirable by the Council. WMAC finds it very difficult to attract members to attend a 1-day meeting and believes that there is an unnecessary duplication of reporting with the main JSC meeting. WMAC proposes to make WMAC sessions a 3-day meeting partially joint with the JSC, with joint sessions covering necessary reporting to JSC and WMAC, and with subsequent reporting of WMAC to JSC.

Main points raised during discussions:

The JSC agreed that WMAC had embarked on a set of valuable activities that corresponded very well to the Council ToRs and JSC expectations. It has also agreed that there needs to be a strategy to improve models for achieving objectives set in the WCRP GCs and so far such strategy does not exist.

With respect to the start of preparatory work for CMIP6, there is a need to start collecting input from all WCRP communities, especially the projects. JSC supported the idea of developing guidelines on documenting model tuning information and requested WMAC and WGCM to consider making such documentation a requirement for CMIP6.

JSC endorsed WMAC proposal to initiate a WCRP Early Career Scientist Model Developer Prize and asked WMAC to develop the necessary arrangements and conditions for such competition.

JSC endorsed ESGF as a WCRP-recommended data and information exchange and access mechanism and requested D/WCRP to prepare an announcement for distribution to ESGF supporting parties, relevant partners, and a press release.

JSC was in overall agreement with the proposals of WMAC on optimising the schedule of the Council meetings taking into account typical agenda of JSC meetings – when this is possible. D/WCRP will send to WWRP a letter requesting WWRP to consider nominating a suitable person to WMAC, in addition to the WGNE representative. The desired expertise may include high-resolution modelling and climate modelling aspects of air quality.

7.2 WDAC

Otis Brown presented WDAC activities to JSC. The mission of WDAC is to

- act as a single entry point for all WCRP data, information, and observation activities with its sister programmes,
- coordinate their high-level aspects across the WCRP,
- ensure cooperation with main WCRP partners such as GCOS, CEOS, CGMS and other observing programmes

WDAC works with the WMAC to promote effective use of observations with models and to address issues related to the coordinated development of data assimilation, reanalysis, observing system experiments, fluxes and paleoclimatic data and their assessments (metrics, etc.).

WDAC held its 2nd session in Darmstadt, Germany, on 4-5 March 2013 hosted by EUMETSAT. The meeting agenda included the following issues:

- Inventories of data generating activities;
- Reanalyses and fluxes;
- Data requirements, assimilation, etc.;
- Dataset assessment, best practices;
- ESG, OBS4MIPs, ANA4MIPS, etc.;
- WDAC organization of business.

There are several flagship activities in which WDAC members are participating or acting as liaisons. WDAC keeps under review the development of SCOPE-CM, the second phase of which is starting in 2014. WDAC encourages the use of the GOSIC – CEOS – CGMS joint harmonization tool for ECV inventories. The issue is how to include quality analysis and control for in situ observations, which can be probably done under the GCOS panels. WDAC established a Task Team to advise on OBS4MIPS and ANA4MIPS activities using ESGF for data exchange. It is planning a WCRP workshop on fluxes in 2014. With respect to dataset quality assessment, WDAC asked GEWEX to provide a short white paper on best practices. This letter will be later circulated to WCRP core projects and, after that, to other relevant communities. WDAC represents WCRP in the GCOS Review process. The third WDAC meeting is planned in Galway, Ireland, in April 2013.

Main points raised during discussions:

The JSC stressed that systematic work on harmonisation, standardization and promotion of dataset assessments, including datasets to be used for model verification, is a priority for WDAC. Best practices of this work need to be promoted. Correspondingly, the work of WDAC should be less focussed on reviewing datasets but more on an in-depth review of WCRP data concerns and finding ways of satisfying the corresponding identified needs. JSC asked WDAC to consult as early as possible with JSC Chair on draft agenda of WDAC-3 so that options for inclusion of WCRP data concerns could be made a priority for that session.

A need was expressed to evaluate WCRP efforts on surface fluxes relative to the plan developed across CLIVAR, GEWEX, WGNE, and SOLAS (as posted on the WCRP website). GEWEX and CLIVAR are therefore requested to consider a joint session on scientific progress in surface fluxes at the 2014 Pan GEWEX/CLIVAR meeting. JSC encourages WDAC to participate in this meeting.

JSC was in favour of declaring OBS4MIP and ANA4MIP recommended WCRP approaches for new data organization. However, it still recommends to widely use the wealth of older datasets which had been developed before the establishment of the new standards. Following the lead of SPARC, WDAC was asked to consider how the use of DOI and open access journals citations for data sets could be promoted across the whole of the WCRP.

8. Core projects

The main theme of the third day of JSC-34 was reporting by projects, followed by science presentations by scientists from the host nation.

8.1 CLIVAR

Martin Visbeck and Lisa Goddard presented the report by CLIVAR Co-chairs. Martin Visbeck started the report.

Eleven scientists make the SSG, and 7 staff comprise the ICPO including the headquarters in Southampton, UK, 3 staff working remotely from Argentina, China, and Italy, and a science officer at JPS in Geneva. A dozen of meetings of the CLIVAR constituent bodies take place every year. A major managerial issue is

continuation of the ICPO, which in the future will be distributed among China, India, and Italy.

During the several past years, CLIVAR has been actively discussion its evolution. Its mission, as seen now, is to improve understanding and prediction of ocean-atmosphere interactions and their influence on climate variability and change, for the benefit of society and the environment.

CLIVAR Objectives are to

- Understand the causes of climate variability on intra-seasonal to centennial time-scales through observations, analysis and modelling;
- Improve predictions of climate variability and change associated with both internal and external processes;
- Extend observational climate record, especially ocean observations, through assembly of quality-controlled data sets; and
- Improve the atmosphere and ocean components of Earth System Models.

CLIVAR remains the ocean-atmosphere program of WCRP. It is in the process of formulating a new set of research opportunities that will contribute to WCRP GCs and the wider context of the oceans role in climate variability and change. CLIVAR will retain its global and balanced approach based on observations, models and theory and their joint exploitation for climate assessment and climate prediction. In doing so, CLIVAR supports the development of sustained climate and ocean observations as well as targeted improvements to the climate and ocean components of earth system models. In order to achieve its objectives, CLIVAR will intensify its cooperation with the marine biogeochemistry and eco-system research community as well as with a selected spectrum of its information user community. CLIVAR will expand its support to education, capacity building, and outreach.

These developments are based on strong input from the CLIVAR research community. The next occasions for consultation with community present themselves at the next AGU Fall Session (December 2013), the annual meeting of the AMS (February 2014). The new CLIVAR strategy will be rolled out at the Ocean Science Meeting in March 2014, and it will be extensively discussed at the Pan-CLIVAR meeting on 16-18 July 2014, to be held together with GEWEX.

Current CLIVAR research directions and Imperatives are

- Anthropogenic Climate Change;
- Intra-to-Seasonal Variability, Predictability and Prediction;
- Decadal Variability, Predictability and Prediction;
- Improved Atmosphere and Ocean Components of ESMs;
- Data Synthesis and Analysis;
- Ocean Observing System; and
- Capacity Building.

Prof. Visbeck then presented highlights from the broad scope of CLIVAR regional activities in all oceans or the world, which were coordinated by the CLIVAR / IOC / GOOS Indian Ocean Implementation Panel (IP), Atlantic IP, Pacific IP, and CLIVAR/CliC/SCAR Southern Ocean IP, and gave some examples of monsoon research coordinated by the monsoon panels in Asia – Australia, Africa, and America, which are joint with GEWEX. It followed from these examples that CLIVAR ocean research strongly helps to develop GOOS, including its in situ and remote sensing components, in all ocean basins, and also deepens our understanding of key

processes in the ocean and its interaction with the atmosphere. The CLIVAR/CCl/JCOMM Expert Team on Climate Change Detection and Indices has a wide scope of activities focusing on detection and attribution of anthropogenic influence on weather and climate extremes at regional scale and attribution of causes of extreme climate events.

The WGOMD coordinates hindcast simulations using the Coupled Ocean-ice Reference Experiments Phase II (CORE-II) protocol to

- evaluate, understand, and improve ocean models;
- investigate mechanisms for seasonal, inter-annual, and decadal variability;
- evaluate the robustness of mechanisms across models; and
- support ocean data assimilation.

Eighteen research groups are participating. Future plans of WGOMD include research on:

- model biases and improving model physics, considering biogeochemistry and ecosystems;
- high-resolution modelling and regional/coastal modeling;
- SL and ocean interactions with ice sheets;
- role of ocean in decadal variability (e.g., AMOC); and
- aspects of operational oceanography and data assimilation.

Lisa Goddard gave the concluding part of the report, which was focussing on new plans and developments of the project. The new CLIVAR will contribute to

- Improving the atmosphere and ocean components of Earth System Models;
- Implementing innovative process studies and sustained ocean observations;
- Facilitating free and open access to climate and ocean data, synthesis and information;
- Support for regional and global networks of climate and ocean scientists;
- Facilitating knowledge exchange and user feedback; and
- Supporting education, capacity building, and outreach.

The following major research topics and issues ("CLIVAR research opportunities") will be pursued:

- Intraseasonal, seasonal and interannual variability and predictability of monsoon systems;
- Decadal variability and predictability of ocean and climate variability;
- Trends, nonlinearities and extreme events;
- Marine biophysical interactions and dynamics of upwelling systems;
- Dynamics of regional sea level variability;
- Consistency between planetary heat balance and ocean heat storage; and
- ENSO in a warmer world.

Dr. Goddard indicated main objectives of research under each of these major topics. The most recent 20th Session of CLIVAR SSG elaborated the project structure that is capable to address them. The following groups will be established or reconstituted:

- Ocean Model Development Panel,
- Global Synthesis and Observations Panel,
- Atlantic Region Panel,
- Pacific Region Panel,

- Indian Ocean Region Panel,
- Southern Ocean Region Panel,
- Knowledge Exchange and Capacity Building Panel,
  and two panels cosponsored with or populated with GEWEX:
- Monsoons Panel, and
- ETCCDI (also cosponsored by CCl and JCOMM).

CLIVAR will rework all the ToRs for its panels and plans to make the WGOMD a panel. CLIVAR will consult further with GEWEX on the ETCCDI GEWEX-affiliated member. Means of ensuring connectivity of CLIVAR activities with WGSIP and WGCM will have to be proposed.

CLIVAR asked JSC for guidance and agreement on the following issues and concerns:

- A single Monsoons panel that would serve all of WCPR's monsoon activities with focused regional working groups under that Panel;
- Decision not to include the Arctic in CLIVAR scope of activities and defer this issue to CliC; and
- Discontinuation of the PAGES-CLIVAR panel but encouraging all groups to liaise with PAGES on a working level (like it is done with CARBON and IMBER).

Main points raised during discussions:

The JSC stated how greatly it was indebted to Martin Visbeck for successfully leading CLIVAR during many years. JSC thanked him for his sustained leadership and contribution to guiding CLIVAR during his tenure. JSC also warmly welcomed Lisa Goddard as a new CLIVAR SSG Co-Chair.

JSC noted the anticipated discontinuation of CLIVAR IPO in Southampton in 2014 and plans for organizing a distributed office in China, India and Italy, with a possibility of participating in WGSIP and WGCM from IPO node in Italy.

JSC also noted that the new CLIVAR research opportunities mapped well against the GCs and that the forthcoming changes in the CLIVAR structure, as presented, seemed to efficiently address the main directions of the expected CLIVAR activities. In responses to questions it was highlighted by the CLIVAR Co-chairs that the renewed regional panels of CLIVAR would not be limited in scope of their work to the oceans but would include broad regional aspects. A question was raised whether there was a need for a body or a mechanism that would help CLIVAR to lead the Regional GC for WCRP or for a group or a task force to lead the regional predictability research within CLIVAR. Research on regional predictability should necessarily involve studies of main regional modes of variability . A gap in the WCRP structure with respect to atmospheric dynamics was highlighted.

The JSC accepted the CLIVAR's decision on discontinuation of the PAGES-CLIVAR panel and the intention of CLIVAR to continue to work directly with PAGES initiatives. The discussion on inclusion of the Arctic Ocean in the scope of WCRP was postponed until the report of CliC. The JSC asked whether GEWEX should be a co-sponsor of the CLIVAR/CCl/JCOMM ETCCDI and whether other WCRP projects should be involved. Another option is to only add members to ETCCDI who would represent relevant communities. It was recommended that ETCCDI consider new indices focused on extreme events related to the cryosphere. CLIVAR and GEWEX

were asked to co-develop a strategy for management and oversight of the Monsoon Panel.

The JSC recommended to CLIVAR to take into account the issues mentioned above in reviewing the ToRs for all its groups and panels. It also asked CLIVAR to develop an implementation strategy for Regonal GC pertaining to regional predictability on time scales from seasons to decades.

8.2 CliC

Jenny Baeseman, the CliC IPO Director, gave the CliC talk on behalf of CliC SSG Chair Greg Flato who was unable to attend. Since 2012 the CliC IPO has acquired an Office Assistant. A 5-year agreement was signed in 2013 between WCRP and the Norwegian Polar Institute (NPI) on hosting the CliC IPO at NPI. CliC renewed or entered into a number of agreements with partner organizations. The sponsorship of CliC has changed. It is now a WCRP project, and IASC and SCAR are CliC partners in several joint activities. This change better reflects the nature of cooperation between CliC, IASC, and SCAR. The project has now a completely new and up-to-date website and a mailing list. The CliC Newsletter has restarted. There are WCRP resources for project activities, and they are augmented by contributions based on a proposal funded by the Research Council of Norway. 13 CliC-cosponsored workshops have been held since June 2012 and eigth more meetings are being planned for 2013.

A major cryospheric meeting “Earth Observations and Cryosphere Science” with participation of approximately 200 scientists from 30 countries was organized jointly by ESA, CliC and EGU in Frascati, Italy, on 13-16 November 2012. Recommendations on the cryospheric remote sensing were summarized in the special issue of the open access online journal “The Cryosphere”. They update recommendations summarized in the 2007 IGOS Theme on Cryosphere Report. A comprehensive poster archive from this conference is maintained through the CliC website.

CliC operates two active sea-ice working groups. The Antarctic Sea Ice Processes and Climate Group (ASPeCt) is co-sponsored by SCAR. The CliC Arctic Sea-Ice Working Group is involved in a number of research activities in the Arctic. Sea ice is the topic of a series of two connected CliC workshops in 2012, which are focusing on Norwegian sea-ice research networks, and the international sea-ice modelling and observing community. CliC is supporting the www.iceplan.org, an Arctic sea-ice measurement campaign coordination tool, and, in cooperation with IARC, the Ice Watch, a mechanism for standardization of research observations on sea ice.

At the ninth SSG meeting in Potsdam, Germany, on 4-7 February 2013, several new CliC activities were discussed by the CliC renewed SSG, as follows:

- West Antarctic glacier - ocean modeling;
- Understanding linkages between cryosphere elements;
- Coordination of cryosphere observations for model evaluation and prediction initialization;
- Arctic freshwater system synthesis;
- Ice-sheet model intercomparisons;
- Arctic climate scenarios information archive and delivery;
- Permafrost retrospective simulation, merged with remote sensing;

- Water availability from mountain glaciers and response to climate change; and
- New forums on ice-sheet modelling, sea-ice and climate, and permafrost modeling.

Some of these potential activities are actively moving ahead.

The West Antarctic Glacier-Ocean Modelling is led by David Holland. This group aims to create state-of-the-art regional-scale simulations and physically based estimates of SL coming from WAIS over the present century and beyond. The main goal is to produce a climatological, annually repeating simulation, forced by a 'common-year' forcing dataset with atmospheric, oceanic, glaciological, and bathymetric inputs for initial and boundary conditions. It will be followed by model intercomparisions to understand the possible response of WAIS to IPCC scenario climate forcing. This is a 5-year initiative, which will likely result in multiple articles, a contribution to the next IPCC, and a CliC contribution to the RSL GC.

There is increasing scientific recognition that changes in the Arctic freshwater systems are producing subsequent changes in bio-geophysical and socio-economic systems of particular importance to northern residents and also produce some extra-Arctic effects that will have global consequences. To address such concerns, CliC proposes an "Arctic Freshwater Synthesis" that will assess various Arctic freshwater sources, fluxes, storage, and effects. Most of these are directly or indirectly controlled by the cryospheric components. The range of sources and fluxes to be assessed include: atmospheric vapour transport, precipitation-evaporation, river flow, ablation of glaciers and ice caps, sea ice formation/ablation and marine (low-salinity water) exchanges. Extra-Arctic sources/fluxes from lower latitudes will also be included given their relatively large influence on the overall Arctic freshwater budget. In considering the changes in the various freshwater components, synergistic roles among components, and the overall budget, the assessment will also evaluate their role in producing effects on regional and global climate, biological productivity and biodiversity, and human and economic systems. The assessment is currently being developed jointly by CliC and IASC. Involvement and roles of AMAP and Arctic – Hydra are also considered. A workshop is being planned for late 2013.

Together with SCAR and IASC, CliC will cosponsor the Ice Sheet Mass Balance and Sea Level Rise (ISMASS) Working Group that focuses on interactions between ice sheets and the climate system and evaluation and promotion of scientific understanding of ice sheet models with an aim to quantitatively estimate their contributions to SL.

CliC is responsible in the WCRP for the Cryosphere GC. A workshop "Cryosphere in a Changing Climate" is planned to this effect in Tromsø, Norway, for 16-18 October 2013. It is cosponsored by the Research Council of Norway.

Before joining CliC, Dr. Baeseman, the Director of CliC IPO, was the founding Executive Director of the Association of Polar Early Career Scientists. With arrival of Dr. Baeseman the CliC is benefiting significantly from cooperation with this community, which is now a very large and vibrant network. CliC will benefit from joint workshop planning, co-leading initiatives and activities, support of and access to databases and catalogs, and an extensive suite of communication and outreach activities of APECS.

CliC is very well equipped and active in supporting and leading cryospheric and polar activities in the new era of scientific communication. The new CliC resources include:

- Support / access to information on cryosphere in the media and news;
- Access to recent cryosphere literature publications;
- Community calendar and planning resource;
- Cryosphere community news;
- Support to polar and cryosphere job opportunities;
- Videos, photos, reports and other useful resources; and
- Cryosphere specialist directory.

Some of these resources are now available for WCRP. CliC was actively engaged in the development of WCRP communication strategy and related activities.

Project organizational development plans include:

- Development of operating procedures and branding;
- Review of current working groups;
- Establishing better connections to WCRP Projects;
- Support to a cryosphere thesis database;
- Support to journal abstract podcast series;
- Webinars for science communicators;
- Outreach and Capacity Development Committee;
- Cryosphere Projects Catalogue;
- Revision of CliC Implementation Plan; and
- Desirable increase of staff and institutional memory.

Main points raised during discussions:

The JSC thanked Jenny Baeseman for standing in for Greg Flato. It emphasized the need to speed up the preparation of the CliC Implementation Plan, with a focus of the Project's contribution to WCRP priorities such as GCs and accelerated development of cryospheric models, and start prioritizing the activities based on the Plan. A concern was expressed regarding the number of new potential initiatives. The JSC has highlighted that the support to development of ice-sheet and ice-shelf models on behalf of the entire WCRP network is one of key WCRP needs, and CliC has all opportunities to help developing a network of scientists involved in this type of modelling research and accelerate the model developments. A similar requirement exists for sea-ice modelling. Developments in cryospheric modelling need to be communicated and taken up in the overall climate and Earth System modelling and climate prediction and projection. In this connection, CliC, WGSIP and WGCM were asked to develop proposals on facilitating their interactions. WGSIP and WGCM were encouraged to participate in the Tromsø Workshop on the Cryosphere GC in October 2013.

Following the concerns by CLIVAR with regard to the lack of a WCRP dedicated body to address the role of Arctic in the climate system, and in view of the number of international bodies involved in Arctic research, JSC asked CliC to identify opportunites for greater cooperation with Arctic Ocean research communities for addressing WCRP research priorities, e.g. GCs. One example of an initiative of potential interest and importance for WCRP and CliC is the Arctic Sea-Ice Outlook.

8.3 GEWEX

Kevin Trenberth presented the GEWEX report. GEWEX stands now for "Global Energy and Water Exchanges" and has renewed very significantly its scope and

modus operandi. Twelve scientists make the SSG, which met most recently for its 25th Session in Sydney, Australia, on 15-18 October 2012. Four staff comprise the IGPO in Columbia, Maryland, USA, sponsored by NASA and supported by NOAA.

