From CCSI Leadership

On a daily basis, ORNL scientists engage in fundamental research that spans scientific domains from Earth system modeling, climate dynamics, algorithm and numerical methods research, carbon cycle and ecosystem modeling, data analytics and visualization, climate change data science, ecosystem processes, and the analysis of climate change impacts and options for adapting to and mitigating future climate change.

Since the early 1980s, ORNL has been a key partner and leader in developing high-performance computational platforms, scaling climate code for maximum throughput, and using these in climate change science and terrestrial ecosystem responses to environmental change. In addition, ORNL has curated important environmental data during the same time frame and has unique holdings that can be interrogated to address many climate change questions.

It is the ability to integrate not only our diverse staff and our world-class resources but our ability to provide the real-time, continuous feedback among our research themes that differentiates ORNL's contributions by further perfecting the models, experiments and analysis to provide true benefit to climate change policy and decision makers.

Institute operations are based on the core values of collaboration, transparency, accessibility, and quantification.

Relevance: All of our work must be relevant to the needs of society and our stakeholders. When we are confronted with choices, we will always seek to shape these choices based on the needs and interests of our stakeholders.

Collaboration: Climate science is intrinsically multidisciplinary and interdisciplinary. Therefore, significant progress can only be achieved through sustained and authentic collaborative efforts.

Transparency: The potential consequences of climate change are grave - avoiding the worst of the consequences will require substantial investment. For society to have the confidence to make investments based on advice from the climate community requires that our methodologies for gathering data and climate simulation be available and subject to rigorous review in the peer-reviewed literature and elsewhere.

Accessibility: Society invests significant resources in climate science and is eager for information that can inform policy. Therefore, we must make our data and models widely and easily available so that society receives the maximum benefit from its investment.

Quantification: Quantitative knowledge on climate change is far more valuable to the community and to policy makers. Therefore, we will strive to place meaningful estimates of uncertainty on all information we provide and will strive to communicate confidence and uncertainty in ways appropriate to the audience.

To support our mission and realize our vision, CCSI will remain dedicated to these principles.

James J. Hack, Director

David C. Bader, Deputy Director

Gary K. Jacobs, Operations and Business Development Manager

Research Sponsors

U.S. DEPARTMENT OF ENERGY
Office of Science

DOE Biological and Environmental Research Program

ASCR

NOAA National Oceanic and Atmospheric Administration, U.S. Department of Commerce

NASA

Contacts

Contact	Program
James J. Hack jhack@ornl.gov.	CCSI Director and Earth System Modeling Theme Lead
David C. Bader baderdc@ornl.gov	CCSI Deputy Director and Data Integration, Dissemination and Informatics Theme Lead
Gary K. Jacobs jacobsgk@ornl.gov	CCSI Operations and Business Development Manager
Peter E. Thornton thorntonpe@ornl.gov	Terrestrial Ecosystem and Carbon Cycle Science Theme Lead
Benjamin L. Preston prestonbl@ornl.gov	Impacts, Adaptation and Vulnerability Science Theme Lead

Partners

DOE National Laboratories

- Argonne National Laboratory
- Brookhaven National Laboratory
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- National Renewable Energy Laboratory
- Pacific Northwest National Laboratory
- Sandia National Laboratory

Universities

- Boise State University
- Florida State University
- Massachusetts Institute of Technology
- New York University
- Purdue University
- Rutgers University
- Texas A&M University
- University of Alberta (Canada)
- University of California-Berkeley
- University of California-Davis
- University of California-Irvine
- University of Illinois – Chicago
- University of Puerto Rico
- University of Tennessee
- University of Utah

National Agencies

- National Aeronautics and Space Administration
- National Center for Atmospheric Research
- National Oceanic and Atmospheric Agency
- US Army Cold Regions Research & Engineering Lab
- US Department of Agriculture
- USDA Forest Service
- USDA Land Mgt & Water Conservation Research
- US Geological Survey
- US Global Change Research Program

Oak Ridge Climate Change Science Institute

One Bethel Valley Road
P.O. Box 2008, MS-6301
Oak Ridge, TN 37831-6301
Phone: 865-574-5435
Fax: 865-574-6476
E-mail: climatechangescience@ornl.gov

For an up to date list of partners, please refer to ORNL Climate Change Science Institute at: http://climatechangescience.ornl.gov/

Climate Change Science Institute

To advance understanding of the Earth system, describe the consequences of climate change, and evaluate and inform policy on the outcomes of climate change responses.

