

**BER Staff**

[science.energy.gov/ber/](http://science.energy.gov/ber/)

Unless noted, email addresses for BER staff follow the format: [firstname.lastname@science.doe.gov](mailto:firstname.lastname@science.doe.gov)

**Associate Director Office**

Sharlene Weatherwax, 301-903-3251  
Associate Director of Science  
for Biological and Environmental Research

David Thomassen, 301-903-9817  
Chief Scientist

Michael R. Riches, 301-903-3264  
Senior Technical Advisor  
[mike.riches@science.doe.gov](mailto:mike.riches@science.doe.gov)

Kathy Holmes, 301-903-3251  
Administrative Specialist

**Biological Systems Science Division (BSSD)**

Todd Anderson, Director, 301-903-3213  
Terry Lagana, Secretary, 301-903-3213  
Joanne Corcoran, Program Support, 301-903-6488

**Genomic Science**

Joseph Graber, 301-903-1239  
Dean Cole, 301-903-3268  
Daniel Drell, 301-903-4742

Roland Hirsch, 301-903-9009  
John Houghton, 301-903-8288  
Pablo Rabinowicz, 301-903-0379  
Michael Thelen (Detailee\*)

**Computational Biosciences**

Susan Gregurick, 301-903-7672

**Biofuels Research and Bioenergy Research Centers**

Catherine Ronning, 301-903-9549  
Joseph Graber, 301-903-1239  
Susan Gregurick, 301-903-7672  
Sharlene Weatherwax, 301-903-3251

**Plant Feedstocks**

Catherine Ronning, 301-903-9549  
Pablo Rabinowicz, 301-903-0379

**Radiochemistry and Imaging Instrumentation**

Prem Srivastava, 301-903-4071

**Radiobiology**

Noelle Metting, 301-903-8309

**Structural Biology Infrastructure**

Roland Hirsch, 301-903-9009

**Human Research Subjects Protection**

Elizabeth White, 301-903-7693

**User Facility**

Joint Genome Institute [www.jgi.doe.gov](http://www.jgi.doe.gov)  
Daniel Drell, 301-903-4742  
Susan Gregurick, 301-903-7672

**Climate and Environmental Sciences Division (CESD)**

Gerald Geernaert, Director, 301-903-3281  
Secretary, Nver Nekerdjian (Contractor), 301-903-3281  
Leslie Runion, Program Support, 301-903-9135  
Karen Carlson-Brown, Program Support, 301-903-3338

**Atmospheric System Research**

Ashley Williamson, 301-903-3120  
Wanda Ferrell, 301-903-0043  
Sally McFarlane, 301-903-0943  
Rick Petty, 301-903-5548

**Terrestrial Ecosystem Science**

Daniel Stover, 301-903-0289

**Terrestrial Carbon Sequestration Research**

Michael Kuperberg, 301-903-3511

**Subsurface Biogeochemical Research**

Paul Bayer, 301-903-5324  
Roland Hirsch, 301-903-9009  
David Lesmes, 301-903-2977

**Regional and Global Climate Modeling**

Renu Joseph, 301-903-9237

**Earth System Climate Modeling**

Dorothy Koch, 301-903-0105

**Integrated Assessment Research for Climate**

Bob Vallario, 301-903-5758

**Climate Information and Data Management**

Wanda Ferrell, 301-903-0043

**User Facilities**

**Atmospheric Radiation Measurement Climate Research Facility** [www.arm.gov](http://www.arm.gov)

Wanda Ferrell, 301-903-0043  
Rick Petty, 301-903-5548

**Environmental Molecular Sciences Laboratory**

[www.emsl.pnl.gov](http://www.emsl.pnl.gov)  
Paul Bayer, 301-903-5324

**Small Business Innovation Research (SBIR)**

**Climate and Environmental Sciences SBIR**

Rick Petty, 301-903-5548  
Renu Joseph, 301-903-9237  
David Lesmes, 301-903-2977  
Ashley Williamson, 301-903-3120

**Biological Systems Science SBIR**

John Houghton, 301-903-8288  
Prem Srivastava, 301-903-4071

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\*Quarter-time detailee not at DOE headquarters.