The GEWEX Vision statement reads: "Water and energy are fundamental for life on Earth. Fresh water is a major pressure point for society owing to increasing demand and vagaries of climate. Extremes of droughts, heat waves and wild fires as well as floods, heavy rains and intense storms increasingly threaten to cause havoc as the climate changes. Other challenges exist on how clouds and aerosols affect energy and climate. Better observations and analysis of these phenomena, and improving our ability to model and predict them, will contribute to increasing information needed by society and decision makers for future planning."

The GEWEX mission is to measure and predict global and regional energy and water variations, trends, and extremes (such as heat waves, floods and droughts) through improved observations and modelling of land, atmosphere and their interactions, thereby providing the scientific underpinnings of climate services.

The new GEWEX has recently published two important planning documents, the "GEWEX Science Questions" and "Imperatives", which summarize the project plans for 2013 and beyond.

The GEWEX Science Questions (GSQ) are:

- How can we better understand and predict precipitation variability and changes?
- How do changes in the land surface and hydrology influence past and future changes in water availability and security?
- How does a warming world affect climate extremes, and especially droughts, floods and heat waves, and how do land processes, in particular, contribute?
- How can understanding of the effects and uncertainties of water and energy exchanges in the current and changing climate be improved and conveyed?

The imperatives include aspects related to:

- observations and dataset development and assessment,
- data analysis and generation of products,
- understanding processes and improving their depiction in models,
- improving models more generally including for data assimilation and predictions,
- applications of all types,
- technology transfer into operations or to users, and
- capacity building of the community and users and training of the next generation of scientists.

The main project components are

- GEWEX Data and Assessments Panel (GDAP),
- Global Atmospheric System Study (GASS),
- Global Land-Atmospheric System Study (GLASS), and
- GEWEX Hydroclimatology Panel (GHP).

GDAP is focusing on radiative processes and transfer codes, production and reprocessing of global data sets, science support to development of observing networks for radiation and soil moisture, assessments and intercomparison studies. The most recent assessments were on radiative fluxes and global cloud datasets

from satellites. A significant challenge for GDAP is associated with the fact that the water and energy balances have not been closed with the energy imbalance of order of 16 W/m^2. After the 30 years of production climate datasets under the ISCCP and other initiatives, GEWEX is moving towards closer interaction of GDAP products and development of a new integrated product with common assumptions. Design of such a product will be conducted in 2013 and will employ data for 2009.

The foci of GHP are globally distributed extensive regional data sets for water and energy cycle to be made available at global data centers to serve hydrological applications and forecasting, such as drought monitoring, hydrological ensemble predictions, etc. The new emphasis is on stronger collaboration between the various RHPs as well as the intercomparison and evaluation of the GEWEX global datasets with the regional data sets. Crucial to success in this endeavor is the linkage between in-situ observations, modelling data and earth observational data and the promotion of the need to address GEWEX science question on regional scale.

The list of former (incomplete), existing, and potential GEWEX RHPs and linked activities includes:

- BALTEX: Baltic Sea Experiment (already in Phase III),
- HyMeX: Hydrological Cycle in the Mediterranean Experiment,
- NEESPI: Northern Eurasian Earth Science Partnership Initiative,
- MAHASRI: Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative,
- TPE: Third Pole Environment,
- MDB: Murray Darling Basin,
- OzEWEX (Australian Energy and Water Exchange initiative),
- AMMA: African Monsoon Multidisciplinary Analysis,
- HyVIC: Hydroclimate of Victoria basin,
- SasRB: Saskatewan River Basin,
- NAWP: North American Water project,
- LBA: Large-scale Biosphere Atmosphere Experiment in Amazonia, and
- LPB: La Plata Basin.

GASS is focussing on atmospheric and boundary layer processes, especially clouds, convection, microphysics; model parameterization evaluation and development; related data sets, tools, and intercomparisons. It strongly cooperates with NWP via WGNE. Often in collaboration with other groups, there have been over 40 projects in the last 20 years. At present there are 15 GASS current and planned projects and four projects that are nearing completion. A Pan-GASS meeting took place on 10-14 September 2012 in Boulder, CO, USA. Approximately 230 participants discussed the status and perspectives of research on

- Land-atmosphere interactions (with GLASS);
- Tropical processes and dynamics (with MJO task force);
- Radiation processes and codes;
- Observations to support model development; and
- Seamless prediction of weather and climate.

The aim of GLASS is to promote community activities that improve estimates and the model representation of land surface state variables, understanding of land/atmosphere feedbacks and the role of land surface in climate predictability. To best achieve these aims, GLASS has been re-structured into three elements:

- model-data fusion,

- land-atmosphere coupling, and
- benchmarking.

In order to respond to the JSC request of developing research strategies in Latin America, Africa, and for some GCs, GEWEX is planning several important meetings, as follows:

- 2-6 September 2013, Rio de Janeiro, Brazil: GDAP/GHP parallel/joint meetings and GHP/GDAP/South America open conference as a prelude to the Latin America and Caribbean Climate Conference;
- 15-18 October 2013, Arusha, Tanzania: the Africa Climate Conference with GEWEX involvement on several fronts (HAP, AMMA, HyVic, WAMME2);
- 5-7 June 2013, Saskatoon, Canada: GC on water availability, GSQ 2;
- 24-26 June 2013, Fort Collins, CO, USA: GC on water availability, GSQ 1;
- 6-12 July 2014, Delft University of Technology; Delft, The Netherlands: GEWEX GSQ Summer Session for Early Career Scientists;
- 13-19 July 2014, The Hague, The Netherlands: the 7th International Scientific Conference on the Global Energy and Water Cycles (including pan-GEWEX and pan-CLIVAR meetings); and
- 2014, ICTP, Trieste, Italy: summer school on attribution and prediction of extreme events linked to the GC on extremes.

The next, 26th GEWEX SSG meeting will be held on 28-31 October 2013 in Boulder, CO, USA.

Implementation of the WCRP GCs and successful addressing GSQs will involve all of the GEWEX Panels and will benefit greatly from strong interactions of GEWEX with all other WCRP projects and other global environmental change research programs or the new Future Earth initiative.

Main points raised during discussions:

The JSC thanked Kevin Trenberth for ably leading GEWEX in the time of transition and acknowledged that the GEWEX Imperatives and Science Questions had vastly improved. JSC suggested expanding GEWEX activities in the domains of applications of climate knowledge in water resource management and hydrological research.

JSC appreciated very much the idea of GEWEX and CLIVAR leadership to organize a joint pan GEWEX and CLIVAR meeting. It noted that the Pan-GEWEX and CLIVAR meeting agenda would include consideration of GC on extremes, for which GEWEX and CLIVAR have the lead, and supported the inclusion of this topic in the agenda of the meeting. Also, there is a need to combine forces of GEWEX and CLIVAR in the work on ocean heat content, which requires research on surface fluxes and analysis of temperature changes. JSC was of opinion that presence of some cryospheric expertise at the Pan-GEWEX and CLIVAR meeting would be also beneficial. JSC members were encouraged to volunteer acting as conveners of sessions at the Pan-GEWEX-CLIVAR meeting.

In terms of planning the activities of GEWEX, JSC was very supportive of the idea to promote crosscutting activities among all the GEWEX RHPs. It also recalled the completed CEOP project of GEWEX and suggested that there must be a merit in using the CEOP dataset for several purposes including model validation.

JSC requested the GEWEX Chair, GDAP/GHP Chairs, and the SSC of the LAC Conference to ensure that the outcomes of the forthcoming (September 2013) GDAP/GHP meeting in Rio de Janeiro contribute to the successful conduct of the Montevideo LAC Conference. This could be facilitated by adjusting the agenda of the meetings in Rio de Janeiro to include issues of importance for the LAC Conference.

8.4 SPARC

Joan Alexander and Greg Bodeker presented the SPARC report. They started it by recalling that the project scope has been recently extended to include chemical and large-scale dynamical processes in the stratosphere and troposphere. The three main SPARC themes are:

- Detection, attribution, and prediction of stratospheric change
- Chemistry–climate interactions
- Stratosphere–troposphere dynamical coupling

The SPARC approach to the choice of research topics and modus operandi are based on the following principles:

- Contribute to WCRP priorities;
- Respond to the needs of assessments (WMO/UNEP and IPCC);
- Grow new activities to meet the needs of research and users of SPARC science and seek for emerging talent;
- Ensure that SPARC activities remain highly focused, have clear deliverables and timelines facilitated through dedicated workshops and benefit from broad community support and involvement;
- Promote the value of SPARC science to national agencies for defining research priorities; and
- Communicate broadly including through SPARC newsletters and SPARC Annual Report.

The current highest priorities for SPARC are to:

- Provide scientific support for the WCRP GCs;
- Organize the next SPARC General Assembly;
- Build capacity in developing countries to both promote their contribution to and use of SPARC; and
- Develop a revised SPARC implementation plan.

The main SPARC activities and accomplishments over the past year are documented in the 2012 SPARC Annual Report. SPARC Co-chairs presented to JSC the main developments and issues of the following SPARC activities:

- Chemistry-Climate Model Initiative (CCMI);
- Dynamical Variability (DynVar) initiative;
- Gravity wave research;
- Solar influences on climate;
- Data assimilation;
- Phase II of the Water Vapour Initiative;
- Assessment of the lifetime of halogen source gases;
- Study of stratospheric temperature change based on the Stratospheric Sounding Unit of the TIROS-N/NOAA Operational Vertical Sounder (TOVS);

- Stratospheric Sulfur and its Role in Climate (SsiRC);
- Reanalysis/analysis Intercomparison Project (S-RIP);
- The Stratospheric Network for the Assessment of Predictability (SNAP);
- Phase II of the SPARC Ozone Profile Initiative;
- SPARC Data Initiative (an intercomparison of 18 different multi-national satellite instrument limb measurements and 25 different trace gas species and aerosol);
- Phase II of the ESA-SPARC initiative (SPIN) to improve the quality of existing measurements and to make new stratosphere climate data records; and
- The SPARC Data Requirements Initiative to define kinds and quality of measurements needed by SPARC and provide input to the WDAC, GCOS, CEOS, and space agencies.

Some outcomes of the SPARC Data Requirements Initiative, as summarized by the recent SPARC data requirements workshop on 20-21 February 2013 in Frascati, Italy, may be of significant value to WCRP. The workshop highlighted the need for error-characterized data sets and recommended full exploitation of the current 'golden age' of measurements as a key reference period. It supported *design* of observing networks including stations in tropics, a need to foster continuation of long-term measurement series including more SSU products, the development of Global Navigation Satellite System radio-occultation products, and the use of diurnal scaling factors for comparing data on short-lived species. SPARC has now successful experience in making source data traceable and can provide guidance on use of DOIs for this purpose.

The Chemistry-Climate Model Initiative (CCMI) is a new collaborative project between SPARC and IGAC and a response to the SPARC mandate to extend its reach into the troposphere. CCMI incorporates core aspects of the former IGAC/SPARC Atmospheric Chemistry and Climate collaboration. Despite being new, CCMI has already helped define and analyze the climate simulations made in support of the 5th IPCC assessment. The next major effort of CCMI will be providing the simulations required by the 2014 WMO/UNEP scientific ozone assessment. A highly successful CCMI workshop was held in Boulder, CO, USA, on 14-16 May 2013.

The next part of the SPARC report dealt with potential contributions of SPARC to WCRP GCs. SPARC is in position to make strong contributions to the Regional GC, GC on Climate Sensitivity and contribute to the GC on Extremes. SPARC will also provide any relevant research through its role in the Polar Climate Predictability Initiative (PCPI).

With regard to the Regional GC, the SPARC DynVar activity will help to identify and understand phenomena that offer some degree of intra-seasonal to inter-annual predictability and to skillfully predict these climate fluctuations and trends. The SPARC SNAP activity also directly addresses the sources and limits of predictability. SPARC role in WGCM should help to identify key model errors that limit prediction skill. SPARC's participation in WGSIP (primarily through CHFP and SHFP) may also channel relevant SPARC research in support of this GC. A number of SPARC activities (including SPIN) focus on producing observational data sets aimed at enhancing the use of observations by the climate modelling community. SPARC is ready to suggest possible candidates for the team to lead the Regional GC.

With regard to the GC on clouds, circulation and climate sensitivity, SPARC expertise in the domain of stratospheric drivers of changes in large-scale circulation systems can strongly contribute to the understanding of climate and hydrological sensitivity.

SPARC can also help in improving the representation of the coupling between cloud-processes and large-scale dynamics. SPARC affiliated scientists are already in the lead of the GC subinitiative on changing patterns aimed at understanding the relative role of local forcing versus large-scale or remotely forced changes in driving regional changes. The GC Initiative "Toward more reliable models" can build on SPARC's process-oriented validation of models.

SPARC is developing a strategy for its capacity building activities. Some concrete steps in this direction will include:

- Organizing summer and/or winter schools with a large share of participants from least-developed countries and SIDS;
- Regional capacity development as part of the General Assembly 2014;
- Developing a visiting scientist programme or a mobility exchange programme;
- Creating a mentoring programme;
- Organizing training initiatives;
- Providing regular travel support for SPARC workshops, General Assemblies and other events;
- Fostering engagement in current and emerging SPARC activities;
- Establish a transparent and effective mechanism to accept and disburse contributions for capacity development; and
- Having an SSG member focussing on capacity development.

The most important SPARC event over many years will be the its forthcoming General Assembly 2014 in Queenstown, New Zealand, on 12-17 January 2014. It will be followed by a session of SPARC SSG. Community support and attendance is critical for the success of this major event in the course of which the new updated title for SPARC ("Stratospheric-tropospheric Processes and their Role in Climate") will be unveiled and new directions of the project research discussed.

The Assembly Scientific Organizing Committee Co-chairs are Adam Scaife and Veronika Eyring.

The Themes of the General Assembly are:

- Atmospheric chemistry, aerosols and climate
- Stratosphere-troposphere-ocean dynamics and predictability of regional climate
- Coupling to the mesosphere and upper atmosphere
- Observational datasets, reanalyses, and attribution studies
- Tropical processes
- Emerging and outstanding research of relevance to SPARC

SPARC and the local organizers of the General Assembly have worked hard to secure sponsorship, which will be used almost entirely to support attendance of students, early career scientists, and scientists from developing countries or countries with economies in transition. In addition SPARC has established a comprehensive carbon offsetting initiative for the meeting cosponsored by the Air New Zealand and supported by the United Bank of Carbon.

JSC members are invited to participate in the General Assembly and help to distribute information about this important event.

Concluding their presentation, Joan Alexander and Greg Bodeker recalled SPARC imperatives, which are to:

- Improve the models by better understanding the relevant processes and through model-measurement comparison;
- Improve the use of (imperfect) model information through model assessment and diagnostic analysis;
- Improve the reanalyses through assessment of the products;
- Improve the observational record through assessment of the products and development of climate data records; and
- Serve user needs by contributing to WMO/UNEP scientific ozone assessments and IPCC assessments (for GFCS SPARC expects are expected to mainly work through the various WCRP working groups).

Main points raised during discussions:

The JSC thanked both speakers for an excellent report and warmly welcomed Joan Alexander as a new SPARC Co-chair. JSC expressed to SPARC its appreciation for exemplary work with JSC on membership issues and especially for a significant number of important and successfully developing SPARC initiatives. Several of these initiatives already respond to the extended SPARC mandate that includes research in the troposphere. JSC noted impressive progress in SPARC efforts to strengthen representation of tropospheric chemistry in models through the new CCMI Initiative. JSC thanked SPARC for an agreement to consider accommodating the research on the role of aerosols in regional climate forcing in CCMI or a new dedicated initiative.

JSC commended the work of SPARC with open access journals and its efforts in terms of improving open access to datasets and their citation. It recommended to WDAC to consider SPARC practices as an example to be followed. At the same time JSC stressed the desirability of considering new approaches and standards in data management, such as OBS4MIP, for SPARC's own activities such as SPIN.

As it pertains to research on atmospheric dynamics in the WCRP, an idea was expressed that SPARC and GEWEX may consider organizing a workshop to scope the issue of large-scale atmospheric dynamics, especially in extratropics, understanding of fundamentals of its variability, and its contribution to climate predictability. The GC on Climate Sensitivity is encouraged to make sure that all SPARC expertise in modelling aspects is used in achieving the GC objectives.

The JSC agreed that the SPARC General Assembly 2014 was very important for creating a vibrant research community to work on scientific issues corresponding to the extended SPARC scope that now includes the tropospheric processes and wished SPARC every success in preparing and holding this event. JSC members were encouraged to attend.

9. Science presentations by host nation

The third work day of the JSC-34 was concluded by two excellent scientific presentations by Brazilian scientists: Paulo Nobre from the National Institute for Space Research (INPE) and Edmo Campos from University of São Paulo.

Paulo Nobre presented to JSC a study of the South Atlantic Convergence Zone (SACZ) with a focus on SST-driven climate variations. Using numerical experiments with an atmospheric GCM and a fully coupled climate model he was able to demonstrate that hydrostatic, thermally driven circulation with ascending motion over

warm ocean waters did not explain the SACZ formation. Only in a fully coupled ocean-atmosphere interactions it was possible to generate SACZ and reproduce its variability. However, in order to predict the formation of SACZ with certain skill, an improved representation of continental diabatic heat source is necessary. This research convincingly showed the importance of developing and improving the atmospheric and coupled models for climate prediction. In response to this need, Brazilian scientists, with international cooperation, are upgrading the Brazilian ESM making it fully interactive.

Edmo Campos gave a talk on the potential role of the leakage of waters from the Indian Ocean to the Atlantic and a model study of their influence on the strength of the Atlantic Meridional Overturning Circulation (AMOC). The upper limb of AMOC in the South Atlantic is formed by waters from the Pacific and the Indian Oceans. It counterbalances the southward flow of the North Atlantic Deep Water Mass (NADW) that forms in the convection zones of the North Atlantic. The "Agulhas Leakage" is the export of Indian Ocean waters into the South Atlantic by rings and filaments at the Agulhas Current Retroflection region. A SCOR/WCRP/IAPSO Working Group recently studied the climatic importance of the Agulhas Current System and detected an increase in the leakage in response to changes in the local winds. A numerical experiment with HYCOM model forced with the NCEP reanalysis data from 1948 to 2012 was used to test the hypothetical positive link between the "Agulhas leakage" and the strength of AMOC. The experiment showed that the wider "Agulhas gap" in winds indeed led to the stronger leakage. However, the simulated AMOC has been weakening since 1960s. The 2004 – 2011 observations also confirmed AMOC weakening trends. There was also a decrease in the transport of NADW estimated using available observations. This all means that the causality of the AMOC variations is more complicated than assumed in the numerical experiments, and that explanation of the simulated and observed trends requires longer and sustained ocean observations. Dr. Campos concluded his presentation by demonstrating highlights of the Brazilian ocean observing programs in the South Atlantic.

Both presentations generated multiple questions and were received by JSC with great interest. They clearly demonstrated the leading position of Brazilian climate and oceanographic research. JSC was very grateful to both speakers and warmly thanked them for their inspiring lectures.

10. Pan-WCRP modelling groups

The fourth day of JSC-34 started with the review of working groups overseeing modelling aspects of climate research.

10.1 WGCM

Gerry Meehl presented the report by WGCM, also on behalf of the other WGCM Co-Chair Sandrine Bony.

WGCM

- reviews and fosters the development of coupled climate models (AOGCMs) and Earth System Models (ESMs) – in partnership with IGBP AIMES, WGNE and WGSIP;
- coordinates model experiments and inter-comparisons to better understand natural climate variability, predict the climate response to natural and anthropogenic perturbations, and assess the climate predictability at the

decadal timescales, for example CMIP (with WGSIP and many MIPs and partners), PMIP, (with IGBP/PAGES), CFMIP (with GCSS), Transpose-AMIP (with WGNE), and CORDEX (with WGRC and CORDEX SAT); and
- promotes and facilitates model validation and diagnosis of shortcomings in them and understanding processes and feedbacks in the climate system (with THORPEX, OBS4MIPs, and partners mentioned above).

WGCM also oversees the implementation of the WCRP GC on climate sensitivity. In this large scope of work WGCM strives to achieve balance between simulation, evaluation, and understanding.

The most important event for WGCM in 2012 was the CMIP5 Model Analysis Workshop on 5-9 March 2012, which was hosted by the International Pacific Research Center at the University of Hawaii, Honolulu, HA, USA. About 160 participants attended. The workshop format was similar to the one used for the CMIP3 Model Analysis Workshop in March 2005.

