Ron Stouffer and the IPCC

or how Ron joined the IPCC and saw the world

Gerald A. Meehl

National Center for Atmospheric Research

U.S. DEPARTMENT OF ENERGY

Office of Science

Biological and Energy Research

Regional and Global Climate Modeling Program

NSF

NCAR

"The IPCC Assessment": first lead author meeting was held at GFDL, March 1989

Prominent drivers were from the British Met Office (Sir John Houghton, John Mitchell, Goeff Jenkins). The intention was to inform U.S. scientists that this was happening, and to get people on board

It was my first visit to GFDL, and the first time I met Ron. We were both early career scientists.

We viewed this as more or less a nuisance activity since we had just completed the DOE State-of-the-Art reports assessing where we stood on understanding climate change

It was decided that the second lead author meeting (to discuss a preliminary outline, form author teams, and start the first draft process) was to be held as a side event at the upcoming DOE Climate Change Workshop at U Mass in May 1989

The Met Office people then wanted a large lead author meeting in December to go over the first draft, and suggested we have it in the U.K.

"I have friends who are doctors. I have friends who are lawyers. When they are asked to do something outside of their normal work, they charge for it and are paid for it. We're being asked to do something outside our normal work, and we won't get paid for it. The least we can do is to have this December meeting in a warm weather location."

--Michael Schlesinger

U Mass DOE climate change workshop and IPCC organizational meeting, May 1989

IPCC lead author meeting, Brisbane, Australia, December, 1989

Ron was called upon to write about 1/3 or the transient climate change chapter, and to calm down Mike Schlesinger

At the final lead author meeting in the U.K. in spring 1990, Suki Manabe attended and showed results comparing a transient climate change simulation with an equilibrium mixed layer simulation with the GFDL model. He wanted these results included in the IPCC Assessment chapter 6 on future projections.

Michael Schlesinger (lead author of projections chapter) pointed out that the chapter had already undergone review, only final edits in response to those reviews were being considered, and it was out of the question to include brand new results that the reviewers hadn't seen, and had not been published

Sir John Houghton disagreed, and insisted on including the new GFDL results

Michael Schlesinger, in a replay of Brisbane, marched out of the room and resigned as lead author

Now what? Sir John looked around the room and noted that Francis Bretherton was in attendance. He asked Francis to be lead author of the projections chapter.

Francis proceeded to re-write the chapter, and sent it back to Ron and me for comment. It was so badly re-written, to the point of having a Francis "thought experiment" as one of the major parts, that Ron and I wrote to Sir John and threatened to resign as authors if the chapter wasn't returned to the pre-Francis state

Sir John prevailed, and the chapter was then returned to the pre-Francis state

6

Time-Dependent Greenhouse-Gas-Induced Climate Change

F.P. BRETHERTON, K. BRYAN, J.D. WOODS

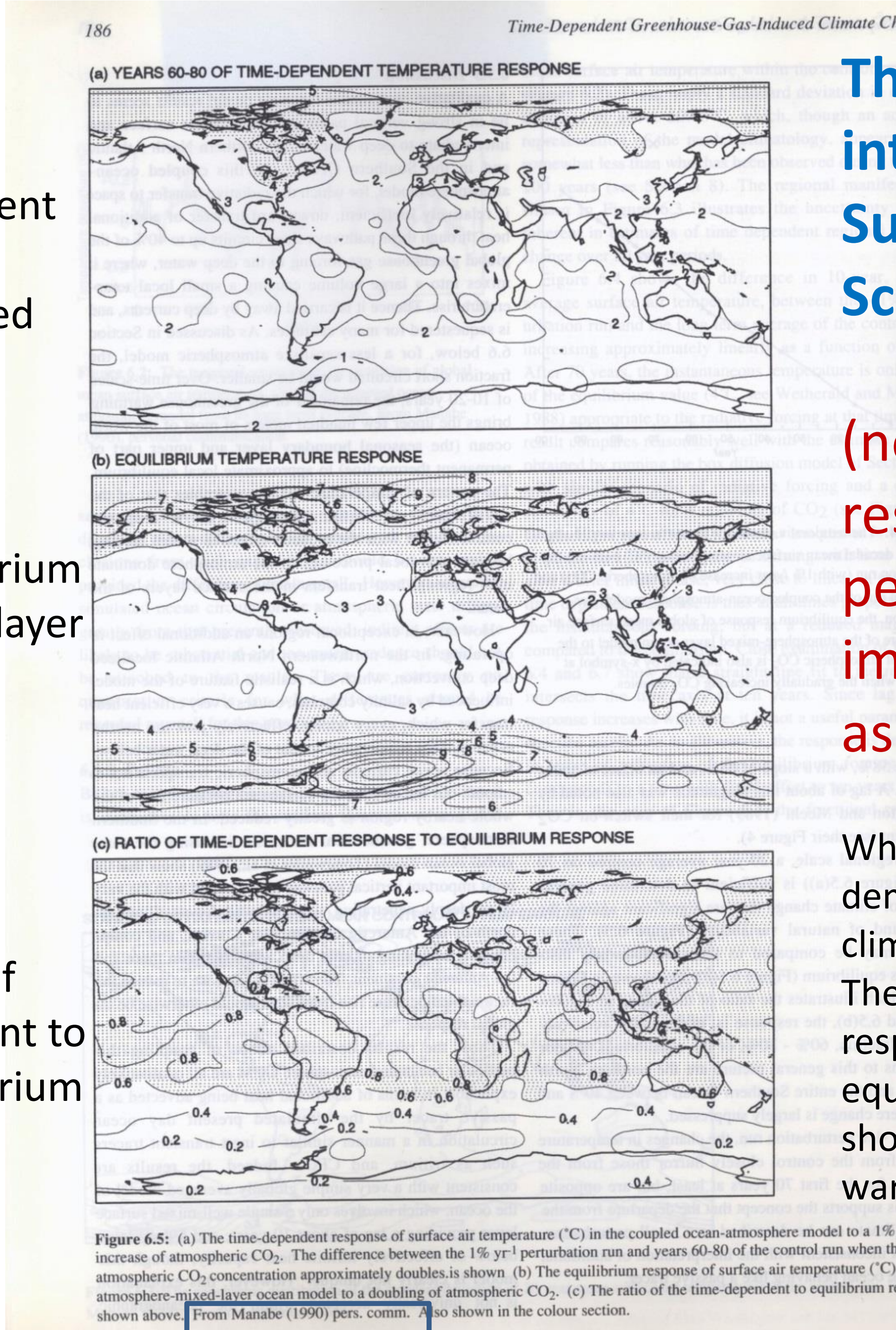
Contributors:
J. Hansen; M. Hoffert; X. Jiang; S. Manabe; G. Meehl; S.C.B. Raper; D. Rind; M. Schlesinger; R. Stouffer; T. Volk; T.M.L. Wigley.

