

**Biological and Environmental Research Advisory Committee  
(BERAC) Meeting Minutes  
October 22-23, 2020  
Remote Access Meeting**

**BERAC Members Present**

Bruce Hungate, Chair

Sarah Assman

Julie Biteen

Katherine Calvin

Leo Donner

Robert Fischetti

Ann Fridlind

Kerstin Kleese van Dam

Cheryl Kuske

Maureen McCann

Gerald Meehl

Jerry Melillo

Gloria Muday

Himadri Pakrasi

Kristala Prather

James Randerson

Patrick Reed

Phil Robertson

Jeremy Schmutz

Daniel Segrè

Matthew Shupe

John Weyant

Huimin Zhao

**Guest Speakers**

Chris Fall

Andrzej Joachimiak

Tim Scheibe

**Designated Federal Officer**

Tristram West

**Others**

Sharlene Weatherwax, Associate Director, Biological and Environmental Research (BER), SC, DOE

Gary Geernaert, Earth and Environmental Systems Sciences Division Director, BER

Todd Anderson, Biological Systems Science Division Director, BER

T. Reneau Conner, Science Writer

Approximately 155 others were in attendance during the course of the meeting.

All presentations are posted to the BERAC internet site: <https://science.osti.gov/ber/berac/Meetings>

**Thursday October 22, 2020**

BERAC Chair Bruce **Hungate** called the meeting to order at 1:00 p.m. Eastern Time (ET) and requested that all BERAC members share science updates.

**News from Office of Biological and Environmental Research (BER)** – Dr. Sharlene Weatherwax, Associate Director  
[Presentation posted]

**Discussion**

**Weatherwax** indicated that the House mark for the FY21 budget is slightly higher than the current FY20 budget. However, the final budget number will depend on the Congressional agreement between the House and Senate marks.

Regarding ways that BER is assisting investigators affected by the COVID-19 limitations on work, **Weatherwax** said that many options have been designed to assist investigators. The recent survey of investigators requested respondents to provide ideas to address the complex issue of

career freezes and the inability to progress professionally. The survey results are not yet available, but they will help SC give careful thought to solutions.

**News from Energy & Environmental Systems Sciences Division (EESSD) – Dr. Gary Geernaert, EESSD Director**  
[Presentation posted]

### **Discussion**

In response to a question about the range of estimates on soot particle size, **Geernaert** explained that in large part the team is illustrating the importance of the geomorphology of these particles and their chemical content. It is important to have a stochastic representation of how these particles truly exist in the atmosphere.

Excitement was expressed about the incorporation of bioenergy plant models into the earth systems models. **Geernaert** commented that the intent of the Energy Exascale Earth System Model (E3SM) is to support DOE broadly, thus bioenergy, where E3SM is heading, is an important component.

The SPRUCE project, on peatland warming, showed a 20-fold warming effect compared to experiments in upland ecosystems. According to **Geernaert**, the SPRUCE project is one of the few projects that has looked at the range of possible conditions because of the different types of heating.

When asked for his views on Artificial Intelligence/Machine Learning (AI/ML) in modeling with regard to internal strategy dynamic and adaptive state-aware action, particularly human systems, **Geernaert** indicated that AI/ML has been discussed within the modeling team. Every program within the division has embraced AI/ML in some way. However, there is no framework to tie it all together because the AI/ML field is moving so fast. The human component will be part of it but it is currently unclear how. Over the next few years there will be workshops to develop ideas.

On the question of incorporating cropping systems into the E3SM modeling of perennial crops and the goal resolution, **Geernaert** explained that in the upcoming principal investigators (PI) meeting and the E3SM review, such issues will be raised. The goal is to get as much resolution as possible, however, there may be more than one resolution for the plants, it may be adaptive mesh. For example, one could choose a region but nested within that may be resolutions as low as 10 meters.

**News from Biological Systems Science Division (BSSD) – Dr. Todd Anderson, BSSD Director**  
[Presentation posted]

### **Discussion**

**Anderson** responded to a question about plans for quantum work in BER and quantum sensing extensions into climate studies. He stated that currently all quantum money is targeting bioimaging. While there is some room to expand, it is focused on quantum enabled concepts, such as entanglement, that might be incorporated into the imaging capabilities. He explained that as different concepts come up there will be other opportunities for other applications. **Geernaert** said that EESSD has not yet talked about quantum, at least for modeling. Over the next couple of years the hope is that the laboratory points-of-contact will discuss this because consideration of such things is necessary in order to have any paradigm shift for the next decade. **Geernaert**

indicated the ARM project is going through the triennial review and this question could be posed there. **Weatherwax** added that BER is contributing to one particular Argonne-managed QIS center because of their goal to develop quantum sensors in the future.

