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REPORT OF THE EIGHTH SESSION OF THE JSC/CLIVAR

WORKING GROUP ON COUPLED MODELLING

**(Frontier Research Centre for Global Change, Yokohama, Japan
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APPENDICES

The eighth session of the JSC/CLIVAR Working Group on Coupled Modelling (WGCM), held jointly with a WGCM/GAIM session was kindly hosted by the Japan Meteorological Agency (JMA) and the Frontier Research Centre for Global Change (FRCGC) at Yokohama, Japan, 25-27 October 2004. The session was opened at 0900 hours on 25 October by the Chairman of WGCM, Prof. J. Mitchell. The list of participants is given in the Appendix A to this report.

The participants were welcomed by the Chairman of WGCM, Prof. J. Mitchell, Dr A. Noda (Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan, and local host), and Dr V. Satyan (Joint Planning Staff, WCRP, Geneva).

On behalf of all participants, Prof. J. Mitchell expressed gratitude to Dr A. Noda for hosting the eighth session of WGCM and the excellent arrangements made. He voiced his appreciation to Dr A. Noda, ably assisted by staff, FRCGC, for the efforts and time they had put into the organization of the session. The Chairman looked forward to the joint WGCM/GAIM session scheduled for the afternoon of 27 October and also to the International Workshop at FRCGC on Climate Change Research during 28-29 October 2004. The Chairman expressed gratitude to Prof. T. Matsuno, Director-General, FRCGC, for inviting the WGCM to the Workshop.

1. REVIEW OF RELEVANT EVENTS IN THE WCRP AND DEVELOPMENTS IN MODELLING-RELATED ACTIVITIES

WGCM endeavours to maintain a broad overview of modelling activities in the WCRP in its basic task of building up comprehensive climate models. WGCM was informed of the main discussions at and recommendations from the twenty-fifth session of the Joint Scientific Committee (JSC) for the WCRP (March 2004), and the thirteenth session of the CLIVAR Scientific Steering Group (June 2004). In addition, updates of the recent developments within the WGCM/CLIVAR Working Group on Ocean Model Development (WGOMD), the JSC/CAS Working Group on Numerical Experimentation (WGNE) AMIP Panel and the modelling activities within CliC were provided.

1.1 Twenty-fifth session of the Joint Scientific Committee (JSC) of WCRP

Dr V. Meleshko briefed the session about the relevant developments and recommendations from the JSC-XXV session. Under the framework of 'Coordinated Observation and Prediction of the Earth System (COPES)', a discussion document has been prepared to provide a basis for development and eventual adoption of the strategy and goals to be pursued by WCRP for the period 2005-2015. The JSC invited comments that would help develop and refine COPES to ensure that the WCRP becomes more effective, more coordinated and more relevant international research programme for the next decade. Under COPES, WCRP will set a number of specific objectives with clear rationale for their importance and relevance. These objectives should be widely debated in the WCRP community and stakeholders asked for their comments. Areas being considered included: monsoons, atmospheric chemistry and climate; sea-level rise; anthropogenic climate change; THORPEX; and data and information management.

In recognition of the central role of modelling in COPES, and the overriding need for coordination of this activity, JSC approved the establishment of a WCRP Modelling Panel with Prof. J. Shukla as its chair. Its members should include specified JSC members, the Chairs of WGNE, WGCM, WOAP (WCRP Observations and Assimilation Panel) and the project modelling groups; and IGBP and IHDP should each be invited to provide a representative. This would meet in conjunction with WGCM and WGNE in alternative years, starting with WGCM in 2005.

The JSC encouraged links between the CLIVAR panels and both Working Group on Ocean Model Development (WGOMD) and Coupled Model Intercomparison Project (CMIP) in the diagnosis of variability in the aspects of climate with which they are concerned. CLIVAR and WGCM should consider whether a broadening of the membership of WGOMD would be useful in this regard. JSC considered that the initialization of the ocean for climate model was a topic that the WOAP should consider. On decadal variability, the JSC noted the suggestions of some predictability on decadal timescales in the Atlantic and the occurrence of a meeting on this topic in Reading in April 2004 and requested a report on this topic to JSC-XXVI.

The JSC encouraged a broad range of GEWEX participation in the Cloud Feedback meeting in Exeter, UK, April 2004.

WGCM discussed the new WCRP strategic framework COPES and how it would like to position itself with respect to COPES. WGCM noted that almost all its members are now into Earth System Modelling (ESM). A Regional Modeller is being brought into the Panel. WGCM is also moving towards increasing cooperation with IGBP/GAIM, which has expertise in carbon cycle and chemistry and land-surface. It is therefore opportune for WGCM to reorient itself towards Earth System Modelling.

1.2 Thirteenth session of CLIVAR Scientific Steering Group

Prof. J. Mitchell briefed the session about the relevant developments and recommendations from the thirteenth session of CLIVAR SSG.The review of WGCM (as part of the wider review of CLIVAR) was generally favourable and the CLIVAR SSG noted the success of projects such as CMIP. It was noted that WGCM should give more consideration to decadal to centennial variability, and should strengthen its reporting to CLIVAR. Both these issues have been addressed, the latter by having CLIVAR appoint Dr G.Meehl as the Vice chair of WGCM. The CLIVAR SSG recommended that WGCM should report only to CLIVAR and not to JSC. This would strengthen the Anthropogenic Climate Change component of CLIVAR. It was also argued that the establishment of a WCRP Modelling Panel made the link to JSC unnecessary. The chair of WGCM welcomed the improved communication between WGCM and CLIVAR. It was noted that most of the guidance to WGCM on issues such as the relationship with IGBP, IPCC etc had come from JSC and not CLIVAR. WGCM feel strongly that WGCM should continue to report to JSC, but CLIVAR should be kept informed of WGCM activities. The group would welcome suggestions from CLIVAR for WGCM activities.

1.3 Working Group on Ocean Model Development (WGOMD)

Dr H. Hasumi reported on the developments in WGMOD during the past year.The fifth session of WGOMD, was held in GFDL, Princeton, 18-19 June 2004, the week before the CLIVAR Conference. Representatives from the CLIVAR basin panels, Arctic Ocean modelling community, PCMDI, and CMIP "special response experiment" were invited. The future direction of an intercomparison project for global ocean models (IPCC-class models) was intensively discussed.

The CLIVAR Workshop "Evaluating the Ocean Component of IPCC-Class Models", 16-18 June 2004, Princeton (GFDL), was held with the sponsorship of WGOMD. The aims of the workshop were:

- to foster a candid and critical evaluation of the state-of-the-art in ocean models used in the IPCC class of climate models,
- to provide guidance towards the evaluation and documentation of the models, and
- to discuss and debate strategies for improving the physical integrity of the simulations. The workshop was composed of four sessions: i) state of the art in ocean climate models, ii) ocean model intercomparison project, iii) key physical processes, and iv) future directions. The workshop gathered more than 80 people from around the world. An outcome of the workshop was a proposal for Coordinated Ocean Reference Experiments (COREs), whose approach is somewhat different from traditional model intercomparison projects, such as AMIP and CMIP.

Intercomparison project for IPCC-class ocean models

The pilot OMIP (P-OMIP) started in 2001, as a feasibility study with limited (6-7 groups) participation. The P-OMIP protocol specifies ERA-15 based daily climatology of surface atmospheric properties, radiative fluxes, and freshwater fluxes. It also recommends relatively strong Sea Surface Salinity(SSS) restore to avoid model drift. There have been requests from outside (CLIVAR basin panels, for example) to encourage comparison of models forced by interannually varying data, not by climatology. For the purpose of looking at interannual variations, strong SSS restore comes under question, since there is no observed interannual SSS dataset.

