SAND2017-13031C

Atmospheric Radiation Measurement (ARM) Research Facility at Oliktok Point Alaska

Atmospheric Radiation Measurement (ARM)

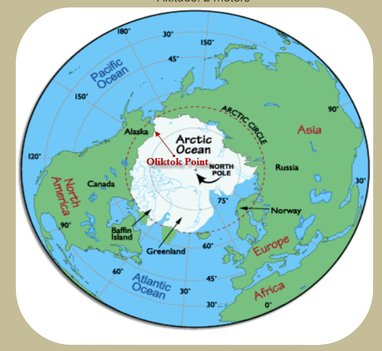
Fred Helsel, Mark Ivey, Jasper Hardesty, Darielle Dexheimer, Erika Roesler, Dan Lucero

Introduction

- The Department of Energy (DOE) designated the ARM Program's scientific infrastructure and data archive as a national user facility.
- Provides infrastructure support for climate research to the scientific community.
- Provides a broad range of data to help answer questions about Arctic climate change.
- AMF3 is gathering data using instruments that obtain continuous measurements of clouds, aerosols, precipitation, energy, and other meteorological variables.
- Provides climate data that is freely available to the international community through the ARM data archive. (https://www.arm.gov/)
- The Unmanned Aerial System (UAS) Program supports aircraft measurements for priority scientific questions, including in-situ cloud properties, aerosol size and chemical composition, and remote sensing of various parameters.

Location

70° N 29' 42.89" N, 149° 53' 12.78" W
Altitude: 2 meters



This ARM Mobile Facility 3 (AMF3) is planned to operate for up to five years at its remote outpost near the U.S. Air Force's Long Range Radar Site at Oliktok. It is ARM's third mobile facility (AMF3) and will be the first one designed to operate for so long at a single location. It will complement data collected since 1997 by ARM's long-term site in Barrow.

MEASUREMENTS AT THE MARGINS

- Trends in climate records point to a warming Arctic.
- Among these trends are the shrinking spread and thickness loss of sea-ice. Temperatures are rising at twice the rate of the rest of world. This increase in temperature is causing instability in the region's permafrost layer, which stores vast amounts of methane in its frozen grip.
- The computer models used to explain and predict arctic trends have yet to simulate these changes with the desired level of accuracy. This is partly due to the difficulties in obtaining the needed observational data for the models.
- AMF3 UAS operations can obtain data at the sea ice edge providing more data for the models to improve accuracy.

OPERATIONAL INSTRUMENTS

Atmospheric Profiling
- Balloon-Borne Sounding System (BBSS)
- Tether Balloon System (TBS)
- Unmanned Aerial Systems (UAS)

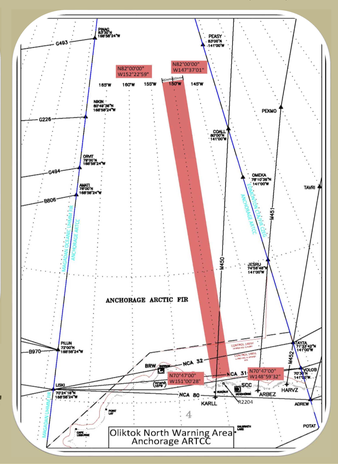
Clouds
- Micro-Pulsed Lidar (MPL)
- Microwave Radiometer, 3-Channel (MWR3C)
- Total Sky Imager (TSI)
- Vaisala Ceilometer (VCEIL)
- Ka-Band ARM Zenith Radar (KAZR) formerly known as the Millimeter Wavelength Cloud Radar (MMCR)
- Doppler Lidar (DL)

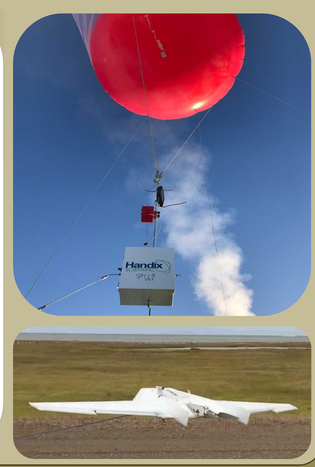
Radiant Flux
- Atmospheric Emitted Radiance Interferometer (AERI)
- Infrared Thermometer (IRT)
- Multi-filter Rotating Shadow band Radiometer (MFRSR)
- Radiometric instrument systems. Provided by groupings of individual broadband instruments such as pyranometers, pyrgeometers, pyrheliometers through the following data streams
- Upwelling radiation (GNDRAD)
- Multi-filter radiometer (MFR)
- Downwelling radiation (SKYRAD)
- CIMEL sun photometer (CSPHOT)

Surface Meteorology
- Meteorological instrumentation (MET)
- Eddy Correlation Flux Measurement System (ECOR)
- Ameriflux Measurement Component (AMC)
- Multi Angle Snow Camera (MASC)
- Precipitation Imaging Package (PIP) NASA instrument

UNMANNED AERIAL SYSTEMS (UAS) OPERATIONS

- Sandia has approval from the USAF to conduct scientific experiments for ARM in Restricted Airspace at Oliktok Point, Alaska.
- In addition, the DOE has acquired from the FAA a Warning Area for conducting UAS operations over international waters adjoining Oliktok.
- The Warning Area designation alerts pilots in the area of potentially hazardous operations to aircraft, such as dropsondes, rocket-launched sondes, small UAS/drones or tethered balloons.
- The ability to use UAS's at Oliktok will allow measurements of many critical Arctic systems and address gaps in scientific understanding of these processes. Examples are mixed-phase cloud systems and the transition zone where land-locked ice thaws into the open sea—called the Marginal Ice Zone, or MIZ. This zone moves with the seasons and changes each year. The lack of data at this important intersection of land and sea exacerbates the already difficult modeling challenge. Fortunately, these kinds of difficulties are what the ARM Mobile Facilities (AMF) were designed for.





Top: Restricted Air Space R2204
Center: Warning Area W220
Right Top: Sandia National Laboratories' Tethered Balloon System (TBS)
Right Bottom: Data Hawk

Mobile Aerosol Observing System (MAOS)

Introduction

- The Mobile Aerosol Observing System (MAOS) is the primary Atmospheric Radiation Measurement (ARM) platform for in situ aerosol measurements at the surface.
- The principal measurements are those of the aerosol absorption and scattering coefficients as a function of the particle size and radiation wavelength.
- Additional measurements include those of the particle number concentration, size distribution, hygroscopic growth, and inorganic chemical composition.
- The MAOS measures aerosol optical properties to better understand how particles interact with solar radiation and influence the earth's radiation balance.
- The measurements are useful for calculating parameters used in radiative forcing calculations such as the aerosol single scattering albedo, asymmetry parameter, mass scattering efficiency, and hygroscopic growth.

Instruments

- Aerosol Chemical Speciation Monitor (ACSM)
- Cavity Attenuated Phase Shift Extinction Monitor (CAPS-PMEX)
- Condensation Particle Counter (CPC)
- Dual Column Cloud Condensation Nuclei Counter (CCN)
- Nephelometer
- Particle Soot Absorption Photometer (PSAP)
- Ozone Monitor
- Scanning Mobility Particle Sizer (SMPS)
- Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)

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