In spite of some delays in model availability and challenges in downloading model data, CMIP5 ended up being farther along than CMIP3 at the similar stage. CMIP5 includes 53 AOGCMs. Ten of them performed decadal and long-term experiments, eight performed decadal experiments only, 45 performed long-term experiments only. CMIP5 was supported by 26 modelling groups from 20 countries. The experimentation programme resulted in 18 decadal climate prediction simulation sets; 13 models had "high-tops" (with top layer atmospheric pressure < 0.01 hPa); and 19 models were ESMs, i.e. included carbon cycle and performed emission-driven experiments. Four models performed high-resolution time-slice experiments with horizontal resolution between 20 and 60 km. CMIP3 had 23 AOGCMs and 16 modelling groups from 11 countries. CMIP5 data volume is approaching 2 petabytes compared to 31 terabytes in CMIP3.

CMIP5 has so far approximately 700 registered users. Over 300 peer-reviewed papers have been published based on CMIP5, and a very large number of new science results have been obtained with respect to regional climate predictability and typical characteristics of dominant processes and roles of various factors in climate variability and change.

CMIP5 provides many capabilities and new types of climate change information including

- carbon cycle feedback, quantifying sources and sinks of carbon for land versus ocean, allowable emissions for different levels of mitigation in the RCP scenarios, ocean acidification, physiological effects of vegetation changes;
- high resolution time slices to study tropical cyclones;
- decadal climate predictions for short term climate change and possible climate shifts (understanding the early 2000s hiatus in the warmong trends);
- paleoclimate simulations that allow analysis of climate response across past, present and future climates and that provide "out of sample" insights to build model credibility and provide possible constraints on nature and magnitude of future climate change;
- analysis of cloud feedbacks;
- revisiting of forcing and feedback that better helps to interpret the spread of model projections; and
- attempts to relate 20th century model biases to projections.

One of the early concerns with regard to CMIP5 was that the spread of future projections from the new generation of AOGCMs, which were of higher complexity, or from ESMs with coupled carbon cycle, would be considerably larger than from the AOGCMs of CMIP3. The concern was unfounded: spread of projections in CMIP5 AOGCMs is comparable to CMIP3, and most first-generation ESMs showed themselves well-behaved and produced comparable first- order results to AOGCMs (but of course with all their additional capabilities). Patterns of future change of temperature and precipitation, equilibrium climate sensitivity, and spread among CMIP5 models is similar to previous generations of models. With CMIP5 addressing more feedbacks and processes, we now better understand the spread and are more confident in these results.

Some quantities showed considerable improvement, such as rate of sea-ice loss in Arctic, reduction in cloud brightness, representation of MJO or decreased model spread, for example in AMOC, seasonal cycle of precipitation in the Caribbean, Greenland ice sheet mass balance from temperature and precipitation, and Nino3 standard deviation. Some known issues have not significantly improved such as double ITCZ, Arctic clouds and atmospheric circulation, Antarctic sea-ice, Southern Ocean warm bias, SPCZ excessive zonality, and weak tropical Atlantic SST gradient.

Given the success of CMIP5 and the benefit of community discussions of its results, WGCM proposes to have regular model analysis workshops. The main purpose would be to foster CMIP model analyses. The next workshop could be held in 2015.

Decadal climate prediction panel, which is joint between WGCM and WGSIP oversees decadal climate prediction experiments and issues that arise in CMIPs and deals more broadly with issues related to decadal climate prediction.

WGCM is already starting planning of CMIP6. It is assumed to have continuity with CMIP5 and be comparable to CMIP5 in terms of involving multiple communities, having a core set of experiments and several idealized experiments, historical and future prediction/projection runs, and several layers of other experiments. It will rely on ESGF for data archival and access. De-coupling CMIP from the IPCC assessment cycle is being discussed but the merits of having models that would be state-of-the-art for IPCC assessment are an important consideration. Some other types of MIPs will likely occur out of IPCC cycle.

The CMIP6 experiment specification requires sufficient detail. Thus it has to start early enough to design effective configuration and good choice of prioritized fields. Continuity with previous scenarios is desirable, but at the same time the IAM community and WCRP community may need to adjust or add sensitivity experiments. Details of land-use change that are adapted by each group need to be addressed. In general, CMIP6 is seen to be following the same timeline as CMIP5, i.e. to occur seven years later, except the model analysis workshop which will likely occur a little earlier than it earlier counterpart.

WGCM planned events in 2013 include:

- International Workshop on Seasonal to Decadal Prediction (13-16 May 2013, Toulouse, France);
- Sustainable Global Climate Mitigation Scenarios Workshop (29-31 May 2013, National Center for Socio-Environmental Synthesis (Annapolis, MD, USA);
- Societal Dimensions Working Group Meeting (20 June 2013, Breckenridge, CO, USA);

- Energy Modeling Forum, Climate Change Impacts and Integrated Assessment (1-2 August 2013, Snowmass, CO, USA, joint for IAMC and WGCM;
- Next generation climate change experiments needed to advance knowledge and for assessment of CMIP6 (August 4-9, Aspen Global Change Institute, Aspen, CO, USA, joint for WGCM, AIMES, IAMC, and other partners);
- Possible US National Academy of Sciences Board on Atmospheric Sciences and Climate (BASC)/Board on Environmental Change and Society (BECS), session on scenarios, Boreal fall 2013; and
- WGCM meeting, October 2013, Victoria, Canada (joint with AIMES).

Main points raised during discussions:

JSC expressed its deep appreciation to Gerry Meehl for long-term and sterling leadership for WCRP and WGCM. JSC guidance to WGCM was that CMIP should continue to maintain the focus on science community priorities and needs, as a matter of first priority. Representatives of CLIVAR also reiterated the JSC position that the main purpose of experiments like CMIP6 should be progress of scientific aspects of climate modelling, prediction, and projection. WCRP GCs were asked to inform CMIP6 of their scientific questions and resulting research requirements. WGCM and its CMIP6 planning group and leadership of GCs were requested to define optimal means of their interaction. A request from some modelling groups to WGCM on easing the deadline for submission of model runs to CMIPs was mentioned in the JSC discussion, which would help the groups in running hindcast experiments.

JSC was in complete agreement with WGCM and the thoughts expressed in earlier talks, e.g. of WMAC and WDAC, that extended use of ESGF is in position to strongly facilitate many aspects of WCRP activities. WGCM reliance on ESGF reconfirmed the endorsement of ESGF made by JSC-34 a day earlier.

10.2 WGSIP

Adam Scaife reported on WGSIP. This modelling group is co-chaired by Adam Scaife and Francisco Doblas-Reyes. The group works closely with the other modelling working groups such as WGCM. WGSIP's main focus is skilful regional climate prediction information from months to years ahead. Thus, it directly feeds into WCRP Regional GC. Many of the WGSIP members also participate in provision of real time climate service. They are designated by WMO to produce seasonal forecasts in real time and distribute them as WMO Global Producing Centres (GPCs) for long-range predictions with multi-model ensembles available through the dedicated WMO Lead Centre (https://www.wmolc.org).

WGSIP recently held the first International Workshop on Seasonal to Interannual Prediction, which was hosted by MeteoFrance in Toulouse on 13-16 May 2013. Around 150 leading scientists from all major groups worldwide attended the meeting. There was a particularly large turnout from the decadal prediction community and the workshop highlighted emerging key themes such as the role of aerosols in decadal climate fluctuations and predictability of the extratropical winter climate on seasonal timescales.

Over the last year the WGSIP flagship project, the Climate Historical Forecast Project (CHFP) has made important strides forward to create the key database for seasonal forecast research. Hindcast (or reforecast) experiments are now available

from 13 world leading seasonal forecast systems with more being added. Users can register online at the website: http://chfps.cima.fcen.uba.ar hosted by CIMA in Argentina. The data are freely available to researchers and it is planned to advertise the database in CLIVAR Exchanges, GEWEX newsletter and other outlets to increase usage of what is the equivalent of the CMIP database for seasonal forecasts. Three WGSIP subprojects on the role of land surface (soil moisture), sea ice, and the stratosphere are progressing with peer-reviewed papers from these and the CHFP in preparation for submission later this year.

Special focus was given to decadal prediction in this presentation. It is planned to design an update to the CMIP decadal prediction protocol as collaboration between WGSIP, WGCM, and CLIVAR with WGSIP taking the lead and presenting a draft protocol at the forthcoming meeting on CMIP6 experiments in Aspen later this year. The proposal will be developed by the Decadal Climate Prediction Panel, which consists of WGSIP, WGCM, and (soon) CLIVAR members. Real time decadal predictions for GFCS were also discussed and these will be an important topic for the next WGSIP meeting in February 2014, which will be held jointly with the WMO CBS Expert Team on Long Range Forecasts.

Main points raised during discussions:

JSC thanked Adam Scaife for the presentation and noted significant progress in winter time seasonal prediction skill. JSC agreed with WGSIP with regard to the perspectives of exploiting predictability associated with stratosphere and sea ice (and, potentially, snow). JSC noted with great appreciation the preparation of CHFP documentation and accessibility of the project data. JSC was supportive of the potential availability of experimental decadal predictions to users under GFCS. JSC recommended to WGSIP to consider taking advantage of ESGF to ensure greater access and visibility to their data.

10.3 WGNE

Christian Jakob presented the report by WGNE, which is chaired by Andy Brown and Jean-Noel Thepaut. This Working Group is jointly sponsored by the JSC of WCRP and the WMO Commission for Atmospheric Sciences (CAS) and it has the responsibility of fostering the development of atmospheric circulation models for use in weather prediction and climate studies on all time scales and for diagnosing and resolving model shortcomings.

WGNE coordinates a wide range of important numerical experimentation projects including:

- Transpose-AMIP (good progress);
- Cloudy-radiance (completed);
- Grey-zone (verifying resolution needed for cloud processes being resolved explicitly and with a parameterization – good progress);
- Verification
  - NWP performance (e.g., tropical cyclones, precipitation – ongoing);
  - Polar (done);
  - Climate metrics (good progress and broad community acceptance);
  - Issues with verification against own analysis (new);
  - MJO / Boreal summer intraseasonal oscillation intercomparisons (with MJO Task Force - new ongoing);

- Importance of aerosols for weather and climate (discussed by WGNE in 2012, to be spun up);
- Quality of monsoon simulations for weather and climate (discussed by WGNE in 2012); and
- Comparison of model momentum budgets (new).

Several important workshops have taken place in 2013 such as

- The GODAE Ocean View /WGNE Ocean coupling workshop in Washington, DC, USA on 19-22 March 2013, with a focus on coupled modelling for short and medium range prediction and the use of shorter-range coupled runs to better understand issues for longer range prediction, e.g. on subseasonal-seasonal time scale; and
- the 4th WGNE Workshop on Systematic Errors in Weather and Climate Models at MetOffice, Exeter, UK, on 15-19 April 2013, to discuss nature and causes of the errors and the use of diagnostic techniques, observations, process models and simplified experiments to understand them better.

The latter workshop came up with a number of important recommendations for model development and improvement, such as:

- Put more emphasis on seamless approaches to model evaluation;
- More efforts for key observations (fluxes, poles, tropics);
- Increase range of diagnostics applied to models (which requires well organized and accessible datasets);
- Strengthen links between weather and climate communities, e.g. through joint workshops;
- Hold special workshops on the diagnosis of dynamics-physics interactions and their role in model error;
- Need of special efforts to improve analyses in the tropics and polar regions;
- Merit of a joint WWRP/WCRP initiative for a repository of diagnostic codes (or a metrics panel?); and
- Harmonization of experiments beyond CMIP to exclude inconsistencies in model versions (wherever possible).

WGNE expects to play an important role in the WCRP research on GCs. Achievement of many of the GCs objectives requires correct “weather” in climate models. WGNE has much experience, a community, and relevant ongoing activities to analyze “weather” in models. Engagement with WGNE can occur through the Transpose-AMIP effort and through the diagnosis of model error on shorter time scales. WGNE also connects directly to modelling centres in which model development occurs and is key to the model development needed in literally all GCs.

The following directions for WGNE future activities are anticipated:

- Contribution to Earth system prediction, in which weather models will be coupled to the ocean, air composition and quality, hydrology, cryosphere, etc. This will require bringing together several communities;
- Short-range weather prediction with focus on weather phenomena such as cloud, rain, surface temperature, which will require increased emphasis on high resolution – up to convection permitting one;
- “Traditional model development” to find champions (with partners) and tackle key issues, such as boreal intraseasonal variability, grey zone between scales with convection resolved and parameterized, drag, model dynamical cores, stratosphere, stochastic physics, etc.

WGNE will continue to work cross-timescale between weather and climate (and air quality/chemistry) and bring together the corresponding communities. It will strive to support and restore the prestige of model development. Successful WGNE activities are impossible without strong links and collaboration with WWRP, DAOS, GASS, polar, subseasonal-seasonal research, WGCM, SPARC, WMAC, GODAE, and WCRP GCs. The main challenges for WGNE are to maintain an active portfolio of projects, workshops, and conferences, to be productively involved in GCs, and continue to actively bridge the weather-climate divide.

Main points raised during discussions:

JSC warmly thanked Christian Jakob for so ably standing in for the WGNE co-chairs and congratulated WGNE for successfully supporting the coordination work on model development on behalf of WCRP.

JSC noted significant progress in climate model evaluation metrics that may in the future contribute to development of "seamless model verification" across time scales. The idea expressed in the report that there may be a very significant benefit of studying early bias evolution in models calls for more specific proposals with regard to a potential Transpose–CMIP experiment. JSC wholeheartedly agreed with WGNE that this group could play a crucial role in the WCRP GCs and especially in the GC on Climate Sensitivity through modelling support to studying clouds, convection, and radiation.

11. WCRP partnerships and joint initiatives

Under this agenda item JSC reviewed the subseasonal to seasonal prediction project (S2S) and the Polar Climate Predictability Initiative (PCPI) that that are developing in cooperation with partners and WCRP cooperation with the three main partner programs: GCOS, IGBP, and WWRP.

11.1 Subseasonal to seasonal prediction project

Gibert Brunet presented the S2S project on behalf of its Co-chairs, Frédéric Vitart and Andrew Robertson. This is one of several major joint activities of WWRP and WCRP. Its high practical value is related to the fact that the sub-seasonal variability controls significantly the distribution of high-impact weather (like the Atlantic storm tracks) in the Northern Hemisphere. This was the reason why the WMO CAS requested at its 15th session in 2009 that WCRP, WWRP, and THORPEX set up an appropriate collaborative structure for subseasonal prediction. A WCRP – WWRP – THORPEX workshop was held in Exeter, UK, in December 2010 and recommended formation of a Planning Group to write an implementation plan for an S2S project under the WCRP-WWRP-THORPEX sponsorship. The implementation plan was written in 2012 and was subsequently endorsed by the WWRP and WCRP JSCs. The S2S came into being in the result of approval by the WMO Executive Council, which also approved the creation of a trust fund for sub-seasonal to seasonal prediction. The project will last 5 years starting in 2013 with the option to extend it based on a review of progress, achievements, and resolution of remaining issues at that time.

The S2S objectives are to

- improve forecast skill and process understanding on the subseasonal to seasonal timescale with special emphasis on high-impact weather events;
- promote the initiative's uptake by operational centres and its exploitation by the applications community; and
- capitalize on the expertise of the weather and climate research communities to address issues of importance to GFCS.

The subseasonal to seasonal time scales make it possible to employ the "Ready -> Set -> Go!" approach, which facilitates early preparedness and specific and timely actions on ground. There is a growing and urgent requirement for the use of sub-seasonal predictions in a wide range of societal and economic applications. This includes:

- Warnings of the likelihood of severe high-impact weather (droughts, flooding, wind storms etc.) to help protect life and property;
- Support to agriculture;
- River-flow service for flood prediction, hydroelectric power generation, and reservoir management;
- Disease planning/control; and
- Humanitarian support and response to disasters.

The following S2S research priorities are needed to achieve practical benefits:

- Evaluation of potential predictability of subseasonal events including identifying windows of opportunity for increased forecast skill;
- Understanding systematic errors and biases in the subseasonal to seasonal forecast range;
- Comparison, verification and testing of multi-model combinations from these forecasts and quantification of their uncertainty; and
- Focus on some specific extreme event case studies.

It is well known that the subseasonal to seasonal time range is extremely difficult to address: it is still an atmospheric initial condition problem as in the medium-range forecasting and a boundary condition problem as in the seasonal forecasting and it normally involves more degrees of freedom than the seasonal prediction. Some sources of predictability on the sub-seasonal time scale are associated with:

- The Madden-Julian Oscillation,
- Sea surface temperature and sea ice,
- Snow cover,
- Soil moisture, and
- Stratospheric initial conditions.

Related modelling issues involve:

- Role of resolution,
- Role of ocean-atmosphere coupling,
- Systematic errors,
- Initialization strategies,
- Ensemble generation,
- Spread/skill relationship,
- Design of forecast systems, and
- Verification.

The modelling and prediction community is now sufficiently mature to tackle these

issues. Numerical models have shown significant improvements in sub-seasonal prediction over the past years, especially in aspects related to MJO. If a decade ago only a couple of operational centres were producing sub-seasonal forecasts, at present eleven GPCs have set sub-seasonal forecasting systems. Handling multi-model ensemble predictions can benefit from the experience of the THORPEX Interactive Grand Global Ensemble (TIGGE) for forecasts of up to two weeks; the WMO lead centre in KMA for ensemble long-range forecasts of monthly to seasonal timescales, and the WCRP CHFP for seasonal hindcasts. S2S will create a multi-model ensemble prediction system (MEPS) database of operational subseasonal forecasts for time ranges of up to 60 days. These forecasts will not be truly operational because initially they will be lagged by about one month relative to real time. However, they will provide a powerful community resource to investigate predictability mechanisms and assess skill and usefulness for applications. There will be several S2S subprojects addressing the issues of monsoons, MJO, predictions for Africa, verification, and prediction of extreme weather.

A few case studies will be developed to demonstrate that using sub-seasonal predictions could be of benefit to society. They will probably include:

- Pakistan floods (2010) concurrent with the Russian heat wave,
- Australian floods (2011), and
- European Cold spell (2011).

The S2S project will be a contribution to GFCS. It will have joint research with CLIVAR and GEWEX including their regional panels and WGNE. It will be built on some outcomes and arrangements used in the course of the Year of Tropical Convection. It will be developed in coordination with the WMO CBS and will involve the existing verification working groups (SVS-LRF and JWGFVR), and the WWRP Polar Prediction Project.

The next steps for S2S will be as follows. An invitation to contribute data to the S2S archives will be sent to GPCs and WMO Members. An S2S Archive Centre will be established at ECMWF and mirrored elsewhere. The WMO EC-65 endorsed the establishment of the International Coordination Office at KMA and transition of the S2S Planning Group into S2S Steering Group. First S2S Science Workshop will be held in February 2014 at NCEP. It will be entitled “Sources of subseasonal predictability and windows of opportunity for applications”.

Main points raised during discussions:

JSC warmly thanked Gilbert Brunet for presenting the impressive progress of S2S to the Committee. It asked the leadership of S2S to continue to appraise JSC and WGSIP on seamless model development and verification activities. It urged S2S leadership to add SPARC-SNAP to list of primary S2S contacts.

11.2 Polar Climate Prediction Initiative

Greg Bodeker presented PCPI on behalf of its co-leaders, Cecilia Bitz and Ted Shepherd. Cecilia Bitz agreed to become a co-leader of PCPI in 2013. The draft PCPI implementation plan arising from the Toronto workshop in April 2012 has been widely circulated and then finalized. It identified six proposed initiatives. The discussion at the WWRP-PPP Steering Committee meeting in December 2012 identified three joint initiatives. A decision has been made not to have a formal steering Committee because it involves too much overhead in terms of time and

travel funding. Instead, two ”champions” for each initiative have been identified, to carry them forward. Careful consideration was given to ensure strong connections to related activities within WCRP and with WWRP-PPP.

The scientific context for PCPI is that

- Important and puzzling changes are occurring at the poles, such as record Arctic sea-ice extent minimum in September 2012 and record Antarctic sea-ice extent maximum in February 2013;
- Agreement between models and observations is not particularly good in polar regions;
- Polar regions appear to be important for global climate, not just “canaries in coal mines” (e.g. role of Southern Ocean); and
- Polar regions may contain sources of predictability on both seasonal and decadal time scales (subpolar seas, snow cover, sea-ice, stratosphere, etc.).

The programmatic context for PCPI is that polar climate predictability cuts across all elements of WCRP. WCRP needs process expertise in polar regions to help improve products and strategies and contribute to several overarching initiatives such as GFCS and the Global Integrated Polar Prediction System (GIPPS), for which PCPI acts as the seasonal to multi-decadal component. There are existing international programs and committees specifically focused on the polar regions: IASC for the Arctic, and SCAR for the Antarctic, while WCRP brings to the table the global perspective and strength in climate research and global modelling. Within WCRP, the PCPI will constitute a sub-initiative of the “Cryosphere in a Changing Climate” GC. PCPI activities need to be focused, have clear timelines, and be developed in areas where WCRP can play a unique role. The PCPI can therefore act as an ‘incubator’ to generate community research efforts that could be adopted, in the longer term, by more permanent components of the WCRP or by partner organizations.

