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

September was a month of "firsts." We had our first Science Advisory Board (SAB) meeting, released the first draft of the CCSI Strategic Plan, and spent our first month in building 2040. The SAB meeting went well from our perspective, and we received useful feedback from the SAB during the de-briefing. We anticipate receiving the written report soon. As expected, the SAB encouraged us to seek involvement among all CCSI staff in the refinement of the Strategic Plan.

The draft that was released is truly that – a draft for discussion and refinement. The SAB also encouraged us to find mechanisms to integrate across our four Research Themes. This will be an important part of our planning for fiscal year 2011. We will be kicking off our "3X5" meetings this month. The purpose of these is to have CCSI staff present vignettes of a key climate change issue or their research. By keeping these short, we can have a diverse suite of topics presented quickly. Later, we can go into more depth. The 3X5 format is one that Virginia Dale has used successfully at ORNL during workshops. Each person has 3 slides and 5 minutes to present an idea for discussion. These sessions will be held once each week over lunch in 2040.

We are planning to host two visits in November: (1) Gary Geernaert, Director of the Climate and Environmental Sciences Division of the DOE/Science Office of Biological and Environmental Research and (2) Jeff Marqusee and John Hall of the Strategic Environmental R&D Program (SERDP).

QUADRENNIAL REVIEW SUPPORT (DOD)

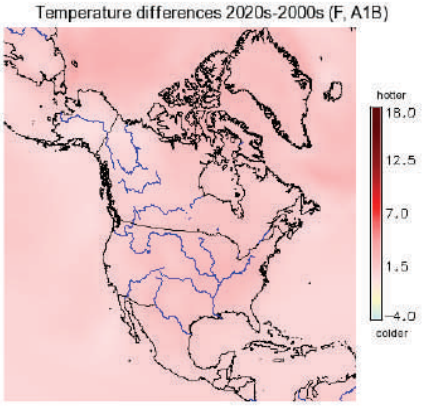
In compliance with Congressional guidance, the U.S. Department of Defense (DoD) sought to better identify the range of risks that trends in environmental climate change suggest for future international security. This analysis included the potential impacts on DoD roles and missions, as well as defense capability requirements throughout the armed forces, its equipment, and supporting infrastructure, facilities, and organizations.

It is increasingly recognized that global demographic, climate, and economic trends will have implications on the defense and security planning scenarios with which the U.S. and other nations of the world will be concerned. In order to consider these implications, DoD required credible climate science research and assessment to assist in the development and analysis of objectives and assumptions for multiple defense policy documents and products. Prominent among these was the 2010 Quadrennial Defense Review (QDR). Supporting climate change science investigation was intended to yield insights affecting Service materiel readiness, the availability and reliability of worldwide Defense infrastructures, as well as the viability and maintainability of force posture in the continental U.S. and abroad.

ORNL developed a methodological approach to demonstrate how different trends in climate (based on the accepted Intergovernmental Panel on Climate Change [IPCC] model and the most up to date peer-reviewed science) impacted issues of major defense and national security concern. The work considered a base case of the most likely trends, a plausible better case, and a plausible worst case. The work also identified the range of plausible but low likelihood shocks suggested by current climate science and trends. The work focused on the implications over three time

Continued on page 5

Difference to Current	2030	2050	2100
Temperature	B1* A1B A1FI	B1 A1B A1FI	B1 A1B A1FI
Precipitation	B1 A1B A1FI	B1 A1B A1FI	B1 A1B A1FI
Precip-Evap	B1 A1B A1FI	B1 A1B A1FI	B1 A1B A1FI



* B1, A1B, and A1FI are three greenhouse gas emission scenarios defined by the IPCC Special Report on Emissions Scenarios (SRES), where B1 is a relatively low emissions scenario (often considered to be a "best case"), A1B is a moderate emissions scenario, and A1FI is a fossil-fuel intensive emissions scenario (often thought of as a "worst case"). Recent observations of emissions make the A1FI the most plausible compared to other scenarios, thus making this the "business as usual" case.