COREs framework

- For COREs, both the normal year and interannually varying forcing datasets are provided. And three COREs are proposed: 1) repeating the normal year forcing, 2) interannual forcing with all the other elements (bulk formulae, SSS restore) being the same as the normal year experiments, and 3) enhanced melt water from the Greenland coast. Strength of SSS restore is not specified, different from the P-OMIP case.

- Four ice-ocean models (Community Climate System Model (CCSM), GFDL, Hybrid Coordinate Ocean Model (HYCOM), ORCA,IPSL) have been run for 100 years as a normal year COREs by now. With relatively weak SSS restore (50m/4yr for CCSM, GFDL, and ORCA; zero for HYCOM), the resulting Atlantic meridional overturning circulation is very different among these models.

- The forcing problem is much larger in the ice-ocean model case than in the atmospheric model case. Surface flux datasets to force ice-ocean models have large error bars compared with SST to force atmospheric models. Ocean modelling community has not reached a consensus on how to force ice-ocean models and therefore, are not ready for providing model output for unspecified analyses by a broader community. Instead, the COREs framework aims to develop standard practice that facilitates collaborative research and model development. In the COREs framework, scientists are encouraged to modify the experimental design as motivated by relevant scientific questions. Experience accumulated by using the COREs approach will lead to a robust methodology for ice-ocean modeling and more traditional-type OMIP.

- The proposal for COREs will appear in CLIVAR Exchanges or Ocean Modelling before long.

1.4 Overview of WGNE-20/GMPP-8 session,Exeter, UK, 11-15 October 2004

Dr B. McAvaney presented the highlights of the WGNE-20/GMPP-8 session, 11-15 October 2004, Exeter, UK. The topics included COPES, the new WCRP Modelling Panel, GEWEX and GEWEX Modeling and Prediction Panel GMPP), Coordinated Enhanced Observing Period (CEOP), GMPP: Global Land/Atmosphere System Study(GLASS), GMPP: GEWEX Cloud System Study(GCSS), Transpose AMIP and AMIP.

COPES is a strategy for “Seamless” model prediction and deals with the prediction of *entire* climate system; it takes an enhanced view of projects to a *global overarching view.*

The WCRP Modelling Panel’s (WMP) main objective was coordination of modelling activities across WCRP. WMP was concerned with questions such as:

- What experiments should WGCM suggest to WGNE?
- What joint experiments?
- How to foster model development?

In GMPP, research activities included:

- Conceptual models / parameterizations
- Comparison of models at various spatial scales
- Large-Eddy Simulation (LES) models, Cloud-Resolving Models (CRMs), Single Column Models (SCMs)
- Evaluation of models in couped and uncoupled modes
- Inputs to Global Models keeping in view
    - Which type of conceptual models are needed for NWP and climate resolutions.
    - Interactive linkages between the surface, PBL and clouds.

In GCSS, the key objective was to improve parameterization of clouds in climate models. There was a refocussing of working Groups on cirrus, extra tropical clouds, deep convection, and arctic clouds. A Pan GCSS workshop was being planned in Athens, 16-20 May 2005. GCSS would like to be better linked to climate models and cloud parameterizations for climate models. GCSS has initiated limited data collection from existing climate models over North Pacific. Participation of WGCM related modelling centres was invited at Pan-GCSS meeting in 2005.

The Global Land-Atmosphere System Study (GLASS) was focussing on three themes:

- role of land surface in climate (GCMs), the Global Land-Atmosphere Coupling Experiment (GLACE) was finding interesting results, such as some regions having ‘tighter coupling’ between land surface and atmosphere and a corresponding greater contribution to predictability (Koster et al. 2004,*Science*). There was need for better integration between the carbon modelling within GLASS and activities relating to coupled modelling;

- local coupling (LoCo) through the use of SCMs (in interaction with GEWEX Atmospheric Boundary Layer Study (GABLS), which will address the role of land-PBL interaction though local coupled modelling, with a view towards improved simulation of the diurnal cycle of surface fluxes); and
- a new project, IPILPS (Isotopes in the Project for Inter-comparison of Land-Surface Parameterisation Schemes), has been initiated to contribute to a comparison of atmospheric, coupled climate, and earth system models that incorporate isotopic representation in their land-surface schemes.

There was need for a greater level of participation of GEWEX Radiation Panel (GRP) in deliberations of WGCM e.g. in methods for computing radiative forcing.

In Transpose AMIP, the goal was to obtain the benefits for climate model development and evaluation that have been realized in weather prediction by using climate models as weather forecasting tools, but without the huge costs of developing a complete NWP system. Initially the climate models are applied at their relatively low application resolutions and are not expected to make the best weather forecasts, however the approach will also encourage higher resolution studies. The method allows direct comparison of parameterized variables such as clouds and precipitation with observations from field programs such as ARM, early in the forecast while the model state is still near that of the real atmosphere. This is in contrast to the more traditional climate model statistical analysis based on the model simulated climate balance. In that approach the parameterizations see the erroneous climate model state rather than the true observed state. A pilot study with the NCAR model had been successfully completed using ERA40 initial conditions. The results demonstrate the viability and utility of this forecast approach for examining climate models and identifying avenues for improvement. WGNE would make a formal proposal to the international climate modelling community (including the AMIP mailing list) for an intercomparison Transpose AMIP.

In the Atmospheric Model Intercomparison Project (AMIP), the PCMDI was planning to “complete” AMIP 2 with a “wrap up” paper in middle 2005.Final submission of non IPCC AMIP 2 model runs was planned for March 2005. The software library "Climate Model Output Rewriter"(CMOR), was being adopted as submission vehicle for all MIPS.WGNE was requested to support CF metadata standard.

WGCM noted the importance of the land surface in climate simulations. In the light of this, WGCM recommends that a representative from GEWEX/GMPP attend the next WGCM meeting to brief the group on the state of the art of land surface modelling for the simulation of climate and climate change.

1.5 Overview of the Climate and Cryosphere Project (CliC)

Dr G.M. Flato presented an overview of developments in CliC during the past year.The precursor to CliC, the Arctic Climate System Study (ACSYS), formally came to a close with the ACSYS Final Science Conference held 11-14 November, 2003, St. Petersburg, Russia. This conference summarized a decade of research on the following topics:

- The state of the Arctic Climate System
- Observing the Arctic Climate
- Process Studies and Modelling
- Interactions with the Global Climate System

The CliC science plan is now well developed and is organized around four project areas:

- The terrestrial cryosphere and hydrometeorology of cold regions
- Glaciers, ice caps and ice sheets, and their relation to sea level
- High latitude oceans and the marine cryosphere
- Linkages between the cryosphere and global climate

Some recent undertakings include the following:

- A review paper entitled,” Observed Changes in the Global Cryosphere during the 20th Century” is in preparation
- A plan for “ISMINT” – the CliC ice sheet model intercomparison – has been developed and key participants have met to begin organizing work
- Workshop on permafrost observations and modelling (Fairbanks, AK, 17-19 October, 2004)
- Workshop on High-Latitude Climate Change (Fairbanks, AK, 6-8 December, 2004)

- An on-line data base of cryospheric data and information is being developed to allow convenient search and access to cryospheric data at various institutions.

WGCM welcomed the plans for CliC presented by Dr Flato. The members queried about the incorporation of ice sheet models in coupled GCMs and indicated the need to run such coupled models for long enough times to interact with ice sheets. WGCM wanted to know if there is any organized activity in CliC involving Program for Climate Model Diagnosis and Intercomparison (PCMDI), and if CliCnet is listed on Model Intercomparison Projects(MIPS) catalogue.

