North Slope Alaska Research Facilities
Unmanned Aerial Systems & Tethered Balloon Operations

SAND2017-5329C

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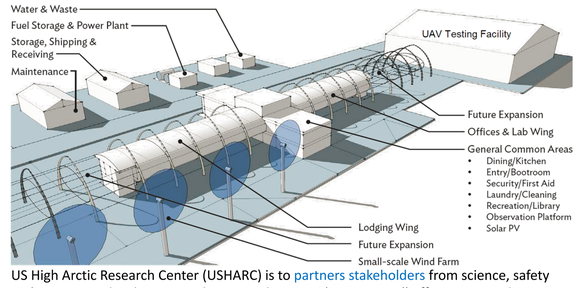
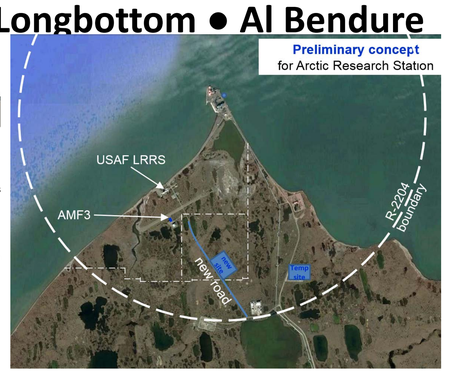


US High Arctic Research Center (USHARC) is to partners stakeholders from science, safety and security to develop comprehensive solutions. The Center will offer year-round use, logistic support; access to varied ecological settings; testing of technologies such as *autonomous platforms, renewable energies, microgrids, and sensors*.



Alaska Arctic Stations and Oliktok Point Controlled Airspaces

2017 = 20 years for ARM at Barrow/Utqiagvik !!

Key North Slope Alaska Partners

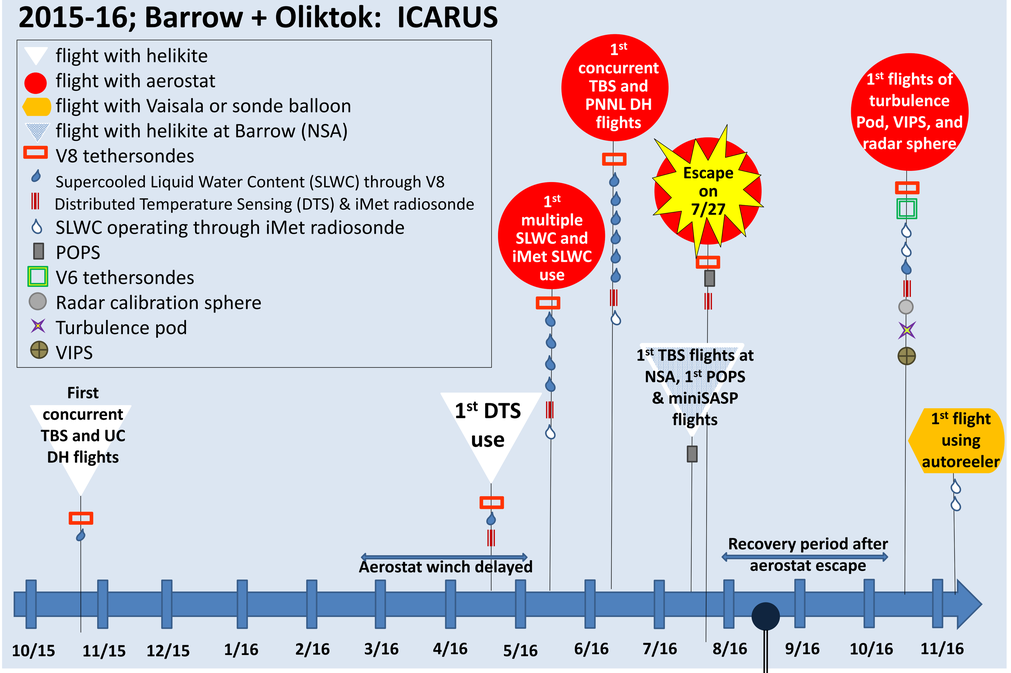
- **Oliktok Science Team**
  Gijs de Boer, Matt Shupe, Allison McComiskey, Amy Solomon, Sergey Matrosov, Jessie Creamean, Dave Turner, Chris Williams, Max Maahn, Carl Schmitt, Hagen Telg

- ARM UAS Advisory Group
  Tim Bates, Gijs de Boer, Matt Fladeland, Jerry Herrington
- USGS, NOAA, NASA, USAF, BLM
- CU-Boulder, Univ. of AK Fairbanks (UAF)

