Grand Ballroom, Gaithersburg Hilton Hotel
620 Perry Parkway
Gaithersburg, Maryland 20877
Wednesday, June 6, 2012 at 8:30 am.

Agenda Wednesday, June 06, 2012 (Day One)

Agenda Thursday, June 07, 2012 (Day Two)

Time	Topic	Page	Speaker
8:30	Science Talk – Diagnosing and Evaluating Climate Feedbacks in CMIP-5 Models	36	Brian Soden, Professor and Associate Dean at the University of Miami's Rosenstiel School for Marine and Atmospheric Science
9:30	Report on DOE-USDA Feedstock Genomics Program	38	Cathy Ronning, BER / Ed Kaleikau, USDA
10:00	Break	42	
10:30	BERAC Charge Discussion - Continuation	42	
12:00	Public Comment	48	

Dr. Gary Stacey, Chairman, was presiding.

ANNOUNCEMENT

Dr. Stacey welcomed everyone to the second of three meetings which will be held in 2012. He noted that the third would be held on October 15th and 16th.

ROLL CALL

Committee/Voting Members Present:
Dr. Gary Stacey, Chair
Dr. Dennis Baldocchi
Dr. Susan Hubbard
Dr. Andrzej Joachimiak
Dr. L. Ruby Leung
Dr. Gerald Mace
Dr. David A. Randall
Dr. G. Philip Robertson
Dr. Gary Sayler
Dr. Martha Schlicher
Dr. Jacqueline Shanks
Dr. Gaius Shaver
Dr. Judy Wall
Dr. Warren M. Washington
Dr. Ray Wildung
Dr. Minghua Zhang

Committee/Voting Members Absent:
Dr. Janet Braam
Dr. Judith Curry
Dr. James Ehleringer
Dr. Joyce E. Penner
Dr. Gregory Petsko
Dr. Karin Remington
Dr. Herman Shugart
Dr. James M. Tiedje
Dr. Humin Zhao

BERAC WELCOME & AROUND THE TABLE COMMENTS

Dr. Stacey noted they would continue the tradition of having introductions around the table to enable the members of BERAC to get to know each other. He asked that they introduce themselves and to discuss any comments or issues that they might want to bring forward at the BERAC meeting including any current research that they felt was of interest.

- Dr. Ruby Leung from the Atmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory stated she would share some information on a recent study they had published. She explained that climate models had projected that in the 21st century the southwestern United States would experience more drought. She indicated that they had studied this from different angles but one study recently published looked at specific phenomena related to the monsoon. She continued that this area received a lot of precipitation from the summer rains from June to early September and she said that in the future if they had increased drought then they would have widespread or frequent dust events. She said that the question they had asked was whether this dust might have a role to play in future droughts. She said they did a modeling study and found from the results that dust played an important role in the year to year variability in monsoon rains. This was because in dry conditions there would be more dust in the atmosphere heating it up by absorbing solar radiation. The result of that condition would be that the heating would draw in additional monsoon circulation and increase moisture to the region which would enhance precipitation. She stated that it could potentially be a negative feedback mechanism because you would have more intense drought and therefore more dust. This might relieve the drought by generating more precipitation to the area. She said they wondered whether climate models were able to capture these types of negative feedback mechanisms because it was difficult to simulate the North American monsoon with climate models due to resolution issues. She noted they would be continuing to look at this particular climate model.

- Dr. Judy Wall from the Department of Agriculture Biochemistry, University of Missouri at Columbia, Mo. stated she had attended the last Department of Energy (DOE), Biological and Environmental Research (BER) subsurface biogeochemistry meeting in the spring and was impressed with the progress that had been made and the quality of the science at the meeting. She noted it was disappointing that the synergy built up would be lost due to changes. She commented they were really only beginning to learn about the response of microbes to metals radionuclides. She said when they grow microbes without changing their standard medium as far as calcium and magnesium, there might be many things they had not identified related to how microbes would handle metals that they were not exposed to all the time. She stated she considered this an exciting area.

- Dr. Dennis Baldocchi from the Department of Environmental Science, Policy and Management, University of California at Berkeley noted they had published a new article titled “The Role of Flux Networks in Biogeo Sciences” in EOS, the weekly newsletter of the American Geophysical Union

which he described as a policy white paper explaining the importance of flux networks to a broader community. He considered it a relevant topic for the BERAC because of the way the DOE was operating the AmeriFlux program. He added that his team was working in the Sacramento/San Joaquin delta with the objective of understanding the role of soil subsidence and greenhouse gas exchange with a network of flux towers measuring methane exchange, carbon dioxide and water vapor. He added they had set up towers and noted that there were people interested in reintroducing wetlands. He stated they were trying to understand the role wetlands played as they seemed to be considerable sources of methane. He said they could potentially stop soil subsidence by flooding land, growing either rice or having wetlands which would build up soil carbon as well as expunge methane in large amounts and he noted the greater the NPP (Net Primary Productivity) the greater potential for methane production.

- Dr. Gaius (Gus) Shaver from the Ecosystems Center at the Marine Biological Laboratory explained that it was his first meeting and that he had missed last year as he was in Scotland at the University of Edinburgh. He stated that he was discussing with colleagues the subject of the canopy, the leafy portion of Arctic vegetation, how it works and how leaves are displayed in tundra plant canopies including how the nitrogen content is displayed. He added he was also designing a field program for the summer of 2012 which they were about to implement in Toolik Lake, Alaska where he had been working on plant ecology and the carbon cycle and the role of plants in carbon cycling. He stated this also included the linkage between the carbon cycle and the nitrogen cycle, or basically how the nitrogen cycle acts to constrain change in the carbon cycle of Arctic tundra systems. He added that during the summer they would be studying how leaf area and nitrogen are displayed in plant canopies of varying kinds in tundra systems. He detailed some of the situations that could occur with the layering of leaves and how nitrogen in the leaves would be displayed. He stated that the work there involved more than 100 people working in a field camp. He also added that he managed the Arctic Long-term Ecological Research Program, one of a network of sites maintained by the NSF (National Science Foundation). He expressed his happiness at attending the meeting.

- Dr. Ray Wildung from the Biological Sciences Division, Pacific Northwest National Laboratory noted he was retired and currently serving as a Laboratory Fellow. He stated his interest was in biogeochemistry. He stated that two meetings occurred recently as part of the subsurface biogeochemistry program, while he was out of the country, but he felt the research significant and he stated he wanted to comment on it. He stated the first was held in the U.K. and was focused on electron transfer at the microbe-mineral interface. He stated the abstracts were fascinating and it concerned a case that was gratifying considering the BER investments that advanced imaging and synchrotron spectrometry and genomic techniques had dramatically accelerated their understanding of cellular and extracellular processes and geochemistry underpinning the reactions with minerals. He stated that a number of the data-based hypotheses developed and presented addressed what one researcher called an intriguing physiological feat of extracellular electron transfer. He discussed an example about cytochromes acting as molecular wires. He stated the information about the meeting was available on biogeochemistry.org. He noted the second meeting

was the Principal Investigator's meeting for the BER SBR (Subsurface Biogeochemistry Research) program. He noted the previous year's meeting had a session on the top-down metagenomic and genomic approaches and their limitations on the ability to incorporate fundamental knowledge of metabolism at the cellular scale. He stated that the meeting in 2012 recognized what an investigator had referred to as the tyranny of scales and offered hope through innovative experimental designs and integrated modeling approaches. He thought both meetings addressed essential research identified in the frontier field research program currently in the draft of BERAC technology documents.

- Dr. Gary Sayler from The Center for Environmental Biotechnology at the University of Tennessee, noted that they had had success in several areas. He stated they had incorporated a new company called 490 Bio Tech based on the expression of the bacterial luciferase gene in mammalian cells and he stated it was beginning to gain traction in biomedical imaging and high throughput drug screening. He stated that they had also just published recent work with JGI (Joint Genome Institute) from a community sequencing project on Thauera aminoaromatica which he stated was a problematic organism in waste-water treatment causing viscous bulking. He added that they had been able to show it makes an unusual polymer and in sequencing and annotating the genome of the organism they were able to identify the source and locations of those genes and their controls. He stated it was important because the organism was problematic with respect to upsets of waste water treatment processes. He discussed in more detail the attributes of that organism. He discussed work being done in collaboration with colleagues at the Oak Ridge National Laboratory (ORNL) in the area of synthetic biology and that they now had proof-of-principal data that they could produce long-chain alkanes directly in Saccharomyces cerevisiae from simple sugars like glucose or cellulosic hydrolysate sugars.

- Dr. Minghua Zhang from the Institute for Terrestrial and Planetary Atmospheres at Stony Brook University, the State University of New York. He stated during the last few months they had been working on a number of things, one of which was about the physical mechanism of cloud feedbacks in general circulation models. He noted that they looked at the mechanism to explain why clouds decreased in some models and increased in others when the climate would become warmer. He said they did controlled experiments and what they determined was that as the temperature and the sea surface temperature increased the latent heat flux, the evaporation from the surface, increased across all models. So he stated that there was a balance, an increase in the water vapor flux near the surface that would be equal to the increase of the water vapor flux at the top half of the boundary layer. He discussed the occurrence of variations and the causes in different models. Dr. Zhang noted the second area concerned the improvement of the cumulus convective parameterization and said they had been working on it for some time and the hope was it would improve simulations like the Madden-Julian oscillation and the Tropic precipitation distribution. He noted he had attended a meeting at Harvard and wanted to discuss one of the interesting results. One of them concerned climate change and he noted that sometimes the climate changing pattern

like El Niño with warming in the eastern Pacific or warming in the western Pacific would have large implications on the general circulation.

- Dr. David A. Randall from the Department of Atmospheric Science at Colorado State University noted over the last few months they had been considering what would happen to the Arctic sea ice in future climate specifically how quickly it would reform during the winter and how thick it would be by the end of that season. He noted that in a few decades no ice would remain at the end of summer. He explained by March at the end of winter when the sun returned and the thickness at that time would determine how long it would take to melt during the summer and how much of the summer would be ice-free. He noted ice was an insulator so the thickness had a huge impact on the air temperature at the top of the ice so the thicker the ice the colder the air. He noted that solar radiation was not a factor during the winter so what would matter for the regrowth of the ice was downwelling infrared which comes from CO_2, water vapor and clouds. He said they had been looking at simulations of 4X $C0_2$ concentrations which was approximately where it would be in early part of the 22nd century or 100 years from now. He explained that the thin ice would allow the air above it to be warmer than the air on the neighboring continents in winter. He explained the negative effects of this problem and stated they hoped to do a lot more work on in the future. He also mentioned his book came out titled “Atmospheric Clouds and Climate” aimed at sophomore physics majors.

- Dr. Gerald Mace from the Department of Atmospheric Sciences, University of Utah stated that during the last few months they had been exploring the capacity for satellite data to tell them about precipitating shallow convection over the world’s oceans. He said they had been combining cloud satellite radar data, a new product, derived from the cloud satellite noise measurement that would tell them about the liquid path. He said they had been combining that with model reflectances to simultaneously derive the properties of clouds and precipitation. He stated it was still ongoing and they were trying to determine what it could tell them and how good it was but he noted that they thought it would allow them to address issues and questions regarding precipitation susceptibility of shallow marine clouds with water path less than a kilogram per square meter and rain rates of 1 millimeter per hour. He added that that would then allow them to ask questions about the effects of aerosols and the aerosol composition by reviewing different places on the planet and address modeling questions such as accretion rate, parameterizations and auto-conversion parameterizations.

- Dr. Warren Washington from the National Center for Atmospheric Research noted that his group had published a paper a few weeks ago in the journal “Geophysical Research Letters” that was highlighted in Science magazine in early June. He explained that the paper was about aerosols and considered if you had lots of aerosols, especially black aerosols, and if there was a large heat source over Asia and India you could generate a wave train downstream that could affect the temperature over the United States. He noted that many people had not considered the wave train or teleconnection aspects of large heat sources except in the El Niño area. He also noted that on June

11th there was going to be a "Night with Warren Washington" at the National Academy of Sciences (NAS) and it would be broadcast by PBS at a later date. He added that the NAS President Ralph Cicerone would be interviewing him about his life. He said many young people had been invited as they would touch on how he came to become involved in the science field and his accomplishments and the fact that he been in an advisory role for four U.S. presidents.

- Dr. Jacqueline Shanks from the Department of Chemical and Biological Engineering of Iowa State University noted that she was a metabolic engineering research leader for their engineering research center funded by NSF and part of that position was getting the team to integrate modeling and experimental approaches so they could better predict what their organism was going to do to optimize production in renewable chemicals. She said her group and that of Dr. Costas Maranas had worked together. She stated that it was E. coli and it was a genome scale model of E. coli but using their experimental flux data and with Dr. Maranas' modeling techniques they were able to predict the first interventions to increase carboxylic acid production in one of their engineered E. coli. She discussed some of the processes of working with her collaborators on this research.