Having introduced the contexts for PCPI, Greg Bodeker then presented in more detail each of the six PCPI initiatives or topics:

Topic 1 “Improve knowledge and understanding of past polar climate variations (up to 100 years)” will be co-led by Sarah Gille and Julie Jones. It will:

- Bring together research efforts focused on past polar climate variations in order to encourage interdisciplinary interpretation of the fields;
- Use the more data-rich recent decades to gain understanding, and then use what data we can to go further back in time; and
- Identify initial ‘straw man’ research questions to help identify core areas and the relevant community of researchers.

Topic 2 “*Assess reanalyses in polar regions”* will be joint with PPP and will be co-led by David Bromwich and James Renwick. It will:

- Assess reliability and self-consistency of reanalyses in polar regions given the limited observational constraints;
- Develop metrics reflecting coupling between different components of the climate system (to inform coupled assimilation efforts); and
- Examine analysis increments to identify potential biases in modelling.

Topic 3 “Improve understanding of polar climate predictability on seasonal to decadal timescales” will be joint with PPP and will be co-led by John Fyfe and Ed Hawkins. It will:

- Build on existing efforts such as WGSIP CHFP, ARCUS SEARCH, and UK APPOSITE and
- Quantify impact of polar variability on lower latitudes.

(There will be an APPOSITE workshop on seasonal to interannual Arctic predictability in the next 12-18 months, which could be tied to a pan-PCPI meeting. WGSIP has the infrastructure and connections to modelling centres but needs polar process expertise to interpret results and design new experiments.)

Topic 4 "Assess performance of CMIP5 models in polar regions" to be co-led by Hugues Goosse and Jennifer Kay. It will:

- Move beyond identifying model biases to understand why models behave differently from each other and observations;
- Encourage a process level link between model evaluation and improvement;
- Engage a small group to identify evaluations that exemplify this approach and invite them to a synthesis workshop;
- Write a review paper as an outcome of the workshop; and
- Identify best practices and key diagnostics that will lead toward model improvements.

(This group is eager to see a pan-PCPI meeting in 2014 to explore links between the different initiatives.)

Topic 5 "Model error" is joint with PPP. It will be co-led by Markus Jochum and Gunilla Svensson and will:

- Explore half a dozen physical processes important for error growth across timescales;
- Use ECMWF WWRP-PPP workshop in June 2013 for further information gathering;
- Hold workshop at the Bolin Centre in Stockholm in boreal fall – early winter 2013 to develop observational/modelling strategies to improve the representation of these processes (possibly jointly with Topic 2); and
- Expect a number of working groups to feed into plans for observations including YOPP, in conjunction with GEWEX GASS.

Topic 6 "Improve understanding of how jets and non-zonal circulation couple to the rest of the system in the Southern Hemisphere" will be co-led by Gareth Marshall and Marilyn Raphael. It will conduct consultations and possibly a workshop to further scope their initiative.

A possibility of having a pan-PCPI workshop in late 2014, possibly in conjunction with PPP SSG meeting, is being discussed. The PCPI initiative is supported by project scientist Diane Pendlebury working at the University of Toronto (also working on SPARC projects). She is funded by the Canadian Space Agency. She will liaise with PPP International Coordination Office at AWI-Bremerhaven and has been developing a PCPI web site to be hosted by CliC IPO.

Main points raised during discussions:

The JSC thanked very much Greg Bodeker for giving the talk on behalf of the PCPI leads and noted progress of PCPI planning and identification of its six initiatives, their leaders, and main objectives. It emphasized the importance of close coordination between PCPI and PPP.

11.3 GCOS

Adrian Simmons spoke on GCOS, which encompasses the climate components of:

- WMO observing systems (WIGOS: GOS, GAW, GCW, Hydrological OS);
- IOC-led co-sponsored Global Ocean Observing System (GOOS);
- FAO-led co-sponsored Global Terrestrial Observing System (GTOS);
- observational elements of research programmes (WCRP, IGBP, ...);
- other systems contributing climate observations, data management or products;

which together form our overall global observing system for climate, and the climate-observing component of the GEO System of Systems.

The GCOS assesses and communicates requirements for climate observations and products, advises on and supports implementation; reviews progress, and reports to its sponsors and the UNFCCC. It supports assessments, policy, research, and services and is concerned with the observations, data preservation, and generation of data records and products.

The three GCOS domain-based panels (represented on WDAC), are the GCOS / WCRP Atmospheric Observation Panel for Climate (AOPC), the GCOS / GOOS / WCRP Ocean Observations Panel for Climate (OOPC), and GTOS / GCOS / WCRP Terrestrial Observation Panel for Climate (TOPC). SPARC routinely and GEWEX intermittently report their activities to AOPC, which is active and has some governance role for reference networks. OOPC is being reactivated with secretariat support from the WMO. Secretariat of GTOS is non-functional at FAO and new arrangements are needed.

The GCOS Steering Committee met in September 2012 and supported conclusions on dataset inventories as proposed by the 1st session of WDAC. GCOS subsequently engaged in CEOS/CGMS/WMO activities and WDAC-2 to advance this activity. The Steering Committee also expressed concern at the number of important topics that WDAC had to consider and asked GCOS panel chairs on the WDAC to work towards ensuring that key items were adequately covered by WDAC or other WCRP activities.

The GCOS programme has started on the process of producing a report on progress and adequacy of climate observation scheduled for 2015 and a new “Implementation Plan” scheduled for 2016, which should identify verifiable, costed actions and potential agents for implementation and specific requirements for products. WCRP-affiliated input to this process will include, inter alia, recommendations from the WCRP OSC White Paper on “Challenges of a sustained climate observing system” by Trenberth et al., outcomes of the 2013 SPARC workshop on data requirements, and any other specific statements of requirements or conclusions from assessments produced under WCRP auspices.

A Workshop on observations for adaptation was hosted by the German Weather Service (DWD) in Offenbach, Germany, on 26-28 February 2013. It was organized in collaboration with IOC and UNEP. Bruce Hewitson represented WCRP. The workshop identified some specific sectorial needs for observation. Its participants stressed the needs for information on data availability, uncertainty and limits of applicability, need for better access to past and present data, inadequacy of information (including projections) for decision-support at the local level, and a need for further investment in ground-based hydro-meteorological networks. However, the

workshop did not discuss in depth the observations needed to provide reliable forecasts and projections for adaptation, and main input on requirements for this application has to come from weather and climate research communities.

Sponsors of GCOS have set up a Review Board under the chairmanship of Wolfgang Kusch, former head of DWD, to assess the added value of the GCOS programme, its mandate and ToR taking account of developments since the sponsors' 1998 MoU was agreed, including the establishment of the GEOSS, GFCS and WIGOS and evolution of requirements for observations and products. The first meeting of Board on 26 and 27 March 2013 received input from WDAC, among others. A questionnaire has been developed and some interviews will be conducted soon. The Board is expected to report in early 2014.

Evolution of the observing system continues. There are several continuing concerns with regard to the deterioration of some in situ networks, lack of progress in filling gaps in others, and limited provision for limb sounding and reference measurement from space. At the same time many improvements (that need sustaining) can be reported including

- quantity and quality of data from several in situ sources, including radiosondes;
- quantity, quality and variety of data from satellites;
- recovery and reprocessing of past data, both in situ and remotely sensed;
- reanalysis, with coupling of atmosphere to ocean and land, and inclusion of chemistry;
- conventional analysis of instrumental records; and
- converging temperature information from various observational and model datasets.

New requirements emerge, for example, for global in situ soil-moisture data to complement remote sensing and reanalysis.

Adrian Simmons concluded his presentation by demonstrating main features of the observing system evolution, improvements in conventional analysis of near-surface observational record and changes in the global mean temperatures in the stratosphere as inferred from reanalyses and three SSU channels.

Main points raised during discussions:

JSC thanked Adrian Simmons very much for his leadership of GCOS and inspiring talk. JSC noted important developments in GCOS including the independent review of the Program by its Sponsors. One issue of immediate concern for WCRP was the evolution of GCOS Panels, all of which are co-sponsored by WCRP. D/WCRP was asked to pass to GCOS a message on importance of having sufficient expertise in deep ocean hydrography on the renewed OOPC, and CLIVAR was requested to review engagement of CLIVAR basin panels in renewed GOOS/OOPC, and their new structure.

11.4 IGBP

Jose A. Marengo, a member of the IGBP Scientific Committee addressed WCRP on behalf of IGBP. Launched in 1987, IGBP has been leading international research on the planet's key biogeochemical processes. It has been pursuing integrated Earth-system approach, working globally and regionally and addressing as well the human

aspects of global change, impacts, adaptation and vulnerability. Its strategic vision is to provide essential scientific leadership and knowledge of the Earth system to help guide society onto a sustainable pathway during rapid global change.

Jose Marengo presented to WCRP some of science highlights of IGBP for the last year. They included the 1st global climate paleo-reconstruction. 8 workgroups of PAGES have reconstructed and analyzed the climate of the last two millennia at a regional scale. A first set of temperature reconstructions based on more than 500 sites worldwide reveals substantial variability through time, but also between regions. The data showed no globally synchronous warm or cold intervals that would define a worldwide Medieval Climate Anomaly or Little Ice Age. Robust features include a millennial-scale cooling trend across almost all regions reversed by the warming measured over the last few decades.

The Global Carbon Project, affiliated with IGBP and WCRP, integrated data on CO_2 emissions from fossil fuel combustion, cement production, and gas flaring. The comparison between actual emissions and all emission scenarios developed for IPCC shows that for 10 years the Earth has been tracking the most carbon intensive scenarios developed, and the most intensive one of the last released, the RCP8.5, which by 2100 would put the Earth on the path to a 4-6.1^{o}C average global temperature increase.

The first quantitative and comprehensive analysis of black carbon (BC) role in climate, coordinated by IGBP's International Global Atmospheric Chemistry (IGAC) project, has synthesized the large volume of literature on and concluded that BC is the second largest man-made contributor to global warming and its influence on climate has been greatly underestimated. Accounting for all of the ways it can affect climate, black carbon is believed to have a warming effect of about 1.1 W/m^2, approximately two thirds of the effect of the largest manmade contributor to global warming, the carbon dioxide. It also negatively affects human health augmenting lung and other diseases. The results indicate that there may be a greater potential to curb warming by reducing BC emissions than previously thought. The Air Pollution and Climate initiative of IGAC is engaging a range of stakeholders (scientists, economists, policy makers, etc.) to assess the status of knowledge with regard to current understanding about air pollution and climate and their interactions, in particular with relation to current and proposed mitigation options and policy discussions. IGAC is working on a strategic framework for integrated programs on air pollution and climate change. One important aspect of this nexus of problems is urbanization.

Detecting and quantifying changes in land-use and land-cover, as well as understanding the factors driving land-use change, will be critical to developing climate change adaptation strategies, as well as tracking changes in land-use and land-cover as people and ecosystems adapt to a changing climate. The Global Land Project, co-sponsored by IGBP and IHDP, has now an IPO in Brazil at INPE. Social drivers of land use change represent an important focus of the current land-use research.

Impact of ocean acidification on marine ecosystems is a major concern: as atmospheric CO_2 increases, so does the pCO_2 of seawater, leading to a decrease in seawater pH. Chemistry of ocean acidification is well understood, but the impacts on individual species and marine ecosystems are complex. This is one of area of active research by IMBER and SOLAS. Together with IOC and SCOR, IGBP organized the third International Symposium on Ocean Acidification on 24-27 September 2012 in Monterey, CA, USA.

The year 2012 was marked for IGBP by the "Planet under Pressure" conference organized jointly by the GEC programs. The Conference (London, UK, 26-29 March 2012) was the largest and most ambitious engagement effort in IGBP's 25-year history. The IGBP Secretariat coordinated the management and delivery of the conference in partnership with the other global-change programmes and ICSU. The four-day conference was designed to build and strengthen the global-change research community, in particular to form closer links between natural and social science – and brought together science, policy, development, investment, industry, media, etc. to share perspectives and continue the development of new collaborations. In many ways it was setting the stage for FE.

IGBP continues strategic interactions with IPCC and is engaged in many aspects of the development of AR5. A good amount of the science assessed by IPCC will be from the IGBP community. IGBP-affiliated scientists join scoping meetings, contribute to the outline of the assessment report, and participate in the expert review. Several joint workshops with IPCC have been organized in advance of AR5. AR5 WG I report will be launched in Stockholm in September 2013, and the IGBP Secretariat is organizing an event in collaboration with IPCC for the public to communicate the outcomes.

The IGBP Scientific Committee met on 17-19 April 2013 in Bern, Switzerland, and chartered the path for the IGBP Synthesis. Its main goals are to frame contribution of IGBP core project science and big picture view of development of Earth System science. Together with IHDP, IGBP will write an "anthropocene paper" outlining the integrated natural and social science perspective of the challenges of the Anthropocene. IGBP Projects and the Scientific Committee will write a series of articles summarising the project science domains and the Earth System perspective on the motivation and highlights of the "IGBP-type" of science, evaluating lessons and achievements of the past and pointing to future opportunities and perspectives. The completion of this synthesis is expected by December 2015.

The next stage for IGBP will be its transition into FE. IGBP will continue until December 2015 to help ensure a smooth transition of core projects and key activities of IGBP into FE and finalize the Synthesis. IGBP is working with its scientific community, funders, and stakeholders to support a smooth transition into FE.

Main points raised during discussions:

The JSC thanked J. Marengo very much for taking the time to join JSC-34 meeting in Brasília and for his excellent presentation on IGBP achievements and status. JSC noted that IGBP would be winding down at the end of 2015. In this connection, JSC emphasized the utmost importance of biogeochemical research and variables for climate and environmental science and services.

11.5 WWRP

Gilbert Brunet, the Chair of the JSC for WWRP, addressed WCRP on behalf of WWRP.

The long-term objectives of WWRP are:

- To improve public safety and economic productivity by accelerating research on the prediction of high-impact weather;

- To demonstrate improvements in the prediction of weather, with emphasis on high-impact events through the exploitation of advances in scientific understanding, observational network design, data assimilation and modelling techniques and information systems;
- To improve understanding of atmospheric processes of importance to weather forecasting through the organization of focused research programmes;
- To encourage the utilization of relevant advances in weather prediction systems to the benefit of all WMO Programmes and all; and
- To maintain a strong focus on training opportunities for young scientists, in particular from developing countries, so that as many countries as possible will be able to contribute to and benefit from the research advances.

Many of WWRP activities are conducted together with partners. The first Strategic Plan for the Implementation of WWRP for 2009-2017 was published in 2009. It integrates WMO Member activities in THORPEX, tropical meteorology, mesoscale weather forecasting, nowcasting, verification and societal and economic applications with those of partners in global and regional forecast research and Earth observation. Several research topics from the plan are central for WCRP, for example ensemble prediction systems, tropical convection, sub-seasonal to seasonal prediction, and polar prediction.

THORPEX has been the central and the largest WWRP project. It started in 2005 and will sunset in 2014. It has accelerated multiple improvements in the accuracy of one-day to two weeks high-impact weather forecasts for the benefit of society, economy and environment. Its legacy will be preserved through three major projects:

- the sub-seasonal to seasonal prediction project (S2S);
- the polar prediction project (PPP); and
- the new high-impact weather (HIW) prediction project.

The mission of the WWRP Polar Prediction Project (PPP) is to promote cooperative international research enabling development of improved weather and environmental prediction services for the polar regions, on time scales from hourly to seasonal, which constitutes the hourly to seasonal research component of the WMO Global Integrated Polar Prediction System (GIPPS). PPP research areas include:

- Observations,
- Data Assimilation,
- Modelling,
- Ensemble Forecasting,
- Predictability and diagnostics,
- Teleconnections,
- Verification, and
- Societal and Economic Research Applications.

Several research activities will be conducted jointly with PCPI as was reported earlier by Greg Bodeker.

PPP is expecting to take advantage of the Year of Polar Prediction (YOPP), which is planned for 2017-2018. The YOPP plans include:

- Intensive observational and modelling period to advance polar prediction capabilities,
- Research into forecast-stakeholder interaction,

- Enhanced verification, and
- Education of students and early career scientists (e.g. via APECS).

The most important WWRP event in 2014 is the WMO – WWRP – THORPEX World Weather Open Science Conference, to be held on 17 – 21 August 2014 in Montréal, Canada. The overarching theme of the OSC is "Seamless Prediction of the Earth System: from minutes to months". The science presented at the conference will range from basic research that extends our knowledge of processes and methods to the applied research required to put the prediction system together and assess the impacts of weather and climate events.

The OSC program will be organized around five science themes:

- Data Assimilation and Observations;
- Predictability and Dynamical/Physical/Chemical Processes;
- Interactions between sub-systems;
- Prediction of the Earth system: putting it all together;
- Impacts of weather and climate events (joint session with UPC)

A particular focus will be given also to major cross cutting themes, such as ensemble prediction.

Main points raised during discussions:

The JSC expressed its great appreciation to Gilbert Brunet for his leadership of WWRP and fruitful and cooperative participation in WCRP meetings and activities. It noted good cooperation and progress in S2S and polar research initiatives of WCRP and WWRP. JSC highlighted the relevance and importance of using the long-lasting expertise of the NWP community in climate research. It also noted with great interest the impressive progress made on short to medium range weather forecasts by the WWRP communities, which is of great interest to climate research community working on seasonal to interannual time scale.

Several speakers indicated benefits of other potential joint research activities between WCRP and WWRP, for example a possibility of organizing cooperative activities in the region of Lake Victoria, where there is also a potential for greater coordination with WMO Hydrology Programme, and merit of strengthening the WWRP PPP Southern Hemisphere activities.

12. IPCC: What next?

Kevin Trenberth addressed JSC with some personal thoughts and considerations on the IPCC process.

In 1988, at the time of the IPCC establishment, its role was defined as follows; "The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation."

Shown below are milestones of IPCC and UNFCCC since 1988:

- 1988 – The establishment of the IPCC (WMO, UNEP)

- 1990 – First IPCC Assessment Report
- 1992 – IPCC Supplementary Reports
  - 1992 – Adoption of the UNFCCC
  - 1994 – Entry into force of the UNFCCC
- 1994 – IPCC Special Report
- 1995 – Second IPCC Assessment Report
  - 1996 – CoP-2, 1997 – CoP-3
  - 1997 – Adoption of Kyoto Protocol at CoP-3
  - 2005 Kyoto Protocol ratified by 164 countries
- 2001 – Third IPCC Assessment Report
  - 2002 – CoP-8, 2003 – CoP-9
- 2007 – Fourth IPCC Assessment Report
  - 2007 – Nobel Peace Prize
  - 2009 – CoP-15 Copenhagen, 2011 – COP-17 Durban
- 2013 – AR5

The schedule of IPCC events in 2013 is as follows:

13 May: Final AR5 WG I draft due to TSU;
7 June – 2 August: AR5 WG I – final government distribution and final government review of SPM;
23 – 26 September: 12th Session of WG I IPCC (approval and acceptance of WGI AR5, Stockholm, Sweden);
28 October – 20 December: AR5 WG II – final government distribution and final government review of SPM; and
13 December – 10 February 2013: AR5 WG III – final government distribution and final government review of SPM.

The role of IPCC as determined at present is to provide policy relevant but not policy prescriptive scientific advice to policy makers and the general public. IPCC scientists with all kinds of value systems, ethnic backgrounds, and from different countries, gather together to produce the best consensus science possible, and with appropriate statements about confidence and uncertainty. Scientists have become accustomed to this role and many find it hard to become advocates for particular courses of action, and have often been criticized as a result.

A major strength of the IPCC has been its intergovernmental process that includes reviews and then approval of the Summary for Policy Makers on a word-by-word basis. This provides ownership. But it has also been subject to criticism as it is much more political. In principle, this process is designed to provide a report in which the content is determined by the science while how it is stated is determined jointly with the governments. Hence, it aids communication between scientists and politicians. Dr. Trenberth noted that in terms of impact of the report, the process was as important as the report itself.

Dr. Trenberth also provided his observations on the IPCC AR5. He noted the increased number of lead authors (LAs) per chapter and more Coordinating LAs per chapter (often 3 instead of 2). In his view this may lead to diffused responsibility whereby more LAs just do their part, and may not take responsibility for whole chapter, let alone the whole volume.

