



## PROJECT REPORT

Report of the second session of the WCRP  
Modelling Advisory Council (WMAC)

Brasilia, Brazil, 27 May 2013

AUGUST 2013

WCRP Report No. 21/2013

## **Executive summary**

The WCRP Modelling Advisory Council met for its second session in Brasilia, on 27 May 2013, in conjunction the WCRP Joint Scientific Committee 34<sup>th</sup> session during the same week. After the inaugural session in Beijing in July 2012, the Council has now started addressing some core actions. Regarding the Grand Challenges (GC), WMAC members noted that many of the GCs will benefit from improvements to models. They were looking forward to attend the GC presentations at the JSC34. The Council further noted that CMIP6 planning is starting soon, whilst the community has barely recovered from CMIP5 with results indicating only marginal progress since CMIP3. WMAC members advised there is a need for more time and a strategy to improve models significantly.

WMAC will promote the establishment of several prizes for significant contributions to model development, with a focus on early career scientists. Support and involvement of WMO and societies such as AMS, RMS, AGU, EGU, EMS, etc will be investigated. WMAC will also promote model development through summer schools focusing on model physics and parameterization, in close collaboration with GASS, GLASS and WGOMD.

Concerns were expressed about the model evaluation framework in CORDEX. It was proposed to revisit the CORDEX framework to enhance the three essential efforts on “ERA-Interim forced runs”, “historical runs forced by CMIP” and “projections forced by CMIP runs”.

WMAC members endorsed the ESGF as the main mechanism for exchanging data (i.e. model runs, observations and (re-)analyses) within WCRP in the decade to come, which has implications also for core projects, beyond the current buy-in of CMIP, CHFP, CORDEX, obs4MIPs and ana4MIPs. Whilst appearing somewhat complex, the suggested ESGF internal structure and governance will be left to the federation, with potential participation of WCRP/WMAC on an Advisory Board, suggested to replace the Review Board.

The Council examined a proposal for a model tuning workshop and recommended WGCM to take the lead on this initiative to cover all aspects of tuning, from process level to coupled systems. WMAC also recommended making documentation of tuning process a requirement for participation in CMIP6.

WMAC discussed the opportunity for a “Dynamics-Physics Coupling” workshop to focus on circulation issues and the representation of these coupling processes in models. These matters are essentially addressed in separate communities but are key to regional climate prediction. The Council recommended the formation of a small group under the auspices of WCRP Grand-Challenge 4 to define the workshop goals and outline of the workshop in collaboration with GASS and SPARC.

WMAC also recommended WDAC to lead a new effort on surface fluxes, building on GEWEX products, reanalyses and SURFA experiences.

WMAC reiterated the need for a WWRP representative and recommended to nominate a WGRC representative next year. The Council also proposed a 3-day meeting for future sessions in conjunction with the JSC, starting on Monday AM with a WMAC separate session, followed by two days of relevant JSC briefs and a second separate session on Wednesday PM and ending with the reporting to the JSC on Thursday.

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**Members:** Christian Jakob (Co-chair) John Mitchell (Co-chair), Joan Alexander (SPARC), Maria Silva Días, Michel Deque (Regional Climate), Adam Scaife (WGSIP)

**Invitees:** Antonio Busalacchi (Chair, WCRP JSC), Otis Brown (WDAC Co-chair), Simon Marsland (CLIVAR), Aaron Boone (GEWEX, via Skype call)

**Staff:** Michel Rixen (WCRP JPS)

**Excused:** Sandrine Bony (WGCM), Andy Brown (WGNE), Peter Cox (IGBP), Gokhan Danabasoglu (CLIVAR), Helge Drange (CLIVAR), Francisco Doblas-Reyes (WGSIP), Greg Flato (CliC), Masahide Kimoto, Toshio Koike (WDAC), Gerald Meehl (WGCM), Joseph Santanello (GEWEX), Jon Petch (GEWEX), Jean-Noël Thépaut (WGNE)

## **1. Introduction**

### **1a. Introduction – WMAC Co-Chairs**

Christian Jakob and John Mitchell, Co-chairs of the WCRP Modelling Advisory Council, welcomed all participants and thanked them for their presence. They recalled that the WMAC1 session devoted most of its time to existential questions and ran through the ToR to remind members about the role of the Council and areas where it is expected to achieve some progress. Whilst noting the largely advisory role of the Council, they expressed their desire for WMAC2 to take forward some concrete actions and urged members to remain concise in their presentation to leave enough time for discussions.

### **1b. Welcome address – Chair JSC**

Antonio Busalacchi, chair of the WCRP Joint Scientific Committee (JSC), welcomed all participants and thanked them for attending this second session of WMAC. He stressed that this year, the Grand Challenges (GC) will be discussed extensively and that WMAC's perspective is fundamental because modelling is central to many activities within the WCRP in general and with the Grand Challenges in particular. The same comment holds for the regional activities within the program, now falling under the Working Group on Regional Climate (WGRC), which offers an interface with WMO regional activities and the Global Framework for Climate Services. It is suggested that CLIVAR might take the lead on the family of monsoon research efforts within the WCRP, on behalf of all core projects.

