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CREATION DATE/TIME:14-OCT-1997 10:32:28.00

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TEXT:

TO: Members of the Subcommittee on Global Research

FROM: Lowell Smith

As many of you might already know, the Board on Atmospheric Sciences and Climate's Climate Research Committee will be meeting Wed-Friday, October 15-17, 1997 at 2001 Wisconsin Avenue, N.W. Green Building, 104, Wash, D.C. On wednesday evening, the committee will be hosting a reception. The committee, invited speakers, and agency representatives will be in attendance to mingle, and informally discuss issues related to climate. A draft agenda is attached. Please feel free to contact us if you need more information.

Thanks

DRAFT AGENDA
CLIMATE RESEARCH COMMITTEE MEETING
15 - 17 OCTOBER 1997

Wednesday, 15 October 1997
Green Building Room 104

OPEN SESSION

8:15 AM Opening Remarks
- CRC statement of task
- meeting objectives
- administrative matters

8:30 AM Introductions
- committee members
- meeting attendees

RESPONSIBILITIES TO OUR CLIENTS:

8:50 AM Report on U.S. Global Change Research Program

- revised USGCRP structure and functioning of USGCRP units
- Nancy Maynard

Each of the following short discussions with a panel of federal program managers is aimed at characterizing the work status of selected USGCRP units and promoting a discussion of their expectations for the work of CRC and its panels. Each discussion should address:

- status of USGCRP major projects and initiatives
- discussion among federal representatives and committee members of each individual units expectations of CRC

9:10 AM Earth System Science W/G
and Integrated Modeling & Prediction T/T
-----Dick Greenfield and Jay Fein

9:30 AM Seasonal to Interannual Climate Variability P/P
-----Ken Mooney

9:50 AM BREAK

10:10 AM Decadal to Centennial Climate Change P/P
-----Pat Crowley

10:30 AM National Assessments W/G
-----Paul Dresler

10:50 AM Monitoring and Observations W/G
-----Bob Schiffer

11:10 AM Wrap-up Discussion of USGCRP Expectations

OUR ONGOING NRC RESPONSIBILITIES:

11:30 AM LUNCH (in meeting room) with Brief Reports from Other NRC Units on their Climate Research Related Activities

Brief reports (~5 min) on other NRC units activities related to climate research, either as a complementary aspect of climate research on the Earth system, or as a potential user of climate research results for impact analysis purposes

- BASC Bill Sprigg (guidance from June BASC meeting)
- BSD and CGCR Dave Goodrich
- OSB Dan Walker
- CGED Anne Linn
- Eco Panel David Policansky
- BOND Steve Parker
- CHDGC no presentation
- PRB Chris Elfring
- NWSM Floyd Hauth

1:00 PM CRC Discussion with Government Officials on the WCRP Science Conference Statement on the Status of Critical Climate Observing Systems
-----Tom Spence
-----Jonathan Pershing
-----Rosina Bierbaum and Peter Backlund

2:00 PM Report on the World Climate Research Programmes Science Conference
-----Larry Gates

2:30 PM Report on the Intergovernmental Panel on Climate Change
----Richard Moss

3:00 PM BREAK

3:20 PM Interactions with and Coordination of CRCs Panels and WSTB
- GEWEX and WSTB
----Soroosh Sorooshian
----Steve Parker
- GOALS
----Peter Webster
- DEC-CEN
----Doug Martinson

5:00 PM Reprise of Days Discussions
---Looking Towards a CRC Work Program

5:45 PM Adjourn Formal Discussions for Day

6:00 PM RECEPTION for all meeting participants
to 8:00 PM ---Informal discussion of issues

Thursday, 16 October 1997
Green Building Room 104

OPEN SESSION

STATUS of OBSERVING SYSTEMS and ACCESS TO DATA RELATED to CLIMATE RESEARCH

8:15 AM Perspective on a Growing Problem
----Tom Karl

This session is aimed at examining the current status and future prospects for observations systems which supply data that are relevant to predicting and documenting climate variability and to documenting climate trends. Discussions will include both the current and prospective adequacy of network functioning and access to network data, taking WMO Resolution 40 and other recent political actions into account.

