

# COMMUNICATING CLIMATE RESEARCH TO DECISION MAKERS

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CHRIS COCKRAM



**WCRP's research in advancing the frontiers of climate science has been a bedrock of credible information for the climate change science assessments of the IPCC.**

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*Prof. V. Ramaswamy, Vice-Chair WCRP Joint Scientific Committee, Reviewer and Contributing Author to TAR, Coordinating Lead Author to AR4*

The World Climate Research Programme, as the premier body for promoting, facilitating and coordinating international climate research, contributes to the Intergovernmental Panel on Climate Change. The Panel was established by the World Meteorological Organization and the United Nations Environment Programme (UNEP) to assess the scientific information related to anthropogenic climate change. WCRP interests in, for example, emissions of major greenhouse gases; the Earth's radiation balance; observation, detection and attribution of human-induced change; and future projections of climate change contribute to IPCC evaluations of the science and socio-economic consequences of climate change and aid its formulation of response strategies for the management of climate change. The IPCC mandate is to make policy-relevant assessments comprising carefully reviewed evidence and consensus on its interpretation. By virtue of their leading roles in international climate research, scientists associated with WCRP and the International Geosphere-Biosphere Programme have been at the forefront in providing the essential scientific bases for all four IPCC assessments.

A total of 127 scientists from 25 countries was involved in the writing and over 200 scientists peer reviewed the First Assessment Report (FAR), which was completed in 1990. Many of the contributing scientists were also engaged in the international climate research organized by WCRP through its core projects, working groups and panels. WCRP's coordinating efforts contributed to: reliable quantification of the radiative forcing due to carbon dioxide and feedbacks in the climate system, for example, water vapour; equilibrium climate response to carbon dioxide changes (with inputs from the WMO 1986 Assessment); and climate data sets, especially on clouds and land surface. FAR concluded that it was certain that "emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases" (notably carbon dioxide), with model simulations using emission scenarios projecting warming into the future. WCRP's significance to FAR lay in the identification of key scientific uncertainties: the control of greenhouse gases by the Earth's systems; cloud radiative processes, precipitation and evaporation; ocean transport and storage of heat; and ecosystem processes. At the end of FAR, it became clear that, while IPCC would continue to have responsibility for



**WCRP serves an irreplaceable role for coordination within the science community, which in turn is invaluable to the IPCC.**

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*Dr S. Solomon, Co-Chair IPCC Working Group (WG) I AR4, past Member WCRP Joint Scientific Committee, Contributing IPCC Author*



**WCRP organized the largest international coordinated climate change modelling experiment and model analysis effort ever attempted, and this was crucial in the IPCC Fourth Assessment Report for quantifying future climate change in ways never before possible.**

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*Dr G. Meehl, Co-Chair WCRP Working Group on Coupled Modelling, Contributing IPCC Author, Coordinating Lead Author to AR4*

assessing the current state of scientific knowledge of climate and climatic changes resulting from human influences, WCRP, with its emphasis on the physical climate, would lead scientific research on physical climate processes and develop the capability for predicting climate variations, while the newly formed IGBP would emphasize the biogeochemistry-climate linkages. FAR was the first internationally achieved compendium communicating state-of-the-art climate research advances relevant to decision making.

### **Evidence for Discernible Human Influence on Global Climate**

In the IPCC Second Assessment Report (SAR) issued in 1995, WCRP contributions again included observational data sets and metrics from model intercomparison projects. A major accomplishment was that the results from the Atmospheric Model Intercomparison Project (AMIP) enabled a detailed assessment of the model-simulated climate variables. Data sets on clouds and land surface proved

useful in the verification and calibration of climate models.

SAR demonstrated significant advances relative to FAR, with atmospheric models portraying reasonably well the seasonal march of the distribution of temperature, pressure, circulation and the response to large-scale sea-surface temperature patterns. However, uncertainties existed in cloud simulations and the land-surface component. Also, ocean and sea-ice models agreed with the observed large-scale distribution of temperature, salinity and sea ice but there were obvious limitations owing to the coarseness of the spatial scales. Overall, through model intercomparisons, SAR characterized the advances by stating that “current models are able to simulate many aspects of the observed climate with a useful level of skill”, and “model simulations are more accurate at large (for example, hemispheric or continental) space scales; at regional scales, the skill is lower”. The SAR conclusions reflected both the state of confidence and limitations concerning climate models.



