



Sunrise at Scott Base, McMurdo Sound, Antarctica in late September 2006. At the end of the polar night, the sun returns to Antarctica. Because it is still very low, red and orange colours dominate. With the end of the polar night, the sun brings the energy needed in the chemical processes that cause the large Ozone depletion leading to the known phenomenon of the 'Ozone hole' over Antarctica. The protection of the ozone layer was agreed through the Vienna Convention and the Montreal Protocol signed in 1985 and 1987 respectively. Observations of trends in Ozone have since been a scientific focus, e.g. of the SPARC LOTUS activity (see report on page 8).

Photo credit: Katja Riedel Photography

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39th session of the WCRP Joint Scientific Committee

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The thirty-ninth session of the Joint Scientific Committee (JSC-39) of the World Climate Research Programme (WCRP) was held at the Nanjing University of Information Science & Technology (NUIST) in Nanjing, China, from 16 April to 20 April 2018.

The session started with a warm welcome by Vice President and Vice Chancellor of NUIST, **Guan Zhaoyong**, who described the role of the University and its significant history of meteorological studies since 1960. He emphasised the partnership with international universities and institutions through the WMO Regional Training Centre Nanjing. JSC chairperson **Guy Brasseur** also welcomed the participants and sincerely thanked the Chinese hosts, mentioning China's high interest and active involvement in climate change research towards a leadership role in future climate change research. For WMO, Deputy Secretary-General **Elena Manaenkova** thanked NUIST for hosting the meeting. She emphasised WCRP's role and underscored, as an example, that the four highest risks mentioned in the 2018 Global Risk Report are related to climate changes and climate extremes. Hence, WMO sees a crucial need to enhance the understanding of the Earth system – a core task of WCRP. **Salvatore Arico** of the Intergovernmental Oceanographic Commission (IOC; remotely connected) confirmed the important task of WCRP in providing information and observation and advocated an enhanced emphasis for ocean science within the WCRP.

Strategic plan and implementation plan

It is critically important for WCRP to thoroughly review its structure (including SPARC and the other core projects) in order to support scientists from around the world who effectively contribute to research underlying WCRP. There is also the need to make its aims and rationale attractive for its key sponsors as well as to outside parties, e.g., funding agencies.

During the session, all groups and projects had the opportunity to report their activities (see below). The presentations covered achievements of the past year and plans for the future. In addition, they gave all branches of WCRP the possibility to state their needs for the com-

ing decade and to provide input to the strategic plan. The focus of the session was put on furthering the new WCRP scientific strategic plan 2019-2029. Discussions on the content of an implementation plan also took place, both in the plenary and in breakout groups.

Elena Manaenkova provided the context by sketching the current WMO strategy 2030, consisting of these overarching priorities:

1. Furthering preparedness for and reducing losses of life and property from hydro-meteorological extremes;
2. Supporting climate-smart decision making to build resilience and adaptation to climate risk, and
3. Enhancing socioeconomic value of weather, climate hydrological and related environmental services.

Long-term goals were defined to underpin these priorities. One is termed “Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services” and is tackled by WCRP and WWRP. The entire WMO structure was redefined for the next decades, with the phrase “What do we want to achieve in the next 40 years?” as a fundamental guideline.

Guy Brasseur emphasized the importance of the strategic plan to comprise the core tasks of WCRP, which scientists from around the world can identify with and support actively. Fundamental climate science should remain the focus. He asked for an open discussion to use the opportunity to rejuvenate WCRP, suggested openness to fundamental ideas, and underscored the need for strengthening partnerships. In the plenary discussion, it was stressed that the strategic plan should express the value that WCRP provides as the international coordinator of climate science. Furthermore, the intended readership has to be kept in mind as WCRP's future will fundamentally depend on the support of climate scientists, of research funding agencies, as well as of relevant political and scientific organizations.

In the breakout sessions it was repeatedly emphasised that WCRP relies on the wide community of scientists participating in its numerous activities and projects. These groupings must be enabled and strengthened by the new strategy. Likewise, the formulation of a strategic plan is seen as a chance to give WCRP a sharpened profile that facilitates communication with sponsors and enhances the programme's visibility to society. Structural changes that might come with the implementation should be used to strengthen bonds with regional activities (for example, it was suggested to use the international program offices as connecting points to regional agencies and communities).

The JSC-39 participants agreed on the necessity to reconsider activities and the formulation of over-arching interests. The breakout groups produced various ideas for the future shape of WCRP. A common focus was to retain the core strengths of the programme, which consists of communities around the core projects, and - at the same time - encouraging these communities to better interact on cross-cutting issues. The S2S initiative is regarded as a good example with clearly defined goals which necessitate good links to all parts of WCRP as well as of WWRP.

