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An introduction for students.

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Who are we?

What are we doing?

Why are we here?

Where are we going?

United States Government

Executive Legislative Judicial

United States Government

Executive | Legislative | Judicial

Cabinet
(15 depts)

Senate
House of Representatives

9 justices

Executive Branch

Department of Agriculture (USDA)
Department of Commerce (DOC)
Department of Defense (DOD)
Department of Education (ED)
Department of Energy (DOE)
Department of Health and Human Services (HHS)
Department of Homeland Security (DHS)
Department of Housing and Urban Development (HUD)
Department of Justice (DOJ)
Department of Labor (DOL)
Department of State (DOS)
Department of the Interior (DOI)
Department of the Treasury
Department of Transportation (DOT)
Department of Veterans Affairs (VA)

The Department of Energy is the single largest Federal government supporter of basic research in the physical sciences in the United States, providing more than 40 percent of total Federal funding for this area.

DOE Program Offices

The DOE is principally a national security agency and all of its missions flow from this core mission to support national security.

Advanced Research Projects Agency - Energy
Office of Electricity Delivery and Energy Reliability
Office of Energy Efficiency & Renewable Energy
Office of Environmental Management
Office of Fossil Energy
Office of Indian Energy Policy and Programs
Office of Legacy Management
Loan Programs Office
Office of Nuclear Energy
Office of Science

National Laboratories and Technology Centers

Ames Laboratory
Argonne National Laboratory
Brookhaven National Laboratory
Fermi National Accelerator Laboratory
Idaho National Laboratory
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
National Energy Technology Laboratory
National Renewable Energy Laboratory
New Brunswick Laboratory
Oak Ridge Institute for Science and Education
Oak Ridge National Laboratory
Pacific Northwest National Laboratory
Princeton Plasma Physics Laboratory
Radiological and Environmental Sciences Laboratory
Sandia National Laboratories
Savannah River Ecology Laboratory
Savannah River National Laboratory
SLAC National Accelerator Laboratory
Thomas Jefferson National Accelerator Facility

Office of Science

Advanced Scientific Computing Research

Basic Energy Sciences

Biological and Environmental Research

Fusion Energy Sciences

High Energy Physics

Nuclear Physics

Workplace Development for Teachers and Scientists

Project Assessment

Safety, Security, and Infrastructure

Small Business Innovation Research and Small Business Technology Transfer

Office of Biological & Environmental Research

Biological Systems Science Division (BSSD)

Climate and Environmental Sciences Division (CESD)

Climate and Environmental Sciences Division

Three research activities:

- **Atmospheric System Research (ASR)**
- Climate and Earth System Modeling (FASTER)
- Environmental System Science activity

Two scientific user facilities:

- **Atmospheric Radiation Measurement (ARM) Climate Research Facility (ACRF)**
- Environmental Molecular Sciences Laboratory (EMSL)

Executive Branch

Department of Energy (DOE)

Office of Science

Biological and Environmental Research

Climate and Environmental Sciences Division

Atmospheric System Research (ASR)
ARM Climate Research Facility (ACRF)

Biological and Environmental Research

*BER supports fundamental research in **climate change**, environmental remediation, genomics, proteomics, radiation biology, and medical sciences.*

Mission: *BER advances world-class biological and environmental research programs and scientific user facilities to support DOE's energy, environmental, and basic research missions.*

Mission priorities:

Develop biofuels as a major secure national energy resource.

Understand relationships between climate change and Earth's ecosystems, and assess options for carbon sequestration.

Predict fate and transport of subsurface contaminants.

Develop new tools to explore the interface of biological and physical sciences.

Long-term Goal of BER:

"*Deliver improved climate data & models for policy makers to determine safe levels of greenhouse gases for the Earth system.*

Climate and Environmental Sciences Division

*CESC supports fundamental research to achieve a predictive, systems-level understanding of **climate change**, as well as subsurface contaminant fate and transport, to advance DOE missions in energy, climate, and environment.*

*CESC focuses on a predictive, systems-level understanding of the fundamental science associated with **climate change** and DOE's environmental challenges; both key to support the DOE mission.*

Atmospheric System Research

*The Atmospheric System Research Activity seeks to resolve the two major areas of uncertainty in **climate change** projections: the role of clouds and the effects of aerosol emissions on the atmospheric radiation balance.*

Mission:

The mission of ASR, in partnership with the ACRF, is to quantify the interactions among aerosols, clouds, precipitation, radiation, dynamics, and thermodynamics to improve fundamental process-level understanding, with the ultimate goal to reduce the uncertainty in global and regional climate simulations and projections.

