

IPCC AR5: Lessons Learnt for Climate Change Research and WCRP

International Space Sciences Institute, Bern, Switzerland

8–10 September 2014

SCIENTIFIC STEERING COMMITTEE WORKSHOP GUIDANCE DOCUMENT

1. Objectives of the Workshop

The workshop is aimed at informal exchanges and brain-storming between scientists involved in climate change research coordination and IPCC authors. Its main purpose is to take stock of key scientific issues identified through the IPCC assessment in WCRP's research plans. This has the potential to help IPCC in its own reflection on future activities.

IPCC Fifth Assessment Report (AR5) has identified a number of emerging themes and outstanding issues in climate change research, some of them outlined as key uncertainties by Working Group I (WGI) and "research and data gaps" by WGII. IPCC authors participating in the workshop will provide their views on debates held at IPCC on those issues. Additional input from the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) and WGIII report will also be considered, as well as new scientific material available since the AR5 cut-off dates. Contributions and discussions will focus on issues which are considered as essential for the progress of climate change research and on actions which may facilitate the evaluation of risks and impacts, and the development of adaptation strategies. The agenda is built around scientific themes and types of research activities which are needed for responding to outstanding questions. Outcomes are expected to benefit the planning of major WCRP projects, particularly the "Grand Science Challenges", defined as major areas where efforts in research, modelling, analysis and observations are needed. Among the aspects of WCRP research which should particularly benefit from the workshop are the planning of climate model intercomparison and evaluation activities, and the development of regional climate projections. It is also expected that the input from IPCC authors from the three working groups will allow help to highlight new orientations which may presently be missing in WCRP remit. In addition, the workshop will feed in the progress report being prepared by the Global Climate Observing System (GCOS). From IPCC viewpoint, it is expected that it will provide constructive comments and recommendations for the content of future assessments and that it will contribute to enhance the quality of research needed to answer the societal challenges addressed by IPCC.

2. Preparatory Scientific Activities

2.1 Scientific Steering Committee

The role of the Scientific Steering Committee (SSC) is to provide scientific guidance in the various stages of the workshop preparation including the invitations, the agenda and the survey, to coordinate the workshop scientific work, and to ensure that the workshop outcomes fulfill the objectives set by WCRP and IPCC.

Composition:

- Guy Brasseur (WCRP JSC member, SSC Co-Chair)
- Thomas Stocker (IPCC WGI Co-Chair, SSC Co-Chair)
- Sandrine Bony (WGCM Co-Chair)
- Anny Cazenave (WCRP JSC member)
- Vladimir Kattsov (WCRP JSC Vice-Chair)
- Katharine Mach (IPCC WGII, TSU Science Director)

- Gian-Kasper Plattner (IPCC WGI TSU Head)
- James Renwick (WCRP JSC member)

Support: Gilles Sommeria (WCRP consultant)

2.2 Survey

A survey has been conducted with IPCC authors, WCRP project leaders and participants. Its purpose was to review how IPCC assessment reports impact on the climate science community in general and WCRP in particular. The survey focused on research gaps, knowledge gaps, and uncertainties, on potential ways forward to make progress (in terms of observing systems, modelling, etc.), and on how all those components are covered in the current existing WCRP programme, including the WCRP Core Projects and Grand Challenges.

The starting point for the survey was the review of outstanding scientific issues identified by IPCC AR5 in WGI report and "research and data gaps" in WGII report, complemented as needed by material from SREX. Views were solicited on how these issues have evolved between AR4 and AR5, how they have been taken up in new studies since AR5 cut-off dates, and how they are dealt with in WCRP plans (through the Core Projects or the Grand Challenges). Suggestions on future IPCC/WCRP interface issues were also welcome as well as on any other aspect of climate research respondents wished to highlight.

The results of the survey will serve as input to the workshop discussions, be made available to WCRP as a resource when refining WCRP workplans and to IPCC to inform the on-going reflection on future IPCC assessments. A survey report is part of the workshop package, detailed answers are available at:

https://www.dropbox.com/sh/nky1yey0ww0rj3q/AAC3eI_2RmF0doTqrzAUf6b8a.