Dr. Trenberth also commented on the starting preparations for CMIP6. CMIP3 and CMIP5 have been linked to AR4 and AR5 but this has created some problems. There may be a significant scientific advantage of separating CMIP6 from the timetable of IPCC. His commentaries for discussion were as follows:

- IPCC comes out every 6 or so years – far too long for abrupt climate "events";
- Demand is increasingly for ongoing assessments and commentary;
- There is the annual BAMS issue on weather/climate events and some attribution; modelling results are also presented;
- Modelling development is "forced" by IPCC cycles: many papers on CMIP5 will not be included in AR5; and
- There is a need for a "climate information system" as part of a climate service, e.g. GFCS.

Main points raised during discussion:

Having discussed Dr. Trenberth's presentation, the JSC did not find it appropriate to form any unsolicited recommendations on IPCC and its AR5 at such a critical time for the IPCC AR5 preparation. It was decided that comments on IPCC process and a discussion on WCRP contribution to it should be discussed after the report has been unveiled and discussed by decision makers and general public. However, JSC found a potential advantage in soliciting and developing major synthesis papers on critical science issues of relevance for policymakers in advance of IPCC assessments. JSC resolved to recommend considering preparation of such papers to WCRP communities.

13. WCRP communication and capacity development

Ghassem Asrar gave a presentation on WCRP communication, outreach and capacity development strategy on behalf of Roberta Boscolo, the WCRP Communication Officer. Its objectives are to:

- Be a reliable source of science-based climate information for the past, present and future state of Earth's climate system;
- Attract the best minds from the international scientific community to continue providing global context and integrative framework for regional climate research and information;
- Increase public awareness about importance of climate and environment for a sustainable future;
- Enhance the profile and the visibility of WCRP projects, activities and products; and
- Support information exchange and dialogue between the WCRP Secretariat and the projects as well as assist WCRP and its projects in securing the necessary resources to fulfill their objectives.

The WCRP communication and outreach strategy target audiences include scientists, media and the general public, sponsors, decision makers, students and Early Career Scientists, scientific assessments, and global and regional environmental conventions. The message that WCRP would like to get across is about the objectivity of climate science, its focus on useful and action-oriented regional climate information. It is essential that the target audiences were aware of importance of observations, models and analysis for providing best science-based climate information. The following communication means are used by WCRP:

- Publications (including flyers and brochures),
- Website,
- E-Bulletins,

- Social media, and
- Networks and Mailing Lists.

The WCRP Communications Team conducts monthly virtual meetings to

- Share ideas, develop better communication among the Core Projects;
- Build synergies for developing communication products and their dissemination;
- Promote a more effective communication approach in all WCRP and Core Project sponsored activities; and
- Develop strategy for engagement of greater community in implementing WCRP and Core Projects communication plan and priorities.

One of recent developments in the sphere of communication and outreach is the WCRP Community Calendar for all core projects, which is powered by Google calendars. The WCRP issues WCRP Community News, which is a collection of news items from CLIVAR, CliC, GEWEX, SPARC and CORDEX powered by the Yahoo Pipes. The new WCRP website was launched in March 2013. It was developed based on Content Management System (CMS), provides a collaborative environment and allows a more flexible development process with Core Projects, and other potential partners. The WCRP E-Zine is quarterly Newsletter published only electronically. Its distribution list includes 2200 subscribers. The WCRP is active in the use of social media and its news items on the webpage feed automatically into Facebook and Twitter.

Dr. Asrar went on to provide a short overview of WCRP Capacity Development and Education Strategy and associated activites. There are two major thrusts in the WCRP approach capacity development, i.e. to

- building research capacity in developing regions by
  - facilitating and coordinating climate research, modelling, analysis and prediction;
  - assisting the research community and institutions of higher learning in education;
  - providing greater opportunities for ECS, especially those from developing regions,
  - strengthening connections between ECS in the developed world and those in the developing world; and
- empowering next generation of climate scientists.

The plans and priorities in this work are:

- Engaging regional experts in climate research, modelling analysis;
- Promoting scientific exchange;
- Training the trainers;
- Conducting summer schools;
- Helping ECS attendance (especially those from developing countries) at WCRP events;
- Fellowships and Scholarships;
- Mentoring Programs; and
- Facilitating access to scientific journals in developing countries.

The table below provides a summary of sponsored students and ECS in 2011-2013:

	Africa	Americas	Asia	Europe	Oceania
ECS 2011	11	41	16	30	4
Students 2011	3	27	10	20	5
ECS 2012	6	23	10	20	2
Students 2012	1	5	5	2	3
ECS 2013	1	8	7	11	1
Students 2013	3	3	3	9	1

The following WCRP Conferences will have a strong capacity development dimension through engagement and sponsorship of students and early career scientists:

- Africa Climate Conference, 15-18 October 2013, Arusha, Tanzania;
- Regional Climate – CORDEX, 4-7 November 2013, Brussels, Belgium;
- Climate and Society for Latin America and the Caribbean, 17-21 March 2014, Montevideo, Uruguay;
- SPARC General Assembly, 12-17 January 2014, Queenstown, New Zealand;
- MAIRS Open Science Conference, 7-10 April 2014, Beijing, China; and
- Climate Research and Earth Observation from Space, 13-17 October 2014, Darmstadt, Germany.

The following CORDEX workshops with a strong capacity development element have been held and are planned:

- 25-26 March 2011, Trieste, Italy;
- 22-23 September 2011, Jeju, Republic of Korea;
- 21-25 November 2011, Cape Town, South Africa;
- 20-24 February 2012, Trieste, Italy;
- 25-26 February 2012, Pune, India;
- 27-30 August 2013, Kathmandu, Nepal; and
- 11-13 September 2013, Lima, Peru.

Sponsored Summer Schools:

- 2012: IMBER / CLIVAR ClimECO Summer School, 23-28 July 2012, Ankara, Turkey;
- 2013: CLIVAR/GEWEX Summer School on Clouds and Climate, 24 June – 5 July, Les Houches, France (jointly organized by EUCLIPSE and WCRP and linked to the WCRP GC on Climate Sensitivity); and
- 2014: Summer School on Attribution and Prediction of Extreme Events, July 2014, Trieste, Italy.

Building a Network of Young Scholars involves

- Creating ECS Networks for each core Project and CORDEX;
- Involving the existing networks in WCRP activities;
- Efficient use of social media for enhancing interaction and creating community; and
- Facilitating participation of ECS networks in international research and providing opportunities to gain the additional skills needed to join the WCRP and other international research networks - e.g., for APECS.

Main points raised during discussions:

JSC thanked Ghassem Asrar and the WCRP Communications and Capacity Development Team for this presentation and requested the Team to prepare a report on progress, lessons learnt, and efficient practices of working with/supporting ECSs and in the area of outreach, and to share the report within the whole WCRP.

14. Membership of constituent bodies

In a closed session the JSC reviewed the membership of WCRP SSG, Working Groups, CORDEX SAT, and two Advisory Councils.

CliC SSG Membership

JSC noted that terms of service of Dr. Annette Rinke (Germany) and Dr. Vladimir Romanovsky (USA) will be completed at the end of 2013 and these two members of SSG will step down from the Group. JSC appointed Dr. Alexandra Jahn (USA) and Dr. Sebastian Mernild (Chile) as new SSG members starting in 2014 for a 3-year term.

CLIVAR SSG Membership

JSC noted that Prof. Martin Visbeck (Germany) will step down from the position of CLIVAR Co-chair at the end of 2013. JSC appointed Dr. Detlef Stammer (Germany) as CLIVAR Co-chair starting 2014. JSC noted that terms of service of Dr. Valerie Masson-Delmonte (France) and Dr. Steve Rintoul (Australia) will be completed at the end of 2013 and these two members of SSG will step down from the Group. JSC appointed Dr. Pacale Braconnot (France), Dr. Stephen Griffies (USA), and Dr. Carlos Moffat (Chile) as new SSG members starting in 2014 for a 3-year term.

GEWEX SSG Membership

JSC noted that at the end of 2013 Dr. Kevin Trenberth (USA) will step down from the position of GEWEX Chair and Prof. Howard Wheater (Canada) will step down from the position of GEWEX Vice-chair. JSC approved Prof. Sonia I. Seneviratne (Switzerland) and Dr. Graeme L. Stephens (USA) as GEWEX Co-Chairs starting 2014. JSC noted that terms of service of Dr. Peter Bauer, Dr. Eleanor Blyth (both UK), Dr. Ronald Stewart (Canada), and Dr. Olga Zolina (France) will be completed at the end of 2013 and that Dr. Stewart and Dr. Zolina will step down from the Group. JSC agreed to extend terms for service of Dr. Bauer and Dr. Blyth for 2 years starting from 1 January 2014. JSC appointed Dr. Remko Uijlenhoet (The Netherlands) as a GEWEX SSG member for three years starting in 2014.

SPARC SSG Membership

JSC noted that terms of service of Dr. Hong-Bin Chen (China), Dr. David Fahey (USA), Dr. Manuel Pulido (Argentina), Dr. Michele Santee (USA), and Dr. Adam Scaife (UK) will be completed at the end of 2013 and that Dr. Chen, Dr. Fahey, and Dr. Pulido will step down from the Group. JSC agreed to extend terms for service of Dr. Santee and Dr. Scaife for 2 years starting from 1 January 2014. JSC appointed Dr. Mark Baldwin (UK), Dr. Tando Ndarana (South Africa), Dr. Seok-Woo Son (Republic of Korea), and Dr. Carolina Vera (Argentina) as SPARC SSG members for three years starting in 2014.

WGCM Membership

JSC noted that terms of service of Dr. Sandrine Bony (France), Dr. Gerald Meehl (USA), and Dr. Colin Jones (Sweden) will be completed at the end of 2013, that Dr. Jones will step down from the Group, and that at the end of 2013 Dr Meehl will step down from the position of WGCM Co-Chair. JSC agreed to extend the term of service for Dr. Meehl for one year starting on 1 January 2014 as a WGCM member. JSC agreed to extend the term of service for Dr. Bony for 2 years starting from 1 January 2014, with Dr. Bony serving as WGCM Co-chair. JSC appointed Dr. Catherine Senior (UK) as WGCM Co-chair starting 2014.

WGSIP Membership

JSC noted that terms of service of Dr. Swadhin Behera (Japan), Dr. Herve Douville (France), Dr. Arun Kumar (USA), Dr. Adam Scaife (UK), and Dr. Sonia Seneviratne (Switzerland) will be completed at the end of 2013 and that Dr. Seneviratne will step down from the Group. JSC agreed to extend terms for service of Dr. Behera, Dr. Douville, Dr. Kumar, and Dr. Scaife for 2 years starting from 1 January 2014, with Dr. Scaife serving as WGSIP Co-chair. JSC appointed Dr. Jee-Hoon Jeong (Republic of Korea) as a WGSIP member for three years starting in 2014.

WGNE Membership

JSC noted that terms of service of Dr. Michel Baldauf (Germany), Dr. Thomas Hamill, William Lapenta (both USA), and Dr. Mikhail Tolstykh (Russian Federation) will be completed at the end of 2013 and that Dr. Hamill and Dr. Tolstykh will step down from the Group. JSC agreed to extend terms for service of Dr. Baldauf and Dr. Lapenta for 2 years starting from 1 January 2014. JSC endorsed the appointment of Dr. Elena Astakhova (Russian Federation), Dr. Francois Engelbrecht (South Africa), and Dr. Carolyn Reynolds (USA) as WGNE members for 4 years starting in 2014.

CORDEX SAT Membership

JSC noted that Dr. Colin Jones (Sweden) decided to step down from the CORDEX SAT due to a job change and that Dr. Claire Goodess (UK) and Dr. Bruce Hewitson (South Africa) decided to step down from the CORDEX SAT because they were appointed the Co-Chairs of WGRC. JSC appointed Dr. William Gutowski (USA), a member for CORDEX SAT as its Co-chair starting 1 August 2013. JSC appointed Dr. Isabelle Angelovski (Spain), Dr. Christopher Lennard (South Africa), Dr. Grigory Nikulin (Sweden), Dr. Tannecia Stephenson (Jamaica), and Dr. Bertrand Timbal (Australia) as CORDEX SAT members for three years starting in 2014.

WMAC Membership

JSC appointed the new CORDEX SAT Co-Chair Dr. William Gutowski (USA) as a WMAC member starting 1 August 2013.

Membership of WDAC and WGRC

No changes were proposed or made.

General discussion on the membership issues

The JSC agreed that one of the lessons learnt in the course of implementation of new approach to nomination and approval of membership was the need for projects

and groups to provide information on candidates for JSC consideration irrespective of the time of their SSG sessions or working group meetings. Submission of list of final candidates by Projects, WGs, and Councils to JSC Vice-chair should be completed 8 weeks in advance of the next JSC meeting. Otherwise approval of new members may be delayed until the following JSC session. This need has to be communicated to projects and groups. Chairs and Directors must ensure that membership spreadsheets are completely and accurately filled out. The date of birth on the candidate table should be substituted with the date of Ph.D. or the highest degree acquisition/award.

Projects and working groups and panels can also use the JSC approach to determination of their membership.

There may be some (maximum 1-2 members) flexibility with respect to number of members on WCRP consitutuent bodies if there is a need to strengthen the composition of an SSG or a working group due to strategic interests. However, the multi-year average number of members in SSGs, Groups and panels should remain unchanged, unless a strong case can be made otherwise.

Principles of gender, geographic balance and age diversity should be observed.

Spreadsheets with information on proposed membership will need to be sent to JSC members in advance of JSC executive sessions.

15. JSC activities

The JSC agreed that in order to improve communication within the JSC between sessions, a telephone conference should be held approximately in the middle of the time between sessions, the first time in October – December 2013. JSC Members would be better prepared for the session if background documents before the JSC session were available on the meeting website at least one month before the meeting. JPS is asked to notify JSC members once the documents are accessible.

The JSC agreed to establish JSC liaisons to WCRP constituencies (as indicated in action 62). As a rule, these liaisons are expected to participate in SSG sessions of core projects or meetings of Councils or working groups. Other JSC members may be chosen for participation taking into account, e.g., location of the meetings. As a rule, more than one JSC member may serve as a liaison to Projects.

The JSC has discussed and agreed list of Actions. It is given in Appendix E.

16. Concluding Session

Starting the concluding session of the meeting, Tony Busallacchi stated that JSC-34 greatly benefitted from having excellent and gracious hosts. Opportunities to interact with them once again confirmed what an impressive climate science was being done in Brazil.

Dr. Busalacchi thanked all participants in the meeting and especially new JSC members who were very active in discussions and productive on ideas. The meeting was very good and much was accomplished. Considerable progress can be noted on all fronts since last year, which includes progress with ACC and LAC conferences,

JPS fund raising, mapping of Core Project and working group activities against GCs. Collectively, JSC appreciated the presentations on implementation approaches to GCs, especially with respect to the Climate Sensitivity GC, which sets the standard for planning of WCRP GCs. JSC appreciates proposed actions, such as ones suggested by WMAC. Impressive positive developments in planning were reported by GEWEX and JSC wholeheartedly supports the conduct of the Pan-GEWEX and CLIVAR meeting in July 2014. No real failures or "show stoppers" were encountered at this JSC session. At the same time it is not yet clear how to organize the WCRP research in the area of tropospheric dynamics.

Dr. Busalacchi assessed as "mixed" the response of speakers to request for information on impediments to GC implementation and the schedules. He recommended core project representatives on WGRC to foster communication between WGRC and the projects. ·Leadership and strategy for the Regional GC sub-initiative on provision of skilful/action-oriented regional climate information on interannual to decadal time scales need more attention. Dr. Busalacchi encouraged leadership of all GCs to consider concept of U.S. CLIVAR Climate Process Teams, which focuses on proactive confrontation of model and data as a possible central component in their implementation approach. For continuing progress on GCs, all projects are urged to develop and articulate strategy for implementation of the GC they lead for the year ahead.

All JSC-34 presenters were asked to specifically address issues raised at JSC-33 and action items as documented in the JSC-33 Report (Appendix C). Response to this request was also mixed. Thus, participants were cordially asked to monitor JSC-34 action items throughout the year and report explicitly at JSC-35. Dr. Busalacchi also highlighted several positive developments reported and ideas expressed at JSC-34, including:

- Considerable interaction at this meeting;
- Increased JPS support to ECS, and ECS engagement by all core projects;
- The proposal of WMAC to initiate an Early Career Scientist Model Developer Prize;
- SPARC pioneering use of use of open access journals and access to datasets and their citation; and
- The idea of suggesting WCRP synthesis papers in advance of IPCC assessments.

He urged WCRP projects and constituencies engaged in joint activities with IGBP (such as IGAC, iLEAPS, AIMES, IMBER, PAGES, and SOLAS) to monitor their status and continuity. The cooperation with WWRP is developing well. The S2S Project and the PCPI are progressing. The proposed new Prediction of Weather and Climate Extremes project, which is one of three projects to replace THOPRPEX, will have overlaps with S2S and PCPI and may have strongly overlapping communities of participants. This issue may need some attention. The new SPARC/IGAC CCMI initiative provides basis for improved representation of tropospheric chemistry in climate models.

17. Date and place for the next Session

Having discussed available options, the JSC agreed that the next 35th Session of JSC would be held in Heidelberg, Germany, on 30 June – 4 July, with a one-day overlap with the 16th Session of the WMO Commission for Climatology.

18. Session closure

JSC Chair Tony Busalacchi closed the 34th Session of JSC on 31 May 2013 at noon. A round of applause was given to thank very much the courteous Brazilian volunteers who helped to successfully conduct the session.

Appendices

APPENDIX A – List of Participants

WCRP Joint Scientific Committee 34th Session (JSC-34)
Brasília, Brazil, 27-31 May 2013

List of Participants

JSC Members

Prof. Antonio J. Busalacchi (Chair)
Earth System Science Interdisciplinary Center
Dept of Atmospheric and Oceanic Science
Suite 4011, M Square Office Building No. 950
5825 University Research Court
University of Maryland
College Park 20740
United States of America
E-mail: tonyb @ essic.umd.edu

Dr Vladimir M. Kattsov (Vice-Chair)
Voeikov Main Geophysical Observatory
7 Karbyshev Str.
St. Petersburg 194021
Russian Federation
E-mail: kattsov @ mail.ru

Prof. Sarah Gille (Officer)
Scripps Institution of Oceanography
9500 Gilman Drive
Mail Code 0230
La Jolla 92093-0230
United States of America
E-mail: sgille @ ucsd.edu

Prof. Teruyuki Nakajima (Officer)
University of Tokyo
5-1-5 Kashiwanoha, Kashiwa
Chiba 277-8568
Japan
E-mail: teruyuki.nakajima @ aori.u-tokyo.ac.jp

Prof. Stephen Belcher
Met Office Hadley Centre
Fitzroy Road
Exeter
United Kingdom
E-mail: stephen.belcher @ metoffice.gov.uk

Prof. Guy P. Brasseur *(unable to attend)*
Helmholtz-Zentrum Geestacht, GmbH
Climate Service Center
Fischertwiete 1
D-20095 Hamburg
Germany
E-mail: gpbrasseur @ gmail.com

Dr Anny Cazenave
Laboratoire d'Etudes en Géophysique et Océanographie Spatiale
Centre National d'Etudes Spatiales
18 av. Edouard Belin
31400 Toulouse
France
E-mail:
anny.cazenave @ legos.obs-mip.fr

Dr Filippo Giorgi
The Abdus Salam International Centre for Theoretical Physics
Strada Costiera 11
P.O. Box 586
I-34100 Trieste
Italy
E-mail : giorgi @ ictp.trieste.it

Prof. Bhupendra Nath Goswami *(unable to attend)*
Indian Institute of Tropical Meteorology
Dr Homi Bhabha Road
Pashan NCL Post
Pune 411 008
India
E-mail: goswami @ tropmet.res.in

Mr Rodney Guillermo Martínez Güingla
Centro Internacional para la Investigación del Fenómeno de El Niño
CIIFEN Escobedo 1204 y 9 de Octubre
PO Box 09014237
Guayaquil
Ecuador
E-mail: r.martinez @ ciifen.org

Dr Hong Liao
Institute of Atmospheric Physics
Chinese Academy of Sciences
Beijing 100029
China
E-mail: hongliao @ @mail.iap.ac.cn

Dr In-Sik Kang
School of Earth Environment Sciences
Seoul National University
Seoul, 151-742
Republic of Korea
E-mail: kang @ climate.snu.ac.kr

Dr Mauricio M. Mata
Institute of Oceanography
Federal University of Rio Grande
Rio Grande, RS
Brazil 96203-900
E-mail: mauricio.mata @ furg.br

Dr James Renwick
Associate Professor of Physical Geography
School of Geography, Environment and Earth Sciences
Victoria University of Wellington
New Zealand
E-mail: james.renwick @ vuw.ac.nz