Figure 1. *From the QDR Climate Change Support interactive website, choosing "NORTHCOM" and "A1B." Predictive temperature differences compared to current temperatures based on a specific greenhouse gas emission scenario.*

Inside this issue:

Ben Preston….. . . . …. .2
Bhaduri in the News…..3
SAR……..….4
QDR Support (cont.) ….5
1st Annual SAB Meeting…...5
CCSI Welcomes New Staff..5
Calendar…….....….5
Publications . ……..6
Current CCSI Job Opportunities …..6

Highlighted Researcher

BEN PRESTON

Benjamin Preston grew up in Atlanta, Georgia. It was in Nunnally's sophomore biology class that Ben found his interest for natural science. "She motivated us to do well," he said. "It was challenging, but I was able to rise to that challenge because I found the material interesting—it had a lot of practical applications in the real world."

A few years down the road, Ben received a BS in biology from the College of William and Mary in Williamsburg, Virginia. A summer course in ecology between his junior and senior years shifted Ben's interest more specifically to environmental biology. He appreciated how the subject focuses on interactions between sub-domains of biology and the affects of these interactions on the environment. Ecology, to Ben, seemed very relevant to society as concerns are ever growing about mankind's affect on the environment and what can be done to mitigate these affects. Naturally, Ben's PhD studies at the Georgia Institute of Technology were in environmental biology, but he also minored in public policy to strengthen his understanding of the policy-making process. According to Ben, "I knew that if I was really interested in environmental science and how it's used in decision-making, I should know something about how decisions are made." After completing his PhD program, Ben worked as a postdoctoral fellow with the Carolina Environmental Program at the University of North Carolina at Chapel Hill where he developed an interest in the application of geographic information systems to investigate spatial and temporal relationships among environmental pressures and outcomes. Ben's interest in making science relevant to decision-making then drove him to Washington, DC where he worked as a senior research fellow at the Pew Center on Global Change. He later moved overseas to join Australia's Commonwealth Scientific and Industrial Research Organization where he was a research scientist with the Division of Marine and Atmospheric Research. He joined ORNL in April of this year.

When Ben is not conducting research that helps policy makers understand how they can help society adapt to and alleviate the consequences of climate change, he is busy keeping up with his one-year-old daughter—and catching up on sleep whenever time permits. Ben and his wife—economist management consultant—enjoy spending time out and about in Knoxville with their daughter, frequenting Saturday morning farmer's markets and enjoying the company of other families in their neighborhood. They stay active by running together, recently completing the Asheville Citizen-Times Half Marathon.

Benjamin Preston is a senior research scientist in ORNL's Environmental Science Division and the lead for CCSI's Impact, Adaptation, and Vulnerability (IAV) Science research theme. His research involves the development of empirical and process models as well as the application of geographic analysis tools to estimate climate impacts and, in particular, characterize the many interactions between climatic and socioeconomic change.

Ben has contributed dozens of publications to the scientific literature on climate change impacts, adaptation and environmental assessment, and he has served as an expert peer-reviewer for a broad range of academic journals in the environmental sciences. He is also a lead author for Working Group II of the Intergovernmental Panel on Climate Change *Fifth Assessment Report*.

Ben's current work includes several collaborative, cross-disciplinary projects, for some of which he is the principal investigator (PI).

Site PI for Developing a Regional Integrated Assessment Model Framework (FY10-15)

Integrated assessment models are designed to link the Earth system and changes in the Earth system to changes in the economy. Researchers develop these models for two reasons: 1) The economy is what drives climate change, and 2) because the economy is what is affected by the consequences of climate change. These kinds of models are designed to explore those interactions and also allow scientists to look at policy decisions so they can simulate the imposition of a policy on the economy—that policy may alter emissions which feed back to affect the climate which feeds back to affect climate change impacts. Typically, integrated assessment models are done in the context of an international policy. The models usually divide the world—North America, Europe, Africa, and South America—which does not give a lot of information about what is going on at the local scale which is what people really want to know. This project is designed to use similar tools used in these global integrated assessment models, but downscaling them to look at drivers and consequences at the regional scale. The team is focusing on the Gulf Coast region of the U.S. The project is being conducted in collaboration with Pacific Northwest National Laboratory, which has been a leader in the development of such integrated models for a number of years. Other CCSI members working on the project are Tom Wilbanks, Tony King, Mac Post, and Auroop Ganguly.