3. Keynote Presentations

Keynote presentations will be prepared by two authors and be presented by one of them. The presentations are expected to highlight research topics and issues that have been identified in the IPCC process and which fit or potentially fit in WCRP remit, with a long term perspective and updates from recent scientific work. They would ideally include specific recommendations on ways to address outstanding issues. Material from the presentations will be made available to SSC and Breakout Group (BOG) chairs, and early contacts of keynote speakers with appropriate BOG chairs are encouraged.

4. Breakout Groups

Breakout Groups (BOGs) 1 to 6 are defined along Grand Challenge objectives and are organised and lead by the coordinators of the WCRP Grand Challenges. BOGs 7 and 8 address issues which might be included in future WCRP activities. Each BOG will be co-led by a chair and one or two rapporteurs. The SSC, in collaboration with the BOG chairs will tentatively pre-assign participants to the 8 BOGs in order to ensure transition from the Plenaries into the BOGs during the meeting. Participants are free to move in and out of BOGs, but room size will limit participation in BOGs to some extent.

The object of BOGs is to come up with ideas that contribute towards addressing IPCC "Key Uncertainties" and WCRP Grand Challenges. Any other recommendations regarding IPCC, WCRP, GCOS, etc., will be welcomed.

All BOGs are expected to address (1) a few overarching (general) questions as well as (2) more specific questions specific to the focus of each BOG. The overarching questions are the following:

1. What are the major gaps in the domain covered by your BOG (revealed by the IPCC AR5 process) in our understanding of the climate system, and what are the best strategic approaches to address these scientific issues in the next 5–8 years?

2. How could the community focusing on the topics discussed by your BOG contribute to key scientific questions, uncertainties and research issues raised/identified by IPCC?
3. What are the inadequacies/requirements of the current/future observing system in relation with the objectives of your BOG? Similarly what are the main modelling or modelling infrastructure inadequacies/requirements in relation with the objectives of your BOG?
4. How could WCRP contribute efficiently to the preparation of the next IPCC assessments? Should WCRP produce some specific synthesis papers in preparation to these IPCC assessments and if so, on which topics?

Role of BOG Chair:

- be the main contact person for the SSC;
- guide and keep the discussions focused, avoid large distractions;
- address different views and maintain balance;
- steer the group towards a set of conclusions/key points (a bullet list), which will be presented to the Plenary;
- provide input to the workshop report and potentially to a scientific publication to come out of the workshop.

Role of BOG Rapporteur(s):

- take notes of the discussions;
- prepare with the BOG Chair the bullet list to be presented to the Plenary;
- prepare a 1–2 page summary of the discussions together with the BOG Chair;
- take part in the workshop report and publication.

During the workshop, members of the organising team will keep track of and collect products (notes, bullet lists, summaries) from all the BOG sessions and of Plenary discussion. Material will be distributed electronically to all meeting participants every day after the meeting adjourns. All meeting material will be made available to the SSC and participants within a few days after the meeting's end.

5. Definition and Composition of Individual Breakout Groups and Questions that will Help Guide the Discussions

BOG-1: Clouds, Circulation and Climate Sensitivity (*Chair Bjorn Stevens; Rapporteurs: Sandrine Bony and Ted Shepherd*)

1. The importance of climate sensitivity
2. Why understanding circulation is critical
3. How clouds mediate forcing
4. The role of cloud processes in natural variability
5. Linking tropospheric circulation to changing patterns of SSTs, land-surface properties, and the middle/upper atmosphere
6. How to reconcile bottom-up (or process-oriented) and top-down (or global) constraints on climate sensitivity
7. Extent and limits of our understanding of changes in large-scale precipitation patterns
8. The role of assessments within WCRP
9. How to focus and support model development
10. Directing ideas towards data
11. The importance of better integrating paleo-indicators into all of our work
12. The importance of hierarchies of models to develop robust understanding

BOG-2: Climate Extremes (*Chair: Xuebin Zhang; Rapporteurs: Rowan Sutton and Sun Ying*)

