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Newsletter

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OAK RIDGE NATIONAL LABORATORY
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LETTER FROM CCSI LEADERSHIP

This week (Dec 13th) is the annual AGU meeting in San Francisco. A search for "oak ridge" yields 75 abstracts in 62 sessions, although not all of these are climate-related. The following staff are convening or co-convening climate-related sessions: Bruce Wilson, Mac Post, Forrest Hoffman, Stan Wullschleger, and Dan Ricciuto. If we have missed anyone, please let us know.

We are starting to plan for our CCSI seminar series. If you have suggestions for speakers, please send them to Mary. We are seeking mid-to-senior career scientists who would appeal broadly to CCSI staff.

For those who have not already heard, Bruce Wilson is leaving ESD and CCSI to lead the Client and Collaboration Technologies Group in ITSD. This group is responsible for managing the broad range of customer-facing systems and collaborative solutions across ORNL. This includes R&D systems support, virtual desktop services, desktop/laptop services and patch management, and mobile/remote computing. Bruce will keep his hand in science and maintain a joint appointment in ESD as he continues with the DataONE project and the National Phenology Network. We wish him luck in this new role for ORNL, and we are happy to have an "insider" in ITSD.

Finally, with the end of the year rapidly approaching, the leadership team would like to thank everyone in the Institute for their efforts over the past year and wish you a happy and peaceful holiday season.

DDT WORKSHOP BRINGS A NEW TOOL TO CCSI SCIENTISTS

Historically, if you were talking about DDT, you were in some way referring to one of the most well-known synthetic pesticides. However, DDT has a completely new meaning for several CCSI staff who attended the December 10th DDT workshop offered by CCSI member and scientist, Kate Evans. Here, DDT stands for Distributed Debugging Tool. The two-hour workshop was led by Rebecca Hartman-Baker, Computational Scientist, and Bill Renaud, High-Performance Computing User Support Specialist, both part of the National Center for Computational Sciences (NCCS).

DDT is a powerful tool used to debug computer code, specifically applications at 200,000 cores simultaneously, written in C, C++, and Fortran. Other popular debugging tools tend to work up to 800 cores and do not offer the visualization options available with DDT. After attending the workshop, post-doctoral research associate, Jeff Nichols, feels that "having better visualization will allow scientists to spend more time on analysis versus debugging." DDT is available to anyone running jobs on Jaguar. There is also a beta version running on YONA for testing GPUs. Another strength of DDT is that it provides a single, comprehensive debugging run, eliminating an issue faced by computing scientists where bugs only show up after making many, many runs.

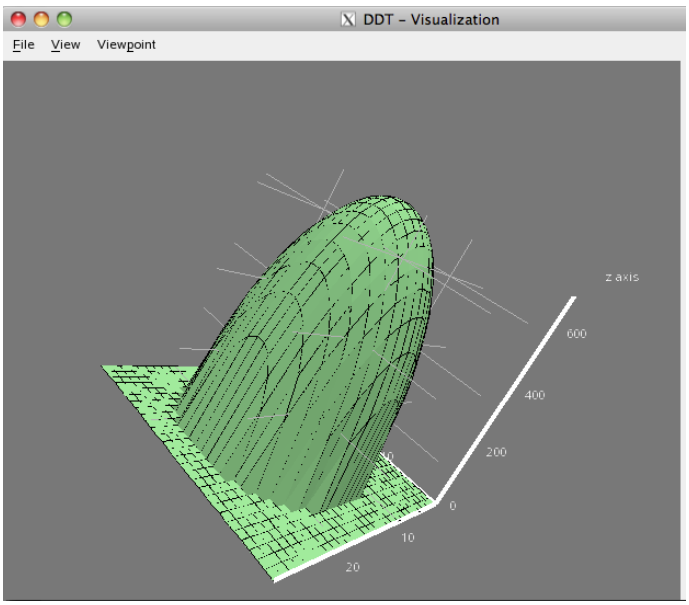

Figure 1. Screenshot from a DDT demonstration run.