**EESSD response to the Committee of Visitors (COV) Report** – Dr. Gary Geernaert, Division Director  
[Presentation posted]

### **Discussion**

**Geernaert** was asked to clarify demographic tracking related to Diversity, Equity, and Inclusion (DEI) to identify trends. He said that SC has not developed a statistical methodology to do that. Because people can decline to provide personal information, the kinds of statistics that could be generated are not necessarily complete. **Weatherwax** added that SC has developed a Code of Conduct and is trying to find ways to harmonize DEI across all the programs; it is a work in progress and will require some retooling of the Portfolio Analysis and Management System (PAMS).

A point was made that the National Science Foundation (NSF) has best practices related to collecting demographic information. **Weatherwax** indicated that SC has discussed, with NSF, their approach. **Geernaert** added that heightened attention to DEI has been given over the past few years to ensure BER is following correct ethical processes and recognizing that DEI is important to how we do business. **Weatherwax** stated that SC has also had discussions with the National Institutes of Health (NIH). While NIH collects a good deal of statistics their system is very robust and would be difficult to emulate.

One individual pointed out that there seemed to be a bit of tension between the COV's recommendations and the BER response, which seemed to imply that the division thought the committee overlooked materials. **Geernaert** responded that there is general SC-wide guidance invoked across the six offices. For example, the 3-year review cycle for a Science Focus Area (SFA) has been a common practice across all of SC, but has only been generalized and made more flexible recently. BER has to be careful to avoid crossing that line within an SC protocol. In spite of that, raising the issue forces BER personnel to at least pay attention to that concern and go up through SC.

Another example of the tension between COV recommendations and BER responses had to do with university/lab funding. While tracking and watching trends is good, it raises the question, what is the goal, the overarching vision, for what the funding balance looks like. Many factors weigh into the discussion, such as other sources of funds and optimal synergies with the universities. The responses from BER seemed to be lack luster. **Geernaert** commented that more balance between the university and lab funding is desired, but BER investments are in large part a response to what Congress appropriates and the language in the Appropriation. A point was made that showing the university/lab funding and DEI trends helps the community to see what is and is not happening.

A COV member described the COV activity as a sprint; there was a short period of time to review a large amount of material and have constructive discussions. There was a universal feeling, among COV members, that the program management was doing a great job and therefore the COV's job was more visionary, in other words, making constructive recommendations for discussion and consideration.

It was mentioned that while the COV charge seemed to be written in such a way as to

indicate a request for self-reflection, the desire is to identify what is in need of attention. The project managers are aware of the COV reports which spur renewed efforts. While university research and the national labs possess different strengths and weaknesses, they are predominantly synergistic. Geernaert and the project managers were thanked for following through on what might not have been evident in the short COV response.

### **General Discussion**

Geernaert was asked about more coordination within the U.S. on higher resolutions of E3SM atmosphere given the European Union's (EU) completely integrated earth system model at 1km with built in impact that looks at earth system predictability from sub-seasonal through the decadal time scale. **Geernaert** responded that the Europeans have already demonstrated the 1km, mostly atmospheric model, on Summit at Oak Ridge – it was the atmospheric piece, it was not in fully coupled mode, and it covered only a couple of months. E3SM is going beyond three or four months. What one is trying to study dictates whether 1km is necessary. DOE has been focusing on adaptive mesh where parts of the model go to ultra-high resolution, even to 1km, while the rest can be at 10km. Although approaches are tougher, and maybe more sophisticated, the U.S. does need to coordinate with the Europeans. Germany and the United Kingdom are being quite aggressive in developing some capabilities that the U.S. needs to pay attention to. DOE is considering such physics-based systems with AI/ML overlay as a future branch of the activity. Hopefully, the workshops over the next few years can lead to an approach, with an abundance of community input, on what is possible and creative in this space. DOE's strength is applying novel technologies, methodologies, and edge computing together, but that is difficult to do.

An argument was levied that while coordination with Europeans was important, a grand challenge in the U.S. concerns wind prediction as it relates to wildfire. The U.S. needs to determine the limits to the current weather systems and how the telescoping capabilities that DOE is developing can help. A lot of those agencies tasked with such time scales do not have the budget to support a broad research agenda to improve prediction. With the cross-agency interest in AI/ML there are approaches that could be helpful if deployed in weather prediction, even 10 years out. **Geernaert** responded that while wildfire modeling is becoming increasingly important to EESSD, DOE does not operate on the weather forecasting time scales, rather the focus is on the subseasonal multi-decadal, towards centennial, time scales. Agencies can work together, but typically the National Oceanic and Atmospheric Administration (NOAA) takes the lead on weather forecasting or risks associated with the weather forecasting time scales.