*Christian Jakob enquired about the link between core projects and Grand Challenges and what resources would be available to implement them. Antonio Busalacchi responded that GCs are integrating activities leveraging existing efforts and networks within the program. Resources are available provided requirements are identified and balanced between the various initiatives within the program. On a question from Adam Scaife about the link with the WMO Global Producing Centres and Lead Centres (operational*

*focus), the chair noted that research itself should not define the interface and is more within WMO's responsibility, and will be discussed also at the 1<sup>st</sup> Intergovernmental Board for Climate Services in July. The exact relation between CORDEX and other WCRP regional activities will also be discussed at the JSC34. Christian Jakob also suggested revisiting the format of the WMAC session to improve attendance, and better coordinating it with the JSC agenda. Antonio Busalacchi stressed that the JSC would be open to any suggestion and flagged the tentative plans for the JSC35 to meet in conjunction with the WMO Commission for Climate.*

### **1c. Adoption of agenda – C. Jakob**

The agenda was adopted without any further comments.

### **1d. Review of WMAC1 actions – C. Jakob**

WMAC1 actions were closed. The WMAC ToR have been adopted at the last JSC33. It was decided that a dedicated WGCM/AIMES working group was currently not required, as the upcoming WGCM17 session will held in conjunction with AIMES in Victoria 1-3 October 2013.

Post WMAC1 discussions suggested the establishment of an International Prize for model development and the organization of dedicated summer schools on model development. These items are part of the WMAC2 agenda and are being discussed below.

### **1e. WCRP update, Grand Challenges – M. Rixen**

Michel Rixen provided an update on the WCRP revised priorities following the OceanObs'09, the World Climate Conference and the ICSU Visioning process, now addressing the Global Framework for Climate Services, the Future Earth priorities (including observing and data systems cross-cutting themes) and the Framework for Ocean Observing. The revised WCRP structure includes the 6 Grand Challenges, identified as priority research themes for the 5 years to come. He recalled the significant contribution of CMIP5 to the IPCC 5<sup>th</sup> Assessment Report, thanks to common metadata conventions, compliance software and user-friendly data delivery methods via the Earth System Grid Federation and highlighted also the upcoming challenges in preparing for the CMIP6 next round of simulations. He noted the growing expectations from stakeholders for higher resolution products (such as those from CORDEX) and downstream applications. It is hence timely to revisit the experimental frameworks, including the CMIP and CORDEX ones in light of international assessment and research agendas. He outlined the importance of reanalysis for climate assessments, model-data comparisons and boundary conditions for regional downscaling, the central role of data archives such as obs4MIPs and ana4MIPs within the Earth System Grid Federation context and the growing expectation from the global and regional modelling community to facilitate their research. He closed the presentation by reviewing the emerging WWRP-WCRP joint activities under the Polar Prediction Project (PPP), the Subseasonal-to-seasonal (S2S) project and other activities which could

benefit from closer collaboration (metrics, verification, coupling, data assimilation, etc).

*The chair observed that the IPCC timeline was very demanding on the WCRP modelling community and not necessarily justified, given the rather marginal improvements between CMIP3 and CMIP5. The need for WMO regional centres to better understand GFCS was highlighted.*

#### **1f. WDAC update – O. Brown/T. Koike**

The presentation summarized the second session of the WCRP Data Advisory Council (WDAC). The meeting made progress on a number of core topics at the heart of WDAC's mandate, namely ECV inventories, data archives, data set quality assessments, data assimilation and reanalysis.

The WCRP Observation and Assimilation Panel (WOAP) workshop on the Evaluation of Satellite Related Global Climate Datasets held in Frascati in April 2011 identified the need for a one stop-shop inventory of satellite and in-situ ECV to help the user community discover and access climate data. Two major initiatives led respectively by GOSIC under GCOS, and the WG Climate under CEOS are relevant in this context, the later being more specific to satellite data. Activities are underway to identify their commonalities and plan for a way to merge these efforts.

Data inventories and archives raise the question of the required level of quality assessment/assurance of data sets being used by the scientific community for climate data assessment. Climate data set assessments are being conducted on a regular basis within the various WCRP core projects and activities, and sister programmes, but approaches, procedures and level of detail and quality vary.

Reanalyses have become a fundamental tool in climate research. The WCRP 4<sup>th</sup> International Conference on Reanalysis identified the need to better understand their respective uncertainties. Observations are key in anchoring climate models simulations to measurements so as to produce optimal estimates of the climate. WDAC recognized the need to assess the respective impact of input observations, (and henceforth the cost-benefit of observing systems), in the quality of reanalyses. Plans are now underway to organize a dedicated workshop on this issue around end 2014. WDAC also considers developing a more systematic approach of assessing and intercomparing reanalyses, under some Reanalysis Intercomparison Project (RIP), which could be greatly facilitated through the ESGF ana4MIPs capabilities.

The Earth System Grid Federation (ESGF) is a major undertaking toward assembling climate model data into common format to support the WCRP Coupled Model Intercomparison Project (CMIP), itself being a major contribution to the IPCC AR5 and other climate assessment activities. The obs4MIPs, a JPL/NASA-PCMDI/DOE initiated activity, aims at identifying observational data sets having a one-to-one equivalence to climate model parameters so as to facilitate the subsequent evaluation of climate simulations

against observations using the same format compliance and same grid technology. A similar initiative called ana4MIPs concerns reanalyses contributing to the ESGF and may be expanded to other quantities such as surface fluxes in the future. The expectation is now growing within the community, owing to the obvious potential for these capabilities to support and de-multiply the scientific activities within the program and it was decided to internationalize the current *ad-hoc* obs4MIPs working group by establishing an appropriate task group under WDAC to oversee these activities and help reaching out to the various networks who could contribute data to the obs4MIPs and ana4MIPs efforts.

Finally the report noted areas of mutual interest between the WMAC and WDAC. Highlighted topics included: \*4MIPS, the Reanalysis Workshop, development of QA/QC approaches for data sets, evaluation metrics, observing system sampling experiments and critical datasets for model comparisons.

