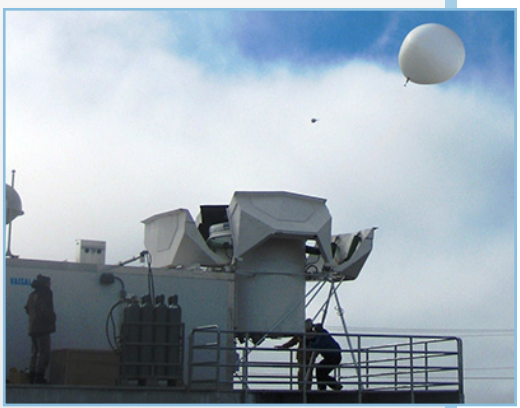
ARM
CLIMATE RESEARCH FACILITY

FACT SHEET

U.S. Department of Energy

North Slope of Alaska



Because the environment in the Arctic is changing rapidly, the North Slope of Alaska has become a focal point for atmospheric and ecological research. Aerosols and clouds have strong impacts on the Arctic surface energy balance through absorption and reflection of shortwave and longwave radiation, and in turn, changes in the surface conditions, such as melting of sea ice, snow, or permafrost, can feed back to atmospheric structure and circulation, water vapor, gas and aerosol emissions, and cloud properties.

Through the U.S. Department of Energy, the Atmospheric Radiation Measurement (ARM) Climate Research Facility has gathered atmospheric data since 1997 at its North Slope of Alaska (NSA) site in Barrow, the northernmost city in the US located on the edge of the Arctic Ocean. The site has collected comprehensive data about cloud and radiative processes in the Arctic Circle using state-of-the-art ARM instrument systems, which have been used to improve the representation of high-latitude cloud and radiation processes in earth system models.

To meet next-generation science questions about the complex interactions and feedbacks among atmospheric circulations, thermodynamics, aerosols, clouds, and the land/ocean/sea-ice surface in the changing Arctic, the ARM Facility is reconfiguring the NSA into one of two "megasites." In 2012, the Facility began expanding its operations in the region by locating its third mobile facility at Oliktok Point, which provides unique opportunities for operating unmanned aerial systems and tethered balloon systems for scientific research. Changes underway will result in more comprehensive scientific data and the processes and tools for scientists to more easily integrate them into climate models.

North Slope Sites

Barrow – Known as the "top of the world," ARM's Barrow research site is providing data about cloud and radiative processes at high latitudes. Many of the same instruments used at warmer ARM sites have been hardened to withstand temperatures that drop well below negative 40 degrees Celsius at the site, which is located 320 miles north of the Arctic Circle, and a mile south of the Arctic Ocean.

Oliktok Point – Opportunities for both air and ground-based measurements at this isolated location provide a unique opportunity for the scientific research of clouds, aerosols, atmospheric conditions, sea ice, and heat exchange at the surface. In addition to the standard array of ground-based instruments deployed with the mobile facility, reconfiguration plans will enhance missions using unmanned aerial systems and tethered balloon systems, and the ARM Aerial Facility Gulfstream-1 (G-1) aircraft to better sample surface fluxes, atmospheric vertical structure, and aerosol and cloud properties. New special-use arctic

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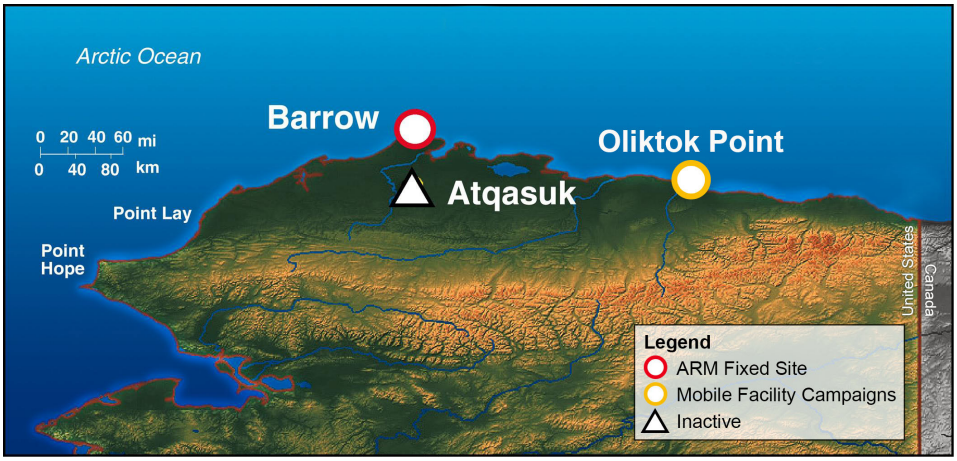

airspace that stretches 700 miles north is available as a resource to conduct climate and atmospheric research.

Atqasuk – While there are no longer ARM instruments at this inland arctic tundra location, it was used to collect data from 1999 to 2011. The resulting data set is available for research purposes through the ARM Data Archive.

Research Focus

ARM facilities on the North Slope are located in the gradient zone along the North Slope coast, where land- and ocean-surface characteristics undergo large spatial and seasonal transitions. These transitions impact fluxes of heat, moisture, and gas and aerosol emissions. The ARM Facility's research focus is to understand how these complex interactions impact cloud properties and the energy budget.

The NSA supports a large range of scientific investigation of the dynamic Arctic climate. For instance, the Indirect and Semi-Direct Aerosol Campaign (ISDAC) at Barrow collected valuable data that will help scientists understand the impacts that aerosols have on Arctic clouds and climate.

As described in the DOE North Slope of Alaska Priorities Workshop Report, continuous data from the NSA allows scientists to:

- Explore relative roles of long-range transport of aerosols, heat, and water vapor versus local processes
- Examine aerosols and their impacts on the energy budget and cloud processes
- Study cloud processes, including mixed-phase clouds and impacts of heterogenous surface conditions on cloud properties
- Investigate what controls the development of the vertical structure of the thermal, water vapor, aerosol and cloud components of the atmosphere

Instrumentation

The Barrow and Oliktok facilities support over 32 different instruments. The extended range atmospheric emitted radiance interferometers at the two sites were built specifically for the high latitudes where low water vapor concentrations are common. Routine observations from scanning radars detect and quantify the structure, spatial distribution, and evolution of Arctic clouds and precipitation. Other instruments provide data on surface boundary conditions and allow for characterization of the physical properties of clouds, particularly mixed-phase clouds composed of both liquid and ice.

The Oliktok instrument suite also includes a Raman lidar, which provides vertical profiles of water vapor as well as information about cloud properties.

As part of the expansion to a megasite, NSA site operators will fly unmanned aircraft over the ARM site and over the land and sea ice and will fly tethered balloons as part of the ARM mission to characterize the heterogeneity of the atmospheric environment and the underlying surface around the ARM site. Manned aircraft will also fly occasional missions to provide a link between the two NSA sites and provide more comprehensive in situ measurements of aerosol and cloud properties.

Additional Information

- General information on the NSA ***www.arm.gov/sites/nsa***
- U.S. Department of Energy North Slope of Alaska Priorities Workshop Report ***www.arm.gov/news/publications/post/34108***
- Data gathered during normal operations or field campaigns through the ARM Data Archive ***www.archive.arm.gov***
- Propose and conduct a field campaign ***www.arm.gov/campaigns/propose***

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DOE/SC-ARM-15-077