8:30 AM Surface Observing Networks
- Global network status
----Chet Ropelewski
- NWSM studies
----Bill Bonner
- Canadian network status
----Ted Yuzyk

9:25 AM Upper Air Observing Networks
- NAOS
----Fred Toepfer
- N. American and Global network status
----Carl Bower

10:05 AM BREAK

10:20 AM Marine Observing Networks
- North American network status
----Laura Cook
- Global network status
----Molly Berringer

11:10 AM Satellite Platform Observations

- NOAA satellite status
- Gary Davis
- MTPE biennial review results
- Bob Schiffer
- CES study on NPOESS / EOS Merger
- Art Charo

12:00 PM LUNCH (in meeting room)

12:20 PM CEOS and IGOS Plans and Status (working lunch discussion)
----Bob Schiffer

1:00 PM Data Access and Management Issues
----Les Merideth
----Anne Linn
----Ferris Webster

1:45 PM GCOS Plans and Implementation Strategy
----Tom Spence

2:30 PM Discussion of Observation Issues
- How accurate are perceptions of network degradation?
- How serious is this situation?
- Is a quick-turnaround CRC study on current trends indicated?
- What should CRCs activities be with respect to developing a USGCRP strategy for support of a global climate observing system?

3:00 PM BREAK

3:20 PM Continuation of Discussion of Observation Issues

4:20 PM DISCUSSION of ADDITIONAL MAJOR CRC ISSUES
- CRC and the BASCs Twenty-first Century Report
- CRC and the IPCCs and the US National Assessment Programs Future Assessment Reports
- CRC and Earth System Science and Integrated Climate System Modeling

5:40 PM Reprise of Days Discussions

6:00 PM Adjourn for Day

Friday, 17 October 1997
Green Building Room 110

EXECUTIVE SESSION

8:30 AM Modeling Report Status

9:00 AM Committee Bias and Balance Discussion

10:00 AM BREAK

10:15 AM Discussion of CRC Priorities (with invited guests)

11:30 AM Discussion of Individual Work Assignments

12:30 PM Working Lunch (in meeting room)

1:30 PM Adjourn Meeting to a Work Session on Draft Modeling Report

RECORD TYPE: PRESIDENTIAL (NOTES MAIL)

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CREATION DATE/TIME: 25-FEB-1999 08:04:18.00

SUBJECT: CRC summary

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TEXT:

This email is to all members of the CRC and those individuals whose comments are paraphrased in the summary of the CRC meeting. The summary is attached below. Please provide me with feedback if your statements are summarized incorrectly. The summary will be posted on the BASC web site by next Wednesday, Feb. 31.

Cheers,
 Peter Schultz

Notes from the Climate Research Committee Meeting

February 3-5, 1999

These notes have not been approved by the NRC, nor do they reflect a consensus of the NRC Climate Research Committee.

Wednesday, February 3

CLOSED SESSION

Topics discussed:

- û meeting agenda
- û dissemination of recent CRC reports on modeling and observations

OPEN SESSION

Introductions

Briefing on the CRC's Panel on Climate Observing Systems? Status report
 Tom Karl (CRC chair), NOAA National Climatic Data Center

Karl discussed the context of the report, including its relationship to the Framework Convention on Climate Change (FCCC) Conference Of Parties 4 and the importance of sustained, precise, accurate, and relevant climate observations. He discussed the stagnant or falling numbers of observing stations in several systems including GHCN, CARDS, and COADS and indicated that no comprehensive system currently exists to explicitly observe or document climate variability or changes. Karl listed some of the key variables that need to be measured to describe climate variations and change relevant to detection, attribution, and direct societal impacts. He briefly listed the 10 basic principles (?commandments?) of climate monitoring put forth in the report. The report provides an assessment, based on the 10 monitoring principles, of how well several key variables are being monitored. Karl provided examples of problems of the manner in which climate observations are currently made, including for polar ice coverage, tropical cyclones, clouds, OLR, snow coverage, temperature, and precipitation. These problems include decreasing numbers of in situ observations, changes in sensors, poor instrument precision and intercalibration, changes in satellite equatorial crossing time, and changes in diagnostic algorithms. He noted that the USGCRP agencies lack the ability to routinize the monitoring of key climate variables and that the USGCRP has neither the charter nor the ability to compel the agencies to do so. Furthermore, no agency has stepped up to the job of monitoring, archiving, and disseminating such variables on a routine basis. He stated that performance measures related to monitoring long-term climate need to be established.