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Highlighted Researcher

BRUCE WILSON

For Bruce Wilson, pursuing chemistry was a family tradition. His father, mother and step-mother all earned doctorates in chemistry, and when Bruce graduated from the University of Washington in 1988 with his doctorate, he continued this tradition. Bruce spent 17 years in the chemical industry—11 years at Eastman in Kingsport, TN, 1 year with Dow Corning, and 5 years with Dow Chemical. He began creating data management tools to handle massive amounts of data resulting from research using liquid crystalline polymers to modify the flow properties of glass fiber reinforced composites for "under-the-hood" engine applications. During those 17 years, Bruce "survived" eight downsizings, but ultimately became the casualty of one. The Wilson family headed back to Michigan, but they found that they missed the mountains of East Tennessee. Bruce had also grown wary of the boom and bust nature of the chemical industry. He kept his eye on job openings at ORNL, eventually finding one that fit his interest and experience with data management. He joined the lab in 2006 as the systems engineer for the ORNL DAAC and became the manager of the DAAC 18 months later. Bruce enjoys a little woodworking and gardening in his rather sparse spare time. His wife works in special collections at the UT library and is currently a master's student in history. Their daughter is beginning her PhD in psycholinguists, and their son is following the family tradition. He is a first year graduate student in inorganic chemistry at the University of Minnesota.

Bruce Wilson's general research focus is in scientific informatics, particularly enabling data-intensive science in ecology and climate science through advancing data storage, curation, distribution, analysis, and visualization technologies and practices

Bruce has been the Group Leader for the Environmental Data Science and Systems Group and the Manager/PI for the ORNL Distributed Active Archive Center for Biogeochemical Dynamics (DAAC) for the past four years. He is also an Adjunct Professor of Information Sciences at the University of Tennessee at Knoxville. Bruce was recently appointed as the Group Leader for the Client and Collaboration Technologies Group in the Information Technology Services Division (ITSD). His new position in ITSD will allow Bruce to focus more intently on providing diverse research projects with the information technology tools that better enable collaboration within the laboratory and between the laboratory and its other partners.

Bruce serves on the Board of Directors for the USA-National Phenology Network (USA-NPN), the Finance Committee for the Federation of Earth Science Information Partners, and the Core Cyberinfrastructure Team for the DataONE (Observation Network for Earth) project. He also serves as a peer-reviewer for several journals and for grant programs at the National Science Foundation, the National Aeronautics and Space Administration (NASA), and the Department of Energy.

The USA-NPN brings together citizen scientists, researchers, government agencies, non-profit groups, educators and students of all ages to monitor the impacts of climate change on plants and animals in the United States. USA-NPN is primarily funded by the US Geological Survey (USGS), and ORNL's involvement is funded through the USGS National Biological Information Infrastructure (NBII) project. Much of the initial cyberinfrastructure for USA-NPN was designed and built at ORNL. As USA-NPN has grown, this work has been taken over by the National Coordinating Office at the University of Arizona. Phenology, which is the study of recurring plant and animal life cycle stages and events, is both an important indicator for climate change and a critical element to understanding ecosystem function and potential ecosystem disruption.

Bruce is involved in a number of highly collaborative, cross-institutional projects, for some of which he is Principal Investigator (PI).

Manager for the ORNL DAAC (an ongoing project that began in FY94)

The ORNL DAAC (Distributed Active Archive Center) is one of 12 science-focused data centers in NASA's Earth Science and Information Systems (ESDIS) project. The ORNL DAAC's primary mission is the archival of NASA-funded field ecology measurements, some of the validation data for remote sensing of terrestrial ecology systems, and related data of interest to researchers in the area of NASA terrestrial ecology and carbon cycle science.

A user working group provides advice on what the ORNL DAAC should do to best serve the scientific community and what particular data sets—beyond those that are directly NASA-funded field ecology experiments—should be obtained. ORNL DAAC members obtain data from researchers, perform quality assurance on data, transfer data into formats appropriate for long-time archival, document protocol for data formatting, and place formatted data on the ORNL DAAC website for access.

Co-Investigator for DataONE—Observation Network for Earth (FY09-14)

The National Science Foundation (NSF)-funded DataONE is seeking to provide universal access to data about life on Earth and the environment that sustains it. DataONE supports environmental science by: (1) engaging the relevant science, data, and policy communities; (2) providing easy, secure, and persistent storage of data; and (3) disseminating integrated and user-friendly tools for data

discovery, analysis, visualization, and decision-making. DataONE can be viewed as having two prongs of attack: the first being the cyber infrastructure side that is building the data management tools and trying to make those tools easy to use and easy to integrate into existing tools like MatLab. The second is the community engagement side which involves creating educational programs that discuss best practices for preparing and sharing data. DataONE is also unique in the ways that it seeks to work with the broad range of stakeholders to catalyze the sociological and technological changes that are needed for this vision.