Objectives:

"*determine the properties of and interactions among aerosols, clouds, precipitation, and radiation that are most critical to understand in order to improve their representation in climate models,*"

"*utilize integrated data products to develop, evaluate, and ultimately improve the parameterization of aerosol-cloud-precipitation-radiation processes in models over a range of scales.*"

Importance of the ASR Program's Research

Research from the ASR program results in improved physical formulations leading to the state-of-the-art science related to clouds, aerosols, radiation, and precipitation. The program is geared to observe and advance understanding of the atmospheric system in a holistic, comprehensive fashion that addresses the full range of interrelated climatic processes. The anticipated end result is that climate models will have reduced uncertainty and improved climate simulation capability so that climate models can be used with increased confidence in decision and policy making.

ASR Program Research Activities

The aerosol-cloud-radiation continuum and its role in the climate system is complex with many physical and dynamical facets. The ASR program's research is centered on these processes that must be well understood as well as transfer of that new knowledge to improve the representation of aerosol, cloud, radiation, and precipitation processes in climate models.

1) Cloud Life Cycle: Development of retrieval algorithms to understand 3-D distribution of clouds; quantification of microphysical and bulk macrophysical processes of clouds occurring at multiple spatial scales; evaluation of two-moment bulk and other microphysics schemes; improved representations and modeling of shallow and deep clouds; liquid and solid phase clouds.

2) Aerosol Life Cycle: Research studies on key processes that determine aerosol formation, composition, structure, and optical properties, with emphases on the formation of secondary organic aerosols and absorbing carbon aerosols; aerosol direct and indirect effects on radiation.

3) Cloud-Aerosol-Precipitation Interactions: Cloud-aerosol interactions, including how droplet and crystal nucleation mechanisms are related to the aerosol properties (size, shape, and composition), and how aerosol properties (including optical properties) are modified by those interactions; testing and evaluating the efficacy of current and future coupled meteorological-chemical-aerosol models at multiple spatial scales; observational and modeling studies of aerosol indirect effects on clouds and precipitation; integration of theory, various measurements from in situ and remote sensing platforms, and models; analysis of vertical distribution of radiative properties of aerosols and clouds.

ARM Climate Research Facility (ACRF)

Mission: "*study, monitoring, assessment, prediction, and information management activities to describe and understand:*

The interactive physical, chemical, and biological processes that regulate the total Earth system"

and

" *The changes that are occurring in the Earth system and the environment and how these changes are influenced by human actions.*"

The ***primary objective*** *is improved scientific understanding of the fundamental physics related to interactions between clouds, aerosols, and radiative feedback processes in the atmosphere.*

By this time it should be clear that
clouds, ***aerosols***, *and* ***radiation*** *are*
coupled and are important to
climate change.

Atmospheric Radiation Measurement (ARM) Climate Research Facility (ACRF)

The ARM program was created in 1989 "to study cloud formation processes and their influence on radative transfer."

ARM manages three fixed study sites (SGP, NSA, TWP); two mobile facilities (AMF1 and AMF2); an aircraft facility; and a data archive.

ARM funds climate research and supports field programs around the world.

Deployments are typically planned years in advance, with proposals being submitted by different groups of scientists stating where these facilities will be located and what scientific questions will be addressed.

Approximately 500 scientists are supported by ARM and many others use ARM data, which are available to all.

ARM Fixed Sites

SGP: Southern Great Plains (OK)
NSA: North Slope of Alaska
TWP: Tropical Western Pacific

ARM Mobile Facility (AMF) Deployments

2005 Point Reyes, CA
2006 Niamey, Niger
2007 Black Forest, Germany
2008 Shouzian, China
2009 Graciosa Island, Azores
2010 Steamboat Springs, CO

Planned

2011 Ganges Valley, India
2011 Long Island, NY
2012 Gan Island, Maldives
2012 Cape Cod, MA
2014 Amazon, Brazil

AMF Vans in Chile

AMF1 in Niger

Second ARM Mobile Facility AMF2

The ARM Mobile Facility AMF1 was first deployed in 2005.

Recently a second ARM Mobile Facility, AMF2, was built with "stimulus" funding under the American Recovery and Reinvestment Act of 2009, or ARRA.

The mobile facilities consist of three 20-foot modified shipping containers called "seatainers," or vans, and other smaller modules, containing radars and other scientific instrumentation.

The vans are designed to operate in a wide range of conditions, including shipboard deployment, and many of the instruments are pre-installed so that the vans can be shipped to any location ready to operate.

