



Study of Aerosol Indirect Effects in China

In 2008, the U.S. Department of Energy (DOE)'s Atmospheric Radiation Measurement (ARM) Climate Research Facility is providing the ARM Mobile Facility (AMF) to conduct a comprehensive investigation of regional aerosol impacts in China as part of a joint program with the Institute of Atmospheric Physics, Chinese Academy of Sciences. The joint program is under the "Climate Sciences" agreement established in 1987 between the DOE and China Ministry of Science and Technology. Other participants from China in the aerosol study include the China Meteorological Administration, Lanzhou University, and Nanjing University of Information Sciences and Technology. Sponsored by the DOE Office of Science, the AMF is obtaining essential cloud, aerosol, radiant energy and meteorological measurements from May to December 2008 for the Study of Aerosol Indirect Effects in China.

Preliminary analyses of multiple satellite data sets over China, combined with data from an ongoing study called the East Asian Study of Tropospheric Aerosols: An International Regional Experiment, show that high concentrations of aerosol particles in the study region may influence the atmosphere across the Pacific Rim, especially the energy balance and cloud properties. Both in situ measurements and independent ground-based remote sensing data from the AMF will help scientists to validate satellite-based findings, understand the mechanisms of aerosol indirect effects in the region, and examine the roles of aerosols in affecting regional climate and atmospheric circulation, with a special focus on the impact of the East Asian monsoon system.

Direct and Indirect Effects

Aerosols affect Earth's climate in two ways: directly, through scattering and absorption of solar and infrared radiation, and indirectly, by influencing the creation (or nucleation) of cloud droplets, leading to increased surface area and reflectivity of clouds. To what extent these different aerosol effects impact the Earth's energy balance is a subject under much investigation by the climate research community.



A hazy sky filters the sun above Shouxian, China.

Regional Data Makes a Difference

To provide a complete picture of aerosol effects in the study area, four instrumented sites will operate throughout the region.

As the primary measurement site, the AMF is located at Shouxian, approximately 500 km west of Shanghai. A supplemental facility with a reduced complement of AMF instruments is obtaining measurements at an observatory on the shores of Lake Taihu, just 96 km west of Shanghai. Both of these facilities will operate from May through December 2008.

An ancillary facility with a subset of AMF instruments has been established to the north to obtain comparative measurements in locations with different environmental conditions. From April through June, the ancillary facility is operating at a location in the semi-desert conditions of Zhangye in north-central China. The ancillary facility then moves to Xianghe on the northeast coast. It will operate in this primarily agricultural environment from July to the end of the AMF deployment in December.

ARM Mobile Facility

The AMF requires a rotating staff to maintain the instruments and ancillary equipment. It consists of the following main components:

- operations shelters
- standard meteorological instrumentation, broadband and spectral radiometer suite, and remote sensing instruments
- data and communications systems.

Operations Shelters

A minimum of two shipping containers serve as the facility shelters. Converted into laboratory space, these shelters house the computer and data systems connected to the high-tech instruments that collect data from the atmosphere. They also provide space for spare parts storage and conducting repairs.

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/fc.stm

Sponsor

The AMF was developed by the ARM Program through funding from the DOE Office of Science. Managed by the ARM Climate Research Facility, numerous national laboratories are responsible for the science, engineering, and operation of the AMF.

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DOE/SC-ARM/P-08-012



The ARM Climate Research Facility is funded through the U.S. Department of Energy's Office of Science. Additional information about ARM Program Science and the ARM Climate Research Facility is available at www.arm.gov.