Dr Graciela L. Binimelis de Raga
(unable to attend)
Centro de Ciencias de la Atmósfera
Universidad Nacional Autónoma de México
Circuito Exterior, Ciudad Universitaria
04510 México, D.F.
E-mail: graciela.raga @ gmail.com and raga @ unam.mx

Prof. Fredrick Semazzi
North Carolina State University
Box 8208
Raleigh 27695
United States of America
Tel.: + 1 919 515 1434
E-mail: fred_semazzi @ ncsu.edu

Dr Soroosh Sorooshian
Department of Civil and Environmental Engineering
Engineering Hall (Building #308), Suite 5300
University of California, Irvine
E-4130 Engineering Gateway
Irvine, CA 92697-2175
USA
E-mail: soroosh @ uci.edu

Prof. Pius Yanda
Institute of Resource Assessment
Dar Es Salaam 35097
Tanzania
E-mail: pyanda @ gmail.com

WCRP Chairs and Directors

Dr Joan Alexander
Co-chair, SPARC Scientific Steering Group
Northwest Research Associates
Colorado Research Associates (CoRA) Division
3380 Mitchell Lane
Boulder, CO 80301
USA
E-mail: alexand @ cora.nwra.com

Dr Jenny Baeseman
Director
CliC International Project Office
Fram Centre
Hjalmar Johansens gate 14
NO-9296 Tromsø
Norway
E-mail: jbaeseman @ gmail.com

Prof. Roger Barry
(unable to attend)
Director, International CLIVAR Project Office
National Oceanography Centre, Southampton
European Way
Southampton, SO14 3ZH
United Kingdom
E-mail: roger.barry @ noc.ac.uk

Dr Gregory Bodeker
Co-chair, SPARC Scientific Steering Group (2012)
Bodeker Scientific
41 Young Lane RD1
Alexandra
9391 Otago
New Zealand
E-mail: greg @ bodekerscientific.com

Dr Sandrine Bony (via telecon)
Co-chair, Working Group on Coupled Modelling
Laboratoire de Meteorologie Dynamique (LMD/IPSL)
CNRS/UPMC, Tour 45-55, 3eme étage
4 place Jussieu, boite 99
75252 Paris cedex 05
France
E-mail: Sandrine.Bony @ lmd.jussieu.fr

Dr Otis B. Brown
Chair, WCRP Data Advisory Council
CICS-NC
NOAA's National Climatic Data Center
151 Patton Avenue
Asheville, NC 28801
USA
E-mail: Otis.Brown @ noaa.gov

Dr Gregory Flato
(unable to attend)
Chair, CliC Scientific Steering Group
Canadian Centre for Climate Modelling and Analysis
University of Victoria
P.O. Box 1700
V8W 2Y2 Victoria
Canada
E-mail: Greg.Flato @ ec.gc.ca

Dr Lisa Goddard
Co-chair, CLIVAR Scientific Steering Group
The International Research Institute for Climate and Society
128 Monell
61 Route 9W
Palisades, New York 10964
United States of America
E-mail: goddard @ iri.columbia.edu

Prof. Christian Jakob
Co-chair, WCRP Modelling Advisory Council
School of Mathematical Sciences
Monash University
Wellington Road
Clayton, VIC 3800
Australia
E-mail: christian.jakob @ sci.monash.edu.au

Dr Gerald A. Meehl
Co-chair, Working Group on Coupled Modelling
National Center for Atmospheric Research (NCAR)
Climate and Global Dynamics Division
P.O. Box 3000
Boulder, CO 80307-3000
USA
E-mail: meehl @ ncar.ucar.edu

Prof. John Mitchell
Co-chair, WCRP Modelling Advisory Council
Met Office
Fitzroy Road, Exeter
Devon, EX1 3PB
United Kingdom
E-mail: john.f.mitchell @ metoffice.gov.uk

Dr Peter J. van Oevelen
Director, International GEWEX Project Office
Suite 1550
8403 Colesville Road
Silver Spring, MD 20910-6374
USA
E-mail: Peter.Vanoevelen @ gewex.org

Dr Adam Scaife
Co-chair, Working Group on Seasonal to Interannual Prediction
Hadley Centre
Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB United Kingdom
E-mail: adam.scaife @ metoffice.com

Dr Adrian Simmons
Chair, GCOS Steering Committee
Chair, GCOS/WCRP Atmospheric Observations Panel for Climate (AOPC)
European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park
Reading RG2 9AX
United Kingdom
E-mail: adrian.simmons @ ecmwf.int

Prof. Johannes Stähelin
Director, SPARC International Project Office
Swiss Federal Institute of Technology (ETH)
Institut f. Atmosphäre und Klima
CHN P 11
Universitätstrasse 16CH-8092 Zürich
Switzerland
E-mail: johannes.staehelin @ env.ethz.ch

Dr Kevin E. Trenberth
Chair, GEWEX Scientific Steering Group
Climate Analysis Section
NCAR
P.O. Box 3000
Boulder, CO 80307
USA
E-mail: trenbert @ ucar.edu

Prof. Martin Visbeck
Co-chair, CLIVAR Scientific Steering Group
Leibniz-Institute of Marine Sciences
Duesternbrooker Weg 20
D-24105 Kiel
Germany
E-mail: mvisbeck @ geomar.de

Representatives of WCRP Sponsors

Mr Jerry Lengoasa *(via teleconference)*
Deputy Secretary-General
World Meteorological Organization
7 bis, avenue de la Paix
Case Postale 2300
CH-1211 Geneva 2
Switzerland
E-mail: JLengoasa @ wmo.int

Capt. Frederico Antonio Saraiva Nogueira
Directorate of Hydrography and Navigation
Rue Barão de Jaceguai, s/n°
Ponta da Armação
Niterói, Rio de Janeiro
CEP 24.048.900
Brazil
E-mail: frederico @ dhn.mar.mil.br

Dr Steven Wilson *(via teleconference)*
Executive Director
International Council for Science (ICSU)
5 rue Auguste Vacquerie
75116 Paris
France
E-mail: Steven.Wilson @ icsu.org

Agencies / Other Invitees

Dr Gilbert Brunet
Chair, WWRP-JSC
Deputy Director of Weather Science
UK Met Office
Fitzroy Road, Exeter
Devon, EX1 3Pb
United Kingdom
E-mail: gilbert.brunet @ metoffice.gov.uk

Dr Edmo J. D. Campos
University of São Paulo
Praça do Oceanográfico, 191
Cidade Universitária
São Paulo
Brazil
E-mail: edmo @ usp.br

Dr Simon Marsland
Centre for Australian Weather and Climate Research
CSIRO Marine and Atmospheric Research
Private Bag No 1
Aspendale VIC 3195
E-mail: Simon.Marsland @ csiro.au

Dr Carlos Nobre
Ministry of Science, Technology and Innovation
Esplanada dos Ministérios, Bloco E
70067-900 Brasília, D.F.
Brazil
E-mail: carlos.nobre @ mct.gov.br

Dr Paulo Nobre
Centro de Previsão de Tempo e Estudos Climáticos, CPTEC/INPE,
Cachoeira Paulista, São Paulo,
12630-000
Brazil
E-mail: pnobre @ cptec.inpe.br

Dr Celeste Saulo *(via teleconference)*
Centro de investigaciones del mar y la atmosfera (CIMA)
Departamento de ciencias de la atmosfera y los oceanos
2do piso, pabellon II, Ciudad Universitaria (1428)
Buenos Aires
Argentina
E-mail: saulo @ cima.fcen.uba.ar

Mrs Janice Romaguera Trotte Duhá
Ministry of Science, Technology and Innovation (MCTI)
E-mail: janice.trotte @ terra.com.br

Dr Richard D. Rosen
Senior Advisor for Climate Research
NOAA Climate Program Office
SSMC3, Room 12872
1315 East-West Highway
Silver Spring, MD 20910
USA
E-mail: rick.rosen @ noaa.gov

Dr Linda Anne Stevenson
Head, Division of Communication and Scientific Affairs
APN Secretariat
East Building, 4F
1-5-2 Wakinohama Kaigan Dori
Chuo-ku, Kobe 651-0073
Japan
E-mail: lastevenson @ apn-gcr.org

Joint Planning Staff for WCRP

c/o World Meteorological Organization
7 bis, Avenue de la Paix
Case Postale 2300
CH-1211 Geneva 2, Switzerland
Fax: +41 22 730 8036
E-mail: wcrp @ wmo.int, web: http://www.wcrp-climate.org

Dr Ghassem Asrar
Director, WCRP
E-mail: gasrar @ wmo.int

Dr Vladimir Ryabinin
Senior Scientific Officer
E-mail: vryabinin @ wmo.int

Dr Michel Rixen
Senior Scientific Officer
E-mail: mrixen @ wmo.int

APPENDIX B – JSC-34 Agenda

Sunday, 26 May

JSC Officers meeting

Monday, 27 May

Opening Session of WCRP Joint Scientific Committee 34th Session (JSC-34)

09h00 – 09h30 Welcome Remarks – MCT Host – C. Nobre

09h30 – 10h00 Report on WCRP developments, time line for new implementation – A. Busalacchi

Dialogue with Sponsors and Stakeholders

Sponsor Updates – Present Status, Evolving Role of WCRP and charges to WCRP JSC-34 (30 min presentation + 10 min discussion)

10h00 – 10h40 WMO Global Framework for Climate Services – J. Lengoasa (via VC)

10h40 – 11h20 ICSU Future Earth – S. Wilson (via VC)

11h40 – 12h20 IOC Integrated Framework for Sustained Ocean Observations – Capt. (Ret) Frederico A. Saraiva Nogueira

12h20 – 13h00 Report on JPS developments, program, personnel, budget – G. Asrar

14h00 – 15h00 Agency Updates: NOAA/R. Rosen, EUMETSAT/J. Schulz, ECMWF/A. Simmons, CEOS and CGMS/J. Schulz

Presentation of WCRP Grand Challenges (progress to date, impediments, implementation schedules, cross project interdependencies and coordination)

Regional Climate Information (each session 30 min presentation) 15h00 – 17h30

15h00 – 16h00 Long-term regional climate information (WGRC lead, inclusive of WGRC report and CORDEX update) – C. Goodess/B. Hewitson (G. Asrar/F. Giorgi reporting)

16h30 – 17h00 Update on Regional Workshops
Africa Climate Conference – P. Yanda and F. Semazzi)
Latin America Workshop – C. Saulo (via VC)

17h00 – 17h30 Regional Partner Updates: APN/L. Stevenson

17h30 – 18h00 Summary of day's discussion

18h00 Ice Breaker

Tuesday, 28 May

08h30 – 09h30 Intraseasonal to seasonal to interannual prediction (CLIVAR lead) + Decadal prediction (CLIVAR lead/L. Goddard)

09h30 – 10h30 Cloud, circulation and Climate Sensitivity (WGCM; 45 minute presentation with 15 min discussion) – S. Bony (via VC)

11h00 – 12h00 Cryosphere in a Changing Climate (CliC/SPARC; 45 minute presentation with 15 min discussion)

12h00 – 13h00 Science Underpinning the Prediction and Attribution of Extreme Events (GEWEX LEAD; 45 minute presentation with 15 min discussion)

14h00 – 15h00 Changes in Water Availability (GEWEX lead; 45 minute presentation with 15 min discussion)

15h00 – 16h00 Regional Sea-Level Rise (CLIVAR lead/M. Visbeck; 45 minute presentation with 15 min discussion)

16h30 – 17h00 Discussion of Grand Challenges and Next Steps

17h00 – 17h30 WMAC Meeting Summary (20 minute presentation with 10 min discussion) – Co-Chairs

17h30 – 18h00 WDAC Meeting Summary (20 minute presentation with 15 min discussion) – O. Brown

Wednesday, 29 May

WCRP Core Projects: Progress and Plans

(Project response to JSC 33 and actions as a result, implementation plans/timeline for new directions, internal structural changes, and cross project interdependencies) (60 min presentation, 30 min discussion)

08h30 – 10h00 CLIVAR

10h30 – 12h00 CliC

12h00 – 13h00 Lunch (JSC Executive Session)

13h00 – 14h30 GEWEX

14h30 – 16h00 SPARC

16h30 – 17h30 Science Presentations by host nation

Dr Paulo Nobre, INPE/CPTEC – "The South Atlantic Convergence Zone and the paradigm of SST-driven climate variations."

Prof. Edmo Campos, USP – "Strengthening of the Agulhas Leakage and weakening of the Atlantic Meridional Overturning Circulation. Fact or model artifact?"

20h00 Optional visit to Clube do Choro

Thursday, 30 May

Reports by Modelling Groups

08h30 – 09h00 WGCM

09h00 – 09h30 WGSIP

09h30 – 10h00 WGNE

WCRP Partnerships and Joint Initiatives

10h00 – 10h30 WCRP perspective on subseasonal to seasonal prediction project – WGSIP Co-Chair

11h00 – 11h30 Status of WCRP Polar Climate Prediction initiative – (SPARC/CliC)

11h30 – 13h00 Partner Presentations (20 min presentation + 10 min discussion)
GCOS – A. Simmons
IGBP – J. Marengo
WWRP (+ report on joint subseasonal to seasonal prediction project and polar prediction) – G. Brunet

14h00 – 14h30 IPCC: What next? – K. Trenberth

14h30 – 15h00 Summary of JSC-34 and Closing Comments – A. Busalacchi

15h30 – 17h30 Executive Session with WCRP Chairs and Directors

Friday, 31 May

JSC Executive Session

09h00 – 12h00 JSC Executive Session

Implementation Issues with respect to Grand Challenges
Engagement with Future Earth (FE)
Membership
Action Items
Other items

APPENDIX C – Status of actions agreed at JSC-33 in 2012

General

JPS to prepare letters of appreciation from JSC to all outgoing project and working group leaders and JSC members and welcoming new project office directors, WDAC and WMAC Co-chairs and new JSC officers. (In progress)

WMAC

Adopt revised WMAC Terms of Reference. (Completed)

WMAC to form a task team with IGBP on Prediction of Earth System. (Building on already existing link between WGCM and AIMES, a joint meeting is being planned in Victoria, British Columbia, in October 2013)

WDAC

Adopt revised WDAC Terms of Reference. (Completed)

WDAC to help facilitate harmonization between the GOSIC and CEOS/CGMS initiatives that would provide a composite inventory of in situ and satellite observations. (This topics was a major focus for the "Climate from Space Week" 18-22 February 2013, and follow-up discussion planned for the WDAC2 meeting in Darmstadt, Germany)

WDAC to encourage contributions from WCRP core projects, CEOS, CGMS, IGBP, SOLAS and the reanalysis community to the obs4MIP activity so as to populate the ESGF and further facilitate model-data comparisons. (Scheduled to be discussed at the WDAC2 meeting in Darmstadt, Germany)

WDAC to initiate planning activities for a 5th WCRP reanalysis workshop addressing issues raised at the 4th conference; focus on coordination of observations that are input into reanalysis. (Discussed at WDAC2, Darmstadt, Germany)

WDAC to work with GCOS, GEOS and CEOS to encourage existing networks to place higher priority on measuring non-physical variables such as partial pressure of carbon dioxide (pCO2) (an Essential Climate Variable (ECV). (In progress)

WDAC to liaise with the WMO Global Cryosphere Watch (GCW) and CliC on Arctic data issues and to help GCW integrate efforts within the wider climate data community activities. (In progress: mechanisms of cooperation among CliC, WDAC, and GCW are in place, and liaison persons have been identified; Arctic Ocean data issues are picked up in several activities including the emerging International Polar Initiative).

WDAC to encourage development of climate data stewardship and efforts towards data set publication and traceability of data set versions (citations, peer-reviewed articles, DOIs). (Completed, as part of the CEOS WG Climate on Maturity indices)

Invite SPARC SPIN to present to WDAC. (Completed)

WGRC

JSC to identify and appoint two Co-Chairs of the WGRC from the names put forward by the Projects. The membership roster to be developed by the WCRP Chairs and Directors based on nominations by the core Projects and partners. (Completed)

Regional aspects of the Grand Challenges to be managed by responsible Projects where applicable; WGRC to act as unique interface with GFCS as per TOR agreed at Boulder JSC. (To be discussed at the 1st WGRC session in April 2013 in Vienna)

Grand Challenges

Grand Challenges will be comprised of research efforts that are likely to demonstrate significant progress in the next five years. In some cases, sub-"initiatives" will be identified. The Grand Challenges will be organized by the Projects as a supplement to their core activities.

White paper authors and project leads to finish rewrites (5/6 pages) and attach a short appendix to each paper that outlines an implementation strategy by first week of September. Consultation across the full breadth of WCRP is encouraged as well as with other relevant research projects and groups. (Completed, papers are posted on WCRP web site)

White paper authors to produce a one page summary and graphic for each GC; JPS to compile the summary and full-length papers in documents aimed at sponsors, funders, researchers, etc. (In progress)

Lead Projects for each GC to organize focused workshops for each of the GCs or "initiatives" within the next year to gather community input and identify specific activities to be promoted and coordinated by the WCRP and its core Projects. Draft implementation plan for each workshop to be reported to JSC by 1 November 2012. (In progress)

Regional

Regional GC to consist of three initiatives, namely: Intraseasonal to seasonal to interannual prediction (CLIVAR lead), Decadal prediction (CLIVAR lead), Long-term regional climate information (WGRC will support initial planning phase). SPARC lead on development of polar climate predictability initiative and CliC to support its implementation as part of the Cryosphere GC and in collaboration with SPARC, GEWEX and CLIVAR. Authors to reconsider the title of this GC. (In progress: a series of actions in underway, including assessment of ice sheet mass balance, ocean dynamics and sea level, and an update on the white paper is in making.) The International Workshop on Seasonal to Decadal Prediction to be held in Toulouse, France on 13-16 May 2013, organized by WGSIP and WGCM, is seen as first event for this GC. The workshop will bring together the community to ascertain how to best approach the seasonal to decadal prediction problem based on the experiences over the past several years. This meeting will take stock of the lessons learned so far and perhaps go as far as developing guidance or 'best practice' guidelines for moving forward.

Regional Sea-level Rise

Authors to rewrite white paper to include global SLR; title to remain same; Projects to provide additional feedback, especially on regional aspect; CLIVAR to support this

GC in close collaboration with CliC and GEWEX; activities of the WCRP-IOC sea-level crosscut should be integrated into this GC. (CLIVAR recently held a workshop on Sea level rise, ocean/ice shelf interactions and ice sheets in Hobart (18-20 Feb). The workshop participants which included representatives from CliC and the WCRP-IOC crosscut aimed to evaluate the state-of-science of ocean and land-ice interactions, identify priorities for reducing uncertainties in the projections of global and regional sea-level rise, and investigate pathways for the development of the next generation of climate models incorporating interactive land-ice components. Discussions at the workshop were also designed to advance planning for the CLIVAR "research opportunity" on regional sea-level rise that parallels the WCRP GC. A report on the workshop outcomes will be available soon.

Cryosphere in a Changing Climate

Authors to identify focused initiatives that could progress significantly in a five-year timeframe. One of these will be polar climate predictability (initially lead by SPARC). Overall responsibility for this Grand Challenge, now entitled "Cryosphere in a Changing Climate", will be with CliC in close coordination with other projects and partner programmes (e.g. IASC…). (In progress: a series of workshop is taking place in Norway in 2013 on sea ice as a part of this Grand Challenge, several related CliC Targeted Activities have been identified at the CliC SSG-9 to be aligned with this GC)

Cloud and Climate Sensitivity

Dr Bony, with input from GEWEX, WGCM, WGNE, GEWEX/GASS and other key groups, will revise the white paper to include greater and leading emphasis on role of clouds and large-scale distribution of precipitation. Role of aerosols to be included in the subtitle. WGCM will "host" this Grand Challenge, now entitled "Cloud and Climate Sensitivity", with assistance from GEWEX for its management. SPARC will lead on the aerosol aspects in close coordination with GEWEX and IGAC. (Completed)

Changes in Water Availability

White paper endorsed but regional emphasis should be strengthened; GEWEX to lead this GC, now entitled "Changes in Water Availability". (GEWEX will hold two workshops in support of this GC – the first to develop a WCRP Strategy for Global Water Resource Systems, in Saskatoon 5-7 June and the second on Observations and Predictions of Precipitation, in Ft Collins 27-29 June.)

Prediction and Attribution of Extreme Events

Authors to invite more feedback from the Projects and to reduce the number of initiatives. GEWEX will take the overall lead on this Grand Challenge, now entitled "Prediction and Attribution of Extreme Events". (No workshops planned, but we are exploring option of having the first workshop together with the ACE workshop. CLIVAR has a parallel "research opportunity" entitled Trends, Nonlinearities and Extreme Events with a focus on atmosphere/ocean processes. Implementation will be discussed at the upcoming CLIVAR SSG in May.)

