# Review of DOE Climate Change Research Division

## Committee of Visitors

## April 25-27, 2007

## A Report of Findings and Recommendations

**Submission to the**

**Biological and Environmental Research Advisory Committee (BERAC)**

**May 2007**

## *Acknowledgement*

We want to thank the work done by the staff of the Office of Biological and Environmental Research (BER) and the Climate Change Research Division (CCRD) to help us prepare for this review and the extensive help provided during the review itself. Dr. Jerry Elwood, Acting Director of the Office of Biological and Environmental Research was a gracious host and the Program Managers (Dr. Kiran Alapaty, Dr. Jeffrey Amthor, Dr. Anjuli Bamzai, Dr. Roger Dahlman, Dr. Wanda Ferrell, Mr. Rickey Petty, Mr. Robert Vallario, and Dr. Ashley Williamson) within the CCRD were readily available to answer any of our questions and special requests. We would like to thank all of the Program Managers for the extensive amount of time they gave to the COV process.

A special thank you to Ms. Leslie Runion from the BER staff, who efficiently handled our many requests with a smile and made our task so much easier. We also thank Ms. Karen Carlson-Brown for her help.

# Table of Contents

## Executive Summary

This is the second Committee of Visitors (COV) to review the Climate Change Research Division (CCRD) within the Office of Biological and Environmental Research (BER). The previous COV review of CCRD was held in March 2004 (report published in November 2004).

The DOE Under Secretary for Science, Dr. Raymond Orbach, charged the COV to provide an assessment of the processes used to solicit, review, and recommend proposal funding actions for FY 2004-2006. It was also to assess the processes used to manage ongoing CCRD research programs, especially the decision-making process. For both DOE laboratory and university grants, the COV was to assess the efficacy, fairness, and quality of processes used to solicit, review, recommend, and document proposal funding actions and the processes used to monitor active projects and programs for progress and outcome.

As part of the review, the panel was asked to specifically address ten particular questions: Is the proposal review process rigorous and fair? Are funding decisions adequately documented and justified? Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants? Are the progress and outcomes of multi-year projects adequately monitored and evaluated to justify decisions about continued funding? Does the process consider the depth and balance in a research portfolio? Does the process solicit and encourage a reasonable amount of exploratory, high-risk research? Does the process link the research to mission needs of DOE and its programmatic goals and objectives? Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program? Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs? Does the process result in a portfolio of research elements and programs that have national and international scientific standing?

The COV was organized along seven subgroups to evaluate the ten active programs within the CCRD. Most subgroups were composed of at least two members of the COV. At the meeting, the COV received a list of all funded grants, at universities and other organizations and at the DOE National Laboratories. Copies of all the files for the funded projects were also available for the COV to analyze and review. A very high fraction of these files were reviewed by the COV subgroups. In addition, the CCRD Director and the Program Managers were available to the COV throughout the review to provide discussion of the review and management process, to provide further clarification on issues and to provide additional materials as requested.

All of the research programs within the CCRD are well recognized nationally and internationally for the important contributions being made to understanding of the climate system and for reducing key uncertainties that are helping policymakers to better determine potential responses to the concerns about global warming. Several of the research programs within CCRD are unique in that there is no other program in the world that is as fully addressing some specific issues. For example, the Atmospheric Radiation Measurement (ARM) program is the premier program for determining the relationships between clouds and radiative transfer effects on climate. In another example, the Climate Modeling program is leading the way in development and evaluation of new climate modeling capabilities. The Program for Ecosystem Research is internationally

recognized for large scale ecosystem manipulations addressing the effects of $CO_2$ and other climate variables on a variety of ecosystem types.

Overall, the COV found there to be significant progress since the 2004 review. There were clear indications that the comments and recommendations made by that COV have been taken seriously. Solicitations are more specific and have greater clarity, and there appears to be a modest increase in the number and diversity of reviewers. We were pleased to see the implementation of a recommendation for selection statements for lab projects, and overall a more balanced treatment of labs and universities. The contents of project jackets, while still needing attention, are more complete than they were at the time of the previous review. Finally CCRD Program Managers are taking a strong and active role in activities of the U.S. Climate Change Science Program (CCSP).

We find substantial differences in the levels of staffing and budget for CCRD Programs relative to comparable programs in other agencies and institutions. We find that insufficient resources, both in terms of personnel and budgetary support, collectively place at risk the ability of the Program Managers to effectively manage and oversee the programs for which they have responsibility. Staffing at both the Program Manager and support staff levels appear to be insufficient for adequate review, oversight, and management of programs. Program Managers effectively work alone to oversee their programs, including assuming leadership roles in national and interagency research endeavors, without deputies or sufficient dedicated support personnel. The COV also found the $6,000 travel budget for the Project Managers to be woefully inadequate for proper oversight of funded projects, where regular rotations of site visits, annual investigator meetings, and attendance at scientific meetings are necessary for effectively managing their programs.

There was consensus among the members of the current COV that preapplications should be encouraged for major proposal solicitations. Preapplications are used to good effect by other agencies since they: a) better allow Program Managers to ensure balance among projects to meet agency and program goals, and b) reduce the size of reviewer pools needed for the actual solicitation.

The COV confirmed their support for maintaining competitive solicitations for the national laboratories as well as for universities. In general, the Division makes effective use of panels and mail reviews. However, we encourage efforts to expand the diversity and turnover of reviewers. The CCRD should consider development of a program-wide electronic database of reviewers. Currently there apparently is no formal mechanism to document communication with Principal Investigators (PIs) when reviewers identify substantive issues regarding specific projects, other than the PI receiving the original review comments. These comments are highly useful to both successful and unsuccessful PIs as a way to improve their projects and/or to improve their chances of receiving funding in future solicitations; they are also crucial in helping Program Managers to select projects that will meet their program and division goals. We recommend that Program Managers, for all programs, include their suggestions to address these comments to successful proposers in either the funding letter (if written) or as a memorandum for the record (if guidance was given verbally), and that similar information should be documented for declined proposals.

Overall the COV feels that Program Managers are doing an excellent job of maintaining project oversight. There are a few areas in which improvement would result in a stronger, more focused program with better understanding of the value and long-term outcomes and deliverables of particular types of projects. The two types of projects that require additional oversight include: 1) uncompeted projects; and 2) very large (multi-cycle) projects. For uncompeted projects, periodic scheduled reviews and proactive management (and documentation of progress against project goals) are essential. For very large projects (those that take multiple funding cycles to complete), it is important that the programs ensure consistent periodic reporting and external review at frequencies commensurate with the level of investment. The reporting and review must be adequate to determine whether timelines and milestones towards project goals are being met.

The COV recommends that final reports be required of all projects, both at universities and at DOE laboratories, and that these final reports become part of the official project jacket. We also recommend that Project Managers prepare an overall Program Report of accomplishments and proposed future directions every three years as part of the COV preparation process.

The COV noted that although there have been improvements since the 2004 COV review, documentation still varies widely across all program elements, and is less substantive for lab projects than it is for university projects. Additional materials (e.g., more documentation on guidance given to PIs, final project reports) would be of great use to the COV and to Program Managers and DOE upper management in assessing progress towards goals. However, the COV understands and is sensitive to the other duties and time demands placed on Program Managers, and does not wish the program staff to assume an unreasonable burden.

The COV strongly recommends that the CCRD conduct a self-study with selected outside members (e.g,. members of the COV) as appropriate, to establish a rubric or checklist for standard project documentation in the official files of record, for both funded projects and declined proposals. We also urge that an integrated, electronic process and tracking system be implemented to ensure that project documentation is complete according to those standards, and to assist in safeguarding confidential information.

For other findings and recommendations regarding the individual programs, we refer the reader to the full report.

## Introduction

This is the second Committee of Visitors (COV) to review the Climate Change Research Division (CCRD) within the Office of Biological and Environmental Research (BER). The previous COV review of CCRD was held in March 2004 (report published in November 2004).

This report consists of an overview of the program, followed by a discussion of the charge for this review as given to BERAC and the response of the COV to this charge. The latter considers the process used to undertake the review. This is followed by the Findings of the Review. The Appendices contain: (A) the list of COV members; (B) the charge letter from the DOE Under Secretary for Science; and (C) the agenda for the three day review.

### *Overview of the DOE Climate Change Research Program*

The mission of the Department of Energy's (DOE) Climate Change Research Program is to deliver relevant scientific knowledge that will enable both scientifically based predictions and assessments of the potential effects of greenhouse gas and aerosol emissions on climate and the environment. It also involves delivering scientific knowledge that will enable the development of approaches for enhancing carbon sequestration in terrestrial ecosystems. The research supported by the Program is intended to reduce and resolve key scientific uncertainties and provide the scientific foundation needed to predict, assess, and help mitigate greenhouse gas forcing of climate resulting from energy production and use.

The Program supports four contributing areas of research: 1) Climate Forcing, including processes that affect climate forcing; 2) Climate Change Modeling; 3) Climate Change Responses; and 4) Climate Change Mitigation. The research is focused on understanding the physical, chemical, and biological processes affecting the Earth's atmosphere, land, and oceans and how these processes may be influenced, either directly or indirectly by changes in radiative forcing of climate resulting from energy production and use, primarily the emission of carbon dioxide and aerosols from fossil fuel combustion.

The research on Climate Forcing is focused on understanding the effect of atmospheric properties and processes on the Earth's radiation balance. This research leads to understanding and quantification of natural and human-induced forcing of the climate system and the processes that affect such forcing, including the role of clouds, aerosols and carbon cycling. Programs included in this area of research are the Atmospheric Radiation Measurement (ARM) science program, ARM Infrastructure (the ARM Climate Research Facility), the Atmospheric Science Program, and the Terrestrial Carbon Cycle Program. It also includes the Data and Information Management activities.

The Climate Change Modeling research is focused on developing coupled climate and Earth system models to simulate and predict the response of the climate system to human-induced and natural changes in radiative forcing. It includes the development, testing, and application of fully coupled climate and Earth system models needed to project the likely response of the climate system to natural and human-induced climate forcing. The only research program in this area is the Climate Change Prediction Program. The climate modeling component of SciDAC

(Scientific Discovery through Advanced Computing), which involves a partnership between BER's Climate Change Research Program and the Office of Advance Scientific Computing Research, is also part of this program.

The Climate Change Response research is focused on understanding and quantifying the potential response of ecological and human systems to climatic and atmospheric changes. The research leads to the understanding and ability to predict the response of ecological and human systems to ongoing and projected future changes in climate and atmospheric composition associated with energy production. It includes the development of methods and models for use in assessing environmental costs and benefits of different climate change scenarios and of different technology or policy options for mitigating human-induced forcing of climate. The programs in this area are the Program for Ecosystem Research and the Integrated Assessment Research Program.

The Climate Change Mitigation research focuses on understanding how natural processes in terrestrial ecosystems can be altered or managed to enhance their long-term capacity to sequester carbon dioxide emitted to the atmosphere, thereby helping to mitigate the increase in atmospheric $CO_2$.

DOE's Climate Change Research Program is designed and planned to provide data that will enable objective assessments of the potential for, and consequences of, global warming. It is intended to provide a scientific basis that will enable decision makers to determine a "safe level" of greenhouse gases in the Earth's atmosphere to avoid a disruptive, human-induced interference in the climate system.

BER's Climate Change Research Program (excluding the Climate Change Mitigation element which focuses on carbon sequestration in the terrestrial biosphere) represents DOE's contribution to the interagency Climate Change Science Program. The Climate Change Mitigation element in Climate Change Research represents part of BER's contribution to the interagency Climate Change Technology Program (CCTP).

## Charge to BERAC

On December 26, 2006, as shown in Appendix B, the DOE Under Secretary for Science, Dr. Raymond Orbach, charged the Biological and Environmental Research Advisory Committee (BERAC) to assemble a Committee of Visitors (COV) to assess the research program management processes in the Climate Change Research Division (CCRD) in BER. In his letter, Dr. Orbach states that the panel should provide an assessment of the processes used to solicit, review, and recommend proposal funding actions for FY 2004-2006. It should also assess the processes used to manage ongoing CCRD research programs, especially the decision-making process.

Specifically, the COV panel should consider and provide evaluation of the following:

1. For both DOE laboratory and university grants, assess the efficacy, fairness, and quality or processes used to:
    a. Solicit, review, recommend, and document proposal funding actions
    b. Monitor active projects and programs for progress and outcome
2. Assess the efficacy and quality of processes used to manage ongoing programs.

As part of the review, the request is for the panel to specifically address the following questions:

- Is the proposal review process rigorous and fair?
- Are funding decisions adequately documented and justified?
- Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?
- Are the progress and outcomes of multi-year projects adequately monitored and evaluated to justify decisions about continued funding?
- Does the process consider the depth and balance in a research portfolio?
- Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?
- Does the process link the research to mission needs of DOE and its programmatic goals and objectives?
- Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?
- Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?
- Does the process result in a portfolio of research elements and programs that have national and international scientific standing?

The COV panel should provide comment on how processes and operations have changed over the FY 2004-2006 period. The panel should also comment on how these processes and operations can continue to be improved.

The panel may examine any files of both DOE laboratory projects and university projects funded in FY 2004-2006. It may also examine any documents related to CCRD program implementation.

## Response to the Charge

The COV was chosen following the guidelines presented in the letter from the Under Secretary for Science. BERAC appointed the chair who then determined and organized the rest of the COV.

The COV was organized along seven subgroups to evaluate the ten active programs within the CCRD. Most subgroups were composed of at least two members of the COV. The only exception is the subgroup reviewing the smaller programs, namely the Integrated Assessment, Education, and the Information / Integration Programs.

Before the review, the COV was sent descriptions of the programs they would be reviewing, copies of the front pages from solicitations during the FY 2004-2006 period, copies of the 2004 COV review, and the CCRD responses to that review. At the meeting, the COV received a list of all funded grants, both at universities and other organizations and at the DOE National Laboratories. The DOE National Laboratories compete for funding in a process similar to the universities, but the DOE National Laboratories do not compete against the universities. Separate funds are maintained within each program to fund the DOE National Laboratories versus the universities and other organizations. Given the different nature of research at the Laboratories relative to universities, the COV was fully supportive of this approach. Copies of all of the files for the funded projects were also available for the COV to analyze and review. A very high fraction (well over half) of these files were reviewed by the COV subgroups.

The agenda for the review is provided in Appendix C. After a plenary session on the first morning, the COV primarily worked in the individual subgroups except for special COV executive sessions that were held each day initially to evaluate progress on the review and later to determine cross-cutting findings and special recommendations. The subgroups wrote their reports for the ten programs using a basic format comprised of summarizing the existing program, providing general comments, responses to the ten questions given in the charge to the COV, and finally, other considerations. However, the subgroups each determined the specific details that went into each of these discussions. The COV review ended with a briefing on the findings presented to Dr. Elwood. This report was completed after the meeting although almost all of the elements for the report were already in place at the meeting.

Dr. Jerry Elwood, Director of the Climate Change Research Division, and the Program Managers (Dr. Kiran Alapaty, Dr. Jeffrey Amthor, Dr. Anjuli Bamzai, Dr. Roger Dahlman, Dr. Wanda Ferrell, Mr. Rickey Petty, Mr. Robert Vallario, and Dr. Ashley Williamson) were available to the COV members throughout the review to provide discussion of the review and management process, to provide further clarification on issues and additional materials as requested by the COV.

A presentation on the results from this review was made by the chair of the COV at the BERAC meeting on May 14, 2007.

## Findings of the Review

The program findings in this report are based on the materials analyzed at the review and discussions with Dr. Jerry Elwood, Director of the Climate Change Research Division, and with the Program Managers (also referred to as PM in this document). The findings begin with a summary of the program (or programs) being reviewed; this is followed by general comments, responses to the specific questions raised in the charge to the COV, and then any additional considerations raised by the COV in the review process.

As much as possible, the COV tried to restrict itself to the issues and questions raised in the charge to the COV. We recognize that some issues raised may be outside the scope of the charge of the COV.

## *Atmospheric Radiation Measurement Research & Infrastructure*

### Program Summary

The Atmospheric Radiation Measurement (ARM) program has been operating for more than 10 years collecting data related to radiation and clouds at three primary sites – the Southern Great Plains (SGP) of the USA, the North Slope of Alaska, and the Tropical West Pacific. The 2004 "Atmospheric Radiation Measurement (ARM) Program Science Plan" (*DOE/ER-ARM-0402*) defines science objectives and long-term goals for the program. The ARM Program has achieved considerable scientific success in a broad range of activities, including site and instrument development, atmospheric radiative transfer, aerosol science, determination of cloud properties, cloud modeling, and cloud parameterization development and testing. As the ARM Program has matured into one of the key components of the U.S. Climate Change Science Program, the focus of ARM science has shifted to an increasing emphasis on modeling and parameterization studies to take advantage of the long time series of data now available.