A sense of under-engagement was expressed about the U.S. Climate Modeling Centers, who have earth-observing satellite mission design, helping the National Aeronautics and Space Agency (NASA) with observational design strategy and integration within the U.S.

BERAC members were asked to consider the charge in the broadest and most expansive way possible, in terms of ideas or directions, and consider what success would look like if BER were in a new international position. **Weatherwax** added that she would like BERAC to think about how BER can best position itself so that the portfolio is world leading, asking BERAC to consider BER's unique piece, its essential niche contribution, to a world leading effort; where is BER special and where is the opportunity?

The meeting was adjourned for the day at 4:40 p.m. ET.

**Friday October 23, 2020**

The meeting reconvened at 1:00 p.m. ET.

**News from DOE SC** – Dr. Chris Fall, Director of Office of Science

Dr. Fall spoke to BERAC about their contributions, the Interagency Council on Advancing Meteorological Services (ICAMS), the National Virtual Biotechnology Laboratory (NVBL), and international benchmarking. The Office of Science has a core value of consultation with the community via Basic Research Needs workshops, Advisory Committees, etc. and Fall expressed his sincere thanks to BERAC members for their contributions.

In ICAMS, Fall is the Principal for SC and BER personnel are participating in subcommittee leadership and other roles. SC was included in ICAMS from the beginning and is being asked for input and contributions.

Weatherwax and BER are being called upon to help SC think through the post-COVID new normal for biosecurity, biomanufacturing, and the bioeconomy. The central question is what to do with the NVBL that was prototyped as a result of the COVID crisis; what should be preserved? While the virtual model collaboration can be accomplished for a crisis, SC wants to examine the opportunity space.

Fall said he is particularly interested in hearing about international benchmarking (what is going on around the world) and trusted science (intellectual property). Both of these require knowledge of what is occurring globally – where are the strengths, where are the weaknesses, and where are the opportunities. The U.S. has excellent international relations with researchers, research organizations, and counterpart government organizations, however, science security and intellectual property is becoming increasingly important. SC now has an Office of International Collaboration and Trusted Science. That team has been asked to take input and work with the programs to develop a much more comprehensive and strategic look at international work across all the programs and across all of SC's equities to maximize engagement. SC aspires to increase its understanding of its goals in their relationships with international science agencies.

Fall closed by saying his goal today was to take the opportunity to sit with BERAC and thank members for being a part of this incredible science. SC is very lucky with the budget and with the mission. It is an amazing time and we want to make the most of it.

## **Discussion**

A question was raised about joint funding calls with other countries. **Fall** said there have been experiments with this, but it is harder than imagined. High Energy Physics coined the term the parallel play model which includes a joint solicitation, collective discussion about the problem, and independent funding. SC is more likely to use this parallel play model. The idea of joint solicitations, where it makes sense, is intriguing. There are many reasons for working together on the international stage – scientific goals, relationship goals, etc.

Fall was asked for his view on the future of DOE's contributions for addressing the COVID crisis. **Fall** explained that this issue comes down to authority. The ability to reprogram exists but DOE does not have the authority to do that. There are many examples where the national labs have come together to address a crisis (e.g., the Fukushima Daiichi nuclear disaster, the Deepwater Horizon oil spill, the 9/11 World Trade Center attacks), but each time it has required an act of Congress to get permission to do so. During the COVID crisis, the DOE Labs

demonstrated what an incredible thing they could do with \$100M from the Coronavirus Aid, Relief, and Economic Security (CARES) Act. It is a remarkable story. But the question is how to preserve that flexibility in the future. DOE cannot supplement the \$100M in a discretionary way to keep that work going. There are proposals on the Hill now to add additional supplemental money. Congress is aware more funds are needed and they are aware the CARES Act funds have been allocated yet the work continues and will go on for some time.

Fall was asked about the current degree of collaboration and cooperation between U.S. government agencies and how that should move in the near future. **Fall** expressed his pleasure that the agencies are working well together. In the international space, the State Department understands SC very well and SC is connected with them on almost every activity. State is aware of SC's initiatives and of who else has equities. Cooperation on COVID is also going reasonably well. However, other agencies do not understand what DOE brings to the table. The scale and breadth and methods DOE uses is not something other agencies understand. How DOE brings hundreds and thousands of scientists together on a problem is a rare and unique skill.