**WCRP research programmes have provided invaluable input to all the IPCC Assessments. IPCC Assessments in turn have provided essential guidance and inspiration for the development of WCRP programmes.**

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*Sir John Houghton, Co-Chair IPCC WG I Assessments FAR, SAR and TAR, past Chair WCRP Joint Scientific Committee*



**WCRP must continue to identify and pursue new areas of science that will be central to future IPCC Assessments as well as continue research to narrow uncertainties revealed in IPCC Assessments.**

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*Dr J. Church, Chair WCRP Joint Scientific Committee, Reviewer and Contributing IPCC Author*

A highlight of SAR was the conclusion that the “balance of evidence suggests a discernible human influence on global climate”. The paper providing the basis for this key finding received the 1998 International Norbert Gerbier-Mumm Award and included several WCRP-associated scientists. Facilitation of international research activities by WCRP and IGBP, too large in human, technical and financial requirements to be performed by a single nation, and the delivery of standardized methods and model intercomparison results, grew visibly in the SAR. The value of international coordination of observing and monitoring important climate variables (with the Global Climate Observing System, GCOS), in providing more than the sum of the individual nations’ contributions, was considered a critical part of the assessment process.

### **Breakthroughs in Coupled Ocean-Atmosphere Modelling**

The various WCRP model intercomparison projects matured further by the IPCC Third Assessment Report (TAR), with many more climate model runs and increased sophistication of analyses both of inter-model and

model-observation comparisons. The WCRP core project on Climate Variability and Predictability and its Working Group on Coupled Modelling (WGCM) co-organized the Coupled Model Intercomparison Project (CMIP), which led to the: evaluation of atmosphere–ocean general circulation models; model runs for an assumed 1% per year steady increase in carbon dioxide enabling comparison of the models’ climate sensitivities; and intercomparison of models running the newly formulated IPCC emissions scenarios to make future climate projections. WCRP-coordinated observational products, such as the satellite-related cloud data generated through the Global Energy and Water cycle EXperiment (GEWEX), were widely used in assessing the models’ simulations.

The Third Assessment Report, issued in 2001, received significant inputs from the WMO/UNEP Assessment on Ozone Depletion (1999) and the WCRP project on Stratospheric Processes And their Role in Climate (SPARC). SPARC led the initiative on the attribution of the observed stratospheric cooling trends to ozone depletion and long-lived greenhouse gas increases (recognized by the 2003 International Norbert Gerbier-Mumm Award) and on radiative forcings originating from the stratosphere, used in some TAR simulations.



**WCRP is becoming the think-tank for the IPCC process, and IPCC the sole agency for an authentic voice.**

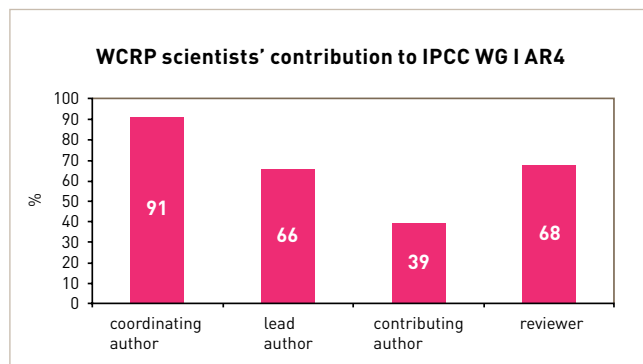
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*Dr G.B. Pant, past Member WCRP Joint Scientific Committee, Reviewer to AR4*

The hallmarks of the TAR were the far-reaching conclusions: “an increasing body of observations gives a collective picture of a warming world”; “emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate”; “natural factors have made small contributions to radiative forcing over the past century”; and “there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities”.