CONTENTS

Transient fully coupled

Equilibrium mixed layer

Ratio of transient to equilibrium



These are the results introduced into Ch. 6 at the 11th hour by Suki that caused Michael Schlesinger to resign as CLA

(note these were unpublished results and are cited as a personal communication—impossible in subsequent IPCC assessments!)

What Sir John liked about these results was the demonstration of the time scale of the coupled climate system response.

The ratio of the transient non-equilibrium response from the fully coupled model to the equilibrium response in the mixed layer model shows the North Atlantic and Southern Ocean warming more slowly than the rest of the system other cases should be treated with caution. In particular, the apparent agreement with the results of the upwelling diffusion model may prove to be illusory, particularly if consideration is given to a very different forcing.

6.5.4 Changes In Ocean Circulation

Examination of the long term changes simulated in the model shows some other trends with potentially important consequences. Under the influence of increasing surface temperature and precipitation, the vertical circulation and overturning in the North Atlantic are becoming systematically weaker (Figure 6.6). That this is not an accidental artefact is confirmed by the minus 1% experiment, in which the radiative forcing becomes steadily more negative and this overturning circulation strengthens significantly. The same does not occur in the Antarctic, where the controls on exchanges with the sub-surface waters are different. The indications are, that if the plus 1% experiment were continued to perhaps 150 years, the downwelling and deep convection in the North Atlantic might cease altogether, with climate there and in Western Europe entering a new regime about which it would be premature to speculate. There might also be a significant effect on the carbon cycle and global atmospheric CO_2 levels (Section 1.2.7.1).

6.6 Projections of Global Mean Change

It is possible to use an energy-balance atmospheric model coupled to an upwelling-diffusion model of the ocean to estimate changes in the global-mean surface air temperature induced by different scenarios of radiative forcing and to help interpret the results from GCMs. Within the limitations of the tracer representation, it summarizes in terms of a few parameters the basic results of more complex simulations of the ocean circulation in time dependent climate change, and enables rapid extrapolation to other cases. As in the case of ocean GCMs, the parameters have been selected to fit geochemical tracer and water mass data and therefore reflect the present state of the world ocean. Therefore, the same caveats must be applied to extrapolating the results of the upwelling diffusion models to very different climatic regimes.

6.6.1 An Upwelling Diffusion Model

Such a simple climate/ocean model was proposed by Hoffert et al. (1980) and has since been used in several studies of the time-dependent response of the climate system to greenhouse-gas-induced radiative forcing [see, for example, Harvey and Schneider (1985); Wigley and Raper (1987), and the review papers by Hoffert and

