SAND2014-20135C

AMF-3 ARM Climate Research Facility

Atmospheric Radiation Measurement (ARM)

Fred Helsel, Jeff Zirzow, Dan Lucero, Bob Cook, Larry Yellowhorse, Darin Desilets, Valerie Sparks, Erika Roesler

ARM CLIMATE RESEARCH FACILITY

U.S. DEPARTMENT OF ENERGY

Introduction

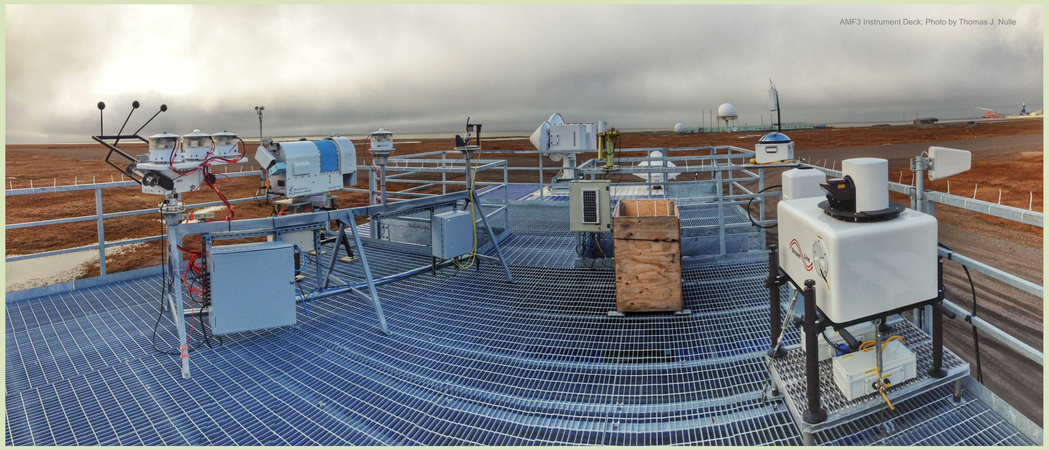
- The Department of Energy (DOE) designated the ARM Program's scientific infrastructure and data archive as a national user facility.
- Provides infrastructure support for climate research to the scientific community.
- Provides a broad range of data to help answer questions about Arctic climate change.
- 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.
- The Unmanned Aerial Vehicles (UAV) 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.

AMF3 Site; Photo by Thomas J. Nulle



AMF3 Instrument Deck; Photo by Thomas J. Nulle

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 (SONDE)
- Tether Balloons, with instrumentented payloads
- Unmanned Aerial Systems (UAS), specification being determined

Clouds

- Micropulse Lidar (MPL)
- Microwave Radiometer, 3-Channel (MWR3C)
- Total Sky Imager (TSI)
- Vaisala Ceilometer (VCEIL)
- C-Band ARM Precipitation Radar (CSAPR)
- Ka-Band Scanning ARM Cloud Radar (KASACR)
- W-Band Scanning ARM Cloud Radar (WSACR)
- Ka-Band ARM Zenith Radar (KAZR) – formerly known as the Millimeter Wavelength Cloud Radar (MMCR)
- Radar Wind Profiler (RWP), 915-MHz for U.S. deployments, 1290-MHz for deployments outside the U.S.
- Doppler Lidar (DL)
- Raman Lidar (RL)

Radiant Flux

- Atmospheric Emitted Radiance Interferometer (AERI)
- Infrared Thermometer (IRT)
- Multifilter Rotating Shadowband Radiometer (MFRSR)
- Radiometric Instrument Systems. Provided by groupings of individual broadband instruments such as pyranometers, pyrgeometers, pyrheliometers through the following datastreams.
- Upwelling Radiation (GNDRAD)
- Multifilter Radiometer (MFR)
- Downwelling Radiation (SKYRAD)
- Cimel Sunphotometer (CSPHOT)

Surface Meteorology

- Meteorological Instrumentation a (MET)
- Eddy Correlation Flux Measurement System (ECOR)
- Ameriflux Measurement Component (AMC)
- Multi Angle Snow Camera (MASC)

AMF3 Site; Photo by Jonathan Leonard (SNL)

PHASE III INSTRUMENTS*

*Summer of 2015

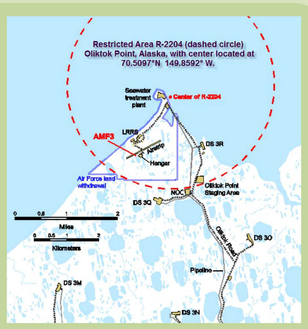
Aerosol Observing System (AOS), included in AOS:

- Ultra-High Sensitivity Aerosol Spectrometer (enhanced)
- Dual Column Cloud Condensation Nuclei Counter (CCN)
- Single Particle Soot Photometer (SP2)
- Scanning Mobility Particle Sizer (SMPS)
- Photo-Acoustic Soot Spectrometer (PASS), 3-Wavelength
- Humidigraph (Scanning Relative Humidity with 3 single wavelength nephelometers)
- Nephelometer, 3-Wavelength
- Condensation Particle Counter (CPC), 10 nm to >3000 nm particle size range
- Condensation Particle Counter (CPC), 2.5 nm to >3000 nm particle size range
- Hygroscopic Tandem Differential Mobility Analyzer (HTDMA)
- Particle Soot Absorption Photometer (PSAP), 3-Wavelength
- 7-Wavelength Aethelometer

UNMANNED AERIAL SYSTEMS (UAS) OPERATIONS AT OLIKTOK POINT

Restricted Area R-2204

- DOE/Sandia operates Restricted Area R-2204.
- Sandia has approval from the USAF for use of selected facilities to conduct scientific experiments for ARM in Restricted Airspace at Oliktok/Long Range Radar Site (LRRS).
- The ability to use UAS at Oliktok will allow measurements of many critical Arctic systems and address gaps in scientific understanding of these processes.



Tethered Balloon Operations

- Balloons allow for longer flight times.
- Can lift heavy instrumentation packages.
- Slower rate of ascent and descent.
- Lower cost of operation compared to aircraft.
- Small crew required to operate.
- Heights up to 5000 feet.

Balloon Photos by Dan Lucero(SNL)

Unmanned Aerial Systems

The DataHawk is an electrically powered miniature UAV equipped with a thermodynamic sensor package measuring pressure, temperature, humidity, turbulence, and mean winds. The DataHawk type of vehicle occupies a niche in between a drop or balloon sonde, which is low cost but cannot be guided, and a typical UAV, which provides guidance flexibility but uses costly avionics and commercial aerospace components. The DataHawk was developed and is operated by the University of Colorado-Boulder.

DataHawk information and photo provided by University of Colorado-Boulder

National Nuclear Security Administration

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Poster C31D-0338

Sandia National Laboratories