



U.S. DOE ARM Facilities, Unmanned Aerial Systems and Campaigns in the Alaska Arctic

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The Atmospheric Radiation Measurement (ARM) Climate Research Facility is a U.S. Department of Energy (DOE) user facility, available to the global research community. The ARM mission is to provide atmospheric observations to improve climate models.

In the Arctic, complex phenomena such as mixed-phase cloud behavior and land-atmosphere-sea ice-ocean interfaces require study to understand processes. The North Slope of Alaska (NSA) observatory is operated by Sandia National Laboratories from two sites; a central facility at Barrow (Utqiagvik), plus a Mobile Facility (AMF3) at Oliktok Point. Both sites support over 32 different instruments, many that are specific to high latitudes.

The Oliktok Point site includes two controlled airspaces. Restricted Airspace is centered at Oliktok Point, with a 2 nautical mile (nm) radius up to 7,000 feet above ground level (AGL). Warning Area near Oliktok Point is 40 nm wide and 700 nm long, up to 10,000 feet AGL across international airspace over the Arctic Ocean toward the North Pole. The NSA sites use unmanned aerial systems (UAS) and tethered balloon systems (TBS) for routine measurements, plus field campaigns for information about thermodynamic structure, aerosols, and cloud properties. ARM welcomes UAS projects with guest investigators at the NSA sites.

The TBS has a payload of 80 pounds, operates to 6,000 feet above ground level (AGL), can sustain long-term flight within clouds, and operates April to November in the Arctic. TBS sensors measure moisture, supercooled liquid water content, pressure, temperature profiles, wind, aerosols, particulates and location.

The ARM Aerial Facility (AAF) UAS inventory includes four small, light, and inexpensive DataHawks that measure location, altitude, pressure, temperature, humidity, wind speed, turbulence, and surface temperature; with an endurance of about 40 minutes. The AAF recently acquired the ArcticShark; a 22-foot wide fixed-wing UAS, with a maximum payload of 100 pounds, able to reach elevations of 18,000 feet AGL; to collect atmospheric data at NSA.

ARM provides resources for field campaigns. Proposals that use ARM facilities, focus on strategic goals of DOE Biological and Environmental Research (BER), and improve regional/global earth system models have priority for two types of field campaigns:

- Small Campaigns cost ARM less than \$300K: may include guest instruments at ARM observatories, instruments for offsite deployments, or novel operations.
- Annual Facility Call Campaigns exceed \$300K cost to ARM: include large observatory campaigns, deployment of ARM mobile facilities or ARM aerial facilities.

The process of submitting, conducting and closing out an ARM field campaign includes

- (1) Read instructions to submit a pre-proposal.
- (2) Submit Pre-Proposal at <https://www.arm.gov/research/campaign-proposal>.
- (3) Pre-proposal review normally takes four weeks.
- (4) Respond to submittal review comments.
- (5) Submit an abstract for the ARM website. A science plan may be required. Work with the site manager to coordinate. Conduct the campaign.
- (6) Submit data/final report to ARM within six months after completion of campaign.