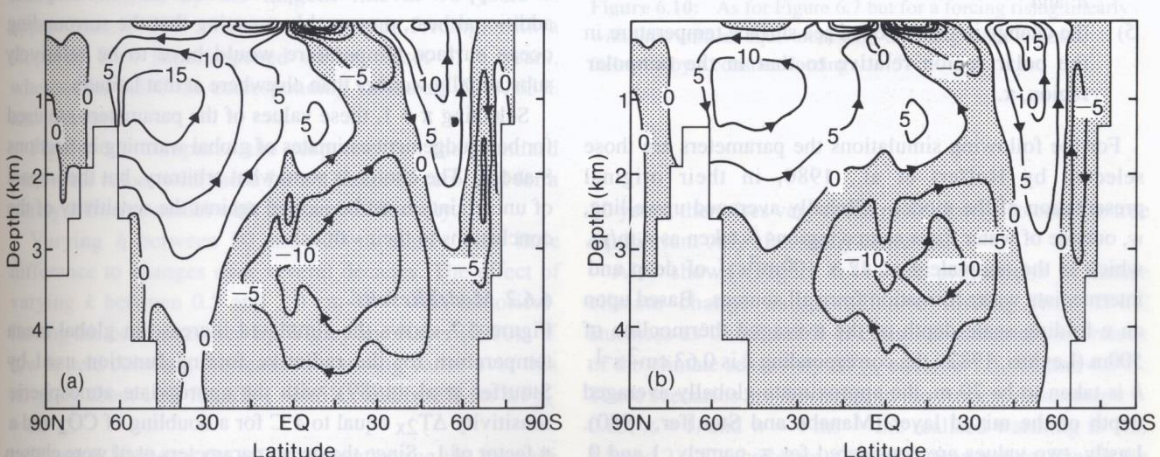
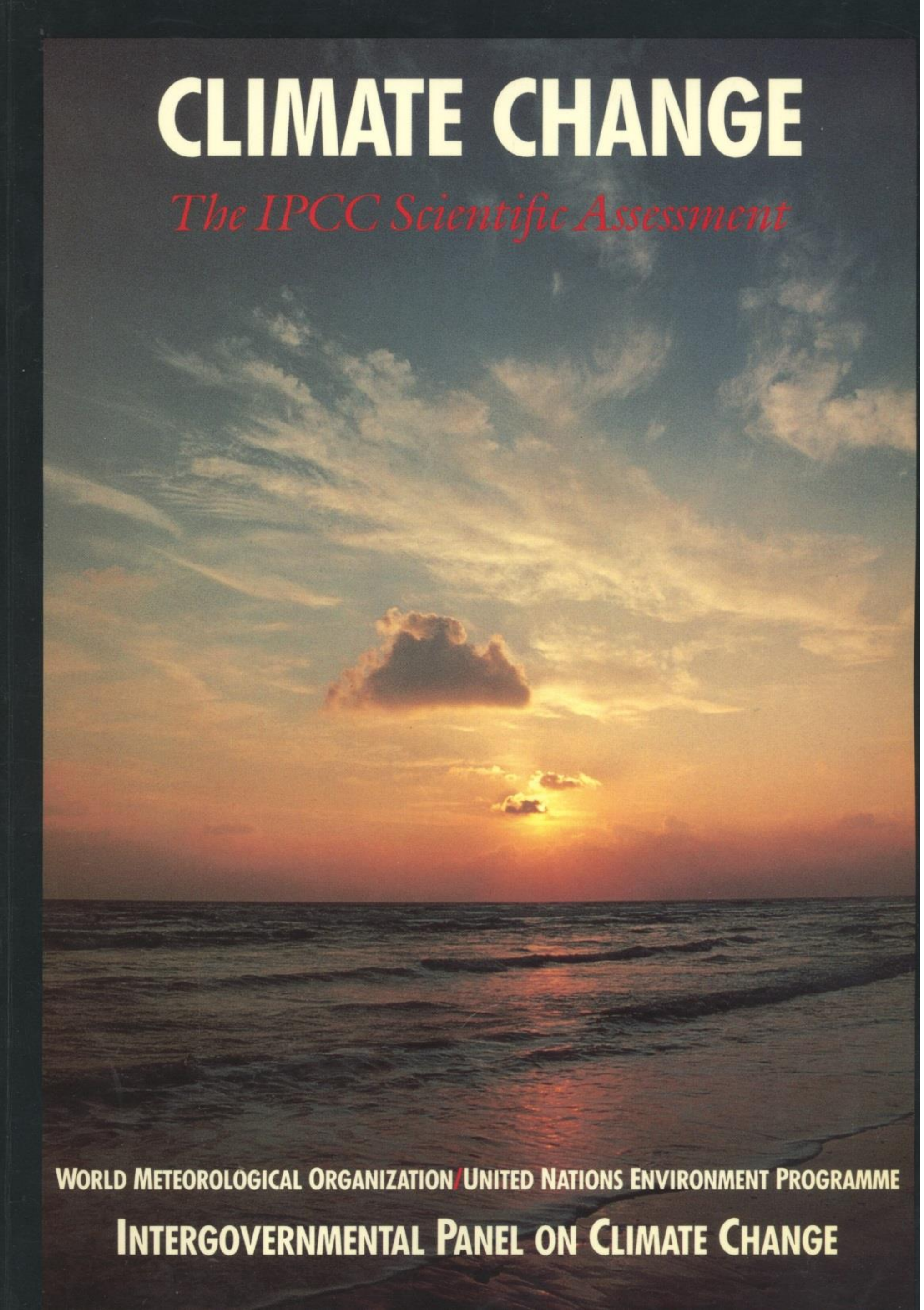


Figure 6.6: The streamfunction describing the vertical circulation in the Atlantic after 100 years: (a) control; (b) increasing forcing. Units are $10^6 m^3 s^{-1}$. From Stouffer et al. (1989).

A figure from Ron's 1989 Nature paper documenting a slowdown in the AMOC with global warming appeared in Ch. 6

(Stouffer, R.J., S. Manabe, and K. Bryan, 1989: Interhemispheric asymmetry in climate response to a gradual increase of CO2. *Nature*, **342**, 660-662.)



The first IPCC assessment in 1990, simply titled "The IPCC Scientific Assessment"

No one knew there would be many more to follow that would require a numbering convention (SAR, TAR, AR4, AR5, and now AR6)

A key input to the IPCC Second Assessment Report:

The first-ever Global Coupled Climate Model Workshop

October, 1994

Organized by SGGCM (changed to CLIVAR NEG2 in 1994; later WGCM), held at Scripps

Included representatives from modeling and analysis groups

The concept for a coupled model intercomparison project first discussed here

More global coupled climate models for the IPCC Second Assessment Report in 1995 with 1% CO2 (pointing toward CMIP1 and CMIP2)

A critical comment was that there was the impression of a lot of model spread, mainly due to one model (NCAR, no flux correction, tropics too warm, huge ice albedo feedback)

(This model spread issue would return in the TAR)