- Dr. Martha Schlicher from the Monsanto Company advised that she leads renewable energy efforts at the company. She said she would like to update the committee on two issues. She said they were having a publication coming out June 7, 2012 in Nature Bio-Tech. She noted that the publication had been an involved process involving a lot of work to pull together all the internal data. She stated it was a paper that reported on the true impact of BT crops from Monsanto's field trials. She said they obtained agreement internally to share and publish the data and it would show that for all their field work where there was an average of 190 bushels per acre, BT crops showed an incremental 8 bushel per acre improvement. She said the benefit was about 8 million tons or the equivalent of an incremental million hectares that would not have to be planted. She said another related piece of work was they had formed a partnership and had agreed to donate and fund much of the same data to the University of Florida to the DSSAT (Decision Support System for Agrotechnology Transfer) model which was a corn model for predicting yields. She added that the last update for data was during the 1980s so there was no impact of bio-tech in that crop model. She stated that they were frustrated that many of the models used to predict crop yields appeared to be economic models versus physiological models and so they felt it important to put all their data and information into the public sphere. She added they were starting with corn as it was a crop they had the most data on but hoped to follow with other crops. She stated they had donated two of their scientists to work full-time on that effort for three years to complete the model. She noted that they thought it important to expand state by state but also to expand globally to tropical maize as well as to put out the field trials to validate the results of that physiological model. She said they considered it a great example of a public/private partnership.

- Dr. Philip Robertson from the Department of Crop and Soil Sciences, W.K. Kellogg Biological Station at Michigan State University noted several things about recent field experiences. He said after the

February meeting he thought there would be an additional month to recoup from the last field season but he experienced, together with others with field programs, a field season starting six weeks early due to the early spring and although he would have liked additional funding he realized that was not to be so. He commented that they were excited about a field campaign they had just begun in collaboration with an engineering group which had relevance with regard to the technology charge to be discussed later. He noted that it continued the scaling theme brought up earlier. He said that one of the most important sources of greenhouse warming impact in cropping systems was nitrous oxide production. He noted that they had been stymied by their inability to scale effectively from their measurements done on the sub meter square basis to the ecosystem and landscape level mainly by technology and he related the challenges. He said they were collaborating with a group that was exploring new ways to measure nitrous oxide quickly in atmospheric concentrations using quantum cascade lasers. He described a recent field campaign using detectors on eddy flux towers in a crop field and noted they would be measuring the flux change over a fertilization event and detailed the process.

- Dr. Susan Hubbard from the Earth Sciences Division of Lawrence Berkeley National Laboratory noted that she had both programmatic and science highlights to share. She noted she was also at the Sub-surface Biogeochemistry PI (Principal Investigator) meeting and stated she agreed with what had been said with regard to the scientific richness and progress that the team was making. She said she participated and led one of three breakout sessions that she was involved in. This was the one focused on identifying gaps associated with biogeochemical cycling and carbon flow in ecosystems particularly thinking about research gaps at the subsurface biogeochemistry community which she said was poised to tackle recognizing that. She noted that the community had been thinking for quite a while about microbial influence on the system and the coupling between the different phases of the system. She said while they had been thinking about that in terms of environmental remediation some of the expertise could potentially be transferable thinking about the processes important for biofuel feedstock production and greenhouse gas regulation. She noted the panel presentations and discussions were excellent and the group came up with good questions and challenges and she gave an example. She noted there was a workshop report coming out. On the science side she referred to a talk she gave to BERAC at the end of 2011 and she showed some photographs of a campaign held in Barrow, Alaska and she said she had just submitted a paper based on the analysis of that data. Dr. Hubbard reviewed some of the highlights of the results of the data and information on the models.

- Dr. Andrzej Joachimiak is from the Biosciences Division of Argonne National Laboratory, the Center for Structural Biology funded by BER (Biological and Environmental Research) and the Midwest Center for Structural Genomics funded by NIH (National Institutes for Health). He noted that in May 2012 they received news that the advanced photon source was going to be upgraded which was a $350 million project that had already started. He added that they secured funding for an advanced protein characterization facility that would be attached at sector 19 to the APS (Advanced Photon

Source) and noted the building had already been designed and the laboratory would begin functioning soon. The building would be completed by the end of 2013 and it would host systems biology, protein production facilities, gene cloning and expression, structural biology and structural genomics groups. He referred to science issues and noted they had just submitted two papers describing how bacteria recognize degradation products of lignin. He reviewed the importance of lignin, one of the most important polymers on earth. He reviewed some of the processes being done as related in the research papers. Dr. Joachimiak noted that he had just returned from Rutgers University where they had a meeting for the Protein Structure Initiative (PSI) Knowledgebase. He noted that BER had funded this effort in the knowledgebase and he said they had been running Knowledgebase in PSI for the past seven years and it was focusing on structure annotation and said that they were also interfacing with biological groups. He thought that there might be potential for interaction with NIH and BER looking at developing a comprehensive database for large-scale projects.

- Dr. Gary Stacey is from the National Soybean Biotechnology Center, Department of Microbiology and Molecular Immunology at the University of Missouri and he noted that he attended the JGI strategic planning meeting in early June 2012 in D.C. and reported it was very interesting. He said that the strategic plan presented at the BER meeting the previous year was the starting point. He stated it was an impressive group of people and said they would hear a report in the next BERAC meeting in October. He stated that what he took away from the meeting was that sequencing should continue. He stated that there was a strong endorsement for the synthetic biology aspect that was in Edward Rubin's original document and strengthening that. He commented that he was surprised at the time of the emphasis of the group on function especially related to annotation. He pointed out that when they sequence genomes 40% or so of the genes are listed as 'unknowns' with no annotation and there was a group who felt that that was a problem that should be addressed. It was felt that JGI should take the lead or the DOE should give this their attention. He said he thought there was excellent discussion and many of the ideas being discussed could be found in their Grand Challenges document which he thought showed its continuing relevance. He noted that one of the things that he would have liked to see was an emphasis on single-cell biology. He said he looked forward to that report. He thought one of the things that was evident in the meeting was also reflected in their technology document to be discussed later which was a need for better integration, more interdisciplinary research and more collaboration although not at the deficit of single investigator or small group research; however, he thought that 21st century science was pushing them in that direction of interaction.

STATE OF BER REPORT

Dr. Sharlene Weatherwax, *BER Associate Director of Science*

- Thanked everyone for speaking at the opening session where she has the opportunity to hear about each member's research and activities and noted that it always reminded her of the breadth of the science represented in the BER portfolio and the expertise of the individual members.
- Added that she was also looking forward to attending the interview of Dr. Warren Washington.
- Stated it was her pleasure to welcome everyone to the meeting and noted she wanted to give everyone an update of events at the highest level. Acknowledged that they would hear more detail from the two division directors.
- Discussed the budget and noted that in the OS (Office of Science) the budget was a main area of discussion:
    - They are currently dealing with the 2012 budget and they were working under the current appropriation.
    - She acknowledged that the program managers were working hard getting their money out the door so people can work on the science.
    - They have been concluding a lot of recent reviews for some solicitations in 2012 as well as a lot of reviews for ongoing projects along with the accompanying paperwork so they could then put up the next increment of funds. She acknowledged the hard work of BER staff many of whom were doing this along with other work such as running workshops and also looking for future opportunities.
    - She noted that they have the request that had been submitted in February 2012 which was the President's Request for 2013.
    - She explained that the fiscal year ends at the end of September so they were working on 2012 until October 1st and then from October 1st they would start fiscal year 2013 and at that point under hopeful circumstances they would receive the President's Request.
    - She pointed out from the chart that there was a divergence of opinion in terms of what Congress would like to provide for funding. She stated the House had met in committee and had produced a mark which was significantly lower than the request and the current appropriation. She stated that the Senate had recommended that the amount fall in line with the President's Request.
    - She stated that the House did not mention any particular program in the language that was published. She said the overall level did not change that much for BER.

- She discussed the Fusion Energy Sciences (FES) program and pointed out that the Current Appropriations Level, President's Request and Senate Mark were flat whereas the House had reinstated funding for ITER (International Thermonuclear Experimental Reactor). She said the House and Senate would have to come to some agreement regarding the difference and the subsequent decision would then impact the OS in 2013.

- She referred to the funding for Program Direction and stated that it referred to salaries of federal employees, the ability of staff to travel and go to meetings to remain engaged with colleagues. She pointed out that a slight increase was requested but noted that both the House and Senate Mark showed that they considered it would not be prudent to further cut these funds.

- She thanked members for including remarks in COV (Committee of Visitors) reports emphasizing the importance of travel for meetings and enabling scientists to continue to engage with each other. She noted it was by doing so that members of the House and Senate understood its importance.

- Advised some personnel changes that had occurred since the last BERAC meeting:

  - Pablo Rabinowicz was on loan from the University of Maryland. He spent a year leading a charge in synthetic biology. He ran a workshop, helped to draft a solicitation for that and just finished holding the review panel. She stated that he would be the resident molecular biologist and was a federal employee from June 4, 2012.

  - Todd Anderson is Director, Biological Systems Sciences Division and has left his program manager's position in the subsurface program. She stated that he was coming into the position with a wealth of experience on the climate environmental sciences side. She said that she was looking forward to hearing some initiatives from him and welcomed him to the BER leadership team. She also took the opportunity to thank all of those who had stepped into this position in the capacity of acting director on an interim basis.

  - Robert Lee has come in to the BER as part of the DOE summer internship program. She stated that he had just graduated from Rockville High School and came with experience working on the school paper, web design and technical work. She said he would be with BER through the summer and then in the fall would be attending the Johns Hopkins University.

- Reviewed the OS Early Career Program which was originally initiated with recovery act funds but was considered of such importance that it has been continued and funded out of program funds. Discussed some important points regarding the program:

  - To support the development of individual research programs of outstanding scientists early in their careers, defined as no more than ten years past their PhD.

- In 2012 BER had 9 awards: 3 to laboratories in the amount of $2,500,000 over 5 years and 6 to universities in the amount of $750,000 over 5 years. Each is a five-year award and represents the commitment to launch scientists in their careers.

- She explained that each office has the discretion to decide the number of awards and also to define the topics so it could be a broad scope or decide on a subset of activities. BER did both. The Climate and Environmental Sciences Division had three topics: Arctic Terrestrial Ecosystem Science; Subsurface Biogeochemistry; and Uncertainty Characterization for Integrated Earth System Modeling. The Biological System Sciences Division had a single topic: Biosystems Design for Bioenergy Production.

- She discussed the recipients of the awards and noted that they are on the OS website and their research abstracts are listed. She noted that the group for the Microbial Systems Biology Design for Bioenergy Production are: John Duebar, James McKinlay, Samuel Payne, Jennifer Reed, Garrett Suen and Jamey Young. Some of their background and details were discussed. She then looked at the group from Climate and Environmental Sciences and noted that one award had been made in each of the areas: Daniel Hayes, Arctic Terrestrial Ecosystem Science; Ming Ye, Subsurface Biogeochemistry; and Celine Bonfils, Uncertainty Characterization for Integrated Earth System Modeling. Their backgrounds and details were reviewed.

- Noted that they would continue to develop topics and the next round would issue around July with the deadline being September.

- Discussed the involvement of BER staff with regard to interagency coordination. Stated she wanted to review some of the activities being done by BER program managers to engage with federal counterparts and ensure they would be leveraging each organization's strengths and developing initiatives in a coordinated fashion. She commented on some of the ways:

  - BER staff assume key leadership roles and she gave as an example her position as co-chair on the Life Sciences Subcommittee and Dr. Geernaert was the principal at USGCRP (United States Global Change Research Program).

  - She stated that there was a lot of activity between CESD staff (Climate and Environmental Sciences Division) and OSTP (Office of Science and Technology Policy) and reviewed a substantial list of committees that CESD program managers were involved with in addition to their regular responsibilities. She explained the importance of these interagency contacts by saying that for a topic like Arctic research that it was well coordinated across the federal agencies.

  - She noted that the BSSD (Biological Systems Science Division) also had activities in which the program staff engaged with other agencies. She clarified for the members that the Working Group on Plant Genomics was just being stood up and they were waiting for final approval by

the OSTP but they had been given the go ahead on the charge and would be recruiting members. She stated that the new committee would be co-chaired by Dr. Cathy Ronning.

- She mentioned another example and stated that the Synthetic Biology Working Group and the efforts of that group would contribute to a report to Congress in the later part of 2012.

- Reviewed some of the interagency research activities and commented that some involved coordinated joint activities, joint solicitations, and co-funding. Noted the different coordinated activities with both divisions of BER and stated that different organizations brought their own areas of expertise to the table. Commented that some activities were existing, for example, with ARM (Atmospheric Radiation Measurement) and others are newer like the GOAmazon project which would involve the NSF, NASA (National Aeronautics and Space Administration) and an international partner. Noted two areas in BBSD concerning Computational Biology and Kbase where there was ongoing coordination with federal partners and the sharing of best practices. Mentioned the importance of giving program managers the opportunity to meet and interact with their colleagues from other agencies.