Future Plans and Capabilities:

- ARM Arctic Shark UAV (PNNL)
- Routine TBS data collection
- Routine joint TBS-UAV flights
- WMO Year of Polar Prediction (YOPP) 2017-19
- Expanded collaboration (e.g. NGEE) and outreach (e.g. STEM)

2015-16; Barrow + Oliktok: ICARUS



TBS Instrumentation:

Aerosols:

- POPS: Printed Optical Particle Spectrometer for aerosol concentrations and size distributions
- Mini-SASP Miniature Scanning Aerosol Solar Photometer for AOD profiles
- CPC: Condensation Particle Counter for aerosol size distribution

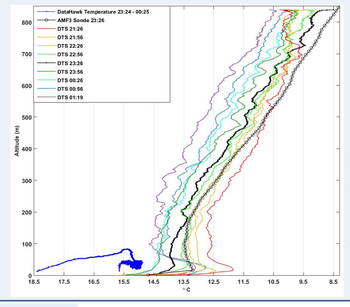
Meteorology & Thermodynamics:

- Tethersondes: for pressure, RH, temp., wind speed/direction, altitude, lat/long
- DTS: Distributed Temperature System for temperature profiles

Ice and Liquid in clouds:

- SLWCs: supercooled liquid water content sensors for cloud liquid water content
- VIPS: Video Ice Particle Sampler for ice microphysics observations

- **Tethered Balloon systems (TBS)**
  - Can operate in clouds
  - Enclosed winch or launch platform
  - 35 m^3 helikites
    - 30 lb payload, up to 2,000' AGL
  - Aerostat
    - 80 lb payload, up to 6,000' AGL
- Distributed Temperature Sensing:
  - Fiber-optic system hi-res measurements of permafrost, active layer, atmosphere, sea ice, and ocean interfaces



6/11/16 21:18 - 01:19	DH Temp	DTS	Sonde
DataHawk Temp		0.30	0.23
DTS	0.30		**0.97**
Sondes	0.23	**0.97**	

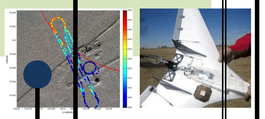
DTS data correlate well with sondes

- Currently measure only when TBS is stationary
- testing fiber optic rotary joint in 2017 for continuous measurements

2015; Oliktok:
First concurrent TBS and DH flights
with CIRES/UC-Boulder

2016-17; Oliktok:
PNNL-DataHawk2 flights
with PNNL

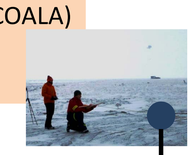
2015-16; Oliktok:
Evaluation of Routine Atmospheric Sounding Measurements with Unmanned Systems (ERASMUS-I,-II)
using DataHawk and Pilatus platforms
with CIRES/UC-Boulder



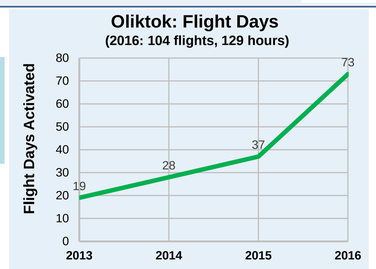
2015; Oliktok:
Arctic Shield Search & Rescue exercise
using ScanEagle platform
with USCG, C-P, Insitu, NOAA, FAA, NSB and Era

2016-17; Oliktok:
Radar calibration sphere on TBS
with PNNL

2014; Oliktok:
Coordinated observations of the Arctic lower atmosphere (COALA)
using DataHawk platform
with CIRES/UC-Boulder



2002; Barrow:
Simultaneous Aerosonde-Radiosondes
with ANL and NSF



2010; Oliktok:
Arctic Lower Troposphere Observed Structure (ALTOS)
using SPEC He-filled balloon;
with SPEC, PSU, Scripps and UAF

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

2001; Barrow:
First UAV flights on North Slope AK
Aerosonde with NSF

2004; Barrow, Atqasuk, Oliktok, Toolik Lake:
Mixed-Phase Arctic Cloud Experiment (M-PACE)
using Vaisala sondes and ARM-Proteus UAV
with UAF, PSU, UIUC, UND, UWisc, PNNL and NOAA

2012; Oliktok:
UAS Test Maneuvers
using BAT-3 + Aeryon Scout
with NMSU

2013; Oliktok:
Marginal Ice Zone Observation & Process Experiment (MIZOPEX)
using Sierra, Datahawk and ScanEagle
with NASA, UAF and CU

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