REPORT OF BER CESD COMMITTEE OF VISITORS

Climate and Environmental Sciences Division
Office of Biological and Environmental Research
Office of Science
US Department of Energy

Findings and Recommendations from a
Review of Fiscal Years 2016-2018

Charge to the Committee

Department of Energy
Office of Science
Washington, DC 20585

OCT 15 2018

Dr. Gary Stacey
Endowed Professor of Plant Sciences and Biochemistry
National Center for Soybean Biotechnology
271E Bond Life Sciences Center
University of Missouri
Columbia, MO 65211

Dear Dr. Stacey:

By this letter I am charging the Biological and Environmental Research Advisory Committee (BERAC) to assemble a Committee of Visitors (COV) to assess the processes used by the Climate and Environmental Sciences Division (CESD) within BER to manage CESD research programs and its user facilities, the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) and the Atmospheric Radiation Measurement (ARM) Climate Research Facility.

The COV should provide an assessment of the processes used to solicit, review, recommend and monitor proposals for research submitted to CESD programs for FY2015 – FY2018. This includes funding at national laboratories and universities and other activities handled by the program during this time period. It should also assess the quality of the resulting scientific portfolio, including its breadth and depth and its national and international standing. Additionally, the COV should also assess the division's management and oversight of the ARM and EMSL user facilities for the same time period. Specifically, I would like the panel to consider and provide an evaluation of the following:

1. For both the DOE national laboratory projects and university grants, assess the efficacy and quality of the processes used by CESD programs during the past three years to:
   a) solicit, review, recommend and document application and proposal actions, and
   b) monitor active awards, projects and programs.
2. Within the boundaries defined by DOE mission and available funding, comment on how the award process has affected: a) the breadth and depth of the portfolio elements and, b) the national and international standing of the portfolio elements.
3. For the ARM and EMSL user facilities, assess the division's management and oversight of these facilities, including facility operations tracking and review, user proposal solicitation, review and recommendation procedures.

For CESD research programs, topics to be investigated can include but are not limited to: the selection of an adequate number of qualified reviewers who are free from bias and/or conflicts of interest; use of the Office of Science merit review criteria; adequacy of documentation; characteristics of the award portfolio; usefulness of progress reports on previously funded research; quality of the overall technical management of the program; relationships between award decisions, program goals and the DOE mission; significant impacts and advances that

have developed since the previous COV review and are demonstrably linked to DOE investments; and the response of the program to recommendations of the previous COV review.

COV members will be given access to all program documentation completed during the period under review including applications, proposals, review documents and other requests. COV members may also request, at their discretion, a representative sample of the program portfolio be provided. In response, CESD may suggest a sample of actions, including new, renewal and supplemental applications and proposals, awards and declinations. In addition, COV members may also choose to review files through a random selection process.

A primary requirement is that the COV have significant expertise across all covered areas within CESD programs and that this expertise not rely upon one person alone. A second requirement is that a significant fraction of the committee receives no direct research support from DOE. A guideline is that approximately 25 percent of the members receive no direct support from DOE. Any person with an action pending (e.g., application or proposals under review, progress report pending approval) in a CESD program under review will not participate as a COV member for that program. Some, but not all members of a COV, may be selected from a previous COV. At least one COV member must be a member of BERAC. The committee should be balanced and drawn from a broad field of qualified reviewers from academia, DOE national laboratories, other federal agencies, private sector entities, and other appropriate institutions. The BERAC chair should also consider a number of other balance factors including, institution, geographic region, diversity, etc. In the end, the COV should constitute an exceptional group of internationally recognized researchers with broad research expertise in the program areas within the CESD as well as deep familiarity with DOE programs. Additional guidance on COV reviews within the Office of Science can be found at http://science.energy.gov/sc-2/committees-of-visitors/ and attachments therein.