A key goal of the ARM program is to use its extensive observational database to improve the representation of clouds and related processes in Global Climate Models (GCMs). This is a high priority for the U. S. Global Change Research Program because uncertainties in the representation of clouds and their sensitivities are largely responsible for the high degree of uncertainty associated with the magnitude of climate change induced by human modification of carbon dioxide, other trace gases, and aerosols.

#### *ARM Program Organizational Structure*

The ARM program as reviewed by the COV is actually three separately managed programs: ARM Climate Research Facility (ACRF), ARM Science, and the Aerial Vehicle Program (AVP). The ACRF and AVP together constitute the ARM Infrastructure. The ACRF includes the three stationary facilities as well as the ARM mobile facility.

The COV found that there is excellent communication and coordination between the current program managers, but the organizational structure does not clearly define roles and responsibilities for the entire scope of ARM activities. For example, the Aerial Vehicle Program

has an independent program manager, yet organizationally it is part of the ACRF Program. The COV recommends that the ARM organizational structure, roles and responsibilities be better clarified.

## General Comments

The COV had extensive discussions with the program managers during the course of the review. Additional information was gleaned from publicly available materials (www.arm.gov), award selection packages, and Science Team documents.

The COV found two major areas of the ARM Program that require high priority attention from DOE management: travel funding for the Program Managers and the need for a second mobile facility.

**Program Manager Travel**: The ACRF Program Manager manages a globally distributed network of three stationary facilities as well as a mobile facility that has deployed to the western U.S. (California), Africa (Niger), Europe (Germany), and plans to deploy to Asia (China) in 2008. A planned deployment to South America (Chile) in 2007 was cancelled just prior to implementation due to political, not scientific, considerations. Additionally, ARM sponsors major field campaigns on a regular basis (e.g., the summer 2007 CLoud And Surface Interaction Campaign, CLASIC).

ARM program management is seriously compromised by the current, completely unrealistic travel budget limitations (~$6 K per year per PM in CCRD). The COV strongly recommends that the travel budgets be revised significantly. Effective program management requires

- In the field participation for each deployment of the mobile facility
- In the field participation for each major deployment of ARM aerial vehicles, including UAVs
- In the field participation for each major field campaign sponsored by the ARM Program
- Annual visits to each primary site (TWP, NSA, SGP) – could be combined with field campaigns staged around the sites
- Annual site visits to the DOE Laboratories supporting the ARM program
- Participation in major scientific conferences at which ARM science is presented (e.g., AGU, AMS)
- Participation in the annual ARM Science Team Meeting and the ARM working group meetings
- ARM Science: multiple visits per year to the primary locations where global climate modelers are developing codes using ARM-based parameterizations (e.g., ECMWF, NCAR, GFDL)

A successful ARM program may be executed on a $6K/year travel budget, but it cannot be managed effectively under these constraints. The travel budget needs to be higher than $6K per year per PM.

**ARM Mobile Facility**: The success of the ARM mobile facility has led the community to develop outstanding interdisciplinary campaigns centered around its deployment. The program

receives far more selectable proposals than can be executed with a single mobile facility (14 % success rate). Significant opportunities have also been lost, for example a polar deployment in conjunction with the International Polar Year (IPY) was judged to be highest merit science, but DOE decided it was programmatically too risky since the deployment might endanger the lone mobile facility.

The COV is supportive of the creation of a second mobile facility by 2010 that would serve this high priority need for the U.S. Climate Change Science Program and the BER program.

## Responses to Specific Questions

### Is the proposal review process rigorous and fair?

SCIENCE: The ARM review and competition process for science proposals is quite rigorous and fair. Proposals are solicited openly from DOE Laboratories and non-Laboratories (including other federal agencies, Universities, International entities, etc.) on a regular basis. Proposals undergo a mail review that includes at least three reviewers, followed by a panel review and discussion, and finally a programmatic and relevance review. This process was found to be well documented and justified at each step. We also found that the DOE Laboratory and non-Laboratory proposals were treated in the same rigorous process, with the laboratory proposals receiving a more detailed review summary.

INFRASTRUCTURE: Being a largely field-observation program, ARM devotes a large percentage (~75%) of its resources to build and maintain its observational and data management infrastructure at the SGP NSA, and WTP focus areas. These infrastructure resources are directed largely to various DOE Laboratories. Contrary to the previous COV report, we found quite extensive reviewing of these ARM infrastructure projects, resulting in many actions to optimize infrastructure investments to meet ARM program goals. However, unlike the science component of the ARM program, the ARM infrastructure is not competed, and, as a result, may not be as efficient in its operations as it could be if subject to being competed. We therefore highly recommend that ARM move toward a strategy to compete its infrastructure investments. Competition will have many benefits, including providing a mandate to the winner, bringing out the best ideas and creativity, and optimizing taxpayer investments. These goals may be met by restricting the competition internal to the DOE Labs or to the non-profit community, but there may be great benefit in opening the competition to all.

### Are funding decisions adequately documented and justified?

For every science proposal we examined, we found complete documentation of the review process, and a summary of the decision and its justification written by the program manager. We feel that this process is working, and that the funding decisions are generally well documented and justified. It is suggested that these processes be made more efficient through the use of electronic filing, as we found most of the documentation to be in paper format.
Two potentially “controversial” decisions were examined in detail, one selection and one declination. They are summarized below.

*"Controversial" Selection decision*
University PI
Merit scores = 6, 7.5, 9; <7.5>
Program Manager notes are explicitly given in three places in the merit evaluation including "this is considered a novel approach with risk, but potential"
Decision rationale:

From selection letter: "It was also recommended that this grant be negotiated with funds being provided for the first year in the amount of x. Contingent upon the availability of funds and progress of the research, the remaining two years will be funded annually."
COV Note: PM recognizes the risk factor in this work and funds it on a contingency basis.
From Reviewer comments:
"Understanding cloud structure on sub-grid scales is highly significant for ARM."
"While it is possible that the analyses will yield information relevant to new parameterizations, there is no way to assess the probability of success in this regard."
"…could lead to implications of the highest importance towards our understanding of the formation and dynamics of clouds…"
" … can lead to further breakthroughs that are certain to stimulate the work of theorists and experimentalists alike, ultimately leading to major impacts on a society that increasingly relies on accurate weather forecasts."
"The proposers are amongst the world leaders in this field. They have helped rejuvenate it with numerous creative and original methods."

The proposal is very well documented and detailed. The physics are described with a clear understanding and mastery. The risk/benefit analysis for this research is openly documented by the Program Manager.

*"Controversial" declination decision*
05-14 solicitation
University PI
Merit scores = 8, 9, 9; <8.7>
Decision rationale: "need to maintain program balance"

From declination letter: "The basis of this decision is that the focus of your application is not in the mainstream of ARM research." COV Note: The same statements would apply to many innovative or high-risk proposals. The letter is otherwise generic.
From Reviewer comments:
Proposed research "should be crucially important" [to ARM]
"All research topics proposed have technical merit and will increase our understanding of the effects of clouds on the climate system, a key goal of ARM."
"Dr. X is renowned for the excellence of [his/her] research."
"Given the number of publications from this work in the last two years, it would appear to have relevance and significant merit for the ARM program."
"For algorithm development, it is proposed to extend it to NSA data (previously shown applicable to TWP and SGP)."

The overall quality of the proposal is excellent. It builds on previously funded ARM research, so the reasons for decline are not obvious. This was clearly a difficult programmatic decision. Documentation on rationale for declination was not as detailed as it might be.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

The ARM solicitations are quite general, allowing for a very broad range of relevant proposals to be submitted. We also noted three symptoms of this process that might be mitigated by providing more explicit solicitation guidance. These symptoms include: (1) success rates decreasing to 13% for some categories of proposals (this low rate may discourage the submission of good proposals in the future), (2) submission of very few "high risk" or "innovative" proposals, and (3) the general impression that DOE Labs are able to construct more relevant proposals (their "inside knowledge" gives them a relevance advantage, because this "inside knowledge" is not available to non-DOE investigators). Therefore, we recommend that the ARM solicitations be written with much more precise and narrow goals that are focused on ARM program science gaps. More precise guidance should help to narrow the proposal pool (resulting in more relevant proposals and higher success rates) and will encourage investigators to propose higher risk and innovative ideas.

In recent solicitations, ARM solicitations have distinguished DOE Lab proposal solicitations as being multi-investigator or multi-disciplinary in nature. This is a positive step to help develop broader science, but we are concerned about non-DOE investigators being excluded from these broader proposals. We therefore recommend that ARM solicit both single-PI proposals and multi-investigator proposals from the entire science community.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

Ideally, we would expect that progress reports be carefully reviewed by program managers to make changes that optimize project success, that final reports be carefully analyzed to understand the project's impact on ARM program goals, and that these final reports and program manager assessments be made publicly available. We found several symptoms that indicate this ideal is not being achieved, which include:

1) While interim progress reports are consistently received and reviewed by program management for non-Laboratory projects, these interim program manager reviews do not seem to have impact on the projects, and in no case has inadequate progress resulted in a project cancellation.

2) Final reports were available for most completed non-Laboratory projects, however, as far as we could tell, these final reports were never reviewed by program management to assess the project's impact on ARM program goals.

3) No progress reports or final reports were available for DOE Laboratory projects. Rather, progress for these projects is expected to be summarized in annual "Field Work Proposals", resulting in no final report ever being submitted. Further, there is no evidence of written documentation of program manager reviews of these field work proposals. Lack of final reports from labs and lack of program management final report assessments leaves the program with no idea of what progress has been made towards its goals.

4) There is no documentation on DOE Laboratory funding sunset dates, especially for the infrastructure projects. It appears that these projects are expected to continue indefinitely. We recommend that ARM program managers be required to compile and submit interim and final assessments on every project and campaign. We also recommend that reporting and documentation be consistent for Lab and non-Lab projects, and that actions be taken based on these reviews to optimize project success (or cancellation in the case of no hope for success).

**Does the process consider the depth and balance in a research portfolio?**

The ARM program has subjected itself to frequent program and science reviews, which has generally resulted in changes and optimizations to result in a comprehensive research portfolio. However, there are both scientific scope and resource limits on the ability of the program to achieve depth and balance. For example, because of the interconnected nature of earth science, ARM may require more in-depth information on the boundaries of its science questions to be truly comprehensive. In some cases, information on these boundaries may be achieved through cooperation with other programs, however, in other cases, ARM may need to expand its science scope to achieve these goals. A second example pertains to the ARM mobile facility. It is clear that demand for this facility cannot be met by a single facility. To fully realize ARM's program goals, a second mobile facility is likely required.

*Funding Statistics*

The ~25% of the ARM portfolio devoted to competitively selected science funding has been consistently distributed in the FY 2004-2006 period with average allocations of 43% to DOE Labs, 44% to universities, and 12% to other federal agency researchers. The COV notes that the university allocation increased from 41% to 48% during this period while the awards to other federal agency researchers decreased from 16% to 9%. It was not clear if this was a deliberate programmatic plan or whether it merely reflected the quality and quantity of the proposals received.

**Announcement # 04-10**

A total of 87 distinct proposals were received by the due date, April 9, 2004. The total number of proposals was 100, but this number includes the multiple/collaborative submissions of identical technical proposals from different organizations.

Twenty-two proposals with an average score of 8.3 or better were placed in the top potential funding category. Thirty-four proposals with an average score between 7.0 and 8.3 were placed in the middle potential funding category. Once decisions on the top tier were determined, proposals in the middle potential funding category were evaluated for funding. The criterion for the funding decision for the remainder of the proposals was to ensure that priority areas were addressed. The available budget was the final constraint.

Twenty-seven proposals were funded.

- The actual programmatic breakdown was as follows: Radiative Transfer & Instrument Development, 18.5%; Aerosols, 18.5%; Cloud Retrievals, 22.2%; Cloud Modeling & Analysis, 14.8%; and GCM, 25.9%
- Nine proposals of the funded proposals were from investigators who had not previously been funded by ARM
- Seven of the funded proposals were from investigators who received their PhDs in the last three years
- The success rates that follow include PIs of joint proposals:
    - 31% of proposals from non-DOE federal laboratories were funded
    - 26% of proposals from universities were funded
    - 57% of proposals from DOE national laboratories were funded

The COV examined the declined proposals as well and accumulated the following count - Declines for 04-10: 14 DOE Labs, 4 UCAR, 1 NRL, 1 APL, 5 Foreign, 5 NASA, 3 NOAA, ~35 University + other. The proposal declination statistics appear reasonable given the selections and the overall proposal pool.

**Announcement # 05-14**

A total of 101 distinct proposals were received by the due date, April 12, 2005. The total number of proposals was 125; this number accounts for the multiple/collaborative submissions of identical technical proposals from different organizations.

Fifty-nine proposals with an average score of greater than 7.0 were placed in the top potential funding category. A relevance review was conducted after the peer review for scientific merit was completed, and proposals were placed in one of the two potential funding categories by the Program Manager. The relevance review was conducted by a panel composed of the ARM Science Team Executive Committee and the ARM Chief Scientist on matters of programmatic relevance and balance.

Twenty-five proposals were funded with a start date of FY 2006.

- The actual programmatic breakdown was as follows: Radiative Transfer & instrument development, 11.5%; aerosols, 7.7%; Cloud Retrievals, 30.8%; Cloud Modeling & Analysis, 34.6%; and GCM, 15.4%. COV NOTE: these percentages correspond to 26 selected proposals.
- Nine proposals of the funded proposals were considered new
- One of the funded proposals was from an investigator who received a PhD in the last three years.
- The success rates that follow include PIs of joint proposals, and the affiliations assigned are those of the lead PI.
    - 13% of proposals from non-DOE federal laboratories were funded
    - 29% of proposals from universities were funded
    - 13% of proposals from DOE national laboratories were funded

The COV examined the declined proposals as well and accumulated the following count - Declines for 05-14: 15 DOE Labs, 9 UCAR, 1 NRL, 5 Foreign, 11 NASA, 3 NOAA, ~30 University and other. The proposal declination statistics appear reasonable given the selections and the overall proposal pool.

**Announcement # 06-20**

The following is an account of the details of specific process used for the re-competed ARM Aerial Vehicle Program (AAVP), (formerly ARM UAV Program.). There were six technical reviewers, and each reviewer reviewed all five of the proposals submitted. The overall average score of all proposals was 7.2. The DOE Laboratories were the only category eligible in the proposal call. Based on the availability of funds and the scope of work, only one proposal could be chosen from the field of five.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Through discussions with program management, we determined that about 1% of projects could be considered as "high-risk", with investigators generally preferring conservative research. Through these discussions we also determined that about 10% of projects could be considered to be conducting "innovative" research. We believe that ARM should be actively engaging in high-risk and innovative research more aggressively because these projects are more likely to produce extremely significant results. However, these projects are also likely to have a higher likelihood of failure. Therefore, the absence of any projects being cancelled as a result as an interim report review is a clear sign that the program is not actively investing in higher-risk research. In summary, the ARM is currently maintaining a very conservative, low-risk research portfolio.

Therefore, we strongly recommend that ARM increase its investments in high-risk and innovative research, on the order of 10% and 25%, respectively. We recognize that it is somewhat elusive to directly solicit and identify these categories of research. But perhaps through more focused research challenges being presented in solicitations higher-risk and more innovative proposals can be received, and through consulting with reviewers and panelists on the risk and innovation level in proposals, a measure can be developed.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

The ARM program is clearly conducting research that is relevant to the ARM and DOE mission needs. However, there is not a clear process on how these links are formally made. One suggestion given previously that might work is to require program management to highlight these beneficial links and relevancies in their reviews of project contributions. There is also a need to more closely coordinate ARM activities with other DOE climate research programs, with potential joint working groups, solicitations, and field efforts. Further, the ARM program needs to actively engage and be represented at national and international coordination activities (i.e., GEOSS, GEWEX, CLIVAR, etc.). Finally, there is a need to increase ARM program relevance

by creating a plan to support research that includes the transition to operational centers of new model components that are developed using ARM data.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

ARM program management does have a philosophy to support scientific convergence through integration and synthesis activities. The construction of shared observational facilities, data management systems, inter-agency field experiments, working groups, and investigator meetings are great examples of this philosophy. However, we believe there are some areas where the science integration process can be improved, as follows:

1) ARM program managers have insufficient travel resources to conduct critical site reviews, facilities assessments, workshop and working group participation, and attendance at key professional meetings. ARM ACRF is in great need of these travel resources, because of its remote facilities in Oklahoma/Kansas, Alaska, and the Western Pacific, and its periodic intensive field studies. Program management should have the resources to conduct yearly site visits to its field facilities, yearly participation in at least two professional conferences, at least one site visit during the duration of each funded project, and participation in all ARM investigator and working group meetings.