1.6 Intergovernmental Panel on Climate Change (IPCC)

Prof. J. Mitchell reported on the recent developments in the IPCC. WGCM noted that:

- there are no new scenarios for AR4,
- the Task Group on Scenarios for Climate and Impact Assessment (TGCIA) will be approaching WGCM/IPCC panel for data from the PCMDI/IPCC database for impact studies.

IPCC Workshop, Maynooth, 11-13 May 2004

The IPCC Workshop on ''Describing Scientific Uncertainties in Climate Change to Support Analysis of Risk and of Options" covered the issue of uncertainty in all IPCC Working groups and noted the need to use consistent terminology throughout. A full report of the meeting is available at http://ipcc-wg1.ucar.edu/meeting/URW/product/URW_Report_v2.pdf

For more detailed discussion on issues related to IPCC, see section 4.1 on CMIP.

1.7 Regional Climate Modelling

Prof. J. Mitchell reported on this agenda item.The joint WGNE/WGCM international Workshop, 'High-resolution climate modelling: Assessment, added value and applications' held in Lund, Sweden, 29 March-2 April 2004 focussed on the application of nested, limited-area models (LAM) for regional-scale climate simulations and climate-change projections. Among the recurring themes at the Workshop were the validation procedure and the identification of the added value beyond the simple increase in resolution. The relative merits and limitations of various approaches used for achieving high-resolution climate simulations (such as time slices of high-resolution GCM, variable-resolution GCM, LAM) and the ensuing climate-change impact analyses were also discussed. Other applications of LAM were also presented, including NWP, Seasonal to Inter-seasonal Prediction, and case studies. The Workshop was the forum of several proposals for collaborative endeavour which included: (i) an inter-comparison project of regional-scale climate-change projections for North America, NARCCAP, proposed by Dr L.Mears from NCAR, (ii) a"Transferability Working Group" (TWG) proposed by DrE.Takle from Iowa State University,and (iii) a coordinated project exploiting the protocol of the "Big-Brother Experiment" (BBE) proposed by Prof. R. Laprise from the Université du Québec à Montréal. The Workshop attracted more than 80 participants from around the world, who contributed some 35 orals and as many poster presentations. The Workshop proceedings is available from http://www.natgeo.lu.se/Lars.barring/RCMworkshop/RCMhome.htm.

WGCM welcomed the report on the RCM Workshop and observed that Big Brother Experiments (BBEs) indicate that regional climate modelling for climate can add genuine detail in simulations. WGCM proposed to have a regional modeller in WGCM.

2. NEWS FROM RELEVANT NATIONAL AND MULTINATIONAL PROJECTS

2.1 PRogram for Integrated earth System Modelling (PRISM), Europe

PRISM is a European infrastructure project and has 22 partners comprising of leading climate research institutes and computer vendors. PRISM involves development of a system for flexible coupling of current state-of-the-art atmosphere, ocean, sea-ice, atmospheric chemistry, land-surface and ocean-biogeochemistry models. A portable, efficient and user-friendly system based on state-of-the-art models with diagnostics and visualization will be developed.

Several European groups are running or intending to run their models in the PRISM system. Prof. J. Mitchell provided a status report on the European Earth System Modelling infrastructure project, PRECIS, which stands for 'Providing Regional Climates for Impacts Studies' (http://www.meto.gov.uk/research/hadleycentre/). The Hadley Centre has developed a Regional Climate Model(RCM) that can be run on a PC and can be applied easily to any area of the globe to generate detailed climate-change predictions. The intention is to make this modelling system (PRECIS), freely available to groups of developing countries so that they can develop climate-change scenarios at national centres of expertise. Prof. J. Mitchell informed that:

- PRECIS is on track to meet its targets in time for its termination at the end of 2004.
- the coupler and the treatment of data formats are probably the most successful aspects of the project
- the project was only intended to demonstrate that the system works.

2.2 Earth Simulator, Japan

Dr A. Noda reported the current status of the Japanese organizations developing coupled atmosphere-ocean GCMs. A new attempt has begun to develop non-hydrostatic coupled atmosphere-ocean model by a group in the Earth Simulator Center.

The Earth Simulator is planning to make a contribution to the IPCC AR4:

- by making scenario runs with very high resolution CGCMs
- by Center for Climate System Research(CCSR)/ National Institute for Environmental Studies (NIES) /FRSGC (completed)
- by Hadley Centre in collaboration with CCSR (underway)
- by NCAR in collaboration with Central Research Institute of the Electric Power Industry (CRIEPI) (completed)
- by making time-slice runs with super high resolution AGCM and RCM to give information about the effects of global warming on severe weather, such as Baiu front, typhoon and heavy precipitation
- by JMA/MRI (completed)
- by making scenario runs with an earth system model to give information about the effects of carbon cycle on global warming
- by FRSGC (underway).

Preliminary results from these runs were reported in detail at the Workshop on Climate Change Research held at the Frontier Research Center for Global Change on 28-29, October 2004.

2.3 Program for Climate Model Diagnosis and Intercomparison (PCMDI), USA

Dr D. Bader presented the activites at PCMDI. PCMDI is carrying out a five-year plan with emphasis in four areas:

(i) Coupled GCM diagnostics and intercomparison
   a. Future PCMDI involvement with WCRP activities will be coordinated principally through the WGCM
   b. Any AMIP2 follow-on will be a subset of future CMIP planning
   c. With the consent of WGNE, further AMIP2 entries will not be accepted or archived.
   d. The completed Coupled Model Appraisal is available at http://www-pcmdi.llnl.gov/model_appraisal.pdf

(ii) Process level diagnostics and model evaluation
   a. Parameterization Testbed has been built around NCAR CAM2 to test parameterization changes and new parameterization packages. Plans are to add GFDL AM2 model
   b. Increased interaction with DOE ARM program
   c. Point of collaboration with GEWEX and WGNE, e.g. Transpose AMIP

(iii) Climate Change Detection and Attribution

(iv) Data archive and data analysis software
   a. Earth System Grid tools for IPCC Archive
   a. Access to the IPCC database http://esg.llnl.gov/portal/
   b. PCMDI data analysis software Version 4 has been released and is available at http://www-pcmdi.llnl.gov

3. CONTRIBUTIONS FROM OTHER MODELLING GROUPS

The session was given reports on developments in coupled modelling during the past year at modelling centres in Australia, USA, Japan, France and UK.

3.1 Bureau of Meteorology Research Centre (BMRC), Australia

Dr B. McAvaney reported on the developments in BMRC. At BMRC, there has been a renewed focus on Coupled Model for Climate change. Short and long-term plans include:

– *Short term*
- BAM4.0 (BMRC Atmospheric Model) + ACOM 2 (CMR) + ORCHIDEE (LMD/IPSL) + Sea Ice (ACE)
- OASIS coupler
- Atmosphere T47L34 – Ocean 1° (0.5° in tropics)
- Climate Network
  – Universities, BMRC, CSIRO

– *Longer term*
- Move to National Earth System Model (Australian Community Climate Earth-System Simulator (ACCESS) Coupled Model

3.2 Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia

Dr T. Hirst reported on the current status of the modelling activities at CSIRO.