### **Discussion of New Charge Topic Areas – Dr. Bruce Hungate, BERAC Chair** [Presentation posted]

#### **Discussion**

BERAC discussed the new charge providing ideas including documents to utilize, places to find reports, elements to identify and record, international positioning, developing an ideal framework, and considerations of international programs. **Hungate** explained that mission relevance is a strong part of the letter and a strong part of the charge. The extent to which outreach maintains a tether to mission relevance is worth considering. While it would be out of scope to think of something that is completely different, how to do more, how to do better, and how to capitalize on what BER has now can include synergies with other research areas. This charge is a chance for BERAC and the subcommittee to articulate what is already going well and key international partnerships that could strengthen BER science output and increase global visibility. BERAC was encouraged to be bold, to think creatively, and to engage people who view these issues more generally.

One recommendation, as an important first step, was to have a dialogue with international collaborators and other institutions. BER needs to be aware of the structures that can facilitate international collaboration and the profile of BER science. BER needs to define what it means to lead. For example, there is a coordinated effort in the EU to run earth system models at a resolution 3-4x higher than the U.S. is proposing. The U.S. has at least three independent efforts that are aiming at 3-4 km earth system model (NSF, E3SM, NOAA) and it may be necessary to consider if BER is positioning itself appropriately.

Identifying BER's international position in terms of institutions, people, facilities, models, tools, etc. will dictate the approach to addressing the charge. For example, BER needs to be an international leader in modeling and fidelity is required to answer questions that people are interested in. DOE needs to engage in communication and outreach to share that they demonstrate international leadership. BER already participates in international efforts such as the World Climate Research Program (WCRP), which is an international structure through the United Nations that facilitates groups of scientists to come together and collaborate internationally to make the case that it is worthwhile to fund certain activities. A lot of BER scientists are playing key roles in WCRP. Good international collaborations, including people

from the DOE labs, already exist. However, while these scientists and researchers are very active in many international societies, DOE labs are never recognized. DOE is somewhat invisible.

Reports and resources that were mentioned as sources of information included the 2017 *Grand Challenges for Biological and Environmental Research: A Long-Term Vision*, and the October 2018 BERAC report, *Scientific User Research Facilities and Biological and Environmental Research: Review and Recommendations*, which is called out in the charge. BERAC was advised to re-read the 2007 National Academy report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (doi:10.17226/11463) as well as reach out to the U.S. user facilities – Joint Genome Institute, Environmental Molecular Sciences Laboratory, Kbase, Bioenergy Research Centers – to gather information. The facilities have a much broader, and more detailed, view about their instruments and opportunities and how those compare with international facilities.

In terms of what to identify and record, BERAC members recommended taking stock of BER's portfolio to specify things that need to be done; reviewing BERAC's strategic vision and points of intersection; documenting the prevailing successes to see where existing investments could accelerate current, or build new, initiatives; considering the international user facilities that U.S. scientists are using and which U.S.-based user facilities international scientists are using; and opening the topic up for discussion and asking the community where international collaborations or access to facilities might best benefit BER research.

Other BERAC members pointed out some of BER's successes including in fundamental plant biology, user facilities, and the ability to attract scientists. A notable success, and unique feature of DOE and BER, is the sheer scale, scope, and transdisciplinarity of the projects. This scale allows scientists to look at vastly broader areas of science more deeply (multilevel, multidimensional) through a different science area. Exponential scaling of the research and the capability that is already in-house could be acknowledged and achieved. Some notable areas for improvement were cloud diversity, critical environments, ocean, permafrost, carpet sinks, forest systems, and turnover in forest systems. Internationally, Europe and China are pushing forward into those areas. BER could build something that is more integrated across climate modeling and ecosystem environments, but it is critical to determine how to more systematically integrate DOE with other U.S. agencies. That integration should enable conversations between gatherers and users of the collected data from cloud physics chambers, for example. Hungate reminded BERAC that while looking domestically across agencies is not the main focus of the report, there is an invitation to think about optimization and a specific reference to other federal agencies. Finally, it was suggested that maintaining international presence relies heavily on students, post docs, and scientific researchers' ability to work with U.S. scientists and gain access to facilities.

An ideal framework includes earth-bound and virtual facilities. Developing a virtual facility would build large international collaborations by sharing access to very large data sets to increase statistical analysis, sharing modeling tools, and leveraging some of the expertise outside the U.S. Synthesis was identified in the User Facilities and the Grand Challenges reports as a way to establish international leadership. Providing a small investment could regularly bring together international scientists with those from the Labs and other U.S. institutions thereby elevating BER's science impact and establishing U.S. leadership. The level of some field experiments could be expanded with a small investment in dollars, planning, and design. And integrating with international and interagency partners could increase BER's impact beyond the current level. For example NASA's Tropical Rainfall Measuring Mission – Large Scale

Biosphere-Atmosphere Experiment (TRMM-LBA) had a profound effect of bringing together Brazilian and U.S. scientists.

