

World Climate Research Programme

(Report prepared with help of Michael McCracken)

Outlook

The World Climate Research Programme (WCRP) had another successful year in supporting the global coordination and integration of climate research, modelling and prediction activities. These coordination and integration activities were carried out through sponsoring over 20 conferences, workshops, meetings and symposia focused on all aspects of Earth's climate system (i.e. oceans, atmosphere, cryosphere and land-surface), with a major emphasis on: 1) seasonal to interannual climate prediction/projection; 2) regional forecasts and their application in climate change adaptation, mitigation and risk and vulnerability assessments; 3) coupled climate system models that represent interactions among the physical, chemical and biological aspects of the climate system; 4) regional capacity building and use of model results for resources management and decision making; and 5) new climate scenarios for future climate change and variability assessments, such as future IPCC and ozone assessments.

WCRP also made great strides in transferring the scientific information and knowledge about the Earth's climate system for policy decisions through the IPCC, the UNFCCC Conference of Parties and its Subsidiary Body on Scientific and Technological Advice (SBSTA). More than one-half of the scientific and technical contributions used in the IPCC assessments were provided by WCRP affiliated scientists. WCRP made a concerted effort to provide world-wide access to its model predictions/projections and research results for use by developing and least developed nations' scientists to assess the potential consequences of climate variability and change on major economic sectors (e.g. food, water, energy, health, etc.), for their country or geographic regions.

This was also a productive year in developing and publishing a variety of peer reviewed scientific and technical papers on research findings, climate model predictions/projections, scientific and technical assessment reports on climate data records, ocean atlases resulting from the legacy projects such as the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean and Global Atmosphere (TOGA) project, and regular newsletters published by WCRP projects and the secretariat. These were all in support of WCRP's commitment to communication and outreach to its present and future constituencies and in the spirit of the "science-servicing-society" mission of its sponsoring agencies.

WCRP continued to build on its existing partnerships with other international research programmes such as the International Geosphere-Biosphere Programme (IGBP) in biogeochemical aspects, the International Human Dimensions Programme (IHDP) on social and human dimensions of climate change research, and with START and regional organizations such as the Asian-Pacific Network (APN) and the Inter-American Institute (IAI) on capacity building, education and outreach.

WCRP Ocean and Climate research

In collaboration with other organizations, CLIVAR provides the focus within WCRP for understanding the role of the ocean in climate, develops observing systems, promotes reanalysis of existing ocean data, and develops ocean modules of global climate models. CliC contributes to these activities on cryospheric and polar aspects and GEWEX and SOLAS in the areas of surface flux and the global hydrological cycle research. As a co-sponsor of the Ocean Observations Panel for Climate (OOPC), WCRP strives to ensure high-quality and long-lived ocean observations for climate research and prediction.

Examples of WCRP recent accomplishments related to ocean research:

- Collaborative intercomparison and assessment of global ocean synthesis products aimed at determining their quality and potential for ocean initialization in climate prediction.
- Ongoing implementation of an integrated Indian Ocean Observing System in collaboration with IOC and Indian Ocean GOOS.
- Facilitating a Tropical Atlantic Climate Experiment (2006-2011) to improve regional climate prediction.
- Supporting and coordination of programmes to monitor the Meridional Overturning Circulation (MOC) in the Atlantic.

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- Input to design the Arctic and Southern Ocean Observing Systems, in collaboration with several partners.
- Coordination of key international climate process studies in the Pacific.
- Developing the tropical moored buoy arrays to provide key observations for seasonal predictions.
- Design of Coordinated Ocean-ice Reference Experiments.
- Assisting the Intergovernmental Oceanographic Commission (IOC) of UNESCO to provide guidelines for the future global deep ocean hydrography and carbon network.

29th session of the WCRP Joint Scientific Committee (JSC, Arcachon, France, 31 March – 4 April 2008)

The Joint Scientific Committee (JSC) for WCRP gathered in France this year to discuss past progress and future direction for WCRP and its projects. The Committee decided to concentrate its discussion on two time horizons of intermediate (2008-2013) and long (post-2013) terms. The focus of intermediate time frame is in line with the WCRP Strategic Framework 2005-2015 and is implemented through WCRP activities and core projects (GEWEX, CLIVAR, SPARC, and CliC). For the post-2013 time frame, the Committee is planning to develop a new WCRP structure supporting a more effective interfacing with the users of climate informational products.