In conclusion, Karl summarized what is needed:

- a. A new paradigm of observing and data management systems for detecting and attributing climate change is required.
- b. The 10 principles should be adopted.

He then summarized what will occur if these needs are not met:

- a. The current system will deteriorate.
- b. The ability of the climate research community to provide accurate information will be compromised.
- c. The USGCRP will continue to struggle to tease out anthropogenic changes vs. natural.

Karl's briefing was followed by an open question and answer session.

Below are some of the comments from the audience:

- û The U.S. agencies need to assume responsibility for the deficiencies highlighted in the PCOSS report.
- û Because the requisite precision standards for climate observations are so high, there needs to be a central organization that uses consistent standards. (Giraytys)
- û As long as the mission statement of the agencies do not have ?climate? in them, there will continue to be a disconnect. While there will always be problems, there are many fundamental improvements that can be made. It is critical that the relevant agencies reflect the key principles in their mission statements.
- û We need to improve our ability to move from research to operational systems. NASA is currently addressing this issue. (Morel)
- û The incremental approach to fixing the problems noted in the report has some merit. For instance, progress is being made in making remote sensing observations more stable for climate applications. (Morel)
- û ?Absolute calibration and absolute accuracy? are missing from the 10 commandments. (Unninayer)
- û There are a few things that could make big improvements, e.g., improving equatorial crossing time and consistency among radiosondes. (Hansen)
- û There is no focal climate point as there is for weather with the NWS.

ú A single system can serve a number of different users if (1) it is ascertained who the users are and (2) a system is designed that meets their needs. This has not happened--not even the initial steps. Moreover, we do not have the money to pay for it. The problem is scientific, engineering, and organizational.

Base Funding, Paper Tapes, Profiling Floats, and Satellites
James Baker, NOAA

Baker noted that, in the past, base funding (i.e., covering inflation-rated costs or adjustments to base) has been difficult. However, the administration's budget this year takes this into account. He discussed upgrading the weather network to a climate reference network, as well as upgrading the cooperative observing network. The replacement of paper tapes for the rain gauge network is now in the works and will deliver 1-minute versus the current 15-minute temporal resolution. Improvements in meta data are also slated. The proposed budget also has funding for improved access to data, carbon monitoring, and ozonesondes on Antarctica. Insurances for the continuity of various data streams are also slated for funding increases. A major push will be made to improve the climate observing network in the 2001 budget.

A commitment to an expanded ocean observing system has been made within NOAA. A first step was converting the research funding mode for the TOGA/TAO array to an operational one. An increase in the 2000 budget has been proposed to expand coverage of autonomous profiling floats. Additional funding is also being sought from Japan, U.K., Germany, and the European Union for these purposes.

Baker discussed the convergence of efforts that is going into the National Polar-orbiting Operational Environmental Satellite System (NPOESS). He noted that the system needs to be linked to climate needs, even though the system is primarily being established for weather needs. The instrument development that was part of EOS will be used in the development of this system. The NPOESS Preparatory Project (NPP) will be a test mission for risk reduction and bridging the EOS program with NPOESS. Interfacing the operational with the research needs of this system is important. He stated that the Academy could provide valuable advice on the transitioning from research to operational functions.

He commented that while climate activities are spread across several of the NOAA line organizations, coordination of these is important and efforts are being made to reflect the needs of the various communities. He stressed the importance of putting GCOS in place.

He briefly mentioned the funding for computer acquisitions in the current budget proposal and the increased funding to GFDL in that regard.

Below are some of the comments, questions, and answers (indented) that followed Baker's presentation:

ú Many of the elements of the current provision of climate services are piecemeal. In particular, the NWS has no explicit climate mission. What are the problems in establishing a Climate Service? (Sarachik)
ô We are ready to start defining such a service. We could start putting in place the essential building blocks. The dialogue should begin now. It can be expected that the end-result will be different from what we currently do for weather. (Baker)

ú This issue of climate services is an inter-agency one, and probably needs to be addressed at the presidential level. (Sarachik)

ô That is something that can be looked at. A joint agency program can work. This is a good issue for Neal Lane and the National Science and Technology Council. (Baker)

