The ARM UAS Implementation Plan

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February, 2015

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Field Campaigns:

- **Fall 1993, Edwards AFB, CA**
- **Spring 1994, Northern OK**
- **Fall 1995, Northern OK**
- **Spring 1996, Northern OK**
- **Fall 1996, Northern OK**
- **Fall 1997, Northern OK**
- **Spring 1999, PMRF Kauai, HI**
- **Summer 1999, Monterey, CA**
- **Winter 2000, Northern OK**
- **Fall 2002, Northern OK**
- **Fall 2004, North Slope, AK**
- **Winter 2006, Darwin, Australia**

GA-ASI "GNAT 750" (F93, S94)

Grob "Egrett" (F95, S96)

GA-ASI "Altus I" (F96, F97)

GA-ASI "Altus II" (Su99)

Twin Otter (F93, S94, F95, S96, F96, F97, Sp99, Su99, W00)

Proteus (F02, F04, W06)

ARM AMS Monograph

Chapter 10

ARM Aircraft Measurements

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ARM
CLIMATE RESEARCH FACILITY

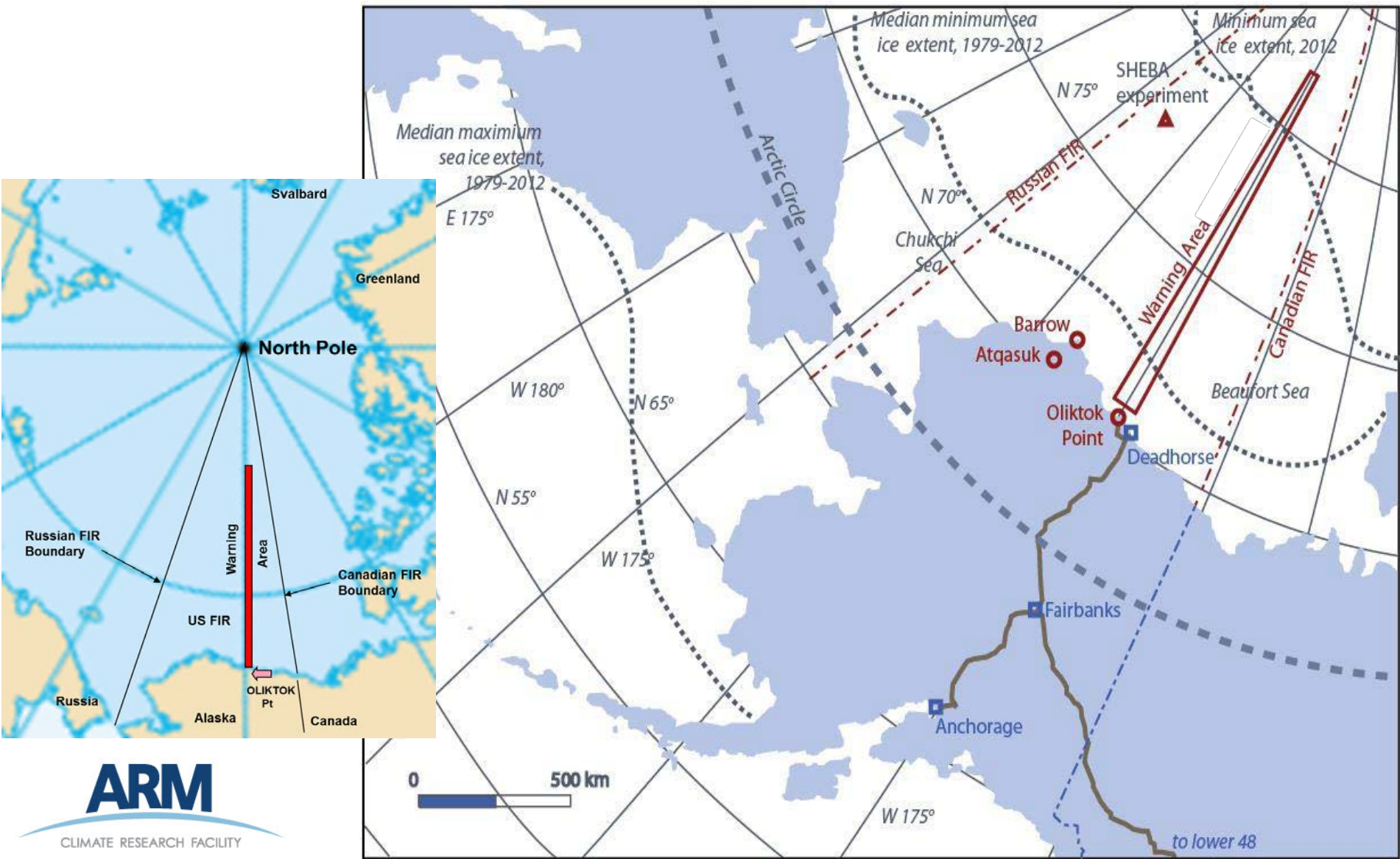U.S. DEPARTMENT OF ENERGY | Office of Science

ARM/SNL has hosted UAS campaigns at Oliktok Point

- 2004 MPACE, TBS
- 2012 BAT-3, TBS
- 2013 MIZOPEX (NASA Sierra, Scan Eagle, DataHawk)
- 2014 COALA (U Colorado, DataHawk)