ESDORA—Earth Science Data in Digital Object Repository Architecture (FY10-12)

ESDORA's goal is to deliver Earth Sciences data, particularly NASA Earth Observing System (EOS) data, using digital content repository technology, promoting best practice in digital provenance and enabling effective access to content and associated metadata. Based on preliminary work, the ESDORA development team expects to couple the Fedora Repository and a Drupal-based Graphic User Interface as key elements of a next-generation NASA Earth system science data center infrastructure, using datasets collected as part of the North American Carbon Program (NACP) Modeling and Synthesis Thematic Data Center (MAST-DC) as the primary science context. The team will use this implementation to enable better and more consistent access to critical metadata, including processing lineage information and administrative metadata, using the capabilities inherent in a digital repository (multiple streams for a given object and remote data streams).

What role does your research play in climate change research?

"Our research and engineering efforts are focused on a number of issues around data for climate change research. What are the best ways to preserve and deliver data, particularly the observational data which is necessary for development and refinement of climate models? There are a number of both technical and sociological challenges here, particularly since there is often a number of real and perceived barriers to sharing data. It can take a significant amount of effort to prepare data for sharing, and it can take effort to develop the necessary metadata. But that same effort is often also useful for investigators going back to their own data after some time has passed. We work to reduce the level of effort that scientists need to spend to share their own data, as well as to find and use the data that others have collected. We are also researching the ways to store data in one format and make it available in multiple different formats, as appropriate to the different communities of practice that our data centers serve. In the end, a lot of the research and engineering that we do is about making it easier for climate scientists to do the science, rather than dealing with arcane incantations often needed to find and use data."

Who is the customer for your research?

"Our customers are primarily scientists doing research, but we also have a number of users in education, policy analysis, and even the general public. Within the science community, there are significant differences between the needs of the climate modelers, the remote sensing scientists, and the field research community. Each of those groups has different types of questions they're trying to address, and those questions drive the tools and practices."

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

"I've joked that I was part of the research community that figured out how to make PET work for water bottles (by reducing the amount of residual acetaldehyde), so working in climate is part of my penance. However, in a broader sense, climate is a huge problem, and one that requires the gifts and talents of a broad range of people. I've understood that part of my mission is to help scientists focus on being able to do science, and climate science is a critical area for that. As I move into my new role in ITSD, I'll continue to do just that -- help scientists focus on doing science, across the range of ways that ORNL is working to solve our climate and energy challenges."

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

"Data intensive science is growing in importance in many disciplines, and climate change science is no exception. We're capable of generating ever growing amounts of observational data and model results, and that's going to continue to change the ways research is done and the ways people collaborate. The concepts inherent in 'genomes to global', as we seek to understand the interrelationships across the huge time and length scales from microbial processes to global climate, are absolutely fascinating. I also see continued integration of things like human behavior and sociology into climate change research, since that's ultimately what's driving the changes and our collective lack of response."

Highlighted Research

NORTH AMERICAN CARBON PROGRAM (NACP)

Carbon is constantly moving through systems on Earth—from the atmosphere, to vegetation, to the soil, and to the oceans.

As such, a number of researchers in CCSI are involved in studies for the North America Carbon Program (NACP), a multidisciplinary research program involving environmental scientists from the US, Canada, and Mexico whose scientific contributions are collated in an attempt to measure and understand sources and sinks of various carbon species (e.g., carbon dioxide, CO_2; methane, CH_4; and carbon monoxide, CO) in North America and in adjacent ocean regions. Something can be considered to be a source of carbon if it emits more carbon than it absorbs. Conversely, if something absorbs more carbon than it emits, it is called a carbon sink.

The success of NACP is founded in strong coordination among observational, experimental, and modeling efforts regarding terrestrial, oceanic, atmospheric, and human components.

Around 200 different investigators focus on a variety of methods by which carbon is naturally and synthetically introduced and removed from the atmosphere. Studied carbon sources include melting permafrost, the burning of fossil fuels, agricultural techniques and deforestation, while studied carbon sinks include reforestation, peat bog engineering and reinforcement, and ocean iron fertilization. NACP relies upon a rich and diverse array of existing observational networks, monitoring sites, and experimental field studies in North America and its adjacent oceans.