ú The PCOSS report paints a gloomy picture; Dr. Baker paints a rosy picture. How do we move from the state of affairs outlined in the PCOSS report to what Dr. Baker is promising? (Rasool)

ô An enormous effort is required to generate new funding. It generally happens piecemeal, because funding to implement some grand plan just has not existed. The incremental pathway needs to be sought out. We need to identify things that are feasible and are not currently being funded, and work to obtain funding for them. (Baker)

ú The PCOSS report does not address any one particular parameter or individual system. It posits a model/paradigm and set of principles in which subsequent observations should be made. (Karl)

ô A set of principles is important and could be used to assess each potential system as it is proposed. (Baker)

ú Would it be useful to set out a straw man charter for a coherent National Climate Observing Service? (Schiffer)

ô I never heard that. A dialogue should probably precede the writing of this document, and the time is probably right for this discussion. (Baker)

ú Will large-scale heat storage be determinable from the proposed ARGO float system, and would achieving that objective require complete funding? (Hansen)

ô Yes. A global system is critical; the U.S. efforts alone are not sufficient. (Baker)

ú One concern is how the community can provide input that will deal with some of the measurement and archival issues associated with NPOESS. (Wood)

Tom Karl summarized Baker's statements as follows:

1. The time is right for a dialogue on climate services, which would encompass observations and modeling.
2. The OSTP is the government framework and the NRC is the external framework for this dialogue.

Comments from Bob Corell, NSF

Corell thanked the CRC for the modeling report.

He discussed the new IT2 (Information Technology in the 21st Century) initiative, which proposes, among other things, advancing high-end modeling capabilities. Climate research is one of the few areas targeted for support by the enhanced computational capabilities. This initiative involves six agencies (NSF, DOE, DOD, NIH, NOAA, and NASA) and the proposed funding is several hundred million dollars. It would provide the information technology infrastructure, including scalable systems with exabyte capabilities and massively parallel communications, to support research in largely academic settings. One of the benchmarks is the provision of a 40-50 Teraflop computer within approximately the next 5 years. Neal Lane has created a policy level body which includes Colwell, Baker, Muniz, Goldin, Varmes, and the Assistant Secretary for Defense Acquisition to oversee this activity.

The new global change budget contains at least \$10 million to develop the next generation of climate models, which will be competitively bid.

?Our Changing Planet? is out for final review. The prepublication should be out by the end of February, with the final version to follow in another month.

Below are some of the comments, questions, and answers (indented) that followed Bob Corell's presentation:

