Climate Change SCIENCE INSTITUTE

Newsletter

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OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

LETTER FROM CCSI LEADERSHIP

We held our first CCSI off-site retreat in January. In attendance were Jim Hack, Dave Bader, Gary Jacobs, Mary Regan, Danny McKenna, Ben Preston, Stan Wullschleger, Peter Thornton, Tom Boden, and Galen Shipman. We reviewed the status of each research theme and confirmed the priorities in each. The Impacts, Adaptation and Vulnerability (IAV) theme is still our #1 priority focus in developing a more comprehensive program. We agreed to take a closer look at emerging opportunities in land-water modeling concepts; Peter is leading that effort. Gary was asked to look into how we might bring our science into the world of carbon markets. We also want to develop some ideas of how we can enrich the experience for our post-docs and help them gain experience across all the research themes. Mary and Danny are tasked formalizing this program. If you would like to contribute in any of these area, please get in touch with the respective individuals.

The call for LDRD proposals will be out soon (see the tentative laboratory schedule on page 6). Expect a similar set of priorities as last year but with even more emphasis on IAV. It is a good time to develop ideas and begin discussions. Integration across divisions will again be important.

The coming months look to be busy amidst much uncertainty. We have three major proposals due to DOE this year. The NGEE proposal (Stan Wullschleger) is due in June and the new Modeling Science Focus Area (SFA) (Dave Bader) and Terrestrial Ecosystem Science SFA (Paul Hanson and Peter Thornton) are due by the end of this fiscal year. Combined, these three proposals represent a significant portion of our research funding.

The budget process in Washington, D.C. is kicking off, and it looks to be interesting. We just need to focus on delivering excellent science and let our leaders wrestle with the challenges of budgets.

PREPARATIONS FOR THE THIRD U.S. NATIONAL CLIMATE CHANGE ASSESSMENT

The U.S. Global Change Research Act of 1990 (GCRA) calls for a national climate change assessment to be prepared "not less frequently than every four years," to analyze effects of global change on at least eight specified sectors (including energy production and use) and to analyze current trends in global change and project major trends. Following the first national assessment, completed in 2000, and what is now being called the second national assessment, a 2009 US Global Change Research Program report on Global Climate Change Impacts in the United States, a third national assessment is due to be issued by June 2013.

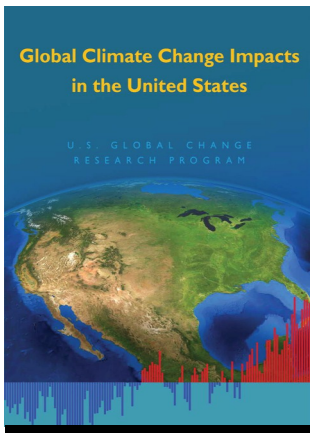

Figure 1. Report from the second National Climate Assessment Global Climate Change Impacts in the United States.

This third national assessment (NCA) is being led by Kathy Jacobs of OSTP, along with an eighteen-agency coordinating team. The objective is not only to produce the report as required by GCRA but to develop a distributed continuing national assessment process that will provide continuing assessment capacities over time and continuity among the periodic assessment reports. Both efforts will include attention to sectoral issues, regional issues, and cross-cutting issues, with the advice of a formally constituted Federal Advisory Committee (FAC).

So far, most of the activity has been focused on ten "process" workshops, concerned with major methodological issues for the continuing assessment process, along with two scoping workshops. Process workshops already held or scheduled include data management, documentation, and peer review; the approach to regional and sectoral assessments; ecological indicators; scenario methodologies, development, and selection; modeling and scaling strategies; social and economic valuation techniques; vulnerability and risk assessment techniques; and indicators of impact and climate drivers.

The next step will be to determine how to address needs for sectoral, regional, and cross-cutting analyses and assessments, both for the 2013 report and the longer-term continuing process. For the near term, neither funding nor particular agency roles are issues that have been fully resolved; but ORNL and CCSI may be asked to assist in a variety of ways, related to our computational facilities and data capabilities, our domain strengths (such as ecosystems, land use, water, and energy), our prominence in the Southeast region, and our strengths in bridging between providers and users of science, such as informatics and visualization.