*Michel Rixen suggested that in the context of obs4MIPs, WMAC could provide inputs to WDAC as to critical data sets required by the modelling community. Christian Jakob recalled that fluxes were identified as a major gap at the WGNE Systematic Error Workshop and suggested WDAC to address fluxes more in details at its next session, building on experience from reanalyses, GEWEX, SURFA and SOLAS efforts. Follow-on discussions elaborated on possible formats for the next WMAC session, recognizing the need for 2 days to cover all issues in some details (see below).*

## **2. Overview of WCRP modelling activities**

### **2a. WGCM, CMIP – J. Mitchell/J. Meehl/S. Bony**

John Mitchell reported that the most recent meeting of WGCM was held in Hamburg in September 2012, including a one-day joint meeting with WGSIP. The broad areas of work covered by WGCM were outlined very briefly, emphasising areas of collaboration with groups within and outside WCRP.

WGCM is taking the lead on Grand Challenge 4, “Clouds, circulation and climate sensitivity”. This is progressing well and five areas of work have been identified: climate and hydrological sensitivity, leveraging the past record, coupling clouds to circulations, changing patterns and working towards more reliable models.

WGCM and WGSIP have set up a Decadal Climate Prediction Panel to oversee the development of experimentation on decadal prediction.

A brief review of the achievements of CMIP5 was given and some of the potential issues for CMIP6 were discussed. The experimental design should be compatible with CMIP5, though there may be some minor revisions to emissions scenarios from the IAM community. There was a desire in the modelling community to make CMIP6 smaller than CMIP5 though this will be difficult given the growing number of people using model data and the demand for additional experiments.

The data produced in CMIP6 is expected to be “near-exabyte” scale- so some thought and planning is needed well ahead of time. Securing funding for ESGF would be helpful in this respect, and metaphor needs work in clarifying the concept and its application. CMIP argue that CMOR should be promoted as a standard protocol. An international approach should be taken for model evaluation, and the metrics panel had proved useful in this respect.

*Christian Jakob cautioned about the possible people/community overlap and duplicated efforts between CMIP and the WCRP Grand Challenges. WCRP research agenda should not be driven by IPCC but WMAC could advise on a number of criteria such as minimum resolution or minimum independence with other models. He wondered about the existence of statistics on the use of ESGF model data and John Mitchell responded that PCMDI should have those. Christian Jakob also noted that the current IPCC timeline does not allow for revolutionary changes in model development. It was recommended to ask JSC to endorse the CMIP6 Decadal Prediction effort led jointly by WGSIP and WGCM. WMAC sees ESGF as the main mechanism for exchanging data (models, observations and reanalyses) within the WCRP in the next decade and this capability should be resourced accordingly. This has implications also for WCRP core projects, beyond the current buy-in of CMIP, CHFP, CORDEX, obs4MIPs and ana4MIPs. Regarding CMIP6, WMAC recommended including some notes on how each model was tuned. This is important as a lot of the model validation in CMIP is done independently of the model developers, and hence the evaluators need to know against which data the model was tuned.*

## **2b. WGSIP, S2S, Decadal Predictions – A. Scaife/F. Doblas-Reyes**

This modelling group is co-chaired by Professors Adam Scaife (Met Office Hadley Centre) and Francisco Doblas-Reyes (IC3 Spain). The group sits alongside and works closely with the other modelling working groups such as WGCM in the WCRP. WGSIP's main focus is to provide skilful regional climate prediction information from months to years ahead and so it directly feeds into Grand Challenge 1 on Regional Climate predictions. Many of the WGSIP members also participate in real time Climate Service provision already, they are designated by WMO to produce seasonal forecasts in real time and distribute them via the WMO Lead Centre for long range multi model ensembles: [www.wmolc.org](http://www.wmolc.org)

WGSIP recently held the first Interannual Workshop on Seasonal to Interannual Prediction, kindly hosted by Meteo France in Toulouse. 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 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/> kindly 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 we see as the equivalent of the CMIP database for seasonal forecasts. Other WGSIP subprojects on 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 a collaboration between WGSIP-WGCM-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 consisting of WGSIP - WGCM - (and soon) CLIVAR members. Real time decadal predictions for the Global Framework for Climate Services were also discussed and these will be an important topic for the next WGSIP meeting in Feb 2014 to be held jointly with the WMO-CBS-Expert Team on Long Range Forecasts.

*Christian Jakob enquired about the difference between CHFP model and CMIP5 models. Adam Scaife responded that some are very similar, others not, and some vary the ways models are initialized. Michel Déqué commented that some seasonal forecasts are based on older “CMIP3” models.*

## **2c. WGNE – C. Jakob/A. Brown/J.-N. Thépaut**

Christian Jakob presented the WGNE activities on behalf of the WGNE co-chairs, Andy Brown and Jean-Noel Thépaut, who were unable to attend the meeting. He highlighted that the WGNE flagship projects, such as Transpose AMIP and the grey-zone project are making good progress. He also informed the WMAC of new projects that are emerging, including an assessment of the need for aerosol representations in NWP models, a potential project on the evaluation of monsoon predictions in NWP and a new project on the momentum budget in atmospheric models for both weather and climate. He presented the major outcomes of two WGNE workshops held in 2013, the GOV/WGNE Ocean Coupling workshop in March 2013 in Washington, and the 4<sup>th</sup> Systematic Errors workshop in Exeter in April 2013. He informed the WMAC of the key conclusions of the systematic errors report ([http://www.metoffice.gov.uk/media/pdf/h/9/WGNE\\_Workshop\\_Summary\\_v1p0.pdf](http://www.metoffice.gov.uk/media/pdf/h/9/WGNE_Workshop_Summary_v1p0.pdf)). He noted that WGNE can play a major role the Grand Challenges, as they have a strong existing community and much experience in evaluating the “weather” in models, a key issue in many of the GCs. Finally, Christian pointed out the ever reducing gap in the interests of the weather and climate community, with an increased focus in NWP on aerosols, ocean coupling and the prediction of clouds and rainfall, highlighting once again the important role

of WGNE in uniting the weather and climate communities in the area of atmospheric modelling.