The COV should take place in the third quarter of FY2019 (Summer 2019) in Germantown, Maryland. A discussion of the COV report by BERAC should be held no later than the Fall 2019 BERAC meeting. Following acceptance of the full BERAC membership, the COV report with findings and recommendations is to be presented to me, as the Acting Director, Office of Science.

If you have any questions regarding this charge, please contact Gary Geernaert, 301-903-3281 or by email Gerald.Geernaert@science.doe.gov.

Sincerely,

JSBinkley

J. Stephen Binkley
Deputy Director For Science Programs
Office of Science

cc. Sharlene Weatherwax

Charge Guidance Synopsis

Provide an assessment of the processes used to solicit, review, recommend and monitor proposals for research submitted to CESD programs for FY2015 - FY2018

- assess the quality of the resulting scientific portfolio, including its breadth and depth and its national and international standing
- assess the division's management and oversight of the ARM and EMSL user facilities
- assess the efficacy and quality of processes used during the past three years to:
  - solicit, review, recommend and document application and proposal a
  - monitor active awards, projects and programs
- comment on how the award process has affected:
  - breadth and depth of the portfolio elements
  - the national and international standing of the portfolio elements
- assess the management and oversight of the ARM and EMSL facilities, including facility operations tracking and review, user proposal solicitation, review and recommendation procedures

Topics can include but are not limited to: the selection of an adequate number of qualified reviewers who are free from bias and/or conflicts of interest; use of the Office of Science merit review criteria; adequacy of documentation; characteristics of the award portfolio; usefulness of progress reports on previously funded research; quality of the overall technical management of the program; relationships between award decisions, program goals and the DOE mission; significant impacts and advances that have developed since the previous COV review and are demonstrably linked to DOE investments; and the response of the program to recommendations of the previous COV review

COV Members

Leo Donner
Geophysical Fluid Dynamics Laboratory/NOAA
Princeton University

Ann Fridlind
NASA Goddard Institute for Space Studies

Randi Johnson
Division of Global Climate Change Institute of Bioenergy, Climate, and Environment National Institute of Food and Agriculture

Tsengdar Lee
Program Scientist
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Pacific Northwest National Laboratory

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Minghua Zhang
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Melissa Dumas
Research Scientist
Oak Ridge National Laboratory

James Hack
National Center for Computational Science
Oak Ridge National Laboratory

Kerstin Kleese van Dam
Computational Science Initiative
Brookhaven National Laboratory

James Randerson
Professor of Earth System Science
University of California Irvine

Elena Shevliakova
Dept. of Ecology & Evolutionary Biology
Princeton University

Nishanth Tharayil Associate Professor
Plant & Environmental Sciences
Clemson University

David Williamson
Climate and Global Dynamics Laboratory
National Center for Atmospheric Research

Agenda

Tuesday, July 9, 2019

6:00-6:15 pm	Working Dinner (Rockville Hilton, Eisenhower	Room)
6:15-6:30 pm	Welcome and overview of BER office structure (Sharlene Weatherwax, Associate Director, BER)	
6:30-7:30 pm	Overview of BER and CESD (Gary Geernaert, CESD Division Director)	
7:30-8:00 pm	Review of Charge Letter and Agenda (Jim Hack, COV Chair)	
8:00-8:30 pm	Review of Meeting Logistics, Conflicts of Interest, (Justin Hnilo, Program Manager)	Q&A
8:30-9:00pm	PAMS overview (Renu Joseph)	

Wednesday, July 10, 2019

1:00-3:00 pm	Breakout Sessions continue (CESD staff as needed)
3:00-3:15 pm	Break
3:15-5:00 pm	Crosscutting Topical Breakouts with CESD Staff (Eisenhower Room)

Topic 1: User Facilities and Community Infrastructure
(Paul Bayer, Jay Hnilo, Sally McFarlane, Ricky Petty)
Topic 2: SFA Administration and Management
(Shaima Nasiri, Daniel Stover, Renu Joseph, Bob Vallario)