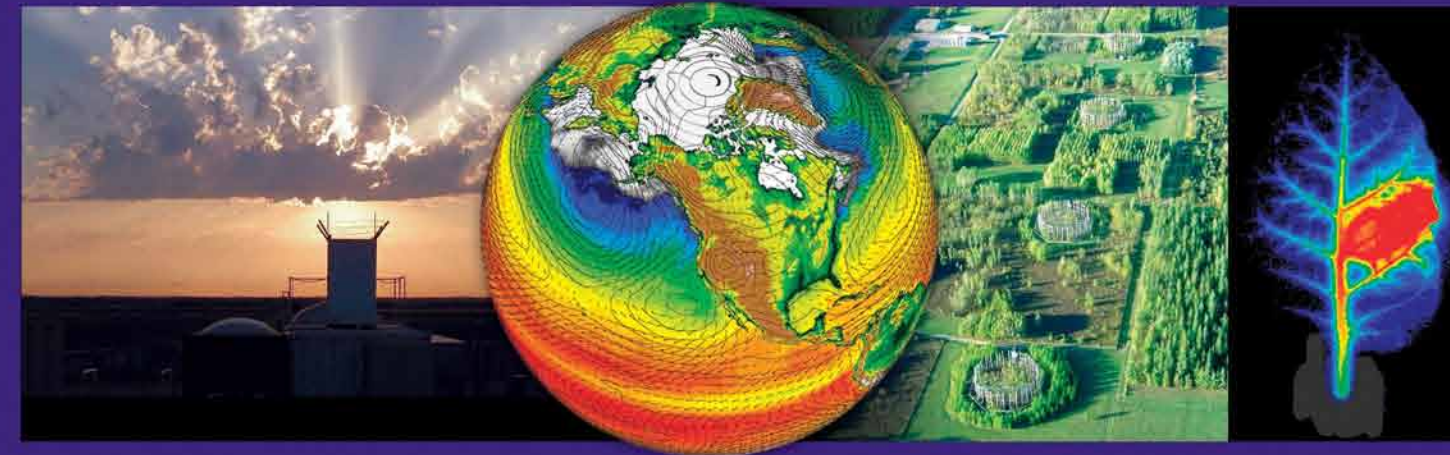
# Biological and Environmental Research

Understand Complex Biological and Environmental Systems by...

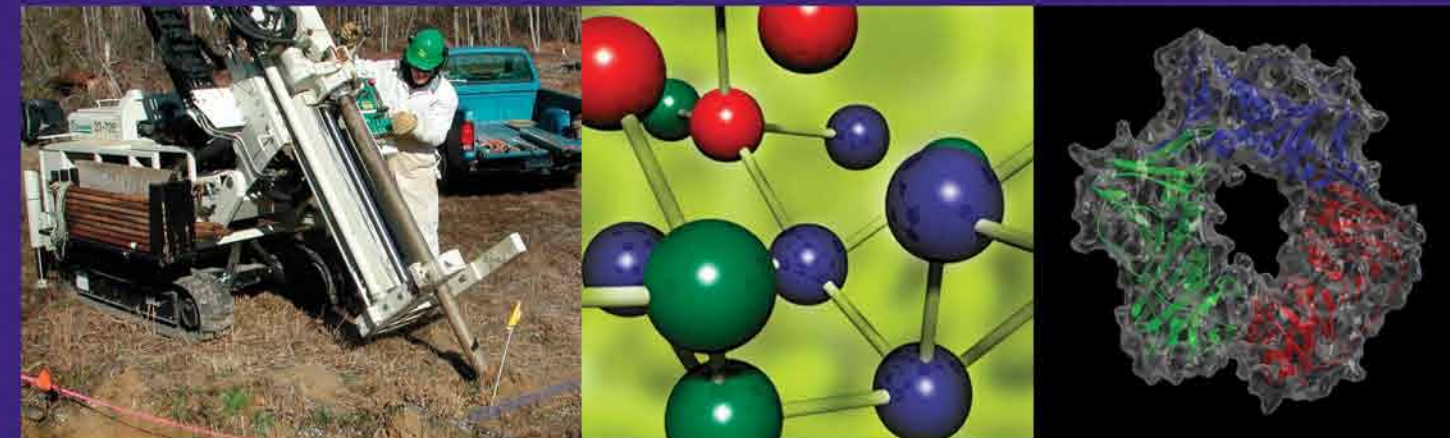
**EXPLORING** the frontiers of genome-enabled biology



**DISCOVERING** the physical, chemical, and biological drivers of climate change



**SEEKING** the biological, geochemical, and hydrological determinants of environmental sustainability and stewardship



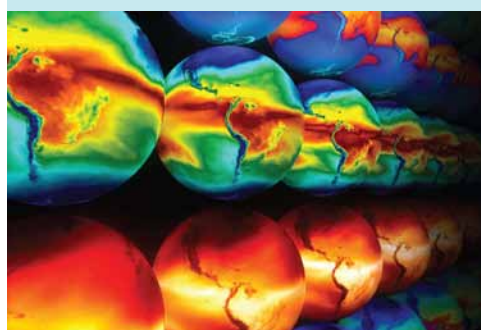


## DOE Mission-Inspired Science

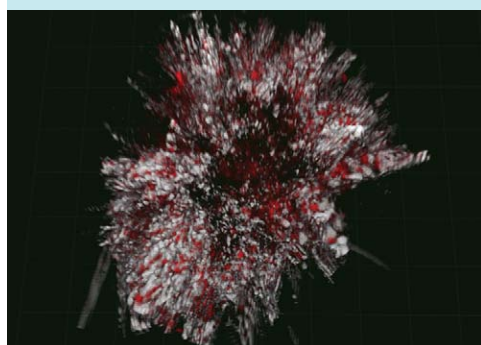
*Addressing critical national needs*



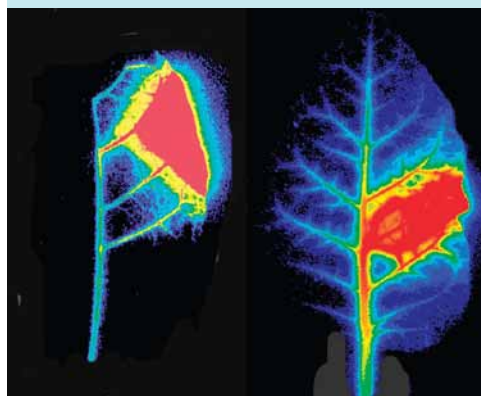
*Insights from genomics are advancing the development of grasses and fast-growing trees for biofuel production.*