CSIRO climate models:

Global coupled model – CSIRO Mk3 model

Atmosphere:	Spectral T63 (1.9° x 1.9°); 18 levels - hybrid σ,p
Land surface:	Soil model – 6 levels, 9 soil types, 13 vegetation types
	Snow cover model – 3 layer
Ocean:	MOM 2.2 code; Grid 0.95°NS x 1.9°EW; 31 levels (8 in top 100 m)
Sea Ice:	Flato-Hibler cavitating-fluid rheology, Semtner Thermodynamics (3 layer)
Applications:	Climate change modelling, experimental seasonal prediction
Reference:	Gordon et al., 2002 http://www.dar.csiro.au/publications/gordon_2002a.pdf

Regional climate model – Conformal-Cubic Atmospheric Model "C-CAM" (John McGregor)

Atmosphere:	Stretch grid model on the global domain
Applications:	Downscaling for climate change, seasonal prediction (experimental), experimental NWP

Aerosol Model (L. Rotstayn)
Consists of sulphate, mineral dust, sea salt, carbonaceous (black and organic) aerosol modules
Interactive with Mk3 atmospheric model physics, i.e., clouds, precipitation, and convection (work in progress)
Not employed in the submitted IPCC AR4 simulations as necessarily experimental in parts.

Oceanic carbon cycle model (R. Matear)
Currently a single nutrient (phosphate), single phytoplankton-type model, but with a full oceanic phosphate, dissolved oxygen and carbon cycle.
Currently run off-line using Mk3 output fields, and on-line in the Mk3 ocean component.

Terrestrial Carbon cycle model (Y. Wang, E. Kowalczyk and M. Raupach)
Developed to study climate-carbon-water-nutrient interactions at time scale from hour to century.
Emphasis is on aspects of the terrestrial biosphere important to Australia (e.g., nutrient limitation)
The model is an active participant of C4MIP, PILPS. Multiple chemical tracers were used to diagnose model results using global atmospheric composition observations.

CSIRO Mk3 IPCC AR4 simulations:

A complete basic set of IPCC AR4 simulations has been performed with the Mk3 model. As of late October 2004, data processing is at advanced (quality control) stage. The basic set of simulations took more than 2 years to complete (on NEC SX-5 machines). No multi-member ensembles have been completed yet due to computer limitations.

Short-term plans are to perform two additional 20th century simulations (to create a three member ensemble), and to re-perform the 1xCO2 and 2xCO2 equilibrium experiments to ensure that all key variables now required are saved.

Merger of BMRC and CSIRO climate modelling programs:

The Bureau of Meteorology and CSIRO are in extensive discussions aimed at a rapid merger of their respective climate modelling programs. The program would involve development of a new modelling system, to be known as the Australian Community Climate Earth System Simulator "ACCESS". The focus of the program would be to build a system for the next decade, and not for short-term aims. This initiative has strong funding agency support and is timed to coincide with the end of the IPCC AR4 development cycle.

3.3 National Center for Atmospheric Research (NCAR), USA

Dr G. Meehl presented the coupled modelling activites at NCAR.Global coupled climate model efforts at NCAR are coordinated nationally through the Community Climate System Model (CCSM) project, with nine working groups addressing each model component (atmosphere, ocean, polar and land surface), biogeochemistry, climate change, climate variability, software engineering, and paleoclimate.

Currently active global coupled climate models at NCAR include the Parallel Climate Model (PCM) with components including atmosphere: CCM3.2, T42, 18L; ocean: Parallel Ocean Program (POP) model, 2/3 to 1/2 degree in eq. Tropics, 32L, biharmonic diffusion, Pacanowski/Philander mixing; sea ice: dynamic (EVP), thermodynamic; and land surface: LSM. Second is the Community Climate System Model version 2 (CCSM2) with atmosphere: CAM2, T42, 26L; ocean: POP, 1 to 1/2 degree in eq. Tropics, 40L, GM, KPP; sea ice: dynamic (EVP), thermodynamic; and land: CLM. And third, CCSM3 with atmosphere: CAM3, T85, 26L (also T31 and T42); ocean: POP, 1 to 1/2 degree in eq. Tropics, 40L, GM, KPP; sea ice: dynamic (EVP), thermodynamic and land: CLM. (T42 class models run 8 years per day on IBM SP Power4; T85 is about a factor of two slower). Another model under development is the Whole Atmosphere Community Climate Model (WACCM) which contains a finite volume dynamical core, many more levels in the stratosphere, and capability for coupled chemistry.

Analysis on the Parallel Climate Model (PCM) on changes in extremes (frost days and heat waves) indicate that the simulations of these extremes in 20th century compare surprisingly well with observations, showing that extreme events can be well-accounted for in current global coupled models, and this builds confidence that changes in future extremes can have some credibility.

The full suite of IPCC simulations for the AR4 have been performed with PCM and CCSM3, with four and five member ensembles, respectively. Additional ensemble members as well as "overshoot" scenarios have been run with the CCSM3 on the Earth Simulator in Japan. Results show that the relative percent increase in sea level compared to stabilized temperature change for the experiment where concentrations are fixed at year 2000 values is roughly an order of magnitude greater, suggesting that sea level rise may be a greater problem than temperature increase in the climate change commitment sense.

3.4 Geophysical Fluid Dynamics Laboratory (GFDL), USA

Dr T. Delworth presented a summary of GFDL modeling activities, especially with regard to the IPCC AR4 simulations. Two new coupled models have been developed at GFDL, called CM2.0 and CM2.1. Both models are being used for IPCC AR4 integrations. The models have the same resolution, but differ in the dynamical core used in the atmosphere, as well as details of the land and ocean models:

- Atmosphere: Grid point formulation 2^o lat, 2.5^o lon, 24 vertical levels
- Ocean: 1^o lon, 1^o lat, refined to 1/3 near Equator, 50 levels, rotated poles. KPP, GM, free surface, true fresh water flux boundary condition.
- Land: Land Dynamic model (C. Milly), enhanced bucket formulation.
- Sea Ice: Winton (2000). Dynamics, three level thermodynamics
- CM2.0: B-grid dynamical core
    - Equilibrium climate sensitivity 3.0K
- CM2.1: Finite Volume dynamical core (SJ Lin).
    - Equilibrium climate sensitivity ~3.4K
- Additional important differences:
    - Radiative tuning (more surface SW in CM2.1)
    - Land model change to warm NH continents in CM2.1
    - Ocean model: reduced viscosity and GM in CM2.1

The overall biases in CM2.1 are generally smaller than those in CM2.0. The CM2.0 model is being used for experimental seasonal forecasting, as well as climate change studies. The CM2.0 model has a climate sensitivity of 3.0K, while the CM2.1 model has a sensitivity of approximately 3.4K (final run to evaluate this is not yet complete). The set of IPCC AR4 runs with CM2.0 has been completed, while the set of IPCC AR4 runs with CM2.1 is currently underway, with completion anticipated for December. Near term model development activities will focus on a higher resolution atmospheric component (approximately 1°), as well as the evaluation of a newly developed isopycnal ocean model as the ocean component of the coupled model.

3.5 Meteorological Research Institute (MRI), Japan

Dr A. Noda reported the activities of the main modeling groups in Japan. As a topic from regional modeling, Dr A. Noda reported a development of a regional coupled atmosphere-ocean climate model (RCCM) at the Meteorological Research Institute. A regional atmospheric climate model (RACM) with a horizontal resolution of 20 km covering Japan Islands is doubly nested in the atmospheric part of the global coupled GCM (MRI-CGCM2.3) with a horizontal resolution of T42. The North Pacific Ocean (NPOCM) model with a horizontal resolution of 1/4 degree in longitude and 1/6 degree in latitude is driven by the heat flux and the wind stress produced by the CGCM. The RACM is coupled through the lower boundary with the NPOCM. A preliminary run shows a better performance in surface temperature simulation over Japan Islands with the RCCM than with the RACM.