PI for Quantifying Economic Losses Associated With Climate Extremes under Conditions of Climatic and Socioeconomic Change (FY10-12)

The goal of this Laboratory Directed Research and Development (LDRD) project is to explore interactions between socioeconomic development and climate change on the economics of climate impacts. Quite often people think about the consequences of climate change by superimposing assumptions about future climate change on top of society as it exists today. Such approaches do not account for future changes in population, population aging, or future development, and thus, lack realism. Particularly over the next 25 to 50 years in places like the U.S. or other areas that are growing rapidly, demographic and socioeconomic change over that time period will have a big influence on exposure to climate extremes and how people respond. Society's ability to control the climate is quite limited, but through mechanisms like city and regional planning and building codes, a lot could be done to build a more resilient society. The team is trying to look at those interactions by integrating information about historical populations, socioeconomic variables, scenarios

of future populations and economic growth, global climate model simulations, regional climate model simulations, and climate observations. They are trying to detect and attribute geographic patterns of economic loses to the combined effects of human development and climate variability and climate change to ultimately gain insights into how sensitive climate risk is to these different factors. Through these scenarios, the team will be able to run simulated scenarios for the future, study how impacts scale over time, and where big increases in impacts of climate extremes are going to be seen due to either rapidly changing climate or rapid development. Willis Shem, a postdoctoral regional climate modeler with CCSI, is also involved in this research.

What role does your research play in climate change research?

"I argued in a book chapter I wrote in 2008 that society has little interest in the science of climate change, apart from the potential consequences of that climate change on assets and resources that are valued by society. Hence, my research is involved in identifying the linkages between the climate system and social and ecological systems that will bear the impacts of climate change. Such research plays two important roles. First, it supports stakeholders in developing a robust understanding of the nature of the problem posed by climate change, which is a necessary first step in supporting decision-making regarding appropriate responses. Second, by linking climate science to consequence and decision analysis, one demonstrates the relevance of climate science to problem solving while developing insights into how that science can be prioritized to meet the needs of end users."

Who is the customer for your research?

"IAV research generally has three different types of customers. The first, and most direct, is the research sponsor who provides financial support for a research project or program in order to advance understanding of a particular research question or challenge. For example, one of CCSI's key sponsors for IAV research is the Integrated Assessment program within the DOE Office of Biological and Environmental Research, which is one of DOE's primary sponsors of research investigating the linkages between the drivers of climate change, the consequences of climate change, and response options such as mitigation and adaptation. Invariably, however, any research endeavor has indirect customers or consumers. Therefore, a second customer is the broader IAV research community which benefits from the collective research contributions of its members. Meanwhile, a third customer would be the public at-large. The impacts of climate change are an issue of growing societal relevance, and thus, any research in this arena hopefully spills over to better inform the public about climate change and its consequences."

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

"The one consistent theme throughout my career has been a strong desire to be involved in science in support of the public interest. Climate change is one of those 'wicked problems' involving complex scientific, economic, behavioral, and even epistemological challenges. That makes it interesting from an intellectual basis. Yet climate change is likely to be the impetus behind future technology and policy initiatives that are incredible in scale, scope, and societal implications. This creates an intense demand for robust information on the timing and magnitude of climate change as well as the costs and benefits associated with different risk management options. As a result, climate change is an arena where science is quite quickly transferred from the research to the policy community. If I can play a role in facilitating that transfer, then I've contributed in some small part to helping society cope with a fairly sizeable challenge, and that's quite satisfying."

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

"I have two pet theories regarding the future of climate change research. The first is that climate change will eventually lose some of its current prominence as a stand-alone research endeavor. Climate change is the most pressing component of the broader phenomenon of global change. The research activity within CCSI and its emphasis on integration is indicative of the need to investigate the climate system in the context of the Earth system. As the climate science community moves further down this pathway of integration, I think we'll eventually realize that we're no longer engaging in climate science per se, but Earth system science, and that will become the new paradigm. One might even argue that this shift has already occurred, with climate change simply being the more societally relevant brand name. The second theory is that much of the climate and assessment services currently provided by the research community will eventually be handed over to the private sector. As consideration for climate change becomes a more routine part of doing business, we're almost certain to see the emergence of service providers capable of delivering climate data and information as well as impact and vulnerability assessments. That is likely to free up the research community to focus on innovation."