### Largest Ever Global Warming Database for Climate Projections

The Fourth IPCC Assessment Report, *Climate Change 2007: The Physical Science Basis*, was published in February 2007. Perhaps the most notable milestone in the annals of climate model results’ collection and analyses has been the creation of the archive of AR4 simulations of the climate from pre-industrial times to 2100, performed as an outcome of WCRP activities. This archive, managed by the Program for Climate Model



*Almost half of the contributors to IPCC AR4 are WCRP-associated scientists.*



**WCRP activities have been particularly important to IPCC in addressing the issue of detection and attribution of climate change, and the evaluation and projection of global and regional climate changes.**

*Dr Y. Ding, past Officer WCRP Joint Scientific Committee, Co-Chair IPCC WG I Technical Summary TAR, Lead Author to TAR and AR4*

Diagnosis and Intercomparison under the generous auspices of the US Department of Energy’s Office of Science, is open to all researchers around the world. The number of CMIP3-derived papers to date, several of which formed the core conclusions of AR4, is astonishing.

A second very important feature of AR4 was the sheer number of WCRP scientists involved as coordinating, lead and contributing authors and reviewers of the various chapters in the Working Group I report. Almost half of the contributors are WCRP-associated scientists, as also are over 90% of the coordinating authors and some 70% of the reviewers. The majority of researchers within the contributing global WCRP community were climate modellers, diagnosticians and cryospheric scientists.<sup>1</sup> In contrast to earlier IPCC Working Group I reports,

<sup>1</sup> For statistical purposes, we considered those climate researchers as WCRP-associated that are or were (at some stage of their career and the existence of the WCRP) active in any of the WCRP working groups, panels, core projects or cross-cutting activities, or otherwise involved in WCRP activities, or WCRP-sponsored participants at workshops/seminars/conferences.

AR4 provides much more uniform and consistent applications of the phrasings of uncertainties across all chapters.

WCRP activities contributed significantly to the scientific basis for the landmark findings in the AR4, each one of which represents a major advance in knowledge: observed “warming of the climate system is unequivocal”; “there is a very high confidence that the globally-averaged net effect of human activities since 1750 has been one of warming”; “most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increases in greenhouse gas concentrations”; improved quantification of and confidence in the Earth’s climate sensitivity provides “increased confidence in the understanding of the climate system response to radiative forcing”; model projections of future climate change indicate that “continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century”; and there is now



**WCRP and IPCC have discussed together the policy-relevant science that is needed and possible and then worked together to see that it is undertaken in a timely and scientifically effective way.**

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*Prof. G. McBean, past Chair  
WCRP Joint Scientific Committee,  
Contributing IPCC Author*



**WCRP played a vital role for the IPCC AR4 assessment in detailing the important role of patterns and modes of behaviour in the climate system that are vital for understanding regional climate variability and change.**

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*Dr K. Trenberth, past Officer WCRP  
Joint Scientific Committee, Reviewer  
and IPCC Author, Coordinating Lead  
Author to AR4*

“higher confidence in projected patterns of warming and other regional-scale features”.

The AR4 demonstrates how climate research has grown and matured. For example, the joint IGBP-WCRP Coupled Carbon Cycle Climate Model Intercomparison Project (C4MIP) experiment was the source of the very worrying positive carbon feedback with global warming. Scientific rigour, to which WCRP has contributed measurably, has steadily increased our understanding of climate change and anthropogenic influences on climate to higher planes of confidence.

### **Unravelling the Complexity of Climate Change in the Twenty-First Century and Beyond**

Following upon the remarkable successes delivered by the world’s climate science community in the AR4, WCRP and IGBP are pursuing newer pathways to consolidate and achieve even greater advances in future assessments. WCRP, IGBP and GCOS plan to grasp the lessons learned from AR4, identify the gaps and tackle the remaining uncertainties, thus further