5:00-5:30 pm	Meeting with CESD Staff (Questions/Requests for Further Information)
5:30-7:30 pm	Dinner on your own (Eisenhower Room)
7:30-9:00 pm	Executive Session: Reviewers at Hotel (Eisenhower Room)

Wednesday, July 10, 2019

8:00-8:30 am	Introductions and Logistics (Eisenhower Room)
8:30-10:30 am	Briefings by Program Staff to Breakout Groups

Group 1 (ESM, RGCM, IAR/MD), Jackson Room
Group 2 (ASR, ARM, CMDV, DM), Montrose Room
Group 3 (TES, SBR, EMSL), Twinbrook Room

10:30-10:45 am	Break
10:45-12:00 pm	Breakout Sessions (CESD staff as needed)

Group 1 (ESM, RGCM, IAR/MD), Jackson Room
Group 2 (ASR, ARM, CMDV, DM), Montrose Room
Group 3 (TES, SBR, EMSL), Twinbrook Room

12:00-1:00 pm	Working Lunch (Provided outside of Eisenhower Room)

Thursday, July 11, 2019

Breakfast (Provided outside of Eisenhower Room)

8:30-10:15 am	Breakout Sessions and Writing (CESD staff as needed)
10:15-10:30 am	Break
10:30-12:00 pm	Breakout Sessions and Writing (CESD staff as needed)
12:00-1:00pm	Lunch (Eisenhower Room)
1:00-2:00 pm	Executive Session (Eisenhower Room)
2:00-3:00 pm	Committee Report Preliminary Findings to BER Staff (Eisenhower Room)
3:00 pm	Adjourn

COV Site Visit: July 9-11, 2019
Materials Examined

Funding Opportunity Announcements (FOAs)

Merit Review Guidance

Preproposals and preproposal decisions

Reviewer and panel compositions

Reviewer and panel compositions

Proposals

Reviews

Summary Presentations by Program Managers

Presentations on Cross Cutting Themes

Justifications of Awards or Declinations

Communications with PIs

Progress Reports and How They Are Used

Information on Workshops and Meetings

Portfolio Quality

Responses to Previous COV Report

Programs and Facilities That Were to be Reviewed

- Earth System Modeling (ESM)
- Regional and Global Climate Modeling (RGCM)
- Integrated Assessment Research (IA)

Breakout 1

- Atmospheric System Research (ASR)
- Climate Model Development & Validation (CMDV)
- Data Management (DATA)
- ARM Climate Research Facility (ARM)

Breakout 2

- Terrestrial Ecosystem Science (TES)
- Subsurface Biogeochemical Research (SBR)
- Environmental Molecular Sciences Laboratory (EMSL)

Breakout 3

Cross Cutting Topics

- User Facilities and Community Infrastructure
- SFA and Management

Acknowledgement

The Committee of Visitors appreciate the hard work invested on the part of the BER and CESD staff (Drs. Sharlene Weatherwax, Gary Geernaert, Justin Hnilo, Renu Joseph, Paul Bayer, Sally McFarlane, Ricky Petty, Shaima Nasiri, Daniel Stover, Bob Vallario, and Andrew Flatness) for assembling and organizing the materials provided for this review. We sincerely appreciated the excellent presentations and the answers that they provided to our many questions. We were also indebted to the ORISE meeting support, particularly Tracy Tracey Vieser, Project Manager for Scientific Assessment and Workforce Development.

Overall the committee was extremely impressed with the management of the BER CESD scientific portfolio which has led to very high-quality science outcomes for BER over the 3-year period examined. The level of professionalism and dedication of the program management and CESD leadership is outstanding.