An overview of the strategic plan is scheduled as an invited presentation by Guy Brasseur during the SPARC General Assembly 2018. After an open consultation process about the strategic plan (www.wcrp-climate.org/wcrp-sp-pc), an implementation plan will be produced based on the JSC discussions and the outcome of the consultation.

Working group reports

For the *Working Group on Numerical Experimentation* (WGNE), **Keith Williams** (remotely connected) emphasised WGNE's broad reporting role for WCRP and beyond, and considered the group as pioneer of seamless studies, with the MJO task force working across all time scales as a pertinent example. The WGNE drag project addressing the parametrized components of surface stress and its partitioning between schemes (e.g. planetary boundary layer, sub-grid orography) is about to evolve into a new project focussing on momentum. Furthermore, a joint project with the WWRP working group on *Predictability, Dynamics, Ensemble Forecasting* (PDEF) is being discussed. Regarding the WCRP review, WGNE agrees that model development groups should go across timescales. A single working group cannot cope with the development of the different Earth systems across all time scales, while adding another panel to oversee the model work only increases bureaucracy. Nevertheless, WGNE proposes to act as a focal point

for model development activities and to retain primary expertise for atmospheric model development while cooperating closely with groups for other geophysical compartments.

The *Coupled Model Intercomparison Project Phase 6* (CMIP6) was introduced by **Greg Flato** as he presented the *Working Group on Coupled Modelling* (WGCM). The project output is targeted to provide input to the next IPCC assessment. Currently, 33 modelling groups are participating and two new MIPs have been defined. Through CMIP6, the community behind WGCM provides WCRP with essential and highly visible products, a most valuable heritage. The report concluded that the coordination of climate modelling through comparison projects as well as of the underpinning model development should remain a central task of WCRP.

Bill Merryfield reported for the *Working Group on Sub-seasonal to Interdecadal Prediction* (WGSIP), which comprises 13 members representing various projects, including S2S and GEWEX/GLASS. A task group is intended to narrow the gap between research and operations, in line with the motto "enabling services rather than providing them". For the future, the necessity for enhanced cooperation with WCRP's core projects and Grand Challenges was stressed.

For the *Sub-seasonal to Seasonal Prediction Project* (S2S), **Andrew Robertson** reported that the S2S-database is being used increasingly, but was facing funding problems. There is a significant interest from developing countries to obtain S2S forecasts. A proposal for a 5-year extension of S2S (2018-2023) was submitted to WMO. The second phase includes topics as database enhancement, new sub-projects on MJO prediction and teleconnections, the relative roles of ocean and sea ice, land surface, stratosphere as well as atmospheric composition and ensemble generation. Additional aims are enhancement of operational infrastructures, development of user applications, and a real-time forecast pilot experiment.

From the working group reports suggestions were collected for possible inclusion in both, the strategic plan and the implementation plan. They included a co-design with stakeholders, model evaluation and verification, as well as the need for data bases, infrastructure, protocols, and open access. As open points remained topics like how far into 'operational' model development WCRP should go, whether there is a critical mass of resources and engagement, and whether WCRP should aim for model development across all time scales, following the value chain closely, and across disciplines.

Reports from CORDEX and Core Projects

William Gutowski presented the *Coordinated Regional Downscaling Experiment (CORDEX)*, which focusses on the regional aspects of WCRP science, and provides a direct link between climate and its impact on communities. He identified high quality, fine-scale, and multivariate observations as a key need for the high resolution models. Peculiar to CORDEX is the tendency that semi-independent core groups form in different regions impeding at times overall coordination. The regions differ in their access to funds which challenges a balanced development of the core groups. In conclusion, it was stressed that science should stay curiosity-driven, and while stakeholder needs have to be taken into account they should not formulate research priorities.

For SPARC, **Neil Harris** presented some of its activities (e.g., LOTUS and CCI₄) with clear timelines related to issues of the Montreal Protocol, and others of a more general science underpinning. He emphasised that for ozone depletion the governments would not seek more evidence for the existence of the problem, but rather need advice on possible actions. Possibly, the Paris Agreement proves to be a turning point in the climate debate; then WCRP should react in an appropriate fashion. Following a number of recent achievements from SPARC activities, the presentation contained an outlook for SPARC's future, the mention of two SSG positions being reserved for colleagues from South America and Africa, and the intention for enhanced internal and external collaboration under a new strategic plan. The plan is to define the "boundaries" to other core projects. Furthermore, the new implementation plan has to seek financial resources commensurate to WCRP's future aims.