COMMITTEE DISCUSSION

Dr. Stacey commented that during their meeting in February 2012 there was discussion concerning the Graduate Fellowships sponsored by the OS. He noted that the BERAC had voted to prepare a letter to support that and this was done and forwarded to Dr. William Brinkman. He asked if there was a status update on the matter. Dr. Weatherwax stated that they were having the cohort in 2012 but that funding was still in question for 2013 due to budget concerns and the House and Senate had yet to come to an agreement on the value of that program.

BIOLOGICAL SYSTEMS SCIENCE DIVISION

Dr. Todd Anderson, *Director, Biological Systems Science Division (BSSD)*

- Noted that the slides for his presentation are always put up on the BERAC website after the meeting.

- Stated he would be providing an update and would touch on some personnel changes, program activities, a Kbase status report and division science highlights.

- Commented on some of the staff changes at BSSD:

  - He noted that the division had a new permanent director and that his start date was March 12, 2012.

  - He congratulated and welcomed Dr. Pablo Rabinowicz as a new federal employee to the division.

- Highlighted some of the division's program activities since mid-April 2012 including FY2012 reviews of DOE National Laboratories SFA (Scientific Focus Area) programs:
    - Foundational Genomics: Both Los Alamos National Laboratory (LANL) and Oak Ridge National Laboratory – LANL reverse site visit July 12-13; and Argonne National Laboratory (ANL) which was completed.
    - Biofuels Research: Lawrence Livermore National Laboratory (LLNL) – reverse site visit July 12-13; and National Renewable Energy Laboratory (NREL) and Oak Ridge National Laboratory which were both completed.
    - Radiochemistry & Imaging: Brookhaven National Laboratory (BNL) – completed; and Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a mail review and is pending.
- Highlighted some of the division's panel reviews which they were finalizing:
    - Plant Feedstock Genomics for Bioenergy: A Joint Research Funding Opportunity Announcement between the USDA (United States Department of Agriculture) and DOE.
        - Run by Dr. Ronning. A joint solicitation between BSSD and the USDA looking at plant biology with a bioenergy perspective.
        - Reviewed 60 applications and now processing a total of 9 awards, 2 funded by the USDA solely and others funding through BER. Notifications to PIs were pending.
    - Integrated Nuclear Medicine Research and Training Projects of Excellence to encourage the next generation of nuclear medicine research within the division in nuclear and radio chemistry.
        - Dr. Prem Srivastava managed the program review.
        - Reviewed 17 applications and they were processing 5 awards with notifications pending to PIs
    - Genomic Science: Biosystems Design to Enable Next-Generation Biofuels. The panel was led by Dr. Rabinowicz and originated from a workshop run in 2011 in biosystems design.
        - Reviewed 88 applications and of that total 33 dealt with synthetic biology applications in plants and 55 were more focused on microbes.
        - In the process of reviewing reviewers' comments and making selections.
- Detailed the symposia/conferences attended or co-organized by the program managers as well as talks given in sessions. Dr. Ronning at the 2012 National Synchrotron Light Source (NSLS) Users Meeting; Dr. Noelle Metting at National Academy of Science at the Nuclear and Radiation Studies Board Meeting; Dr. Joseph Graber coordinating a session at the upcoming ASM (American Society

for Microbiology) meeting in San Francisco. Noted that Dr. Dean Cole had been a representative in looking at life science opportunities on the International Space Station (ISS) with NASA.

- Discussed the JGI workshop, "Joint Genome Institute Strategic Planning Workshop" hosted May 30-31, 2012 which had 38 participants from a wide variety of areas. Noted the rapid changes taking place in sequencing technology and the rapidly decreasing cost. Stated that the scale of instrumentation was becoming a bench-top application as opposed to a facility-led endeavor and added that that would cause some challenges for the office for a facility-led genome sequencing center. Reviewed the three main questions that were posed to the participants of the workshop in three breakout sessions. Stated that the three breakout Chairs were reviewing the comments developed at the workshop and a report would be prepared in draft form by the end of August.

- Provided a status update on the systems biology knowledge base, Kbase led by Dr. Susan Gregurick. Noted that Kbase reported to her on their progress and he noted that the knowledge base was a catalyzing project for their program going forward. Advised on some points:

  - He said they had made progress in developing the central data model (CDM), putting in the electronic links to link to JGI, to other databases and pulling them all together in the Kbase framework which would serve as the central data model for Kbase.

  - He noted they had made progress in developing the user interface, the application programming interface. He added that Kbase developers wanted to keep close contact with users to ensure that the programming interface was user friendly. They would have to make it accessible so a biologist would be able to access the high throughput information, an enormous amount of sequencing and data that was available in the program and to be able to use the data in a meaningful way without needing a computational science degree.

  - He said Kbase had tested the ESnet capabilities within DOE connecting the different nodes among BNL, ANL, ORNL and Lawrence Berkeley National Laboratory (LBNL), the pipeline for Kbase. He stated that Kbase was built around a cloud architecture so having the high-volume and high-traffic connections among the different nodes and the Kbase architecture would help facilitate the cloud base format.

  - He stated that Kbase was working on some of the preliminary tools that would populate the Kbase API (Applications Program Interface).

  - He discussed what they considered as a crucial connection between JGI and Kbase going forward where JGI was facilitating larger scale genome science, contributing sequencing and other information into Kbase and Kbase bringing in sequencing information from other sources. He added that they see it being a core of an approach to science that links genome sequence with the experimentation capabilities of researchers and linking with modeling. He stated that they considered the connection a "Hypothesis Generating Engine for BSSD Programs" going

forward. He noted that this model could explore issues such as: synthetic biology; bioenergy; environmental remediation; and carbon sequestration.

- Discussed some of the science highlights:
  - From the Great Lakes Bioenergy Research Center looking at complex physiological responses during conversion of biomass to biofuels. This had an objective of improving the efficiency of biofuel production by understanding the physiology of cells converting biomass hydrolysate to biofuel and the laboratory was using a strain of E. coli grown in AFEX (Ammonia Fiber Expansion Treated) - treated corn stover hydrolysates. Several of the approaches taken were discussed.
  - From the researchers at the Joint Bioenergy Institute (JBEI) who were looking at understanding ionic liquid tolerance in cellulose degrading microbes. This had an objective of pretreating biomass with ionic liquids (ILs) which separated lignin and polysaccharides but residual ILs are toxic to microbes involved in polysaccharide breakdown and fuel synthesis. Their question was: "How could they improve microbial tolerance to ILs?" The approach was discussed.
  - From the Genomic Sciences Program studying genome scale models to advance an understanding of methanogen physiology. He stated it was a group out of the University of Illinois at Urbana Champagne. It had an objective of resolving key differences in methanogen physiology by iteratively coupling genome scale model results into experimental designs. Their approach was discussed and the results found that the genome scale model proved to be a useful iterative research tool for incorporating the latest results from the literature and the laboratory to assemble, guide and converge testable hypotheses towards validated understanding. He noted that this particular project illustrated the previous approach about the value of combining genome-enabled information and modeling in an experiment in an iterative process to understand gaps in a metabolic pathway.
  - From the Low Dose Radiation Research Program studying the effects of the translationally-controlled tumor protein (TCTP) after low does irradiation. He noted that this research recently came out in a paper in PNAS (Proceedings of the National Academy of Sciences) and that the protein appears to be implicated in conferring protection for cells against the effects of low dose radiation. He discussed the results and continuing questions regarding the research about this protein in further detail.
  - Highlighted some of the high-impact publications that have come from JGI over recent months. Noted that the publications are posted on the JGI website.

COMMITTEE DISCUSSION

Dr. Stacey commented that at the meeting there seemed to be some confusion as to what Kbase actually was because when he had spoken to some involved in Kbase building the infrastructure and

another person advised it was an integrated data resource. He noted also that part of the problem was that NSF's IPlant was not that well known and people working on it were only just formulating a plan several years into it. He thought it was important that they should articulate to the community what Kbase was and try to clear up any confusion. He thought people should be looking forward to integrating what they were doing with what Kbase would be. Dr. Anderson responded that they were conscious of that and he acknowledged that one of the challenges for Kbase was communicating what kind of tools and capabilities would be produced and made available to the community. He added that staff from Kbase would meet with some of the BRC (Bioenergy Research Centers) projects. Dr. Stacy also commented that there was concern about where the line was drawn between what Kbase would do and what the various units would do. He added from the standpoint of the community they wanted to know exactly what they were working toward. Dr. Anderson responded that they were in contact with the BRCs and also were in attendance at the genomic sciences meeting, running their own sessions with the purpose of informing the community about what Kbase was, the capabilities involved in Kbase, the privacy concerns for working with data from another laboratory.

CLIMATE AND ENVIRONMENTAL SCIENCES DIVISION

Dr. Gary Geernaert, *Director, Climate and Environmental Sciences Division*

- Described his division and the strategy that they had developed over the past year focused on advancing predictability through a systems-type modeling approach that would build upon observational and experimental activity. Presented a chart which illustrated observational and experimental activity along with integrators of the work carried out on the observational side. Emphasized it was not just a flow inward but they wanted to use a flow outward from the modeling column to help define the highest priorities and what the highest returns on investment in the field activities would be.

- Stated that the division was interested in building a culture that was inter-dependent and integrative, inter-disciplinary and collaborative across all the programs. Noted that they had considered carefully what projects would bridge that interaction across the programs.

- Described several platforms for science integration and noted that they had looked at observational infrastructure, community models and community data infrastructures where they could begin interacting. Identified some key priorities such as: uncertainty characterization; extremes and thresholds; and exploiting the DOE computational assets. Indicated they were also trying to identify how they would use the mix of collaboration to advance the new goals: in integrative modeling; biogeochemistry; looking at the relationships between the atmosphere and terrestrial systems; and the infrastructure and building up the mission space so they would have the end-user input to help guide what would be important for scientific investments.

- Discussed NGEE (Next Generation Ecosystem Experiment) under the scope of interdisciplinary science projects. Stated they focused on NGEE because it bridged the observational and modeling

pieces and considered what was globally important. Noted that so far NGEE had emphasized climate modeling community systems as an integrating platform. Indicated that they wanted to broaden that so in the future subsurface would have a role within upcoming NGEE initiatives. Stated that the ARM program was observational for many years with little connection to modeling or other programs. Said that with its three-dimensional capabilities from ARRA (American Recovery and Reinvestment Act of 2009) investments they were seeing a tighter relationship on how ARM would be building the databases necessary for next-generation climate model validations. Noted that the societal dimensions area was a new component of the CESM (Community Earth System Modeling Framework) and they would be more active in having influence on the direction that the societal dimensions priorities would be heading.

- Provided some facts on FOAs (Funding Opportunity Announcements). Took the time to acknowledge the time, effort and concentrated work done by the laboratories in submitting the proposals. Highlighted several:
    - May 2012 – AmeriFlux: 4 were received and 1 was selected for Berkeley.
    - May 2012 – RGC (Regional Global Climate Model)/ASR (Atmospheric Systems Research) program: collaborated in releasing an FOA and 46 were received and 5 projects were selected to go forward.
- Reviewed the CESD meetings and workshops both the PI meetings and the workshops which he noted bridged many programs. Highlighted one workshop, an ARM science strategy workshop coming up in the fall, based on a discussion in which the Europeans had expressed an interest in establishing a similar facility within Europe which would build on the ARM paradigm. Expressed the hope that ARM might become international with multiple countries.
- Discussed the SFAs (Scientific Focus Area) which were initiated approximately three years ago as three-year efforts with the understanding that they would go through a triennial review. Stated that those reviews were taking place mainly in 2012 so there was a list now involved in that process. Noted it was very active and would continue through the fall. Showed a slide with a selection of the SFAs. Acknowledged the substantial work done by the program managers when the SFAs come up for review. Stated that many proposals had been accepted with minor revisions and it was a continuing process.
- Discussed some science highlights:
    - He stated that the ARM program has had some growth. They had expanded the whole program with an additional permanent station and a mobile facility. He mentioned the mobile facility, the Toolik Lake site in Alaska was being established in 2012 as a multi-year mobile facility and they expect it to be there for two to three years. He added that by FY2015 it would migrate to another site to be determined. He described the second one TCAP (Two Column Aerosol

Program) was an aerosol project which will be on Cape Cod starting in the summer of 2012. He said the third one was called MAGIC (Marine ARM GPCI Investigations of Clouds) is different from past ARM deployments in that it would be on a ship transiting between Honolulu and Los Angeles and would be collecting three-dimensional information on the evolution of stratus clouds and sub-strata cumulous clouds to understand what roles they play. He noted that GOAmazon was coming up in FY2014, another ARM project located in the Amazon and would be an international group collaboration. He added that the Europeans were building a major tower.

- He discussed Aerosol indirect effects. He added that when scientists talk about indirect effects they would be looking at aerosols and cloud droplet relationships. He explained that if one went back to basic atmospheric sciences the role of looking at aerosols in clouds was not just to study the color but how the aerosol would change the droplet size distribution and the number and that in turn affects radiative transfer through the clouds. He listed the many types of effects of aerosols and noted that atmospheric scientists have been forced to look at all the independent effects to try to understand the relationships so with community atmospheric models they can combine all the effects. He commented on a slide which discussed the first indirect effect.