DOE Special Use Airspace in Alaska

- Oliktok Restricted Airspace R-2204 (up to 7'000 ft)
- Oliktok Warning Area W-220 (up to 10'000 ft)

ARM – UAS Implementation Plan
Baseline Documents

- UAS White Paper (Verlinde et al. 2012);
- UAS Workshop, July 2013;
- Oliktok Infrastructure Recommendations Report (Fong, Warner, 2013);
- Next Generation ARM and corresponding AAF and NSA Strategy Documents (2014);
- NSA Workshop 2014 and associated white papers;
- ARM Decadal Vision Document (Mather, 2014);
- Unmet Measurement Needs (Sisterson, 2014);
- **UAS Implementation Plan, Spring 2015:**
  - *a new report describing the implementation of a robust and vigorous program for use of UAS and TBS for the science missions ARM supports.*

ARM – UAS Capability Development Approach

- ARM will be developing a UAS program over the next 2-3 years

- Multi-pronged approach:
    - Continue to host UAS and TBS activities at Oliktok Pt.
    - Build up in-house UAS capabilities.
    - SNL and PNNL will jointly implement the ARM UAS Program

- Platforms
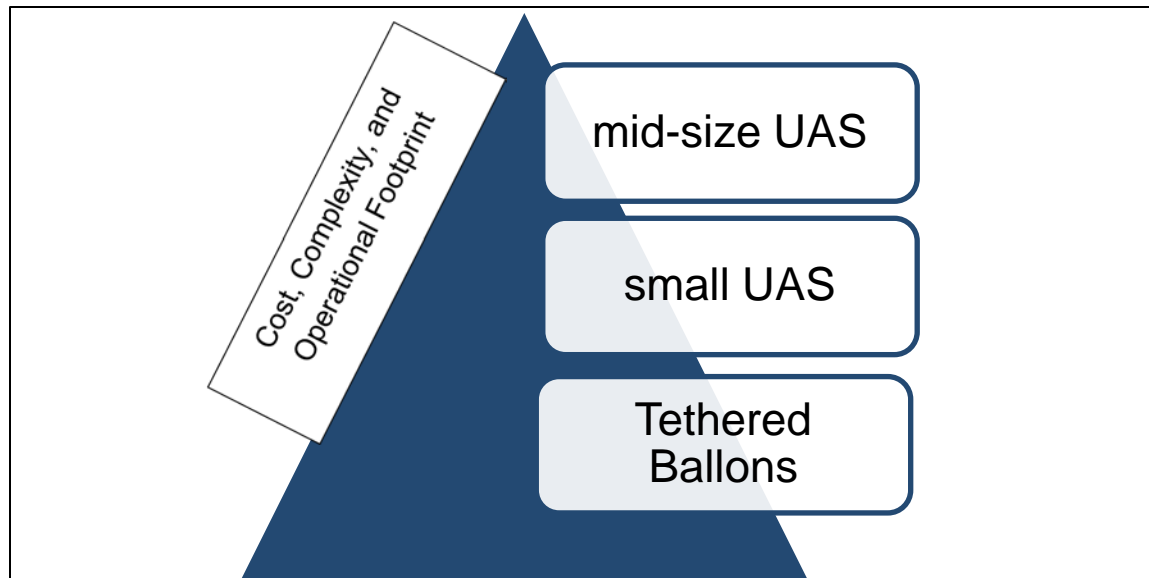
Elements of ARM UAS Program

- Advisory Board
- Safety
- Training
- Maintenance
- Instrumentation
- Operations
- Data Management

ARM UAS ADVISORY GROUP

Tim Bates, atmospheric chemist at NOAA's Pacific Marine Environmental Laboratory and University of Washington/Joint Institute for the Study of the Atmosphere and Ocean

John Cassano, associate professor of atmospheric and oceanic sciences at the University of Colorado Boulder and researcher at NOAA's Earth System Research Laboratory and Cooperative Institute for Research in Environmental Sciences

Matt Fladeland, Manager, Airborne Science Program Office, NASA Ames Research Center

Martin Stuefer, assistant director at Alaska Climate Research Center and assistant research professor at the Geophysical Institute at the University of Alaska Fairbanks

Jerry Harrington, associate professor of meteorology at Pennsylvania State University

ARM – UAS Capability Development
Mid-Size UAS

- Market research.

- NDA with an industry leader

- ROM cost estimate from industry leader used as budget guidance in Implementation Plan

- PNNL ran an RFI (Jan/Feb 2015) with minimum requirements:

  - 15,000' service ceiling

  - Line of sight communications and data downlink of 50 nm.

  - Minimum endurance of 12 hours

  - Minimum payload of 40 pounds

  - Minimum payload power of 300 Watts

Wingspan: 16 ft
MTOW: 135 lbs
Payload: 40 lbs, 350 W

Instrumentation

Category	Measurement
1	atmospheric thermodynamics
2	radiation (broad band and spectral, SW and LW)
3	in situ aerosol properties
4	in situ cloud properties
5	in situ gas phase
6	passive remote sensing (imaging, any wavelength)
7	active remote sensing (any wavelength)