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Highlighted Researcher

PAT MULHOLLAND

Pat, like many other CCSI staff, started his educational journey by starting down the engineering path. It wasn't until after he received his undergraduate degree in civil environmental engineering and a master's in Environmental Engineering from Cornell University when Pat realized that he far more enjoyed studying natural systems versus manmade systems. So, Pat moved south to the University of North Carolina (UNC) where he received his PhD in Environmental Sciences in a program that was really aquatic ecology even though it was called environmental biology. As far back as this graduate program, Pat was drawn to studying stream ecosystems – his. While at UNC, Pat's advisor, Dr. Ed Kuenzler, gave Pat the opportunity to delve into stream research. For Pat's dissertation, he studied metabolism of carbon and nutrient dynamics in a swamp stream ecosystem – which established a path that led Pat to ORNL and to be one of the most recognized stream ecosystem scientists in the U.S.

Pat Mulholland came to ORNL in 1979 to write environmental impact statements. It was not long before Pat was ready to get back into field-based research, at which point he joined a National Science Foundation (NSF) project with Jerry Ellwood and Denis Newbold – two individuals who became significant influences on and mentors for Pat's research career. This NSF project (Nutrient Spiraling in Streams) was executed primarily in the Walker Branch watershed, the beginning of 30 years of research focused on this watershed for Pat.

Pat feels that his most significant project was LINX – Lotic Intersite Nitrogen eXperiment. LINX was a series of collaborative studies of nitrogen cycling in streams involving simulation modeling, field tracer ^{15}N additions, and intersite comparison. The team's central hypothesis was:

> *The considerable variability among streams in uptake, retention, and cycling of nitrogen is controlled by key hydrodynamic, chemical, and metabolic characteristics that determine water retention, degree of nitrogen deficiency, and energy flow through food webs in stream ecosystems.*

The original LINX project ran from September 1996 through August 2001 and resulted in 26 publications, 7 theses and dissertations, and 69 presentations. Its follow-on project, LINX II, was a 5-year project that began in September 2001 and ran through 2006.

According to Pat, he has always had an interest in climate change and its effect on stream ecosystems. "Stream processes are highly dependent on organic matter inputs which can change greatly in quantity and chemical quality with climate change. They are greatly influenced by variations in precipitation and runoff." Temperature increases could result in major impacts on small forested streams during the summer because many stream organisms have fairly low thermal tolerances.

In 2010, Pat led the "Greenhouse Gas (GHG) Emissions From a Temperate U.S. Hydropower Reservoir Project." The Department of Energy funded this work because so little was known about temperate zone reservoirs and their emissions. There have been a few recent studies on this area where they have found high levels of GHG emissions, methane in particular, from hydropower reservoirs in the tropics. Scientists believe that this is a result of the reservoir construction process with includes flooding organic rich soil and vegetation that subsequently die and decompose. Oxygen is depleted and, under anaerobic conditions, considerable amounts of methane are formed by the decomposition of organic matter. This was a natural extension of Pat's interests that he developed over course of his career in studying GHG emissions from streams and aquatic ecosystems as it has been found that streams can be a significant source of carbon dioxide, methane and nitrous oxide in the atmosphere.

It is thought that the GHG emissions from the reservoirs in the temperate zone may not be nearly as high as in the tropics. It has always been assumed that hydropower was a green source of energy, but if it results in a significant increase in GHG, hydropower would not be as green as originally thought. Therefore, they will continue measuring annual GHG emissions from 8-10 hydropower reservoirs in the southeastern U.S. Other ORNL team members for this project include Jennifer Mosher (a postdoctoral research associate), Alison Fortner and Jana Phillips.

More recently, Pat has been working on the SPRUCE project where his role with postdoctoral research associate, Natalie Griffiths, and Minnesota Forest Service representative, Steve Sebestyen, is to evaluate the hydrologic changes and change in ground water and runoff chemistry—particularly carbon chemistry.