- He highlighted a recent discovery by EMSL (Environmental Molecular Sciences Laboratory) in a PNAS article that looked at organic aerosols such as aerosols emitted from forest canopies or trees and studied how those aerosols emitted from botanical systems were evolving in the atmosphere and were eventually becoming cloud condensation nuclei and in turn affecting cloud dynamical processes. He described the study reviewing the objective, approach and results. He noted the importance of this work as it was concerned with organic aerosols and this was an area of study for the GOAmazon project.

- He discussed the snow albedo reduction by black carbon which has been studied by multiple laboratories and the university community. He said the study was important because there had been suggestions that black carbon in the Arctic which has been depositing for many decades, was having an impact in accelerating the melt of snow and the loss of ice. He added it was previously speculation but he noted this study was quantifying how critical a part the black carbon was playing in melting snow and ice in the Arctic. He stated that the SNICAR (Snow Ice and Aerosol Radiative Model) within CESM had been demonstrated in the study to reproduce the observations well. He reviewed the objective, approach and results for the study.

- He stated that the PCMDI (Program for Climate Model Diagnosis and Intercomparison) at LLNL was touching on the topic of detection and attribution and was carrying out the work on behalf of the climate community at large. It concerned human induced global ocean warming on multi-decadal timescales. He stated there had always been debate over the fact that even though the oceans were warming, was that warming significant. He added was it significant enough to convincingly say the oceans are warming and that they are warming based on anthropogenic influences. He said the key issue was having a data record of a sufficiently long period, the

significance of those results start to increase. He said in the study they tested different lengths of records going back to 1970 and tried to identify with a multi-model and multi-agency approach when that significance would start to exceed 5% or 2% or 1%. He stated that the study demonstrated such methodologies.

- He stated the next study looked at the relative outcomes of climate change mitigation related to global temperature versus sea level rise. He noted that it tackled the problem, debated in the media, of a perception among the public that if carbon emissions to the atmosphere are reduced the sea level rise or the atmospheric warming will immediately start to reverse and he stated this was not true. He stated that the study summarized that even if carbon emissions were turned off today the sea level rise would continue for the next several centuries. The only impact would be that the sea level rise would be slower.

- He highlighted the study which had an objective of understanding the competing roles of temperature and photoperiod on photosynthetic activity in a changing climate. He discussed the terrestrial sphere and stated that one of the weaknesses was that the community land model has a long way to go to start adopting much of the observational framework and databases generated by the TES (Terrestrial Ecosystems Science) programs and hopefully a combination TES and subsurface program. He stated they were looked at CLM (Community Land Model) to over the next decade to move to high resolution. He noted that the paper illustrated that you could not exclude photoperiod. He discussed the approach and results/impacts.

- Detailed some management priorities over the next 6 to 12 months:

  - He noted that they had an agenda within the division to advance hydrology as an integrating platform in SBR and TES and the modeling programs and to include BSSD. He said the whole system needed to be treated in terms of systems dynamics from genomics to subsurface processes, all variabilities across those so they could have a better handle on how predictability would be framed.

  - He said that CESM was one of the big community integrating platforms and noted they would be placing more effort to ensure that CESM and their investments in CESM have the highest returns on DOE investment.

  - He said they wanted to get a roadmap of where the NGEE concept would play in all of their observational investments. He noted that they would be discussing in BER to sketch out a framework for a workshop in which all members of BERAC and the larger community would be invited to help guide them on where future NGEEs ought to be directed.

  - He referred to ARM moving into the international domain and noted they were pleased that the Europeans would be using the paradigm and success of ARM in the U.S.

- He noted that in the future they were thinking of beyond the CESM of AR5 and looking at CESM of AR6 and where IPCC (Intergovernmental Panel on Climate Change) of AR6 would be heading in approximately 2020.

- He mentioned town halls and stated CESD was aggressive and ambitious to advertise their investments and priorities and relationships to the community through town halls at big national meetings including a presence at the upcoming Ecological Society meeting.

COMMITTEE DISCUSSION

Dr. Stacey remarked that people in different areas of science try to 'read the tea leaves' in that there is some paranoia out there. He asked, given his own background and considering the reduction of funding in some subsurface programs and the fact that he did not provide many examples in that area, he might assume that those areas were being de-emphasized. He asked if he could respond to that. Dr. Geernaert responded that it was true that they were re-thinking where the ESS (Environmental System Science) was heading. He added that they were looking at ESS as an integration of TES and SBR and he said they were trying to get a framework to entrain the community's input on the biggest priorities for the science and how would they build around community platforms to advance that in an efficient way. He said that in terms of where the investments were going there was a flat investment across ESS but there were individual shifts. He said one of the things they had been discussing over the past several years was building upon the excitement of new thrusts, for example NGEE. He added they were looking at SBR as a component of how they would go forward there.

Dr. Washington mentioned CESM and asked if they would coordinate with NSF in terms of who would do what and he also asked, within DOE, in order to do climate or system modeling if they would rely upon large computers in the ASCR (Advanced Scientific Computing Research) part of DOE, OS as well as the data. He referred to the data for their operation and even in running simulations for the IPCC and said they were getting into the petabyte scale and issues surrounding large datasets. He said getting data out to the users was becoming more and more of a problem. He asked if he could respond. Dr. Geernaert responded that there might be an opportunity to expand collaboration with NSF. He said he had discussed this with NSF and he had asked about coordination between NSF and DOE, their investments and priorities and intentions with CESM over the long term. He said the CAB (CESM Advisory Board) had representation from DOE, NSF but also other agencies. He added that there were discussions within the CESM community to create another component which would involve the big agencies that had a vested interest in CESM.

BREAK

The Biological and Environmental Research Advisory Committee recessed for a break.

Dr. Thomassen noted that the next speaker was Dr. Petters, an AAAS Fellow working in the OS. He noted that for those members on BERAC a year ago there was a charge about big data and about sharing data

and there was teleconference meeting in June 2011. A report was written. He said that what Dr. Petters would be talking about was how that activity would fit into the broader federal efforts as well as the OS efforts.

DATA INITIATIVES IN FEDERALLY FUNDED RESEARCH

Dr. Jonathan Petters, *AAAS Fellow, DOE, Office of Science*

- Thanked Dr. Thomassen for the introduction and gave details regarding his education and background.
- Stated that he would be discussing data initiatives in federally-funded research relevant to BER and with developments happening at the program and inter-agency levels.
- Discussed the challenges and opportunities with regard to dealing with large amounts of data. Noted that they were currently under a data deluge and he referred to an article in Science magazine from February 2011 discussing the issue, specifically issues in data, big data and large data sets and scientific research. Stated that more data was being generated than it was possible to store and many datasets were too large and poorly organized. Added that many datasets were heterogeneous in type, structure, semantics and granularity and many of these things are limiting the ability to interpret and use it effectively.
- Noted that there were some initiatives set up to address these issues and one was the charge given by Dr. Brinkman in February 2011 about looking at the dissemination of research results and current policies and practices involved. Stated that BER as well as the other five OS program Advisory Committees also wrote reports about this.
- Stated that the charge was in response to the America COMPETES Reauthorization Act, section 103. Noted that in the Act there was a push for looking at ways to make federally-funded research accessible and preservation and access to publicly-funded research. Added that in addition there was an Interagency Working Group on Digital Data formed to "coordinate federal science agency research and policies related to the dissemination and long-term stewardship of the results of unclassified research supported by funding from federal science agencies".
- Stated that in addition to the report there, BERACs long-term vision report identified a grand challenge in computing for BER. Reviewed several of the goals of that challenge: establish a new data management paradigm; create a new publishing paradigm; develop new computing paradigms; designing and building new software solutions; and several others. Stated that there were currently new initiatives taking place that were addressing these goals at one level or another.
- Discussed main points about the National Big Data Research and Development Initiative:
    - Announced with an official press release in March 2012.

- It is being run through a Big Data Senior Steering Group chartered in the spring of 2011 and has participation from several agencies including the DOE-OS, DARPA (Defense Advanced Research Projects Agency) DOD (Department of Defense), NARA (National Archives and Records Administration), NSA and NOAA (National Oceanic and Atmospheric Administration) among others.
- The group is being co-chaired by the NIH (National Institutes of Health) and the NSF.
- It is a long-term, national initiative with four major components.

- Discussed the rollout announcement of the National Big Data Research and Development Initiative:
  - Announcement came out on March 29, 2012.
  - Six federal departments and agencies announced more than $200 million in new commitments to improve tools and techniques needed to access, organize and glean discoveries from large volumes of digital.
  - The OS announced the creation of the SciDAC (Scientific Discovery through Advanced Computing) and the Institute of Scalable Data Management, Analysis and Visualization (SDAV Institute).

- Discussed the four major areas:
  - Core Technologies – Foundational research to develop new techniques and technologies to derive knowledge from data. Stated that the OS was not currently involved but was in the form of a solicitation joint between NIH and NSF.
  - Domain Research – Looking at cyber-infrastructure to manage, curate and serve data to research communities. He stated that the group was currently trying to identify potential data and computational-intensive research domains where interagency coordination could be beneficial. He stated that the group had identified several things related to climate work that they were interested in further coordinating. One is the impacts of climate change on human health. The other is the EarthCube project from NSF which could be compared to Kbase for the geosciences.
  - Workforce Development – A new approach for education and workforce development. He stated that for science there was currently not a clear career path for people to get into data-intensive work. He discussed the McKinsey Report published in May 2011 which highlighted the shortage of people who have analytical skills and the ability to make decisions on the data that's available. He stated that as a starting step they were looking at building communities of fellows across agencies and he gave as an example the DOE Computer Science Graduate Fellowship

Conference in the summer of 2012, which was being made available to similar fellows across other agencies.

- Challenges – A focus on challenges and competitions as a way to drive new data analytic ideas, approaches and tools from a more diverse stakeholder population. He discussed the new Ideation Challenge which was forthcoming and BER would be participating through the ARM program. He explained that responders would be asked to generate ideas for applications/tools that can: address participating agencies' missions; allow heterogeneous collections of data to become more homogeneous and searchable; and involve more than one data set (at least one of which is large).

- Discussed data citation and attribution and noted that one of the things in the Grand Challenges Report was looking at how to modify the publishing paradigm to get recognition for data sets. He noted that:

  - ARM has been coordinating with OSTI (Office of Scientific and Technical information) to make some headway by assigning digital object identifiers (DOIs) to datastreams available through the ARM website. The goal is to improve the discoverability of and access to ARM datastreams.

  - ARM has coordinated with OSTI on data citation for ARM data streams and he commented on a relevant screen shot of the site.

  - Provided a snapshot of the information currently suggested for a citation. ARM has decided to do it through data streams. He noted that OSTI had recently given a presentation to BER on what they had been doing with the citation and attribution and the program managers were very excited about it.

- Discussed the Scientific Challenge and the internal group working on Dr. Brinkman's charge. Noted that there was an internal working group on digital data represented by each program. He said what the group had been doing so far included:

  - Sharing information about data issues, policies and research across programs.

  - Considering pathways to improve SC digital data management (e.g. data standards, access and preservation)

  - It was formed partially in response to the America COMPETES Reauthorization Act, section 103, and the Dr. Brinkman's charge will respond to guidance from the Interagency Working Group on Digital Data. That guidance is currently awaited.

  - He stated that in lieu of guidance they were: moving at a slower pace; learning from other agencies/communities' experiences in data management (including from BER); and currently considering options.

COMMITTEE DISCUSSION

Dr. Baldocchi noted that he appreciated his talk and the need to deal with big datasets. He noted that he often hears about the necessity of combining heterogeneous datasets. He asked what was out there in terms of how they could proceed to take heterogeneous datasets and bring them together and harmonize it. Dr. Petters responded that as far as approaches in dealing with datasets, as a computer scientist expert, he stated he would have to pass. He noted that he did not have the knowledge of the current ideas of how to approach it. He added that it was a large issue and health records were a good example of a heterogeneous dataset and he elaborated on some problematic issues with datasets of that type. Dr. Baldocchi said that it was important to have a two-way interaction. He said for him working on the margins he got the impression that they should have better meta data that would be searchable by the computer scientists. He said that his group, as data producers, would be more aware of that and hopefully they would be able to produce improved datasets that could yield the information.

Dr. Washington noted that he wanted to give one example that was something called the climate end station which he said had been in existence for five or six years where the climate modeling community had worked with the computing community to put together a way of potentially making the data available over the internet. He said they had several thousand users and the software that allowed for people to use the data had been installed at most of the major modeling centers around the world. He explained if you wanted to get something like surface temperature all you needed to do was specify the place you wanted the information from and it would process that request. He said if the users were not involved it would not work.

Dr. Joachimiak noted that he saw it as an opportunity for BER as they would discuss the complexity of biological systems and the amount of data that they are generating was tremendous in sequencing and imaging and other areas. He thought there should be an important discussion on standardizing how the meta data is being generated and then the knowledge base that is funded by BER is an important component. Dr. Petters responded that that sounded great and he thought the program managers from BSSD would be happy to talk to them about coordinating and getting better data standards available.