ú With respect to the computing and communications initiatives, will data access issues be covered under this? (Karl)
 ô Yes. There are 4 major components: (1) integration; (2) exabyte storage capabilities; (3) communications and access, (4) major investments in education and training for both scientists and other personnel. (Corell)
 ú What is the relationship between this initiative and ACPI? (Sarachik)
 ô It is integral to this. ACPI was written by four agencies, even though the primary document is from DOE. (Corell)
 ú Should the NRC go on to document some of the issues that were not included in the recent NRC modeling and observational reports (e.g., parameterizations in climate models)? (Karl)
 ô We should engage in those discussions over the next month. (Corell)
 ú Baker said he was willing to champion an effort to establish a National Climate Service. What is your take on this? (Karl)
 ô ?Our Changing Planet? addresses some specific targets, including the establishment of service to broadly address global environmental change needs, involving an interface between government offices, researchers, and user communities. (Corell)
 ú How will such a service be brought to fruition? (Sarachik)
 ô That will be decided jointly by the agencies. (Corell)
 ú In such an initiative, it will be important to establish a baseline against which future changes can be compared. (Rasool)
 ú It is not a viable solution to wait for NPOESS to provide the complete answer, although it should be part of it. Originally NPOESS was not designed to address the climate issue, but now this opportunity is being seriously revisited. (Corell)
 ú Tom Spence has returned from Geneva and is now in Corell's office and working on the observation issues. (Corell)
 ú What happens to the NRC reports when they come out? How are they used? How can we improve the impact the reports have? (Karl)
 ô Reports that set the long-range horizon powerfully influence what we do. (Corell)
 ú The sum of the reports is somewhat different from each report in isolation. How can we exert collective influence? (Miller)
 ô There is an opportunity to educate a lot of people. You can do a series of briefings, but that momentum soon fizzles out. The message needs to continue to be carried. You might go beyond press releases to things like ?one pagers? and informal briefings to inform individuals such as the House Science Committee. We are in a new era where stunningly well done reports sometimes may not be enough. (Corell)
 ô The NRC is currently exploring these options.
 ú A problem with a big omnibus like the Pathways report is that priorities still remain to be established. However, some things that are highlighted in there (e.g., carbon cycle) can be used in the process and make a difference. (Goodrich)
 ú Can the executive summaries of some of the NRC reports be included in ?Our Changing Planet?? (Sarachik)
 ô It's certainly a possibility. We will explore it. (Corell)
 ú The Global Change Research Information Office could also help disseminate the reports? information. (Miller)
 ú The new NSF director says that fundamental research is drastically underfunded. Funding for NSF should be of the same order of magnitude as for health. But to accomplish this we cannot continue to argue for more of the same. Large, convergent issues need to be collectively identified and pursued. This has happened with the carbon cycle in the present budget proposal. One possibility for the future is with the hydrologic cycle. (Corell)
 ú A comprehensive Climate Observing System does have the potential for being something that could be labeled as ?new.? (Backlund)
 ô One way to increase the practical feasibility of a Climate Observing System is to make it part of a larger thing: e.g., a Climate Service. (Corell)
 ú Why is the carbon cycle different from climate observations in terms of generating additional funding? (Sarachik)
 ô One reason is because there has already been significant money spent on observations, but very little on the carbon cycle. (Backlund)
 ô There is a distinction, however, between an observing system and the carbon cycle initiative. The observations must be sustained, whereas the carbon cycle initiative involves an increase in understanding that is of a limited-time endeavor. (Giraytys)
 ú A legitimate question to pose is what trade-offs would we be willing to make. e.g., trading some new sensors vs. one long-term, well-calibrated sensor. (Goodrich)
 ú One of the reasons that particle physics gets so much money is that they speak with a common voice. (Sarachik)
 ú The findings of the various NRC reports should be taken to the highest governmental levels. This is an issue for Bruce Alberts. (Sarachik)

ú We need to rethink the way we pitch our ideas in terms of answers instead of as problems. (Miller)
 ú Could there be an off-the-record meeting of the chairs of the various relevant NRC committees (and possibly other committees, e.g., Sarmiento) and the relevant agency representatives? (Corell)

Thursday, February 4

OPEN SESSION

Briefing on the GEWEX Panel's activities
 Soroosh Sorooshian, GEWEX Panel Chair, University of Arizona

The panel is currently conducting a review of the Global Water Vapor Program. Sorooshian discussed the context of the relationship between GEWEX and CLIVAR, including discussions at the October 1998 GEWEX panel meeting that pointed toward the necessity of the contributions of GEWEX to CLIVAR. He summarized the principal recommendations from the panel's recent report on GEWEX-CLIVAR interactions, including the potential for colocation of the U.S. CLIVAR program office with a U.S. GEWEX program office. The panel has received a letter from Jay Fein, Pam Stephens, and Doug James (NSF) urging the NRC GEWEX panel and the interagency CLIVAR scientific steering committee to examine opportunities for coordination between the two programs. The panel will be examining this coordination issue more closely at its upcoming meeting on March 18-19 in Irvine, California. Sorooshian requested the USGCRP agencies to relay to the NRC whether they want the GEWEX panel or an independent SSC to provide guidance to U.S. GEWEX activities. At the upcoming meeting, the GEWEX panel will also consider the proposed follow-on to GCIP: the GEWEX American Prediction Project (GAPP), which will emphasize predicting water resources on time scales up to seasonal. Sorooshian briefly mentioned the upcoming GEWEX Coordinated Extended Observing Period (CEOP) and the scientific contributions that the CEOP is expected to make.

Rick Lawford, NOAA, GCIP Program Manager

Lawford discussed some of the existing and proposed data products that have been produced within GCIP, including the creation of a NEXRAD and in situ precipitation data base to provide hourly estimates over the Mississippi River basin. He discussed some of the numerous scientific advances that have come out of GCIP and linking these advances with other GEWEX and non-GEWEX projects. He outlined several areas where more work is needed, including in the realms of extended range/ENSO forecasting, land data collection, management, assimilation, and water resource applications. Lawford also discussed the principal research elements of GAPP: (a) land surface memory; (b) American monsoon (CLIVAR/VAMOS/PACS links); (c) global land surface processes; and (d) water resource assessments.