Pat has also been taking long-term measurements of hydrology and stream chemistry in the Walker Branch water shed. He has accumulated 20 years of data which is now being analyzed to see if there have been major changes that may be related to climate warming over this 20-year period. The analysis has included close collaboration with Brian Lutz and Emily

Burnhardt (both from Duke University). Pat has collected seven years of continuous metabolism data in the Walker Branch stream. Natalie Griffiths took over collecting both of these measurements when she joined ORNL last September. "The value of these long-term data sets," Pat stated, "is that we can determine trends over time as well as the relationship with climate variability from year to year."

Pat has been recognized numerous times by his peers for his scientific contributions.

- Scientific Achievement Award, Environmental Sciences Division, Oak Ridge National Laboratory in 1991.
- Distinguished Alumni Award, Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, 1995.
- Elected a Fellow of the American Association for the Advancement of Science (AAAS) in 1997
- Pat's project titled "Riparian ecosystem management at military installations: Determination of impacts and evaluation of restoration strategies, SI-1186." was recognized as the 2007 *Project of the Year* by the U.S. Department of Defense/Strategic Environmental Research and Development Program (SERDP).
- Elected a Fellow of the American Geophysical Union in 2009.
- At the 2010 summer meeting of the American Society of Limnology (ASLO) and the North American Benthological Society (NABS) it was announced that Pat would be the recipient of the 2011 NABS Award of Excellence. This is the top honor given to a member of the leading stream ecology society in the world.

Pat's body of scientific work including 146 articles cited more than 4,000 times includes nine authored or co-authored publications that have been cited more than 100 times.

What role does your research play in climate change research?

"I see the problem as two-fold. First, it is designed to evaluate the effects of climate variability and change on streams and watersheds. Second, it evaluates the role of streams and other aquatic ecosystems on GHG emissions and in turn feedbacks to climate."

Who is the customer for your research?

"The customer is multi-level. The proximate customer is the sponsor, but ultimately, the customers of my research are other scientists, policy makers (where it has policy implications) and the general public."

Why is it important to you, personally, to become involved in climate change research?

"I believe that climate change is arguably the most important and long lasting environmental issue we face today."

In what direction do you see the future of climate change research going?

"There is a great deal that we need to know about the effects of temperature and hydrologic changes on aquatic ecosystems but also the role of aquatic ecosystems in the feedbacks to climate—be it physical, chemical, biological—are important."

Figure 2. *Walker Branch watershed weir.*

The Walker Branch Research site was established in 1967 by Dan Nelson (for whom the DJ Nelson Auditorium in named) as well as other researchers interested in watershed research of the ecological and biogeochemical changes in both the forest and streams. "Since its inception," Pat stated, "one could arguably say that Walker Branch has received the most intensive research per square meter of any watershed in the world." This watershed has proven ideal for research since it is forested and has been undisturbed since 1943 when the reservation was established. The Walker Branch watershed has two weirs to monitor flow on the east and west forks which have allowed hydrologic budgets to be developed.

Highlighted Research

ARM ARCHIVE

ATMOSPHERIC RADIATION MEASUREMENT

How do research scientists working in the area of atmospheric radiation find exactly the data they need among a collection of observations totaling 200 terabytes? It's a lot like locating a specific speck of dust in the Biltmore. This is where ORNL's Atmospheric Radiation Measurement (ARM) Archive comes in. The Archive gives users a host of tools and interfaces to find just what they want from the data streams the DOE ARM Program has been generating from the various observing sites around the world since 1992. Each month, the Archive receives between 50,000 and 100,000 new data files, and processes more than 500 requests for data totaling several terabytes. Since its inception, the Archive has ingested and stored more than 10 million data files.