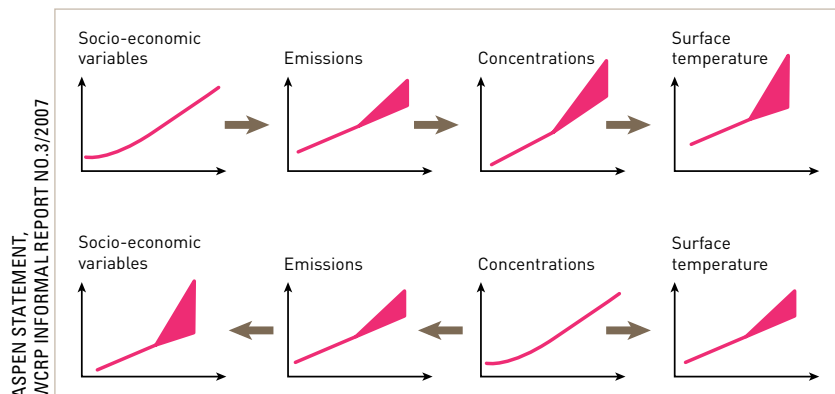
**WCRP and IPCC have a highly symbiotic relationship. The programmes of WCRP provide a lot of the underpinning science on which IPCC assessments are based and in turn the resulting gaps in knowledge identified by IPCC then form the basis of future WCRP research.**

*Dr D. Griggs, Officer WCRP Joint Scientific Committee, Head Technical Support Unit, Reviewer and Lead Author to TAR, Reviewer to AR4*

WCRP is focused now on synthesizing its science for applications relevant to society (for example, extremes, regional climate change) and to deliver the outcomes to bodies like the IPCC, United Nations Framework Convention on Climate Change, policymakers and other societal sectors. Many of the activities are with international partners such as IGBP and the Earth System Science Partnership, and with stronger linkages to national scientific research organizations and governments (through National Hydrological and Meteorological Services). WCRP's cross-cutting activities relevant to anthropogenic climate change include:

- Improved quantification of the climate forcing exerted by various chemical species (including pollutants) (jointly with IGBP);
- Transient climate change and evolution of mean climate through improved global-scale modelling with higher spatial resolution;

advancing climate change science. An important step in this regard has been the initiation of cross-cutting activities in WCRP, based on the fundamental science done by all projects, working groups and panels.



ASPEN STATEMENT,  
WCRP INFORMAL REPORT NO. 3/2007

*Schematic of traditional forward approach (top panel) beginning with socio-economic variables to derive emissions, concentrations and then temperature and other climate changes from climate models, and newly proposed methodology where the starting point is concentrations run in climate models, which are used to derive emissions and then socio-economic factors to achieve those emissions (bottom panel).*

- Better integration of biogeochemical and physical climate systems (with IGBP);
- Climate impacts on glaciers, ice sheets and sea-level rise;
- Decadal predictability;
- Quantifying regional climate change with more accurate and reliable techniques so that the impacts can be understood on the scales of interest to society and adaptation pursued;
- Quantifying extremes such as heat waves, intense precipitation and tropical cyclones;
- Understanding monsoon variability, predictability and trends.

A framework presenting a unified picture of the future emission scenarios across the IPCC Working Groups I, II and III and thus the entire climate community has been defined in the 'Aspen Statement' (WCRP Informal Report No. 3/2007) facilitated by the modelling groups of WCRP and IGBP. Among the important recommendations is the need to have an integrated effort to produce past-to-future emissions of aerosols and ozone precursors that would ensure the use of consistent and documented data relevant to communities working on climate, carbon, aerosols and chemistry. WCRP has also recognized the need for regionalization of future climate

prediction utilizing the concept of seamless prediction that spans all space and time scales feeding into the Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change. An important part of future developments is the need to invest in capacity building around the globe to develop personnel skilled in climate science and its applications, for example, as in the partnership between WCRP and the International Centre for Theoretical Physics.

With the emergence of human-induced climate change as one of the most important scientific problems confronting society, and with the increasing requirement of reliable predictions of climate over a vast range (from global to regional spatial scales and from daily to decadal time scales and beyond), the leadership role of WCRP (and other international research bodies) and the responsibility of delivering robust information about climate has increased multi-fold. One challenge for the future is to continuously advance the frontiers of global climate sciences. A second challenge, of increasing importance, is to channel the scientific output into substantive, relevant information for society as it seeks to learn about the impacts of climate variations and change and calls for answers concerning climate mitigation and adaptation.