



Clouds, Aerosol, and Precipitation in the Marine Boundary Layer

The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Climate Research Facility is sponsoring a 20-month field study on Graciosa Island in the Azores. Scientists involved in the Clouds, Aerosol, and Precipitation in the Marine Boundary Layer field campaign are using the ARM Mobile Facility—a portable climate observatory—to study low-level clouds and aerosol in a marine environment. Collaborators from the Regional Directorate of Science and Technology of the Government of Azores, the University of the Azores, and the Portuguese Meteorological Institute are providing key logistical and operations support.

Starting in May and lasting through December 2010, data from the prolonged deployment will result in the first climatology of the detailed vertical structure and precipitation properties of low clouds at a remote subtropical marine site. Combined with associated data sets, this information will be extremely important in the validation and testing of large-scale computer models and for improved climate predictions.

Why Marine Boundary-Layer Clouds?

The boundary layer is the atmosphere between the Earth's surface and an altitude of about 1 to 2 kilometers. In a marine environment, boundary-layer clouds passively filter the sun, but also act as interactive systems that influence and modulate sea surface temperature and trade winds on seasonal to interannual timescales. Because this cloud type is found in coastal environments around the world, they play a major role in the global climate system. For accurate predictions of future climate, scientists need a better understanding of the dynamic elements that control the lifecycle—formation, maintenance, and dissipation—of these cloud types.

Significance

During the past 15 years, model simulations have repeatedly shown differing reactions by low-level clouds to increasing sea surface temperature, seasonal cycles, greenhouse gases, and aerosol properties. These results are a major reason for disagreements in predictions of future climate, and are



due primarily to technological limitations that have largely precluded detailed, long-term observations about these dynamic processes, particularly over remote oceans.

Because the Azores typically experiences relatively clean conditions but with periodic episodes of polluted air masses from nearby continents, the location on Graciosa is ideal for capturing a wide range of conditions. The extensive instrument suite provided by the ARM Mobile Facility, combined with the length of the deployment, will provide particularly important new information about the structure and variability of the remote marine boundary-layer system and the factors that influence it.



ARM Mobile Facility

The AMF consist of shelters, instrumentation, and data and communications systems for climate studies. A full-time staff monitors and maintains the facility to assure that the best and most complete data set is acquired during each deployment. Data are collected 24/7.

Operations Shelters

A minimum of two shipping containers serve as operations shelters. These structures house several instruments, as well as the computers and data systems. They also provide space for a small workshop, office, and spare parts storage.

Measurement Capabilities

Measurement capabilities include the standard meteorological instrumentation, broadband and spectral radiometer suite, and remote sensing instruments.

- 95-gigahertz W-band ARM Cloud Radar
- Micropulse Lidar and Laser Ceilometer
- Microwave Radiometer
- Microwave Radiometer Profiler
- Atmospheric Emitted Radiance Interferometer
- Sky Radiation System – a collection of radiometers to measure visible diffuse, global, and direct visible and infrared solar radiation
- Ground Radiation System – a collection of radiometers to measure visible and infrared radiation coming from the ground
- Radar Wind Profiler
- Total Sky Imager
- Balloon-Borne Sounding System – sondes launched each day at regular intervals
- Aerosol Observing System
- Surface Meteorology Station
- Eddy Correlation System
- Cimel Sunphotometer



Data and Communication System

Continuous measurements obtained by the sensors and instruments are collected by computers in the operations shelters. These data are routinely checked for quality and transmitted to the ACRF Data Archive for storage and availability to the scientific community.

Using the ARM Mobile Facility

The AMF is available to collaborate with experiments (especially those involving aircraft) from other agencies. It also can accommodate other instruments in addition to, or in place of, the baseline collection. Organizations interested in using the AMF are encouraged to submit proposals at the following website: www.arm.gov/acrf/jfc.stm

Sponsor

The AMF was developed by the ARM Program through funding from the DOE Office of Science, Office of Biological and Environmental Research. Numerous national laboratories are responsible for the science, engineering, and operation of the AMF, which is managed by the ARM Climate Research Facility.

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