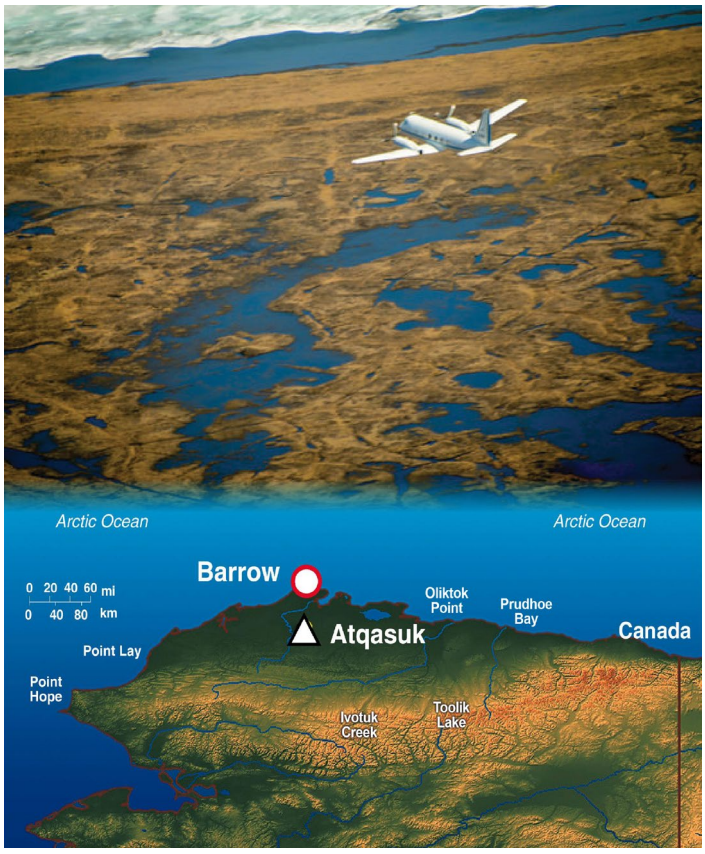
ARM
CLIMATE RESEARCH FACILITY

ARM Airborne Carbon Measurement on the North Slope

Trace gases make up 1 percent of the Earth's atmosphere, but have a big impact on the climate. Increased concentrations of trace gases such as carbon dioxide and methane that contribute to the Earth's greenhouse effect may push the Earth system into unprecedented global temperature change. This is particularly an issue in the Arctic. When permafrost—a layer of permanently frozen sub-soil—melts it unlocks stored carbon, which may contribute to large increases in the atmospheric mixing ratios of greenhouse gases. Current climate model projections underestimate warming in the Arctic and better observations are needed to understand the relevant processes and improve the model predictions.



Using the ARM Aerial Facility's G-1 research aircraft, the ARM-ACME V team will fly three possible flight paths between Alaska's Prudhoe Bay, Oliktok Point, Barrow, Atqasuk, Ivotuk, and Toolik Lake measuring carbon dioxide, methane, and carbon monoxide.

During the summer of 2015, a research campaign gave scientists insight into trends and variability of trace gases in the atmosphere over the Atmospheric Radiation Measurement (ARM) Climate Research Facility's North Slope of Alaska site to improve Arctic climate models. The ARM Airborne Carbon Measurements (ARM-ACME) campaign—finalizing the fifth phase in the Arctic—is providing a new observational perspective on the Earth's carbon cycle, and how carbon dioxide and other trace gases are exchanged between the atmosphere, land, oceans, and ecosystems. The carbon cycle is one of the most critical cycles in making the Earth suitable for life.

The ARM-ACME campaign began observations in 2000, with the first four phases studying trace gases in the atmosphere at ARM's Southern Great Plains (SGP) research site in Oklahoma. After completing the fifth campaign on the North Slope, the sixth phase of ARM-ACME returns to the SGP, beginning in fall of 2015.

SCIENCE OBJECTIVE

Airborne observations from ARM-ACME V are expected to help scientists accomplish several objectives to enhance understanding of Earth's weather patterns in hopes of reducing uncertainty of current global and regional climate simulations and projections.

ARM-ACME V will supply data to:

- measure and model the exchange of carbon dioxide, water vapor, and other trace gases by the natural, agricultural, and industrial ecosystems, and
- develop and test measurement and modeling approaches to estimate regional carbon balances and human-made sources.

RESEARCH INSTRUMENTATION

There is no better way to learn about the atmosphere than being up in the air. This campaign utilized the ARM Aerial Facility's Gulfstream-159 (G-1)—as well as instrumentation located at the ARM North Slope sites. Based in Deadhorse, Alaska, near the third ARM Mobile Facility (AMF3), the aircraft logged over 300 flight hours over the course of three months, measuring trace gases in the atmosphere for the study of the carbon cycle.

When passing over established ground sites, such as the two ARM sites at Oliktok Point and Barrow, the G-1 flew a spiral pattern up to a maximum of 10,000 or 20,000 feet, depending upon whether or not significant quantities of carbon cycle gases are encountered. The higher the plane flies, the larger the region of influence.

The ARM sites are ideally instrumented to study trace gases, with continuous surface carbon dioxide concentration and flux measurements. Each site is equipped with a suite of scanning and vertically pointing cloud radar products to identify cloud vertical and horizontal extent and duration, and surface meteorological measurements.

ARM-ACME V provides a unique opportunity to couple ground-based and airborne observations of greenhouse gases concentrations in the Arctic.

PAST ARM-ACME CAMPAIGN DATA

Routine vertical flights are the backbone of this 15-year campaign. They are the most frequent routine airborne measurements feeding data to national carbon observing networks to quantify the long-term trend in atmospheric carbon dioxide concentrations. These are the only airborne observations in the United States routinely compared to continuous in situ measurements.

Data collections from the first four ARM-ACME campaigns over the SGP are complete and freely available in the ARM Data Archive. Data from the fifth ARM-ACME flights are being prepared for delivery to the data archive in 2016.

The ARM Climate Research Facility established climate research sites on the North Slope of Alaska to provide data about cloud and radiative processes in cold environments and high latitudes. Shown here is the X-band scanning ARM precipitation radar.

ARM-ACME V Website:
www.arm.gov/campaigns/aaf2014armacmev

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Additional information is available on the ARM website at www.arm.gov.