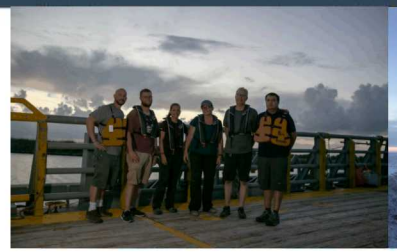
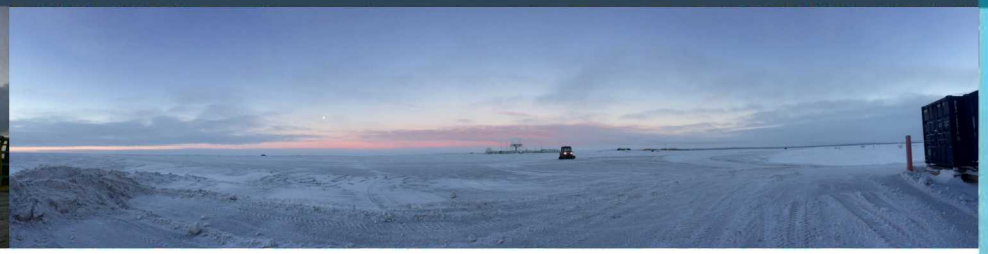
SAND2019-12717PE

Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY
Office of Science

BER REVIEW
Sandia Climate Measurements Program





PRESENTED BY

Jasper (Joe) Hardesty

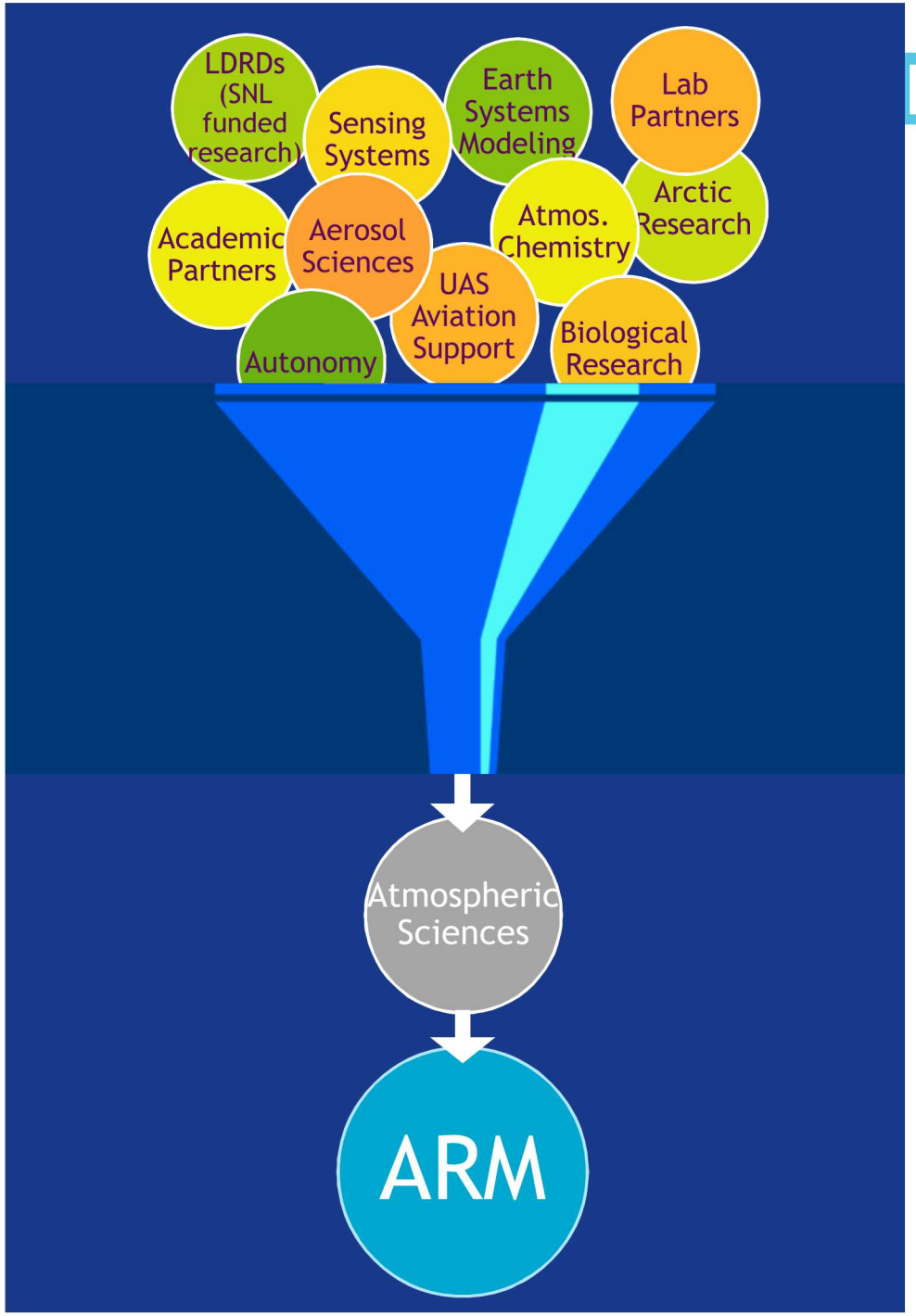
BER Review

22 Oct 2019

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Our Value to the ARM Mission

Sandia Atmospheric Sciences provides engineering capabilities that support ARM facilities while offering engineering and science innovation toward integrated operations, measurements, modeling and scientific research, by drawing on complementary capabilities at Sandia and with partners elsewhere.



