

# ARM Aerial Instrumentation Workshop

## Update and Discussion

Conveners: Beat Schmid, Fan Mei, Darielle Dexheimer

2:00 - 4:00 pm EST (11:00-13:00 PST), June 24, 2020

- Beat/Fan: Welcome, virtual meeting logistics, introduction
- Beat: Challenger 850 and ArcticShark update
- Jason: Challenger 850 modifications performed under contract and infrastructure requested that would go beyond
- Fan: Instruments (existing and proposed) for Challenger 850 aircraft
- Dari/Fan: Instruments (existing and proposed) for TBS and UAS
- All: Discussion and Prioritization

# ARM Aerial Instrumentation Workshop

Discovery Hall @ PNNL, Richland, WA · March 2 & 3, 2020

Conveners: Beat Schmid, Fan Mei, Darielle Dexheimer



- ▶ Led by AAF and TBS teams
- ▶ By invitation only
  - 27 invited experts (1 remote) from 21 different institutions.
  - 28 advisees (4 remote) from ARM infrastructure
  - 4 ARM/ASR Program Managers (remote)
  - 45 presentations



# Tethered Balloon Systems (TBS) Team

Led by D. Dexheimer at Sandia National Laboratories

**ARM**



# ARM Aerial Facility AAF Team

## Led by B. Schmid at Pacific Northwest National Laboratory



### ► People:

- ~14 full-time equivalent staff at PNNL
- Mentors at BNL, LBNL, NOAA/CIRES
- Users/collaborators at national laboratories, universities, and private industry

### ► Platforms

- Bombardier Challenger 850 Regional Jet
- ArcticShark Group 3 UAS

### ► Instruments

- >60 AAF
- User instruments



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## ► Instrumentation:

- Platforms: Challenger 850, Tethered Balloon Systems, ArcticShark
- Measurements: Meteorology, Radiation, Gases, Aerosols, Clouds

## ► Call for White Papers

- 42 submissions
- All represented

## ► Agenda Philosophy

- Session chairs - invited experts
- Session co-chairs - AAF/TBS staff
- Motivating Presentations - invited experts
- White paper presentations - mixed

## ► Workshop Report (early draft submitted to Sally on May 22, 2020, to be published July 2020)

## ► Breakout Session at ARM/ASR PI Meeting (Summary, Prioritization)



# G-1: Supported DOE's Biological and Environmental Research Mission for 30 Years



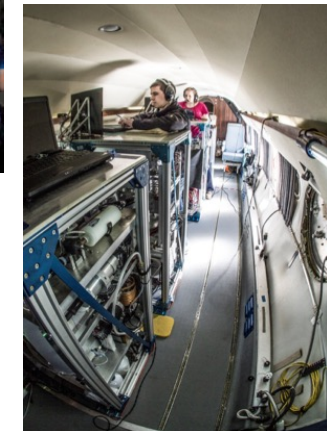
Atmospheric Chemistry  
Program (1989–2004)

ARM Research Facility  
(2010–2019)



## ARM Campaigns

- 2010, CARES, California (16)<sup>1)</sup>
- 2011, Calwater I, California (6)
- 2012 & 2013, TCAP I & II, Massachusetts (13)
- 2013, BBOP, Washington and Tennessee (7)
- 2014, GoAmazon I & II, Manaus, Brazil (14)
- 2015, ACAPEX/Calwater II, California (3)
- 2015, ACME 5, Alaska (2)
- 2016, HI-SCALE I & II, Oklahoma (2)
- 2017 & 2018, ACE-ENA I & II, Azores, Portugal (1)
- 2018, CACTI, Cordoba, Argentina



<sup>1)</sup> Published peer-reviewed journal papers using G-1 data. Typically there are many additional papers using surface based data.

# ARM Aerial Facility Publications (as of 6/16/2020)



U.S. DEPARTMENT OF ENERGY

Unique records in data base	216
Papers from AAF led missions	185
Papers form campaigns with AAF instrument loans	13
Papers that reference AAF but do not use data	6
Papers describing instrument development funded by AAF	5
Papers in queue	7



# AAF Bombardier Challenger 850 Regional Jet

(Entered into service 1998, low time: < 5500 hours; < 2600 landings, painted in 2015)



- ▶ Replaces (and surpasses) the measurement capabilities of the G-1
- ▶ Maintain capability of G-1 for “low and slow” flights
- ▶ Increased cabin space
- ▶ Increased payload weight
- ▶ Increased max. altitude
- ▶ Larger geographical range

## ▶ Timeline:

- Mission Need approved Feb 2017
- Funding secured FY 2019 for aircraft purchase and modifications
- Aircraft purchase finalized June 2019
- Contract for modifications (18 months) placed



and aircraft delivered to contractor in June 2020.

- CY 2022 Science and Engineering Test Flights
- CY 2023 First Science Mission



# AAF Bombardier Challenger 850 Regional Jet

(First Science Mission)



First opportunity for the research community to propose a research mission with the Challenger 850 will be in response to ARM's regular call for proposals in ~March 2022 with a decision in October 2022.

## Risk Mitigation:

- CY2023 mission no earlier than April 2023
- For a CY2023 mission, restrict possible deployment locations to the following ARM sites: AMF3 and SGP.
- For CY2023 allow for a maximum of 2 guest (non-AAF) instruments that must have previously flown on the G-1. AAF will develop a list of eligible guest instruments. Relax this restriction in later years.
- For a CY2024 mission, restrict possible deployment locations to continental US (including Alaska)
- For CY2025 allow international locations.

# Hangar Replacement



- ▶ Owned by and leased from Port of Pasco
- ▶ Merges two hangars (UAS and G-1) into one
- ▶ ~18,000 ft<sup>2</sup>
- ▶ Room for ~15 people
- ▶ Beneficial Occupancy: July 2020

# ArcticShark Update



## ArcticShark Group 3 UAS - Technical Data:

- ▶ Wingspan 22'
- ▶ Length 14' 3"
- ▶ Empty Weight 427 lb
- ▶ Max T/O Weight 650 lb
- ▶ Max Payload 100 lb
- ▶ Payload Power 2,500 W
- ▶ Underwing Hard Points 4
- ▶ Max Altitude 15,000 ft
- ▶ Endurance 8 hours
- ▶ SatCom Capabilities
  - Over the horizon ops



- Two Mishaps in 2019
  - April 25<sup>th</sup>, failed nose landing gear steering servo in flight. Follow automated landing, aircraft veered off the runway
  - September 25<sup>th</sup>, aircraft failed to properly execute an automated missed approached initiated at 66 ft AGL
- Mishap Causal Analysis Concluded March 2020
- Corrective Action Plan issued
- Analyses of Alternatives completed
- Some engineering efforts were allowed to continue during pause
- Acceptance test flights with repaired/modified ArcticShark in June 2021
- Working on flights on TigerShark platforms operated by partners (MSU, NAVAIR)

# 1<sup>st</sup> Science Mission: Clear air flight over SGP



## COA for UAS flight operations over SGP

- Approved Summer 2019, valid for 2 years
- 1200 – 5500 ft agl
- Using 4 teams of Visual Observers (VO)
- Maximum distance from VO's to UAS is 2.1 nm (green line)
- Will practice this in Mississippi