2) While there are good integration activities ongoing within the ARM community, better efforts to integrate with other agencies is possible. The ARM-led inter-agency CLASIC field campaign is a great example of inter-agency coordination. This kind of good inter-agency coordination effort should be extended to the development of coordinated data-bases, models, and science goals.

3) Traditionally, ARM has supported many small single-investigator projects. It may be possible to encourage more interdisciplinary coordination by devoting some component of program resources to larger multi-investigator projects.

4) Central to ARM's mission is the development of improved atmospheric and cloud model parameterizations. Ideally, these improved model components should be useful for operational climate prediction centers (GFDL and NCAR for example). We therefore recommend that coordination with operational modeling centers be intentionally planned to provide pathways for model component transition to operations. These plans could be included as solicitation guidance, or perhaps through the support of joint modeling facilities such as the Joint Center for Satellite Data Assimilation or NOAA's Climate Modeling Testbed.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

The COV felt that the program did have sufficient turnover, but a higher level of risk is probably needed. Quantitative statistical information is needed to assess this fairly.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

The ARM program clearly has international stature and recognition and has enjoyed great publication success. However, beyond lists of research publications, its real impact has not been objectively measured. We therefore recommend that the program conduct periodic citation index reviews and analyze these through time to understand its significance. Publication impact assessments can also be used as a metric for evaluating high profile funding decisions such as mobile lab deployments and interdisciplinary field campaigns.

## Other Considerations

### *Responses to 2004 COV Report*

The Program Managers elaborated on the responses provided to the 2004 COV report. All questions and concerns from the 2004 COV were answered directly and adequately. Much of the data was provided as Appendices 7 and 8 of the COV pre-review package.

A persistent theme in the findings of the 2004 COV was an apparent misunderstanding by the COV of the ARM program funding management. Approximately 75% of the ARM budget is directed to the support of the ACRF (ARM infrastructure) and approximately 25% of the annual funding is allocated to ARM Science. The ACRF program is reviewed periodically as a program: individual awards are not subject to peer review. The selection of ARM Science awards is made via a traditional peer-review process. The lack of regular peer review for the ACRF Program will be discussed below.

A significant programmatic concern raised by the 2004 COV was that the program supported "development of new cloud and radiation parameterizations." According to the 2004 COV report: "It is not clear how ARM's mission to develop model parameterizations for climate models is related to the US Climate Change Science Program's climate modeling objective." It was unclear what kind of parameterizations were required or whether the new parameterizations were needed by GCMs.

A key goal of the ARM program is to use the ARM observational database to improve the representation of clouds and related processes in Global Climate Models (GCMs). This is a high priority for the U.S. Global Change Research Program because uncertainties in the representation of clouds and their sensitivities are largely responsible the high degree of uncertainty associated with the magnitude of climate change induced by human modification of carbon dioxide, other trace gases, and aerosols. The 2006 document "ARM's Support for GCM Improvement" (*ARM-06-012*) reviews the progress towards this goal. This progress was divided into two parts – methodologies that allow modelers to use the data collected by ARM and actual improvements in climate models made by ARM supported scientists. Four examples of these GCM improvements are discussed in detail in the 2006 document cited above.

## *Atmospheric Science Program (ASP)*

**Program Summary**

Following recommendations of the Biological and Environmental Research Advisory Committee (BERAC) of the DOE Office of Science, the Atmospheric Science Program (ASP) was reconfigured in 2004 to concentrate on the role of aerosols in climate change. The effects of aerosols on the earth's radiation budget are thought to be as important as trace gases, but they are not as well understood. Two kinds of effects are recognized: direct effects of suspended particles on the scattering and absorption of radiation, and indirect effects through the influence of aerosols on cloud droplet sizes and concentration and the formation of precipitation. Major areas of uncertainty are: (1) the loading, distribution, and fate of atmospheric aerosols, and their chemical and physical properties that affect radiative transfer; and (2) the magnitude of indirect effects of aerosols on clouds and their radiative properties. The reconfigured program has as its goal the reduction of uncertainties in these two areas. It is recognized that achieving the goal requires a balanced program of field measurements, laboratory experiments, theoretical analyses with process modeling, and the development of new instrumentation.

In May 2004, the DOE Office of Science posted on its web site a solicitation for proposals to contribute to the understanding of climate change by reducing the uncertainties described above. A total of 155 proposals were received. One of these was subsequently withdrawn and the remaining 154 underwent peer review using mail reviews. Proposals were separated into three institutional categories: DOE laboratories (54 proposals), other federal laboratories (11 proposals), and universities and private industry (89 proposals). The same review process and review criteria were applied to all categories. Though nearly 300 qualified reviewers were invited to review proposals only 161 were willing to help, partly because of the timing of the process over the summer months. These reviewers were assigned between one and nine proposals each, the average being about three. Each proposal was assigned to at least three reviewers. Because of the limited number of qualified reviewers, it was necessary to use some reviewers who were also proposers. In fact, only about a third of the reviewers were not proposers. To avoid conflicts of interest, reviewers and proposals were separated according to institutional category (DOE Labs and non-DOE institutions), and reviewers did not evaluate proposals from the category including their proposals.

Following the scientific peer review, Peter Lunn, the Program Manager at the time, made a programmatic evaluation considering relevance and applicability to program goals, balance across research areas, and other needs and objectives of ASP. He recommended awards for 35 of the proposals. The selection process led to a fairly even balance of field measurements, laboratory experiments, theoretical analyses, and instrument development.

The awards consist of 13 to universities and private sector, 19 to DOE labs, and 3 to other federal labs. Thus, 46% of the awards were to non-DOE applicants. In terms of the award amounts, however, only 28% of the funding was to non-DOE applicants. This is mainly a consequence of the relatively high cost of field experiments, which are primarily the responsibility of DOE labs. Also, 29% of the awards went to new lead principal investigators, and 11% were considered by Ashley Williamson, the current Program Manager, to be highly innovative.

Peter Lunn, who had led ACP, retired in June 2005. Rick Petty took over management of the program until Ashley Williamson was appointed as the new permanent program manager in June 2006.

The projects supported under the 2004 solicitation have demonstrated significant scientific progress. While it is too early for all results to be available in the peer-reviewed literature, outcomes presented in early publications, conference presentations, and presentations at science team meetings indicate strong scientific productivity, a coherent team effort, and results that will significantly improve our understanding of direct and indirect forcing of climate by natural and anthropogenic aerosols.

## General Comments

At the time of the solicitation and the PI selections, it was not known which major field programs would be conducted during the award period. It would facilitate selection decisions if plans for potential field programs were known (to the proposers!), at least tentatively. It is also difficult to plan for infrastructure and logistics costs if there is not even a rough plan for field deployments available. Apparently the Program Manager has little flexibility in later years because the entire program budget appeared to be committed through the solicitation.

## Responses to Specific Questions

### Is the proposal review process rigorous and fair?

Yes, generally. Questions remain about possibly unequal treatment of government and university proposals and about the reliance on a pool of reviewers who may not be sufficiently disinterested. Attempts should be made to handle the management of proposals and awards from government labs the same way as those from universities and to broaden the reviewer pool by enlisting more young scientists and scientists from overseas. Finally, a balance of sectors and institutions should be sought for each set of reviewers (e.g., the three reviewers should represent different institutions).

All proposals reviewed had three reviews, which were generally substantive. The selection of reviewers appeared appropriate, although occasionally not all three reviewers had the full expertise needed to evaluate the entire proposal under consideration. The selection statements generally include good documentation of the Program Manager's evaluation and interpretation of the proposal. Another positive feature is the inclusion of the PI's response to the reviews and the Program Manager's reactions to that response.

Occasionally, the three review grades had a wide spread. This was generally acknowledged by the Program Manager, although in the case of declines, not explicitly resolved. Moreover, the documentation provided does not give detailed information on how the programmatic review was conducted. Another uncertainty about the process is the information provided to reviewers. It is not clear what instructions and guidance they are given. Are they supplied with a copy of the solicitation? Are they made aware of programmatic considerations? Apparently the reviewers are

not asked to address programmatic relevance directly, although those more familiar with the ASP may have used such considerations in their review.

The role of the Chief Scientist was not clear. He competed for funds, provided programmatic input, and also served as a mail reviewer. It is suggested that the chief scientist's role should be clearly defined, and that careful consideration should be exercised before using the chief scientist as a peer reviewer.

**Are funding decisions adequately documented and justified?**

Yes, in the case of accepted proposals. It is clear that the program officer conscientiously considers not only the ratings supplied by reviewers, but also the needs of the program and its balance in making funding decisions. However, there is room for improvement in the written justifications for declination and the letters to PIs, which are often perfunctory, lacking specific reasons for the decision. In declination letters reviewed, typically only the ratings are cited (even when they are high), but sometimes the decision is described as "based on programmatic considerations," without any elaboration. It would be more helpful for the PI and for the review record if specific reasons rather than generic ones were given. Including the Program Manager's reasons for declining on programmatic grounds would improve the consistency and transparency of the process. (This point was, in fact, also noted by the 2004 COV.) Moreover, in some instances, it might be appropriate in award letters to encourage the PIs to pay attention to suggestions provided by reviewers, or for the program managers to supply their own advice on ways the project might be improved. It would be helpful for the program manager and for future COVs if the award jackets contained brief evaluations of the annual reports. Even a short paragraph describing major accomplishments, strengths, and weaknesses would be useful for the record.

It was observed that where funding for a DOE lab award was reduced, the explanation for this was typically the following statement: "The cost-savings associated with this reduction is attributed to synergism with other ASP projects supported at [the lab]. Thus there is no appreciable reduction in scope of effort." This is unconvincing as the actual justification for two reasons: (1) the repeated use of this wording and (2) the roundness of the cuts (e.g., 20%).

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

Yes, although the program announcement was quite broad, which may account for the large number of submissions. It is not clear that the solicitation is tuned to some of the goals of DOE – specifically the encouragement of a reasonable amount of exploratory research and a reasonable turnover of funded investigators.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

Probably, though documentation of the evaluation is lacking. However, DOE managers, apart from written documentation, interact with the investigators at annual science team meetings where progress is reported and future directions are discussed.

**Does the process consider the depth and balance in a research portfolio?**

The portfolio of awards indicates a balance among the four "functional categories" identified in the solicitation. Awards to DOE labs vs. non-DOE labs are not equally distributed among these categories. However, this appears to reflect the distribution of the submissions, and also the philosophy that the DOE labs should focus on types of projects that cannot easily be carried out by university investigators, such as providing the infrastructure and execution of airborne field campaigns. The committee noted that there was relatively little support for the development of new instrumentation, and all the projects were at DOE labs.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Not explicitly; however, novel instrument development falls into this category, and some projects of this kind were awarded. These projects may produce benefits at a time later than the original funding cycle, so it could be tempting to reduce support for them under conditions of budgetary constraint. The committee encourages the Program to continue to include high risk/potential high reward projects in its portfolio in the future.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

It appears to, though the extent of consultation and collaboration between different programs within DOE is not clear. An exception to this has been the much-improved collaboration between ASP and ARM in recent years, as well as between ASP and other CCSP agencies (NASA, NOAA, NSF), which can provide valuable synergies for the program and higher visibility. One example is the commendable practice of making the annual PI meetings open to experts and program managers from other agencies and seeking their input. A continuation of these efforts is highly desirable. The committee also recommends stronger interactions with the Climate Change Prediction Program (CCPP) within the CCRD in the future in order to better link observational studies and climate modeling.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

Yes, to the extent that limited budgets allow. However, the documentation available to this committee does not provide much evidence for the process employed, and the Program Manager who was responsible for the selections in 2004 has retired and is therefore not available for

verbal explanations. Nevertheless, the portfolio supported appears to be coherent, as was evidenced by the strong performance of ASP investigators in recent field campaigns.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

The last solicitation did result in a significant number of first-time ASP awards (approximately 30% of the awards) but few young investigators. Apparently some new/young investigators are involved as co-PIs with more established scientists. Maybe not surprisingly, the fraction of new and young investigators is significantly higher among the proposals declined.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Yes. The awarded proposals we have reviewed are of high quality. They compare favorably with their peers.

**Other Considerations**

The process of reviewing proposals could be made more efficient for the program manager and more transparent to the COV by keeping systematic records in each jacket. While the information is now much more complete than at the time of the previous COV, still lacking is a simple review record for each proposal, including the names and affiliations of everyone asked to review the proposal, the dates the request was submitted, an indication of whether and when the review was received, and the rating.

## *Terrestrial Carbon Cycle Program*

**Program Summary**

Research funded by this program focuses on terrestrial components of the global carbon cycle, with emphasis primarily on observational and experimental studies in the U.S. The supported research seeks to understand processes and mechanisms that control carbon exchange among plants, soils, and the atmosphere, particularly at the ecosystem level. Although the research domain of the program overlaps that of the Carbon Sequestration program, the Committee reviewed the TCP and CS programs separately.

During the period of review, the Terrestrial Carbon Cycle Program made major contributions to national-level efforts to understand interactions between climate, atmospheric composition, and the carbon cycle. Particularly noteworthy in this regard are the many long-term field studies under the AmeriFlux and FACE programs, which have involved research groups from both universities and national laboratories. The U.S. FACE studies have yielded insights about the response of diverse terrestrial ecosystems to elevated $CO_2$, in some cases including interactions with other environmental factors, that have contributed to national and international (e.g., IPCC) assessments of the changing global carbon cycle. The AmeriFlux program includes studies of carbon, water, and energy fluxes, and is a primary source of information on patterns of annual

carbon exchange and factors influencing interannual variations thereof in major terrestrial ecosystems of the U.S.

The balance of TCP projects funded during the 2004 – 2006 period was distributed well among AmeriFlux (38%), FACE (34%), and other studies (29%). Funding was divided equally between university and national laboratories (50%/50%). It's worth noting that 40% of the university projects came to completion during the review period, whereas nearly all national lab projects received continued funding throughout the review period. The emphasis on long-term studies precludes much exploratory or high-risk research, but some high-risk studies (c. 15%) were included in the overall research portfolio.

This aforementioned balance of TCP projects changed dramatically following the most recent round of funding, which did not support any new FACE studies because of a CCRD decision to wind-down funding for FACE research. Twenty proposals were funded with a start date in FY2006, with the distribution being 12 for AmeriFlux and NACP, four for carbon cycling modeling, and four for soil carbon. Many of the FACE projects were rated highly by external reviewers but all were declined for programmatic reasons.

## General Comments

The COV had very helpful discussions with the program manager of the Terrestrial Carbon Cycle Program during the course of the review. He was able to answer all of our questions. We found only one set of reviews missing in all the files and as soon as we mentioned it, the program manager was able to find it and bring it to us. The COV is impressed with the very good cooperation between the various program managers from DOE, NASA, NOAA, NSF and USDA involved in Terrestrial Carbon Cycle research. The COV members have participated in many workshops of the Ameriflux, NACP and FACE programs and we have observed an excellent interaction between the program manager of the Terrestrial Carbon Cycle Program and the lead scientists in the various projects.

## Responses to Specific Questions

### Is the proposal review process rigorous and fair?

Yes, with a few major exceptions (see below). The number and quality of reviews and reviewers is generally high. The diversity of reviewers is low, likely because the number of experts in these fields is small. Likewise, many of the reviewers are funded by the programs for which they review. While there is a high potential for conflict of interest, there is little evidence that this is a problem. One recommendation is that, if possible, reviewers be chosen from a pool larger than those researchers who have been funded by the program.

There are a few exceptions to the general opinion of fair process.

- The use of a Chief Scientist to aid in the funding decisions was questioned because in some cases that person is funded by the same program and therefore presents some potential for biased influence. For example, the Chief Scientist might promote or retard a

particular kind of science because of personal involvement. There is no evidence that this occurred, however, and in general it is commendable that the PM seeks expert advice.

- The 2006 solicitation to the Terrestrial Carbon Processes program specified $CO_2$ exchange (e.g., AmeriFlux) and elevated $CO_2$ (e.g. FACE) studies as the scope of the research to be funded. A large number of proposals for continuation funding of existing FACE experiments were submitted to the March, 2006 deadline. About the same time, BERAC initiated a review of FACE that resulted in a recommendation that existing FACE studies be phased out and new more integrative experiments be phased in. DOE then decided to terminate support for the existing FACE studies under the TCP. Thus, all of the FACE proposals were declined for "other reasons", which included programmatic considerations. The Program Announcement did include language indicating that a review of FACE was underway, but nonetheless, it is at least unfortunate that there were futile efforts on the part of those submitting applications proposing elevated $CO_2$ experiments.