IN THE NEWS

Budhendra Bhaduri was named as a recipient of a 2010 Homeland Security Award presented by the Christopher Columbus Fellowship Foundation and AgustaWetland North America. This award was in recognition of Bhaduri's leadership in the development of LandScan USA, a database that estimates at 90-meter cells population distribution of the 50 states during daytime and nighttime hours. Bhaduri's award was for Emergency Response to Natural and Manmade Disaster, one of four award categories.

From ORNL 10/5/10 Press Release

Highlighted Research

SYNTHETIC APERTURE RADAR (SAR)

Members of ORNL's Distributed Active Archive Center (DAAC) are collaborating with the Alaska Satellite Facility (ASF)—through the National Aeronautic and Space Administration's (NASA) Tech Infusion Project to make a type of high-resolution imaging data called Synthetic Aperture Radar (SAR) data more accessible to terrestrial ecologists.

SAR data provides imaging of the Earth over broad areas at very high-resolutions using radio waves. Unlike other remote sensing sensors that use visible, infrared and near-infrared waves of the electromagnetic spectrum, SAR data can penetrate cloud cover and can also be used at night. It can be employed to follow the movement of icebergs, estimate biomass, track oil spill boundaries on water, create maps of terrain for a variety of uses, and measure small (centimeter scale) changes in the Earth's surface after earthquakes. SAR data may also have an abundance of undiscovered uses as SAR data technology has only recently begun to become economical on a smaller scale.

"Our primary goal with the Tech Infusion Project is to work with ASF to slowly build familiarity with SAR data," explained ORNL DAAC research scientist Suresh K. Santhana Vannan, also the lead at ORNL for the Tech Infusion Project. Along with Bruce Wilson who is also a research scientist at the ORNL DAAC, Suresh will act as a liaison between field researchers at ORNL and data managers at ASF to specify how SAR data can be better tailored for use by terrestrial ecologists. As the primary data archive for SAR data, ASF will provide this data to the ORNL DAAC. Eventually, Suresh hopes that terrestrial ecologists will have access to SAR data in an easy to use format to address variety of scientific questions.

One of the barriers that scientists face in using SAR data is the need for additional data processing. Additional polarization processing must be done on top of raw SAR data to get a meaningful image from the scattered radar signals. Different planes of polarization provide different outputs, and thus different scientific research requires different polarization processing. At this point, many researchers are unfamiliar with the levels of SAR data processing and what level is best for their research. It is the complexity of the data and the processing of the data that creates a barrier to the scientists who could use SAR data.

Unfortunately, polarization processing is not the only barrier to using SAR data. This radar data is currently stored in CEOS format (a mixed ascii and binary format), while other types of NASA satellite data are stored in HDF (hierarchical data format). One of the key goals of the Tech Infusion Project is to put SAR data into HDF, netCDF (network common data form), and GeoTIFF formats so that researchers may easily use SAR data along with multiple types of terrestrial data in their research.

Another goal of this project is to not only provide the data but also allow people to search for very specific SAR data via Mercury, a metadata search engine. Researchers could use Mercury to search for specific data using detailed temporal and spatial search criteria.

ASF will be providing SAR data for approximately 50 sites initially. These sites will correspond with sites where data is already collected by other instruments like NASA's MODIS (Moderate Resolution Imaging Spectroradiometer) sensor and micrometeorological data collecting flux towers. This will allow researchers to validate the accuracy of SAR data against data that is already validated and widely used.

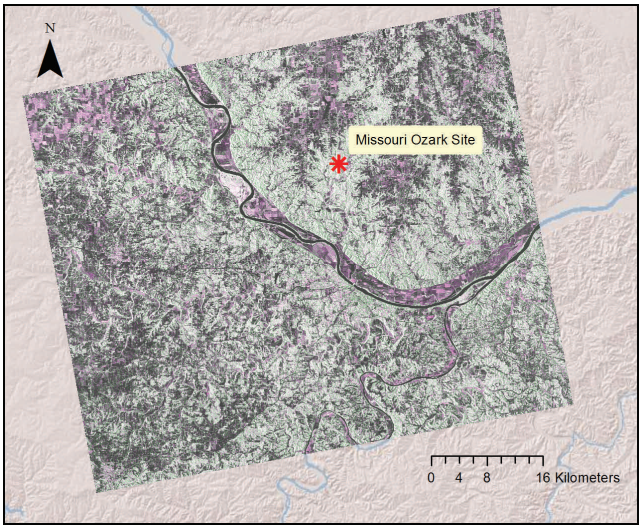


Figure 2. *An ALOS-PALSAR SAR image acquired on August 4th 2010 over Missouri Ozark flux tower site. Shades of green in the image depict vegetation and shades of pink denote barren land.*

According to Suresh, climate models stand to gain much from SAR data. "There is a need for a high-quality soil moisture map," he explained. "For some climate models, that's critical information. The accuracy of climate models is often not up to the mark because there is no on-going map of soil moisture. This kind of soil moisture data that SAR data could provide can help to fine-tune climate models."