The ARM Program itself was created in 1989 and is sponsored by DOE's Office of Science. Its task from its inception was to develop several highly instrumented ground stations to study cloud formation processes and their influence on atmospheric radiative transfer. The ARM scientific infrastructure now includes three permanent, fixed-location facilities; two mobile facilities; an aerial facility; and the ARM Archive, which together comprise a national scientific research program available for use by scientists worldwide. A primary objective of the program is improved scientific understanding of the fundamental physics related to interactions between clouds and radiative feedback processes in the atmosphere. ARM focuses on obtaining continuous field measurements and providing data products that promote the advancement of climate models. The ARM Archive stores and provides access to all of the data and products generated by the ARM Program.

ARM Archive data are available free of charge to any interested user, worldwide, upon the completion of a brief registration process that helps the program track basic details of the ARM user community. The Archive has over 6,000 registered users and about 1,100 active users each year, of which 40–60% of are ARM-funded scientists. The user community represents 20 U.S. federal and state agencies, 475 domestic and foreign universities, and 71 foreign countries.

The ARM Archive is tasked not only with storing multiple terabytes of data, but also with being able to locate discrete data sets and serve them up in a form most familiar to its customers – customers who have become accustomed to the likes of amazon.com and ebay.com. Commercial sites such as these have become benchmarks for how Archive customers expect (or at least would prefer) to see information presented. Accomplishing this requires staff with diverse skills to keep pace with the rapid evolution of web service technology.

Over the past year, the ARM Archive has been undergoing a major hardware upgrade that will provide 4 to 7 times more processing speed and 10 times more interim data storage capacity. This interim storage capacity is important due to the extreme variability in the number of files stored and requested each month. (see Figure 4)

Figure 3. *ARM Sites and Facilities*

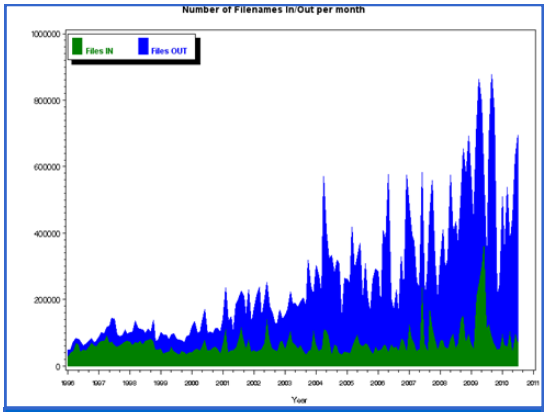


Figure 4. *ARM Archive Data and Usage Statistics - Archive Data Flow (http://www.archive.arm.gov/stats/flow1.html)*

ARM also recently received major capital funding for new instrumentation, including 3-D scanning radars and lidars, which will create a 7- to 10-fold increase in the volume of data currently being generated. According to ARM Archive Director Raymond McCord, "The most novel of these new instruments is the scanning cloud radar, which measures droplet size distribution, particle size and motion, and various cloud density properties. It's novel because of the huge volume of data generated—10 to 15 GB per day from a single radar—and the fact that ARM has never operated this type of radar continuously." The ARM Program has almost 20 radars, two-thirds of which are scanning radars.

Planning a long-term scanning strategy is difficult for these new radars because researchers are still analyzing data gathered by these instruments to determine if information is being missed and whether adjustments need to be made. A big challenge for the Archive is developing means for visualization of data from 3-D instrumentation so that researchers can see patterns and determine what needs to be extracted for developing climatologies of cloud properties. To date, the research community has generally tried to determine climatologies by looking through many data plots that are interlinked; however, an ideal system would be one that allows interactive visualization.