- Currently a Letter of Intent is encouraged prior to submitting a full proposal, but this letter is not used to as strongly as it could be. First, it is not required, and second, it is not used as a basis for rejecting further effort. A proper preproposal system is recommended as a way to both reduce the burden of reviewing proposals that clearly do not address the Program Announcement and to discourage prospective applicants from submitting proposals that would not be relevant to the terms of reference in the Announcement.

**Are funding decisions adequately documented and justified?**

Certainly yes for the university proposals. The Selection Statement provided by the program manager is thorough and provides clear explanation of the merits of the funded proposals. The efficiency of the review process is excellent. Generally decisions are made within two or three months.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

Yes, the Program Announcements are generally clearly written and sufficiently specific. For a major exception, see first question above.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

University projects provide an annual report describing accomplishments and publications. National labs apparently do not provide an annual report but do include detailed accomplishments in the continuation requests provided as a Field Work Proposal. There was no documented evidence provided to the COV that either university or laboratory projects are required to file final project reports. Addition of a final report as a requirement could provide a more consistent means of evaluating requests for continued funding for multi-cycle projects. In

addition, a brief progress report by the program manager, based on his/her review of the PIs' annual report would be useful as a record of oversight on the research projects.

**Does the process consider the depth and balance in a research portfolio?**

The TCP may be overly focused on carbon *per se* rather than other greenhouse gases including methane and nitrous oxide. The process does not encourage "curiosity-driven" research in climate change science, but it does encourage much targeted research.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Generally yes. About 15 to 20% of funded proposals from universities included elements that could be considered high-risk.

The National Labs have a greater opportunity to explore high-risk questions because of the longer-term nature of their project funding and the support from existing infrastructure. (It is unclear if the labs are taking advantage of these opportunities.)

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

Yes, the science questions posed are being properly addressed. The program managers are generally quite familiar with their projects and do a good job of keeping projects focused on the DOE's mission.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

The process does not appear to foster integration across different university research projects, although within the national labs, integration is specifically encouraged in the Program Announcement. Moreover, the Program Announcement for universities does mention a recent BERAC Panel recommendation for integrated modeling and analysis toward the construction of a National Terrestrial Carbon Model.

This shortcoming could be remedied, in part, with additional resources for annual meetings of PIs within a given research area. A positive aspect is that the program does encourage and help organize scientific workshops but the frequency of these meetings is not high.
Some concern was raised about the process whereby funding for elevated $CO_2$ research was withdrawn. See first question above (Question 1). The COV was concerned that this funding decision process does not sufficiently support commitment to scientific questions that required multiyear – to decadal level research over the next 5-10 years.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

Probably not. It is difficult to achieve this given the small number of experts in a given area and the long-term nature of the research required to achieve meaningful results.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Definitely yes. The overall quality of research is very high and that research clearly has major standing nationally and internationally.

A shortcoming is that additional emphasis could be placed on the science-policy interface, which is not identified as a goal of the projects.

**Other Considerations**

*How have processes and operations changed over the FY 2004-2006 period?*

The diversity of reviewers seems to have increased as a result of the PM's active efforts; within one program in 2006, 40% of reviewers were from outside the U.S.

*How can these processes and operations continue to be improved?*

Research proposals should be required to include a timeline and clear statement of deliverables. These were found to be more lacking in university than lab proposals.

Without overburdening program manager, it would be nice if the PM could develop a very brief annual summary of each program's major accomplishments. Toward this end, we recommend increased funding for staff support and site visits by the PM.

We recommend that a mechanism for stakeholder involvement (NGOs, local governments, etc.) be developed so that scientists can be linked more directly to end-users of research findings.

It would be a good idea to revisit the overarching science questions more frequently. These do not seem to be sufficiently dynamic in light of the pace of research.

The science-policy connection is weak in these programs. Its worth considering whether this link is strengthened, particularly at the federal labs, by requiring more attention to the national and international policy needs that could be served by the science.

## *Carbon Sequestration*

**Program Summary**

The program has thus far been sharply focused on identifying processes and controls which impact carbon sequestration in soils and biota. Being a highly successful program thus far, it is

important that the scope of the carbon sequestration research funded by the Office of Science, Department of Energy (DOE), be expanded to cover the following:

a) Importance of energy plantations on: (i) soil carbon pool, (ii) the net emissions of greenhouse gases, and (iii) cycles of $H_2O$, N, P, S (iv.) ecosystem services including biodiversity and water quality, (v.) role of dissolved organic and (vi.) fate of C transported by erosional process
b) Interactive effects of soil organic carbon dynamics on secondary carbonates in arid and semi-arid ecosystems, leaching of biocarbonates in irrigated or sub-humid ecosystems,
c) Translocation of dissolved organic carbon and fate of carbon transported by erosional processes,
d) Potential of wetlands on ecosystem carbon pool and dynamics, and
e) Assessment of sink capacity of terrestrial ecosystems at local, regional and national scales.

## General Comments

The research supported by the Office of Science under the auspices of the Biological and Environmental Research program and the Climate Change Research Program on carbon sequestration in the terrestrial ecosystem is commendable. The program has advanced the scientific knowledge in: (i) mechanistic processes of carbon sequestration in soils and forests, (ii) residence time and turnover of C in managed and natural terrestrial ecosystems, (iii) rates of carbon sequestration in diverse land uses and management systems, (iv) economics of forest management.

The program has focused on carbon sinks in forests and agricultural soils at several national labs (e.g., ORNL, LANL, PNNL, BNL, LBNL), universities (e.g., UC-Davis, Colorado State University, University of Nebraska, NMSU) and research centers (e.g., Woods Hole). It is a dynamic and visionary program that has, while enhancing the scientific knowledge, created awareness about the importance of terrestrial biosphere in mitigating the climate change among policy makers and the public at large. The program management, despite budgetary constraints that restrict travel and limit staff support, has been outstanding in implementing a wide range of projects. Support is distributed among a wide range of institutions located in diverse eco-regions and geographical locations.

## Responses to Specific Questions

### Is the proposal review process rigorous and fair?

Across the board, the review process is rigorous and fair. We note that the pool of reviewers seems small, resulting in some reviewers being used repeatedly to review diverse proposals, but acknowledge that this may reflect the size and nature of the program element. The program has evolved a good coping strategy by having lab PIs reviewing university projects and vice versa. We also note that several successful projects had low to moderate ratings of 5-7, and that there appears to be no provision for project revision in light of reviewers' comments. Program

documentation does not provide criteria for choice of reviewers. The rigor of the process could be improved through the development and use of such criteria.

**Are funding decisions adequately documented and justified?**

All of the carbon sequestration proposal files from universities contain highly detailed memoranda from Program Managers, each of which summarizes review comments and documents funding decisions. However, national laboratory funding decisions are not documented well, especially when compared with the documentation on university funding decisions. Lab proposal files typically contain a brief, two- or three-sentence guidance paragraph stating only the project title, funding amount provided, and list of deliverables.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

There were no new solicitations in Carbon Sequestration within the 2004-2006 time period, so there is no direct basis for evaluation. In order to provide some measure of sufficiency of solicitation guidance, we examined a 2006 solicitation from the allied "Terrestrial Carbon Processes Research" program. The solicitation provides explicit and detailed science goals for the program and objectives for the current solicitation. The solicitation further lists the criteria against which proposals will be judged, including priority areas of approach. The solicitation explicitly states proposal format, length, and submission information.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

Progress and outcomes of multiyear projects are extremely well-monitored in university grants, but often are noted only by perfunctory boilerplate memos in lab jackets. The project files for labs usually contain a summary of required deliverables and measures of success in their yearly guidance, but they do not contain the required reports themselves. In carbon sequestration, only one lab project file contained the actual progress reports, whereas all university project files contained actual progress reports.

**Does the process consider the depth and balance in a research portfolio?**

Since there were no new solicitations for carbon sequestration projects in the review period, it was difficult to assess what the total original pool of proposals looked like. A comparable solicitation from the Terrestrial Carbon Processes Research program contained explicit statements that proposals would be reviewed not only for technical merit but for responsiveness to DOE programmatic needs and DOE Climate Change Program goals. Given the constraints imposed by the overall size of the program, the carbon sequestration proposals actually funded during 2004-2006 do reflect reasonable balance and depth.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

During the 2004-2006 period, the program contained very little high-risk research (one task in one proposal might be considered high-risk). We acknowledge the difficulty of justifying high-risk components in a resource-scarce environment, but also point out that high risk research can yields a high level of benefit and can move a scientific field ahead more than incrementally. We recommend that some mechanism be designed into the program to accommodate some level of this type of work.

There is a strong need to identify innovative strategies which enhance/accentuate processes that lead to carbon sequestration and stabilization in terrestrial ecosystems. In this regard, it may be crucial to encourage inter-disciplinary (and inter-institutional) proposals. For example, science of carbon stabilization in soils may be strengthened by close cooperation between soil scientists and chemists, physicists, geologists, mineralogists, microbiologists, biochemists, hydrologists, sedimentologists, ecologists and plant molecular geneticists who can create plants with recalcitrant biomass and a high root-to-shoot ratio. The hypothesis to be tested and methodology to be used should foster cooperation among disciplines. The answers to several important science questions (e.g., Processes enhancing the residence time of carbon? Sources of carbon? Source of carbon input in old vs. newly sequestered carbon? Fate of carbon transported by erosion processes?) can only be determined by interdisciplinary teams comprised of diverse disciplines.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

Evaluating linkages to DOE mission and programmatic goals and objectives is done via analysis of proposal themes only, since there were no new carbon sequestration solicitations during the relevant time period. From that basis, there is reasonable linkage to mission, goals and objectives regarding carbon sequestration. The comparable solicitation from the Terrestrial Carbon Processes Research program mentioned above emphasizes the desire on the part of the program to have projects that are integrated, multi-investigator, and that leverage capabilities and resources.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

As discussed above in the section on high-risk research, there is a strong need for projects that are both innovative and integrated across disciplines and institutions in order to address questions that require capacity beyond that of a single research group or lab. The program is making strides in this direction based on the encouragement given in current solicitations, and the CSiTE activity is a good example of programs that foster integration and collaboration.

Close interaction of the Program Manager with the scientific community is essential to identification of innovative rather than routine projects, of demand driven rather than safe projects, of relevant to societal needs rather than of personal interest themes, and to the management of such efforts once approved and funded. This can only be achieved by increasing

the funding support for: (i) the program manager not only to visit the ongoing projects but also to attend national and international conferences relevant to the theme, (ii) organizing thematic workshops to identify researchable themes, (iii) commission state-of-the-knowledge position papers, and (iv) interaction with stakeholders.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

There were no new solicitations for carbon sequestration research over the time period 2004-2006. This reflects an emphasis on longer-term multi-year projects which are understandable in this particular scientific field, and in a program of this size. However, the predominance of long-term projects reduces the frequency of solicitations and thus restricts the ability of the program to foster new projects and new PIs.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Collectively, the funded projects demonstrate reasonable depth and breadth across ecological carbon sequestration science. Two of the university proposals examined were collaborative across institutions; however, among the lab proposals only the two CSiTE projects were multi-institutional. We understand that changes are being made to the lab funding approach to increase integration across projects, investigators, and institutions for added scientific value. On some proposals, reviewers also noted relevance to extrinsic goals. One major measure of scientific standing is the publication of results in peer-reviewed journals and in presentations at international conferences. Most of the University proposals included lists of publications and presentations resulting from their work. It would be appropriate to request the same from labs as measures of success of their projects.

## Other Considerations

### *Synergistic Interaction with NETL*

The Office of Fossil Energy and NETL have given high priority to geologic sequestration (capture, compression, transport and injection), but have included Terrestrial Carbon Sequestration (TCS) as a component of the regional partnership program. The NETL-sponsored TCS focuses on application of the knowledge and demonstrating the large-scale implementation of proven technology. In comparison, the Office of Science deals with the study of basic processes, soil/environmental constants of TCS, and on techniques of measurement and monitoring of the terrestrial carbon pool at landscape scale. A close cooperation among the offices in identification of mutually supportive programs and topics of common interest would be extremely helpful and have synergistic effects. Establishment of a joint task force, organizing jointly sponsored workshops, and publications of jointly commissioned thematic reports would enhance cooperation and advance the goals of TCS of both offices.

### *Support to National Labs*

National Labs (e.g., ORNL, LANL, BNL, ANL, LBNL) have an excellent track record of conducting world-class research on carbon sequestration in soils and trees. Several examples of the high impact research by national labs include: the role of stable micro-aggregates, C-SITE project implemented on three diverse but complementary biomes, modeling soil carbon dynamics, non-invasive and rapid measurement techniques (e.g., LIBS INS) and others. Support to national labs for these and other innovative programs must be continued and strengthened.

The review process, reporting protocol, assessment of the progress, and submission of the final report are different for the national labs vis-à-vis the university and other grant recipients. While such differences are inevitable because of the differences in management and relations with DOE, it may be important to revisit the process of funding support to the national labs to further enhance the efficiency, productivity, transparency, and credibility. Increasing involvement of the universities, USDA, and industry in the DOE-funded program at the national labs may be highly desirable.

### *Commodification of Terrestrial Carbon*

Voluntary or mandatory trading of carbon sequestered in terrestrial ecosystems is an important strategy to provide incentives to land managers to adopt recommended land use and management practices. Wherever carbon sequestered in the forest biomass has been widely recognized as a tradeable commodity, tradeability of soil carbon is slowly gaining momentum. A principal constraint to commodification of soil carbon is the identification of a technique for a credible assessment of the change in soil carbon pool (to a specified depth of about .5 to 1m) over a specified period of one to two years or more. The soil carbon pool assessment involves aggregation over a county, watershed, or a region. Development of a technological protocol, involving measurements at soil-scape level using GIS and other aggregation techniques, is important to making soil carbon a tradeable commodity. Uncertainties involved in presently used methods of "best guesstimates" are not conducive for land managers to undertake trading of credits based on carbon sequestration in soil.

## *Climate Modeling Program (CMP)*

### Program Summary

**Program Mission:** The mission of the DOE Climate Change Prediction Program (CCPP) is to rapidly advance the science of climate change prediction on the time scale of decades to centuries on spatial scales from global to regional. To achieve this requires the development, evaluation and application of the most advanced climate models on the most advanced scientific computers. The U.S. Scientific Discovery through Advanced Computing (SciDAC) program was created to bring together many of the nation's top researchers to develop new computational methods for tackling some of the most challenging scientific problems. The CMP consists of two primary elements: The Climate Change Prediction Program (CCPP) and the Scientific Discovery through Advanced Computing (SciDAC)-Climate Program.

**Program Objectives:** The CCPP objectives are: (i) to incorporate better representations of key climate processes (land surface processes, convective transport, ocean and sea-ice processes, *etc*) to simulate decadal-to-centennial climate change; (ii) to develop diagnostic methods and tools to evaluate GCM-based climate models; (iii) to test models based on definitive theoretical foundations and improved computational methods; (iv) to test and apply climate models that stay at leading edge of scientific knowledge and computational technology for climate change projections under various scenarios, e.g. IPCC runs; (v) to increase accuracy and computational performance of climate models enabling improved projections of future climate system response to increasing atmospheric concentrations of greenhouse gases; and (vi) to examine issues of detection and attribution of climate change.

The CCPP contributes directly to the BER Long Term Measure of scientific advancement of delivering improved climate data and models needed to determine acceptable levels of greenhouse gases in the atmosphere. The Program also contributes to the Climate Variability and Change element of the U.S. Climate Change Science Program (CCSP), and coordinates its activities with the climate modeling programs of other CCSP agencies, primarily those supported by the National Science Foundation, the National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration. The program also supports the larger DOE Energy Strategic Goal "to protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy" by providing sound scientific basis of understanding and attributing climate variability and change under a range of energy supply options.

**Program Implementation:**

Present SciDAC-CCPP research activities are organized into several distinct, but coordinated, components.

***Research Grants*:** The CCPP supports research at universities through a competitive, peer-reviewed grants program. The funded projects are devoted to long-term basic research addressing climate science and, through the CCPP's association with the DOE Office of Science's SciDAC program, advanced numerical methods useful in climate simulation on high-performance computer systems.

***Design and Testing of a Global Cloud-Resolving Model (GCRM)*:** This SciDAC project will develop and test a global cloud resolving model (GCRM).

***Climate Model Development and Evaluation:*** The CCPP development and application projects are focused on the Community Climate System Model (CCSM3), a community modeling program based at the National Center for Atmospheric Research (NCAR) with major development components at the DOE National Laboratories.