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Responses and actions from last COV

Recommendation	Actions during FY16-18
CESD should continue and enhance coordination with other US and international agencies to, e.g., seek opportunities for joint solicitation	CESD expanded coordination on multi-sector dynamics, Arctic, climate analysis. CESD was a driver behind the annual Climate Modeling Summit.meetings.
Program managers should provide more detailed feedback to PIs, particularly for proposals not supported.	In many cases, more feedback was provided to applicants, both electronically and by phone.
Program Managers should carefully track diversity metrics for both review panels and the participants of strategic planning workshops.	This recommendation was elevated to the Office of Science. In spite of this, BER documents as best it can to assure that diversity is an important factor in organizing panel reviews and workshop invitations.
CESD should ask the NAS to create a study group to strengthen strategic planning.	CESD decided to conduct strategic planning in coordination with relevant NSTC subcommittees.
CESD should formulate a more formal and transparent process for initiating and terminating SFAs and other large projects; and consistency is needed for review frequency and process.	CESD uses a standard review process, and review frequency has been uniformly placed on a triennial cycle.
CESD should increase funding to Universities relative to Laboratory funding	CESD has maintained a similar fraction of university vs Laboratory funding. However, SFAs have been more proactive to engage universities as part of their work.
CESD should expand its number of performance metrics beyond publications, to include e.g. conference presentations and citations.	CESD expanded the set of metrics to include software development with respect to advanced modeling.
Individual Program Managers should have travel budgets and management support to attend key meetings and visit Labs	BER received an increase in travel funds, mainly during FY2018.

U.S. DEPARTMENT OF ENERGY

Responses and actions from last COV

Program-specific Recommendation	Actions during FY16-18
The 100 km atmosphere of ACME should be for efficient testing, and to focus on high-resolution prediction.	CESD maintains its emphasis on a low resolution and high resolution version of E3SM.
Research in subsurface radionuclide transport should not be abandoned. Further integration of elements of SBR and TES is encouraged.	SBR and TES issued a joint solicitation during the FY16-18 period.
The ASR program should strive to maintain a balance between scientific use of ARM data and innovative remote sensing for new data product development.	Both the ASR and SBIR programs have solicited proposals to enhance sensing capabilities in support of scientific community priorities.
ASR should expand its scope to include research that does not make use of ARM data.	For strategic reasons, the ASR program will continue to require utilization of ARM data.
ASR should consider joint solicitation with other agencies to exploit other data sets for process research	ASR increased its coordination with other agencies that are engaged in atmospheric research, in particular NASA, NOAA, and NSF.
The Data Management program should develop a list of high priority capabilities it needs to provide to the CESD community, that exploit opportunities across SC and other agencies.	Based on community workshops, CESD invested in a more extensive and sophisticated archiving capability, e.g., ESS-DIVE. ESS-DIVE has been exploring relationships with other data archives, e.g., Kbase and NEON,
CESD should determine If the data management infrastructure would function better as a User Facility.	Much discussion on this recommendation took place. However, ESGF and ESS-DIVE will continue to focus on BER

Findings/Recommendations

Finding

- Outstanding level of detail and completeness in the information that is captured by the proposal process. Review content is remarkably substantive and an indication of a fair and rigorous review process

Comments

- PAMS process is a great improvement but might benefit from technology improvements
- There are organizational opportunities for improvements to collection/navigation of data for external review processes
- Provision of review process guidelines to the COV (for FOAs) would benefit future review

Findings/Recommendations

Portfolio Balance

Findings

- Very impressed with the breadth of mechanisms by which CESD is engaging the external community

Comments

- The committee was left with the impression that the balance may have shifted away from university and other external engagement over the last decade. It will be important for future reviews that a quantification of funding trends over time is included in review material
- How is CESD ensuring access to next generation of scientific talent (strategic investments in scientific workforce development)? Focused efforts to further engage the university community would be beneficial to this important objective
- CESD is encouraged to provide additional scientific engagement with university community with the goal of improving scientific outcomes

Findings/Recommendations

Data

Finding

- There are at present a number of different archives - ESGF, MYEMSL, ESS-DIVE and ARM, operated at different labs, on different equipment, with different staff, offering different levels of service to PIs and communities. The longevity as implied through grant mechanisms varies. ARM and EMSL are DOE designated User Facilities with long lifetimes, whereas ESGF and ESS-DIVE appear to operate on short term 3-year contracts. Users and program managers indicated that it was not always clear what data should be maintained or could be deposited in which archive.