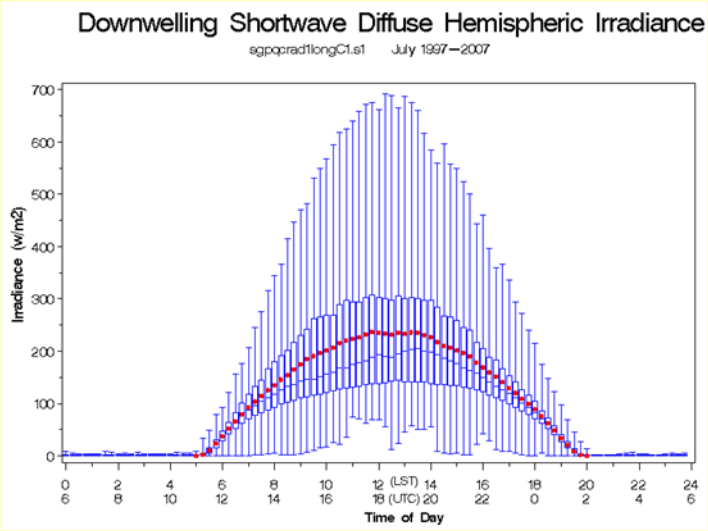
ARM Archive staff create, inventory, and make discoverable several hundred to a thousand data plots per day in various user interfaces. The challenge is enabling the user to look at one or more data plots and request and receive the data related to those plots. This kind of interface has been built for time series and 2-D data, but the 3-D data will require a new extension of Archive user interfaces because of the ability to obtain multiple plots (views) from the same data product. Archive staff must work with the instrumentation experts on what the optimal visualization should look like as well as with the scientists who have various perspectives on how the data might be used. Two to three staff members are typically involved in creating the visualization, indexing it, and building the user interface to organize how it is displayed.

As mentioned above, there is an underlying expectation of the Archive to maintain a constant awareness of web service technologies and the most accepted (i.e., current) presentation standards while being able to seamlessly migrate and keep available all previously stored data—not an easy task when you consider that the ARM Archive was initiated prior to

ARM ARCHIVE (CONT.)

the existence of the Internet. The Internet itself has had a huge impact on data retention—all data products are expected to have a web existence and thus, a forced presumption that if you have listed results, you should be able to bring forward the data on which those results are based. Again, it is their customers' experience with commercial websites that is driving the appearance and functionality of the ARM Archive user interface. This in turn creates the need for a lot of reprocessing of original, raw data and restructuring older products so that a common structure can be preserved, and, consequently, constant quality assurance to verify that the files are being stored as planned. Performance of these systems is constantly being monitored to keep things running smoothly. All of this requires maintaining a technical staff with strong, diverse scientific experience to keep up with all of these changes behind the scenes.

ARM Data in Climate Research



Diurnal variation of July downwelling shortwave diffuse irradiance at the ARM Southern Great Plains (SGP) site, averaged over the entire period of record, 1997–2007.

Since climate research focuses around case studies, ARM is a primary source of data as it has been collecting continuous data for 14–17 years, depending on location. The data reflects real statistical distribution phenomena for researchers. An important tool recently developed at the Archive to assist climate modelers in their verification studies is the ARM Statistical Browser, which, in addition to producing plots of key climate model parameters actually measured at ARM sites around the world (above), the Browser allows users to extract the data behind the statistical plots and obtain the original measurements that were used in calculating the statistics.