Core Projects

SPARC

JSC concurs with SPARC proposal for regional capacity development activity, but advises coordination with WGRC. (In progress, to be discussed at the WGRC meeting)

Predictability should be enhanced and made more prominent in the polar climate initiative; SPARC to coordinate with WGSIP and CLIVAR in this regard. (In progress.)

CLIVAR

JSC concurs with proposed CLIVAR matrix structure; welcomes capacity building/outreach efforts, but advises considerable development; JSC questioned need for proposed 5-year terms. (How to best manage the new CLIVAR "research opportunities" and "key capabilities" will be revisited at the upcoming CLIVAR SSG meeting (6-9 May), as well as the strategy for capacity development and outreach.

CLIVAR to revisit project name; acronym to remain same. ICPO has polled the CLIVAR panels and the preferred extended name is: CLIVAR – Variability and Predictability of the Ocean/Atmosphere System, but more input is being sought, in particular from students and early career scientists. A final decision will be taken at the CLIVAR SSG meeting in Kiel 6-9 May.

The Expert Team on Climate Change Detection and Indices (ETCCDI) to remain within CLIVAR. (In progress, to be considered as an activity of the Extremes GC)

CliC

JSC proposes that CliC SSG be primarily advisory; working groups should be formed to carry out activities.
(Completed, the CliC SSG-9 in February 2013 identified leaders for the new CliC Targeted Activities and discussed the roles and responsibilities of the SSG members in these activities)

JSC recommends CliC engagement with the Global Carbon Project vis-à-vis the role of permafrost in carbon cycle. (Completed, this engagement has been in place since the inception of the carbon and permafrost theme by CliC, the International Permafrost Association, and the Global Carbon Project.)

GEWEX

GEWEX to confer with SPARC on the need for a panel on global atmosphere synthesis. (Several email exchanges between the SPARC and GEWEX leaderships have taken place. Current thinking is that the best way to get interaction is when it is driven by a problem that needs addressing. It has been suggested that this may arise most strongly in the "Clouds, circulation and climate sensitivity" Grand Challenge, which will be connecting the mesoscale/regional scale to the global scale –exactly the GASS/SPARC connection. They are currently attempting to get the principals together at a meeting of opportunity, e.g., in May in Boulder.)

All Core Projects

CLIVAR and GEWEX to join forces to coordinate monsoon activities with CLIVAR taking the lead in managing this under new pan-monsoon panel. Monsoon panel to explore greater collaboration with MAIRS. (A preliminary draft of a justification/proposal for a Pan-WCRP Monsoon Advisory Panel (PMAP), has been prepared by the Asian-Australian Monsoon Panel. The draft document is proposing a high level advisory group across WCRP but still retaining the regional panels within the projects, particularly GEWEX-CLIVAR African Climate Panel, VAMOS and AAMP. After receiving comments from VAMOS and MAIRS the new version of the document is being compiled and will be distributed to the JSC, GEWEX and CLIVAR to seek their input)

VACS and VAMOS, with full support and engagement of CLIVAR, GEWEX and the JSC, to take the lead in forming scientific organizing committees for conferences that will identify future directions for WCRP in climate research for Africa and for Latin America and the Caribbean, respectfully. JPS to assist in fund raising. VACS and VAMOS to be jointly administered by CLIVAR and GEWEX, at least until the conferences. (The CLIVAR-GEWEX Africa Panel has been very active over the last 9 months, having produced a WCRP Africa Newsletter and a special issue of CLIVAR Exchanges on Africa. A steering committee for the African Climate Conference (ACC) has been established and the Conference is scheduled for 15-18 October 2013 in Arusha, Tanzania. A great deal of community effort has gone into producing a "Frontiers" document for discussion at the ACC, as well as an elaborate call for abstracts that will be issued next week (4-8 March); the web site and registration will go live as soon as logistics for collecting the registration fee are agreed/ established. For more info now see http://www.clivar.org/organization/africa).
VAMOS in consultation with GEWEX has formed a Steering Committee for the WCRP Latin America and Caribbean Conference that will meet 4-5 March. The Conference is to be held in Montevideo, Uruguay, 7-21 March 2014.

JSC agrees to proposed name changes for SPARC and GEWEX; acronyms for all four core projects remain the same. (Adopted)

Modelling

WGCM

Request to all WCRP affiliated projects to consider advocating and supporting CMIP5 synthesis papers. (In progress, many CMIP5 papers submitted for AR5 inclusion, call for synthesis papers being issued)

CORDEX

Provide some guidance on use/limitations of data on CORDEX website. (Completed, and will be updated on a regular basis)

CORDEX in collaboration with WGCM to plan some activities that compare regional and global modelling approaches. (In progress)

CORDEX to reconsider name of domain covering Middle East in keeping with all other CORDEX domain names that are geographic. (Completed)

JSC encourages MAIRS to provide feedback to CORDEX by evaluating products using regional knowledge and data sets, as well as continue to interact with the new

Monsoon Panel. (In progress, MAIRS is involved in CORDEX Asia activities and as a partner on a funding proposal to the Asia Pacific Network)

Capacity Development

JSC endorsed strategy outlined in white paper on WCRP Education, Training and Capacity Development. Projects and JSC members to alert JPS to regional and national fellowships, scholarships and employment opportunities that could benefit WCRP community. (In progress, more than 70 young scholars were supported by WCRP in 2012, a proposal has been prepared and submitted to ICTP for a summer school on extreme events for 2014. If the proposal is successful we will make this part of a series of summer schools addressing the WCRP Grand Challenges. WCRP will be also a co-sponsor of a summer school in 2013 on Clouds and Circulation GC in Les Houches, France)

Communication and Outreach

JSC endorsed strategy outlined in white paper on WCRP Communication and Outreach. JSC members to comment on any potential gaps in outreach matrix. (In progress, no additional feedback received from JSC members, WCRP web site is re-designed, the content management system is being adopted for design and development of WCRP and core Projects web sites, the communication officers of the IPOs have regular teleconferences to discuss the implementation of the strategy as well as to discuss the gaps)

Projects and JSC members to bring to the attention of JPS and IPOs recent and upcoming publications and research results that are particularly newsworthy.(In progress, a forum has been established among the communication officers of the IPOs for exchanging news on the project results. We plan to launch a WCRP Grand Challenges Newsletter where we collect newsworthy contributions of WCRP community to the Grand Challenges. Efforts are under way to revamp the WCRP and all four Projects web pages)

Crosscuts

Sea-level and extremes crosscuts raised to GCs; Decadal an initiative under regional GC. (In progress, highlights of Hobart Workshop will be provided)

Atmospheric Chemistry and Climate (AC&C) to continue until agreement reached by SPARC with IGAC on how best to proceed. (In progress, summary of latest discussion between SPARC and IGAC will be provided)

Funding

JPS to develop a funding strategy for engagement with development community (i.e., World Bank, IADB, ADB, NGOs, etc.). (In progress, several requests submitted for funding of capacity development for CORDEX and other regional activities)

Membership

JSC to form membership team chaired by Vice-chair; several months in advance of JSC meeting. Projects to identify a slate of potential new members and iterate with the membership team until agreement reached; then Projects to approach candidates to inquire whether they are willing to serve; confirmation of membership

to be made at JSC meeting. (Being implemented, several requests were submitted by core Projects for JSC consideration)

APPENDIX D – WGRC ToRs (as updated by JSC-34 on 30 May 2013)

To facilitate coordination of WCRP research activities relevant to the provision of regional climate information and related climate services.

To integrate the user and decision maker context into the design and development of regional climate science through two-way communication and co-production activities.

To facilitate, in co-operation with other relevant international organizations, the provision of good practice guidance for potential users on the identification, selection, processing, application and interpretation of regional climate information.

To provide advice to the WCRP regarding research activities needed to support and improve regional climate science and prediction.

To provide recommendations to WCRP regarding the provision and communication of information for regional impact assessment, decision making, and climate services as related to, for example, water, health, food and disaster risk reduction. This includes helping to ensure that observing networks are optimized, maintained over the long term, and adapted to user needs.

To oversee and promote specific WCRP regional climate research initiatives including the Coordinated Regional Downscaling Experiment (CORDEX), and other activities that may be established in the future, either independently or in collaboration among the WCRP Projects or with other sister research programmes.

To strengthen the role of regional climate science within the WCRP with research results communicated effectively to, or where possible designed in partnership with, climate service institutions. This may include preparation of web-based information, publication of reports, organization of targeted workshops, encouraging building of research partnerships, etc. It should also be informed by and support research on climate science communication.

To liaise, as appropriate, with other organizations or bodies developing scenarios of environmental and socioeconomic conditions, and to facilitate the assessment (and develop a set of best practices with respect of) the consistency and plausibility of regional climate projections in the context of integrated scenario development.

To foster communication between the WCRP and the GFCS and Future Earth, and to serve as the point of contact between the WCRP and regional climate information/service entities. (e.g., WMO Regional Climate Centers, the Climate Services Partnership (CSP), etc.).

To liaise as appropriate with other relevant international weather, oceanographic, climate and global change research programmes and communicate science priorities to funding agencies, NGOs and development agencies.

APPENDIX E – Actions resulting from JSC-34 decisions

The Table below contains numbers of JSC-34 actions pertaining to WCRP Working Bodies and individuals. Bold numbers indicate the overall responsibility or co-lead for the action or for the initiation of the action. The actions are listed after the Table.

WCRP Working Body, Responsible Group, or Person	Action Number(s)
JSC Members	2,17,21,22,58,**62**
JSC Chair	40
Anne Cazenave	**23**
Hugo Berbery	**48**
D/WCRP and JPS	**2**,**4**,**6**,**11**,**12**,**13**,**24**,**26**,27,**28**,30, **31**,**33**,**38**,39,**40**,45,**56**,**59**,**60,61**, **63**,**64**
CliC SSG Chair and Director CliC IPO	**8**,14,15,**17**,**18,19,20,**24,26,34, 43,**45**, **46**,**47**,52,58,**59**
CLIVAR SSG Co-chairs and Director ICPO	**1**,**3**,**8**,**14**,**15**,17,19,21,22,23,24, **25**,26,34,37,**38**,**39**,**41**,**42**,**43**,**44**, 52,**57**,58,**59**
GEWEX SSG Co-chairs and Director IGPO	**1**,**3**,**8**,14,15,11,17,21,22,24,26, 32,34,37,39,43,**44**,**48**,**49**,52,58, **59**
SPARC SSG Co-chairs and Director SPARC IPO	**3**,14,15,17,19,34,**43**,44,**51**,**52, 54,**58,**59**
SOLAS SSC Chair and Head of SOLAS IPO	37,58
WMAC Co-Chairs	**27**,28,58
WDAC Co-Chairs	**3**,**5**,28,**32**,**34**,**35**,**36**,**37**,**50**,58
WGCM Co-Chairs	**1**,**3**,14,15,17,23,**29**,**30**,**46**
WGNE Chair	**1**,37,43
WGSIP Co-Chairs	**1**,14,15,17,**18**,19, **46**,**53**
WGRC Co-Chairs	**1**,**8**,**9**,10,14,15
CORDEX SAT	**1**,**9**,10,15
PCPI Co-Chairs	**1**,19
LAC (Montevideo) Conference SSC	**11**,**12**,**13**
Africa (Arusha) Conference SSC	**12**,**13**
Task Team on GC on Climate Extremes	**21**,24,25,26,**52**,58
Task Team on GC on Water Availability	**22**, 24,25,26,**52**,58
Task Team on GC on Regional Sea Level	**23**, 24,25,26,**52**,58
Task Team on Regional GC (once established)	24,25,43,**52**,58
Task Team on Cryosphere GC (once established)	24,25,**52**,58
Leads of Climate Sensitivity GC	24,25,43,**52**,58
Leads of SPARC/IGAC CCMI	**51**
CMIP6 Planning Group	**52**
Co-Chairs of S2S Project	**1**,**54**,**55**

<u>WMO and Global Framework for Climate Services</u>

Action 1
WCRP JSC and its constituencies to engage in implementation of the Research, Modelling and Prediction component of GFCS, for which WCRP has the lead; engage in this work National Hydrometeorological Services; and make an effort on

achieving successful outcomes during the initial stage of GFCS implementation, particularly in the activities of the Compendium of GFCS activities with WCRP responsibilities, focussing on GFCS initial priorities: water resources management, food security and agriculture, disaster risk reduction, and human health protection.
Deadline: Workplans to be determined by the end of 2013

ICSU and Future Earth

Action 2
WCRP JSC to review the draft design report of the Future Earth Transition team, provide comments and suggestions on its content and text to D/WCRP. D/WCRP to pass WCRP comments and suggestions on the Report to the Transition Team.
Deadline: As soon as the report is available

Action 3
WCRP projects and constituencies WCRP engaged in joint activities with IGBP (such as IGAC, iLEAPS, AIMES, IMBER, PAGES, SOLAS) to monitor their status and continuity.
Deadline: report on status and progress of joint activities at JSC-35

NOAA

Action 4
D/WCRP to send a letter to NOAA thanking Administration for many years of supporting CLIVAR and GEWEX.
Deadline: at the time of the CLIVAR IPO closure in Southampton

CEOS, CGMS

Action 5
WCRP to consider ways of participating in and contributing to the CEOS Strategy Report on Climate Monitoring Architecture and provide to CEOS Working Group on Climate a list of working groups that are in position to contribute to inventory of data and data products such as FCDRs and assessment of ECVs. To make an effort to include data and products based both on Earth observations from space and on in-situ observations.
Deadline: depending on the timing of the Report

EUMETSAT

Action 6
In partnership with EUMETSAT, GCOS, CEOS, and CGMS, WCRP to continue preparations of the conference "Climate Research and Earth Observations from Space: Climate Information for Decision Making" with a view to contributing to co-design of an effective future climate space monitoring architecture. To include the information requirements of WCRP GCs on the agenda of the Conference, taking into account not only space but also in situ observations.
Who: JPS to lead
When: continuously, report progress at JSC-35

Regional Grand Challenge

Action 7
To approve the modifications of the ToRs of WGRC (done, Appendix D).

Action 8
Ensure that members of WGRC representing projects not only work within WGRC but also serve as active liaisons between WGRC and project regional activities, especially GEWEX GHPs, and that they participate in corresponding project meetings such as SSGs. Recommend to GEWEX- and CLIVAR-affiliated WGRC members to participate in the 2014 Pan- GEWEX and CLIVAR meeting.
Deadline: continuously, start immediately after JSC

Action 9
CORDEX SAT to develop for consideration by WGRC and endorsement by JSC a mechanism for proposing and endorsing new CORDEX domains and review a need for such domains.
Deadline: report at JSC-35

Action 10
CORDEX to report on status and advances of activities in major domains and lessons learnt.
Deadline: report at JSC-35

Latin America and Caribbean (LAC) Workshop

Action 11
To ask Carolina Vera to continue to serve as a JSC liaison to the LAC Conference SSC. D/WCRP to inform the SSC about this nominaiton.
Deadline: August 2013

Africa Climate Conference

Action 12
To request Scientific Organizing Committees of the African and LAC Conferences to include issues related to WCRP Grand Challenges, especially Regional GC and GCs on water availability and extremes, on the agenda of the Conferences and target Conferences outcomes towards identifying means and opportunities for GCs implementation. D/WCRP to inform the SSCs of this recommendation.
When: ASAP.

Action 13
To establish contacts, compare notes, exchange information and ideas on the LAC and African Conferences.
Deadline: August-September 2013

Intraseasonal to seasonal and interannual prediction, decadal

Action 14
To prepare an expanded contribution on interannual – decadal predictability research to the Regional GC white paper and include in it contribution from all WCRP Projects, with emphasis on tractable opportunities for regional predictability research. To include an analysis of opportunities to involve research on modes of climate

variability as a contribution to this white paper. To brainstorm on this problem, and particularly on the idea of focussing on science versus services and on moving ahead as a series of smaller initiatives under the GC focus of the provision of climate information on regional scales.
Deadline: Approach/strategy to be reported to JSC-35

Action 15
To identify optimal choice of leadership for the WCRP research work on provision of skilful/action-oriented regional climate information on interannual to decadal time scales.
Deadline: report at JSC 35

Action 16
All WCRP Core Projects to consider involving NMHS, as appropriate, in the research on Grand Challenge and invite them to participate in regional topical science conferences.
Deadline: Continuing

Cryosphere in a Changing Climate

Action 17
JSC, WGCM, WGSIP, core Projects to provide input to CliC on the structure, goals, and objectives of the Cryosphere GC workshop and strongly encourage participation in the workshop of their affiliated scientists.
When: August 2013

Action 18
WCRP to seek opportunities of contributing to or strengthening international research on the role or declining Arctic Ocean sea-ice in climate predictability and on its impact on the atmospheric circulation. CliC and WGSIP to discuss how to organise effective cooperation of research on cryosphere, especially sea-ice and snow, on predictability on time scales of relevance for WGSIP, and take advantage of the Cryosphere GC Workshop.
Deadline: To report the Workshop outcomes to JSC-35

Action 19
CliC to focus efforts on strengthening sea-ice and ice-sheet modelling research in support of WGSIP, WGCM and WGNE
When: report at JSC-35

Action 20
CliC to update Chair of JSC on structure, goals, and objectives of GC Cryosphere Workshop.
Deadline: 31 August 2013

Science Underpinning the Prediction and Attribution of Extreme Events

Action 21
Request the GC Task Team, in cooperation with CLIVAR and GEWEX, to update the GC white paper on extremes and include in it, inter alia, a definition of (climate) extremes, characteristics of their scales in space in time, etc. Develop implementation strategy for the GC.
Deadline: October 2013, JSC to comment by 1 January 2014

Changes in Water Availability

Action 22
Request the GC Task Team, in cooperation with CLIVAR and GEWEX, to develop a white paper on the GC that would include implementation considerations for the GC.
Deadline: end 2013 for JSC review within 2 months

Regional Sea Level

Action 23
To consider opportunities and benefits of a MIP for regional SL models that would use historical information and benefit from constantly improving datasets, especially SL observations from space and tide gauges.
Deadline: report to JSC-35

Discussion on All Grand Challenges

Action 24
To establish communication (telecons) between GC, invite GC leaders to the JSC session, and take advantage of the Pan-GEWEX/CLIVAR meeting in establishing cooperation and communication between the WCRP GC teams.
Deadline: once the leads are in place

Action 25
To recommend to all GCs to *consider* the benefits of including within their activities, if feasible, the approach of U.S. Climate Process Teams CPTs), which are, as a rule, built around the idea of using observations to motivate climate model improvements, take advantage of regular meetings, e-mail discussions, and telecons, and involve a number of full-time post-doctoral researchers. CLIVAR IPO to send information to GC leaders.
Deadline: once leadership of GC is determined

Action 26
All Projects to develop and articulate implementation considerations for the GC that they host/lead for the year ahead, i.e. until the JSC-35 in July 2014. JPS provide a template for such a document that would also include a request to identify GC modelled and observed data and information requirements. SSG Chairs and identified leads of GCs to respond by deadline
Deadline: 31 August 2013

WMAC

Action 27
To initiate a WCRP Early Career Scientist Model Developer Prize. WMAC in coordination with JPS to develop the necessary arrangements and conditions for competition.
Deadline: As soon as possible

Action 28
JSC to endorse ESGF as a WCRP-recommended platform for data/information exchange and access. D/WCRP to prepare an announcement to be distributed to ESGF supporting parties, relevant partners, and a press release.