*Model simulations project future climate.*



*Microbes can transform minerals in the subsurface environment.*



*Movement of plant compounds is tracked using radiochemistry tools developed for human medicine.*

### Sustainable Biofuels

To support the development of biofuels as major sustainable national energy resources, the DOE Biological and Environmental Research (BER) program is using the power of genomics and systems biology to study microbes, fungi, and plants important to solving energy challenges.

### Climate Science

To inform decision making about energy use and climate change, BER is seeking to resolve the greatest uncertainties in climate science. Research activities include studying the effects of greenhouse gas emissions on Earth's climate and biosphere, improving the world's most powerful climate models, and working to understand carbon cycling in terrestrial ecosystems.

### Subsurface Biogeochemistry

To advance understanding and predictions of contaminant mobility in the subsurface, BER is developing predictive models that integrate hydrological, microbiological, and geochemical knowledge over a range of scales. These models also will aid assessments of potential approaches to carbon sequestration and waste isolation.

### Biology-Physics Interface

To develop technologies that are transferable to diverse applications, BER is exploring research at the interface of biological and physical sciences.

## Biological and Environmental Research

### Mission

Advance world-class biological and environmental research and provide scientific user facilities to support Department of Energy missions in scientific discovery and innovation, energy security, and environmental responsibility.

### Approach

- Understand complex biological and environmental systems across many spatial and temporal scales.
- Leverage diverse scientific insights by coupling theory, observations, experiments, models, and simulations.
- Support interdisciplinary research that engages scientists from national laboratories, academia, and industry.

### Divisions

#### Biological Systems Science Division (BSSD)

BSSD aims to achieve a predictive understanding of complex biological systems with potential use in bioenergy, carbon cycling, and biogeochemistry.

BSSD research activities include

- Using genomics and systems biology to understand plants and microbes.
- Supporting DOE Bioenergy Research Centers to provide transformational breakthroughs in cellulosic biofuels.
- Developing real-time, high-resolution technologies for analyzing dynamic biological processes.

#### Climate and Environmental Sciences Division (CESD)

CESD aims to achieve a predictive understanding of climate change, ecosystem response to climate change, and contaminant fate and transport in the subsurface.

CESD research activities include

- Resolving the greatest uncertainties in climate change.
- Improving the world's most powerful climate models.
- Providing the science to inform environmental remediation strategies.
- Working to understand carbon cycling in terrestrial systems.



### DOE Bioenergy Research Centers

Bringing together top scientists from multiple disciplines, DOE BER established three Bioenergy Research Centers in 2007 to deliver high-risk, high-return breakthroughs in cellulosic biofuel production. DOE's Oak Ridge National Laboratory leads the BioEnergy Science Center in Tennessee. The University of Wisconsin-Madison leads the Great Lakes Bioenergy Research Center. DOE's Lawrence Berkeley

National Laboratory leads the Joint BioEnergy Institute in California. Each center is using genomics and advanced analytical technologies to understand (1) how to make grasses, wood, and other cellulosic materials easier to break down into sugars, (2) which enzymes degrade biomass most efficiently, and (3) how to advance the microbial production of ethanol and other gasoline-replaceable fuels from sugars.

## User Facilities

*Empowering an international community of scientists with the most advanced technologies*

### DOE Joint Genome Institute (JGI)

Sequencing more than one trillion DNA base pairs per year, JGI in Walnut Creek, California, provides state-of-the-science capabilities for genome sequencing and analysis. With more than 1800 worldwide collaborators on active projects, JGI is the preeminent facility for sequencing plants, microbes, and microbial communities that are foundational to energy and environmental research.



*As one of the largest dedicated DNA sequencing facilities in the world, JGI expertise and technologies enable analysis of complex genomes.*

### DOE Environmental Molecular Sciences Laboratory (EMSL)

By integrating experimentation with supercomputing, EMSL in Richland, Washington, enables the study of environmental challenges at the molecular level. EMSL has helped thousands of researchers use a multidisciplinary, collaborative approach to solve important challenges in biological interactions and dynamics, subsurface science, and interactions at the interfaces of natural and engineered materials.



*The electron spectrometer at EMSL is used to study the chemical properties of materials at nanoscale resolution.*

### DOE Atmospheric Radiation Measurement (ARM) Climate Research Facility

The ARM Climate Research Facility provides highly instrumented ground stations at various locations, mobile resources, and aerial vehicles to continuously measure cloud and aerosol properties. ARM Facility measurements have set the standard for long-term climate research observations and provide an unparalleled resource for examining atmospheric processes and evaluating climate model performance.



*Observations from the ARM Facility's scanning cloud radars reduce uncertainties in cloud parameterizations used in climate models.*