SNL Support for ARM Climate Measurements

Sandia support of ARM Climate Measurements and Mission includes

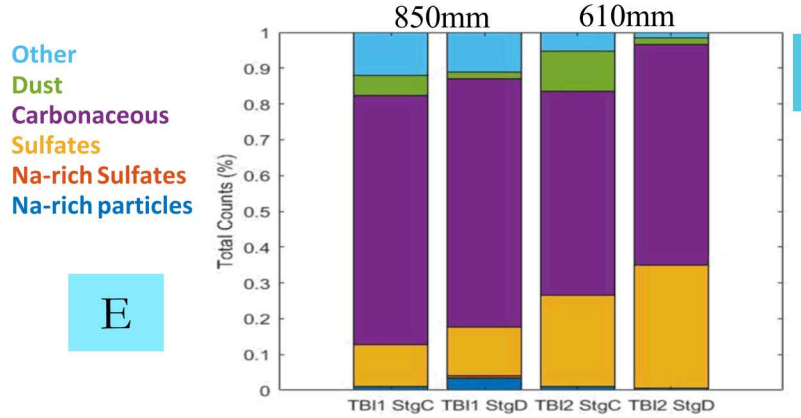
- Management and Operations of the NSA and AMF3 facilities
- Controlled airspace management (R-2204 and W-220 at Oliktok Point)
- Logistics and operational support of ARM Field Campaigns
- Mentoring and Operations of the Tethered Balloon System (TBS)
- Advising ARM, OAM in developing unmanned(UAS)/TBS standards
- ARM Radars technical support
- ARM Lidars mentorship
- Review proposals with ARM

2019 Accomplishments - 1

- **Unified operations at both Alaska sites**
  - Standardized practices, lessons learned
  - Uniform training curriculum across sites
  - Inter-site on-call support
- TBS platform for ARM baseline measurements and campaigns
  - A. Improved TBS data collection
  - B. New process for annual TBS planning
  - C. Flights at AMF3, plus initial campaigns conducted at SGP
  - D. Coordinated with ARM Aerial Facility (AAF) to select and test new instruments
  - E. Worked with Environmental Molecular Sciences Lab (EMSL) for samples analysis
  - F. Excellence in engineering of new TBS winch system
    - Greater performance for higher wind limits (7m/s → 13 m/s)
    - Increased efficiency, saved costs (3-4 crew → 1-2 crew)
    - Semi-automated controls and standard flight profiles
    - Maintained high safety operations

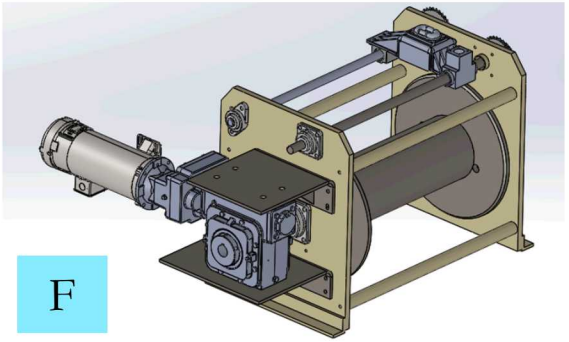
TBS = Tethered Balloon System

E



Particle categories at different altitudes from July SGP TBS impactors

F



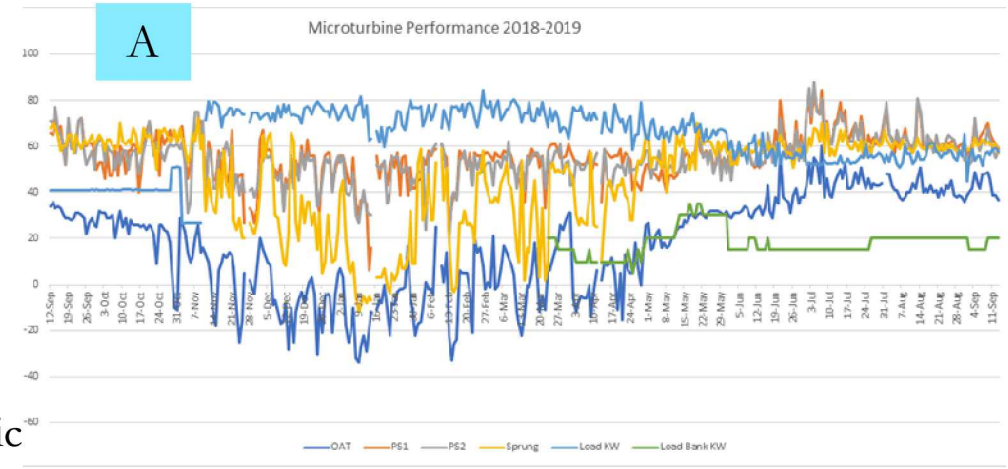
Model of new gearbox and motor for TBS winch