CALENDAR

Amer. Assoc. for the Advancement of Science Annual Meeting (Washington, DC)……..17-21 Feb 2011
1st INTERFACE (Integrated Network for Terrestrial Ecosystem Research on Feedbacks to the Atmosphere and Climate): How do we improve Earth System Models? (Captiva Island, FL)……..28 Feb - 3 March 2011
Resilience 2011 (Tempe, AZ)……11-16 March 2011
CESM Joint Land / BGC / Chemistry Working Group Meeting (Boulder, CO) ……15-17 March 2011
American Physical Society (APS) March Meeting (Dallas, TX)……..21-25 March 2011
The 5th International Conference on Community Based Adaptation (CBA) to Climate Change (Dhakar, Bangladesh) ……24-31 March 2011
Greenhouse 2011 (Queensland, Australia) ……..4-8 April 2011
ICARUS-II: Vulnerability and Adaptation: Marginal Peoples and Environments (Ann Arbor, MI) ……..5-8 May 2011
Colorado Conference on Earth System Governance (CSU, Fort Collins, CO)……17-20 May 2011
Conference on Adaptation to Climate Change in Low-Income Countries (Washington, DC) ……..18-19 May 2011
World Environmental and Water Resource Conference (Palm Springs, CA)……..22-26 May 2011
Impact Assessment and Responsible Development for Infrastructure, Business and Industry (Puebla, Mexico) ……..28 May - 4 June 2011
Resilient Cities (Bonn, Germany) ……..3-5 June 2011
16th Annual CESM Workshop (Boulder, CO) ……20-23 June 2011
2011 SciDAC Conference (Denver, CO)……..10-14 July 2011
Federation of Earth Science Information Partners Summer Meeting (Santa Fe, NM)……..12-15 July 2011
TeraGrid '11 (Salt Lake City, UT)……..18-21 July 2011
19th Conference on Applied Climatology (Asheville, North Carolina)……..18–20 July 2011
Third International Conference on Climate Change (Rio De Janeiro, Brazil)……21-22 July 2011
Community Earth System Modeling Tutorial (Boulder, CO)……..1-5 August 2011
96th Annual Ecological Society of America Meeting (Austin, TX)……..7-11 August 2011
Climate Science and Coastal Management Workshop (Charleston, SC) …….. 8-12 August 2011
Fifth Intl. Conference on Flood Management (Tsukuba, Japan)……27-29 September 2011
ASA, CSSA, and SSSA International Annual Meetings (San Antonio, TX)……16-19 October, 2011
ICCCGW 2011: International Conference on Climate Change and Global Warming (Venice, Italy)……..23-25 November 2011
Partners in Environmental Technology Technical Symposium and Workshop (Washington, DC)……..29 Nov–1 Dec 2011
92nd Amer. Meteorological Society Meeting (New Orleans, LA)……..22-26 January 2012
AAAS Annual Meeting (Vancouver, Canada)……..16-20 Feb 2012
2012 Ocean Sciences Meeting (Salt Lake City, UT)……..20–24 February 2012

AMERIFLUX MEETING

More than a dozen CCSI researchers traveled to New Orleans for the third North American Carbon Program (NACP) All-Investigators meeting and annual AmeriFlux Science Meeting the week of January 31st.

The first day and a half of the meeting was devoted to AmeriFlux, a network of towers that observe fluxes of carbon dioxide and energy along with other meteorological and biological variables. Carbon Dioxide Information Analysis Center (CDIAC) leader Tom Boden presented some impressive statistics for this network of towers: data have been submitted from 134 sites totaling 745 site-years of observations. Multiple agencies support these towers, and data are submitted in diverse formats. These data are quality controlled, standardized and gap-filled by CDIAC staff in coordination with the global network FLUXNET. In their presentations, AmeriFlux and NACP leaders emphasized the need for continued observations with a need for standardization of instrumentation and long-term financial support for the network. AmeriFlux is the foundation for a number of synthesis activities presented at the meeting. These syntheses have greatly advanced understanding about terrestrial carbon cycling—in particular, the response of the carbon cycle to climate variability and disturbance events.

A hot topic during the NACP portion of the meeting was model-data integration. One such integration activity is the NACP interim site-level synthesis, led in part by CCSI modelers Peter Thornton and Dan Ricciuto. Twenty-two models have been used for simulations for 45 AmeriFlux and Canadian flux tower sites, and this intercomparison has revealed large differences in model representations of the carbon cycle in different ecosystems. Forcing, observation, and model output data products were compiled by the Modeling and Synthesis Thematic Data Center (MAST-DC), led by Bob Cook. Several teams of NACP investigators formed during the past two years to analyze this dataset presented their results at this meeting. Several analyses indicated the mean of the models outperforms the individual models, suggesting an ensemble model prediction approach may be effective in the future. However, other presentations revealed that there are specific cases where all models provide poor results, such as in agricultural systems, where nearly all models underestimate the intense carbon uptake rates observed in corn fields. Another example is in wetlands, where models generally fail to account for the effects of water table depth.

