ARM
CLIMATE RESEARCH FACILITY

FACT SHEET

U.S. Department of Energy

American Recovery and Reinvestment Act of 2009

The Atmospheric Radiation Measurement (ARM) Climate Research Facility, a U.S. Department of Energy (DOE) scientific user facility, gathers climate measurements around the world. Instruments at three permanent sites, two mobile facilities, and an aerial facility measure clouds, aerosols, radiation, and the interactions among them. Scientists use these measurements to improve the computer models that simulate Earth's climate system.

Through the American Recovery and Reinvestment Act of 2009, the ARM Facility received $60 million for new and upgraded instrumentation, equipment, and infrastructure to improve these atmospheric data sets.

Scanning Radars

With nearly $30 million to invest in new radar technology, the ARM Facility is deploying an unprecedented set of scanning cloud and precipitation radars for climate research. These radars provide a unique capability for the high-resolution delineation of cloud evolution, morphology, and characteristics. Through scanning strategies developed for these radars, ARM is extending its measurements of clouds and precipitation beyond the confines of the vertical atmospheric column to include a true spatial picture for process studies and evaluation of model fields.

A total of two "C-band" and four "X-band" scanning ARM precipitation radars (SAPR) will be installed at ARM's Southern Great Plains (SGP), North Slope of Alaska (NSA), and Tropical Western Pacific (TWP) sites. These SAPRs are dual-polarization Doppler radars that enable scientists to provide accurate rainfall estimates, classify precipitation types (such as rain, hail, sleet, etc.), and map wind fields.

Scanning ARM cloud radars (SACR), scheduled for deployment at SGP, NSA, TWP, and the two ARM Mobile Facilities (AMF1 and AMF2), represent the first operational dual-frequency and dual-polarization scanning cloud radars ever deployed. Observations from the scanning cloud radars will help reduce uncertainties in the cloud parameterizations contained in global climate models.

Lidars

Three different lidar systems, optimized for different types of measurements, will be installed at all of the ARM Facility's permanent and mobile sites.

High Spectral Resolution Lidar (HSRL)—This advanced lidar system detects aerosol extinction, backscatter, and depolarization, using optical filters to distinguish between photons scattered from molecules and those scattered by aerosol or cloud particles. The ability to separate aerosol versus molecular contributions in the return signal enables HSRLs to measure aerosol optical properties more directly than any other lidar system. Two new HSRL systems will be deployed—one at the ARM NSA site in Barrow and one with AMF2, which can accommodate shipboard deployments.

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Raman Lidar—Developed for ARM as the first turn-key operational Raman lidar in the world, the original ARM Raman lidar has operated nearly autonomously at the SGP site since 1996. This system measures both elastic and Raman-shifted backscatter returns from the atmosphere. Through the Recovery Act, ARM is upgrading the Raman lidar at its SGP site and developing a second system for deployment at the TWP site in Darwin, Australia. The new ARM Raman lidar will be the first operational Raman lidar in the tropics and the only active remote sensing instrument capable of providing simultaneous measurements of water vapor, clouds, and aerosols at the Darwin site.

Doppler Lidar—ARM is adding three new Doppler lidar systems to its measurement suite. The Doppler lidar produces range-resolved measurements of the line-of-sight (or radial) component of wind velocity by detecting the Doppler shift in the return. Doppler lidar measurements acquire long-term height- and time-resolved measurements of vertical air velocity in the lower troposphere. In addition, the new ARM Doppler lidars will have full upper-hemispherical scanning capabilities. This will enable 3D mapping of turbulence structure and measurement of horizontal wind profiles. Two of the new Doppler lidars will be deployed at the SGP site and the TWP Darwin site, while one system will travel with AMF1.

Optics contained inside the Raman lidar shelter guide backscattered laser radiation in order to measure signals collected by the telescope.

Recovery Act Instruments

The ARM Facility procured a total of 143 instruments through the Recovery Act. In addition to the instruments discussed in detail, the purchase also included wind profilers, surface flux and aerosol instrumentation, microwave radiometers, and infrared and solar spectrometers.

The number of instruments per site will vary based on needs of the site and existing instrumentation. New equipment totals for the sites are approximately as follows: 10 for the NSA site, 11 for the SGP site, 21 for the ARM Aerial Facility, 24 for the TWP site, and 38 for the mobile facilities. The remaining instruments (about 40) will be deployed as needed throughout the facility.

Aerosol Measurements

Through its aerosol observation system (AOS), the ARM Facility provides an array of aerosol measurements: absorption, concentration, and scattering; backscattered radiation; cloud condensation nuclei; hygroscopic growth; inorganic chemical composition; and particle number concentration and size distribution. These measurements are acquired using a comprehensive suite of instruments: two nephelometers, a light absorption photometer, a condensation nuclei counter, and an ozone monitor.

The Recovery Act provides for modernized instruments and three new AOS units: one for deployment at the TWP Darwin site; another with the AMF2; and a third stand-alone Mobile Aerosol Observing System (MAOS) composed of two separate 20-foot containers, one for aerosol and the other for chemistry measurements.

Cloud Probes

Recently developed probe designs with slanted tips and faster electronics are designed to minimize the shattering effect that previously resulted in a disproportionate amount of smaller cloud particles being measured by the sensor beam. Through the Recovery Act, the ARM Aerial Facility is adding 18 new instruments to its research arsenal, including 6 new cloud probes, all with the newly designed tips and electronics. One of these new cloud probes is the High Volume Precipitation Spectrometer, which measures the number and size of precipitation particles, including snowflakes, in the 150 micron to 1.92 centimeter size range. This is the only aircraft research instrument of its kind that provides complete digital images of precipitation particles up to nearly 2 centimeters in size.

Other aircraft instruments include probes and sensors for measuring atmospheric aerosols and gases, similar to those used in the aforementioned AOS section. Together, these new aircraft instruments more than triple ARM's in-house capabilities for measuring in situ cloud particle and aerosol composition, size distribution, and chemistry.

For more information, contact:

http://www.arm.gov/about/recovery-act

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