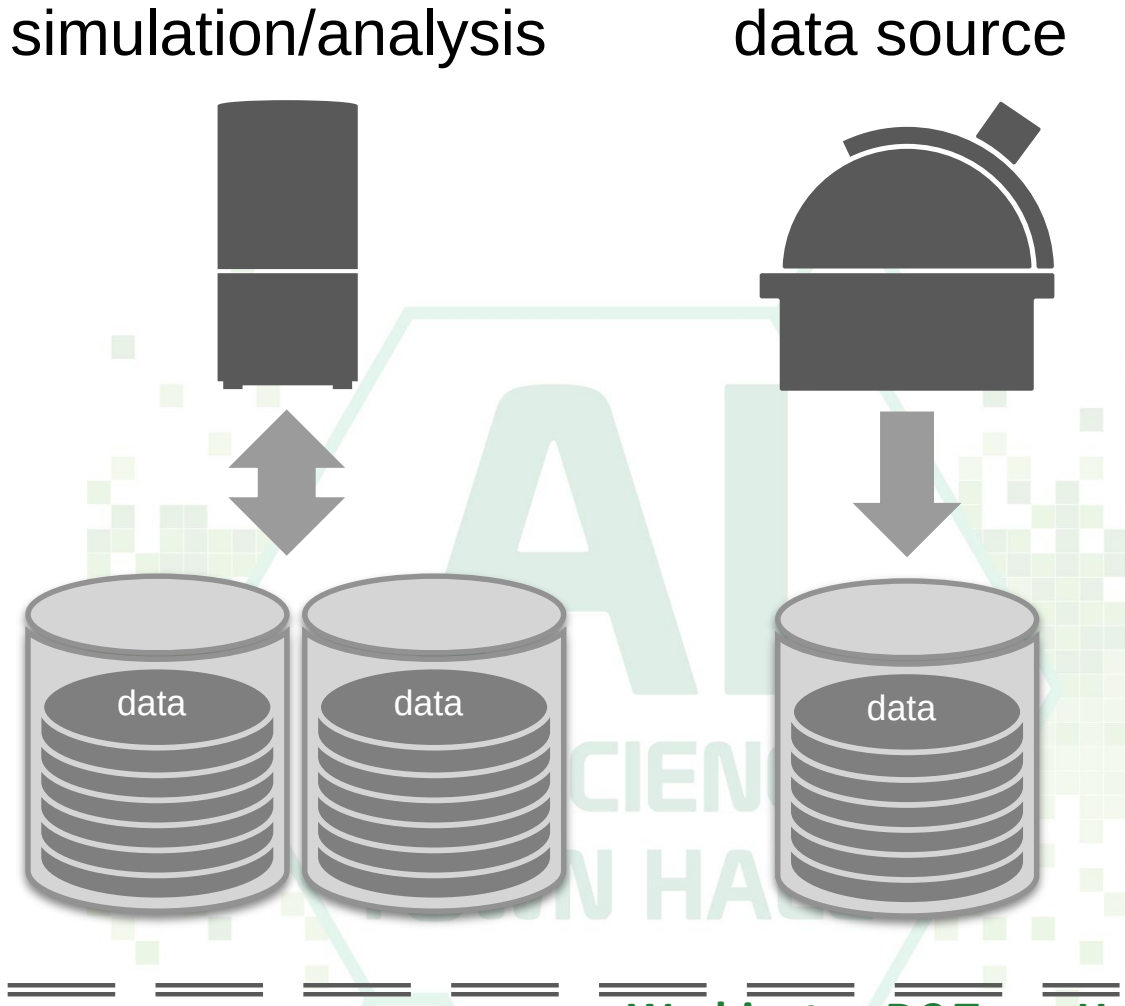
Recommendation

- CESD should embark on harmonizing their data collection, archive, and access services in terms of an overarching data services plan, best practice implementation, longevity - strategy and implementation plan. An integrated architecture and harmonized strategic plan would be helpful for future investment and research planning, could lead to