A member noted that it sounded as if there were several efforts in place trying to address the issue with the Kbase on board and with the climate change models. She said if they started recognizing the problem, which they all did, would they all have to go down to ground zero. She asked if they could build on the programs. She asked about the programs already doing some of the work and wondered if they were scalable. Dr. Petters responded that it might be an idea for a workshop and noted that her question about skills was a difficult one and he gave an example using the AmeriFlux network and elaborated.

Dr. Stacey noted that he was frustrated by the visualization tools. He said they talked a lot about data, putting data in, maintaining data, analyzing and integrating data but not a lot about visualizing data. He said the two-dimensional tools they had on a computer could be frustrating. He said what he would like

to have was a situation where all the data was on the screen and you just pulled the data up or pushed it back so it would all be there. He said for example, he could take a metabolic pathway and pull it up and compare it right to the genome sequence as opposed to flipping through multiple screens.

A comment was made that this was one of the reasons why the SciDAC Institute had been formed, the (SDAV Institute). He said there was going to be a briefing for BER.

LUNCH

The Biological and Environmental Research Advisory Committee recessed for lunch.

CHANGING VIEWS OF A CHANGING ARCTIC CARBON BALANCE

Dr. Gus Shaver, *BERAC, Science Talk*

- Explained that he was asked and decided to give a presentation on the topic as there was a lot of interest in the Arctic and the Arctic was recently shown to contain in the permafrost regions, both Arctic tundra and boreal forest, about two and half times as much carbon as there was in the atmosphere. Noted there was a lot of concern about the existence of the carbon in a warming world.

- Stated that the term “Changing Views” was used as there had been a progression of chapters of understanding of how carbon balance and Arctic systems were regulated during the past 41 years.

- Said that he was going to discuss two of the most recent chapters and how we currently think about the Arctic carbon balance. Referred to the opening slide and commented that it showed Toolik Lake with the Toolik field station on the shore and the view was looking south towards the Brooks Range over the foothills region of the north slope of Alaska and where the work was based.

- Noted that Toolik Lake had warmed in annual temperature by about 2 or 3 degrees since the late 1950s.

- Described the tundra which he said was changing and this information came from a variety of sources, among them remote sensing analyses which was suggesting that the boreal forest was browning in northern Canada and Alaska. Noted that throughout the Arctic the Arctic tundra was greening, it was increasing in stature and canopy density and he added species composition.

- Stated that scientists know the systems are changing but what many people did not understand is that the Arctic is patchy, a mosaic of different systems. Noted there were systems on the north slope of Alaska which consist of deciduous shrubs, grasses and sedges, mixes of low shrubs such evergreens with a lot of lichen as well as moist tussock tundra, the most common type of vegetation.

- Commented that the productivity of the kinds of systems was highly variable and there was a three order of magnitude variation among patches of kinds of systems in Arctic tundras. Explained that one way to begin to think about the process of developing a model of carbon balance in the systems without modeling every inch of ground would be to look for relationships that would help to simplify the problem. Stated that he had started looking up to 20 years ago at old international biological program data and found that there was a somewhat consistent relationship between production and biomass among the old sites. Said that when they looked at data from Toolik Lake where they had measured production and biomass by harvesting over 20 years they found that they had a regular relationship between production and biomass. Found that year to year variation fell upon a straight line and when you added the results of their harvest of fertilized plots it appeared that fertilizing the systems made them more productive with the relationship between production and biomass the same.

- Described work concerning plant canopies which were similar to each other in the relationship between LAI (Leaf Area Index) per square meter of leaf and per square meter of ground and the amount of nitrogen in the canopy. Noted that they would be investigating the relationship further in the summer of 2012.

- Showed slides of researchers conducting research in canopy photosynthesis in Greenland which had similar vegetation to Toolik Lake. Commented on another group of researchers in Sweden. Stated they had spent four years travelling to different places making measurements of net ecosystem exchange of carbon in relation to light.

- Discussed the datasets for Alaska and in Abisko, Sweden for 70 plots at 32 site/vegetation combinations (1454 flux measurements in 125 light response curves). Explained the process of measuring light response curves.

- Discussed the curves and commented on how they analyze them. Stated there were two approaches: to think of the Arctic as a mosaic of patches with different properties; and the Arctic as a continuously varying system. Discussed the PIRT model which is a patch-based approach. Explained 'PIRT'- there are the four parameters in the model. Confirmed they ended with seven different parameter sets and were able to predict the Net Ecosystem Exchange (NEE) of all light response curves at the site. Commented on the problems of applying this to larger areas. They would need to know the number of patches for the whole tundra. Discussed the use of the same data with light curves and with a different type of analysis.

- Noted that there were similar results in Alaska with experimental plots showing the same relationships among photosynthesis, NDVI and leaf area as in Scandinavia except in fertilized plots.

- Commented on the NEE equation for cross-site modeling and discussed the data sets for several slides concerning data from Sweden and Alaska.

- Described the two different model types, patch models versus the continuous variation approach. Stated the following:
  - Patch models can be very accurate but require separate parameterization of each patch type.
  - Patch models are subject to additional errors of classification and within-patch variation.
  - Continuous variation model has about double the error of the patch model but requires only a single parameterization.
  - Continuous variation model parameterized with data from one part of the Arctic can be used to predict CO_2 fluxes in other parts of the Arctic.
  - For a continuous variation model the patch size is the same as the scale of measurements on which predictions are based.
- Stated that 80% of the variation in net CO_2, flux (NEE) for a wide range of low Arctic ecosystems can be explained knowing only leaf area, air temperature and light. Noted that species/functional type composition did not seem to matter and composition changed dramatically and often along climatic gradients but NEE changed smoothly with leaf area. Stated that the success of the continuous model would indicate a high level of convergence in canopy structure and function among diverse tundras.
- Stated that that was one view of how carbon balance of northern systems was controlled. Discussed another view and stated that in 2007 there was a wildfire 25 miles north of Toolik Lake. Stated that until 2007 they did not think about fires in Alaska. Noted there were lightning storms in the mountains but this was not the case 20 miles out of the mountains at Toolik Lake. Stated since 2000 they noted there had been a dramatic increase in lightning strikes on the North Slope. Acknowledged that some might have been due to improved reporting but it was undeniable. Stated in 2007 was the summer of the great sea ice melt and it was a dry summer. Showed a slide of the North Slope of Alaska, about the size of Minnesota which showed a fire.
- Discussed the fire which burned in July for several weeks and then started burning again in September even as the weather was cooling and lakes were freezing. Noted that a researcher came and cored the lake and found no charcoal all the way to the bottom of the core, only at the top. Stated that there were no fires in the area for 5,000 years. Showed several slides of the areas burned by the fire, some of it with variable burns and a high-center polygon where all organic matter was lost. Described some of their measurements of early regrowth of vegetation in the burned areas. Found that the soil carried the fire. Discussed the nature of the burn using two studies by Boelman et al of 2010 and Jones et al. of 2009.
- Discussed the amount of carbon lost in the burning and compared the combustion losses in relation to the NEE of the Kuparuk River Watershed studied in the late 1990s. Noted it was a lot of carbon

coming out of a small area and he considered it an event of regional significance in the carbon balance of the Arctic.

- Described how a researcher went into the area and set up flux towers in three areas, unburned, moderate and severe. Reviewed slides of his results concerning growth and burn severity and the NEE of CO_2, or daily cycle of loss of carbon.
- Showed and discussed a slide showing cumulative carbon exchange through the summer of 2008 for the burn site.
- Reviewed a summary of data from the first two years after the fire and considered both the facts and data as to whether it was an event of regional significance. Commented on the results of the data and interpreted what the results meant.
- Stated that the changes had continued in NEE for the burned tundra for three years, 2009 to 2011 and reviewed the graphs.
- Showed slides showing the recovery and comparing burn area in June 2008 and in July 2011 showing many species of plants re-growing.
- Discussed the interactions with permafrost which might override direct impacts of fire on carbon cycling. Showed slides and discussed the active layer displacements on the burn site and a retrogressive thaw slump. Showed a short movie illustrating what was happening when the permafrost would thaw. Noted that the burn site showed the tundra sliding downhill as more heat was going into the ground. The movie showed the movement on an hourly basis during the course of the summer. Stated that from what was shown it appeared to be a hot spot of carbon cycling or of changing carbon cycling.
- Stated that if they have more fires and thermokarsts on burn sites that would be where change would take place. Stated that the changes in response to warming were small by comparison. Added that these disturbances would be where the real changes would occur in the future.

COMMITTEE DISCUSSION

A member asked if they had tried to separate the surface/plant resurface respiration from root respiration and microbial respiration for CO_2. Dr. Shaver responded no, but maybe in the summer of 2012 they would do it if they had time. He said that he had tried to do that during his first summer in 1972 as a graduate student and added it was tedious. He added he had tried plucking roots out and measuring respiration but added they did not have a good data set on root versus non-root respiration.

A member commented on the recovery of the severe burn sites with respect to NEE and both the moderately and the severe and having a higher NEE after a couple of years. He said that was likely because of increased nitrogen availability and went into greater detail regarding the results. Dr. Shaver

responded that the soils were warmer, more deeply thawed and the nitrogen mineralization was higher. He noted that a researcher had resin bags out there and was getting more nitrate and ammonium in the soil. He added that nitrogen availability was higher and the turnover of organic matter in the soil was higher and he added the soils were better drained.

A member commented on the plant communities in the burn area and asked if that was a series of mosaics? He also asked if it came back as mosaics or did invader species come in and if he could speak more about the communities. Dr. Shaver showed the slide again showing the new growth in July 2011 and noted that 63% of the area looked like that and said it was big patches and was one reason why they were able to set up flux towers in the area. The member noted that after the fire, after the plant communities started to come back. He asked was the cotton grass an invader species or was it there before the fire. Dr. Shaver responded that the cotton grass tussocks appeared to be the only plants remaining alive. He said they lost 7 centimeters of ground on average and of that it would be the seed bank of all the other plants and most of the rhizomes of all of the other species. He added the species that had rhizomes buried deeply enough would be able to regenerate. He said most of the lichens and mosses were gone, even though sphagnum was known for surviving but it was burned.

Dr. Robertson asked how many years of carbon accumulation had disappeared in the fire. Dr. Shaver responded that the number calculated was about 30 years. He added it was 2 kilograms. He said the calculation showed about 500 years of nitrogen.

Dr. Stacey referred to the seven centimeters of soil and asked was that because it burned or was it due to some subsidence. Dr. Shaver responded that it had burned. He asked if there were any legumes that would have come in that might contribute to the nitrogen balance. Dr. Shaver responded that there were legumes in the system, a variety of species but most of them would be more common in the river gravel beds. He added that the fire itself had burned between two river beds.

BREAK

The Biological and Environmental Research Advisory Committee recessed for a break.

BERAC CHARGE DISCUSSION: TECHNOLOGY IMPLEMENTATION FOR LONG TERM VISION

Dr. Stacey opened the discussion by stating that they would be commenting on the report which had also been discussed at previous BERAC meetings. He advised the committee members that they were an award-winning group for the creation of reports. He stated that he had received a certificate attesting to the fact that they were an award-winning group from the Society for Technical Communication for "Distinguished Technical Communication" for the Grand Challenges Report.

Dr. Stacey referred members their packets and he thanked the sub-committee who had spent considerable time on the document. He stated he did have his own ideas but wanted to open it up for

discussion as to what members thought about the document as it stood and what changes, if any, needed to be made.

Dr. Hubbard stated that she liked the way it was being developed so far. She thought one thing that they could do was to start prioritizing some of the things that they would need to highlight as she thought there was currently a lot there. She noted that they could consider a structure and she said they had talked previously about the Grand Challenges and several pillars holding it up. She said now in the current version they also had coordination of facilities, maybe coordination of some synthesis centers. She said perhaps they could consider several structures and walk through them, so take an example in bioenergy or climate. She noted she had a few smaller comments, one under the vertically integrated field lab plus ARM 2.0 and asked if they could be combined into one. She thought that might strengthen the message coming through in many other parts about the need to have different components of the system talk. Dr. Stacey referred members to the Executive Summary and she commented her last comments referred to page six through eight.

A member remarked that he had a thought on similar lines during the presentations. He said looking at Dr. Geernaert's presentation where he separated NGEE and ARM modeling under interdisciplinary science projects. He suggested there might be some ties there concerning the whole hydrologic cycle and the impact it might be regional. He also commented and asked was ARM making measurements at the level that could be integrated with water fluxes from the surface.

A member said that the section on ARM 2.0 was interesting and he said he did not have any problem with the content but he thought it was important for it to be run by the ARM leadership. He added that he had done some checking and that did not seem to have happened. He said that as a professional courtesy they were making comments but he thought the leadership should have a chance to comment.

Dr. Stacey asked Dr. Weatherwax if she wanted it to be independent of her staff or be done in conjunction with her staff or alternatively, did she want her staff to have input. Dr. Weatherwax responded that the draft was fairly far along in terms of ideas but in terms of specific facts she suggested that if they needed that kind of information from the programs then she thought that if it was a straightforward question or something more detailed then it was fine to communicate with the program. The member said that he was not referring to DOE ARM staff. He said it would include people on the science team leadership. He added it was not a question of them advising BERAC what to say but more a formality of running it by them.