3.6 Institut Pierre Simon Laplace (IPSL), France

Dr P. Braconnot presented the activities of the IPSL modeling groups. A large part of the resources are now devoted to the IPCC scenarios. The coupled model IPSL_CM4 is basically the one presented last year. SRES scenarios have just started and will be ready by the end of the year, with the stabilization part finished in early 2005. Pre-industrial simulation is running. A first set of 20^{th} century simulations is finished (only trace gases and sulfate included). CMIP 1%/y simulation completed, together with stabilization to 2 CO2, whereas stabilization to 4 CO2 is running and will be available soon. The CNRM group at Météo-France also runs the IPCC scenarios. Their timeframe is similar to the one of IPSL. Some common analysis of the set of French simulations is planned. Results are being processed to be sent to PCMDI.

Several people registered for the "CMIP" analysis of IPCC simulations; subjects include: analysis of ENSO (E. Guilyardi), Indian ocean and monsoon (P. Terray), evaluation of cloud feedback (S. Bony and J.-L. Dufresne), the analysis of the indirect effect of aerosols (J. Quaas). Proposal for analysis on high latitude climate came also from LGGE (Grenoble, France) for an analysis of ice-sheet and sea-level, and Alpine glaciers.

Two ongoing studies related to the analysis of climate change scenarios were highlighted: 1) an analysis suggesting how information on cloud feedbacks from the modern climate could be used to assess the realism of cloud feedback in future climate experiments; 2) sensitivity experiments to fresh water fluxes were performed with IPSL_CM4 to investigate model sensitivity and possible impact of changes in these fluxes in future climate scenarios. Future plans for the IPSL group concern the introduction of the carbon cycle, interactive chemistry and aerosols, as well as land use studies. Information was also given on additional activity concerning the AMMA (African monsoon multidisciplinary analysis) project that will consider extensive field campaign and modeling activity, including development of model parameterization and interactions with chemistry. Dr H. Le Treut also indicated the collaboration and regional studies going on in the European Climate Change Assessment and Impact Studies (CLARIS) project, and the desire of modeling groups in south America to be able to follow the activity of WGCM, and to have their activity recognized.

3.7 Hadley Centre, UK

Prof. J. Mitchell presented a summary of some recent work done at the Hadley Centre. These included:

(i) detection and attribution of climate change,
(ii) quantifying uncertainty including regional uncertainties,
(iii) deacdal prediction,
(iv) regional modelling, and
(v) carbon cycle modelling.

The summer of 2003 was the hottest summer in records stretching back 500 years. Observed European mean temperatures since 1900 are compared with Hadley Centre model simulations from 1900 to 2100. By the middle of this century summers like 2003 could become the norm in Europe. Comparison has been made between HadCM3 and PCM simulations of past and future (SRES A2) temperature changes; scaling to 20th century the observed temperature changes brings predictions into better agreement.

In quantifying uncertainty, large ensembles were designed to sample uncertainties in predictions of long term climate change. The ensembles were initialised from observations to predict interannual to decadal climate anomalies. A multi-model ensemble of climate change predictions was very useful, but difficult to use as a basis for risk assessment as it was:

- too small
- not designed to sample uncertainties systematically
- all models treated as equally reliable.

A “perturbed physics ensemble’’ provided a systematic, traceable approach to sampling modelling uncertainties. The approach here was to:

- use HadAM3 coupled to a mixed layer (“slab”) ocean
- sample uncertainties by perturbing ill-constrained model parameters
- perturb 29 parameters one at a time to expert-estimated limits of uncertainty ranges
- use 53 member ensemble

The approach does not sample structural or stochastic parameterisation uncertainties. It provides equilibrium response to doubled CO_2 assuming no ocean circulation changes.

For predictions of transient climate change one needs to use fully coupled models. This is computationally more demanding and one has to use flux adjustments. Initial ensemble of 16 members with multiple perturbations to atmosphere parameters was used. Uncertainty in predictions ranges from alternative ensemble designs(HadCM3 perturbed physics and CMIP2 multi-model).

In decadal prediction the skill was assessed in a set of hindcasts:

- Assimilation run from 1979 to 2001
- Forecasts spun off every season (Mar, Jun, Sep, Dec), each run for 10 years
- Four ensemble members (starting from consecutive days)
- Greenhouse gases included
- Repeat previous 11 year solar cycle
- Exponential decay of volcanic aerosol

In carbon cycle modelling of terrestrial carbon cycle feedbacks, changes in vegetation carbon and soil carbon were studied:

- In the run neglecting climate change total terrestrial carbon storage *increases* by about 450 GtC from 2000-2100.

- When climate change is included both vegetation and soil carbon decrease from around 2050, such that total terrestrial carbon storage *decreases* by about 170 GtC over the 21st century.

Recent observed CO_2 increases:

There is a lot of evidence for increase in northern hemisphere forest fires in 2002 and 2003:

- CO, H_2, Methyl-Chloroform data from Mace Head, Ireland
- European sites and Satellite CO data
- Anecdotal evidence from Siberia (August 2003)

4. REVIEW OF WGCM INITIATIVES

4.1 Coupled Model Intercomparison project (CMIP)

CMIP (http://www-pcmdi.llnl.gov/cmip/) was one of the most important and long-standing initiatives of WGCM, having been started in 1995. There are now three components: CMIP1 to collect and document features of global coupled model simulations of present-day climate (control-runs); CMIP2 to document features of control runs and climate sensitivity experiments with CO_2 increasing at 1% per year; CMIP2+, as CMIP2, but many extra fields and data, and monthly means, and some daily data were being collected.

Dr G. Meehl (Chairman of the CMIP) reported on the current status summarizing the significant accomplishments related to CMIP, Oct. 2003 – Sept. 2004. The IPCC model analysis project was approved by WGCM at its meeting last year. PCMDI has agreed to collect, archive and distribute the model data; The WGCM Climate Simulation Panel (Members: Drs G. Meehl, Chair, J. Mitchell, B. McAvaney, M. Latif, C. Covey, R. Stouffer) has been set up by WGCM to oversee and coordinate collection, archival, and analysis of model data for the IPCC AR4. Model data collection has begun. An invitation for participation was published in CLIVAR Exchanges (June 2004) and EOS (July 2004). To date, 218 scientists have registered to analyze the IPCC model data.

An international IPCC model analysis workshop will be convened in March, 2005, by US CLIVAR, hosted by IPRC (University of Hawaii) and overseen by the WGCM Climate Simulation Panel. The Coupled Model Evaluation Project (CMEP) has been set up through US CLIVAR and funding has been awarded to 15 PI's to analyze, at minimum, 20th century IPCC runs from US models in IPCC model dataset at PCMDI.

Currently, all CMIP2+ data are available for analysis from PCMDI. Additionally, a catalogue of MIPs, assembled with cooperation of WGCM and GAIM, is maintained on WCRP web page with link from CMIP web page.