substantial savings (hardware and infrastructure maintenance), and could clarify for users where to find data, and what mechanisms are available for exploring the available data. A long-term data strategy needs to be developed and communicated to the user community.

The Data Topic is of growing interest across SC

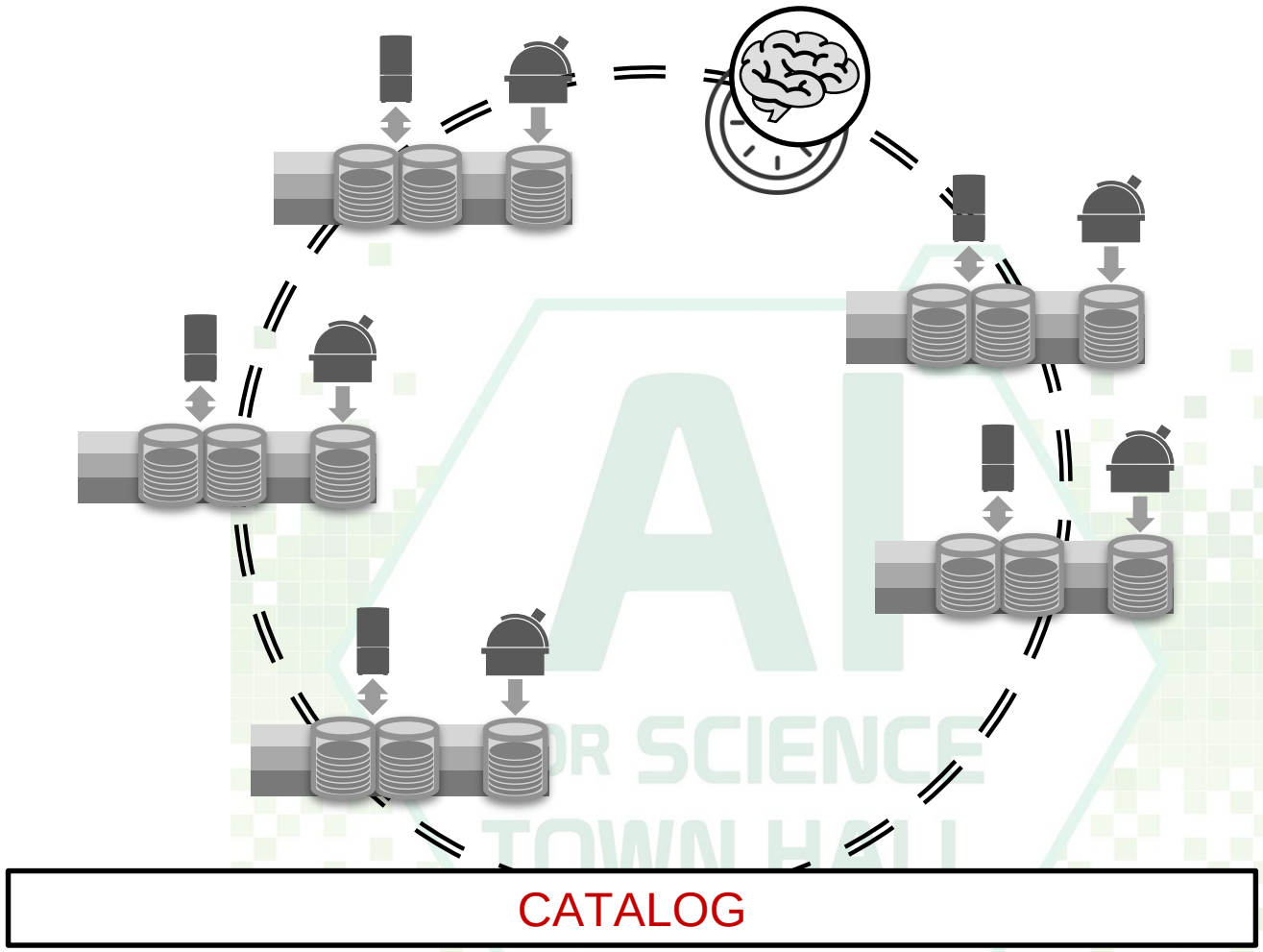
State of the Art: Data Management and Movement