Deadline: August 2013

Action 29
Co-Chairs WGCM to send to JSC via D/WCRP documentation on rules of participation in / joining CMIP to be sent.
Deadline: as soon as such documentation is available for CMIP6

Action 30
Develop guidelines on documenting model tuning information and consider making such documentation a requirement for CMIP6.
Deadline: by JSC-35

Action 31
Request WWRP to consider nominating a person to WMAC, for example the WWRP Chair.
Deadline: August 2013

WDAC

Action 32
To summarise best practices on process of publishing datasets and their endorsement. Request a white paper on this subject from projects starting with GEWEX. WDAC to coordinate development of a WCRP-wide dataset assessment process.
Deadline: WDAC to request the paper from GEWEX in July-August 2013, GEWEX to complete the white paper by the end of 2013. WDAC to distribute it to other Core Projects for input/comment in March-May 2014

Action 33
D/WCRP to send the report of the WCRP/GCOS dataset meeting in Frascati to JSC
Deadline: As soon as possible after the JSC-34

Action 34
To develop guidelines for submitting datasets to ESGF. Core Project data sets will be considered as early entrants to ESGF. Core Projects and other entities represented on WDAC should nominate datasets (both old and new) for inclusion in the ESGF by next WDAC meeting.
Deadline: continuously starting in August 2013

Action 35
JSC asks WDAC to consult as early as possible with JSC Chair on draft agenda of WDAC-3 so that options for inclusion of WCRP data-related interests and concerns could be made a priority for that session.
Deadline: as early as possible before WDAC-3

Action 36
Following the lead of SPARC, WDAC to consider the use of open access journal citations for data sets via use of DOI across the whole of the WCRP. WDAC to discuss and draft a recommendation to the JSC on using DOIs as a way to document data sets from Core Projects. This topic to be discussed at WDAC-3.
Deadline: Report to JSC 35

Action 37
To evaluate WCRP efforts on surface fluxes relative to the Action Plan developed by WOAP in consultation with across CLIVAR, GEWEX, WGNE, and SOLAS, as posted

on the WCRP website. Core Projects to nominate representatives to surface flux discussion in early 2014. GEWEX and CLIVAR to consider joint session making scientific progress on surface fluxes at 2014 Pan-GEWEX/CLIVAR meetings. WDAC to include a specific agenda item on fluxes at its next session and seek ways to reinvigorate this effort.
Deadline: Report to JSC 35

CLIVAR

Action 38
Inform IGBP and PAGES on discontinuation of CLIVAR/PAGES Panel.
Deadline: August 2013

Action 39
To inform CCI and JCOMM that GEWEX was accepted by WCRP as a cosponsor of the CLIVAR/CCI/JCOMM ETCCDI and to invite CliC to provide to ETCCDI an expert with cryospheric expertise.
Deadline: August-September 2013

Action 40
Encourage JSC members to participate in the Pan-GEWEX/CLIVAR meeting of 2014 and act as conveners.
Deadline: in the course of the meeting preparation

Action 41
CLIVAR to review ToRs for all its groups.
Deadline: to report at JSC-35

Action 42
CLIVAR to develop an implementation strategy for the Regional GC pertaining to regional predictability on time scales from seasons to decades.
Deadline: once feasible

Action 43
CLIVAR, GEWEX, SPARC, WGNE, CliC, Regional GC and GC on climate sensitivity to propose a solution with regard of the gap in the WCRP structure in the domain of research on atmospheric dynamics. CLIVAR to take the lead in organising this discussion.
Deadline: to report at JSC-35

Action 44
CLIVAR and GEWEX to co-develop strategy for management and oversight of the Monsoon Panel
Deadline: to report at JSC-35

CliC

Action 45
Better define the role of CliC in involving Arctic Ocean research communities in addressing WCRP priorities. Involve key partners such as IASC.
Deadline: to report at JSC-35

Action 46
CliC, WGSIP, and WGCM to develop proposals on facilitating their interactions. WGSIP and WGCM are invited to participate in the Tromsø Workshop on the Cryosphere GC.
Deadline: August 2013, details to be decided before WGCM session in October 2013 in Victoria, BC, Canada

Action 47
CliC Chair to develop a plan for development of sea-ice and ice sheet modelling to present at JSC-35.
Deadline: to report at JSC-35

GEWEX

Action 48
Request GEWEX Chair, the GDAP/GHP Chairs, and Organising Committee of the LAC Conference to ensure that the outcomes of the forthcoming (September 2013) GDAP/GHP meeting in Rio de Janeiro contribute to the successful conduct of the Montevideo LAC Conference. To request the GEWEX Panels to adjust agenda of the meetings in Rio to include issues of importance for LAC Conference.
Deadline: September 2013

Action 49
Request GEWEX SSG to consider strengthening GEWEX SSG expertise and ways of expanding GEWEX activities in the domains of applications of climate knowledge in water resource management and research in the land-atmosphere interactions, near-surface hydrology, climate effects of subsurface topography/properties, etc.
Deadline: to report in advance of JSC-35

SPARC

Action 50
With respect to commendable work of SPARC with regard to open access journals and on the arena of improving open access to datasets and their citation, Recommend WDAC to consider SPARC practices as an example to be followed.
Deadline: continuously

Action 51
SPARC and CCMI to consider a new initiative on the role of aerosols in regional climate forcing as a part of or building upon SPARC/IGAC CCMI. SPARC to report on the issues and perspectives of research on the role of tropospheric chemistry in climate to JSC-35.
Deadline: to discuss at SPARC SSG in 2014 and to report to JSC-35

WGCM

Action 52
WCRP GCs to inform CMIP6 of their scientific questions and resulting research requirements. WGCM and its CMIP6 planning group and leadership of GCs to define optimal means of interaction.
Deadline: As soon as possible for GCs leading teams in formation; in September 2013, i.e. before he WGCM Session in Victoria, BC, Canada, for existing GC leading teams; responsible projects for GCs teams that are not yet in place

WGSIP

Action 53
To consider WGSIP plan/decision on engagement in ESGF.
Deadline: to report at JSC-35

S2S project

Action 54
To add SPARC-SNAP to list of primary S2S contacts.
Deadline: Immediately

Action 55
To continue to appraise JSC and WGSIP on seamless model development and progress in prediction verification activities.
Deadline: continuously, to report to JSC-35

GCOS

Action 56
D/WCRP to pass to GCOS a message on importance of having sufficient expertise in deep ocean hydrography on the renewed OOPC.
Deadline: August 2013

Action 57
CLIVAR to review engagement of CLIVAR basin panels in renewed GOOS/OOPC and their new structure.
Deadline: when feasible

WCRP Contribution to IPCC

Action 58
Recommend WCRP communities to develop synthesis papers in advance of IPCC assessments.
Deadline: as appropriate

WCRP Communications and Capacity Building

Action 59
Update information on WCRP and Core Project websites, especially with regard to membership of working bodies, calendar of meetings, and other current information.
Deadline: As soon as possible

Action 60
The WCRP Communications and Capacity Development team to prepare a report on progress, lessons learnt, and efficient practices of working with/supporting ECSs and in the area of outreach and share it within the whole WCRP.
Deadline: 2013

JSC Activities

Action 61
To organise a teleconference of JSC in the middle of intersessional period.
When: in the middle between JSC-34 and JSC-35

Action 62
To establish JSC liaisons to WCRP constituencies, as follows:
CliC – James Renwick
CLIVAR – Stephen Belcher, In-Sik Kang
GEWEX – Frederick Semazzi and Soroosh Sorooshan
SPARC – Teriuki Nakajima, Hong Liao
WMAC – Stephen Belcher
WDAC – Anny Cazenave
WGRC – Filippo Giorgi, Rodney Martinez
As a rule, these liaisons are expected to participate in SSG sessions of Core projects, relevant email deliberations, or meetings of Councils or working groups. Other JSC members may be chosen for participation taking into account location of the meetings. More than one JSC member may serve as a liaison to Projects.

Action 63
To ensure that background documents before the JSC session are available on the meeting website at least one month before the meeting and to inform JSC members once they are available.
Deadline: at least 1 month before JSC-35 and future JSC sessions

Action 64
To introduce a practice of organizing an executive session of JSC for available members immediately after the end of the meeting of JSC Officers. To continue optimization of the JSC Agenda taking into account the proposal of WMAC for shared sessions at the beginning of the JSC Sessions and the merit of having Project reports presented earlier than the GC reports.
Deadline: starting with JSC-35 and then continuously

APPENDIX F – List of used abbreviations

ACC	Africa Climate Conference
ACPC	African Climate Policy Centre
AEROCOM	Aerosol Comparisons between Observations and Models
AfClix	Africa Climate Exchange
AfDB	African Development Bank
AGU	American Geophysical Union
AICC	Arusha International Conference Centre
AIMES	Analysis, Integration and Modelling of the Earth System
AMAP	Arctic Monitoring and Assessment Programme
AMMA	African Monsoon Multidisciplinary Analysis
AMOC	Atlantic Meridional Overturning Circulation
AMS	Merican Meteorological Society
ANA4MIPS	Analysis for Model intercomparisons initiative
AOGCM	Atmosphere – Ocean (coupled) GCM
APCC	APEC Climate Center
APEC	Asia-Pacific Economic Cooperation
APECS	Association of Polar Early Career Scientists
APN	Asia-Pacific Network for Global Change Research
APPOSITE	(UK) Arctic Predictability On Seasonal to Inter-annual Time scales
ARCUS	Arctic Research Consortium of the US
AR5	IPCC Assessment Report no. 5
ASPeCt	Antarctic Sea Ice Processes and Climate Group
A-Train	"Afternoon Train (a satellite constellation)
AUC	African Union Commission
BADC	British Atmospheric Data Centre
BAMS	Bulletin of American Meteorological Society
BC	black carbon
BON	Biodiversity Observations Network (GEO)
CAF	Climate Adaptation Framework (APN)
CAS	WMO Commission for Atmospheric Sciences
CBS	WMO Commission for Basic Systems
CCAFS	Research Program on Climate Change, Agriculture and Food Security
CCC	Cryosphere in a Changing Climate
CCDAII	2nd Conference on Climate Change and Development in Africa
CCl	WMO Technical Commission or Climatology
CCMI	Chemistry-Climate Model Initiative
CCMVal	Chemistry-Climate Model Validation
CD	Capacity Development
CDR	Climate Data Record
CENPERM	Centre for Permafrost dynamics in Greenland
CEOP	Coordinated Enhanced Observing Period (a former GEWEX project)
CEOS	Committee on Earth Observation Satellites
CFMIP	Cloud Feedback Model Intercomparison Project
CGILS	CFMIP-GCSS Intercomparison of Large-Eddy and Single-Column Models
CGMS	Coordination Group for Meteorological Satellites
CHFP	Climate-system Historical Forecast Project
CHy	WMO Commission for Hydrology
CIIFEN	Centro Internacional para la Investigación del Fenómeno de el Niño (Ecuador)
CIMA	Centro de Investigaciones del Mar y la Atmosfera (Argentina)
CLA	Coordinating Lead Author
CliC	Climate and Cryosphere Project

ClimDev	Climate for Development in Africa
CLIVAR	Climate Variability and Predictability Project
CMIP5	Coupled Model Intercomparison Project, Phase 5
CMIP	Coupled Model Intercomparison Project
CMS	Content Management System
CNES	Centre National d'Etudes Spatiales
CoP	Conference of Parties
CORDEX	WCRP Coordinated Regional Downscaling Experiment
CORE	Coordinated Ocean-ice Reference Experiments
CPTEC	Centre for Weather Forecasting and Climate Research (INPE)
CRM	Cloud Resolving Model
CSIS	Climate Services Information System
CSP	Climate Service Partnership
CTB	Climate Test Bed
DAOS	THORPEX Data Assimilation and Observing Systems working group
DKRZ	German Climate Computing Centre
DIVERSITAS	GEC Programme on biodiversity science
DMI	Danish Meteorological Institute
DOI	Digital Object Identifier
DRR	Disaster Risk Research
DWD	Deutscher Wetterdienst (German Weather Service)
DynVar	Dynamical Variability initiative (SPARC)
EC	Executive Council
ECMWF	European Centre for Medium-range Weather Forecasts
ECS	Early Career Scientist
ECV	Essential Climate Variable
EGU	European Geosciences Union
EMS	European Meteorological Society
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
ENSO	El Niño – Southern Oscillation
ERA	ECMWF Re-Analysis
ESA	European Space Agency
ESG	Earth System Grid
ESGF	Earth System Grid Federation
ESM	Earth System Model
ESSIC	Earth System Science Interdisciplinary Center
ESSP	Earth System Science Partnership
EU	European Union
EUCLIPSE	European Union Cloud Intercomparison, Process Study and Evaluation
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	UN Food and Agriculture Organization
FCDR	Fundamental Climate Data Record
FE	Future Earth
FOO	Framework for Ocean Observing
FP	Framework Program
FURG	Universidade Federal do Rio Grande (Brazil)
GASS	Global Atmospheric System Studies (GEWEX)
GAW	Global Atmosphere Watch
GC	Grand Challenge
GCM	General Circulation Model
GCOS	Global Climate Observing System
GCW	Global Cryosphere Watch
GDAP	GEWEX Data and Assessments Panel
GEC	Global Environmental Change

GEMS	Global and regional Earth-system (Atmosphere) Monitoring using Satellite and in-situ data (GEMS)
GEO	Group on Earth Observations
GEOSS	Group on Earth Observations System of Systems
GEWEX	Global Energy and Water Exchanges
GFCS	Global Framework for Climate Services
GHG	Greenhouse gas
GHP	The GEWEX Hydroclimatology Panel
GIPPS	Global Integrated Polar Prediction System
GLASS	Global Land/Atmosphere System Study (GEWEX)
GMES	Global Monitoring for Environment and Security
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GOS	Global Observing System (WMO)
GOSIC	Global Observing Systems Information Center
GPC	Global Producing Centre
GPCC	Global Precipitation Climatology Centre
GPCP	Global Precipitation Climatology Project
GPM	Global Precipitation Mission
GSQ	GEWEX Science Questions
GSICS	Global Space-based Inter Calibration System
GTN	Global Terrestrial Network
GTN-G	Global Terrestrial Network for Glaciers
GTN-H	Global Terrestrial Network for Hydrology
GTN-L	Global Terrestrial Network for Lake Level/Area
GTN-P	Global Terrestrial Network for Permafrost
GTN-R	Global Terrestrial Network for River Discharge
GTOS	Global Terrestrial Observing System
HAP	Hydrological Applications Project (GEWEX)
HEPPA	High Energy Particle Precipitation in the Atmosphere (SPARC)
HLO	High-level Objective
HLPP	CGMS high-level priority plan (CGMS)
HYCOM	HYbrid Coordinate Ocean Model
HyVIC	Hydroclimate of Victoria Basin
IAI	InterAmerican Institute for Global Change Research
IAM	Integrated Assessment Modeling
IAMC	Integrated Assessment Modeling Consortium
IAPSO	International Association for the Physical Sciences of the Oceans
IASC	International Arctic Science Committee
ICPO	International CLIVAR Project Office
ICSU	International Council for Science
ICTP	International Center for Theoretical Physics
IGAC	International Global Atmospheric Chemistry (IGBP)
IGBP	International Geosphere – Biosphere Programme
IGFA	International Group of Funding Agencies for Global Change Research
IGOS	Integrated Global Observing Strategy
IGPO	Internatonal GEWEX Project Office
IHDP	International Human Dimension Programme on Global Environmental Change
IHP	International Hydrological Programme (of UNESCO)
IITM	Indian Institute of Tropical Meteorology
iLEAPS	Integrated Land Ecosystem-Atmosphere Processes Study (IGBP)
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research (IGBP)
INPE	Institute for Space Research (Brazil)
IOC	Intergovernmental Oceanographic Commission of UNESCO

INPE	Institute for Space Research (Brazil)
IPCC	Intergovernmental Panel on Climate Change
IP	Implementation Panel
IPO	International Project Office
IRI	International Research Institute for Climate and Society
ISCCP	International Satellite Cloud Climatology Project
ISMASS	Ice Sheet Mass Balance and Sea Level Rise (working group)
IT	Information Technology
ITCZ	Intertropical Convergence Zone
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JPS	Joint Planning Staff (for WCRP)
JSC	Joint Scientific Committee
JWGFVR	Joint Working Group on Forecast Verification Research
KMA	Korean Meteorological Administration
LA	Lead Author
LAC	Latin America and Caribbean
LEGOS	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (France)
LES	Large Eddy Simulation
MACC	Monitoring Atmospheric Composition and Climate
MAIRS	Monsoon Asia Integrated Regional Study
MCTI	Ministry of Science, Technology and Innovations (Brazil)
MEPS	Multi-Model Ensemble Prediction System
MERCOSUR	Southern Common Market (South America)
MIP	Model Intercomparison Project
MJO	Madden – Julian Oscillation
MoU	Memorandum of Understanding
NADW	North Atlantic Deep Water Mass
NAO	North Atlantic Oscillation
NARCCAP	North American Regional Climate Change Assessment Program
NASA	(U.S.) National Aeronautics and Space Administraiton
NCAR	(U.S.) National Center for Atmospheric Research
NCEP	(U.S.) National Centers for Environmental Prediction
NGEE	Next-Generation Ecosystem Experiments
NGO	Non-governmental organization
NMHS	National Meteorological and Hydrological Service
NOAA	(U.S.) National Oceanic and Atmospheric Administration
NPI	Norwegian Polar Institute
NRC	National Research Council of the U.S. National Academies
NSF	(U.S.) National Science Foundation
NWP	Numerical Weather Prediction
OBS	Observations and Monitoring
OBS4MIPS	Observations for Model intercomparisons initiative
OOPC	Ocean Observations Panel for Climate
OS	Observing System
OSC	Open Science Conference
PAGE21	Changing Permafrost in the Arctic and its Global Effects in the 21st Century
PAGES	Past Global Changes (IGBP)
PB	Petabyte
PDO	Pacific Decadal Oscillation
PIRATA	Prediction and Research Moored Array in the Atlantic
PMIP	Paleoclimate Modelling Intercomparison Project
PoC	Point of Contact
PPP	WWRP Polar Prediction Project
PRECIS	Providing REgional Climates for Impacts Studies (a model)

PROVIA	Programme of Research on Climate Change Vulnerability, Impacts and Adaptation
RCC	Regional Climate Centre
RCD	Regional Climate Downscaling
RCN	Research Coordination Network
RCOF	Regional Climate Outlook Forum
RCP	Representative Concentration Pathway
RegCM	Regional Climate Model (ICTP)
RHP	Regional Hydroclimate Project (GEWEX GHP)
RMP	Research, Modelling, and Prediction
RMS	Royal Meteorological Society (UK)
RSL	Regional Sea level
S2S	Subseasonal to Seasonal Initiative
SACZ	South Atlantic Convergence Zone
SAF	Satellite Application Facility (EUMETSAT)
SCOPE-CM	Sustained Coordinated Processing of Environmental Satellite Data for Climate Monitoring
SCOR	Scientific Comimttee on Oceanic Research
SEARCH	Study of Environmental Arctic Change
SeaRISE	Sea-level Response to Ice Sheet Evolution
SERA	WWRP Working Group on Societal and Economic Research Applications
SHFP	Stratosphere Historical Forecast Project
SMHI	Swedish Meteorological and Hydrological Institute
SIDS	Small Island Developing State
SL	Sea level
SOLARIS	Solar Influence for SPARC
SOLAS	Surface Ocean – Lower Atmosphere Study (IGBP)
SNAP	Stratospheric Network for the Assessment of Predictability
SPARC	Stratospheric Processes And their Role in Climate Project
SPD	Science-Policy Dialogues
SPIN	ESA-SPARC initiative on measurements and data
SPCZ	South Pacific Convergence Zone
SPM	Summary for policymakers
SSC	Scientific Steering Committee
SSG	Scientific Steering Group
SST	Sea-surface temperature
START	Global Change System for Analysis, Research, and Training
SURFA	Surface Flux Analysis
SVS-LRF	Standard Verification System of Long Range Forecasts
TB	Terabyte
TFRCD	Task Force on Regional Climate Downscaling
THORPEX	The Observing System Research and Predictability Experiment
TIGGE	THORPEX Interactive Grand Global Ensemble
TIROS	Television InfraRed Operational Satellite - Next-generation
TOVS	TIROS-N/NOAA Operational Vertical Sounder
TRMM	Tropical Rainfall Measuring Mission
TSU	Technical Support Unit (IPCC)
UCT	University of Cape Town
UIP	User Interface Platform
UN	United Nations
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

UV	Ultra-violet
VAMOS	Variability of the American Monsoon Systems
VIA	Vulnerability, Impact, and Adaptation
WAIS	West Antarctic Ice Sheet
WAMME	West African Monsoon Modeling and Evaluation
WCC-3	Third World Climate Conference
WCP	World Climate Programme
WCRP	World Climate Research Programme
WCSP	World Climate Services Programme
WDAC	WCRP Data Advisory Council
WG	Working Group
WGClimate	Working Group on Climate (CEOS)
WGCM	WCRP Working Group on Coupled Modelling
WGNE	Working Group on Numerical Experimentation
WGOMD	Working Group on Ocean Model Development (CLIVAR)
WGRC	WCRP Working Group on Regional Climate
WGSIP	WCRP Working Group on Seasonal to Interannual Prediction
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMAC	WCRP Modelling Advisory Council
WMO	World Meteorological Organization
WTG	Weak Temperature Gradient (approximation)
WRF	Weather Research and Forecasting model
WWRP	WMO World Weather Research Programme
YOPP	Year of Polar Prediction
YOTC	Year of Tropical Convection
ZAMG	Austrian Central Institute for Meteorology and Geodynamic