*Christian Jakob noted that the WGNE Systematic Error Workshop had many presentations showing limitations of current models, but very few actually investigated the reasons behind these errors. He also stressed the difficulty of having different model configurations which prevent drawing conclusions about model errors. He highlighted the importance of flux data in this context, where SOLAS and the GEWEX Data and Assessments Panel are also active. On a question by Maria Silva Dias on the role of WGNE in Earth System Models (ESM), Christian concluded that WGNE is more focused on physical models from NWP to climate timescales, but interested to learn from ESM. Adam Scaife cautioned not to oversell seamless analysis and prediction because conclusions may not apply everywhere on different time scales.*

## **2d. CLIVAR– S. Marsland/H. Drange/G. Danabasoglu**

CLIVAR was represented through its Working Group on Ocean Model Development (WGOMD). CLIVAR's three Core Research Areas (Anthropogenic Climate Change; Decadal Variability, Predictability and Prediction; Intra-to-Seasonal Variability, Predictability and Prediction) and five Core Capabilities (Improved Atmosphere and Ocean Components of ESMs; Data Synthesis and Analysis; Ocean Observing System; Knowledge Exchange; Capacity Building) were noted. In addition to these Core activities that are carried forward by its panels and working groups, CLIVAR has developed a set of 'Research Opportunities', being themes/topics of critical importance that, through enhanced international coordination, have been identified for their potential to yield significant progress. Importantly, the Research Opportunities framework allows for the generation of new opportunities as future needs arise as identified by the CLIVAR community. A variety of examples of CLIVAR science addressing Research Opportunities were presented.

Overall, the CLIVAR Research Opportunities are well aligned with the WCRP Grand Challenges. CLIVAR, for example, is to lead the seasonal and decadal component of the Regional Climate Information GC, and this will be developed through the matching CLIVAR Research Opportunities (monsoons, ENSO, decadal). The extremes theme in CLIVAR matches onto the extremes GC, and the regional sea level variability research opportunity aligns with the sea level GC. With the introduction of the 'Research Opportunities', the CLIVAR organizational landscape has some proposed modifications: the various basin panels (Atlantic, Indian, Pacific, Southern) shall be preserved, as will GSOP and ETCCDI; WGOMD would become the Ocean Model Development Panel with expanded ToRs; a Monsoons Panel will be created to oversee the coordination of the work being done in the regional monsoon panels; and a new Knowledge Exchange and Capacity Building Panel would be created. Development of the Research Opportunities and proposed CLIVAR organizational structure will be furthered at a first Pan-CLIVAR meeting, held jointly with the Pan-GEWEX meeting, planned for July 16-18, 2014 in The Hague, Netherlands.

An update on activities of the WGOMD was also presented. After holding a successful WGOMD/SOP Workshop on Sea Level Rise, Ocean-Ice shelf Interactions and Ice Sheets (Hobart, Feb 2013), there is now a proposed WGOMD Workshop on High Resolution Ocean Modelling (Kiel, Spring 2014). Currently, the key modelling activity of WGOMD is a series of inter-comparison studies under the Co-ordinated Ocean-ice Reference Experiment protocols. Results were presented from mature manuscripts focussing on Atlantic Meridional Overturning Circulation, and on thermocline sea-level evolution in the 20th century. Along with a variety of other CORE studies, these manuscripts will comprise a special issue of Ocean Modelling. This work is essentially a \*MIP for the 18 participating global ocean and sea-ice climate models.

*Simon Marsland commented that extended climate records are often an overlooked aspect of our research. Christian Jakob pointed out the major contribution CLIVAR made regarding global modelling and recalled that even in the ocean there are major unresolved issues. Adam Scaife noted that WGSIP is well connected with CLIVAR (e.g. attendance at CLIVAR SSG) and offered CHFP as a database to study monsoons. Maria Silva Dias enquired about the future of VAMOS panels. Michel Rixen commented that this will depend on the final CLIVAR structure to be discussed at the WCRP Conference for Latin America and the Caribbean. WMAC suggested CLIVAR to draft a TOGA-support letter to be vetted by the JSC and/or WMAC.*

