

U.S. Department of Energy

Atmospheric Radiation Measurement Program

The U.S. Department of Energy's (DOE's) Atmospheric Radiation Measurement (ARM) Program, created in 1989 as part of the U.S. Global Change Research Program, is improving the treatment of atmospheric radiative and cloud processes in large-scale computer models used to predict global climate change. Of primary interest is the impact of clouds on solar radiant energy reaching the ground and absorbed by the atmosphere, and on the re-radiation of heat from the earth. Scientists believe the impact of clouds may be a key response of the climate system to increasing greenhouse gases.

In the late 1980s, DOE-supported research showed that improvements in the models and parameterizations representing cloud and radiative processes would require data of higher accuracy and precision than previously available. The ARM Program is providing basic research and observational data to support these advances.

Significant features and milestones of the ARM Program include the following:

- The ARM Program is one element of a coordinated DOE effort to resolve scientific uncertainties about potential global climate change. ARM is DOE's largest global climate change research effort and part of the multi-agency U.S. Climate Change Science Program. Related DOE programs address atmospheric chemistry and diffusion, ecosystem response, ocean effects, terrestrial carbon processes, climate prediction, global climate change education, information integration, and integrated assessment modeling.
- Science Working Groups, led by the ARM Chief Scientist, set the ongoing research agenda for ARM. Engineering and Operations groups support this agenda through development of instruments and data systems as well as management of three primary ARM field measurement sites.
- The first of three primary field measurement sites, located in the U.S. Southern Great Plains, was dedicated in November 1992. This site covers approximately 143,000 square kilometers (55,000 square miles) in north-central Oklahoma and south-central Kansas. The site consists of a heavily instrumented central facility—about 64 hectares (160 acres)—and a network of smaller sites with limited instruments spread over the larger area.
- The second of the three sites, located in the Tropical Western Pacific locale, was commissioned in September 1996 when an instrument suite was installed on Manus Island in Papua New Guinea. A second instrument set was installed on Nauru in 1998. A third instrument set was installed at Darwin, Australia, in 2002. The Tropical Western Pacific locale lies roughly in the area between 10°N and 10°S of the equator from 120°E to 180°E longitude.



- The North Slope of Alaska site has been operational since 1997. The main cluster of instruments is installed near Barrow, Alaska, while a smaller instrument array, installed in 1999, is located to the south near the village of Atkasuk.
- Data from the ARM sites are being collected on a continuous basis for ten years or more. The ARM Archive provides all data through a website at no cost to the requestor. Since its inception in June 1992, the ARM Archive has collected about 21,000 gigabytes of data in over 5 million files, with more arriving daily. Archive users retrieve 80,000 to 150,000 data files per month from the stored file location.
- Data from the sites are greatly increased during intensive operational periods, or IOPs, when measurements are taken more frequently, and additional instruments are often added to the site's instrument suite. These IOPs are executed in response to the scientific needs of the program. For example, IOPs at the Southern Great Plains site have helped evaluate new advanced remote sensors, such as high-resolution spectral radiometers, lidar, and radar. These sensors have been incorporated into the routine observational schemes of all three sites as appropriate.
- In 1997-1998, ARM participated in the Surface Heat Balance of the Arctic, or SHEBA, campaign to better understand climate processes in polar regions. To obtain the SHEBA data, an icebreaker was frozen into the Arctic ice pack and drifted for a year while scientists measured atmospheric, ice, and oceanic conditions.
- A sound IOP, characterized by intermittent participation, occurred in 1999 when ARM sponsored an international research collaboration conducted on and around the island of Nauru. The National Oceanic and Atmospheric Administration (NOAA) research ship Ron Brown and the Japanese Marine Science and Technology Center (JAMSTEC) research ship Mirai measured surface and radiation fluxes at sea, for comparison with the land-based instruments and the Tropical Atmosphere Ocean (TAO) buoy array. Research resulting from this intensive month-long campaign is being used to understand spatial variability and island effects.
- ARM Program researchers come from DOE laboratories, universities, other federal laboratories, private agencies, and international participants. Currently, more than 75 groups are involved in the research efforts.
- ARM collaborates extensively with National Aeronautics and Space Administration (NASA), NOAA, and other agencies. International collaborations include the Global Ocean-Atmosphere-Land System (GOALS) and Global Energy and Water Experiment (GEWEX), both elements of the World Climate Research Programme. These collaborations help optimize the acquisition, distribution, and use of data from state-of-the-art ground, airborne, and satellite instruments.

The data and model testing capabilities, provided through ARM, will contribute significantly to improvements in global climate models and weather forecasting models. Ultimately, ARM research is intended to improve predictions of how the earth's climate might change, how fast the change could occur, and what the regional effects of that change might be. This information is needed by national and world leaders to make energy and economic policy decisions.

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