- High-Performance Facilities
  - Facilitate storage, movement, and analysis of large domain science modeling/simulation datasets
- Data Sources
  - Experimental, observational, and local computational facilities hold large data repositories
  - Data management generally limited by lack of adherence to findable, accessible, interoperable, and repeatable (FAIR) data principles
- Issues
  - Repositories largely independent from larger ecosystem both internally and across the broader community



Challenges - Resource Orchestration

- Distributed infrastructure requires cross-facility coordination and orchestration
  - Global orchestrator supporting linkages of experiments, distributed repositories, local computing, local and wide-area networks, storage, compute, and people in the loop
    - need to deal with quasi-real-time heterogeneous landscape
    - potential to be trained to ensure high-utilization of "network components"
    - touches resource management, scheduling mechanisms, runtime systems, and workflows
  - Develop policies to allow seamless co-scheduling of computational, data, and experimental/observational science resources for accelerated productivity



Expected Outcomes

- With appropriate direction, coordination, and resourcing a seamlessly interconnected DOE complex can be achieved in 10 years
  - Will allow scientists to build AI-driven experimentation and discovery workflows, optimized and controlled by embedded AI
  - Will enable data and compute resources to be directed according to scientific needs and availability of resources, without a human in the loop

Findings/Recommendations

Model Integration Across Scales

Finding

- CESD should be commended for a variety of efforts to stimulate integration between various modeling programs, although at the moment these efforts appear to be incomplete in a broader sense. It is not clear that integration between different modeling components of the scientific program with observational components is as complete as it should be, particularly the more mature program elements

Recommendation

- Develop a concrete overarching vision for integrated modeling across scales and subject areas (incl. BSSD). Increase community engagement (broad audiences such as AGU) around this vision to enable the development of new strategies and research topics
- Ensure that observational and modeling components of the scientific program are more tightly aligned and that the synergies are optimally benefiting broader scientific objectives

Findings/Recommendations

Computing Resources

Finding

- BER CESD leverages ASCR computing resources effectively for its mission accomplishments, and supplements these resources as needed with resources procured through CESD

Recommendation

- CESD should consider conducting a regular comprehensive review of its computational needs at all levels across its broad range of scientific programs and use this information to develop a living plan for computational resource investments. This will result in better utilization of the available resources and a more strategic and efficient way of making computational infrastructure investments

Findings/Recommendations

Diversity

Finding

- It appears that review panels, strategic planning workshops, etc. continue to be lacking in demographic diversity with respect to gender, ethnic background, institution type, etc.

Recommendation	Actions during FY16-18
Program Managers should carefully track diversity metrics for both review panels and the participants of strategic planning workshops	This recommendation was elevated to the Office of Science. In spite of this, BER documents as best it can to assure that diversity is an important factor in organizing panel reviews and workshop invitations

Recommendation

- **Make a Formal Commitment to inclusive excellence**
- Codify a plan that articulates diversity goals; strive to broaden diversification of review panels, etc.
- Explore alignment with other Federal agency best practices
- Needs to include capturing relevant statistics/metrics (defined audience and desired outcomes)
  - Diversity (geographic, institutional, gender, …), oversubscription for resourcing (meritorious, not simple response statistics), success metrics, … opportunities for workforce development