At the JSC meeting, Prof. Antonio J. Busalacchi from the Earth System Science Interdisciplinary Center, ESSIC, University of Maryland, USA, was elected the new Chair of the WCRP JSC. Dr David Griggs from the Monash University, Clayton, Australia, is the new JSC Vice-Chair. The JSC Session marked the first week in office for the new Director of WCRP, Dr Ghassem Asrar.

Paving the way for future climate research

WCRP, in conjunction with the IGBP and the Global Climate Observing System (GCOS) organized a major workshop in October 2007 to use the findings of the IPCC Fourth Assessment Report in helping to guide future strategies for climate change observations, research and assessment. This Sydney Workshop looked specifically at the most critical gaps in basic science and at deficiencies in the information about climate change used for the estimation of impacts, design of adaptation measures, and assessment of vulnerability, particularly on a regional scale. For example, Workshop identified two priority items, which currently limit our confidence in projections of climate change. They are our poor understanding of ice sheet behaviour and its implications for sea-level rise, and gaps in knowledge about the hydrological and carbon cycles. The workshop also made suggestions on the research necessary to improve performance of regional climate change models. Workshop participants developed a risk management framework to better link science questions with societal concerns in various regions and various sectors.

WCRP in cooperation with IGBP is developing a strategy for using climate system models for the next IPCC assessment. The next generation climate change stabilization experiments are outlined in the 'Aspen White Paper' (WCRP Informal Report No. 3/2007).

World Modelling Summit for Climate Prediction (Reading, UK, 6-9 May 2008)

The world's leading climate researchers from within WCRP, IGBP, and the World Weather Research Programme discussed progress in state-of-the-art climate modelling capabilities and laid plans for the future. Current generation climate models have serious limitations in simulating regional features such as rainfall, mid-latitude storms, and ecosystem dynamics. At the Summit, the modelling community agreed that these limitations are mainly due to our inability for representing properly these features in the climate models, and having powerful enough computers to simulate years of Earth's climate in days of computer time.

The Summit statement reports on the potential for progress that could be made and called for creation of The Climate Prediction Project, which would include formation of a coordinated international modelling program. As the effort will involve ocean modelling, a copy of the Summit Statement is attached as Annex to this Report.

Advances in seasonal to decadal prediction

With the successful development of Argo and other observational techniques, WCRP works towards engaging the predictive potential of the ocean in the tasks of extending the predictive skill of seasonal forecasting systems and determining climate predictability at decadal time scales, which requires a breakthrough in our quantitative understanding of decadal modes of atmospheric circulation.

In June 2007, the First WCRP Seasonal Prediction Workshop was held in Barcelona, Spain, bringing together climate researchers, forecast providers and application experts to address the current status of seasonal forecasting and the application of seasonal forecasts by users. As an important outcome, workshop participants developed a guideline document outlining recommendations and best practices in the science of seasonal.

During the Workshop, the WCRP Climate-system Historical Forecast Project (CHFP) was launched. This project is a multi-model, multi-institutional experimental framework for the assessment of state-of-the-science seasonal forecast systems, and to evaluate the potential for untapped predictability due to interactions between the components of the climate system that are currently not fully accounted for in seasonal forecasts. Main thrusts in these experiments are to improve account of ocean data in the predictions and generate the predictions using ensembles of coupled global climate models with well-resolved ocean.

In 2007, a new cross-cutting WCRP initiative was endorsed to advance the science of decadal prediction. Using state-of-the-science coupled models, a first series of experiments focusses on short-term climate prediction for the next 30 years. Early results point towards the possibility of routine decadal climate predictions using a method that considers both internal natural climate variations and projected future anthropogenic forcing. Evidence for the existence of decadal predictability has arisen from research on the El Niño phenomenon and other global-scale oscillation systems including hurricane activity, surface-temperature and rainfall variations. Perspectives of the decadal predictability research are intimately linked with assimilation of oceanographic observations.