Figure 2. *Foresters measure forest growth, which will be compared with modeling estimates of growth in the North American Carbon Program.*

A dozen scientists from CCSI are involved in NACP including experimentalists Rich Norby, Paul Hanson, and Colleen Iverson; modelers Mac Post, Peter Thornton, Dan Ricciuto, Dan Hayes, and Tony King; flux tower investigators Lianhong Gu and Bai Yang; and data center staff Tom Boden, Barbara Jackson, Yaxing Wei, and Bob Cook. Post, Thornton, Hanson, Norby, King, and Bob Cook have served on the NACP Science Steering Group.

NACP uses different approaches to measure carbon. There are over 30 carbon flux towers across North America that measure the exchange of CO_2 and are critical to linking carbon fluxes and remote sensing data (from satellites, aircrafts, etc.). Ecosystem and carbon accounting models—models that look at how much carbon is being released into the biomass via photosynthesis and respiration in plants—are another means of measuring CO_2 exchange. The National Aeronautic and Space Administration (NASA) and the US Geological Survey contribute satellite information to NACP researchers, and the US Department of Agriculture supplies information about what crops are being grown where and in what abundance.

NACP also uses atmospheric transport models which employ an array of numerical observations of gas concentrations in the atmosphere over North America. These concentrations are combined with information about atmospheric transport of the winds which allows researchers to look at a parcel of air as it moves across the continent, noting the rise and fall of carbon. By looking at the changes in the carbon in the air mass, they can predict where the carbon sources and sinks are on the ground.

While each of these approaches supplies vital information about carbon exchange on Earth, a fundamental goal of NACP is to synthesize data from each of these approaches. A grant through NASA created the Modeling and Synthesis Thematic Data Center (MAST-DC), designed to support NACP by providing data products and data management services needed to fuse data from multiple sources. MAST-DC coordinates all NACP interim synthesis groups.

"We take data from flux towers, satellites, and experiments and format it so that it can be compared directly with models," says Bob Cook, PI for MAST-DC. "What we've found in other studies is that it takes more time to deal with data than it does to do the actual research. We're trying to lighten the load for the scientists to enable more science." Co-PIs for MAST-DC are Peter Thornton and Mac Post. Also

Figure 3. *Estimates of carbon uptake by crops made from flux tower measurements and from agricultural yield measurements are used to understand the processes affecting carbon sources and sinks.*

NACP (CONT.)

involved in interim synthesis work for NACP are Dan Hayes, Dan Ricciuto and post-doctoral research associate, Yaxing Wei.

A recent synthesis study has examined how approximately 20 different ecosystem and carbon accounting models parameterize and simulate photosynthesis. Modelers can choose to use different numerical representations of photosynthesis, namely light-use efficiency and enzyme kinetics. "It turns out that when you look at a whole suite of models, and they fall into these two diff categories, there's a real separation in the results from these approaches," says Cook. "We're in the process of trying to understand what the best representation for photosynthesis is."

For more information on NACP, visit http://www.nacarbon.org/nacp/.

DDT WORKSHOP (CONT.)

Evans was pleased with the turn-out and is looking forward to offering a VAMPIR workshop in the near future. "By offering these types of workshops, it forges new links between the NCCS and CCSI," stated Evans. Additional information on DDT can be found at www.allinea.com/?page=48.

CCSI WELCOMES NEW STAFF

Kathy Huczko has joined the Environmental Science Division (ESD) as a Technical Project Manager working with Stan Wullschleger, Paul Hansen, and Peter Thornton to support SPRUCE, NGEE, and other ESD projects. Kathy has an MS in Project Management from The George Washington University, a BS in Mechanical Engineering Science from UT Knoxville, and a BS in Mechanical Engineering Technology from the University of Pittsburgh. Kathy has been at ORNL since 2006 and has been the Standards-Based Management System (SBMS) manager for nearly four years. The SBMS experience has provided Kathy with in-depth knowledge of ORNL processes and allowed her to build relationships with staff in all organizations across ORNL. Prior to ORNL, Kathy spent 27 years in industrial companies enhancing her engineering and project management skills with significant experience in engineering design, engineering management, and project management.