***Modeling the Earth System:*** This SciDAC project will create a first generation Earth system model that fully simulates the coupling between the physical, chemical, and biogeochemical processes in the climate system.

***Climate, Ocean, and Sea Ice Modeling Project***: The CCPP sponsors the Climate, Ocean, and Sea Ice Modeling (COSIM) project at Los Alamos National Laboratory (LANL). Currently, efforts are focused on the hybrid coordinate ocean model HYPOP and a new ice sheet model.

***Program for Climate Model Diagnosis and Intercomparison*: T**he PCMDI at Lawrence Livermore National Laboratory works with national and international model development groups to identify the shortcomings of present climate models by independently providing universal diagnostic tools for evaluating climate model performance. The CCPP-ARM Parameterization Testbed (CAPT) at PCMDI uses numerical weather prediction methods to provide climate model developers a means to evaluate new parameterizations.

**Climate Simulation and Prediction:** NCAR's Climate Change and Prediction (CCP) group collaborates closely with major DOE laboratories applying the Community Climate System Model (CCSM) to study the sensitivity and variability of the Earth climate to a variety of natural and human-made forcings.

## General Comments

The Climate Program is exceptionally complex, representing a wide diversity of activities and management structures. These include single institution grants to universities, support for large collaborative projects at DOE labs, and cooperative agreements with UCAR. Moreover, a significant fraction of the funded activities are committed to the development of the Community Climate System Model (CCSM) – these activities are carried out in coordination with the National Science Foundation.

The Committee feels that, judging from results, program management generally deals effectively with this complexity. While the Committee raises a number of questions and issues, these, for the most part, arise from complexities inherent in the management of a complicated program and should not be construed as criticisms.

- *Overall allocation of resources:* How is the overall allocation of resources between university, DOE lab, and other-agency labs determined, and is there any ongoing or periodic review of that allocation?

- *Funding model for lab activities:* All the DOE labs support the CCPP through efforts funded from CCMP. PCMDI is an example of an outstanding return on a more than twenty-year investment. PCMDI is readily accessible for direct collaboration with other agencies, because there is a defined role and a stable funding commitment. There is, however, no identifiable ‘core’ DOE investment at DOE labs that straightforwardly allows other agency program managers to forge direct collaborations in CCPP-related research.

- *Change in focus for funded activities at DOE labs:* The plan of DOE to phase out individual PI projects at the labs will eventually impact the quality and character of the workforce at the labs, and this should be recognized. It will become more difficult to generate innovative or high-risk project concepts at the labs under this plan. It is likely

that some innovative concepts can emerge only at the labs because of their unique facilities/capabilities, e.g., computing facilities, experimental coupled model configurations, co-location with applied scientific computing capabilities at the NNSA/DOE labs, etc.

- *Interactions with broader climate research community:* To the external community it is sometimes difficult to understand how to engage, 'DOE'. It would be of value to support a 'climate' document / website that identifies the spectrum of DOE investments, lab location, principal points of contact and potential research opportunities. Perhaps many community members are well aware of these details, but DOE might benefit from a clearer window into their investments/products and ongoing research investments.

- *Computing resources:* Very large allocations of computing resources are essential for climate science, especially the realistic global and regional-scale modeling that is the focus of CCPP activities, yet computing resource allocations are made separately from the allocation of funding. This can place an onerous burden on investigators, especially since there is no assurance that the computing resources necessary for carrying out a CCPP supported project are, or will be made, available.

In reviewing the overall activities of the CCPP, we note there are four categories of proposals, applying to three categories of funded activities.

1. Field Work Proposals (FWPs) for Awards to single or multiple DOE labs

   These proposals, which comprise a vital component of the overall US effort in climate simulation and climate-model development, represent more than half of the CCPP's funded activities. We perceive that excellent and important works results from these activities. We are concerned, however, that the level of documentation, at least that which was available to us in the jackets, is less than sufficient for justifying, to others in Government, the high level of investment in these activities and the extent to which they are necessary to meet DOE requirements. Similarly, the documentation we reviewed would not be sufficient to assure continuity of large and complex projects, which require long-term stability, across changes in program managers or a reorganization of the management structure. The maintenance of more comprehensive documentation would be facilitated by increased staffing and improved cyber-infrastructure for program management, issues addressed elsewhere in this report.

2. External awards to universities/private industry (except for Cooperative Agreements)

   Overall, these projects are awarded and managed in a fair and transparent manner that, despite the relatively greater focus of the research, is largely consistent with, for, example, NSF practices, and, therefore, should be familiar to university investigators. We raise the question, however, whether the available resources for externally funded awards are sufficient, given that engagement with the external community is needed for DOE research to succeed. The resources available to the external community through research calls are approximately 20% of the overall CMP budget (~35% if include the Cooperative

Agreements with NCAR and with Randall at CSU). This level of support may allow the essential connections with the community to be maintained, but this is not clear from the information provided.

3. Computer Resource/Infrastructure

   We did not have the opportunity to review the process through which lab and outside investigators apply for computing resources. Given the importance of computing for CMP activities, as noted above, these are important proposals. We recommend that future COVs review this process.

4. DOE-UCAR Cooperative Agreement

   The "DOE climate model" is now the NCAR CCSM. Given the complexity of modern climate models, with concomitant costs and great demands on human resources required for their development and maintenance, this is a rational strategy. Much of this DOE-NCAR collaboration is carried out under two DOE-UCAR cooperative agreements that comprise nearly 15% of the CMP budget. This DOE support is critical to the continued progress of highly regarded climate-system modeling efforts at NCAR and at other organizations contributing to the CCSM effort.

Despite the prominence of these activities within the CMP portfolio, and their importance for climate modeling in the US, these cooperative agreements appear to be reviewed and managed in a somewhat *ad hoc* manner. While the cooperative agreements are subject to external review, the reviewers include individuals, such as an NSF program manager, who may have a significant interest in the outcome (it is certainly fine to have the NSF counterpart comment on the proposal but it is not OK to treat his comments as a peer review). The cooperative agreements, while external to DOE, are treated more like a DOE FWP than an external grant, in that they are reviewed but not competed. More substantive issues arise regarding the management of these agreements. Mechanisms through which DOE Program Managers exercise oversight or influence at NCAR are absent. The DOE must rely on the CCSM management structure – its scientific steering committee (SSC) and the CCSM advisory board (CAB) – but it is not clear that either can represent DOE interests. For example, the CAB cannot function in a formal advisory capacity to DOE program management. The CMP program manager is an *ex officio* member of the SSC, but this offers limited influence. There is little ability to assure that UCAR/NCAR makes needed investments in computational in infrastructure and software engineering support to assure the delivery of DOE-required elements. It also appears that the CMP does not receive appropriate credit or recognition for accomplishments arising from the DOE-UCAR collaboration. While these issues are related to management structure, they effect outcomes, in the sense that is has proven difficult to implement DOE-developed model components in the CCSM, due to under-resourcing of the CCSM development at NCAR, and there is a general perception at DOE that CCSM development is "slow".

**Responses to Specific Questions**

**Is the proposal review process rigorous and fair?**
The review process for university proposals seems adequate, rigorous, and fair. There has been a modest increase in the number of reviewers since the previous COV. The larger proposals still would benefit from a greater number of reviewers. For example, proposals in the range of $200K per year for three to five years had only three reviewers each, with technical credentials in some cases perhaps too limited, and with one review possibly conflicted (an NSF program manager reviewing a project in which NCAR is a stakeholder).

The PMs maintain their own reviewer databases. A move to a uniform BERAC-wide reviewer database (as used, e.g., at NSF) might be worthwhile.

The review process for Lab proposals is difficult to evaluate. There is no clear view as to how large multi-lab efforts are developed, justified, and reviewed for DOE alignment.

**Are funding decisions adequately documented and justified?**

For university/other agency proposals, generally yes. The justification for declines is rather limited, however. There is little documented detail concerning the rationale for continued funding of large-scale multi-lab projects, other than a statement that the PM agrees that the project is proceeding based on the most recent progress report in the annual field work proposal. We could find no documentation of an assessment of the degree of success for the projects upon completion.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

Yes, in general. We suggest that DOE consider mechanisms to communicate funding opportunities more broadly to the university research community at large (e.g., a targeted web-site, brochures at scientific conferences.)

The CCPP 2004 solicitation could be made more "user-friendly" – e.g., for those exposed to the program for the first time, it is not easy to find the essential information on themes.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

For university/other agency projects, this cannot be evaluated from the documentation provided. Annual and final reports are required and new research calls appear to be based upon progress among grants awarded, but specific information on this aspect of the process is not documented.

For large, multi-lab projects, periodic reviews appear to be on an approximately 5-year basis, but there is little documented evidence of substantive annual reviews. Documentation of progress on milestones, technical issues, and related items should be done on a regular basis and used as the basis for continued funding.

**Does the process consider the depth and balance in a research portfolio?**

The program attempts to maintain a balance among DOE Lab research efforts and externally funded grants. Lab activities have a strong focus on multi-investigator 'team' efforts toward development of elements of climate models and, within SciDAC, the coupling of components leading to an Earth System Model. University projects tend to be broader than lab activities, with more research that involves experimentation with models and analyses of model output, rather than specific model development, although there is some model development work funded at universities. Within the constraints of the announcements, there is a good diversity of funded activities at universities and this is consistent with DOE lab efforts.

It is not clear how and at what frequency DOE-lab research efforts are reviewed, and as a result there is some question as to how balance is evaluated and adjusted in a research environment where high priority questions change over relatively short time scales.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

This issue was discussed with Dr. Bamzai. Overall, about 10% of her portfolio is high risk. Activities that may be classified as high risk include the development of model components that may not make their way into national models in the near term. These include explorations of exotic numerical methods that may not turn out to be optimal choices, insufficient improvements to justify the overhead of their implementation, or because the national models, namely the CCSM, may not be ready for their inclusion. With an emphasis on rapid improvements in decision-quality results, there is a requirement to support research efforts closer to an end product.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

The solicitations clearly define research objectives that fit within overall CCPP program goals. This is reinforced by the pre-application process.

The mechanism for DOE to assure value of its investments in the NCAR/lab consortium is not clear (e.g., the DOE-sponsored chemistry component has been developed through investments over five years, but it will not be included in the CCSM version used for the next IPCC assessment).

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

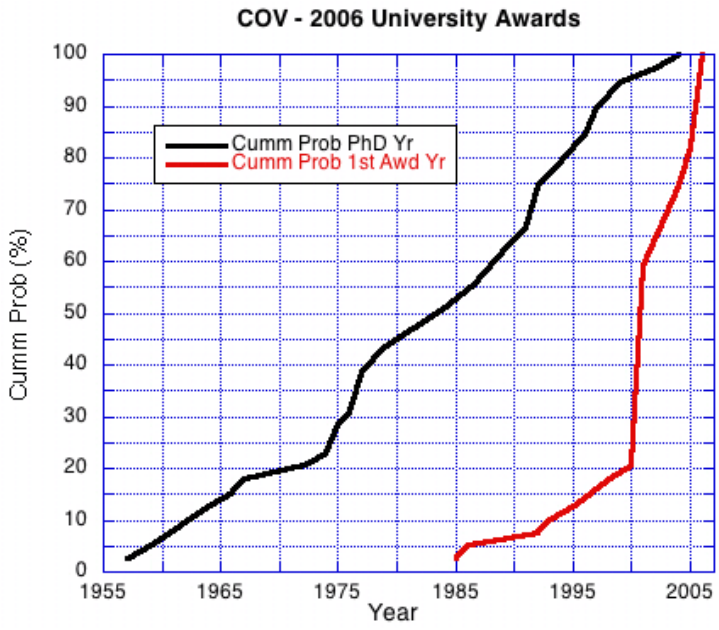
The support for collaborative lab projects, as well as the cooperative agreements with UCAR/NCAR and CSU, encourages a coherent approach to DOE research objectives. The other university projects are loosely connected, but this is consistent with programmatic balance.

This is most clearly the case for the large-scale lab projects that are collaborative and supported under cooperative agreements.

Research calls encourage integrated efforts, but it is not clear how successful this has been with respect to the university/other agency research grants. It is very evident in the DOE Lab investigations, where it appears that integrated projects within and across labs are well defined before an announcement for lab proposals.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

The project is doing a good job in this regard. The cumulative probabilities of PhD dates and first DOE Climate Modeling Program awards for 2006 active award recipients are shown below.




Half of the recipients received their first awards since 2000, and half the recipients received their PhDs since the early 1980s. The picture from these graphs is somewhat more favorable in terms of the program supporting investigators that are new to the program than in funding young scientists.

In the "University and other" category, the turnover list provided by the PM indicates 10% of successful proposal PIs had PhD degree for five or fewer years, and 15% had PhD for between six and 10 years. In the lab category, no PIs were within eight or fewer years of receipt of PhD, reflecting the nature of DOE lab proposals that include large multi-investigator efforts.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

This is difficult for the COV to evaluate, and is, in fact, beyond the scope of our evaluation of the program. It is not clear how the PM evaluates the overall success and impact of her program. That said, a focus of the program is support for the development of the CCSM, and

maintenance/improvement of PCMDI, both internationally recognized efforts. These activities are high profile with very high impact (though, as noted elsewhere, CCPP may not receive its full share of credit for its contributions).

**Other Considerations**

Combined with General Comments section.

## *Ecosystems Research*

**Program Summary**

The following program description comes from the DOE PER website, and we judge it an accurate assessment of the program:

*'The mission of the DOE Program for Ecosystem Research (PER) is to produce scientific knowledge about potential effects of climatic change on ecosystems so that decision makers (including the public) can determine if fossil-based energy production is "safe".*

*The PER's mission [aims]… to "deliver improved scientific data and models about the potential response of the Earth's climate and terrestrial biosphere to increased greenhouse gas levels for policy makers to determine safe levels of greenhouse gases in the atmosphere". The PER contributes to this by providing scientific understanding of how changes in climate and atmospheric greenhouse gas concentrations might affect important terrestrial ecosystems; that understanding can potentially be used as one means to define "safe" greenhouse gas levels.*

*The PER carries out its mission by soliciting, selecting, and funding basic-research projects studying potential effects of climatic change (and associated changes in atmospheric composition) on terrestrial ecosystems in the United States. The research is meant to measurably improve the scientific basis for forecasting effects of climatic change on terrestrial ecosystems and their component organisms and processes. The PER supports manipulative experiments, in both the field and the laboratory, and the development and testing of ecosystem models through support to universities, government laboratories, and private research institutions.*

*The PER considers all levels of biological organization from macromolecules (e.g., DNA, RNA, and proteins) to whole ecosystems (e.g., forests, shrublands, and prairies). Research projects are directed at measurable endpoints attainable within a specified period. Types of ecosystems, their functions, and their component organisms most valued by society are of highest priority to the PER.*

*The specific environmental changes of interest to the PER are:*

- *Warming and changes in daily, seasonal, and interannual temperature cycles.*
- *Systematic changes in seasonal and annual precipitation amount and temporal distribution.*
- *Increases in atmospheric carbon dioxide concentration.*

*The PER's focus is on ecosystem-scale effects of these environmental changes, with specific consideration of (1) adjustments at the ecosystem scale, such as changes in the organized hierarchy of ecosystem processes, structures, species composition, primary production, or succession, as well as (2) adjustments at the organismal scale that are manifested at the ecosystem scale, including physiological, biochemical, and genetic changes that may affect ecosystem stability or functioning.*

**General Comments**

The Program Manager should be commended for actively managing a high quality program of relevant research and especially for moving NIGEC to NICCR.

- Consolidating the Centers reduced the overhead, and placing the center management out for competitive proposals substantially improved the quality of the scientific experience of the Center Directors and brought a new interest among the community and new investigators and funded proposals.

Program is well managed.

- Solicitations were clear, as were the instructions for review of the NICCR Center proposals, and relevance of the research to DOE mission was well identified.
- A good mix of quality reviewers was selected and their opinions counted.
- There is a balance between funding to National Laboratories and Universities, solicitations in this period were for very risky fundamental new research, and a good mix of previously funded research was maintained.
- Project oversight is thorough and helpful for the investigators, with annual meetings, site visits and annual reports.
- Use of required pre-proposals helps the Program and the community.
- The Chief Scientist was well selected and respected by the community and not conflicted with most program activities.
- Convening panels by phone and having panels review proposals (the same scientists review all of the relevant proposals) saves money and provides consistency.

Problems identified in the previous COV have been addressed through improved documentation, and there are many examples of a commitment by the Program Manager to high quality science.

Suggestions for program improvement.