## **2e. GEWEX – A. Boone/J. Santanello/J. Petch (remote presentation)**

A summary of GEWEX modelling activities and how they fit within the GEWEX imperatives was presented by Aaron Boone (together with Joe Santanello) with a focus on activities of the three panels which have considerable model development and evaluation components: Global Atmospheric System Study panel (GASS), the Global Land/Atmosphere System Study (GLASS), and the GEWEX Hydroclimatology Panel (GHP). The GEWEX imperatives are being addressed by the aforementioned groups through a set of core science questions covering issues related to precipitation variability, global water resources, changes in extremes and water and energy cycles and processes. The GASS panel has the primary goal of improving the representation of atmospheric processes in weather prediction and climate models. The role of the panel is to coordinate international scientific projects, which then will facilitate model improvements through the use of data from field campaigns. Current projects are specifically addressing boundary layer clouds and surface coupling, convection and microphysics. The idea of promoting a model development summer school was evoked, and an example was given for the annual WRF course at NCAR: it was recommended to devote more time instruction on physics as opposed to the current emphasis on technical aspects of running the model. GHP focuses on issues related to regional scale hydro-climate and land surface projects, with the main goal of achieving skill in predicting changes in water resources as an integral part of the climate system up to seasonal and annual timescales. Current projects are organized by region with an effort to

encompass a wide range of contrasting climates and surfaces, with linkages to regional climate projects (such as CORDEX). In addition, GHP is working on validating global datasets together with the GEWEX GDAP panel, thus providing the community with quality datasets, which can then be used for model evaluation and improvement. Finally, GLASS projects focus on three main activities; providing the best estimates of land surface state variables and fluxes (through both offline multi-model simulations and improved land-data assimilation methods), improving the understanding of land atmosphere feedbacks (using observational data in multi-model inter-comparison projects) and better quantifying the role of the land surface in predictability (using fully coupled global climate models, with strong links to CMIP). The improvement of the representation of land surface processes and the coupling with the atmosphere is being implicitly addressed by most of the GLASS projects. Finally, a series of GEWEX workshops have been planned for the remainder of 2013 and 2014, which will address the difference science questions as themes. Each of the workshops has links with one or more of the core GEWEX panels. GEWEX could potentially benefit from a WMAC-coordinated strategy or template for model inter-comparison projects, which seek to improve model physics (as one of their primary goals). An additional goal of this strategy could also be to facilitate concomitant improvements across themes (since many projects tend to focus on certain processes somewhat in isolation, for example improving convective parameterizations while not looking at turbulence, and vice versa, etc...).

*It was recommended to have GEWEX represented at the next WGSIP session.*

## **2f. SPARC – J. Alexander**

Joan Alexander reported on SPARC modelling activities: (1) The Chemistry Climate Model Initiative (CCMI), is a joint project between SPARC & IGAC focusing on development and validation. Phase I simulations will fulfil requirements of the next WMO/UNEP ozone assessment, and in Phase II some of the models may be coupled to ocean models and participate in CMIP6. The simulations include hindcasts and forecasts with a variety of sensitivity experiments. (2) The Dynamical Variability activity (DynVar) focuses on dynamical coupling of the troposphere and stratosphere and promotes the development and use of coupled atmosphere-ocean sea ice models with extended upper boundaries. A recent focus was on analysis of SHFP and CMIP5 models, and a next phase will focus on reducing model circulation biases, improving variability, and elucidating mechanisms of stratosphere-troposphere coupling. (3) SNAP (Stratospheric Network for the Assessment of Predictability) is an emerging SPARC activity. Plans include preparing a review on stratospheric predictability, and performing predictability experiments with participation of operational forecast centres. Plans also include working with S2S to analyse stratosphere-troposphere coupled predictability in the S2S archive of forecasts and hindcasts. (4) The Gravity Wave activity began a momentum budget study in 2013, examining terms in the momentum budget in climate models and reanalysis products. The group will coordinate with WGNE regarding their parallel surface momentum budget

study. One member of the SPARC group is involved in both studies. (5) The activity on Solar Influences (SOLARIS/HEPPA) has prepared a review of the newest solar spectral irradiance (SSI) dataset and is providing forcing data for CCMI sensitivity to SSI experiments. (6) The new activity on Stratospheric Sulphur Aerosols (SSiRC) is aimed at including interactive stratospheric aerosol layers in models for both climate and geo-engineering applications.

*Simon Marsland wondered about the use of RCP6.0 in some simulations, as we seem to be heading for the RCP8.5 scenario. It was recalled that GCOS has the lead on Essential Climate Variables (ECV) and that GCOS is represented on WDAC through its panel chairs. The SPARC Gravity wave/momentum effort was invited to liaise with WGNE.*

## **2g. CLiC, PPP, PCPI – J. Alexander**

On behalf of Ted Shepherd and Cecilia Bitz, Joan Alexander presented the programmatic context for the Polar Climate Predictability Initiative (PCPI). Polar Climate Predictability cuts across all elements of WCRP: Working groups need process expertise in Polar regions to improve long-range forecasts and products for climate services. PCPI will focus on seasonal-to-multi-decadal timescales, while WWRP's PPP focuses on hour-to-seasonal timescales. The two projects PCPI and PPP have a common coordination office, and will liaise closely. Within WCRP, PCPI will constitute a sub-initiative of the Cryosphere Grand Challenge. Last year's developments in PCPI include drafting an implementation plan, where six initiatives were proposed. Three of these have since become joint initiatives with PPP. Cecilia Bitz joined Shepherd as PCPI co-lead, and two champions for each initiative have been identified. The initiatives are:

- Initiative 1: Improve knowledge and understanding of past polar climate variations (up to 100 years)
- Initiative 2: Assess reanalyses in Polar regions (joint with PPP)
- Initiative 3: Improve understanding of polar climate predictability on seasonal to decadal timescales (joint with PPP)
- Initiative 4: Assess performance of CMIP5 models in polar regions
- Initiative 5: Model error (joint with PPP)
- Initiative 6: Improve understanding of how jets and non-zonal circulation couple to the rest of the system in the Southern Hemisphere

*Christian Jakob wondered about model development efforts within PCPI and Joan Alexander pointed out that the PCPI Initiative 5 is focusing on this very precise issue.*