The *Global Energy and Water Cycle Experiment (GEWEX)*, investigating the heat reservoirs and fresh water resources on the planet, was presented by **Graeme Stephens**. A new panel in *Global Atmospheric System Studies (GASS)* was

formed focussing on moist atmospheric processes in the evaluation of model physics. Large cooperation potentials with SPARC were identified, considering the atmospheric part, especially with respect to *Process Evaluation Studies (PROES)*, as well as troposphere-stratosphere interactions, and deep convection.

Detlef Stammer presented recent developments within the *Climate and Ocean: Variability, Predictability, and Change (CLIVAR)* project. A science plan was recently finalised, organising the project through panels and research foci. A new panel to coordinate and facilitate activities on the role of the northern oceans in the context of the global climate system from a coupled ocean-air-ice perspective (CLIC/CLIVAR NORP) is considered to fill a gap in the science programme. CLIVAR is to organise yearly schools on CLIVAR related and societally relevant science, alternating between Qingdao (China) and Trieste (Italy), and funded through external sponsors. It was discussed how various WCRP projects on decadal variability should be handled, and plans were mentioned to merge the CLIVAR groups with other projects with similar interests.

News from the *Climate and Cryosphere* project (CliC) were presented by **James Renwick**. A highlight consisted of the "Arctic Sea Ice Prediction" stake holders workshop, held in Tromsø in January 2018. The discussion stressed that the treatment of commercial stakeholders necessitates special care, and CliC does yet not have a general strategy in this regard. CliC witnesses that numerous complementary research activities are undertaken in other organisations, which provides the challenge to seek cooperation with a wider community while concentrating up-to-date climate and cryosphere research. With regard to the strategic plan CliC underscored the urgent need for basic observations and their integration into modelling studies. Finally, the importance of CliC research for societal linkages was underscored.



Figure 1: Participants of the JSC-39 session.

Reports from partner projects

Several partner projects to WCRP provided updated overviews. The *Global Climate Observing System* (GCOS) recently introduced a new strategy. **Rodney Martinez** emphasised parallels to the development of the strategic plan for WCRP, e.g., the envisaged enhanced monitoring of global circulation circuits, motivated by the Paris Agreement. The need for good communication between GCOS and WCRP was underscored, as the data records collected through GCOS are needed as input for WCRP projects. Likewise, observations made during short-term WCRP projects should be fed into the GCOS database. Sharing panels is one useful possibility of interacting with the WCRP core projects. It was also noted that adaptation to climate change is an important issue which necessitates detailed information. Down-scaling of global findings continues to be a science topic with high relevance for governmental needs.

Øystein Hov used the opportunity to present ideas on science for services: a curiosity-driven circuit of discovery, translation, and application. He provided examples for potential partnerships following such a scheme – one of them being to strengthen existing links between SPARC, the *International Global Atmospheric Chemistry* project (IGAC), and the *Commission of Atmospheric Sciences* (CAS) to provide a common focus for research related with atmospheric composition.

The search for collaborative opportunities between projects was repeated in **Greg Carmichael's** presentation for the *Global Atmospheric Watch* Programme (GAW). This WMO programme builds on cooperation involving contributions from 100 countries. As there are common interests with neighbouring programmes, GAW sees the potential for strong collaboration in a number of research topics, among them greenhouse gas fluxes, SLCPs, as well as upgrading observing systems and modelling capabilities.

For the *World Weather Research Programme* (WWRP), **Michael Morgan** identified four action areas: high impact weather, water, urbanisation, and new technologies. There is a clear need for the co-design of science activities to make advances both in science and its service for society. Furthermore, joint activities between WCRP and WWRP could help to use available resources more efficiently. Proper coordination and co-design avoided unnecessary duplication of effort and brought to bear the diverse talents of the respective communities to tackle some of humanity's most vexing environmental challenges.

Marie-France Loutre introduced the *Past Global Changes* project (PAGES), a core project of Future Earth and a scientific partner of WCRP. A link between WCRP and PAGES has been established through Gabi Hegerl (WCRP grand challenge on climate extremes) and Hugues Goosse (PAGES activity on Extreme events and risk assessment).

Grand Challenges Reports

As topical foci, WCRP supports seven Grand Challenges (GCs), each addressing for a limited period a problem area high concern within climate change research. All Grand Challenges reported increased collaboration among each other, as well as with the core projects, the working groups and external partners. Generally, concern was expressed regarding the tightening of budget limits in recent years.