Findings/Recommendations

SFAs

Findings

- SFAs have had a positive transformative effect on CESD scientific program
- COV commends the trends toward scientific collaborations and encourage continued broadening of collaborative opportunities with university community

Comments

- COV encourages flexibility on renewal process timeline
- For very large SFAs there needs to be better and more transparent mechanisms for engaging the broader university community

Other Findings/Recommendations

- **Atmospheric Radiation Measurement (ARM) Program**
  - Review process suggestions
  - Workshop panel compositions to include end users (modeling community)
  - Introduction of robust tracking procedures for user and publication statistics
  - Reiteration of earlier comments on identifying and prioritizing legacy data products that can be easily and reliably used by the (modeling) community

- **Atmospheric System Research (ASR) Program**
  - Composition of working groups to better connect with modeling community
  - International workshops for defining paths foreward
  - Importance of engaging large-scale climate modeling community (bridge scales)

Other Comments/Recommendations

Staffing

Comments

- The COV was highly impressed with the quality and dedication of the program management staff. Their commitment to programmatic success is outstanding.
- ***Inadequate staffing is clearly an issue to sustainable efficient execution of such a broad and vibrant program and its strategic evolution.***

Recommendation

- ***Priority should be given to filling a large number of vacant positions***

Summary of the site visit

- Assess the quality of the resulting scientific portfolio, including its breadth and depth and its national and international standing
- Assess the division's management and oversight of the ARM and EMSL user facilities
- Assess the efficacy and quality of processes used during the past three years to:
  - solicit, review, recommend and document application and proposal a
  - monitor active awards, projects and programs
- Comment on how the award process has affected:
  - breadth and depth of the portfolio elements
  - the national and international standing of the portfolio elements
- Assess the management and oversight of the ARM and EMSL facilities, including facility operations tracking and review, user proposal solicitation, review and recommendation procedures

Concluding Remarks

- CESD's programs remain scientifically strong and well managed
- The funding processes are of high quality (outstanding levels of detail and completeness are captured by the PAMS proposal process). The peer review content is remarkably substantive and speaks to a fair and rigorous review process
- CESD's Program Managers exhibit an outstanding level of professionalism, dedication, and proficiency in their management of the CESD portfolio
- The COV report will include other observations and recommendations on a variety of subjects, including external reviews, feedback to proposers, creation and termination of large projects, program balance, the relationship between ARM and ASR, and performance metrics,

Additional Slides

Reviewer Assignments

Group	Program Area(s)	Funding Opportunities	Reviewers
1	Earth System Modeling (ESM) Regional and Global Climate Modeling (RGCM) Integrated Assessment Research (IA)	18-1862 (RGCM, ESM) LAB 17-1681 (ESM - SciDac) LAB 17-1682 (ESM - SciDac) 16-1682 (ESM - SciDac) 16-1482 (ESM) 16-1531 (RGMA, IA)	Jim Hack Leo Donner Melissa Dumas Jennie Rice David Williamson
2	Atmospheric Systems Research (ASR) Climate Model Development & Validation (CMDV) Data Management (DATA) ARM Climate Research (ARM) Facility	18-1845 (ASR) 16-1638 (ASR) 16-1430 (ASR) 16-1431 (ASR) 16-1530 (ARM, ASR, ESM) LAB 16-1530 (ARM, ASR, ESM)	Ann Fridland Minghua Zhang Tsengdar Lee Kerstin Kleese Van Dam Jim Randerson
3	Terrestrial Ecosystem Science (TES) Subsurface Biogeochemical Research (SBR) Environmental Molecular Sciences Laboratory (EMSL) Facility	18-1855 (TES) 16-1437 (TES) 16-1724 (SBR)	Mike Wilkins Nishanth Tharayil Patricia Sobecky Elena Shevliakova Randi Johnson