AMF2 Radar Van

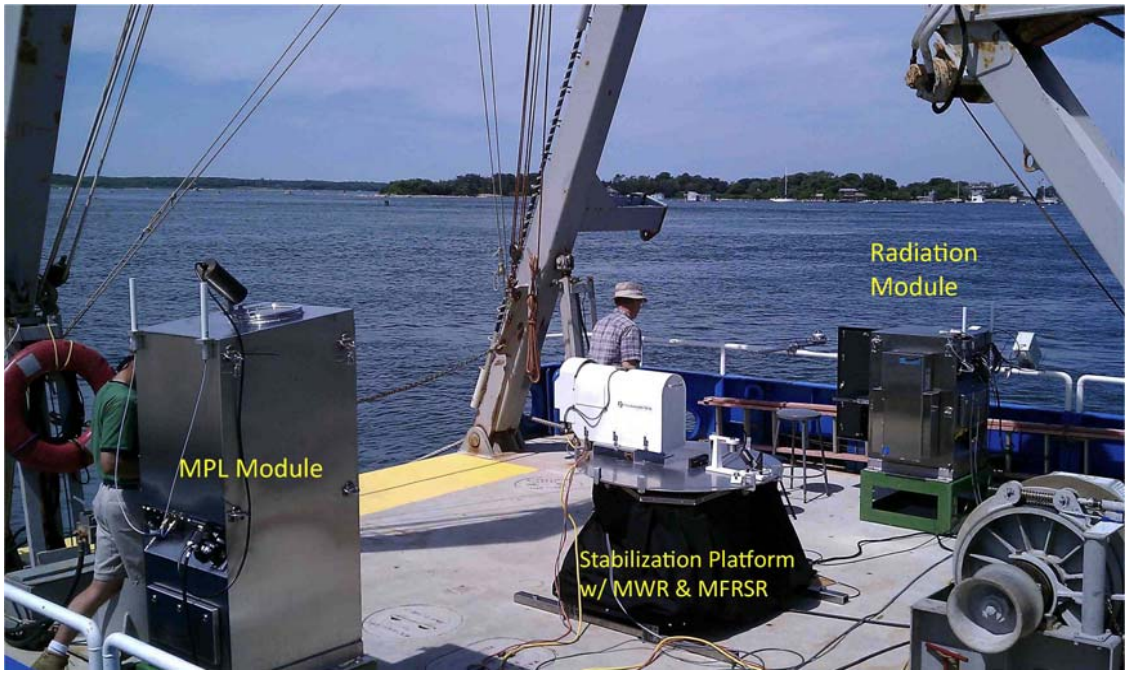
AMF2 Radar Van

AMF2 Aerosol Van

AMF2 Operations Van

AMF2 Operations Van

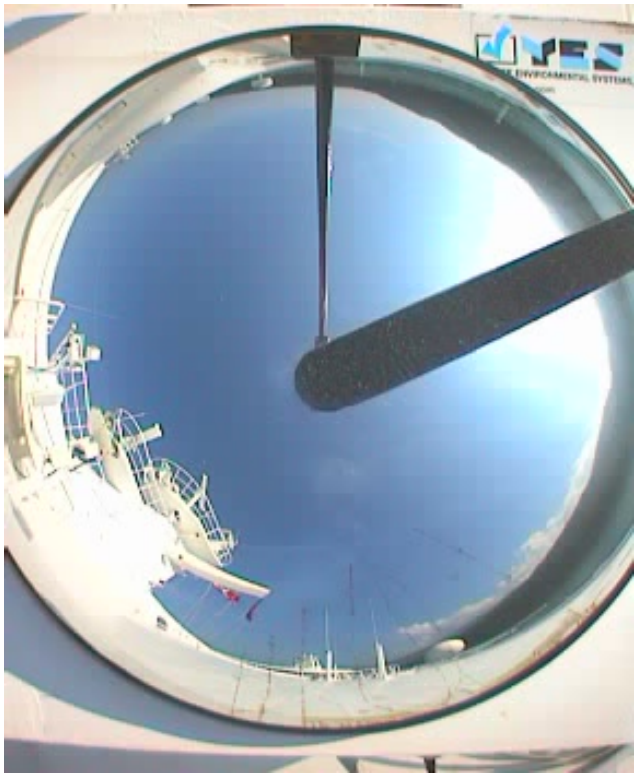
Modules



Modules on a Woods Hole Oceanographic Institution ship

Module anchored to deck

Total Sky Imager, TSI



Microwave Radiometer, MWR (mailbox)

Radar Wind Profiler, RWP (bathtub)