Sea-level rise

Another WCRP research focus of immediate importance, especially to coastal communities and human properties is to determine sea-level variability and change. Over the past decade, global mean sea level has been observed by both tide gauges and satellite altimeters to have risen at a rate of just above 3 mm per year, compared to a rate of less than 2 mm per year from tide gauges over the past half century. However, the extent to which this increase reflects natural variability versus anthropogenic climate change is unknown. The Sea-level Task Team was established by the WCRP to focus on this research issue, and to provide a periodic assessment of the best available state-of-the-science knowledge for decision makers.

Challenges of observation, data collection, assimilation and reanalyses

High quality observations are required for (1) monitoring the climate system; (2) detecting and attributing climate change; (3) assessing the impacts of climate variability and change; and (4) supporting research toward improved understanding, modelling and predicting of the climate system. The WCRP research mandate emphasizes the importance of taking observations of highest quality in time and across space scales with the attendant continuity, and of generating climate data records through reprocessing. Improved observational data sets also form the basis for reanalyses to obtain homogeneous data sets from historical climate records for climate change detection and attribution studies, 'climate now-casting' and other applications.

Through two panels, the Atmospheric Observation Panel for Climate (AOPC) and the Ocean Observations Panel for Climate (OOPC), WCRP advises the observation operators on data needs for climate change detection, attribution, and prediction. Technological solutions, proposed by WCRP in its earlier scientific experiments, like TOGA and WOCE, now form the foundation of operational observing systems.

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Climate records often show biases that mask long-term variations in the climate system. The technique of reanalysis, the reprocessing of all available historical data, both in situ and satellite observations, produces a coherent description of the changing states of the atmosphere, ocean or other components of the climate system leading to a coherent description of the Earth's climate system. Originally, only atmospheric reanalyses had been developed but the method is advancing so rapidly that it is now being used for oceans and sea-ice observations. Products of global reanalysis have provided the basis for advances in many areas, including climate now-casting and diagnostic studies of complex systems such as monsoons or the El Niño-Southern Oscillation. Global reanalysis is also the foundation for regional reanalysis projects and downscaling to study local climate and climate impacts. In addition, the development of comprehensive Earth system models requires to expand the scope of reanalysis and conduct coupled atmosphere-ocean data assimilation. As the science of reanalysis grows, there is an urgent need to align financial and infrastructural resources for data handling and processing and to foster sustained international cooperation. Advances and challenges in this rapidly evolving field were discussed at the Third WCRP International Conference on Reanalysis held on 28 January to 1 February 2008 in Tokyo, Japan.

Building capacity and supporting adaptation planning

One of WCRP's major concerns is to make the climate informational products useful and easily accessible to the broad science community and to society as a whole. However, many of the tools and data sets need first skilful interpreters. WCRP is pursuing a multi-pronged approach to building capacity with its partners. Major thrusts are:

- Training young scientist and scientists in the developing world to become full partners in the climate research enterprise;
- Training climate practitioners to be able to better analyze and interpret climate information products for adaptation planning and risk reduction;
- Developing a dialogue with decision makers, politicians and the development community to find common language and understanding of the latest climate research findings;
- Providing opportunities for young scientists to develop an Earth system science approach to climate research in the future.

Recognizing that response to climate change requires the capability to assess and properly interpret research findings and to apply them to national planning initiatives, WCRP and the International Centre for Theoretical Physics (ICTP) began the process of capacity building in developing and least developed countries. The recent training seminar focussed on analyzing and interpreting the international ensemble of climate simulations for the 20th and 21st centuries completed as part of the Third WCRP Coupled Model Intercomparison Project CMIP3 and containing simulations undertaken in support of the IPCC Fourth Assessment Report. The 30 participants from developing nations worked on their own projects utilizing the WCRP CMIP3 archive in a way that is relevant and helpful to their home nation or organization. Above all, the young talents learnt to understand the uncertainties associated with RCM-based regional climate change projections.