The member made another point directing them to page 10 of the report, under Climate Modeling. He said there were several places where he thought the discussion was unclear. He noted the first was minor and referred to under: "Climate Modeling Efforts Over the Next Five Years" should include and the first bullet says, "decreasing the resolution" and that would not be what was intended, it meant increasing the resolution. The second bullet: "exploration of different configurations for the atmospheric core including a multi-phased formulation and stochastic? formulations". He said that he did not know what those words meant. He suggested did multi-phased mean to say multi-scale and if so, that could

mean many different things. He thought the content confusing and he noted the term ”stochastic” as problematic as scientists talk about stochastic physics but this content is about the atmospheric core. He asked if this could be clarified. He noted his last point, in the paragraph just above, the last sentences says: “Because these models are increasingly being used to support decision-making in a regulatory environment it is essential that they are fully documented and include a comprehensive uncertainty analysis”. He said he had no objection to the idea of uncertainty analysis but he wondered about the word ‘fully’ in the sentence and said that it would be difficult to get a consensus among the members that the sentence, as is, belonged in the document.

He asked what the process was, were the members suggesting edits to the document. He asked who decided on the content of the final version. Dr. Stacey responded that that kind of decision-making he was asking about had not yet come up. He said he had been an arbiter but the document had gone to the subcommittee and if he made any edits they would have to be approved by the subcommittee. Dr. Stacey said perhaps the best way for members to make revisions would be to not give abstract ideas but make concrete suggestions for revised language.

Dr. Stacey said whatever revisions are sent to him would be incorporated into the next draft and then it would go to the subcommittee. He noted that BERAC would have the final say. He said that after the discussion on the second day of the meeting they would then have to talk about the logistics of moving forward as it had to be approved no later than the next meeting and passed it on to Dr. Brinkman.

A member commented about the Executive Summary which she thought was the most impactful. She said that she found it unclear as to what they were recommending. She said she did not know what functionally would be required or what BERAC was asking for. She continued were they asking for something that required bricks and mortar or software. She referred to the first paragraph in the Executive Summary under “Network of Integrated Field Observatories”. She continued in the fourth line, “best applied as a single experimental site” and then “depending on scientific focus these observatories may represent specific locations or an affiliation of virtual laboratories”. She thought some of this was mixed messages. Dr. Stacey responded and said he agreed and he thought it got back to Dr. Hubbard’s comments about priorities. He said that he should defend the subcommittee as he had written the entire Executive Summary and it had not been approved by anyone before the discussion today. He added that some of the areas unclear in the summary reflected a lack of clarity in the document itself.

A member indicated that he was new but was not familiar with the DOE. He said that when he read it he was impressed that the people who wrote it were aware of issues he considered important. He thought the document showed the expanse of knowledge in BERAC. He thought what was not clear what the priorities were. He thought that the ideas were interesting but it was not different from what the larger research community was already talking about, in other words, it was not new. He continued it was not a criticism but he wondered what the aim was, was it to find something unique or show that BERAC was up to speed on research in the field. He thought if the aim was to show something new then that had not been accomplished in the document. Dr. Stacey responded by saying that what the charge was, was

to look at the technological and tool needs for BER science going forward ten years. He added the hope was that they would come up with something novel that would push the science to a new paradigm. He said his own view of the document right now was that it made a good case for stating the issues and the importance of pointing out where the grand challenges lie but he acknowledged there were no specifics there and he sensed that Dr. Brinkman was looking for those specifics. The importance of reflecting the strengths of the DOE was also discussed.

A member suggested that they look at the Grand Challenges Report and take that as a starting point and use some of the important features that had come out of that report.

Dr. Joachimiak said that he agreed that they had to look at it as a process as it was reflecting a long-term vision and the tools and facilities are supposed to map into the vision. He said it would be hard to know the type of science they would be doing in 20 years but they would have to build it on a DOE and BER strengths. He thought what it might be missing was some specific examples that they would be able to address in five to ten years.

Dr. Wildung noted he agreed with what had been said. He said he wanted to point out that there was a Grand Challenges Report and that document laid out many of the highlighted items that were important that needed to be featured in the report. He also pointed out that it was a somewhat mundane charge from the DOE. He detailed the charge and said some of those themes were assumed to be part of the report.

Dr. Stacey said he was struck by a comment made by Dr. Brinkman about the Grand Challenges Report and that was that he thought it was a very good report but he wasn't clear what the actionable items were. Dr. Stacey added that for an administrator you had to be able to turn them into action in some way and he thought that that was what he was asking for, the BERAC members to take the technology and tool development part of the Grand Challenges Report and give him actionable items.

Dr. Stacey noted that what came up in the conference calls and what they recognized as a weakness in the report was already brought up in the discussion was the aspect of the BER-supported user facilities which he felt should be integrated into the document. He asked some of the members for their ideas as to how the user facilities should be brought into the document.

A member noted that they had the Integrated Field Research Sites and he felt like they could be used as building blocks for further integration and added that there was a substantial amount of data collection going on already.

A member noted there was a suggestion for an annotation facility component which she mentioned had come out of the JGI meeting. She added that they felt that annotation of genes or open reading frames and potential proteins was lacking. She thought a concerted effort in that area was a way that they might be able to bring in EMSL and the JGI as active participants. She suggested that they not omit structural data in the annotation effort.

A member noted that he attended a Kbase meeting and said there were more than 13 million models now for proteins. He added that there was an effort going on at NIH trying to generate models basically for all the proteins. He noted that some of that type of information was useful for predicting function and he thought it could be coordinated with NIH. On another matter he said that DOE was investing substantial funding amounting to 2 billion into several new resources that would be operational in 5 to 10 years the new laser facility at Stanford that was being upgraded and another was the NSLS (National Synchrotron Light Source) coming up online in 2017. He felt that the document might not be taking advantage of these new resources.

Dr. Hubbard noted that in the imaging and sensing section there were a lot of individual components or facilities called out. She wondered how they would go about deciding which to pull forward. She noted that there was some overlap between the cyber-infrastructure knowledge discovery and the modeling sections.

Dr. Stacey said Dr. Randall had reminded him that it was not just BERAC members that could contribute to the report but they could also reach out to the leadership of ARM and other groups for their comments. He noted that the whole process had begun with that process and that perhaps it was time to go back and give further comments on the document including their own priorities. He added this could also be done to some of the main people in the sub-disciplines.

Dr. Stacey said there had been some good suggestions but not enough to impact the document and he felt it was time to reach out. He suggested that perhaps the group itself was not suited to be able to write a document with a high degree of specificity of what would be needed with respect to tools, technology and infrastructure in the future.

A member stated that they had identified the areas but they might need more clarity on what those investments would innovate.

Dr. Stacey said Dr. Brinkman would like to know what would the next step after receiving the report. The framework was already provided by the OS. He said Dr. Brinkman would ask what action should be taken next.

Dr. Weatherwax noted that some of the ideas in the document were actionable and they were able to use the ideas at times when opportunities presented themselves and sometimes in long-term planning. Dr. Stacey thought the more specific the recommendation the better rather than a vague reference that would be interpreted differently by other people.

A member said that there had been a revolution in new instrumentation in the last 5 years that was not considered when ARM was first planned. He said there was a whole new generation of proton transfer mass reaction sensors for example that measured a whole suite of hydrocarbons needed to understand aerosols. Dr. Stacey said that was a good example because one of the things they were looking at was how do we re-equip or better equip the user facilities for the kinds of research the community would

like to do in 10 years. He said if new instrumentation of that type would have a big enough user base out there that he felt that was the kind of thing they should recommend.

A member noted that it appeared to him that the committee was struggling with finding an appropriate level to pitch it. He thought that the 30,000-foot view was provided by the strategic plan. He said what they were trying to get today was not the 5-foot view which would be the specific instruments but the 5,000-foot view, the more intermediate level which would provide more actionable potentials. He thought that they should pull out of the report specific recommendations that they could put in an executive summary and then list a series of steps.

PUBLIC COMMENT

Dr. Douglas Ray, Pacific Northwest National Laboratory

- Noted his comments related to the last report. Stated he hoped they were aware that in the computing area of the OS that there were a number of workshops and reports concerning opportunities at exascale for computing and biology and climate science. Noted as they were considering the tools to go forward he recommended that they look at those areas.
- Stated that he attended about 5 years ago an EMSL workshop about instrumentation needs they had going forward. Explained how they set it up might be of interest to BERAC. Advised that they organized it around the three science themes that EMSL had in place and brought in scientists in those areas and instead of identifying specific instruments what several of the speakers did was they explained what they needed to do although they did not know how to do it. Stated that that can inspire people in the community who build instruments to come up with the solution. Noted that might be an approach, put the challenges out there as opposed to being limited to what already exists and that you can buy.

ADJOURNMENT

The Biological and Environment Research Advisory Committee adjourned for the day at 5:00 p.m. The Committee will reconvene tomorrow, Thursday, June 7, 2012 at 8:30 a.m.

THURSDAY, JUNE 7, 2012

Dr. Randall introduced Dr. Brian Soden and he provided details on his educational and professional background. He said he was a remote sensor, a radio transfer person and also a climate dynamacist discussed some of his publications and academic papers.

SCIENCE TALK – DIAGNOSING AND EVALUATING CLIMATE FEEDBACKS IN CMIP-5 MODELS

Dr. Brian Soden, *Professor and Associate Dean, University of Miami, Rosenstiel School for Marine and Atmospheric Science*

- Thanked the members of BERAC for the opportunity to speak to their committee.
- Stated he would be discussing climate feedbacks within the CMIP5 models and noted that CMIP stood for (Coupled Model Intercomparison Project) and explained that it represented an archive of climate models from around the world used to assess uncertainties in climate change and projections for future climate change. Stated that they were coordinated to support the IPCC.
- Acknowledged some of the scientists working in his group and he mentioned Eui-Sook Chung who had completed much of the analysis of the CMIP5 models.
- Outlined his presentation which would cover: motivation; methodology – radiative kernels; climate feedbacks in CMIP5 models; and radiative forcings in CMIP5 models.
- Discussed motivation:
    - He discussed the first chart of global mean surface temperature and noted if this was looked at in different models and said that what was plotted in the graph were the global mean temperatures for a variety of climate models from all around the world. He explained that they had increased CO2 for the first century and then it would be held constant. He said it showed a warming and then a stabilizing. He said there was a spread from about 2 degrees Centigrade to 4 degrees Centigrade in terms of how much a model projects the warming for the same increase in CO2. He said that you could break down the response into the amount of the warming due to directly the CO2 itself and the amount due to feedback processes and he elaborated on the different variations and causes.
    - He reviewed the IPCC assessments and noted that there were two feedback processes, the water vapor feedback process and the cloud feedback process. He provided a chart that gave a timeline of how the IPCC viewed these feedbacks starting from 1990 to 2007. He reviewed all the assessments and described ongoing progress shown for both of the processes at each time period.
    - He showed several charts illustrating differences between water vapor feedback and cloud feedback. He showed a slide that showed maps illustrating the relationship between water vapor, ocean temperature and the greenhouse effect.
- Discussed methodology: “Radiative Kernels”:

- He noted that it was difficult to make progress on the understanding of cloud feedback. He said it was also cumbersome to calculate what the feedbacks were in different models. He said many researchers because of the difficulties would take a variety of shortcuts to facilitate that and that would lead to inconsistent methodologies and would be problematic in comparing one model to another. He said to alleviate that a method was developed called "Radiative Kernels" and they would: a. quantify the partial radiative response that would result from changes in each feedback variable; and b. secondly this would allow for a consistent intermodal comparison.
- He reviewed an example of the Kernel Method illustrated by an equation.
- He explained diagrams concerning water vapor feedback kernels.
- He reviewed regional maps showing temperature and water vapor feedbacks.
- He showed a graph illustrating climate feedbacks in IPCC AR (Assessment Report) 4 models. He said they wanted to calculate the strengths of feedbacks in different models using a consistent methodology and compare them to what had been reported in literature previously. He said the graph showed values of feedback strengths for different feedback processes. He reviewed the graph data.
- He showed a graph showing climate feedbacks in IPCC AR5 Models to compare with different scenarios
- He showed a slide illustrating the vertical distribution of cloud feedbacks: AR4 and AR5 and discussed the variations.
- He showed slides concerning cloud types in particular regions and how they affect cloud feedback using AR4 and AR5.
- He discussed intermodel spreads with differing resolutions in cloud feedbacks with AR5.
- He discussed a graph illustrating climate feedbacks in IPCC AR5 Models with the historical scenario using two methods, the differencing method and the regression method.

- Summarized and explained the remaining challenges:
  - Feedbacks in AR5 (CMIP5) models are very similar to those simulated in AR4 (CMIP3) era models…but still no answer for why low cloud feedback is positive.
  - No evidence for the indirect forcing of clouds by CO2 but there is for aerosols?
  - Equatorial Pacific convective clouds and low marine subtropical clouds are biggest contributors to spread…may depend on climatology/resolution of model?