At a larger spatial scale, the NACP regional interim synthesis collected existing forward and inverse model simulations for North America. Observations were also compiled to validate the models, particularly forest and agricultural inventory data. The regional synthesis is led in part by CCSI modelers Mac Post and Dan Hayes, with coordination and data support from MAST-DC. Initial results from this intercomparison show that carbon cycle predictions are highly dependent on model structure, in particular the equations that govern photosynthesis. The activity also revealed the need for a standardized protocol, forcing datasets and validation metrics for continental to global scale model simulations. This need will be fulfilled in part by MsTIMIP, the Multi-Scale Synthesis and Terrestrial Model Intercomparison NASA-funded project, led by co-PIs Mac Post and Bob Cook. This project will also be closely coordinated with the International Land Model Benchmark (ILAMB), a model-data intercomparison and integration project co-led by Forrest Hoffman. ILAMB is designed to improve the performance of land models and improve the design of new observation campaigns. In a side meeting, 34 investigators from 17 institutions in the US and Canada expressed interest in participating in these activities.

Other presentations demonstrated the importance of including nutrient cycling, trace gas cycling, and other aspects of the Earth system in terrestrial carbon cycle models. Hanquin Tian (Auburn University), in coordination with the regional interim synthesis team, quantified the influence of N_2O emissions, showing that the CO_2 fertilization sink is effectively reduced by 40-50% through N_2O emissions originating from nitrogen deposition and nitrogen fertilization. The new US Carbon Cycle Carbon Plan, discussed at the meeting and currently under review, emphasizes the need to quantify uncertainty and attribute variability in the carbon cycle to specific processes including carbon cycle management where applicable. This will require long-term observations, manipulative experiments, and more detailed model formulations that accurately represent interactions between cycling of carbon, nutrients, other greenhouse gases and climate variables.

TENTATIVE LDRD SCHEDULE

Task	Start	End	2011					
			February	March	April	May	June	July
Call: Pre-Proposals	2/18/2011	2/18/2011						
DUE: Pre-Proposals	3/18/2011	3/18/2011						
DUE: Pre-Proposals (DD)	3/28/2011	3/28/2011						
Pre-Proposal Reviews & Selections	3/28/2011	4/8/2011						
Call: Full Proposal	4/14/2011	4/15/2011						
Full Proposal Development	4/16/2011	5/12/2011						
DUE: Full Proposal	5/13/2011	5/13/2011						
DUE: Full Proposal (DD)	5/20/2011	5/20/2011						
LDRD Review Committee	5/31/2011	6/24/2011						
ALD Review w/DDST	6/28/2011	7/1/2011						
LDRD Awards Announced	7/18/2011	7/18/2011						

RELIABLE METHODS DEVELOPED FOR ESTIMATION OF BIOCHEMICAL PARAMETERS FOR PHOTOSYNTHESIS WITHIN CARBON CYCLE MODELS

The Farquhar–von Caemmerer–Berry (FvCB) model of photosynthesis is a change-point model and structurally overparameterized for interpreting the response of leaf net assimilation (A) to intercellular CO_2 concentration (Ci). The use of conventional fitting methods may lead not only to incorrect parameters but also several previously unrecognized consequences. For example, the relationships between key parameters may be fixed computationally and certain fits may be produced in which the estimated parameters result in contradictory identification of the limitation states of the data. In their recent publication in *Plant, Cell & Environment*, CCSI scientists Lianhong Gu and Stan Wullschleger (along with scientists from the University of Missouri, University of California—Berkeley, and Oregon State University) describe a new approach that is better suited to the FvCB model characteristics. It consists of four main steps: (1) enumeration of all possible distributions of limitation states; (2) fitting the FvCB model to each limitation state distribution by minimizing a distributionwise cost function that has desirable properties for parameter estimation; (3) identification and correction of inadmissible fits; and (4) selection of the best fit from all possible limitation state distributions.

The new approach implemented theoretical parameter resolvability with numerical procedures that maximally use the information content of the data. It was tested with model simulations, sampled A/Ci curves, and chlorophyll fluorescence measurements of different tree species. The new approach is accessible through the automated website leafweb.ornl.gov.