WCRP is increasingly interfacing directly with the users of climate prediction tools to better respond the users' needs. WCRP's preferred approach is to work with its partners from around the world, including START (the System for Analysis, Research and Training), IAI (the Inter-American Institute for Global Change Research), APN (the Asian Pacific Network) and the WMO/CLIPS project. A most successful example is the START, WMO/CLIPS and WCRP 'train-the-trainers' workshop held in Dar es Salaam, United Republic of Tanzania, in July 2006, which was designed to transfer the necessary knowledge and understanding of seasonal prediction methods so that the region can be self-sufficient in teaching climate forecasters.

WCRP together with the IGBP project IMBER held a first-of-its-kind ClimEco Training Seminar for Young Marine Scientists in Brest, France, April 2008. Participants in it learned about the interactions between physical climate, marine biogeochemistry and ecosystems. The workshop helped to to entrain young scientists across disciplines in Earth system research.

Ocean-related Activities by WCRP Projects: CLIVAR

The WCRP core project on Climate Variability and Predictability (CLIVAR) is the main focus in WCRP for studies of climate variability. Its mission is to observe, simulate and predict the Earth's climate system, with a focus on ocean-atmosphere interactions enabling better understanding of climate variability, predictability and change to the benefit of society and the environment in which we live.

Examples of CLIVAR recent accomplishments related to oceans:

- Coordination of climate model scenario experiments for IPCC. Key inputs on changes in climate extremes to IPCC AR4.
- Model intercomparison activities aimed at improving seasonal predictions and ocean model performance.
- Coordination of field studies to help improve parameterization schemes for atmosphere and ocean climate models and their interactions.
- Synthesis of ocean data and information.
- Advocacy for real time data and high quality delayed mode observational data for operations and research.
- Development of an electronic African Climate Atlas, a tool for research on African climate.
- Organizing and sponsoring training workshops on seasonal prediction in Africa, climate impacts on ocean ecosystems, climate data and extremes and ENSO.

Ocean-related Activities by WCRP Projects: CliC

The mission of the WCRP/SCAR/IASC Climate and Cryosphere (CliC) project is to understand and represent in models the role of the cryosphere in Earth's climate system and to assess and quantify the impacts that climate variability and change have on components of the cryosphere and its overall stability, and the consequences of these impacts for the climate system.

Examples of CliC accomplishments related to oceans:

- Developing the IGOS Theme on Cryosphere (IGOS-Cryo) in partnership with SCAR, and achieving the broad consensus on the planned development of cryospheric observations for years to come. In May 2007, the 15th WMO Congress approved Canada's proposal to create a Global Cryospheric Watch based on the IGOS-Cryo recommendations. These activities will lead to better observations of marine cryosphere including all forms of sea ice and ice shelves.
- Coordinating strong input from the climate research community to the scientific programme of IPY 2007-2008. This included a concept of polar satellite snapshot aimed at obtaining unprecedented coverage of both polar regions including Arctic and Southern Ocean with observations from space.
- Drawing the attention of the world's scientific community to the role of the cryosphere in the climate system, such as developing a chapter on Snow, Ice and Frozen Ground for the IPCC Assessment Report 4 (2007). The report highlights the contribution of melted water to recent sea-level change.

Ocean-related Activities by WCRP Projects: SOLAS

The WCRP cosponsors SOLAS with three partners including SCOR, and a report of this very dynamic and successful project will be presented to SCOR outside of this WCRP Report.

WCRP activities during the International Polar Year (IPY) 2007-2008

The main goals of WCRP in IPY are to address existing gaps in the knowledge of polar processes, develop understanding of the role of polar regions in Earth's climate system and an ability to better predict global climate. Many of the IPY project leaders and participants are members of WCRP projects and groups.

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WCRP contributions to IPY scientific achievements related to oceans:

- Establishing a basis for an Arctic Ocean Observing System and sustaining Arctic observing networks.
- Establishing an Arctic hydrological cycle observing system to advance polar hydrology and enable global studies of ocean freshwater balance.
- Promoting a sustained survey of the Southern Ocean forming the foundation of the Southern Ocean Observing System.
- Coordinating for the first time a satellite snapshot of the polar regions by major space agencies, especially with the Synthetic Aperture Radars.
- Initiating a bi-polar coordinated permafrost monitoring system.
- Obtaining a record-long ice-core based climate history reconstruction (Chinese contribution).
- Strengthening interoperable data exchange and information archival.
- Building capacity for generation and use of climate information products and services in Polar Regions in cooperation with the WMO project on Climate Information and Prediction Services (CLIPS).
- Reconstructing snapshots of the polar cryosphere and polar oceans, atmosphere, including stratosphere and mesosphere, as a benchmark for an integrated 'atmosphere-cryosphere-ocean' study.