COMMITTEE DISCUSSION

A member referred to the summary slide and to the statement that it was unclear as to why there was low positive cloud feedback. He noted that during the talk that he had shown that the high cloud feedback was consistently positive with relatively no disagreement. He asked if he could comment on why that would happen. Dr. Soden responded that there was a hypothesis out there called the fixed-amble temperature hypothesis which stated that clouds respond to a change of climate in such a way that the temperature at the tops of clouds remained constant. He elaborated for an increase in CO2 the atmosphere would warm which would lead to an increase in the outgoing emission to space but as clouds shifted up so their emission temperature would remain constant. He added there was some analysis showing that models all showed a consistent fixed-amble temperature response. He said that would explain why there was such consistency across models for high clouds.

A member noted that it was interesting to see how the model comparisons had led to increased clarity in how the feedbacks were contributing to responses in temperature. He asked if he was seeing similar sorts of clarity brought to the precipitation issue or what were the models under comparison saying about the precipitation differences. Dr. Soden responded that when he thought about precipitation response he thought about two things, the fact that global mean precipitation increases and with that increase in global mean precipitation you would get an increase in precipitation extremes. He said both of those results were robust and consistent across models. He said the bigger issue within the community was that a 3% increase per degree warming right. He wondered if it was consistent with observations and he said there was some observation evidence to suggest that precipitation had increased more rapidly than 3%.

REPORT ON DOE-USDA PLANT FEEDSTOCK GENOMICS FOR BIOENERGY PROGRAM

Dr. Cathy Ronning, *BER*

- Thanked the committee for the opportunity of presenting information about the program.
- Advised that the co-speaker Dr. Ed Kaleikau would be unable to present and sent his regrets.
- Provided some background and information on the program:
  - The program began in 2006 as a joint competitive grants program between the DOE-BER and the USDA (United States Department of Agriculture) and National Institute of Food and Agriculture (NIFA). The program originated from discussions between the DOE that had genome sequencing and analysis capabilities in its programs and the USDA that had as part of its programs research in crop development. Both parties realized that they could develop a program that was complementary and synergistic.
  - The goal of the program is: “Genomics-based research leading to improved use of biomass and plant feedstocks for the production of fuels such as ethanol or renewable chemical feedstocks”. Under the umbrella of the goal some of the areas of interest are:

- Improving biomass characteristics, biomass yield or sustainability, water and nitrogen use efficiency.
- Understanding carbon partitioning and nutrient cycling in feedstocks.
- Enhancing fundamental knowledge of structure, function and organization of feedstock plant genomes.
- Enabling plants to be efficiently bred or manipulated for such use.

- Some of the topics over the past several years for the program are: regulation of gene networks, proteins and metabolites; comparative genomics; systems biology; and integration of genomics with more traditional approaches.

- Discussed how the program scope had evolved:
  - During the 2006 to 2007 the focus was on regulatory mechanisms: lignocellulose, cell wall manipulation; genetic markers; genome organization; and model plants. She noted that some of the projects funded included marker development for maize, lignin biosysnthesis and cell wall profiling among others. She added that essentially they were looking at specific pathways in genes relevant to bioenergy production.
  - In 2008 the program looked at sustainability and environmental issues and some of the projects funded in 2008 included the development of computation resources for grasses and others. It also included looking at an epigenomic project in poplar and the development of additional genetic and genomic tools.
  - In 2009 and 2010 the program turned to a more systems approach, more whole plant and moving away from specific genes and pathways and looking at a more whole plant like rhizome-sphere-type projects. The work also included regulatory networks and some of the projects funded included nitrogen use efficiency and sorghum root architecture, sodium and water use in poplar and winter survival in switchgrass.
  - In 2011 and 2012 the work focus changed. She stated that one of the bottlenecks toward developing feedstocks is in phenotyping the traits which cannot be seen such as cell walls. They looked at methods for phenotyping traits and getting more translation of the genomics information to developing real croplands. She stated they were interested in projects using phenomics or (genotype-to-phenotype).
- Discussed the project management and noted that the program was dynamic not static and evolved along with the science. Noted it was managed between the USDA-NIFA and DOE-BER and was competitive and peer-reviewed. Added that they had annual PI meetings either in Washington or at the Plant and Animal Genome Conference (PAG) in San Diego. Noted two years earlier following the PI meeting they had a workshop to develop/look at Kbase and plant needs.
- Discussed several of the plants and crops that had been funded over the past few years which included: Brachypodium, model crops, rice and promising biofuel crops such as poplar and switchgrass. Added that they had looked at different processes and resources such as: small RNAs;

micro RNAs; plant-microbe interactions; biosynthetic pathways in the cell wall; and database development.

- Noted that they had funding projects across the United States and showed a slide reflecting the geographic diversity of their portfolio. Added that they understood that when developing crops, regionality would be an important consideration.
- Discussed the allocations by crop and with a pie chart slide showed the crops broken down by dollars and reflecting a percentage of the portfolio. Noted that populous, brachypodium, sorghum and switchgrass received the most funding. The balance was made up of a variety of crops.
- Discussed the funding allocations by research area.
- Noted that the group had been prolific in publishing and showed a wide range in subject matter, varying from areas such as crop science to theory and applied genetics. Added that articles were published in journals such as PNAS and in magazines like Science and Nature.
- Discussed some of the highlights of their research work:
  - She discussed the model plant Brachypodium and research work done by John Vogel at the USDA-ARS in Albany, California. She said he was funded to look at Brachypodium which is a model for bioenergy grasses. She added that phenotyping was sometimes problematic in developing crops for bioenergy so his project was working with the Australian Plant Phenomics Facility. She discussed the facility, tools and some of the research.
  - She discussed the identification of an important component of the Sorghum Lignin Biosynthetic Pathway. She added that there was a gene called brown midrib (bmr6) known to be associated with low lignin and is easily deconstructed with a visible phenotype. She said this research was being conducted by Wilfred Vermerris at the University of Florida. She said they were able to identify of the gene as a cinnamyl alcohol dehydrogenase (CAD), a major gene in the lignin biosynthetic pathway.
  - She discussed the work of Andrew Paterson at the University of Georgia who had developed genetic maps of Miscanthus sinensis and M. Sacchariflorus, the two progenitors of Miscanthus x giganteus or the candidate biofuel crop. She discussed some of the challenges of this research.
  - She discussed the work of Markus Pauly at the University of California at Berkeley with the discovery of Corngrass1 (Cg1) which was discovered in maize. She explained that Corngrass1 keeps the maize plant in a juvenile state and therefore accumulates more biomass. She stated they were able to transform switchgrass with Cg1. She stated it was important because they had been able to transfer the trait from a model crop to a potential bioenergy crop.
  - She discussed a USDA-funded project to Rex Bernardo at the University of Minnesota and he was looking at corn for both food and fuel. She added that they were not funding corn as a biofuel feedstock but if they could use corn for both food and fuel that was the goal of the project. She added that they wanted to investigate what type of breeding program would be most efficient if they want to breed corn for both. They found many QTLs (Quantitative trait loci) correlated with traits such as grain yield, lignin, glucose concentration, and glucose release. She noted that it meant rather than trying to pyramid genes to increase yield in biomass they

would be better off doing a marker-assisted recurrent selection type original wide selection approach.

- She discussed the work of Steven Strauss at Oregon State University in which he was looking at epigenetic modifications and gene expression in Populus. She noted the objective was to investigate variation in genome-level cytosine methylation in poplar. He mapped to reference the genome and compared gene expression of methylated and unmethylated genes among tissues. He found that when he looked at tissues there was a differential presence of methylated DNA between tissues in the different stages of growth.

- Discussed database resources for bioenergy feedstocks and noted that there was not much available. Noted two examples of database resources: the Soybean KnowledgeBase developed by Dr. Stacy's laboratory and the Biofuel Feedstock Genomics Resource (BFGR) – Genome Website developed by Robin Buell's group at Michigan State University.
- Stated that the "Foxtail millet genome sequence: a collaboration with JGI, BESC, JBEI" which was just published in Nature Biotechnology. Stated that foxtail millet is an up and coming model plant for feedstocks such as switchgrass.
- Stated that in 2011 ten projects were funded in switchgass, Populus, sorghum, Brachypodium, Miscanthus and energy cane. Added that in 2012, proposals due February 24, 2012 are still under review. Added that she was pleased with the selections and they complemented the portfolio and add new and innovative technologies.

COMMITTEE DISCUSSION

Dr. Stacy asked if she knew what the theme would be for the next RFP coming out. Dr. Ronning responded that she had a few ideas but it was not yet decided.

A member asked if she had funded more theoretical-type work conducive with experiment. She noted she was trying to use what was known about QTLs and also with sequencing and systems biology or trying to leverage the strengths on different methods to go about breeding. Dr. Ronning asked for clarification. The member explained that there were QTLs and the traditional breeding using markers but now more knowledge was being uncovered on sequencing regions so she continued, trying to leverage all the work that had been done with QTLs and breeding with more of the systems biology-type efforts. Dr. Ronning said some of the more recent projects had started to look at that. She added that that was part of the focus trying to translate genomics information to breeding and that would include taking the systems approach.

A member referred to the work being done in the rhizome-sphere area. He asked what the net impact was and how much of the work was going on and was it starting to come out with new findings. Dr. Ronning responded that they had two projects that occurred to her right away involving rhizome-sphere and she provided the locations of work being done.

A member noted that about three quarters of the proposals were being funded by DOE and one quarter by USDA. He asked if that was an anomaly for the past year due to NIFA being pushed to a joint 2012/2013 competed for in the fall. Dr. Ronning responded that that had been the case for the last three years. She stated it had been about $2 million, three quarter/one quarter. She said she could not speak to their funding structure. The member noted that they seemed committed to it. Dr. Ronning confirmed that they were committed to it.

BREAK

The Biological and Environmental Research Committee recessed for a break.

BERAC CHARGE DISCUSSION - CONTINUATION

Dr. Stacey confirmed that the committee members would not be continuing with the discussion of the document in view of the many proposed changes discussed the previous day. He also referred to the homework assignment given members of coming up with a priority list or recommendation list. He suggested that they could begin with that to generate some discussion.

Dr. Joachimiak referred to his comments the day before and noted that he had looked back at the strategic document which he thought was a good document discussing tools and facilities. He thought in the current document they were working on that they should try to address some of the questions and determine some of the solutions and facilities. He said he was concerned about the proteomic structure of biology and he said they had posted questions. He noted that as they increased the number of sequences the annotations of these genes was lagging significantly so 40% to 50% of genes discovered through sequencing and they had no functional annotation. He noted that this problem would only increase as they doubled the number of sequences every 12 to 18 months. He said they were not capable of revealing the functions of the plotting just through sequence. He agreed they could not do all but one of the facilities that they could propose in the tools and facilities document was a proteomic facility. He thought it might be a good idea to come out with a diagram for the tools and facilities document. He acknowledged that they had existing facilities but he thought if they wanted to create new approaches they might need to create new facilities. He said they needed to be able to do things in high throughput, in parallel, and needed to be able to address difficult problems. He said he would be willing to prepare additional sections for the document. Dr. Stacey asked him to please do so.

Dr. Hubbard stated that her priority was basically a virtual facility that would include two of the big components that were in the document. She stated that one was data to knowledge and ideally to the multi-scale, multi-physics models paired with the frontier vertically integrated field facilities. She stated that to her their Grand Challenges document included a message that we have a serious amount of complexity and multi-scale data and processes and that the biggest obstacle was that they did not have a way to take advantage of it for process understanding and prediction. She thought this would take advantage of what they did have in BER, great datasets. ARM, AmeriFlux, climate subsurface, Kbase but

she said there is no way for them to speak to each other to do synthesis or analysis across scales, across processes.

Dr. Robertson recommended that they establish an Advanced Verticially Integrated Field Laboratory (AVIFL) as a frontier facility. He thought that if they recommended this they would also be able to qualify the recommendation with suggestions for workshops designed to prioritize specific questions, as well as locations and instrumentation that would be uniquely suited to BER's Grand Challenges priorities and BER's instrumentation and modeling capabilities. He thought it was important to be careful with the recommendation, to not recommend something that was already in force or in planning. He thought there was the potential of some overlap with NEON (National Ecological Observatory Network) but he thought it might be primarily the concept of NEON that it overlapped with, not as NEON was being built out. He noted that NEON is narrower than originally envisioned and he thought the reason was that it had to be disbursed over 20 locations, which diluted what could be done at individual locations. He thought that if they took a converse approach and established only one or two of these to concentrate all of the power of analytical capacities, it would have a complementary and promising approach to mroe comprehensively integrating from bedrock to atmosphere. He said a second recommendation would be a specific instrumentation recommendation and he noted he would like to see the development of trace gas sensors that could be distributed across a landscape and provide spatial and temporal coverage now achieved with difficulty.