## **2h. Regional Climate, CORDEX – M. Déqué**

Since a couple of years, the downscaling of the CMIP exercises is done under the umbrella of the COordinated Regional Downscaling EXperiment coordinated by WCRP, whereas this activity was organized at the national or continental (ENSEMBLES, NARCCAP) level in the past. CORDEX contains a statistical part and a modelling part, but is often perceived as a modelling exercise, because the coordination is easier in a community that uses or

shares very similar tools (RCM, regional Climate Model). The CORDEX framework is designed to

- Evaluate and improve regional models and techniques
- Provide a coordinated set of RCM-based projections/predictions for regions worldwide
- Facilitate the involvement of the research community from developing countries

CORDEX works both as an AMIP-like exercise, with lateral boundary conditions (LBC) provided by past reanalyses, and a CMIP-like exercise, with a production of scenarios for the future based on AOGCM simulations. For the first exercise, the forcing is Era-Interim 1989-2008 data. For the second one, RCP 4.5 and 8.5 are used for 1951-2100. A CORDEX-light exercise is also proposed (1980-2050). It is also planned to downscale the CMIP5 decadal forecasts 1980-2010, 1990-2020 and 2005-2035, the last one being a true forecast, the first two being designed to evaluate a reference climate for calculating the anomalies.

CORDEX proposes 12 domains over the world, but the list is not closed. Amongst these domains, Africa is a mandatory one to be eligible to the CORDEX label.

There has been in the recent past many presentations at international broad spectrum as well as CORDEX-focused meetings

- EGU RCM session still largest in the CL area (87 abstracts)
- Regional modelling session at AGU
- Med-CORDEX: Toulouse, France, 28-30 March 2012
- Euro-Cordex: Hamburg, Germany, November 2011
- EA-Cordex: Jeju, Korea, 22-23 September 2011
- SA-Cordex: Pune, India, 25-26 February 2012, 17-20 October 2012

Many groups have completed simulations over various domains, including ensemble simulations (e.g. SMHI or CSC). Scientific papers are appearing with explicit use of CORDEX framework (JC, CD, JGR, CR, CC etc.). The most active groups are Africa-Cordex, Euro-Cordex, Med-Cordex, Cordex South Asia and Cordex East Asia. For South-America, a coordinated activity has started. In North America, Central-America, Australia and Arctic, there is some modelling activity ongoing, but no formal coordination.

It has been recently proposed to organize the CORDEX database using the Earth System Grid (ESG) system, as for CMIP5. Initially, more freedom was let to the data storage, provided it was based on CF-compliant netCDF format. CORDEX nodes are planned at BADC, DKRZ, DMI, SMHI, ENEA, UXT, IITN and KMA.

The Task Force on Regional Climate Downscaling has been replaced in 2012 by a scientific advisory team (SAT). A new working group on regional climate (WGRC) has been created in 2013 with C. Goodess and B. Hewitson as co-chairs. This group is in charge of linking the CORDEX community to the GFCS (see the web page <http://www.wcrp-climate.org/index.php/regional-climate>). In the WMAC discussion, it was proposed that this new WCRP working group organizes the evaluation of the CORDEX ERA-interim driven simulation. This exercise has been designed specifically to evaluate the capacity of an RCM to reproduce small-scale climate features with more accuracy than the AOGCM. However, from a climate service point of view, the useful simulation is the GCM-driven one, because it serves as a reference for

the future scenarios. It will be asked to the WGRC to examine also the systematic errors in the historical period (1980-2010). Some systematic errors are inherited from the lateral boundary conditions, but the CORDEX domains are large enough to expect some improvement. WMAC stressed that the validation of the regional simulations must be done with the same care as the validation of the AGCMs (AMIP, CFMIP) and AOGCMs (CMIP). The fact that the resolution is higher, and thus better looking for climate data users (in particular over regions with complex topography) should not exempt the regional modelling community to evaluate seriously the added value of a higher resolution by a comprehensive comparison to observations. In the AOGCM world coordinating this task is assigned to WGCM (e.g. by promoting common metrics).

*Michel Rixen enquired about any documented added value of downscaling in Med CORDEX. Michel Déqué commented that this had been done in the framework of the PRUDENCE project. He also highlighted the existence of some user-friendly interfaces at Météo-France through which ASCII data over locations in France can be downloaded for immediate use by the application community. He also confirmed that CORDEX is very much involved in process studies, which was the primary driver for the ERA-Interim based simulations. WMAC members recommended clarifying the experimental framework slide. WMAC recommended clarifying the 3 core elements of the CORDEX experimental framework (ERA-Interim, reforecast and projections).*

## **2i. Additional contributions – M.A. Silva Dias**

The efforts to build up a model development community in Brazil were described from the perspective of a joint effort by the Brazilian government to create a new institution CPTEC – Centre for Weather Forecasting and Climate Studies – and by the research community involved in LBA – The Large Scale Biosphere Atmosphere Experiment in Amazonia. This led to development of CATT-BRAMS a model that includes land cover features such as deforestation, and the emission by biomass burning inline with the atmospheric model. The resulting progress in understanding the earth system behaviour in Amazon and the model improvements generated has been documented in a series of publications. In the present, however, excessive demands from the operational sector and from the need to run climate scenarios, downscaling, plus the longer time involved in publishing model development results, has severely reduced the number of people involved in model improvement. Two suggestions on what can be done to build up the modelling development focus in Brazil: (1) expand the earth system modelling community by attracting people from the Applied Mathematics community: multi-scaling and numerical methods. (2) Foster graduate programs with specific focus in earth system modelling.