- Final reports that are required for university projects should also be required for National laboratory projects. The Program Manager should specify the type of reporting (for example, a collection of scientific papers versus a stand alone report) on a project by project basis.
- Funding letters should include suggestions for alterations based on proposal reviews.
- NICCR Centers should continue to be monitored to ensure they follow through on their proposals.
- Travel funds should be sufficient for site visits, program oversight, and attending scientific meetings.
- PM should periodically (every three years for the COV cycle) document accomplishments, and this document should be publicly available.

- Formal involvement of the community (perhaps at a workshop) would help when setting new directions for the program.

For both DOE laboratory and university grants, assess the efficacy, fairness, and quality of processes used to:

- Solicit, review, recommend, and document proposal funding actions
  *For 4-14, Lab 4-14, Lab 4-23, 05-19, 06-08*
  Excellent documentation was found. We reviewed all project files. Solicitations were very clear, as were instructions to reviewers for the NICCR Centers. Proposals had a minimum of three and often four or five reviewers. Reviews were taken seriously as indicated by no awards given in Lab 4-14! The PM was active in the reviewing process and made detailed summaries of reviews. The Selection Statements for funded projects are detailed and complete. Declination letters ranged from a form type letter (for poorly ranked proposals) to extensive discussion of the specifics of why the proposal was declined (for proposals that nearly made it). All received copies of the reviews with the reviewers' names and affiliations removed. For most funded projects, there was now guidance on issues the PM would like addressed during project implementation based on reviews. An excellent example of such a letter was found in the Firestone jacket. We encourage the PM to ensure all funded projects get such a letter. We suspect these discussions take place between PM and PI's during PI meetings, but a letter would make a more formal declaration to the proposer and be more enduring.

  Monitor active projects and programs for progress and outcomes.
  Projects examined in 4-14 and older solicitations had submitted progress reports. Reports generally indicated progress and productivity. Where problems were identified, PM took appropriate action with a review or site visit to rectify the problem.

**Responses to Specific Questions**

**Is the proposal review process rigorous and fair?**

Definitely so for 4-14, Lab 4-14, Lab 4-23, 05-19, 06-08. There is an adequate number of reviewers. A review of a subset of the proposals that were accepted and declined and the reviewer comments indicated the reviews were rigorous and that it was clear why proposals were declined or funded. During this COV review period (2004-2006), six solicitations were processed. Eighty-two pre-applications were received and 69 were encouraged to develop a full proposal. Eighty-one full proposals were processed and 14 were funded. For the five DOE solicitations in aggregate, the success rate was 17%. Success rate for individual solicitations ranged from 0% (Lab 4-14) to 50% (Lab 4-23).

**Are funding decisions adequately documented and justified?**

For 4-14, Lab 4-14, Lab 4-23, 05-19, 06-08, absolutely. The selection statements are very convincing, very well documented, and well related to reviews by qualified scientists with a variety of backgrounds and experience. The split of available funds to university or laboratory solicitations is up to the discretion of the PM, and this should stay so. A general rule of thumb is

50% but the PM adjusts this based on the quality of the proposals received from universities and labs.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

Yes. Solicitation announcements were clear, detailed, and informative. Lab 4-14 solicitation resulted in no funded proposals due to poor scores, but the same solicitation open to universities brought in many good proposals. A new solicitation Lab 4-23 was issued. Solicitation Lab 4-24 was significantly changed from Lab 4-14 and resulted in more proposals being responsive.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

Yes. We sampled progress reports from 4-14 and from projects funded under solicitations not covered by this COV. Progress reports were generally informative and a good basis for the decisions to provide continued funding. Renewal proposals were rigorously reviewed.
The PM holds annual investigator meetings for the entire Ecosystems Program where each funded project participates and gives technical presentations. In 2004-2006, the PM invited several outside experts to attend these meetings. He asked them to look for areas that are missing in the program, and to identify possible linkages between projects. These outside "reviewers" would present their observations informally to the PM. We feel this is an excellent protocol and should be continued and possibly expanded in scope. Site reviews of long-term projects are held on an *ad hoc* basis, but site visits are limited by small travel budget. Additional travel funds to support meeting attendance and additional site visits would improve the program.

The PM selected a Chief Scientist from a National Lab to help him review pre-proposals and proposals, and to participate in site reviews. This role is new and does not relate to the solicitations we reviewed. We strongly support and encourage effective use of the Chief Scientist. We believe the level of effort required to be effective in this program is 33-50% of the Chief Scientist's time.

For long-term projects (5-10 years), site reviews involving outside experts are held. In some cases, formal reports are written. No site reviews were held for projects funded in our review period (04-06). It should be noted that PM's have limited travel budgets and are not allowed to accept travel funds from others. This is an issue and can limit the use of site visits as a management tool.

Annual (or 24 month) progress reports are required for university projects and Lab projects discuss progress in their annual FWP's. The PM uses these reports and annual investigator meetings to justify continued funding. There is evidence that continuation funding for one project was declined based on inadequate progress.

**Does the process consider the depth and balance in a research portfolio?**

Yes. The PM invites outside experts to the annual investigator meetings who provide input on missing program elements and opportunities to link projects. The PM uses reports such as the IPCC suite, Academy reports, CCSP reports, and Interagency Working Groups to fine-tune the program when funding becomes available from terminated projects or new funding becomes available.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Yes. The solicitations for 04-14 (the use of new genomic technologies to extrapolate across scales) were specifically for high-risk research and represented one of four research solicitations during the period. Also, experimental field research is inherently high risk.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

Yes. All solicitations covered under this COV clearly state DOE mission needs. The PM in his reviews often discusses links or missing links to DOE or programmatic needs.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

The annual investigator meetings are a vehicle to accomplish this for funded projects, and the program funds are reasonably well distributed among different investigators and ecosystems. It is more difficult to accomplish this at the solicitation stage, as competitions do not necessarily result in all projects relevant to each other. There is a possible conflict between having a coherent program of research (which likely means much selection by the PM) and rigorous review and selection based on merit and link to DOE goals. We suggest that a focus on merit should continue to receive priority.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

Yes. The following data is for funded projects active in FY 2006. For National Laboratories, there are 17 active projects. To evaluate the age distribution of PIs, we looked at year PhD received. The oldest was 1974 (one project) and the youngest was 2002 (one project). Distribution by decade was 1970's (four), 1980's (eight) 1990's (four) 2000's (one). The PER started in 1993. Of the 17 active national lab projects, two date back to 1993, one to 1996, five to 2002, one to 2003, two to 2004, five to 2005, and one to 2006.

There are 16 University projects active in 2006. The oldest PI (as by date of degree) was 1975 (1 project). The youngest was 2002(1 project). Distribution by decade was 1970's (one), 1980's (six), 1990's (seven), 2000's (two). The PER started in 1993. Of the 16 active university

projects, one dates back to 1993, one to 1995, three to 2002, four to 2004, three to 2005, and two to 2006.

The majority of investigators in both university and lab programs received their degrees in the 80's and 90's. Eight of 17 lab projects are five years or older, six of 16 university projects are five years or older. There do not appear to be significant differences in age distribution of investigators or project turnover between lab and university funded project.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Yes. Long and short-term experiments and National Laboratory and university projects have all received much attention and have set standards for work in the field. The FACE experiment is the only $CO_2$ x ozone experiment in the world, and has resulted in many important papers in high profile journals. The quantity and quality of scientific outputs from the program is impressive.

**Other Considerations**

***Reevaluation of Findings in the 2004 COV Report***

- Proposals that were funded are narrower than in the one solicitation reviewed in 2004.
  *Solicitations 4-14, Lab 4-14, and Lab 4-23 contained very good instructions about what was expected and what was important. A wide range of science was funded for proposals from these solicitations. Solicitations 5-19 and 6-08 were general, but that was appropriate for Center selection. Funded Center proposals addressed the criteria and were broad and creative.*

- Documentation is not always complete on funding decisions for proposals for investigators at National labs.
  *The new Selection Statements for proposals funded for investigators at National Labs implemented since the 2004 review is very responsive to this concern. Proposals are of high quality and the justification for selection is thorough and persuasive.*

- There is no documentation that the PM requests responses to reviewer comments in his selection process.
  *We observed no changes. However, we do not believe this is a critical issue. We believe it would be beneficial for the PM to provide some written guidance to newly funded projects that emphasize areas that could help project implementation based on reviews.*

- Systematic and disturbing difference between documentation for documentation of the review process for Laboratory versus outside proposals. No responses to reviews, no selection memos.
  *The Selection Statement for National Laboratories found in all jackets reviewed addresses this concern. We are recommending that funding letters from the PM provide guidance to PI's on critical issues from the reviews.*

- There were only a few female reviewers (3/17)
  *For the five solicitations covered in our analysis, 11/50 reviewers were female.*

- There was somewhat of a concern women scientists are under-represented in the research portfolio.
  *For active projects at labs, our best estimate is six of 17 PIs (35%) are female. For active projects at universities, our best estimate is four of 21 PIs (19%) are female. For all active projects, 20% of the PIs are female.*

- Documentation in Jackets for Labs needs to be improved.
  *We see that it has been substantially improved. See items 2, 3 and 4 above.*

- No indication of how program planning and prioritization of the program was done.
  *The PM documented the use of IPCC, Academy, CCSP , and Interagency Working Group products to help focus the program, as new funds are available.*

- Lack of documentation for program declinations, no summary data on funding success rates, gender balance, etc.
  *See answers above. Data on the number of pre-proposals, proposals, proposals selected, and declinations were available for our review. We reviewed a sample of declined proposals and generally agreed with reviewers and PM decisions.*

- Difference between breadth of solicitations and what is actually funded. Primarily fund major ecosystem manipulations.
  *The solicitations we reviewed were very focused (4-14, lab 4-14, lab 4-23), and did not only fund new ecosystem manipulations. The Center solicitations were more general and allowed for broader work. But, we emphasize that the PER program is focused on specific problems and experiments, and the PM has made these foci very clear.*

- There is a need to be clear about what the program has accomplished and how its direction will be set for the future.
  *The PER website has much information about program goals, history, funding, and accomplishments. We recommend that the PM prepare a short publicly available report on program accomplishments every three years (corresponding with the COV cycle. We recommend the community should be involved when recommending future research directions (maybe through a workshop at the ESA or AGU meetings).*

## *Other Programs (Integrated Assessment, Education, and Information / Integration)*

The discussion of these three programs are provided as separate discussions.

***Integrated Assessment Program***

**Program Summary**

The Integrated Assessment Research (IARP) program is a unique and important component of the interagency US Climate Change Science Program (CCSP). The program funds efforts to understand and to model the contributions and adaptability of natural, managed, and human systems to climate and global change, especially the economic and other costs and benefits of climate change under scenarios that include technological innovation and policy interventions. This understanding and predictive capability is critical to the evaluation of policy options, but does not undertake that evaluation. The program is to be complimented for the high quality of science it has funded, for its investment in the development of new research capabilities for the nation in this area. Research by IARP investigators has been a basis for some of the Synthesis and Assessment Products of the CCSP. It has also been a basis for several components of the 2007 IPCC Assessment of Climate Change. Finally, it has been cited by other studies, such as the 2006 assessment by the Stern Commission of the UK. These are very important contributions and DOE CCRD should be congratulated on continuing these investments and substantially contributing to the development of this field of research. The contributions of the program are especially impressive given the small amount of funding available to the program ($3M annually).

The program has supported the development of two integrated assessment models through three lead research institutions, two universities and one national laboratory joint center. Traditionally about half of the funding for the program supports these institutions for model development and to build a community of practice through workshops and other means. The other half of the program funding is set aside for competitive solicitations for contributing basic research, including the development of components or modules for the models, as well as collection and analysis of critical data and for other focused investigations.

The IA program is now in the midst of a transition with a new program manager who will be responsible for the program in the future. In addition, CCRD intends that the program evolve 1) to put greater emphasis on developing the capability to model impacts and adaptations of climate and global change and 2) to increase the capability of the predictions by linkage to more sophisticated models and the assimilation of a greater range of data. This evolution would make the program an even more valuable component of the CCSP and make its research more valuable for the evaluation of policy and the COV agrees with this new direction.

**General Comments**

Because of the limited funding, the program attracts a smaller pool of applications (27 proposals in 2004 and 14 in 2005) for support than some of the other CCRD programs. However, there is clearly a strong and growing community in this area of research and the quality of the applicants is high. The new directions being discussed for funding should also increase the applicant pool for the program.

The COV identified opportunities to enhance the program and increase its performance that are consistent with the evolution of the program that is under consideration. As CCRD considers the evolution of the areas to be supported, we encourage them to: 1) work with the larger modeling community to identify opportunities and paths for future increases in the sophistication of the modeling approach, 2) work with the other CCRD research communities to identify new components that could improve the ability of the models to identify ecosystem and climate system impacts and adaptations, 3) work with other federal agencies involved in impact/adaptation research to identify opportunities for synergy, 4) use a variety of opportunities to strengthen and expand the community of researchers involved in integrated assessment (for example, use newer investigators as mail reviewers in addition to more senior members of the community so that the newer investigators begin to see the range of subject matter being considered by IA and understand the proposal and review process better).

In addition we suggest that the new program manager take advantage of the opportunity to interact with program officers at other agencies who fund studies of the human dimensions of global change and who fund impacts and adaptations research. This will provide him with colleagues who we think will welcome interaction and will enhance the knowledge of and appreciation for the CCRD Integrated Assessment Research Program.

The COV also identified opportunities to strengthen the review of the program. The program relies too heavily on a few senior researchers for review who have been part of the panel review over the years. The program has also invested in three institutions for the development and support of the two integrated models, but there has never been a site review of these programs although they account for half of the funding of the program over the years. It is critical that such reviews take place. As CCRD and the program consider new areas for support it is important to have such reviews, to evaluate the current program direction, and to consider different approaches as well as allow consideration of different institutions to support those approaches.

**Responses to Specific Questions**

**Is the proposal review process rigorous and fair?**

Yes, the review process is generally rigorous and fair. However, the review process depends very heavily on a few senior researchers who have been reviewers for many years. The typical review process empanels a group of seven to 10 researchers (this is an increase over past years when the average panel was only six researchers). Each proposal, whether from a national lab or a university/research institute receives a written review by at least three members of the panel. In a few cases, where additional expertise was deemed necessary, an additional mail review was solicited.

The last COV indicated that “most reviewers appear to be drawn from the same community of modelers as the investigators who submitted funded proposals” and expressed concern that reviewers familiar with alternative modeling approaches and fresh approaches were not included on panels. The program appears to have made some effort to address this in 2004. The program decided to include more individuals who were not part of the previously funded group. They included two individuals who are familiar with IA, but not currently funded. In addition they

included two individuals who are not familiar with the program, but who are knowledgeable in some aspect of integrated assessment. In addition, the program made some effort to increase the range of individuals reviewing the program: in 2004, seven of the 27 proposals submitted received one additional mail review by an individual who was not part of the 10-member panel.

However, in 2005 only two of the 14 proposals submitted received one additional mail review by an individual who was not part of the seven-member panel. The COV is pleased to see these steps toward increasing the expertise of the review. However, given the small number of proposals, it appears to us that it would not be a burden to find more reviewers for all proposals. Although practice in CCRD is varied, many CCRD programs include at least three reviewers who may or may not be members of the panel for each proposal.

There is a perspective in the program that the size of the research community is small and that it would limit the number of appropriate reviewers. The COV does not share that view. We believe that discussions with other agencies would identify many individuals who have expertise related to IA who would bring important strengths to the review process. We also encourage the program to avoid reliance on the same two or three individuals who have been on review panels for many years. We also suggest that the program consider ways to avoid having individuals who have proposed to the program involved in the review of other proposals.

The proposal load is small enough that the Program Manager can have preliminary discussions with proposers and program management is very interactive with the community. Pre-proposals are required for the program, but there is virtually no documentation on them. Information is not available on whether/how many proposers were discouraged from submitting full proposals and whether they did, in fact, not submit and what role the pre-proposals played in the overall review process.

**Are funding decisions adequately documented and justified?**

Yes, the program manager generally writes a complete justification for funding decisions that includes discussion of the review comments, the role of the proposed research in meeting the goals of DOE/CCRD and the program. In some cases reviewers have raised questions that the program has asked proposers to address. Materials that have been submitted by proposers in response to the questions are included in the award folder. The program officer has included discussion of whether he believes that the questions are adequately addressed. In general, however, the program manager has not asked the reviewer(s) who raised the concern to review these materials. If such materials are used for the basis of a funding decision, we urge the program manager to allow the reviewer to see the response and comment on whether their concerns are adequately addressed.