Citation: Gu L, Pallardy SG, Tu K, Law BE, Wullschleger SD (2010) Reliable estimation of biochemical parameters from C3 leaf photosynthesis–intercellular carbon dioxide response curves. Plant, Cell and Environment 33:1852-1874, doi: 10.1111/j.1365-3040.2010.02192.x

CCSI WELCOMES NEW STAFF

Valentine Anantharaj is a Computational Climate Scientist with the Scientific Computing Group in the National Center for Computational Sciences (NCCS). Prior to joining ORNL, he was an Associate Research Professor at the Geosystems Research Institute (GRI) as well as Adjunct Faculty with the Department of Electrical and Computer Engineering in Mississippi State University. He holds a PhD in Computational Engineering, an MS in Meteorology, and BS in Physics. Valentine was a NASA Enterprise for Innovating Geospatial Solutions Graduate Fellow for two years during his graduate studies. Prior to his tenure at GRI, he started his scientific career as an Associate Scientist at the former Institute for Naval Oceanography, managed by University Corporation for Atmospheric Research. Valentine has broad professional experience in the areas of scientific data management, software engineering and applications development for operational implementation, decision support frameworks, integration of remote sensing data in numerical models, satellite precipitation estimation, and regional climate modeling. His recent research interests include land surface hydrology, land-atmosphere interactions, and characterization of uncertainties in global climate models, particularly shortwave radiation. Valentine intends to devote his skills and experience to advance the leadership scale climate modeling activities at NCCS as well as the core competencies within CCSI.

Matt Norman is a Computational Climate Scientist also with the Scientific Computing Group in the NCCS. Attending North Carolina State University for both undergraduate and graduate work, Matt received a BS in Computer Science, a BS in Meteorology, and a minor in Mathematics, working on projects ranging from stability analysis of semi-implicit semi-Lagrangian schemes to data mining and analysis. For the MS in Atmospheric Sciences, the thesis title was "Investigation of Higher-Order Accuracy for a Conservative Semi-Lagrangian Discretization of the Atmospheric Dynamical Equations". For the PhD in Atmospheric Sciences, the dissertation title was "Characteristics-Based Methods for Efficient Parallel Integration of the Atmospheric Dynamical Equations". Most recently, Matt's focus has been on striving for GPU efficiency in the atmospheric dynamical core from the level of the algorithm choices more so than extensive memory optimization. Matt has also been working to gain efficiency with minimal coding effort by ensuring efficient use of the per-multiprocessor L1 cache. He will be working with OLCF3 readiness for CESM/CAM/HOMME along with user and project assistance in NCCS. For work with CCSI, he will continue work in dynamical core algorithm development thereby complimenting the GPU porting work.

Gangsheng Wang is a postdoctoral research associate in the Ecosystem Simulation Science group, coming to ORNL from Washington State University (Pullman) where he recently completed a PhD in Biological/Agricultural Engineering. He also holds a PhD in Physical Geography from the Chinese Academy of Sciences, Beijing, China (2005) and an MS in Hydrology and Water Resources from Wuhan University, China (2002). Gangsheng will conduct research on greenhouse gas (GHG) emissions associated with agricultural land use and land use change with Keith Kline and Mac Post. In addition, he will work on the application of a cropland ecosystem model for bioenergy feedstock sustainability analyses, GHG calculation methods, data and uncertainty analysis (latter topics will support our collaborations with International Standards Organization and others developing GHG method standards).

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Highlighted Research: Visual Data Exploration & Analysis of Ultra-Large Climate Data

Developing and executing programs for the multi-agency, multi-disciplinary climate change research partnerships at Oak Ridge National Laboratory.

RECENT PUBLICATIONS

Brosi GB , McCulley RL, Bush LP, Nelson JA, Classen AT, Norby RJ (2011) Effects of multiple climate change factors on the tall fescue-fungal endophyte symbiosis: infection frequency and tissue chemistry. New Phytologist 189:797-805.

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