CCSI Mission Statement

OAK RIDGE National Laboratory

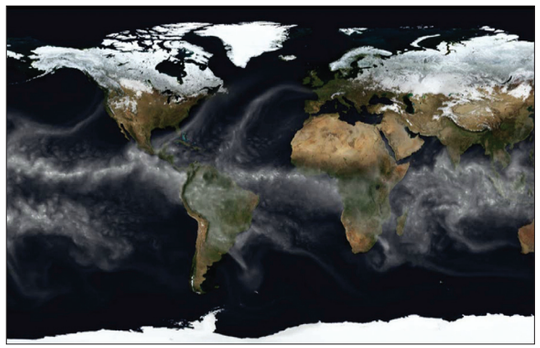
Climate Change SCIENCE INSTITUTE

ORNL 10-G01581/abh

The Issue

There is a growing demand for scientific insights regarding climate change, its consequences, and how disparate organizations from local communities to national government and international agencies can best respond to challenges in both adaptation and mitigation of climate change. The questions being asked are less about how much warming may occur, but rather specifics about extreme events such as heat waves, droughts, floods, or rapid sea-level rise. The answers to these questions call for a new generation of comprehensive, high-resolution Earth system models that predict the physical, biogeochemical, and coupled chemical evolution of the climate system.

To deal with the projected impacts effectively, it is necessary to provide information to decision makers to support adaptation planning and mitigation actions. Yet at present, climate information is not available on appropriate scales or in forms easily accessible to stakeholders. Decision makers need access to climate projections that encapsulate the latest scientific understanding with accurately quantified uncertainties - to reliably assess the potential benefits in weighing the cost of adapting policies, practices and legacy infrastructure against the losses in nature, managed ecosystems, the built environment and human health.

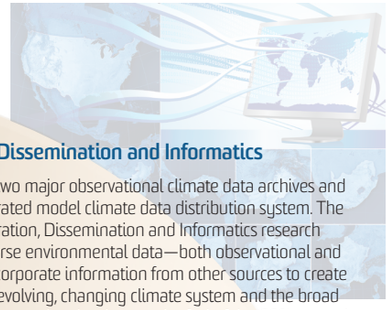


Long Term Perspective

- We will be recognized as an international leader in seasonal to decadal to centennial predictions of climate change relevant to global and regional scales.
- We will provide in-depth interpretation and synthesis information to increase the availability and usability of climate predictions for research on climate change impacts and assessment.
- ORNL research will continue to be at the forefront in understanding climate-carbon cycle feedbacks and in determining how terrestrial ecosystems respond to changes in temperature, atmospheric CO_2 concentrations, and precipitation.
- We will be recognized as a strategic international partner with other climate change research and impacts institutes and top tier universities.

Earth System Modeling

Exploiting ORNL and DOE Office of Science competencies in high-performance computing and multi-scale computational science, the Earth System Modeling research theme focuses on determining the benefit of exploiting very-high-resolution global models to support the investigation of regional climate phenomena, especially those related to the hydrological cycle. An important part in the development and deployment of an ultra-high-resolution model will be to test the hypothesis that high-resolution models are necessary to simulate non-linear phenomena and interactions on the small scale that have feedbacks on large scale climate behavior, as well as the accurate simulation of local to regional scale phenomena.