Paul Try, SAIC, Director of the International GEWEX Program

Try outlined some of the major foci for the international GEWEX program including: the upcoming CEOP; extension of certain data sets to provide overlapping, global coverage; increasing the attention to modeling and prediction; greater exploitation of the Continental-Scale Experiments (CSE), in particular for examining water resource issues; and increasing the emphasis on intra-GEWEX/inter-WCRP planning and coordination. He discussed current deficiencies in the operational use of available hydrological knowledge such as the use of constant evapotranspiration and groundwater recharge values from one year to the next by the water planners of Tucson, Arizona. He also mentioned deficiencies in knowledge that impair water resource decision making, such as the spatial gaps in NEXRAD coverage in the U.S. Rocky Mountains which affects the ability to derive reliable snowpack estimates.

Tom Karl initiated the ensuing discussion by asking where the GEWEX panel should be focusing its future efforts. In response, Jay Fein made several comments, summarized as follows:

ú There will be a convergence of global observing systems between 2002 and 2005+, including a new array of ocean floats, a new set of small satellites to produce atmospheric profiles of water vapor and temperature, and the EOS satellites. This provides, for the first time, the opportunity for there to be a global climate prediction system. In order for the potential of this convergence of observing systems to be realized, certain steps need to be taken, such as strong coordination between the GEWEX CEOP and EOS. (Fein)

The following questions and comments were then posed to Fein:

ú Is the science moving forward to take advantage of these opportunities? (Soroosh)

ú How does this new opportunity relate to the GEWEX-CLIVAR planning considerations? (Try)

ó Those discussions are very relevant. It is important for the GEWEX community to plan around what will be available. (Fein)

ú The land component of Fein's system is deficient. But there is a potential WMO initiative that is in the early stages of discussion to address this need. (Wood)

ó The United States, however, is not sending anyone to these discussions because it is not an active member of UNESCO. (Soroosh)

ú Operational observations and operational forecasts are required. Fein discussed a convergence of observing systems that, while extremely useful, is not operational. A substantial program is required to transition into operational activities. How do we make science programs operational? (Giraytys)

ó An NRC workshop has been proposed for this summer to address the issue of research-to-operational transitioning. (Karl)

Briefing on the CRC's report "Capacity of U.S. Climate Modeling
to Support Climate Change Assessment Activities?"
Edward Sarachik, University of Washington

Sarachik discussed the CRC's statement of task vis-a-vis the modeling report, as well as the report's background, including the U.S. contributions to the second IPCC report. He outlined the report's two primary findings:

1. The lack of a coordinated U.S. climate modeling strategy is hampering progress in high-end climate modeling activities, and;
2. The United States lacks the computational capabilities to carry out the high-end climate modeling simulations and experiments to apply the existing U.S. intellectual expertise to important science and policy questions.

He indicated what the current computational capabilities are at the major U.S. modeling centers (i.e., 5-15 GFLOPS) and that we should be headed toward at least 10TFLOPS capabilities in the next few years. A 1TFLOPS machine is currently available from NEC (SX/5), however, the U.S. is effectively prohibited from purchasing such a machine. He discussed the multiple imperatives for why the U.S. should increase its modeling capabilities and that these imperatives have nothing to do with jingoism.

Sarachik discussed issues that still need to be addressed by the modeling community:

1. Determination of current modeling assets.
2. Coordination of modeling
 - Establishing mechanisms for interagency coordination (USGCRP?)
 - Establishing the nature of a national plan
3. Access to large computer resources
4. Access to both domestic and foreign model output
5. Commercialization by Europeans. Enhancing our own high-end capabilities can obviate the associated problems.
6. Interactions between scales. Weather, Seasonal-Interannual, Decadal, Long-term (to Ice Age)
7. Physical facility
 - The U.S. needs a facility comparable in scale to the Fermi lab with development, diagnostics, and theoretical people, but NOT modelers. It would facilitate a common modeling infrastructure.

He asked the agency representatives whether the CRC should assist in defining some of these issues.