*These suggestions were duly noted by WMAC for fostering activities on model development.*

## **2j. Discussion**

N/A

## **3. Model development – discussion and way ahead**

### **3a. Model development (prize, summer school)**

Christian Jakob recalled that the WCRP Open Science Conference suggested the need for a dedicated model development initiative within the program. At stakeholder level, there is little understanding of the importance of this topic. Otis Brown noted that the natural inclination for many scientists is to conduct analysis of model outputs, not to develop a model and that field experimentalists have similar issues. It was decided to develop a dedicated prize on model development within the year with potential support and involvement of WMO and societies such as AMS, RMS, AGU, EGU, EMS, etc. A small task team was established to that effect.

It was noted that many modelling summer schools cover some numerical aspects but do not examine details about physics (boundary layer, convection schemes, etc.). Some opportunities exist for joint initiatives, as ECMWF is holding regular training courses already and UKMO could focus one (part of the) school on the Unified Model. Adam Scaife noted that the CASE funding mechanism could be used to support some students in the UK. It was decided to develop plans for a summer school on model development with a focus on parameterization in close collaboration with GASS and GLASS. A task team was established to that effect.

### **3b. Joint WGSIP/WGCM/WGNE meeting on model tuning**

There was a suggestion to hold a workshop on model tuning for various centres to exchange their experience and to discuss how to document this in assessment reports and to what extent this would become a requirement. Generally speaking, this is a matter of credibility of WCRP modelling activities. A couple of centres have already published papers on model tuning (LMD, MPI, NCAR, etc.). Adam Scaife noted that model tuning is very expensive and we could have a more practical focus on model (climate) and/or parameter sensitivity. Otis Brown suggested inviting main centres to WMAC3 with a dedicated item on this issue. Simon Marsland remarked that some groups might be reluctant to participate because their tuning methods are too much ‘*ad-hoc*’. It was recommended to have WGCM the lead entity on this initiative, with WMAC providing advice when necessary.

### **3c. Workshop “Frontiers of global modelling for weather and climate”**

Christian Jakob sought feedback from WMAC members if there was interest in a workshop on how one would put together a weather-climate prediction model today if one started from scratch. The workshop could discuss all issues related to this topic from computing to dynamical cores to parameterization. It would be of some interest to compare the

recommendations from such a workshop with current practice to identify where change in the latter is most needed. While there was general interest in such a workshop, no concrete proposal was developed and the discussion was deferred to the next WMAC meeting.

### **3d. Dynamical aspects of climate change**

The Council stressed that there is a requirement to address “dynamics – physics” (and circulation) aspects more explicitly within WCRP, which are (a.o) the focus of GC4 and part of the regular work of GASS, through a dedicated meeting. WMAC members suggested that the best entity to champion this was hence the GC4 leads and GASS, also because several people are active on both efforts. It was recommended that Ted Shepherd would take the lead on this from the GC4 perspective with involvement of GASS and SPARC.

### **3e. ESMs, links to AIMES/IGBP**

ESM issues will be addressed at the upcoming joint WGCM-AIMES meeting in Victoria, 1-3 October 2013.

## **4. ESGF governance, CMIP standards, obs4MIPs**

### **4a. ESGF governance – M. Rixen**

Michel Rixen reviewed the ESGF proposed governance document. WMAC members remarked that the multi-level structure with 1 board and 3 committees seemed maybe excessive for an effective management of the framework, as some functions might be duplicated. They recommended replacing the Review Board by an Advisory Board with membership drawn from relevant partners, including WCRP.

### **4b. obs4MIPs, ana4MIPs – O. Brown**

See WDAC brief above.

### **4c. CMIP standards across WCRP – M. Rixen**

Michel Rixen reviewed the current experimental framework for CMIP5 and the Decadal Climate Prediction efforts and suggested this same approach could be adopted by WGSIP and CORDEX, with e.g. a number of core, tier 1 and tier 2 simulations divided up into “model evaluation”, “process studies” and “projections/predictions”. He further offered to elaborate on these with WGSIP and CORDEX.

### **4d. WMAC – WDAC interactions**

The current cross representation of WMAC at WDAC meetings and vice-versa seems adequate but could be revisited in the future depending on availability of co-chairs and expertise.

## **5. WMAC Business**

### **5a. Review of planned meetings/events – gaps, duplicates, requirements**

See above.

### **5b. Next WMAC Meeting**

The next 35<sup>th</sup> Session of JSC would be held in Heidelberg, Germany, on 30 June – 4 July, with a one-day overlap with the 16<sup>th</sup> Session of the WMO Commission for Climatology. Exact format is still TBD. WMAC3 would be held during the same week. The Council proposed 3-day meeting for future sessions in conjunction with the JSC, starting on Monday AM with a WMAC separate session, followed by two days of relevant JSC briefs and a second separate session on Wednesday PM and ending with the reporting to the JSC on Thursday.

### **5c. AOB**

N/A

### **5d. Review of Draft actions list**

The draft actions were reviewed and are presented in annex C. The co-chairs thanked all attendees for their active participation and looked forward to their further engagement in implementing the agreed upon actions.

## **6. WCRP Joint Scientific Committee 34th Session**

### **6a. Summary of WMAC2 meeting**

See the executive summary at the beginning of this report, which covers the various elements presented in details to the JSC by John Mitchell on behalf of WMAC.

### **6b. Summary of WDAC2 meeting**

See point 1f, as presented by Otis Brown.