A member noted she was new to the committee. She said she wasn't sure how much chemistry would get into the mix but one of the strengths she had seen for the DOE is having the genomics and annotation but also what has come out of the DOE has been the genome-wide and cyclical models where you could take the genome and translate it into a stoichiometric metabolic model which would give help to a phenotype. She considered it a big leap from genotype to phenotype but she said what was missing was a way to get functional annotation. She thought because the DOE had a history of experimental expertise she thought it was important to go after the difficult annotation, in other words get annotations back that say we have a, b, and c, transporters among others. She thought Kbase was a natural route for the data to be stored. She said people were not being trained in biochemistry or biology to do that type of work as they were more interested in molecular biology.

Dr. Stacey said if they were doing genome annotation it would have to start with the computational piece but then you would be left with this 40% to 50% unknowns. He said both speakers had suggested that they should develop an enzyme expression facility so they could then analyze and he said there was discussion at a recent JGI meeting in which he presented work where they had started with a computational approach and then gone down to a funnel to identify candidates and then finally purified the protein and identified the enzyme. He said they had had a grant for three years. He mentioned that Eddie Rubin had asked him how many proteins he had put through the funnel and the reply was one. He said the incident was not related to criticize the work but it was an example of how difficult the work was. He said if he had a certain amount of funding and wanted to optimize his ability to annotate genes he would put it into a mutagenesis project. He explained the process and noted that he thought that

was a more rapid approach to some information about the function of an unknown gene than to purify the protein and make guesses about what the enzyme function would be.

A member said he could give some feedback along the lines mentioned the day before by Dr. Randall about the climate modeling section in the document. He said he had a question for Dr. Weatherwax and that was in relation to the section dealing with cyber-infrastructure in the knowledge/discovery. He stated they would have to rely upon the ASCR (Advanced Scientific Computing Research) program to some extent. He asked if there was some balance of what BER would do in terms of data storage and capability and cyber-infrastructure versus what ASCR did. Dr. Weatherwax responded that her understanding of ASCR and their priorities would be that they did not necessarily want to just provide data storage for BER. She said what they would have liked to provide was computing testbeds for BER's applications so if BER had something it needed to do and it required testing in a high performance computing setting, at a scale appropriate for any of their facilities, that would be where they would like to provide assistance.

She said once BER stabilized on that and decided it would no longer be a test situation for ASCR in terms of what do they tweak on the hardware or software end to have BER's applications run then she thought ASCR would prefer to then transition that responsibility over to BER. So to summarize at some point the computing would be developmental on both sides but once it stopped being developmental on the computing end then it would BER's responsibility to maintain. The member asked how that would work out for the large petabyte climate model data stored at the various computing centers. He said would the cost of that be expected to be borne by BER. Dr. Weatherwax responded she did not know how the cost structure would work out but she thought the cost of storage had come down. She thought ASCR and the scientific community in general wanted BER to think about what they actually needed to store. She said in some disciplines like biology you would store everything but for ASCR it was a combination of being able to store a great deal of data but then also have the ability to go in and retrieve and analyze it.

A member said that he agreed with Dr. Hubbard and thought that the most important actionable item that would have a big impact on research would be taking the datasets that are enormous and converting them into knowledge. He thought that there was substantial data out there in atmospheric science, observations, model output and other areas that was untapped. He thought that should be emphasized more directly. He said that he was thinking about specifics for the ARM 2.0 which he thought was currently vague in the document. He thought that it should be science-driven instead of technology-driven. He said that if you made the assumption that they were going to GCMs with four-kilometer resolutions you would need to think about what questions would be there. He thought that ARM 2.0 would have to resolve the dynamics or the vertical motion on scales of hundreds of meters and at the same time resolve the aerosol, the cloud properties and the precipitation properties. He thought that should be the goal.

A member noted he had a few suggestions and said he agreed with the earlier comment that it was important to not suggest things already being done. They also should be important and should be a

good fit for DOE. He suggested the idea of testing the climate models by doing weather prediction, short-range, 10-day weather prediction. He acknowledged it was not a new idea, that it had been around for some years, but he said despite all that it was not actually being done. He said part of the reason was that there was a need for additional resources and you would need more people and some different kinds of expertise to move in that direction as well as additional computing power. He said from a resource point of view DOE was more than capable of stepping into that. He said no one else was doing it and it was a good idea and therefore it was an opportunity for DOE to lead.

He said the two other comments were related to ARM. He said in connection with Dr. Soden's presentation he said that Dr. Soden had shown the importance of the low clouds, both strata-cumulus type and shallow cumulous clouds over the oceans as being the largest contributors to the uncertainty of cloud feedback. He said that ARM was about to start doing the Honolulu to California transects with a mobile facility and he considered that relevant but he thought that ARM had always made it a point to collect long-term datasets. He said he would see some value in finding a way to keep that going longer than just a year or two, perhaps ten years. He said a second similar suggestion would be to do something similar in the Arctic and he said he was thinking about the Arctic Ocean and tundra plus ARM was already located at Barrow. He said he had heard that there was some discussion of doing some measurements on the ice and he thought that would be important and specifically a long-term measurement program.

Dr. Zhang commented that he considered the charge and thought most of the members would agree that they had the categories of modeling, measurement, controlled experiment and data, the Kbase and he thought they needed to propose something new, important and doable for DOE. He said that he was going to suggest something new in terms of modeling. He proposed a virtual-use facility that would accelerate transforming ideas into models. He said right now the process was difficult in the community especially if one had ideas to improve the model and to make that happen it would take several years and you might not have the funding. He said the codes for climate models were so complex that the university could not really implement ideas quickly enough so he thought that in that area DOE had a very unique role to play, the virtual use of a facility that could help to accelerate knowledge and ideas into actual models. Dr. Stacey asked him for an example, to explain how it would work and Dr. Zhang elaborated.

A member said that he thought they should further emphasize the utility of the vertically integrated research field capabilities. He said that a graphic was passed on and that BER already had its origin in the subsurface science program but its molecular field to field scale research was a good graphic that they could use or modify to suit their purposes. He thought the concept of the vertically integrated facilities was critically important in bringing together the essential elements of microbial plant, microbial inter-relationships as they influenced things like biogeochemical cycling. He said that they had too little capability as currently existed to go into the post-genomic area of looking at how the communities of organisms and genes were network-connected and inter-connected, responded to subsidy stress

gradients, demonstrate resilience and could potentially be manipulated for the betterment of what they were trying to achieve.

A member noted that he agreed with many of the members with regard to the development of the advanced vertically-integrated field laboratories. He said there were several things that he would like to see as well. He said that there are major obstacles to experimentally understand the function of soil plant, microbial plant interactions. He said when he would say experimental he meant to get at the interactions to the communities at the cellular and physiological level, perhaps also the molecular level in a way that could be extrapolated to larger scales. He said that that would take you to the subject of modeling and simulation and he said that he believed it should be done at each phase of the experimental program. He also wanted to ask the members to consider how the vertically-integrated facilities could function in terms of the fluxes, measurement and modeling of the fluxes that occurred to the atmosphere and the impact that that might have on vapor content of the air above the land surface. He thought that would require a focused program project and said that you would follow the hydrologic cycle, examine the fluxes from the hydrologic cycle, examine the fluxes from the land surface in the hydrologic cycle and then have the ARM-type models, pick that up and use it in a way that would determine the influence on global warming.

A member said his general recommendation about the document was that someone who would know a lot about DOE should go through it and make the document more DOE-specific, highlight areas where DOE's contribution was particularly novel or important and where DOE's capabilities are particularly important. He thought other than that he said he would just like to strengthen those comments made about the attractiveness of the integrated field observatory concept. He thought it was something that environmental sciences had been advocating for 30 years. He thought they might want to consider not only having a network but have one landscape and study it intensively from the biochemical perspective to the atmospheric chemistry and physics perspective.

Dr. Baldocchi said that he thought they were at verge of a new revolution of the potential out-flux networks. He said that he was a flux individual because the state of the atmosphere was a function of the rate of transfer of mass and energy into the atmosphere. He said if they wanted to think big with DOE you would want to come to a stage where they wanted to be able to assess and predict fluxes and mass and energy everywhere and all the time. He said the fluxes were the bottom boundary condition of all the models and they needed to assess them well. He said they had a wonderful resource in DOE already that could be built on and this was the AmeriFlux network with over 15 years of data. He said that he felt they were at the stage where they should be considering the future of the flux networks and how could they evolve beyond carbon dioxide and water. He said they were experiencing a revolution of sensors and he elaborated. Dr. Stacey asked him to write a paragraph or so about AmeriFlux.

A member said that she thought the vertically-integrated site would be a very productive approach to cutting across scales and she said she was a fan of fluxes, metabolic fluxes in particular if one was looking at the budget of energy, carbon and water on a given area. She brought up annotation and said

that if they understood the enzymes and what they were capable of doing, what they would do in the environment and what communities they operated in and what relationships they had in the energy budget then they would have a better understanding in that vertical extrapolation.

Dr. Leung stated that many good ideas were already in the document. She said she had some suggestions about some areas in terms of how to organize the report to make the points clearer. She said in terms of observation she said that she thought of it as what they needed in order to improve their predictive capabilities. She said ultimately what they wanted for the research in terms of both biology or climate was predictive capabilities so she said the ideas about observation was how do they support better predictive capabilities in the future which would mostly be related to modeling. She said when she considered the type of modeling that they would be doing in the future it would be two different aspects, one would be multi-scale and the other would be integrated. She said with multi-scale they would need to go to high resolution but also model the multi-scale behavior of different types of systems including the water cycle. She commented that in terms of observation she asked if they had the capability to design and pool together the data and match data in order to support the multi-scale modeling. She emphasized also the second part, the integrative modeling and she described aspects of integrated modeling. She said she wanted to highlight these two ideas. She referred to cyber-infrastructure and noted that she saw a lot of challenge in terms of data volume and better models.

Dr. Michael Kuperberg, the program manager for AmeriFlux provided a short description of the program. He stated that Dr. Baldocchi was a founding father of the eddy-flux measurements and the AmeriFlux network and was one of the leaders of the international flux-net network of networks. He said the program had been around since the 1990s and flux measurements had been made since that time. He said the long-term data records provided the ecosystem community, the carbon cycle community and the modeling community with long-term data records. He said there were about 100 sites in the AmeriFllux network and it was an informal network of people that shared a common measurement technology and approach. He stated the sites are funded by the NSF and the DOE, the Forestry Service and others. The DOE made a decision several years ago that the long-term sites warranted consideration for a different mechanism of support as opposed to individual PI proposals. He said that a call went out to the national labs to continue to provide support for the community of different types including financial support to a set of sites across the United States that met three criteria. The sites would have long-term data records, robust data records and that were geographically representative. He stated that of the national labs LBNL won the competition and over the next few years would put in place a set of sub-contracts to 13 or 14 AmeriFlux sites around the country to provide long-term stable funding.

Dr. Stacey stated he had a wish list regarding the document and started from a plant point of view as it was his background. He said that with plants it was clear that with the genomic technology they had solved the genotyping issues. He said that the problem was that they did not have the phenotypes to match with that information so they had a wealth of genetic information but no way to correlate it with phenotype. He said there was therefore a huge need for being able to do phenotyping in a high

throughput mode. He said this was recognized by the NSF that had had a meeting on phenomics. He said for him phenomics was a problem of instrumentation as opposed to a biological problem. He said they were limited in the kinds of equipment that they had to do those kinds of measurements. He said he saw it as a problem of physics, chemistry and engineering. He said looking at all the federal agencies those three areas were in the DOE and he said he wanted to see an initiative focused on developing the instrumentation and he said an example would be mass spectrometers. He discussed the development of sensors by the national laboratories and having them turn into user facilities where they might be used for a high throughput phenotyping process for example. He discussed a diagram given to him by Dr. Joachimiak and this brought him to his second issue which was the need to integrate those kinds of capabilities. He said that they needed to be able to make multiple kinds of measurements and to be able to integrate those. He discussed multiple measurements as opposed to single measurement which he considered something of a waste of resources.

Dr. Stacey mentioned that Dr. Anne Summers at the University of Georgia and stated that she sent an email which raised the question of the importance of training new scientists. He noted she said that people must design, upgrade and use the instruments and national labs were short of qualified personnel from electricians to lab leaders as evidenced by the wait times for access to jobs. He noted that she thought the DOE should rethink the investment in and training of the next generation of scientists. He said that it referred back to the beginning of the meeting where they had discussed the Graduate Fellowships Program out of the OS. He expressed disappointment as to why Congress felt that the NSF and NIH would be proper agencies for fellowships but not DOE.

Dr. Stacey referred to members who had agreed to write sections and asked if they could please send them to him within a week or so. He said he would then prepare another draft and the subcommittee that was working on it would have another phone call and they would try to digest all the comments based on the new draft. He said subsequent to the conference call he would like to then go out to various people in the community and try to get feedback from them which would generate a later draft. He said they would probably need a subsequent BERAC conference call. He said he would like to go into the October meeting with a final or very near final document. He said any final comments from the BERAC committee would be addressed in the conference call. He said there might be minor corrections but he would like to vote and approve the document during the October meeting.

PUBLIC COMMENT

There was no public comment.

ADJOURNMENT

The Biological and Environmental Research Committee adjourned for the day at 12:30 p.m.