Comments from Ari Patrinos, DOE

Patrinos accepted most of the CRC modeling report's criticisms. He also indicated that there are encouraging developments. The IT2 initiative in the administration's budget is one. He also pointed toward the significant modeling-related budget requests for this purpose in the NSF, NOAA, and NASA budgets. He committed to improving the coordination of U.S. modeling and indicated that deliberations and discussions on this must be rapid to influence the process.

If the DOE initiative reaches fruition, climate modeling would get 1/2 of a 40-teraflop machine by the mid- to early part of the next decade. Although climate modeling is competing with several other potential fields of computational endeavor, it has been identified as one of the front runners in terms of readiness to utilize advanced computational capabilities. However, the danger in being a front runner is that front runners become targets.

Patrinos concluded by noting that if funding for the new initiatives is forthcoming, the agencies will need solid and timely advice on how to implement their activities and that this input could come from the CRC.

Discussion of the March 8-9 NRC/IPCC Workshop on
Reconciling Temperature Observations
Joe Friday, National Research Council

Friday described a potential series of workshops on critical areas in climate research. There are indications that such a series would be of interest to a wide range of business, industry, policy, and science concerns. The first workshop in this series is a joint undertaking with the Intergovernmental Panel on Climate Change (IPCC) to examine the biases of the Microwave Sounding Unit (MSU) and radiosonde observations of tropospheric temperature and the apparent discrepancies of these data with in situ observations of surface temperature. The study will articulate the areas of agreement and disagreement, and a path toward resolving the issues in a consensus report. An ad hoc panel of the CRC, comprised of experts representing all major scientific sides of the issue, will produce this report. Thirty percent of the funding for this activity is from Alcoa; the remainder is from the USGCRP.

Discussion on the use of small, low orbit satellites in evaluating climate
models
Richard Goody

Goody described a system that he, James Anderson, and Gerald North proposed in the Bulletin of the American Meteorological Society (Vol. 79, No. 11) to test climate models using thermal brightness temperatures and refractivities measured from an array of small, low orbit satellites. In discussing the background for this proposal, he remarked that while there will never be a magic bullet for model testing, doing nothing less than all that we can is essential.

The technique that his group has put forth to measure spectral radiances is global, precise, and calibratable against absolute standards to an accuracy of ~ 0.1 K. Their technique for measuring refractivities (a function of temperature and humidity) uses radio occultation measurements of the Global Positioning System, which give data of accuracy similar to the aforementioned radiances. Refractivities and radiances are quantities that can be directly compared to quantities that are precisely derivable from climate model output. This is a low cost approach: $\sim \$40$ million for a 6-satellite array capable of making ~ 3000 occultation observations per day. The multiple platform array largely eliminates problems of changes in equatorial crossing time associated with single platform systems.

Goody briefly discussed an optimal filtering technique and the use of high-order statistics that might be used to compare model output to the observations of radiances and refractivities to assess GCM performance. If a model is reliable it should contain the same EOFs as the observations. If not, it will likely predict a false climate sensitivity. Furthermore, he stated that by using the proposed observational system and a robust model, an anthropogenic climate fingerprint could be determined in approximately 10 years.

Goody stated that while the approach he has put forth is a relatively simple one, its transparency is one of its strengths. It should, of course, be used in concert with other evaluation approaches.

Below are some of the comments and questions posed to Goody.

- ú Do we have the capability to appeal to the agencies to adopt this approach? (Karl)
- ö I didn't come here to persuade you of anything. But it is important to make proposals, write papers, and put ideas in the public domain for direct testing of climate models. This is one of several proposals that might be made. (Goody)
- ú Models have not passed previous tests, even crude ones. I would not expect them to pass a high precision test such as the one that you propose. Perhaps because of this, rigorous techniques such as yours have been passed over. (Sarachik)
- ú It is interesting that NASA tends to reject inexpensive, but possibly high-risk proposals. This was the case with past sensors that have been proposed for soil moisture remote sensing. (Soroosh)

Discussion of a potential NRC study on abrupt climate change Peter Schultz, National Research Council

Schultz described the results of a recent NRC-funded workshop examining the outstanding scientific questions that are central to the study of abrupt climate change. The attendees at the workshop were representatives of the four major relevant disciplines: paleoclimatology (Jonathon Overpeck and Richard Alley), observational climatology (J. Michael Wallace and Douglas Martinson), physical oceanography (Mark Cane and Jochem Marotzke), and human dimensions (William Nordhaus and Michael Glantz). Schultz summarized several of the critical areas that require further work.