## Annex A - Agenda

<i>Time</i>	<i>Agenda Item</i>	<i>Docs</i>
<b><u>Monday 27 May 2013</u></b>		
<b>1. Introduction – Chairs C. Jakob, J. Mitchell</b>		
08h30 – 08h45	a. Introduction – WMAC Co-Chairs	
08h45 – 09h00	b. Welcome address – host and/or Chair JSC (TBC)	
09h00 – 09h10	c. Adoption of agenda	1
09h10 – 09h20	d. Review of WMAC1 actions	3
09h20 – 09h40	e. WCRP update, Grand Challenges – M. Rixen	4,5
09h40 – 10h00	f. WDAC update – O. Brown/T. Koike	6
<b>2. Overview of WCRP modelling activities Part I (includes 5 minutes for questions) – Chair: C. Jakob</b>		
10h00 – 10h20	a. WGCM, CMIP – J. Mitchell/J. Meehl/S. Bony	7
10h20 – 10h40	<i>Coffee break</i>	
10h40 – 11h00	b. WGSIP, S2S, Decadal Predictions – A. Scaife/F. Doblas-Reyes	8,9,10
11h00 – 11h20	c. WGNE – C. Jakob/A. Brown/J.-N. Thépaut	11,12
11h20 – 11h40	d. CLIVAR– S. Marsland/H. Drange/G. Danabasoglu	13,14
11h40 – 12h00	e. GEWEX – A. Boone/J. Santanello/Jon Petch (remote presentation)	26-31
12h00 – 13h00	<i>Lunch</i>	
<b>2. Overview of WCRP modelling activities Part II (includes 5 minutes for questions) – Chair: J. Mitchell</b>		
13h00 – 13h20	f. SPARC – J. Alexander	15
13h20 – 13h40	g. CLiC, PPP, PCPI – J. Alexander	16,17,18
13h40 – 14h00	h. Regional Climate, CORDEX – M. Deque	19,20,21
14h00 – 14h20	i. Additional contributions – M.A. Silva Dias	
14h20 – 14h40	j. Discussion	
<b>3. Model development – discussion and way ahead - Chair C. Jakob</b>		
14h40 – 15h30	a. Model development (prize, summer school) b. Joint WGSIP/WGCM/WGNE meeting on	

	model tuning c. Workshop “Frontiers of global modelling for weather and climate”	
15h30 – 16h00	<i>Coffee break</i>	
16h00 – 16h30	d. Dynamical aspects of climate change e. ESMs, links to AIMEs/IGBP	
<b>4. ESGF governance, CMIP standards, obs4MIPs - Chairs J. Mitchell, O. Brown</b>		
16h30 – 17h00	a. ESGF governance – M. Rixen b. obs4MIPs, ana4MIPs – O. Brown c. CMIP standards across WCRP – M. Rixen d. WMAC – WDAC interactions	22,23, 24,25
<b>5. WMAC Business – Chairs J. Mitchell, C. Jakob</b>		
17h00 – 17h15	a. Review of planned meetings/events – gaps, duplicates, requirements	
17h15 – 17h30	b. Next WMAC Meeting c. AOB	
17h30 – 18h00	d. Review of Draft actions list	
19h00	<i>Dinner</i>	
<b><u>Tuesday 28 May 2013</u></b>		
<b>6. WCRP Joint Scientific Committee 34<sup>th</sup> Session</b>		
16h30 – 17h15	a. Summary of WMAC2 meeting – WMAC Co-chairs J. Mitchell/C. Jakob	
17h15 – 18h00	b. Summary of WDAC2 meeting – WDAC Co-chairs O. Brown/T. Koike	

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## Annex C: Actions

	<b>Action</b>	<b>POC</b>	<b>Date</b>
1	Ask GEWEX to nominate someone to attend next WGSIP session	Aaron Boone/GEWEX	Done
2	JSC to endorse recommendation of WMAC on the CMIP6 Decadal Prediction effort led by WGSIP and WGCM	JSC34	Done
3	WDAC3 to address surface fluxes with inputs from reanalysis, GEWEX and SURFA and SOLAS communities	WDAC co-chairs	WDAC3
4	Draft letter of support to TOGA array	Simon Marsland/CLIVAR	Fall 2013
5	SPARC Gravity wave/momentum research effort to liaise with WGNE	Joan Alexander/SPARC	October 2013
6	CORDEX to clarify the 3 core elements of their experimental framework (ERA-Interim, reforecast, projections)	CORDEX	WMAC3
7	Implement a WMO Prize for significant achievement on model development focused on early career scientists with potential involvement of other societies	John Mitchell, Joan Alexander, Adam Scaife, Maria Silva Dias	Spring 2014
8	Implement Summer Schools focusing on model development	Christian Jakob, GASS, GLASS, WGOMD	2014
9	Organize a workshop on all aspects of model tuning, from process level to coupled systems	WGCM	2014
10	Organize a 'Dynamics-physics' meeting	Ted Shepherd/GC4 with GASS, SPARC and support of WMAC co-chairs	2014
11	Increase consistency of modeling experimental framework across WCRP (including WGIP and CORDEX)	Michel Rixen	WMAC3
12	Forward WMAC recommendation on ESGF structure	Michel Rixen, Christian Jakob	Winter 2013
13	Revisit the WMAC meeting structure with dedicated WMAC session on Monday AM	JSC, WMAC Co-chairs	JSC35

	and Wed PM, and joint session with JSC in between; WMAC reporting to JSC on Thur		
14	JSC to consider a WWRP representative on WMAC; JSC to consider a WGRC nomination on WMAC	JSC	JSC35