Detlef Stammer introduced the GC on *Regional Sea-Level Change and Coastal Impacts*. Its key event was the International Sea Level Conference in July 2017 in New York City, attended by more than 300 participants from over 40 countries. Highlights and an Official Statement are contained in the still living website <http://sealevel2017.org>.

The GC on *Clouds, Circulation and Climate Sensitivity* concerns questions about variations in storm tracks, the position and strength of tropical rain belts, the importance of convective aggregation for climate, and the contribution of convection to cloud feedbacks. **Bjorn Stevens** (remotely connected) summarized model inter-comparison projects and introduced a coordinated field study, the EUREC4A campaign, scheduled for 2020 around Barbados. EUREC4A aims to test mechanisms that control the low-cloud feedback in climate models using several research aircraft that will be coordinated with satellites, ground stations, and ships. The GC on *Carbon feedbacks in the climate system*, launched in 2016, addresses the durability and persistence of land and ocean carbon sinks.

Pierre Friedlingstein (remotely connected) introduced inter alia a plan for a carbon predictions meeting in 2019 to discuss new analyses for the UNFCCC global stocktakes. An EU Horizon2020 proposal was submitted for the *Climate-Carbon Interactions in the Coming Century* (CCiCC), to narrow down knowledge gaps in climate science in support of IPCC reports. Concerning the WCRP strategic plan, the GC expressed the need of a stronger connection between science and policy.

Jan Polcher reviewed the GC on *Water for the Food Baskets of the World* and presented the intention of dividing the GC in two complementary research activities; one focussing on observation based studies to improve understanding of surface-atmosphere-interaction and the second aiming at enhancing predictive capabilities while climate changes and increasing human intervention increases. The refined science questions for this GC are well linked to the GEWEX science questions, while being of wider scope concerning water usage. The GC should make use of *Regional Hydroclimate Projects* (RHPs) of GEWEX and CORDEX regional activities, and seek collaboration with the WMO *Commission for Hydrology* (CHy), the UNESCO *International Hydrological Programme* (IHP) as well as the *Integrated Land Ecosystem-Atmosphere Processes Study* (iLEAPS) of the Future Earth.

For the GC on *Weather and Climate Extremes*, **Xuebin Zhang** reported coordination efforts to enhance global extreme datasets (e.g. HadEx3, INTENSE) and to model specific physical processes (e.g. high-resolution convection permitting models). He highlighted so-called Compound Events as important for the GC implementation (cf. a recent Nature Climate Change perspective article; www.nature.com/articles/s41558-018-0156-3). With its wide range of issues and the diversity of stakeholders for extremes, the GC regards maintaining its focus as a challenge, as it intends to remain open to research and to services communities. In light of the decision of WMO to close the joint CCI-WCRP-JCOMM *Expert Team on Climate Change Detection and Indices* (ETCCDI), the GC requested that WCRP would identify a home for these tasks with the GC-Extremes as a standing committee.

For the GC on *Melting Ice and Global Consequences*, **Greg Flato** identified numerous topics in common with the CliC project. A focus were activities targeted at the cryosphere in climate models such as Sea-Ice Model Intercomparison, Ice Sheet Model Intercomparison and the ESMSnowMIP. For the future, overlaps between CliC and the GC should be clarified. The GC received an invitation to participate in model intercomparison initiative, developed by a large European consortium.

Masahide Kimoto introduced the GC on *Near-Term Climate Prediction*, which transposed its white paper to a journal article (to be submitted to Nature Climate Change). The GC now has 19 international partners and members from all WCRP core projects. The

agreed objectives include promoting and providing new knowledge about climate mechanisms and climate forecasting systems, exploring operational decadal predictions in close coordination with WMO as well as experimental decadal outlooks. To this end, this GC plans to initiate real-time “Global Annual to Decadal Climate Updates” each year, for which specific diagnostics are being developed.

Advisory Council reports

Jean-Noël Thépaut presented the work of the WCRP *Data Advisory Council* (WDAC). Major efforts are led by task teams termed obs4MIPs (to prepare observations for model intercomparison), TIRA (reanalyses inter-comparison), and SurFlux (provide surface fluxes WCRP-wide). It was stressed that observations stand at the heart of model development and process understanding, in addition to data assimilation, model verification and model initialization. It was proposed to specifically address the topic of “big data science” within WCRP, and to put an emphasis on fluxes. Likewise, attracting funding for data assimilation development was regarded as important as for model development. Finally, the need for a cross-cutting “observations/analysis” forum was stressed.