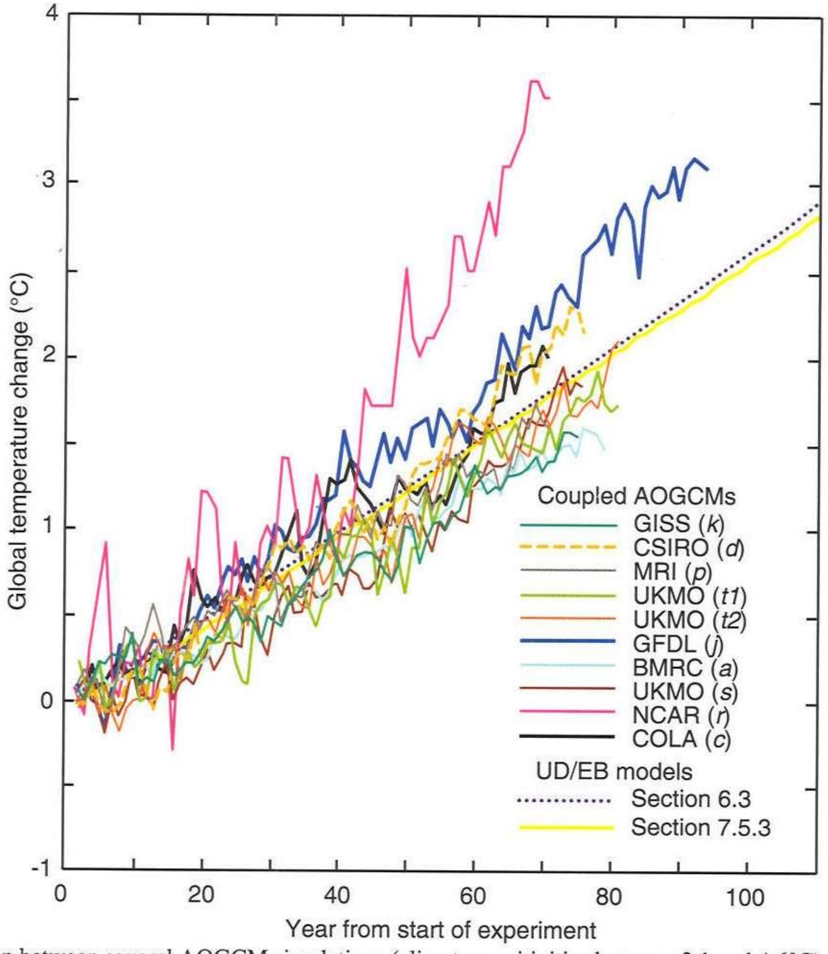


Figure 6.4: Comparison between several AOGCM simulations (climate sensitivities between 2.1 and 4.6°C), the UD/EB model of Section 6.3 (climate sensitivity 2.5°C) and the simple climate model of Section 7.5.3 (climate sensitivity of about 2.2°C). All models were forced with 1%/yr (compound) increase of atmospheric CO_2 concentration from equilibrium or near-equilibrium in 1990.

IPCC Third Assessment Report (SAR)

First lead author meeting, Bad Munstereifel, Germany, June, 1998

Seated, Ch. 10 (climate change projections) authors: Ron Stouffer, Jerry Meehl, Ulrich Cubasch, George Boer;
Standing: IPCC WG1 chair: Sir John Houghton

The infamous Arusha, Tanzania, second lead author meeting for the TAR, Sept., 1999;

safaris and a 24 hour return flight delay that involved nearly all the lead authors (Ron had to snap Curt Covey out of a breakdown on the grounded aircraft)

Third lead author meeting for the TAR, Victoria, British Columbia

Ron and Sarah Raper responding to reviewer comments

The Ch. 10 author team

New for the IPCC Third Assessment Report in 2001—the SRES scenarios

Initial resistance from the modeling groups: SRES scenarios had little perceived science value for them

scenarios were run at the last minute; going into the final lead author meeting, this was the multi-model figure—after the SAR, we were sensitive to the "model spread" issue, so at this point we had fairly acceptable model spread

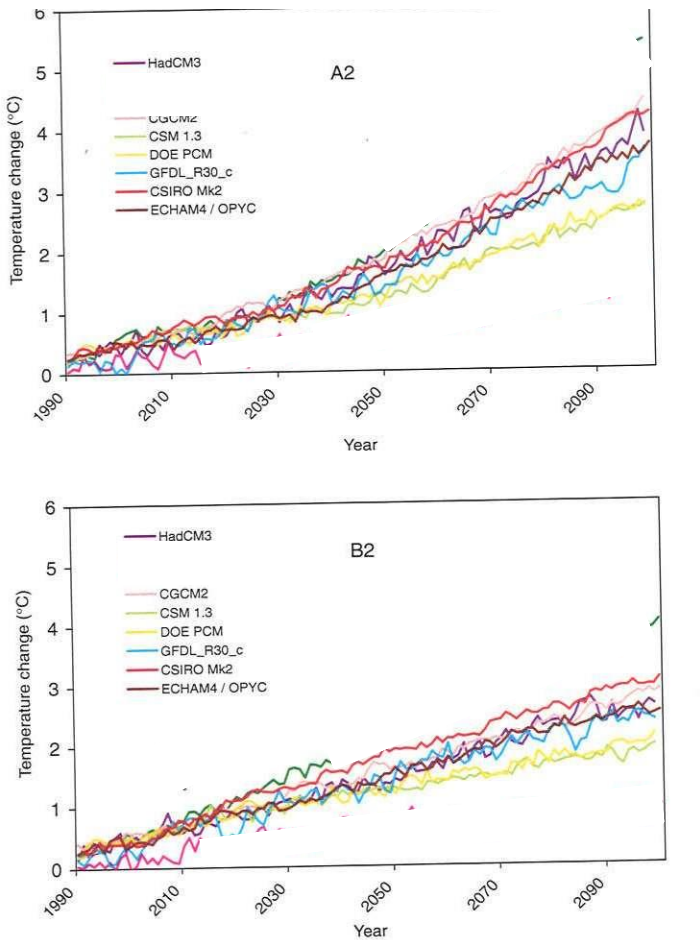


Figure 9.6: (a) The time evolution of the globally averaged temperature c (top) and B2 (bottom) (Unit: °C). See Table 9.1 for more information on the individual models used here. (b) The time evolution of the globally averaged precipitation change relative to the years (1961 to 1990) of the SRES simulations A2 (top) and B2 (bottom) (Unit: %). See Table 9.1 for more information on the individual models used here.

At the last minute, two more modeling groups submitted their SRES runs, both groups from Japan, both were outliers, one low and one high

Model spread expanded, but should we include these fresh-off-the-computer results? Maybe they had bugs, or were wrong in some other way.

