ARM
Atmospheric Radiation Measurement

Fact Sheet

U.S. Department of Energy

North Slope of Alaska/ Adjacent Arctic Ocean

The U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Program established the North Slope of Alaska/Adjacent Arctic Ocean (NSA/AAO) site to provide data about cloud and radiative processes at high latitudes and in cold environments. It is widely believed that the Polar regions will be more affected by changing climate associated with global warming than other areas of the globe. The ARM Program objectives for its NSA/AAO activity are focused on improving our understanding of high latitude cloud and radiation processes and their representation in global climate models.

In implementing its NSA/AAO activity, ARM took advantage of an early opportunity. The Surface Heat Budget of the Arctic (SHEBA), a multi-agency initiative led by the National Science Foundation, established an ice station around a "frozen-in" icebreaker in the fall of 1997. SHEBA successfully completed a one-year drift experiment in 1998. ARM participated with a core set of instruments and a data system that handled not only the ARM instruments, but selected instruments provided by the National Oceanic and Atmospheric Administration (NOAA) as well. SHEBA provided a wealth of data on atmospheric, ice, and ocean conditions, and provided ARM with first-hand experience in acquiring data successfully under Arctic winter conditions.

Implementation of the NSA/AAO land site actually began in the spring of 1997, in part to ensure complementary measurements to those being acquired by SHEBA during the latter part of that experiment. The instrumentation and data systems were originally designed to fit into two instrument shelters the size of standard shipping containers, but for Barrow were configured in a single shelter. The Atqasuk site was established with the basic set of instruments returning from SHEBA and remains a site with a more limited suite of instruments. Additional instrument sites are anticipated as required for specific measurement efforts.

Instrument systems installed at the Barrow site include solar and infrared broadband radiometric instruments, a Fourier transform infrared radiometer, cloud lidar, cloud radar, radar wind profiler, radiosonde system, sky imager, and microwave radiometer, as well as standard meteorological instruments mounted at four levels on a 40-meter tower. The Atqasuk site includes solar and infrared broadband radiometric instruments, a cloud lidar, sky imager, and microwave radiometer, as well as standard meteorological instruments mounted on a 10-meter tower.

Cloud and radiation processes at high latitudes are fundamentally different from those at mid- or tropical latitudes for the following reasons:

- Water vapor amounts in the Arctic atmosphere are low, particularly in winter. This changes the radiative characteristics of the atmosphere, allowing more infrared radiation from the earth and lower atmosphere to escape to space.
- The surface is covered by ice and snow for much of the year. This increases the amount of solar radiation reflected back to space and changes surface fluxes of moisture and heat.
- Clouds in the Arctic exist in an atmosphere with a very different vertical thermal structure than at lower latitudes. As a result, water drops tend to be much smaller than in lower latitude clouds.
- Clouds are more confined to shallow layers in the atmosphere than at lower latitudes.

Aerial View of Barrow

- On an annual basis, low altitude clouds dominate cloud amount.
- Ice and snow are the predominant forms of condensed water, although mixed-phase (ice, water) clouds can be found at all times of the year.

These are just a few of the characteristics of the NSA/AAO environment that make it unlike lower latitudes. The acquisition of high-accuracy, high-precision data from these sites will greatly benefit the development of improved climate models and have an important side effect—to support and/or make feasible related research by other agencies and programs that can build on the core of ARM measurements to develop broader-focus research efforts.

It should be noted that both Barrow and Atqasuk are research-intensive locations wherein several agencies and programs interact and mutually benefit. In moving to the North Slope, ARM joined several other meteorological and climate research activities already established at Barrow, as well as those being established there. Close collaborations are maintained with the National Science Foundation, the North Slope Borough Wildlife Management Department, and the Climate Monitoring and Diagnostic Laboratory of NOAA on whose land ARM sited its instruments and facilities. Barrow is also the site of the only National Weather Service Station on the Arctic coast of Alaska. The National Science Foundation supports several research projects at Atqasuk and maintains a facility there that ARM shares as well.

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