The WCRP *Modelling Advisory Council* (WMAC), presented by **Gerald Meehl** (remotely connected), is considered very active, coordinating 47 individual modelling projects (67, when counting CMIP). In 2017, WMAC initiated a WCRP/WWRP International Prize for Model Development. WMAC reported slow progress in reducing systematic model errors, called for more coordinated activities, and brought up the issue of exascale computing, which should be addressed across WWRP, GAW, and WCRP. The sheer number of modelling activities scattered across WCRP, necessitates a mechanism to facilitate communication and efficient coordination. Therefore, the current WCRP web site containing a list of active modelling projects (with short descriptions of status and chair/leader contact information) should be maintained. WMAC proposed “model development” as a task of central interest for WMO, and consequently the formation of a “working group on Model Development” involving the entire WMO research programme and also other programmes dealing with modelling aspects (e.g. AIMES of Future Earth). Finally, it was suggested that each modelling working group within WCRP has a designated model development activity that could be coordinated by the Model Development Working Group.

JSC-39 concluded with a presentation by **Victor Dike**, a representative of the YESS, the community of *Young Earth System Scientists*. He gave a short introduction of the latest development of the network, as well as the young scientists' view on the future climate science for input to the new WCRP Scientific Strategy. Dike re-emphasized the need and benefit for WCRP and for the future of climate community to actively entrain young scientists in their various activities. He also stressed that early career scientists should be encouraged of getting pro-actively involved in this process, individually and through ECR networks.

Thursday was devoted to a scientific workshop entitled "Future Directions for Fundamental Research on the Climate System". The program was interleaved with talks on the state-of-the-art climate science in the remit of WCRP activities, presented by the scientific leaders of WCRP groups and by leading Chinese researchers. The audience was vividly engaged, asked questions, and made good use of the special opportunity for discussions with experts from all over China and from around the planet (as represented by WCRP members).

Personal thoughts related to WCRP's new Strategic Plan

Neil Harris and Judith Perlwitz (SPARC co-chairs)

WCRP is currently developing its Strategic Plan 2019-2029. This new plan and the related implementation plan have to take into account that climate scientists are now operating in a different political environment. Since the signing of the Paris Agreement, the role of climate scientists is to help governments meet their targets on climate change. It is much more than presenting and assessing evidence as to whether climate change is occurring. There are strong parallels to the Montreal Protocol process since 1987. Over the years, SPARC has organised numerous reports answering specific questions in advance of the UNEP-WMO Ozone Assessments, most recently the LOTUS and CTC reports. The role of similarly focussed reports organised in support of the IPCC process should be growing.

A major point of discussion at the recent WCRP-JSC meeting was how to maintain a balance between fundamental research (processes, measurements, model development, etc.) and more applied aspects (regional, economic, social, etc.). Practical aspects of accomplishing such a balance will be developed in the Implementation Plan. From a SPARC perspective it is important to have clear homes for the various facets of atmospheric dynamics and for coordinating international research on atmospheric composition.

Understanding climate globally and regionally requires coordinated research between scientists interested in the atmosphere, ice, land and ocean. However, for an increasing number of particular research topics, joint work involving multiple communities from inside and outside WCRP is required. The challenge is to assure that WCRP provides optimal coordination of these

areas of common interest. The Subseasonal-to-Seasonal Prediction (S2S) Project is an excellent example of current collaborative programmes. It is a project under WCRP and WWRP sponsorship, many WCRP sub-groups are contributing (e.g., the SNAP activity of SPARC), there is strong research community interest, and it is productive. SPARC has a track record of collaboration with external partners such as IGAC and GAW and should support other interdisciplinary initiatives on topics such as convection or radiative forcing.

At its 39th session, the WCRP-JSC discussed intensely the role of the scientific communities in a revised WCRP. The strength of the communities is outstanding as seen by the number of scientists attending the recent General Assemblies of the core projects (including the upcoming SPARC GA in 2018). These communities roughly correspond to the four current core projects (dealing with atmosphere, ice, land and ocean, respectively) and regional activities with some omissions in certain technical areas (model development). We are keenly aware of the contributions of so many excellent scientists to SPARC's success and think it is essential that everyone who wants to can identify with some part of the revised WCRP. We fully recognize that the nature of that home will evolve over time as new interdisciplinary challenges are being addressed.

The new WCRP Strategic Plan is currently open for discussion (www.wcrp-climate.org/wcrp-sp-pc). As current co-chairs of SPARC, we strongly recommend that all interested SPARC scientists read it and provide their thoughts as SPARC and WCRP's success crucially depends on broad intellectual support.