"We have to include them or we'll start an international incident"
--Ron Stouffer

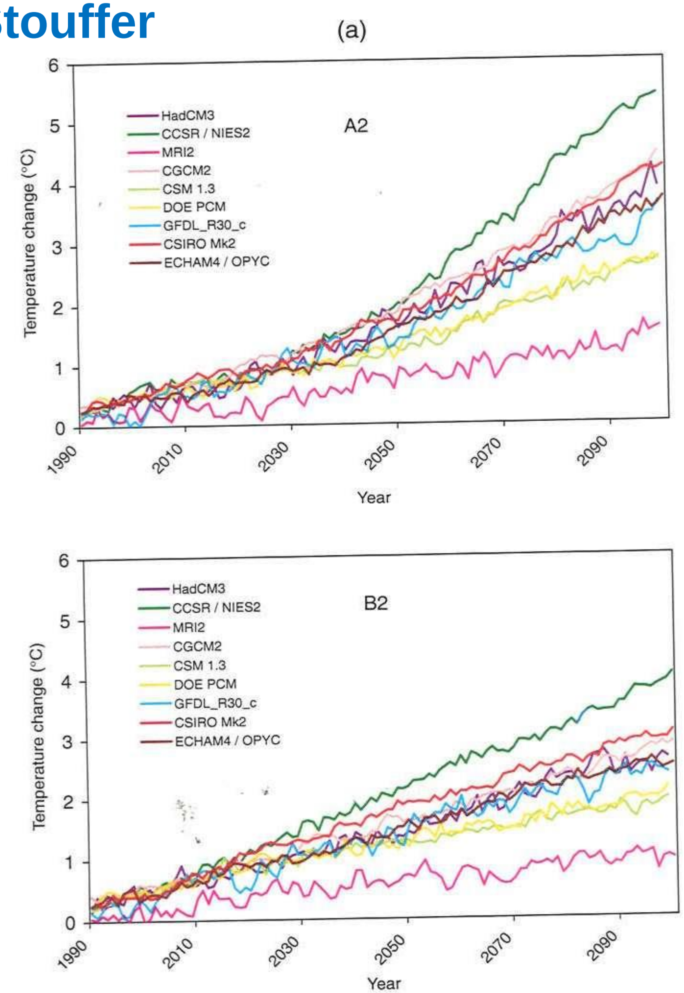


Figure 9.6: (a) The time evolution of the globally averaged temperature change relative to the years (1961 to 1990) of the SRES simulations A2 (top) and B2 (bottom) (Unit: °C). See Table 9.1 for more information on the individual models used here. (b) The time evolution of the globally averaged precipitation change relative to the years (1961 to 1990) of the SRES simulations A2 (top) and B2 (bottom) (Unit: %). See Table 9.1 for more information on the individual models used here.

IPCC WG1 Plenary for the TAR, Shanghai, China, January, 2001

The "smoking gun" statement in the IPCC TAR

Going into the plenary:
"A **substantial amount** of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations"

After two days of wrangling:
"**Most** of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations"

There was no discussion of "likely" (a 66% chance of being true)
In the 2007 Paris plenary for the AR4, "most" was uncontested, but tremendous argument about upgrading "likely" to "very likely" (90% chance)

Discussion among these three scientists (Tom Karl, Ron Stouffer, Ulrich Cubasch) and others present at the Shanghai plenary came up with definitions for "most" ranging from "a bit more than half" to "about 80%".

Ron played a key role in two days of negotiation over the what he called the "DET" (damned extremes table)

Here's what was finally approved (Sir John said he never thought we'd get it through)

Confidence in observed changes (latter half of the 20th century)	Changes in Phenomenon	Confidence in projected changes (during the 21st century)
Likely	**Higher maximum temperatures and more hot days[a] over nearly all land areas**	Very likely
Very likely	**Higher minimum temperatures, fewer cold days and frost days over nearly all land areas**	Very likely
Very likely	**Reduced diurnal temperature range over most land areas**	Very likely
Likely, over many areas	**Increase of heat index[b] over land areas**	Very likely, over most areas
Likely, over many Northern Hemisphere mid- to high latitude land areas	**More intense precipitation events[c]**	Very likely, over many areas
Likely, in a few areas	**Increased summer continental drying and associated risk of drought**	Likely, over most mid-latitude continental interiors. (Lack of consistent projections in other areas)
Not observed in the few analyses available	**Increase in tropical cyclone peak wind intensities[d]**	Likely, over some areas
Insufficient data for assessment	**Increase in tropical cyclone mean and peak precipitation intensities[d]**	Likely, over some areas

[a] Hot days refers to a day whose maximum temperature reaches or exceeds some temperature that is considered a critical threshold for impacts on human and natural systems. Actual thresholds vary regionally, but typical values include 32°C, 35°C or 40°C.

[b] Heat index refers to a combination of temperature and humidity that measures effects on human comfort.

[c] For other areas, there are either insufficient data or conflicting analyses.

[d] Past and future changes in tropical cyclone location and frequency are uncertain.

In preparation for the AR4, there was a workshop in Paris in 2004 on climate sensitivity.

Here's Ron on the Seine dinner cruise demonstrating the magnitude of climate sensitivity: ("it's about this big")

IPCC Plenary for acceptance of the AR4, Paris, France, Jan. 29-Feb. 1, 2007

IPCC AR4: for the first time in IPCC history, Ron was not an author of the projections chapter

Climate Models and Their Evaluation

Coordinating Lead Authors:

David A. Randall (USA), Richard A. Wood (UK)

Lead Authors:

Sandrine Bony (France), Robert Colman (Australia), Thierry Fichefet (Belgium), John Fyfe (Canada), Vladimir Kattsov (Russian Federation), Andrew Pitman (Australia), Jagadish Shukla (USA), Jayaraman Srinivasan (India), Ronald J. Stouffer (USA), Akimasa Sumi (Japan), Karl E. Taylor (USA)

IPCC Plenary for acceptance of the AR4, Paris, France, Jan. 29-Feb. 1, 2007

There was a media frenzy at the closing press conference

IPCC AR4 press conference, Paris, February 2, 2007

Ron stayed at the press conference for about an hour, then had to leave to catch a plane.