Finally, BERAC members mentioned the consideration of other, non-DOE, programs where DOE could make an impact and establish collaborations, such as in the Binational Agricultural Research and Development, Human Frontiers in Science which funds innovative research and supports high-risk ventures, the National Security Partnerships programs for international collaboration, and international scientific institutes such as the International Centre for Genetic Engineering and Biotechnology in China and the Intergovernmental Panel on Climate Change in India. There was also discussion of the European Molecular Biology Laboratory facility which showcases the capabilities of European facilities while training graduate students and post docs. It was suggested that DOE consider this practice to ensure that when graduate students become independent PIs they are aware of the resources available to them.

**Report briefing: Integrated Hydro-Terrestrial Modeling** – Dr. Tim Scheibe (PNNL)  
[Presentation posted] <https://doi.org/10.25584/09102020/1659275>

### **Discussion**

None.

**COVID-19 Research Update** – Dr. Andrzej Joachimiak (ANL)  
[Presentation posted]

### **Discussion**

Joachimiak was asked about the DOE computing resources that have been leveraged for COVID-19 research, for example in docking studies. **Joachimiak** said the national labs put together a large team of over 150 scientists who are using all the information that scientists around the world are producing to perform docking experiments and to create new inhibitors.

**MOSAiC Update** – Dr. Matt Shupe (University of Colorado)  
[Presentation posted]

### **Discussion**

Shupe was asked about the experience of hearing about the pandemic while in the Arctic. **Shupe** said it was a blessing to be there. The news trickled in and there were days when COVID was not even a thought.

One BERAC member asked about the thickness of the ice and about the closest call (safety) for the expedition. **Shupe** shared that the team was hoping to find 1M thick ice to provide stability for the equipment. However, the ice was at most 60-70 cm and highly unstable. In terms of the dangers, Shupe said that the crew was amazingly safe. There were good protocols for safety from bears. There were wet feet, wet legs, total water emersion, and one broken leg from a slip on the ship.

The upcoming Tracer Campaign, with NASA and NSF, is seeing the same seeding aspect as DOE provided in MOSAiC. One of the main things that made getting the science from the MOSAiC project possible was DOE's commitment to funding for the use of the data. The data was already flowing and scientists were able to use some of the data in proposals to ARM. **Shupe** added that there were 20 nations involved in the project at an impressive funding level.

Shupe was asked what he would do differently next time based on this experience, if there were instruments or experiments to add. **Shupe** suggested rethinking how the tools could be used or set up in a way that accounts for the thickness of the ice, more reliance on unmanned systems and autonomous systems, and continued development of variances to accommodate the future inability to stand on the ice for very long.

Regarding the presence of continuous ice that survived the summer, **Shupe** explained that while he did not participate in that leg of the voyage, the ship went back up and passed through the North Pole. The crew was in the middle of a significant change in the Arctic. The community needs to come to terms with this rapidly evolving system because it will have big implications on ecosystems, on climate, on weather prediction, and many other things.

### **Open Discussion – BERAC**

BERAC was asked to provide their thoughts on the charge in broad terms or identify what reports and documents might need to be gathered. They were also asked to email Hungate to volunteer to serve on the subcommittee.

The open discussion brought up comments about education, training, and teams. One BERAC member asked about structural changes related to training, remarking that post doc level training has been approached by different funding models (such as a fully paid-for PhD) to enormous investments by countries in certain fields. Another member suggested working with other agencies, such as NSF, on the topic of education and international collaborations. And still another BERAC member stated that it is important to consider the vulnerability of the talent pipeline in terms of maintaining the international presence that BER wants.

The suggestion of a mechanism that could integrate graduate students and post docs into large scale projects with an international outreach component was voiced. Another example of a training model was DOE's summer school that brings in students and post docs for an extended week-long training to introduce them to the program. NASA used to have such a program to bring in a visiting scholar for a week; that could be reinvigorated with a small amount of seed funding.

Finally, the BERAC meeting themes were summarized as what can be done with science at scale, bridging science between the different sides of BER, and stepping outside of DOE to other agencies and internationally.

### **Public Comment**

None.

**Hungate** adjourned the meeting at 4:10 p.m. ET.

Respectfully submitted,  
T. Reneau Conner, PhD, PMP, AHIP, ORISE  
November 4, 2020