CALENDAR

Strategic Environmental R&D Program Annual Symposium (Washington, DC)……30 Nov—2 Dec 2010
American Geophysical Union Fall Meeting (San Francisco, CA) ……13-17 December 2010
Federation of Earth Science Information Partners Winter Meeting (Washington, DC)……4-6 January 2011
91st Annual Amer. Meteorological Society Meeting (Seattle, WA)…… 23-27 January 2011
Energy, Utility and Environmental Conference 2011 (Phoenix, AZ) …… 31 Jan- 02 Feb 2011
AmeriFlux Science Meeting & 3rd NACP All-Investigators Meeting (New Orleans)…… 31 Jan—4 Feb 2011
ASETSDefense 2011: Sustainable Surface Engineering for Aerospace and Defense (New Orleans, LA)…… 8-11 Feb 2011
Amer. Assoc. for the Advancement of Science Annual Meeting (Washington, DC)……17-21 Feb 2011
Resilience 2011 (Tempe, AZ)……11-16 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
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

OAK RIDGE CLIMATE CHANGE SCIENCE INSTITUTE

One Bethel Valley Road
P.O. Box 2008, MS-6301
Oak Ridge, TN 37831-6008

Phone: 865-574-5435
Fax: 865-574-6476
E-mail: climatenews@ornl.gov

We're on the Web!
www.climatechangescience.ornl.gov

RECENT DATA PRODUCTS

ORNL DAAC has added 6 Gridded Population of the World (version 3) layers, which are provided by SEDAC GPWv3 OGC WMS service, into two instances of the WebGIS tool:

- GPWv3 1990 Population Density
- GPWv3 1995 Population Density
- GPWv3 2000 Population Density
- GPWv3 2005 Population Density
- GPWv3 2010 Population Density
- GPWv3 2015 Population Density

Coming in December

Highlighted Researcher: Lianhong Gu
Highlighted Research: Ice Sheet Modeling

RECENT PUBLICATIONS

Brosi GB , McCulley RL, Bush LP, Nelson JA, Classen AT, Norby RJ. 2010. Effects of multiple climate change factors on the tall fescue-fungal endophyte symbiosis: infection frequency and tissue chemistry. New Phytologist, doi: 10.1111/j.1469-8137.2010.03532.x.

Classen AT, Norby RJ, Campany CE, Sides KE, Weltzin JF. 2010. Climate change alters seedling emergence and establishment in an old-field ecosystem. PLoS ONE 5: e13476.

De Graaff M.A., A.T. Classen, H.F. Castro and C.W. Schadt (2010). Labile soil carbon inputs mediate the soil microbial community composition and plant residue decomposition rates. New Phytologist (in press).

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Friedlingstein P, Houghton RA, Marland G, Hack;ler J, Boden TA, Conway TJ, Canadell JG, Raupach MR, Ciais P, Le Quere C (2010) Update on CO2 emissions. Nature Geosciences (advanced online publication, 21 November 2010).

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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

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Hanson PJ, Childs KW, Wullschleger SD, Riggs JS, Thomas WK, Todd DE and Warren JM (in press) A method for experimental heating of intact soil profiles for application to climate change experiments. Global Change Biology ??:???-???, doi: 10.1111/j.1365-2486.2010.02221.x

Norby RJ, Warren JM, Iversen CM, Medlyn BE, McMurtrie RE. 2010. CO2 enhancement of forest productivity constrained by limited nitrogen availability. Proceedings of the National Academy of Sciences 107: 19368-19373.

Parton WJ, Hanson PJ, Swanston C, Torn M, Trumbore SE, Riley W, Kelly R (2010) ForCent Model Development and Testing using the Enriched Background Isotope Study (EBIS) experiment. JGR-Biogeosciences 115:G04001, doi:10.1029/2009JG001193

Warren, JW, Pötzelsberger E, Wullschleger SD, Thornton PE, Norby RJ. 2010. Ecohydrological response of forests to elevated CO2—from mechanisms to models. Ecohydrology DOI: 10.1002/eco.173.

Yin, T.M., M. Davis, L. Gunter, X. Zhang, R. Priya, R. Sykes, S.D. Wullschleger G.A. Tuskan (2010). Differential expression of genetic loci underlying above- and below-ground lignin contents in Populus. PLoS Genetics 5: e14021.

CURRENT CCSI JOB OPPORTUNITIES

We seek motivated individuals across a range of educational and professional experience including M.S. through Ph.D. academic qualifications at junior, as well as senior levels of experience to address some of the most pressing questions in global climate change science. You can view complete staff position descriptions and apply at http://jobs.ornl.gov. Postdoctoral and post-master's research position descriptions and online application are at http://www.orau.org/ornl/postdocs/ornl-pd-pm/default.aspx.

- Climate Computational Scientists
- Technical Project Leads—Environmental Sciences
- Postdoctoral Research Associates