Ron recalled, **"Sky News interviewed me as I was walking down the street going back to the hotel. Somebody saw the interview live in Europe (I forget who). It was a weird experience".**

Ron Stouffer wins Nobel Peace Prize for his IPCC work

(along with several hundred of his closest friends/colleagues)

Al is holding Ron’s award and it is shown in the next slide

Al Gore was kind enough to travel to Oslo to accept Ron’s Nobel Peace Prize for him

Den Norske Nobelkomite
har overenssemmende med
reglene i det av

ALFRED NOBEL

den 27, November 1895
opprettede testamente tildelt

Intergovernmental
Panel on Climate
Change

Ronald Stouffer

Nobels Fredspris

for 2007

Oslo, 10 Desember 2007

How do scientists celebrate the Nobel Peace Prize?

Hold a science workshop in Hawaii!

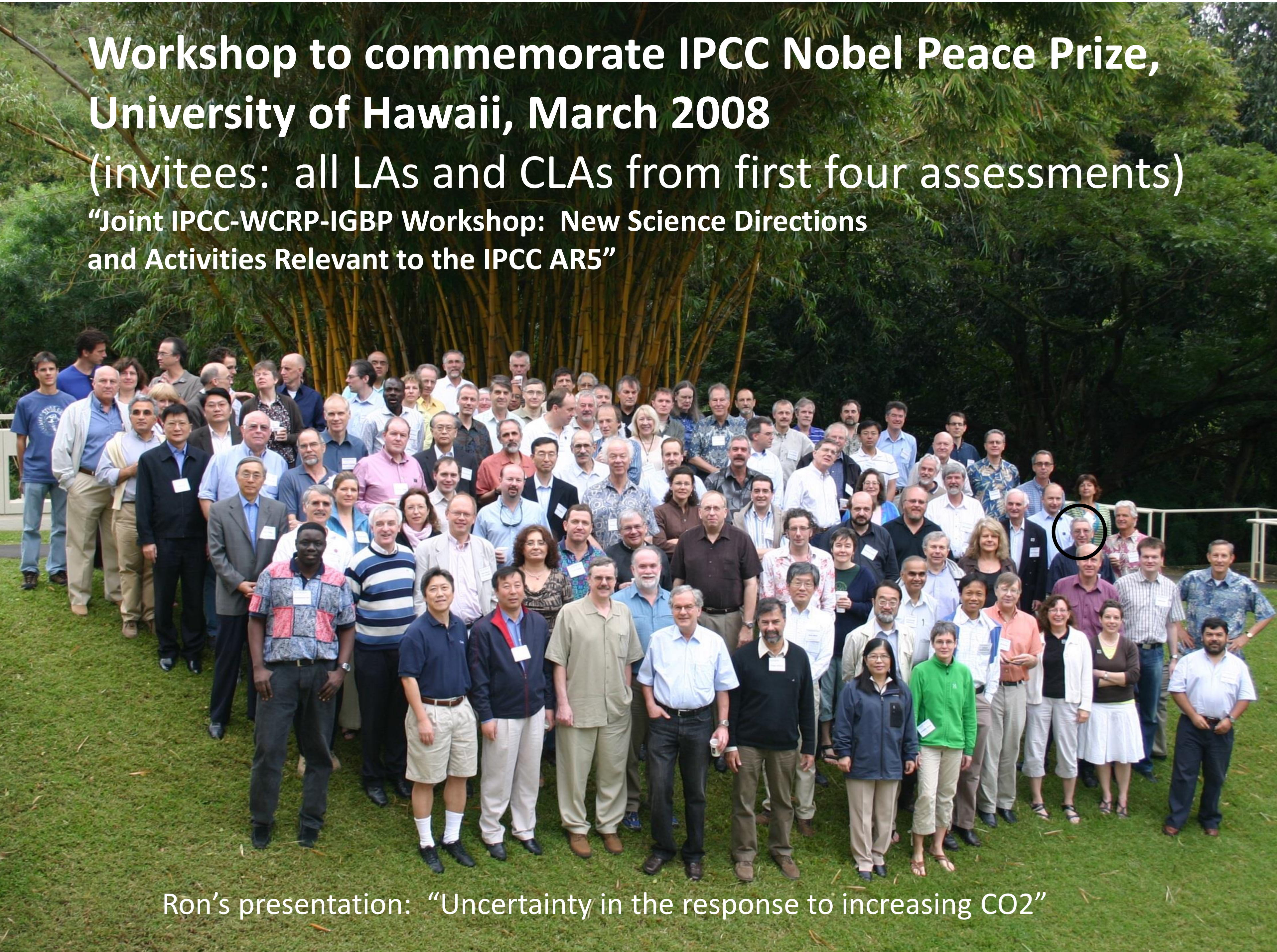
Organizing committee for science workshop to commemorate the awarding of the Nobel Peace Prize to IPCC (March, 2008, hosted by IPRC, University of Hawaii):

Jerry Meehl, Susan Solomon, Kevin Hamilton, Thomas Stocker, Ron Stouffer

Workshop to commemorate IPCC Nobel Peace Prize, University of Hawaii, March 2008

(invitees: all LAs and CLAs from first four assessments)

"Joint IPCC-WCRP-IGBP Workshop: New Science Directions and Activities Relevant to the IPCC AR5"



Ron's presentation: "Uncertainty in the response to increasing CO2"

It's been a great pleasure working with Ron on the IPCC assessments over the years, sharing travel adventures (and it's always an adventure when Ron travels, like the time he single-handedly closed down the Victoria, British Columbia, airport and they tried to blow up his GFDL laptop…). Marla and I have greatly appreciated spending time with Ron and Pat in various exotic meeting locales…next stop, Tucson!

The start of the modern era of multi-model global coupled climate model simulations (IPCC 1992 update to the First Assessment Report)

GFDL (USA), MPI (Germany), NCAR (USA), UKMO (UK); 1% per year CO2 increase, ~5° resolution (more "personal communication" results!)