A summary of the Sept. 2003 CMIP Workshop is in press (2004) in Bulletin of American Meteorological Society. CMIP subprojects have produced 47 peer-reviewed publications, 6 other publications, 4 PCMDI publications, and will produce significant contributions to IPCC AR4; As of October 2004 there are 43 CMIP2+ subprojects currently active, in addition to 10 completed subprojects from CMIP1 and 22 from CMIP2

IPCC Working Group I Workshop on Climate Sensitivity

Dr G. Meehl summarized the Working Group 1 contribution to the IPCC Fourth Assessment Report: Climate Change 2007: The Physical Science Basis. This includes chapters:

Ch. 1 Historical overview
Ch. 2 Changes in atmospheric constituents and radiative forcing
Ch. 3 Observations: Surface and atmospheric climate change
Ch. 4 Observations: Changes in snow, ice and frozen ground
Ch. 5 Observations: Oceanic climate change and sea level
Ch. 6 Paleoclimate
Ch. 7 Couplings between changes in the climate system and biogeochemistry
Ch. 8 Climate models and their evaluation
Ch. 9 Understanding and attributing climate change
Ch. 10 Global climate projections
Ch. 11 Regional climate projections

Dr Meehl also reported on the IPCC Working Group I Workshop on Climate Sensitivity, held at École Normale Supérieure, 26–29 July 2004, Paris, France. The aims of the climate sensitivity workshop were to:

- Evaluate a range of climate model results so as to relate different climate sensitivity estimates to differences descriptions of physical processes, particularly those related to atmospheric water vapor, clouds, lapse rate changes, ocean heat uptake, treatment of evapotranspiration, land-atmosphere coupling, etc.
- Obtain a more comprehensive picture of the relationships between climate sensitivity and other model features such as resolution, numerical approach, radiative transfer parameters, etc.
- Consider how current, historical, and paleoclimatic data can aid in the determination of the likely range of climate sensitivity.
- Improve the understanding of the interpretation and limits of the climate sensitivity concept, including for example possible dependencies upon different forcing agents, predictability questions, and transient and steady-state responses.
- Start a process towards objective assessment to critically determine whether the range 1.5 to 4.5^0C remains appropriate in the AR4 – e.g. by defining criteria that may assist in the evaluation of results from many different climate models.

The workshop was structured around four topics:

1. Climate sensitivity from models
2. Climate sensitivity from observations (including modern and paleoclimatic observations)
3. Radiative transfer and forcing
4. Probabilistic measures of climate sensitivity

Outcomes for IPCC AR4:

1.Climate sensitivity from paleo in Ch. 6
2.Climate sensitivity from observations in Ch. 9
3.Climate sensitivity from models in Ch. 10
4.Radiative forcing from models in Ch. 10
5.Probabilistic measures from models in Ch. 10
6.Summary box of pdfs from all estimations in Ch. 10

IPCC/WGCM Sensitivity Workshop, 19-22 April 2004, Exeter

Dr B. McAvaney reported on the IPCC/WGCM Sensitivity workshop held at Exeter,19-22 April 2004. At this workshop,early results from International Cloud Feedback Model Intercomparison Project (CFMIP) were presented. Working groups:

a) recommended metrics for Climate models- a firm proposal of a perfect model methodology to determine objectively a climate model metric that is planned to relate the skill of a model in reproducing the current climate with the climate sensitivity of the model.

b) urged CFMIP to continue but with greater emphasis of slab model experiments; encouragement to pursue CO2 radiative forcing
c) recommended exploration of definitions of climate sensitivity and encouragement to consider regional aspects.

IPCC Workshop, 11-13 May 2004, Maynooth

Prof. J. Mitchell reported on the IPCC Workshop, Maynooth, 11-13 May 2004.The IPCC Workshop on ‘’Describing Scientific Uncertainties in Climate Change to Support Analysis of Risk and of Options” covered the issue of uncertainty in all IPCC Working groups and noted the need to use consistent terminology throughout. A full report of the meeting is available at http://ipcc-wg1.ucar.edu/meeting/URW/product/URW_Report_v2.pdf

4.2 International Cloud Feedback Model Intercomparison Project (CFMIP)

Dr B. McAvaney reported about the progress of the International Cloud Feedback Model Intercomparison Project. Progress in support now includes: Met Office Web site http://www.cfmip.net/ and Analysis Team; IPSL Data server and PCMDI CMOR MIP table. There are now 11 committed participants. There has been encouraging progress with ISCCP simulator in clustering, dynamic regimes, partial radiation perturbation feedback analysis (PRP), and simplified PRP. Analysis of results from SLOM subproject will be completed by May 2005. Problems still remain with radiative forcing definition with ad hoc decisions being made by modelling groups.

4.3 Forcing scenarios

Historical Forcings

Dr R. Stouffer introduced this item. Groups are using many new radiative forcing constituents in the new AR4 runs. The historical solar time series is very uncertain. No one group is overseeing the collection and vetting of these important time series.

WGCM will ask various WCRP projects to oversee different aspects of historical forcings: for e.g., SPARC could oversee radiative, aerosols and volcanic forcings.

4.4 Initialization of coupled models

Dr R. Stouffer led the discussion on this agenda item.To find pre-industrial initial conditions, Stouffer et al propose a method in which one starts with today’s climate, turns radiative forcing back to 1860, runs for a few centuries, and then declares the start to 1860 control (Stouffer, R.J., A.J. Weaver, and M. Eby, 2004: A method for obtaining pre-twentieth century initial conditions for use in climate change studies. Climate Dynamics, 23, 327-339). Most groups are using a variant of their method to find initial conditions for their pre-industrial control integrations.

4.5 Decadal Variability

Dr T. Delworth presented the progress in this area. One of the dominant themes emerging from key meetings over the past year on decadal variability is decadal variability and continental hydrology. Recent results have shown the ability of atmospheric models to reproduce twentieth century droughts, when forced with global SST patterns. The availability of model results from the IPCC AR4 models at PCMDI provides an excellent opportunity for the decadal variability community to analyze these models.

The Thermohaline Circulation (THC) Response to increasing greenhouse gas(GHG) concentrations in the atmosphere: Coordinated Experiments

The data collection phase is almost over. The early results show that in most models, the THC weakens about 20% due to changes in the surface heat fluxes as the GHGs increase. The THC response to the water fluxes is much more varied. Even in integrations where the water fluxes are specified, there is a wide range in the THC response. A paper will be submitted by year end for inclusion in the AR4 report.

4.6 Detection and attribution of climate change

Detection and attribution studies have been extended from global scale temperature changes to include regional scale temperature changes, global scale changes in surface pressure and precipitation and precipitation extremes. The group noted that the limitation of the regional attribution of changes should be clearly stated; in particular, the difficulty of estimating the multi-decadal variability at a regional scale, and the dependence of uniquely identifying the anthropogenic signal at a regional scale.

Although individual extreme events cannot usually be attributed to a particular cause, one can estimate the fraction of the risk attributable to a particular cause. (This is common in the medical world, for example estimating the increase in risk of death due to smoking). Work by Stott et al looks at the attribution of fractional risk of 2003 European heat wave to greenhouse gases.

A presentation from Dr G. Hegerl on this agenda item was given by Prof. J. Mitchell. The outcome of an informal poll on 20C3M forcing from the International Ad Hoc Detection group, after a great deal of input and discussion was as follows:

There seems to be an overwhelming consensus that it is a good idea to collect the 20C3M simulations, and that each group first running their own best guess of the 20th century forcing is a good thing since this will give us a first estimate of forcing and model uncertainty combined (probably not a complete one). There were no voices that took issue with doing that, but several people suggested actions in addition to that, some of which CMIP or WGCM can help with:

1) We would like to be able to better evaluate the implications of forcing and model uncertainty for 20th century detection than possible from the standard 20C3M simulations. A more thorough evaluation of which models and forcings are consistent with observed climate change over the 20th century would also be useful to IPCC. CMIP could help achieve this goal by asking participants to submit the forcing data used in their experiments. Groups collaborating with CMIP could use these data to repeat experiments with other models, thereby separating the effects of forcing and model uncertainty. Ideally, all forcings could be used in one model for intercomparison.