Major ocean-related meetings organised with Partners: International Symposium “Effects of Climate Change on the World's Oceans” (Gijón, Spain, 19-23 May 2008)

Together with SCOR and GLOBEC WCRP was a co-sponsor of the recent 'Gijón Symposium', organised by IOC, PICES, and ICES. More than 300 scientists from 48 nations gathered in Gijón to review the state of research and knowledge in the full spectrum of ocean topics. Three top priorities were identified which require urgent attention. Firstly, a greater engagement by marine scientists is needed to address climate change issues including climate variability and change and their impact on ecosystem structure, biodiversity, fisheries, and species' and society's adaptation to these changes. Secondly, it is essential to sustain the global scale observing system already implemented, to compile available data into quality controlled and easily accessible data bases, and to agree and implement a plan to expand the system beyond its present physical and biochemical variables. Thirdly, a critical need for sustained funding to support sustained observations was identified.

Major ocean-related meetings organised with Partners: Met-Ocean Committee of the International Association of Oil and Gas Producers (OGP), the JCOMM and WCRP Workshop on Climate Change and the Offshore Industry (Geneva, Switzerland, 27-29 May 2008)

The very successful workshop, attended by approximately 60 participants, opened the dialogue on climate change between specialists from oil companies and environmental research organizations. The following areas for future research towards the adaptation of the offshore industry services to climate change were identified: understanding of the performance of climate models at various resolutions, time scales and in various regions; advanced regional downscaling methodologies; standards for (meta-)data; non-stationary extreme value analysis techniques for key metocean parameters such as wind speeds, wave heights, sea-level, sea-ice coverage, and explicit inclusion of uncertainty in extreme value analyses.

El Niño-Southern Oscillation (ENSO): Dynamics and Predictability (Puna, Big Island, Hawaii, USA, 14-24 June 2008)

Sixteen graduate students in oceanography, meteorology and geology from 12 countries gathered at the jointly organized WCRP/CLIVAR – IGBP/PAGES summer school to learn from lecturers on a broad swath of ENSO-related topics: ENSO theory, phenomenology, predictability and its sensitivity to past and future climate change. The students worked on their own research projects and in teams, studying the effects of ENSO on the Antarctic Peninsula, the rapid end of the 2008 La Niña event, the geographical reaches of a tropical drought some 4,200 years ago, and many other themes.

Some relevant major reports and assessments

- Future Climate Change Research and Observations: GCOS, WCRP and IGBP learning from the IPCC Fourth Assessment Report. January 2008, Series Report WCRP-127, WMO/TD-No. 1418.
- Integrated Global Observing Strategy. IGOS Cryosphere Theme Report: For the Monitoring of our Environment from Space and from Earth. August 2007, WMO/TD-No. 1405.
- WCRP Position Paper on Seasonal Prediction. Report from the First WCRP Seasonal Prediction Workshop, Barcelona, Spain, 4-7 June 2007. WCRP Informal Report 3/2008.
- A strategy for climate change stabilization experiments with AOGCMs and ESMs, Aspen, Colorado, 30 July – 5 August 2006. White paper from the Aspen Meeting on Earth System Modelling. WCRP Informal Report 3/2007.
- The BACC Author Team: Assessment of Climate Change for the Baltic Sea Basin. 2008, 474 pp., Publisher Springer, ISBN: 978-3-540-72785-9.
- WCRP Annual Report 2006-2007: Providing the Science for Climate Change Solutions. WMO/TD-No. 1404.

Other relevant research products

- African Climate Atlas, Part V on the WCRP CMIP3 Multi-Model Data Module (2007), published by the Variability of the African Climate System (VACS) programme of WCRP's project CLIVAR.
- World Ocean Circulation Experiment WOCE (2007): Pacific Ocean Hydrographic Atlas. Compiled by L.D. Talley.