As climate modelers seek to create multi-decadal simulations of future global climate, increasing amounts accurate observational data—as opposed to proxy numbers—must be included in models to provide more precise simulations. Not only can SAR data provide soil moisture levels, it can quantify changes in biomass, such as forest reduction, which has a direct impact on how much carbon dioxide is moving into the atmosphere. Radar data can determine increases in urban development, differentiate between crop types, and provide information on diseased tree populations. It could be used for renewable energy assessments to look at how much feedstock and switchgrass is available in different areas to determine how much can used to produce biofuel.

For the next few months, however, the Tech Infusion Project's primary goals involve strengthening awareness of SAR data, creating a versatile file format, and waiting for feedback from researchers who find uses for the data in their studies.

"We'd like to see a few researchers make use of the data in some fashion to facilitate their research," Suresh explained. "We hope that some researchers will produce peer-reviewed journal articles about using the data. As we move along, we'll have a better understanding of what is needed by our community."

QUADRENNIAL REVIEW SUPPORT (DOD) (CONTINUED)

bands: 10-20 years, 20-50 years, and 50+ years.

ORNL applied robust, model-based predictive visual analysis and display of climatic conditions over time to the analysis. ORNL created visualizations of projections of global climate conditions from IPCC simulations based on current global trends of emissions, as well as trends based on IPCC scenarios of emissions reduced by mitigation approaches (Figures 1 and 3). Initially, the team focused on specific regions including Russia, China, India, and the Korean Peninsula. Standard IPCC scenarios were used that consider factors such as global population and demographic statistics. Data was of best fidelity available considering computational and data resources.

ORNL used the projected future climates to create global and regionally-focused reports with accompanying graphics that assess potential impacts to security-relevant topics such as water scarcity, migration of people, food shortages, and increased natural disasters that can test the capacity of DoD. ORNL drew not only on its own climate change projections, but also on a wider range of climate change impact research and assessment literatures, where relevant, and expert judgment, as appropriate.

Additionally, ORNL supported two Office of the Secretary of Defense (Policy)-sponsored, National Defense University-hosted workshops that further explicated current trends (including drivers and indicators) of potential impact within the pivotal geographic centers/regions previously identified. The workshops examined the implications of these trends for future US security strategy.

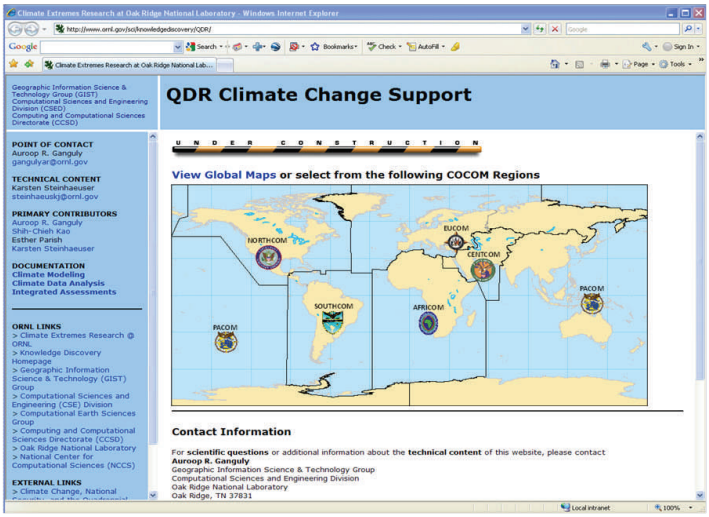
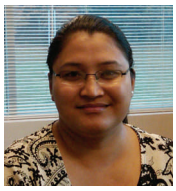