2) Some (particularly Drs B. Santer and S. Tett, and on the modeling side Drs G. Boer and G. Flato) are interested in offering a complete 20th century forcing for modeling groups willing to use this in addition (ideally) to their own 20th century run. A discussion on how to do this and what to include is underway, CMIP participants are being polled about their interest in a model comparison based on a single forcing. Since nobody has the magic bullet forcing, it is important that such a common forcing not be perceived as the best one, just as a resource for model-comparisons.
   Even better were a best guess and 5% to 95% limit for each individual component, but this may not be realistic.

3) On most useful simulations to estimate signals:

   Dr Stott points out that the most efficient method to estimate the contribution of an individual forcing is to simulate the 20th century climate change first with, then without that particular forcing. For example, if a best estimate of greenhouse gas contributions is the goal, the least noise affected estimate of the GHG signal is based on simulations with all forcings and then all forcings but greenhouse gases; if a best estimate of the total anthropogenic contribution is the goal, a natural and anthropogenic and a natural only simulation of the 20th century are best. In addition to providing the least uncertain estimate of the "dropped out" forcing, this method is also superior if forcings interact (so far, there may be little evidence for nonlinear interactions between signals on a global scale, but this may be different on smaller scales).

4.7 Paleo-climatic modelling

Dr P. Braconnot reported on the recent development in the area of paleo-climatic modelling, and in particular the Paleoclimate Modelling Intercomparison Project (PMIP) (http://www-pcmdi.llnl.gov/pmip/).

New results were highlighted for mid-Holocene, Last Glacial Maximum(LGM) and Last Glacial Inception. In recent years, more coupled AO simulations have been made for all these time periods. The new results concern:

- role of ocean feedback in the tropics
- strength of ocean feedback, vegetation feedback and of their synergy in high latitudes
- evaluation of 6 ka simulations against improved reconstruction of biomes from pollen data in high latitudes
- recent coupled simulations of LGM and the large spread of changes in the THC for LGM amongst model results
- new ideas to infer climate sensitivity and evaluate model sensitivity from LGM simulations. A series of results were shown to illustrate these different points.

A subset of these analyses was illustrated:

- Intercomparison of available coupled simulations for the mid-Holocene were analyzed in order to extract robust features related to the ocean feedback. In particular, a late summer warming in the northwester part of the Indian Ocean slows down the retreat of the monsoon in this region. Where the ocean warms, a feedback loop was identified between, SST warming, convergence of humidity, increased precipitation, stratification of the ocean, due to both warming and fresh water and further amplification of the local warming.

- Analysis of model results in high latitudes against new reconstruction of biome data allows one to estimate the degree of realisms of the model simulations, and attribute the mismatch between model and data. In particular, models have a tendency to produce too much forest in Europe and excessive continental drying in central Asia.

- Thanks to the large effort from the Multiproxy Approach for the Reconstruction of the Glacial Ocean (MARGO) project, compilation and revision of SST estimates from different proxy indicators are now available for LGM. These data will serve as a basis to evaluate LGM coupled simulation.

- Last glacial inception is also part of the new focus of PMIP2. Available simulations highlight the role of local feedback in high latitudes and the equatorial to pole heat transport through latent heat.

5. OTHER ISSUES AND ACTIVITIES

5.1 Simulations of climate of the 20th century (Atmosphere-only AMIP-type)

The Third workshop of the C20C project took place in Trieste, Italy, 19-23 April 2004. The workshop included: presentations of results of Phase 1 integrations and initial Phase 2 results, discussion on planning for Phase 2 and beyond and discussion from representatives of WCRP programs on how to specify/deal with forcings and coupled models. Planning for comparison with coupled models includes: (i) coupling to mixed layer or dynamical ocean, (ii) maintaining the time evolution of surface forcing through imposed tropical SST, (iii) proposed new coordination with WGSIP; then WGCM, and (iv) efficient estimation of anthropogenic signals.

5.2 Data Management

The lack of a data portal for model data was emphasised. The WGCM recognizes the important of a metadata framework for defining model output and observations. The WGCM requires the use of the CF convention for its model intercomparison projects and encourages its continued development. In addition, the WGCM recommends that the WCRP support the Climate and Forecast (CF) Metadata Convention. It is hoped that the WCRP would also encourage financial support of the CF convention.

6. ADMINISTRATIVE MATTERS

6.1 Membership

WGCM considered memberships of those members whose terms were expiring at the end of 2004 and 2005.

WGCM recommended that Drs J. Mitchell and G. Meehl whose terms were ending 31 December 2005 be re-appointed as Co-Chairs with immediate effect till 31 December 2007; the term of Dr T. Delworth which was expiring on 31 December 2004 be extended by two years and the terms of Drs P. Braconnot and A. Hirst expiring on 31 December 2005 be extended by two years. Drs G. Hegerl, M. Latif and A. Noda

whose terms were ending 31 December 2004 would be leaving the group. Dr B. McAvaney whose term is ending 31 December 2005 would be leaving the group. The group recommended that Drs D. Karoly (Univ. of Oklahoma), M. Giorgetta (Max Planck Institute, Germany), C. Le Quéré (Max Planck Institute fur Biogeochemie, Germany), M. Kimoto (University of Tokyo) and F. Giorgi (International Centre for Theoretical Physics, Italy) be invited to be members of the group for an initial term of four years effective 1 January 2005.

Drs G. Flato and P.Braconnot were nominated the WGCM representatives for WCRP Observation and Assimilation Panel (WOAP) and Working Group on Surface Fluxes (WGOA), respectively.

6.2 Next session of WGCM

At the kind invitation of Prof. J. Mitchell, Met Office, UK, the next session of WGCM, the ninth, would be held at Exeter, UK, 3-5 October 2005.

6.3 Closure of the Session

The participants expressed their thanks to the local organizers Dr A. Noda, Meteorological Research Institute, Japan Meteorological Agency (JMA) and to the staff of the Frontier Research Centre for Global Change (FRCGC) for hosting this session, their excellent arrangements made, and the facilities and hospitality offered. Grateful thanks were also expressed to FRCGC for their invitation to the participants for the International Workshop at FRCGC on Climate Change Research. The eighth session of WGCM was closed at 13.30 hours on 27 October 2004.

7. WGCM-GAIM JOINT SESSION, 27 October 2004

A joint session with the Global Analysis, Integration, and Modelling(GAIM), IGBP was held on the afternoon of 27 October 2004. There were presentations on:

- major issues for coupled Earth System Models (ESMs) covering biosphere(Dr C. Prentice), chemistry (Dr G. Brasseur) and atmosphere(Prof. J. Mitchell) and

- specific topics such as C4MIP (Coupled Climate-Carbon Cycle Models Intercomparison Project (Dr F. Pierre)), CMIP/CFMIP (Dr G. Meehl), PMIP (Dr P. Braconnot)) and EMICS (Earth System Models of Intermediate Complexity (Dr M. Claussen)).

The last part of the session was a discussion on ‘possible future activities’ including IPCC Fourth Assessment: Chapters of interest to GAIM, and GAIM-WGCM co-operation.

WGCM expressed its keenness in having such joint meetings once every two years and looked forward to developing a suitable meeting format with GAIM. Noting that IGBP-Analysis, Integration and Modeling of the Earth System (AIMES) has a broad mandate, WGCM felt that there were too many overlaps between AIMES and Past Global Changes (PAGES). IGBP expressed the need for more interaction with WCRP in bringing together climate and biogeochemistry communities.