In general, the proposal budgets are not discussed in depth by reviewers, nor is there much discussion of budget by the program manager. In cases where there is substantial difference between the requested and awarded budgets (10% or more), we believe that there should be better discussion of the impact of the changed budget on the research.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

Yes, the solicitation process for proposals provides sufficient and useful guidance to prospective applicants.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

It is not clear how the progress and outcomes of multi-year projects are monitored. While annual progress reports are included for non-federal lab investigators, there is little discussion of how/whether these impact decisions on continued funding. In the case of federal lab funding, there is only a simple one-sentence statement that work is progressing. Some notes, however informal, about the program manager's judgment about progress would be helpful.

In addition, the lack of travel funds has prevented the program manager from making site visits to monitor the progress of research. It is of special concern that the previous program manager has never had a site visit at the two universities and the national laboratory joint center that are responsible for the development of the two primary models. The program manager may have visited those universities and the joint center at some time, but not in the context of a site visit. We urge CCRD to make adequate funds available to the new program manager to visit these key sites and believe that this is an exceptionally high priority for adequate management of the program.

The previous program manager also never had formal meetings of all of the investigators funded by the program. From time to time he held informal meetings at the annual Snowmass conference. Those awardees in attendance could use this as an opportunity to talk with the program officer. The new program manager intends to use the Snowmass conference to have formal meetings of awardees. We urge CCRD to make adequate funds available to the new program manager to attend Snowmass and have these meetings *as well as* the site visits.

**Does the process consider the depth and balance in a research portfolio?**

It is unclear how depth and balance are achieved. The COV believes that the portfolio balance of funded researchers is reasonable but it is not clear whether this is solely a function of the program manager's decisions among fundable proposals or whether the review panel also considers depth and balance of the program.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Yes, the solicitation includes wording that encourages exploratory research, however it is not clear how the review panel or the program manager evaluate exploratory, high-risk research and how either balances such research against core program needs and progress.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

Yes, the process links the research to mission needs of DOE and its programmatic goals and objectives as well as CCSP needs, goals and objectives.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

Yes, the process enables the support of a coherent suite of projects that are integrated and collectively of added scientific value to the program.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

It is important to highlight that in the 2004 and 2005 program there were new investigators funded and that the program sought to increase the diversity of investigators as well. This turnover is healthy and we congratulate the program on it. While there has been new turnover of funded investigators, but it is not clear that the process has ensured sufficient turnover over the years. We urge the new program manager to continue to encourage turnover and to consider ways in which further turnover can be fostered through the review process.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

The IA program is unique and has national and international standing. It is an important and recognized asset of the CCRD program. Our suggestions are meant to improve processes so that the program can continue to evolve, incorporate new ideas, and stimulate the global change community.

**Other Considerations**

Combined with General Comments section.

## *Education Program*

**Program Summary**

The Global Change Education Program (GCEP) began as a program funded by DOE/CCRD through Oak Ridge Institute for Science and Education in partnership with Argonne National Laboratory (ANL) in1999. The program continued in this manner until the chief scientist left ANL for a university position. The program refers to the DOE/CCRD manager as the “funding manager”, the ORISE lead as the “program manager”, and the university faculty member as the “chief scientist”.

The program was initiated and justified by concerns about replenishment of the workforce in global change and focuses on workforce development. The program specifically addresses the issue of research experience and mentorship by providing direct funding to undergraduates for Summer Undergraduate Research Experiences (SURE) and to graduates for Graduate Research Environmental Fellowships (GREF). There is a well developed process for review of the applications that results in high quality cohorts of undergraduate and graduate students. The program has also been very successful in attracting well-known global change researchers to serve as mentors for the research experiences. A workshop in Washington DC allows the students to present their research activities and allows CCRD program managers to meet the students and appreciate the quality of their work.

A 2006 survey of past participants indicates that more than 90% are still in the field, with ¾ being employed and 20% in post-docs. Most are at universities, with 10% in government, 13% in industry, and the remainder in not-for-profits and self-employed. Most receive federal funding for continued research. The 2006 survey also clearly shows that the participants considered this a valuable experience that contributed to their career development.

The COV believes that the Global Change Education Program has been valuable and has provided unique opportunities for students at the undergraduate and graduate level to have research opportunities with DOE investigators and to be mentored. However, the program has never undergone an external peer review. Such a review should be undertaken to help further enhance what we regard as its existing excellent performance, thus ensuring that the program contributes to workforce development in the most productive way, so that the program management is the best possible, and so that it is stimulated with ideas and insights from the research community.

The program is under new management at CCRD. We encourage the CCRD program manager to improve documentation of performance of the program on other than high quality review of student applications, and to improve documentation of guidance to the program. We also encourage the CCRD program manager to take advantage of the opportunity to network with education, diversity and workforce development programs in global change/earth system science/geosciences at other federal agencies and in relevant professional societies. This area has received considerable attention by other groups since GCEP was initiated and the CCRD program manager will find a community eager to share ideas and experiences and eager to discuss the opportunities to leverage each others investments and capabilities.
The COV reviewed 100% of all the actions that were completed by the Program for FY2004-2006. This included three field work proposals, information on the review of student applications during all three years, and a 2006 survey of past participants' current positions, funding and thoughts on the program.

**General Comments**

Concerning evolution of processes and operations from FY2004-2006 and suggestions for the future, this program was not reviewed separately during the last COV, so it is not possible to determine whether processes and/or operations evolved.

The program should undergo an external peer review as soon as possible and should be put on a regular schedule for external review. Reviewers should include a broad representation of previous participants, DOE programs/labs with global change interests, university representatives of global change interests or of global changed education/workforce development expertise, representatives of professional societies who have taken a leadership position in this area, and federal agencies with related programs. Reviewers should have an opportunity to comment on the success of the program, the success of the approach, the management of the program, and the role of the program in the broader framework of global change/earth system science / geoscience education and workforce development.

Efforts should be made to improve documentation on the success of the program in meeting yearly goals and deliverables, and guidance to the program.

**Responses to Specific Questions**

**Is the proposal review process rigorous and fair?**

There is no evidence in the program award documentation of peer reviews of the program at the time of its initiation. There is also no evidence of an external review of the program since its initiation, although there was a 2006 survey of participants to follow up on their career progress since participating in the program and to solicit their views on the role that the program played in their overall preparation for careers. The results of this survey were very positive.

Although the program may have begun as a CCRD initiative to address workforce issues, and although the survey of past participants showed that they valued the experience and felt that it was important to their continuation in global change, the program should undergo regular peer reviews to evaluate: the success of its model compared to other research experience/mentorship programs, whether there are improvements to the program that would make it more successful, whether this model continues to be the one for which there is the greatest need in global change workforce development, and whether the program is well structured and managed.

Furthermore, there has been substantial evolution of the federal agency activities in global change/earth system science / geoscience education and diversity activities since this program was established. There is now a broad spectrum of federal agency activities in education and workforce development in this field. It would also be appropriate to look at the program in the context of these interagency efforts to understand its role and to have the CCRD program manager and the ORISE program manager participate in this active federal community effort. Any peer review should consider this relationship and the potential of the linkages for the future.

Finally, the professional societies associated with global change research have become very active in fostering activities and in providing a venue for research into global change/earth system science / geoscience education and workforce development. For example, the AGU meeting now routinely has tens of sessions on this topic. Any future peer review should include consideration of the program in light of research into global change/earth system science / geoscience workforce development.

**Are funding decisions adequately documented and justified?**

Because the field work proposal is not reviewed and there has been no other peer review, there is little in the award document folder to indicate the basis for the continuation of the award or the amount of the award. Documentation for the funding decision should be included in the future.

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

The guidance to ANL for the program is minimal. The CCRD program manager should provide guidance to ANL concerning priorities for the year.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

The award documentation includes substantial information on the review of students applying for support, and includes the results of the survey of participants. It does not, however, include any information on the progress of the awardee in meeting the deliverables indicated in the field work proposal. This should be included each year in the award documentation.

**Does the process consider the depth and balance in a research portfolio?**

Not applicable. A peer review of the program that included consideration of whether the specific approach continues to be appropriate for CCRD would address this question.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Not applicable.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

It is clear that the program does address the needs that DOE/CCRD identified for workforce development, but there is little in the way of process that addresses this issue.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

Not applicable. However, a peer review of the program that included consideration of whether the specific approach continues to be appropriate for CCRD would address this question.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

No. There has been no competition or evaluation of the specific investigators to determine whether they continue to be the best to run such a program.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Clearly, the results of the research and mentoring experiences for the students affect their careers and they will be ambassadors for the program. However, the program is not well known outside of DOE and is not bringing DOE recognition in the science community, the professional societies, or the federal agency community. Greater participation in the community and agency activities associated with education, diversity, and workforce development would enhance perception of the program.

**Other Considerations**

Combined with General Comments section.

## *Information / Integration (CDIAC)*

**Program Summary**

The Carbon Dioxide Information Analysis Center (CDIAC) was established in 1982 at ORNL to serve the global change community by providing stewardship of $CO_2$ and related carbon cycle science data generated by DOE-funded global change programs, access to a wide variety of other data related to atmospheric trace gases, $CO_2$ and vegetation, carbon fluxes, ocean carbon chemistry and global, national and regional $CO_2$ emissions from fossil-fuel combustion. In addition, CDIAC actively brings new data sets into the information center that are in danger of being lost with the retirement of the investigators. CDIAC serves as a repository for some DOE programs such as AmeriFlux. CDIAC also synthesizes and provides additional information for many of its resources. Finally, CDIAC provides unrestricted, free distribution of data products credited to the data contributors and serves all users.

The COV believes that the CDIAC program is an important element of CCRD's overall carbon cycle activity and that it serves both the CCRD research community as well as other communities very well. Although the program has been funded exclusively through non-peer reviewed field work proposals from ORNL, the CDIAC has undergone regular peer review that has been appropriate, well-managed, and fruitful. Program management has maintained close communication with CDIAC leadership to ensure that the recommendations of peer reviews, as well as the priorities of CCRD are incorporated into the work plan of CDIAC. Peer reviews have been set up so that the needs of the user community are identified and so that new ideas for information as well as new ideas for the technical aspects of data stewardship are identified. CDIAC has evolved with time in response to the reviews and program management. In response

to the most recent (2005) review, CDIAC will establish an advisory committee to further improve its ability to meet the needs of DOE and the carbon cycle research community.

The COV reviewed 100% of all the actions that were completed by the Program for FY 2004-2006. This included three yearly field work proposal actions and the 2005 peer review.

## General Comments

Concerning evolution of processes and operations from FY2004-2006 and suggestions for the future, it is not clear that there has been any change in the year-to-year process and operations, but the regular peer review of the program and the documentation of the reviews and their influence on guidance to the program are excellent. This activity was not reviewed separately in 2004, so there were no specific suggestions.

The documentation in the award folders, including the field work proposals, the guidance to ORNL, and information concerning the peer review is good. It should be supplemented by a more useful and complete yearly statement by the program manager concerning the progress on timelines and deliverables (e.g., Were all the deliverables produced? Were there delays that affected the science programs?, etc.). The documentation should also be supplemented by some record of the monthly management discussions between the program manager and awardee.

## Responses to Specific Questions

### Is the proposal review process rigorous and fair?

Because CDIAC is an ongoing data and information center supported at Oak Ridge National Laboratory, there is no solicitation letter, proposal, and proposal review. However, there is a strong and continuing record of peer review of CDIAC activities and management. External peer reviews are held at three-year intervals. The latest review was held over two days at ORNL in June, 2005. Seven independent external reviewers (three female, four male) represented individual users at universities and national labs, program (ARM) users, the director of a related global change information system (CIESIN), a representative of the DOE Energy Information Administration (EIA), and an information technology expert. This well-balanced review group had an opportunity to review the data set stewardship activities of CDIAC, the computing systems and applications activities, the specialized activities in support of DOE and multi-agency programs. They also had an opportunity to hear about proposed future activities.

Each reviewer completed a separate written review, answering questions about research support, data management, and center management. The review panel also had an opportunity to comment on any other issues that they believed were important. For example, they discussed comparisons with other federal global change data management activities and issues of overlap/duplication.

This review process was rigorous and fair.

**Are funding decisions adequately documented and justified?**

The program materials include a summary report of the peer review prepared by the program manager (as well as those of previous reviews). It details the review comments and suggestions for each of the three review questions. Materials are complete and include all reviewers and their affiliations, the letter of invitation, the review criteria and agenda of the review.
These regular reviews provide an evaluation of progress and an opportunity for the users to provide not only backward-looking review, but also forward-looking suggestions for the future to advise the program manager in her consideration of future funding decisions

**Does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants?**

The program manager provides year-to-year guidance on priorities through the initial guidance to ORNL. Those priorities are specific and included in 2006 a request to produce a specific plan by 9/2006 to address the Peer Review Panel recommendations.

**Are the progress and outcomes of multiyear projects adequately monitored and evaluated to justify decisions about continued funding?**

The center provides year-to-year milestones and deliverables in their field work proposal. Progress is monitored through monthly telephone conferences between the program manager and the PI and his management group. However, there is no record in the proposal jacket of this oversight activity (e.g. email correspondence of agendas for the phone conferences, of agreed actions, etc.). Inclusion of such correspondence or summaries of the telephone conferences would provide the paper trail for decisions about continued funding.

**Does the process consider the depth and balance in a research portfolio?**

Because there is one award to ORNL, this question is not applicable directly, but the program manager does manage depth and balance in the activities of the center through use of the regular peer review process and the requirement for the center to respond directly to the recommendations of the peer review.

**Does the process solicit and encourage a reasonable amount of exploratory, high-risk research?**

Not applicable.

**Does the process link the research to mission needs of DOE and its programmatic goals and objectives?**

Yes, this is done through the regular peer review. In addition, a recommendation of the 2005 peer review was that an advisory committee to the center be established that includes individuals representing fields of science and applications. This committee would be another mechanism to ensure that the center was responsive to the needs of the programs supported by DOE.

**Does the process enable the support of coherent suites of projects that are integrated and collectively of added scientific value to the program?**

Yes, the peer review process highlights needs for new projects and for integration. The yearly guidance to ORNL sets priorities for specific projects and the monthly teleconferences monitor progress.

**Does the process ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs?**

Not applicable. New projects are supported at the center, however, in response to the peer review and program guidance. The new advisory committee will also assist in this process.

**Does the process result in a portfolio of research elements and programs that have national and international scientific standing?**

Yes, the peer review highlighted the extensive use of the data holdings and systems supported by the center, including international use. They have, however, encouraged the center to either include or link to additional internationally held data.

**Other Considerations**

Combined with General Comments section.

## *Cross-Cutting Issues and Overall Recommendations*

### *Progress since Last COV Review*

Overall, the committee notes significant progress since the last Committee of Visitors review and clear indication that the comments and recommendations made by that COV have been taken seriously. Solicitations are more specific and have greater clarity, and there appears to be a modest increase in the number and diversity of reviewers. We were pleased to see the implementation of a recommendation for selection statements for lab projects, and overall a more balanced treatment of labs and universities. The contents of project jackets, while still needing attention, are more complete than they were at the time of the previous review. Finally we are aware that Program Managers are taking a strong and active role in activities of the U.S. Climate Change Science Program (CCSP), including but not limited to participation and leadership in relevant CCSP Interagency Working Groups, and in the preparation of the annual CCSP report, "Our Changing Planet."

### *Program Support*

The COV found substantial differences in the levels of staffing and budget for CCRD Programs relative to comparable programs in other agencies and institutions. We find that insufficient resources, both in terms of personnel and budgetary support, collectively place at risk the ability

of the Program Managers to effectively manage and maintain oversight of the programs for which they have responsibility.

Staffing at both the Program Manager and support staff levels appear to be insufficient for adequate review, oversight, and management of programs. Program Managers effectively work alone to oversee their programs, including assuming leadership roles in national and interagency research endeavors, without deputies or sufficient dedicated support personnel. This hampers the Program Managers' ability to provide true oversight and guidance to PIs, or to comply fully with recordkeeping requirements of their programs. Further, we understand that the travel budget per Program Manager is ~$6K/year. This amount is grossly inadequate for the oversight of funded projects. Program Managers should undertake regular rotations of site visits, annual investigator meetings, and attend scientific meetings to effectively manage their programs, and funds should be made available that are adequate for these purposes.

This COV is making recommendations that require additional staff and support, including the development of more complete project dossiers and the development or acquisition of electronic document management and database systems for tracking, recordkeeping and oversight. However, these additions are small compared with the basic need for adequate staffing and travel support to allow Program Managers to effectively do their jobs. The COV recommends in the strongest terms that additional resources be made available to CCRD programs in order to achieve Division and Program goals, to reduce risk in the management and oversight of significant national research components, and to ensure that DOE has a continued and appropriate presence in national and interagency initiatives.