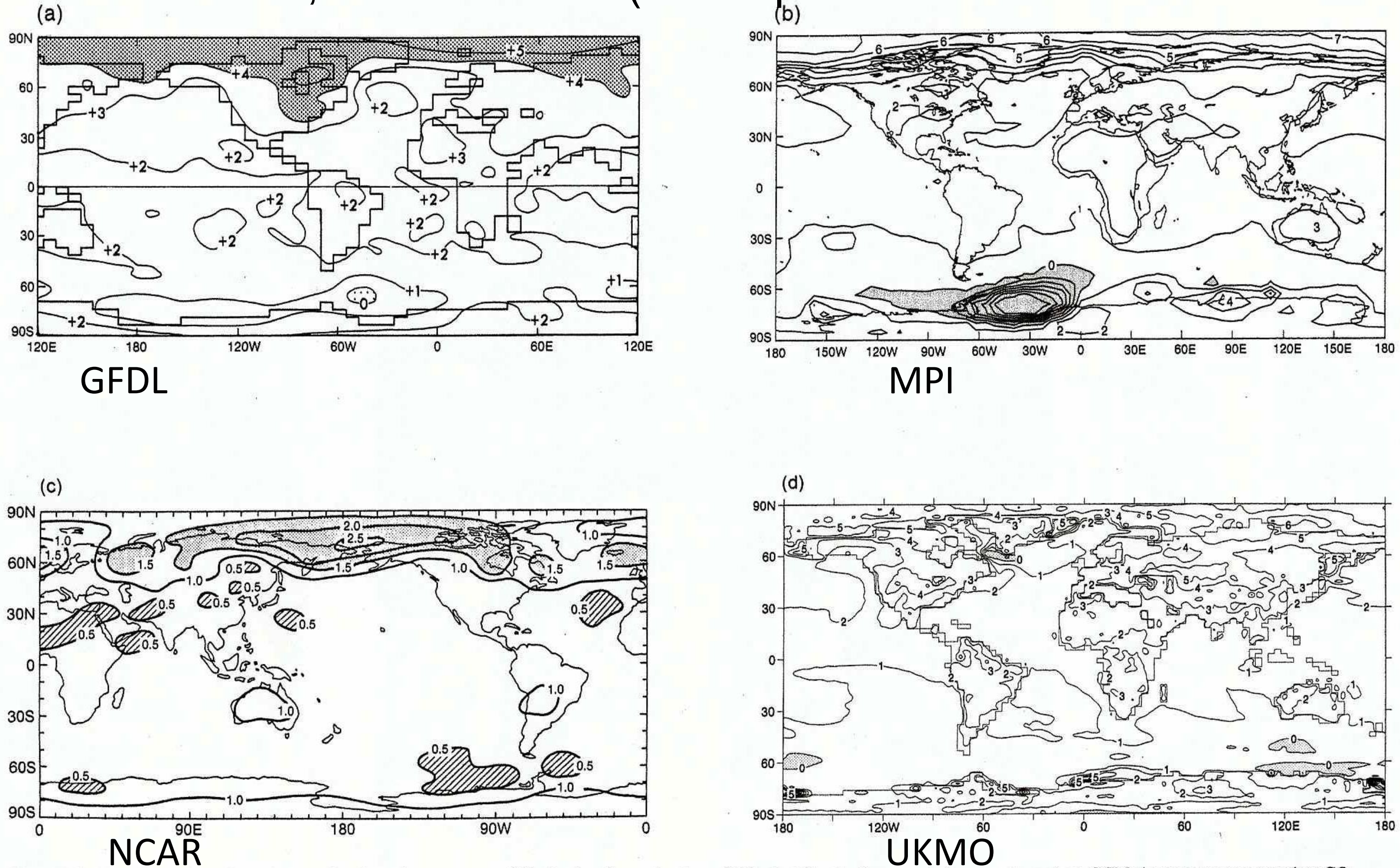


Figure B4: The distribution of the change of surface air temperature (°C) simulated near the time of CO_2 doubling by four coupled ocean-atmosphere GCMs in response to a transient CO_2 increase. (a) The GFDL results are averaged over years 60-80 and referenced to the 100-year average of a control; (b) the MPI results are averaged over years 56-65 and referenced to the corresponding years of a control; (c) the NCAR results are averaged over years 31-60 and referenced to the corresponding control years; (d) the UKMO results are averaged over years 65-75 and are referenced to the corresponding years of a control (Manabe *et al.*, 1991; U. Cubasch, G.A. Meehl and J.F.B. Mitchell, all by personal communication.)

1992 was the year of the Earth Summit in Rio that marked the start of the interface between climate science and policy on the international scale

An update to the 1990 IPCC First Assessment had just been published earlier in 1992; there were then four global coupled climate models, and many more groups were developing new models around the world

An AGCI session was convened in the summer of 1992 to modestly chart the future course of earth system modeling

1992 "next steps" proposed as a strategy for the future of earth system modeling in the Eos article (obvious now, but in 1992 these were new concepts):

--higher model resolution
--improvements in model physics
--"time slice" experiments with high resolution atmospheric models
--level of complexity of ESMs related to analysis and impact studies
--must understand the mechanisms of forcing related to internal variability
--must understand the responses to a variety of anthropogenic and natural forcings
--must improve understanding of clouds and cloud feedbacks
--more observational programs and incorporate knowledge from those programs into the models
--improved representation of land surface processes
--must understand mechanisms of decadal variability such as that associated with the "conveyor belt" in the Atlantic
--include atmospheric chemistry and prognostic aerosols
--include terrestrial ecosystem components
--model results need to be appropriate for impacts analyses
--earth system models should be used to inform adaptation and mitigation strategies
--must take into account population and technological solutions related to adaptation and mitigation
--earth system model information "must be disseminated to national, state and local policymakers based on adaptations of model-based scenarios with appropriate caveats"

Another landmark AGCI session: August, 2006, to formulate CMIP5

Participants were climate modelers, chemistry and aerosol modelers, land surface modelers, biogeochemistry modelers, IAM modelers, IAV researchers

“Firsts” in the 2006 AGCI CMIP5 session (described by Hibbard et al 2007 Eos article)

--first time the future climate change problem was divided into near-term and long-term timescales, reflecting a shift of the science with the emergence of decadal climate prediction and the needs of the stakeholder community for near-term climate change information