APPENDIX A

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APPENDIX B

WGCM-8th Session, 25-27 October 2004
Agenda

Monday, October 25

9.00 Welcome (*A. Noda, J. Mitchell, V. Satyan)*
Introductions
Times, agenda, local arrangements

9.20 Review of WCRP events, developments (5 minutes each)
JSC-XXV session, COPES, Modelling Panel (*V. Meleshko*)
JSC Officers, Chairs & Directors Meeting (*J. Mitchell*)
Review of WGCM (*J. Mitchell*)

9.35 CLIVAR SSG and ICPO (*G. Meehl*)

9:45 Other modelling activities (10 minutes each)

WGOMD (*H. Hasumi*)
WGNE/GMPP (*B. McAvaney*)
AMIP (*C. Covey*)

10.30 Coffee break

11.00 Other WCRP programmes and WGCM relevant activities (10 minutes each)

CliC (*G. Flato*)
GEWEX (*B. McAvaney)*
IPCC

- Fourth Assessment – update *(G. Meehl)*
- Report on Sensitivity Workshops: Paris Workshop *(G. Meehl)*
  Exeter Workshop *(B. McAvaney)*
  Maynooth Workshop *(J. Mitchell)*

- What WGCM needs to have in place?

TGCIA (*J. Mitchell*)
Update on regional modelling (*J. Mitchell*)

12.30 Lunch

13.45 News from relevant national and multinational projects (15 minutes each)

PRISM (*J. Mitchell)*
Earth Simulator (*A. Noda*)
PCMDI (*D. Bader*)

14.30 Reports from modelling groups (10 minutes each)

BMRC (*B. McAvaney*)
CSIRO (*T. Hirst*)
CCCM (*G. Flato*)

15.00 Coffee break

15.15 Reports from modelling groups (continued)
NCAR (*G. Meehl*)
GFDL (*T. Delworth*)
All Japanese groups (*A. Noda*)
Hadley Centre (*J. Mitchell*)
French groups (*P. Braconnot/H. Le Treut*)

Tuesday, October 26

9.00 Data Management issues *(lead R. Stouffer and PCMDI rep.)*

9.30 WGCM activities
(i) CMIP (*G. Meehl, C. Covey*)
(ii) CMIP/IPCC model analysis (*G. Meehl)*
(iii) CFMIP/Idealised experiments (*B. McAvaney*)

10.30 Coffee break

10.45 WGCM activities (continued)

(iv) Forcing scenarios (*R. Stouffer to lead*)
(v) Initialization of models (*R. Stouffer*)
(vi) Detection (*J. Mitchell*)

12.30 Lunch

14.00 WGCM activities (continued)
(vi) Paleo (*P. Braconnot*)
(vii) Atm.– ocean variability and predictability on decadal timescales (*M. Latif, T. Delworth*)

15.00 Coffee break

15.15 WGCM activities (continued)

Wednesday, October 27

9.00 WGCM activities (continued)
- issues for WGCM: parentage, links with Modelling Panel, etc.
- Revisit ' Future perspectives of WGCM'

10.30 Coffee break

10.45 GAIM- issues for discussion in the joint session:
GAIM task force, chemistry –climate interactions, interactions with biosphere, …
Other business:
- Next session- time, place
- WGCM membership issues

12.30 Adjourn

Wednesday, October 27, afternoon

WGCM-GAIM Joint Session

Provisional Agenda

14.00 Welcome and outline of joint WGCM-GAIM interests (*?, J. Mitchell*)

14.10 Issues for coupled Earth System Models (20 minutes each)

- Biosphere (*C. Prentice*)
- Chemistry (*G. Brasseur*)
- Atmosphere/Ocean (*J. Mitchell)*

15.10-16.00 Coffee break + Visit to the Earth Simulator

16.00 Specific topics (15 minutes each)

- C4MIP (*F. Pierre*)
- CMIP/CFMIP (*G. Meehl*)
- PMIP (*P. Braconnot)*
- EMICS (*M. Claussen)*

17.00 Discussion, including possible future activities

- IPCC Fourth Assessment: Chapters of interest to GAIM
- Any proposal for joint GAIM-WGCM event in future?
- GAIM-WGCM co-operation

APPENDIX C

SUMMARY OF THE MAIN DECISIONS, RECOMMENDATIONS AND ACTIONS

WGCM-8 Session, Yokohama, Japan, 25-27 October 2004

1. Thirteenth session of the CLIVAR SSG

Regarding the CLIVAR SSG recommendation that WGCM should give more consideration to decadal to centennial variability, and should strengthen its reporting to CLIVAR, the WGCM noted that both these issues have now been addressed, the latter by having CLIVAR appoint Dr G. Meehl as the vice chair of WGCM. As for CLIVAR SSG's recommendation that WGCM should report only to CLIVAR and not to JSC, WGCM noted that most of the guidance to WGCM on issues such as the relationship with IGBP, IPCC etc. had come from JSC and not CLIVAR. WGCM feel strongly that WGCM should continue to report to JSC, but CLIVAR should be kept informed of WGCM activities. The group would welcome suggestions from CLIVAR for WGCM activities.

2. Climate and Cryosphere Project (CliC)

WGCM queried about the incorporation of ice sheet models in coupled GCMs and indicated the need to run such coupled models for long enough times to interact with ice sheets.

3. WGNE/GMPP session Exeter, UK, 11-15 October 2004

WGCM noted the importance of the land surface in climate simulations. In the light of this, WGCM recommends that a representative from GEWEX/GMPP attend the next WGCM meeting to brief the group on the state of the art of land surface modelling for the simulation of climate and climate change (*Dr V. Satyan to ensure).*

4. Report on the RCM Workshop, 2004

WGCM welcomed the report on the RCM Workshop and observed that Big brother experiments indicate that regional climate modelling for climate can add genuine detail in simulations. WGCM proposed to have a regional modeller in WGCM.

5. AMIP

WGCM recommends that AMIP should continue under CMIP. WGCM agreed that there was no compelling reason to change the present AMIP format, only take it forward in time.

6. Historical Forcings

WGCM will ask various WCRP projects to oversee different aspects of historical forcings:
For eg., SPARC could oversee radiative, aerosols and volcanic forcings *(Dr J. Mitchell to write to WCRP project Chairs, and bring this issue to JSC as well).*

7. Future of WGCM

With the new framework of 'Coordinated Observation and Prediction of the Earth System (COPES)' on the horizon, WGCM would like to position itself with respect to COPES. WGCM noted that almost all its members are now into Earth System Modelling (ESM). A Regional Modeller is being brought into the Panel. WGCM is also moving towards increasing cooperation with IGBP/GAIM, which has expertise in carbon cycle and chemistry and land-surface. It is therefore opportune for WGCM to reorient itself towards Earth System Modelling.

8. WGCM-GAIM Joint Session

WGCM expressed its keenness in having joint meetings with GAIM once every two years and continues to develop a suitable meeting format with GAIM (*Dr V. Satyan to liaise with GAIM)*.

9. The international multi-model analysis activity for the IPCC

Nearly 250 people have registered to analyze the multi-model dataset from all over the world and about 125 are presenting results at the Workshop on Analyses of Climate Model Simulations for the IPCC AR4 to be held in Hawaii, 1-4 March 2005. It is expected that about 14 international global coupled models will ultimately be available for analysis thanks to archiving by PCMDI. Such a large-scale coordinated model experiment and analysis has never been attempted before. The JSC is asked to note the importance of this WGCM contribution to the international climate modelling, analysis and ACC communities, and its direct relevance to IPCC.