In the opinion of the workshop attendees and the three NRC boards involved (BASC, OSB, PRB), there is a clear need for Academy involvement in this issue as there is considerable scientific attention being directed toward the problem. However, there is no comprehensive, objective review of the state of the issue and no overall plan for coordinated action. Fundamental agreement as to which issues require the most attention has not been widely achieved. Guidance is needed to steer the myriad current efforts and especially to better blend science and policy needs and move toward resolution of the most relevant questions. An NRC study would help assess these considerable, diverse scientific efforts and provide guidance to identify high priority research needs, and thus more efficiently use limited funds to address this problem. The attendees agreed that such a study would:

1. Describe what is currently known from paleoclimate proxies, historical observations, and numerical modeling regarding abrupt climate change, including patterns and magnitudes of possible changes, mechanisms, forcing thresholds, and probabilities (at least qualitatively).
2. Articulate the critical knowledge gaps concerning the potential for future abrupt climate changes?i.e., What do we need to know?
3. Outline a research strategy to fill the critical knowledge gaps?i.e., How do we get from what we currently know to what we need to know?

The members of the CRC provided favorable comments regarding the pursuit of this activity and wished to be apprised of progress as it occurs in the process of getting the study off the ground.

Discussion of a potential NRC study on polar climate research issues Jamie Morison, University of Washington

Morison discussed several of the fundamental changes that have been observed since the late 1980s and early 1990s in the Arctic. These include dramatic thinning of sea ice, freshening of the upper water column, and strong shifts in oceanic and atmospheric circulation patterns. He briefly described the NSF steering committee that has been assembled to address this issue, which is focusing primarily on the nature of these changes themselves. Morison emphasized, however, that the extra-polar implications are at least as tantalizing as these poorly observed Arctic phenomena. For example, the Arctic Oscillation (AO), described by Thompson and Wallace, is a newly revealed, coherent mode of both polar and extra-polar variability that acts in concert in three of the Northern Hemisphere's major oceans (Atlantic, Pacific, and Arctic). Understanding the potential predictability of the AO and its fundamental causal and associated climate system changes is a new scientific frontier. In an analog to the NRC's guidance of early research on the predictability and prediction of ENSO

(e.g., the TOGA panel), the NRC might provide valuable advice to the agencies and scientific community in articulating a science strategy for increasing understanding of the dramatic changes that are occurring in the Arctic and their extra-polar influence.

The comments to this proposal are summarized below.

- ú It would be valuable to undertake a study session of this at an upcoming CRC meeting. (Sarachik)
- ú This issue has the potential to bridge several gaps: ocean, sea ice, climate, etc. It will be challenging to bring all of these communities together. (Karl)
- ú There are some new cryospheric sensors that are under discussion that should be considered in an NRC study of this issue. (Running)
- ú Drawing the Arctic research community into the global climate research community could be an invaluable contribution of such an activity. (Ledbetter)
- ú There is a general consensus around the table that something should be done. (Karl)
- ú The NRC (led by the Polar Research Board in collaboration with the Board on Atmospheric Sciences and Climate) will continue to work to develop a statement of task. (Schultz)

Comments from the NRC panel on Human Dimensions of Climate Variability
Paul Stern, National Research Council

Stern discussed the genesis and focus of the panel's report titled "Achieving the Promise of Climate Forecasting." This report, which will be available shortly to the public, examines the human dimensions of climate prediction including: coping strategies; the potential of climate forecasts and the potential utility of information; measuring the consequences of climate variability; and future priorities.

Perceptions of climate change among the various members of the panel were interesting. One issue concerned the barriers that inhibit the use of forecasts. Another concerned how to most effectively disseminate climate information, including observations and forecasts. (Sarachik, a Human Dimensions panel member)

Some of the comments included the following:

- ú It might be worth relating human dimensions research to the CLIVAR plan. (Miller)
- ú We might examine that issue at an upcoming CRC meeting. (Karl)

CLOSED SESSION

Topics discussed:

- ú Future CRC activities
- ú Climate services in the United States

Meeting adjourned.