1. How can we improve the collation, dissemination and quality of observations needed to assess extremes and what new observations do we need?
2. Can models be further improved to better simulate, predict and project extremes?
3. What do we understand about the interactions between large-scale drivers and regional-scale land-surface feedbacks that affect extremes and how can these processes be improved in models?
4. To what extent can detected changes in extremes be attributed to forcing external to the climate system and/or to internal factors such as modes of variability?
5. What factors have contributed to the changes in probability of a particular observed event?
6. How has drought changed in the past and what were the causes, and how will it change in the future?
7. Are changes in the frequency and intensity of extremes predictable at seasonal to decadal scale and if so, how can we best realize that potential, and how can society best use such forecasts?
8. How will large-scale phenomena such as monsoons and modes of variability change in the future, and how will this affect extremes?

BOG-3: Regional Sea Level Rise (*Chair: Anny Cazenave; Rapporteurs: Catia Motta Domingues and Detlef Stammer*)

1. How reduce uncertainties on observations of sea level components (global & regional)?
2. Can the sea level closure budget approach help for estimating the deep ocean heat content? implication for Earth's energy imbalance.
3. How improve past sea level reconstructions and ocean reanalyses?
4. Detection/Attribution applied to regional sea level patterns
5. Need for an intercomparison project of all data sets used in sea level studies; Expand model-data intercomparisons (sea level & components)
6. How improve the ice sheet and land hydrology components of long-term sea level projections?
7. Importance of decadal & centennial regional sea level projections, accounting for all climate- & non climate-related processes; Downscaling to the coast.
8. Need for integrative studies of coastal impacts of sea level rise

BOG-4: Changes in Cryosphere (*Chair Vladimir Kattsov; Rapporteur: Gregory Flato*)

1. Better quantification of uncertainty in historical observations/reconstructions of cryosphere variability and change (needed both for model evaluation and detection and attribution studies).
2. Reduce uncertainty in contribution of ice sheets and mountain glaciers to future sea-level rise.
3. Improve modeling and reduce uncertainty in permafrost change and associated changes in carbon sources/sinks.
4. Conciliate modeling and observations of variations in Antarctic sea-ice extent.
5. Improve quantification of impacts of cryosphere changes on water availability.
6. Consequences and risks associated with declining sea-ice in the Arctic.

BOG-5: Regional Climate Information (*Chair Lisa Goddard /Rapporteurs: Francisco Doblas-Reyes, Clare Goodess and Bruce Hewitson*)

1. What gaps in our scientific understanding and information, if addressed, would maximise the value content of regional climate information at all time scales of interest to a wide range of stakeholders?
2. How can we define the best ways to post-process climate data to provide the targeted regional information required for IAV applications within the context of risk management? This implies that climate data is not climate information and includes how to best use information from ensembles of simulations to provide trustworthy uncertainty estimates.
3. How to best convey credibility and uncertainty in its multiple forms to users of regional climate information?

4. What new approaches are needed to understand the sources of uncertainty at the regional level as a function of methods, scales and processes? Is it possible to disaggregate the contribution from local, regional and remote processes, including the co-behaviour of processes?
5. Can we define the role(s) of high-quality regional observations, including historical and proxy observations?
6. How to draw on and bring added value to initiatives and work undertaken in other grand challenges without duplicating them?

BOG-6: Water Availability (*Chair: Sonia Seneviratne; Rapporteurs: Taikan Oki and Kevin Trenberth*)

1. How can we better understand and predict precipitation variability and changes, and how do changes in land surface and hydrology influence past and future changes in water availability and security?
2. How well can precipitation be described by various observing systems, and what basic measurement deficiencies and model assumptions determine the uncertainty estimates at various space and time scales?
3. How do changes in climate affect the characteristics (distribution, amount, intensity, frequency, duration, type) of precipitation – with particular emphasis on extremes of droughts and floods?
4. How do models become better and how much confidence do we have in global and regional climate predictions and projections of precipitation?
5. How do changes in the land surface and hydrology influence past and future changes in water availability and security?
6. How do changes in climate affect terrestrial ecosystems, hydrological processes, water resources and water quality, especially water temperature?
7. How can new observations lead to improvements in water management?
8. How can better climate models lead to improvements in water management?