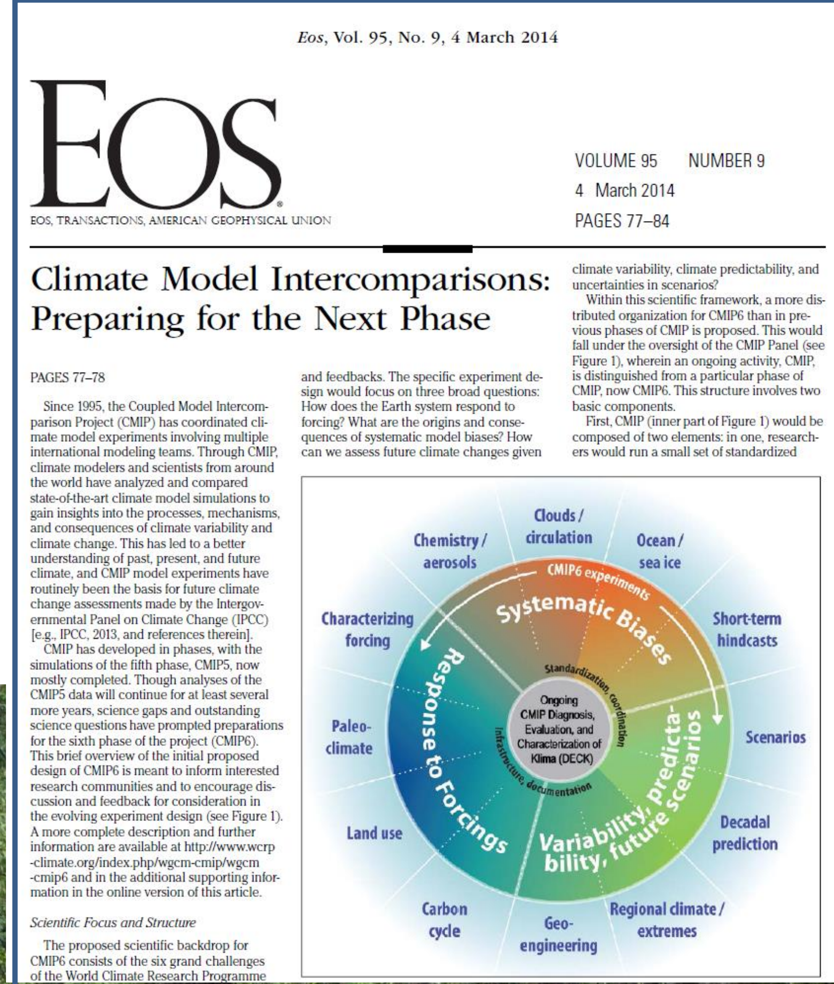
--this session essentially launched the field of decadal climate prediction as a new area of climate science

--the first time ESM experiments were included in a CMIP phase, reflecting the rise of carbon cycle components being included in standard AOGCMs

--first time to connect the Earth System Modeling Community with the Integrated Assessment Modeling community in planning a CMIP phase

--the first time idealized experiments to promote understanding of the climate system were formulated for inclusion in a CMIP phase

2013: Given the success of the 2006 AGCI session in formulating CMIP5, it was decided to convene an AGCI session in 2013 to plan CMIP6 bringing together climate scientists, IAM modelers and IAV researchers



Eos, Vol. 95, No. 9, 4 March 2014

EOS

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

VOLUME 95 NUMBER 9
4 March 2014
PAGES 77–84

Climate Model Intercomparisons: Preparing for the Next Phase

PAGES 77–78

Since 1995, the Coupled Model Intercomparison Project (CMIP) has coordinated climate model experiments involving multiple international modeling teams. Through CMIP, climate modelers and scientists from around the world have analyzed and compared state-of-the-art climate model simulations to gain insights into the processes, mechanisms, and consequences of climate variability and climate change. This has led to a better understanding of past, present, and future climate, and CMIP model experiments have routinely been the basis for future climate change assessments made by the Intergovernmental Panel on Climate Change (IPCC) [e.g., IPCC, 2013, and references therein].

CMIP has developed in phases, with the simulations of the fifth phase, CMIP5, now mostly completed. Though analyses of the CMIP5 data will continue for at least several more years, science gaps and outstanding science questions have prompted preparations for the sixth phase of the project (CMIP6). This brief overview of the initial proposed design of CMIP6 is meant to inform interested research communities and to encourage discussion and feedback for consideration in the evolving experiment design (see Figure 1). A more complete description and further information are available at http://www.wcrp-climate.org/index.php/wgcm-cmip/wgcm-cmip6 and in the additional supporting information in the online version of this article.

Scientific Focus and Structure

The proposed scientific backdrop for CMIP6 consists of the six grand challenges of the World Climate Research Programme

and feedbacks. The specific experiment design would focus on three broad questions: How does the Earth system respond to forcing? What are the origins and consequences of systematic model biases? How can we assess future climate changes given

Clouds / circulation
Ocean / sea ice
Chemistry / aerosols
CMIP6 experiments
Systematic Biases
Characterizing forcing
Short-term hindcasts
Response to Forcings
Standardization, coordination
Ongoing CMIP Diagnosis, Evaluation, and Characterization of Klima (DECK)
Infrastructure, documentation
Paleo-climate
Scenarios
Variability, predictability, future scenarios
Land use
Decadal prediction
Carbon cycle
Geo-engineering
Regional climate / extremes

climate variability, climate predictability, and uncertainties in scenarios?

Within this scientific framework, a more distributed organization for CMIP6 than in previous phases of CMIP is proposed. This would fall under the oversight of the CMIP Panel (see Figure 1), wherein an ongoing activity, CMIP, is distinguished from a particular phase of CMIP, now CMIP6. This structure involves two basic components.

First, CMIP (inner part of Figure 1) would be composed of two elements: in one, researchers would run a small set of standardized