***Proposal Solicitation and Review Process***

Preapplications and Reviewer Pools

There was consensus among the members of the current COV that preapplications should be encouraged for major proposal solicitations. Preapplications are used to good effect by other agencies since they a) better allow Program Managers to ensure balance among projects to meet agency and program goals, and b) reduce the size of reviewer pools needed for the actual solicitation. This in turn also serves to reduce the number of reviewers with potential conflicts of interest. Further, we encourage the Programs to continue efforts to expand the diversity and turnover of reviewers, and recommend that the Division develop an integrated electronic database of reviewers to ensure balance, eliminate potential conflicts of interest, and to ensure that the number and diversity of proposals that reviewers see is appropriate.

In general, the Division makes effective use of panels and mail reviews. However, we note that in many cases, current proposers are used as reviewers in the same solicitation under which they have proposed. While this is not an uncommon practice, it sets up the conditions for real and apparent conflicts of interest. We encourage efforts to expand the diversity and turnover of reviewers.

Similarly, the Chief Scientist is a critical extension of the Program Manager and we support that position. That being said, it is critical that Chief Scientists not play a role in funding decisions where they are proposers (either as reviewers of proposals or in making recommendations for funding). The Chief Scientist is best used to help provide technical and strategic advice and

review and troubleshoot program projects. We recommend that the role of the Chief Scientists be clarified and optimized to make best use of these individuals while eliminating the potential for real or perceived conflict of interest.

Clearer Instructions to Reviewers

Currently, most reviewers receive a standard letter containing Office of Science instructions. In some cases, the letter is supplemented with additional instructions specific to the solicitation at hand (a good example of such a letter is the review instructions for the NICCR proposals). The COV feels that these tailored instructions are essential and recommends that Program Managers routinely supplement the standard Office of Science instructions to reviewers to focus the reviews and ensure useful reviews. Copies of this letter should be added to project jackets to document what guidance is given to reviewers.

Guidance Regarding Funding Decisions

Currently there apparently is no formal mechanism to document communication with PIs when reviewers identify substantive issues regarding specific projects, other than the PI receiving the original review comments. These comments are highly useful to both successful and unsuccessful PIs as a way to improve their projects and/or to improve their chances of receiving funding in future solicitations; they are also crucial in helping Program Managers to select projects that will meet their program and division goals. We understand that guidance of this type is often given verbally in conversations between the Program Manager and PI, and we are sensitive to the need to keep formalized paperwork to a reasonable level. Since the advantages of having such guidance documented in the project jackets is significant, we recommend that Program Managers for all programs include their suggestions to address these comments to successful proposers in either the funding letter (if written) or as a memorandum for the record (if guidance was given verbally), and that similar information should be documented for declined proposals.

***Project Management and Oversight***

Overall the COV feels that Program Managers are doing an excellent job of maintaining project oversight. There are a few areas in which improvement would result in a stronger, more focused program with better understanding of the value and long-term outcomes and deliverables of particular types of projects. The two types of projects that require additional oversight include 1) uncompeted projects; and 2) very large (which are often also multi-cycle) projects. Uncompeted projects may in some cases be needed to maintain core competencies at labs and other institutions. When this is the case, periodic scheduled reviews and proactive management (and documentation of progress against project goals) are essential. The COV recommends that in addition, justification to management levels above the Program Manager should be required for projects expected to continue in uncompeted status.

Very large projects (those that take multiple funding cycles to complete) are sometimes necessary to achieve large, multidisciplinary, and integrated goals. In these cases it is important that the programs ensure consistent periodic reporting and external review at frequencies

commensurate with the level of investment. The reporting and review must be adequate to determine whether timelines and milestones towards project goals are being met. There is an attendant danger -- very large projects that receive multiple renewals without review or timelines have a way of becoming considered to be perpetual parts of a research group's base funding. Because of the resource implications for such projects, better clarity, rigorous review, and clear timelines are needed on the projects themselves, and on the process for deciding continuations beyond the initial funding period.

In addition to the recommendations above, the COV recommends that final reports be required of all projects, both at universities and at DOE labs, and that these final reports become part of the official project jacket. We also recommend that Project Managers prepare an overall Program Report of accomplishments and proposed future directions every three years as part of the COV preparation process. Such reports would provide a way of assessing and communicating progress towards overall program and division goals, and would be useful not just to the COV, but also to DOE management and to the scientific community.

***Documentation and Records Keeping***

The COV noted that although there have been improvements since the 2004 COV review, documentation still varies widely across all program elements, and is much less substantive for lab projects than it is for university projects. Additional materials (e.g. more documentation on guidance given to PIs, final project reports) would be of great use to the COV and to Program Managers and DOE upper management in assessing progress towards goals. However, the COV understands and is sensitive to the other duties and time demands placed on Program Managers, and does not wish the program staff to assume an unreasonable burden.

In the absence of standards for file documentation, it is easy for both upper management and outside review bodies like the COV to develop unrealistic expectations in terms of file content. It is important to balance the need for full legal and fiduciary documentation against the workload imposed by those needs on Program Managers and staff. The COV strongly recommends that the CCRD conduct a self-study with selected outside members (e.g. members of the COV) as appropriate, to establish a rubric or checklist for standard project documentation in the official files of record, for both funded projects and declined proposals. We also urge that an integrated, electronic process and tracking system be implemented to ensure that project documentation is complete according to those standards, and to assist in safeguarding confidential information.

## *Appendix A*


**Donald J. Wuebbles, Chair**
Professor and Executive Coordinator School of Earth, Society, and Environment
University of Illinois, Urbana-Champaign
202 Atmospheric Sciences
105 S. Gregory St.
Urbana, IL 61801
wuebbles@uiuc.edu
(phone) 217-244-1568
(fax) 217-244-4393


### Atmospheric Radiation Measurement


**Warren M. Washington**
National Center for Atmospheric Research
1850 Table Mesa Drive
Boulder, CO 80305
wmw@ucar.edu
(phone) 303-497-1321
(fax) 303-497-1348

**Charles E. Miller**
Jet Propulsion Laboratory
M/S 183-501
4800 Oak Grove Drive
Pasadena, CA 91109
charles.e.miller@jpl.nasa.gov
(phone) 818-393-6294
(fax) 818-354-0966

**Paul R. Houser**
Professor of Global Hydrology and CREW Director
George Mason University & Center for Research on Environment and Water 4041 Powder Mill Road, Suite 302
Calverton, MD 20705-3106
phouser@gmu.edu
(phone) 301-931-7280
(cell) 301-613-3782
(fax) 301-595-9790


### Atmospheric Science


**Anne-Marie Schmoltner**
Section Head (Acting) and Program Director
Atmospheric Sciences
National Science Foundation
4201 Wilson Boulevard, #775
Arlington, Virginia 22230
aschmolt@nsf.gov
(phone) 703-292-4716
(fax) 703-292-9022

**Kea U. Duckenfield**
Atmospheric Composition and Climate
NOAA Climate Program Office
1315 East/West Hwy, Rm 12110
Silver Spring, Maryland 20910
www.climate.noaa.gov
kea.duckenfield@noaa.gov
(301)734-1216
(301) 713-0518 (FAX)

**Roddy R. Rogers**
Emeritus Professor of Meteorology
McGill University
358 Mill Street
Williamsville, NY 14221
rogers.roddy@adelphia.net
(phone) 716-634-0094


### Terrestrial Carbon Cycle


**Ray Desjardins**
Agriculture and Agri-Food Canada
960 Carling Avenue K.W. Neatby Building
Ottawa ON K1A 0C6
CANADA
desjardins@agr.gc.ca
(phone) 613-759-1522
(fax) 613-759-1432

## Terrestrial Carbon Cycle (cont'd)

**George W. Koch**
Professor of Biological Sciences
Co-Director Western Regional Center
National Institute for Climatic Change Research
Box 5640
Northern Arizona University
Flagstaff, AZ 86011
george.koch@nau.edu
(phone) 928-523-7150
(fax) 928-523-7500

## Climate Modeling

**Donald E. Anderson**
Modeling, Analysis and Prediction
Earth Science Division
Science Mission Directorate
3G84
NASA HQ
Washington, DC, 20546-0001
donald.anderson-1@nasa.gov
(phone) 202-358-1432
(fax) 202-358-2770

**Walter A. Robinson**
Associate Program Director
Climate and Large Scale Dynamics Program
National Science Foundation
4201 Wilson Boulevard, #775
Arlington, VA 22230
warobins@nsf.gov
(phone) 703-292-8527
(fax) 703-292-9022

**William P. Dannevik**
Saint Louis University
Earth & Atmospheric Sciences
O'Neill Hall
3642 Lindell Ave
St. Louis, MO 63108
dannevik@slu.edu
(phone) 314-977-3115
(fax) 314-977-3117

## Ecosystems

**Stephen G. Hildebrand**
Retired Director
Environmental Sciences Division
Oak Ridge National Laboratory
329 Axton Drive
Farragut, TN 37934
shildebrand6333@charter.net
(phone) 865-966-6333

**Michael G. Ryan**
USDA Forest Service, Rocky Mountain Research Station
240 West Prospect Road
Fort Collins, CO 80526-2098
mgryan@fs.fed.us
(phone) 970-498-1012
(fax) 970-498-1010

## Information/Integration, Integrated Assessment, Education

**Margaret S. Leinen**
Chief Science Officer
Climos, Inc.
119 S. Columbus Street
Alexandria, VA 22314
mleinen@climos.com
(phone) 202-415-6545
(fax) 703-683-2792

## Carbon Sequestration

**Patricia A. Jellison**
Acting Associate Program Coordinator
Geographic Analysis & Monitoring
U.S. Geological Survey
519 National Center
Reston VA 20192
pjellison@usgs.gov
(phone) 703-648-4773
(cell) 571-749-8434
(fax) 703-648-5542

## Carbon Sequestration (cont'd)

**Rattan Lal**
Professor,
School of Natural Resources College of Food, Agricultural, and Environmental Science
Director
Carbon Management and Sequestration Center
Ohio Agricultural Research and Development Center
The Ohio State University
422B Kottman Hall
2021 Coffey Road
Columbus, OH 43210
lal.1@osu.edu
(phone) 614-292-9069
(fax) 614-292-7432

## *Appendix B*

**Under Secretary for Science**
Washington, DC 20585

December 27, 2006

Dr. Michelle S. Broido
Associate Vice Chancellor for Basic Biomedical Research
and Director, Office of Research, Health Sciences
University of Pittsburgh
Scaife Hall, Suite 401
3550 Terrace Street
Pittsburgh, PA 15261

Dear Dr. Broido:

By this letter, I am charging the Biological and Environmental Research Advisory Committee (BERAC) to assemble a Committee of Visitors (COV) to assess the research program management processes in the Climate Change Research Division (CCRD) in BER. The COV panel will be provided with background material on the processes prior to its first meeting, including the previous COV report and the CCRD response to the COV recommendations and comments.

The panel should provide an assessment of the processes used to solicit, review, and recommend proposal funding actions for FY 2004-2006. It also should assess the processes used to manage ongoing research programs in the CCRD, especially the decision-making processes. I would like the panel to consider and provide evaluation of the following:

1. For both the DOE laboratory projects and university grants, assess the efficacy, fairness, and quality of the processes used to: (a) solicit, review, recommend, and document proposal funding actions, and (b) monitor active projects and programs for progress and outcomes. For example, is the proposal review process rigorous and fair, are funding decisions adequately documented and justified, does the solicitation process for proposals provide sufficient and useful guidance to prospective applicants, and are the progress and outcomes of multi-year projects adequately monitored and evaluated to justify decisions about continued funding?

2. Assess the efficacy and quality of processes used to manage ongoing programs. For example, does the process (a) consider the depth and balance in a research portfolio, (b) solicit and encourage a reasonable amount of exploratory, high-risk research, (c) link the research to mission needs of DOE and its programmatic goals and objectives, (d) enable the support of coherent suites of projects that are integrated and collectively of added scientific value to programs, (e) ensure a reasonable and appropriate turnover of funded investigators to enable and foster the support of new projects and scientists by programs, and (f) result in a portfolio of research elements and programs that have national and international scientific standing?

The panel should assess the processes and operations used for proposal funding actions and program implementation decisions in the CCRD during FY 2004-2006, and the panel should provide comments on how they have changed overall, based on the recommendations of the previous COV Panel. The Panel should also comment on how these processes and operations can continue to be improved. It may examine any files of both DOE laboratory projects and university projects funded in FY 2004-2006. It may also examine any documents related to CCRD program implementation. The panel is asked to review the aforementioned processes used by all CCRD programs and elements.

A primary requirement is that the COV should have significant scientific and administrative expertise across all covered areas, and that this expertise should not rely upon one person alone. A second requirement is that a significant fraction of the committee receives no direct research support from the DOE. A guideline is that approximately 25% of the members, including the Committee Chair, receive no support from DOE. It is also important to have representation on the COV from individuals with experience in managing research programs, either at DOE or other science agencies in the Federal government. There should be an attempt to balance between university scientists and national laboratory scientists. A final overlay should also consider a number of other balance factors, including institution, geographic region, etc. In the end, the COV should constitute an exceptional group of recognized scientists and research program managers, with broad research expertise in the program areas in BER's CCRD. Panel members should also have some familiarity with DOE programs.

The COV should take place early in 2007 at the BER/DOE Germantown location at 19901 Germantown Road, Germantown, Maryland. A presentation on the status and progress of the COV to BERAC is requested at its May 14-15, 2007 meeting. Following acceptance of the full BERAC committee, the COV report with findings and recommendations is to be presented to me, as the Under Secretary for Science.

If you have any questions regarding this charge, please contact Jerry Elwood at 301-903-3281, or by email, jerry.elwood@science.doe.gov.

Sincerely,

Raymond L. Orbach
Under Secretary for Science

cc:
Jerry Elwood
David Thomassen

## *Appendix C*

**Committee of Visitors**
**AGENDA (REVISED)**
**U.S. Department of Energy**
**Office of Science**
**Biological and Environmental Research Program**
**Climate Change Research Program**

**April 25-27, 2007**

**Wednesday, April 25th**

(Rm. # G-207, Continental Breakfast available at 8:30am)

| | | |
|---|---|---|
| **9:00** | **Welcome and Introductions**<br>**Signing/Collection of remaining COI Forms** | **Jerry Elwood** |
| **9:15** | **Overview: A Historical Perspective**<br>**Why a COV?/Charge to the Committee** | **Jerry Elwood**<br>**Jerry Elwood** |
| **9:30** | **Discussion of Procedures for the COV** | **Don Wuebbles** |
| **10:00** | **Breakout Sessions** | **Review Groups & Appropriate Staff** |

***DOE Program Managers will be available to reviewers each day in the following rooms:***

Atmospheric Science ..... G-207
Atmospheric Radiation Measurement Research & Infrastructure .....J-108
Terrestrial Carbon Cycle & Carbon Sequestration Research ..... G-258
Climate Modeling ..... G-207
Ecosystems ..... G-165
Information/Integration, Integrated Assessment and Education ..... G-436

| | |
|---|---|
| **12:00** | **Lunch, cash-only lunch service available in the DOE Cafeteria** |
| **1:00** | **Breakout Sessions Continue (see rooms above)**<br>*Continue reviewing projects, begin drafting comments, using templates as a guide* |
| **2:00** | **Refreshments, G-207** |

**2:15** **Breakout Sessions Continue (see rooms above)**

**4:15** **COV Panel Meets with BER Leadership**
*Raise issues or suggestions on process*

**4:45** **Depart DOE**

**Thursday, April 26th**

(Rm. # G-207, Continental Breakfast available at 8:30am)

**9:00** **COV Executive Session, G-207**

**9:30** **Breakout Sessions Continued (see rooms on page 1)**
*Continue reviewing projects & drafting comments*

**12:00** **Working Lunch (served), G-207**

**2:00** **Refreshments, G-207**

**2:15** **Breakout Sessions Continued (see rooms on page 1)**

**4:15** **COV Panel Meets with BER Leadership, G-207**

**4:45** **Depart DOE**

**Friday, April 27th**

(Rm. # G-207, Continental Breakfast available at 8:30am)

**9:00** **Prepare COV Report**
*Consult, comment, and address questions on the templates*

**12:00** **Working Lunch (served), G-207**

**1:30** **COV Executive Session**
*Prepare for discussion with BER Management, discuss final conclusions and recommendations*

**2:00** **Refreshments, G-207**

**2:15** **COV De-Brief to BER Leadership** **Wuebbles/Elwood**
*Summary of conclusions and recommendations*
*Prepare for report to BERAC*

**3:00** **Adjourn**