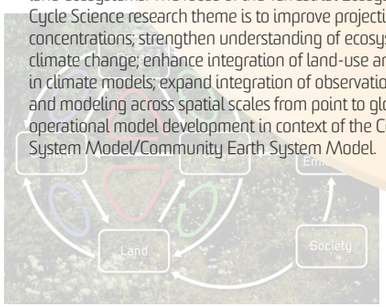


Data Integration, Dissemination and Informatics

ORNL is the home of two major observational climate data archives and a participant in a federated model climate data distribution system. The goal of the Data Integration, Dissemination and Informatics research theme is to "fuse" diverse environmental data—both observational and model based—and incorporate information from other sources to create knowledge about the evolving, changing climate system and the broad range of spatial and temporal scales that are the foci of the CCSI research agenda. Topics within this theme range from the real-time acquisition and archival of experimental data from field experiments, to research development of advanced analytical tools for multi-petabyte remotely sensed data.

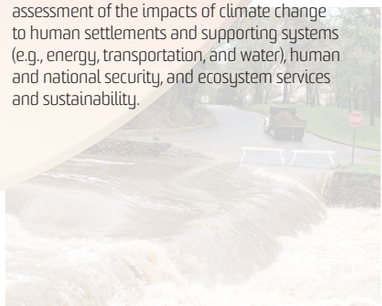
Terrestrial Ecosystem and Carbon Cycle Science

Prediction of future climate trajectories depends on prediction of the atmospheric concentration of CO_2 and other greenhouse gases and on prediction of the distribution, structure, and functioning of land ecosystems. The focus of the Terrestrial Ecosystem and Carbon Cycle Science research theme is to improve projection of future CO_2 concentrations; strengthen understanding of ecosystem response to climate change; enhance integration of land-use and land-cover change in climate models; expand integration of observations, experimentation, and modeling across spatial scales from point to globe; and to focus on operational model development in context of the Community Climate System Model/Community Earth System Model.



Impacts, Adaptation, and Vulnerability Science

The Impacts, Adaptation, and Vulnerability research theme represents the gateway to a broad range of ORNL capabilities and knowledge relevant to understanding the societal and ecological consequences of climate change and is, therefore, a critical vehicle for translating research achievements in the other CCSI research themes into policy-relevant insights that inform decision-making on adaptation and mitigation. This theme places particular focus on four sub-domains: characterization of climate extremes, assessment of the impacts of climate change to human settlements and supporting systems (e.g., energy, transportation, and water), human and national security, and ecosystem services and sustainability.



Recent ORNL Contibutions to Climate Change

- Manipulated grasslands and forests to see how precipitation, CO_2 and temperature changes affect the biosphere and highlighted the results to a worldwide audience in *Scientific American*.
- Conceived, simulated, constructed, and tested a new experimental system for simulating future belowground temperature increases in a temperate deciduous forest at ORNL.
- Observed a high degree of homeostasis while studying photosynthetic sensitivity to temperature and the potential for acclimation in relation to the climatic provenance, indicating that direct impacts of climatic warming on forest productivity, species survival, and range limits may be less than predicted by existing models.
- Directly contributed to the scalability and doubling of performance in the April 2010 release of the Community Climate System Model.
- Analyses showed that aggressive adoption of advanced carbon sequestration technologies could greatly increase the potential cumulative increase in carbon by 2100.
- Proposed a framework for dealing with greenhouse gas inventory uncertainties which should have a large impact on the functioning and effectiveness of the Kyoto Protocol and its successor.
- Successfully performed a coupled global high-resolution simulation that represented the interaction between tropical cyclones and the ocean surface.
- Improved geospatial resolution of cropland carbon fluxes in the US using inventory based carbon accounting.
- Observed that changes in plant dominance patterns and community evenness are an important part of community responses to climatic change, and generally, that such compositional shifts can alter ecosystem biomass production and nutrient inputs.
- Developed a parallel version of the Glimmer-CISM ice sheet model through the SEACISM project that uses a scalable, accurate solver so that fine-scale simulations can occur more efficiently and robustly.