Figure 3. *All deliverables for this project were presented within a web-based architecture allowing access from distributed QDR participants, available at the following link: http://www.ornl.gov/sci/knowledgediscovery/QDR/*

CALENDAR

World Climate Research Programme—Open Science Conf. (Denver, CO)……24-28 October 2010
Climate Adaptation in the Nordic Countries: Science, Practice, Policy (Stockholm) ...8 -10 Nov 2010
Special Symposium on Climate Change & Impact Assessment sponsored by the IAIA (Washington, DC)…….....15-16 November 2010
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
91st Annual Amer. Meteorological Society Meeting (Seattle, WA)…..……..…….. 23-27 January 2011
AmeriFlux Science Meeting & 3rd NACP All-Investigators Mtg (New Orleans)…. 31 Jan—4 Feb 2011
Amer. Assoc. for the Advancement of Science Annual Meeting (Washington, DC)…...17-21 Feb 2011
Colorado Conference on Earth System Governance (CSU, Fort Collins, CO)…….17-20 May 2011
Fifth Intl. Conf on Flood Management (Tsukuba, Japan)…..…….27-29 September 2011

CCSI WELCOMES NEW STAFF



Biva Shrestha has joined the Environmental Science Division as a postmaster's research associate. Shrestha will be primarily working with Jerry Pan on the ESDORA project focused on how to use digital object management technology for improved management and provenance tracking. Shrestha holds a BS in Computer Engineering from Kathmandu Engineering College, Tribhuwan University in Kathmandu, Nepal and an MS in Computer Science from Appalachia State University.

CCSI 1ST ANNUAL SAB MEETING

CCSI held its first annual meeting with its Science Advisory Board (SAB) September 28-30. After an introductory dinner with ORNL and CCSI Leadership, Jim Hack, CCSI Director, and the other research theme leads provided overviews as part of a plenary session followed by discussions of the CCSI's Strategic Plan including focused discussions around each of the four research themes, current and planned projects, and the efforts to integrate these research themes. CCSI staff had an opportunity to meet one-on-one with the SAB members during a two-hour poster session on Wednesday evening which allowed CCSI staff to showcase their expertise as well as the wide variety of projects under the Institute's umbrella (Figure 5). "I saw a lot of enthusiasm about the Institute among the ORNL scientists and am looking forward to its continued evolution, " said Tony Janetos, SAB Chair. The SAB's recommendations are key inputs as CCSI finalizes its strategic plan over the next few weeks. The next SAB meeting will be in the May/June 2011 timeframe, and annually thereafter.

Figure 4. *CCSI Science Advisory Board (left to right): Jim Randerson, Virginia Burkett, Jeff Kiehl, Sara Graves, Venkatramini Balaji, Tony Janetos, Rob Jackson*

Figure 5. *Virginia Burkett watches a demonstration by Giri Palanisamy during the Poster Session.*

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RECENT DATA PRODUCTS

'LBA-ECO CD-06 Land Use/Land Cover Time Series, Ji-Parana Basin, Brazil: 1986-2001'. See http://webmap.ornl.gov/wcsdown/dataset.jsp?ds_id=844. Google Earth visualization available at http://webmap.ornl.gov/kmz/ornldaac_ds844.kmz.

'ISLSCP II Continuous Fields Of Vegetation Cover, 1992-1993'. See http://webmap.ornl.gov/wcsdown/dataset.jsp?ds_id=931. Google Earth visualization available at http://webmap.ornl.gov/kmz/ornldaac_ds931.kmz.

Coming in October

Highlighted Researcher: Rich Norby
Highlighted Research: Earth System Modeling

RECENT PUBLICATIONS

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Kardol P, Campany CE, Souza L, Norby RJ, Weltzin JF, Classen AT. Climate change effects on plant biomass alter dominance patterns and community evenness in an experimental old-field ecosystem. Global Change Biology 16:2676-2687

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Marland, G., 2010. Accounting for carbon dioxide emissions from bioenergy systems, Journal of Industrial Ecology, in press.

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T. Wilbanks and R. Kates, "Beyond Adapting to Climate Change: Embedding Adaptation in Responses to Multiple Threats and Stresses," Annals of the Association of American Geographers, 100 (2010): 1-9. doi: 10.1175/2010MWR3288.1

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 position descriptions and apply at http://jobs.ornl.gov .

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