BOG-7: Biogeochemical, Aerosols, Atmospheric Chemistry Aspects (*Chairs: Venkatachalam Ramaswamy and Sybil Seitzinger; Rapporteurs: Fortunat Joos and Drew Shindell*)

Biogeochemistry, including Atmospheric Chemistry: Issues post-CMIP5 (selecting a few “important” subjects).

For all the points below, key questions that arise are: how much of these processes are relevant for seasonal, decadal or centennial time scales, relevant for regional or global climate change/sensitivity, occurring on natural and/or anthropogenic forcing, what are the relevant metrics, what are the sources of uncertainties,.....

1. Strength of the feedbacks in the interactions between climate and the carbon and nitrogen cycles. These encompass land and ocean areas, including coastal zones.
 - On the Carbon side, the two main feedbacks at play are CO₂ concentration–carbon cycle and climate–carbon cycle. Both have large uncertainties and are poorly constrained by observations. Uncertainty is larger for land than for ocean carbon cycle.
 - On the role of Nitrogen: It regulates the carbon cycle (main limiting nutrient on land) hence controls the strength of the 2 feedbacks above. N₂O emissions are also directly dependent on nitrogen cycling (both on land and ocean). (Note: CMIP5 had only one N-enabled model).
2. Methane emissions and feedback with the climate system. Not covered in CMIP5. This would come from wetlands but potentially more important from permafrost. Methane hydrate from ocean shelves are not considered as yet in ESMs.
3. Chemistry-climate: Tropospheric and stratospheric ozone linkages with climate evolution, including interactions with atmospheric circulation. Ozone-methane connections, and regional air quality and climate.
4. Aerosol-climate: aerosol radiative interactions involving the different species especially black carbon. Emissions, transport and transformation. Influences on variables beyond surface temperature. Role of dust – how much of this is human-induced and how does it modify climate? Scenarios of space-time aerosol emissions beyond ~2000.

5. Aerosol-cloud-climate interactions: nature of changes in tropics, extratropics, and polar regions. Influences on circulation and precipitation. Fast feedbacks and cloud changes. Aerosol-induced feedback processes versus other cloud feedback processes.

BOG-8: Decadal Timescale Quantification: Attribution and Prediction (*Chair: Jochem Marotzke; Rapporteurs: George Boer and Peter Stott*)

1. Is it possible to attribute individual weather and climate events, including their impacts, and if so how?
2. Is it possible to reliably quantify the contributions of internal variability as well as external forcings to observed decadal scale climate variability at regional scales?
3. To what extent can the probability of extremes be linked to inter-decadal climate variability, including large scale modes of variability such as PDO, AMO, etc.?
4. Can we develop a seamless way of presenting observations, decadal predictions and multi-decadal projections and their uncertainties? [ref. to continuing difficulties with presenting projections in terms of earlier reference periods, see Note a to Table SPM.2 on page 23 of the AR5 SPM, and also difficulties in assessing future warming in 2016–2035 relative to 1986-2005, see the discussion at 11.3.6.3]
5. How do we verify initialised climate predictions and uninitialised climate projections? [ref. to the global warming hiatus and the issue of whether or not the CMIP5 models were inconsistent with the observed warming hiatus; e.g., Fyfe, Zwiers, Gillett concluded that recent observed global warming is significantly less than that simulated by climate models but Risbey et al concluded that climate models simulated the pause well when selected for ENSO phase]
6. Are changes in the frequency and intensity of extremes predictable at the decadal scale?

6. Expected Outcomes and Follow Up Activities

The workshop report will be prepared under SSC supervision with input from keynote speakers and taking into account the BOG reports prepared by the BOG Chairs/Rapporteurs. It will serve as input material for WCRP planning and IPCC reflection, and as a basis for a potential scientific publication. GCOS will make use some of the workshop output for its on-going progress report.