C

2019 Accomplishments - 2

- Alaska Arctic Facilities:
  - A. Engineered power systems at AMF3
    - less emissions
    - improved reliability
    - backup power integration
  - B. NWS soundings coordination at NSA
    - Autosonde upgrades
    - hydrogen generator installed
  - C. Installed new Meteorological Automatic
  - D. Great safety record
  - E. Consistent instrument operations and data collection
- ARM Radars Team Support
  - a. Increased ARM radar team coordination
  - b. Support of CACTI radar systems
  - c. MOSAiC ARM radars support
- Finalized documents for UAS/TBS requirements, standards, approvals process, operation guidelines
- Transition of Lidars Mentorship
- Hosted VIP visits to AK Facilities
  - i. DOE Office of Science Director Chris Fall
  - ii. Sandia leadership
  - iii. LANL and PNNL collaborators
  - iv. ARM IMB (Jennifer Comstock, PNNL)

A



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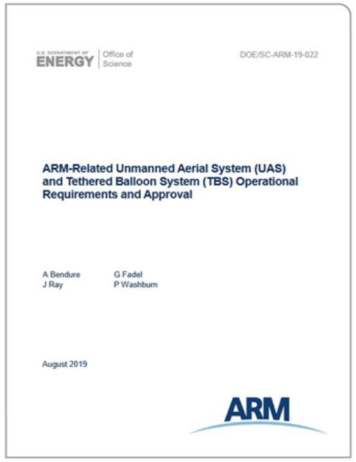

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2019 Management Responsiveness

Sustained and Safe Operations in Remote and Harsh Conditions

Arctic operations (shipping, lodging, field support, power systems, icing, snow drifting, site access, scarce infrastructure, supply chain, services, wildlife, etc.)

→ Planning, partnering, public-private collaboration, redundant systems/supplies, training, consulting with FC PIs.

SNL ARM Team Integration

Al Bendure pending retirement → George Slad understudy, experienced aviator, UAS expertise

Building TBS bench: Technologist Garth Rohr with electronics/controls expertise

Strengthening capabilities: Technologist Ben Bishop training for power systems and radar systems

Barrow Facility Manager Dan Lucero retirement → Fred Helsel managing both sites for ARM in Alaska

•Barrow observer Walter Brower (20+ year veteran) retirement → two new technologists trained by Walter

AMF3 observer David Oaks (5-year veteran, now supporting COMBLE → new technologist contracted

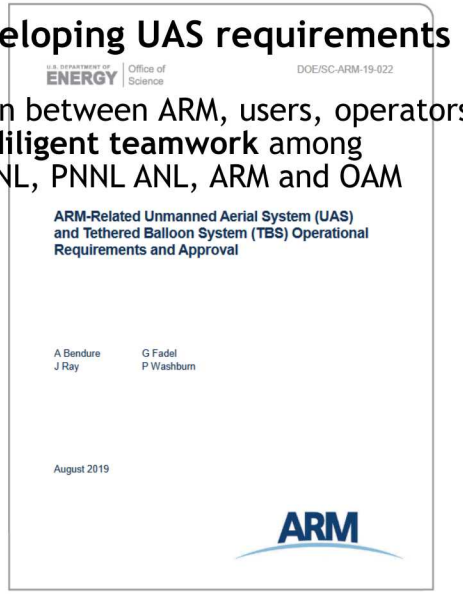
Radars and Lidars Support

Lidars mentors: John Goldsmith transition to colleague Ray Bambha

Radars: Todd Houchens coordination with ARM radar team, vendors and mentors; Ben Bishop radar training to support ARM team.

Feedback for developing UAS requirements

Frequent coordination between ARM, users, operators and DOE-OAM; with **diligent teamwork** among aviation experts at SNL, PNNL ANL, ARM and OAM


U.S. DEPARTMENT OF ENERGY | Office of Science

DOE/SC-ARM-19-022

ARM-Related Unmanned Aerial System (UAS) and Tethered Balloon System (TBS) Operational Requirements and Approval

A Bendure
J Ray

G Fadel
P Washburn

August 2019

ARM

TBS integration into baseline operations

Planning and coordination with ARM IMB, mentors, PIs with interest, and ARM data systems office and developers.

Future Activities and Opportunities - I

- Site Operations
  - **Barrow/Utqiagvik:**
    - A. Adding instruments (Radar, scanning HSRL)
    - B. New deck installation for relocated RL (from AMF3)
    - C. Continued coordination for NWS sonde launches
    - D. Neighboring NOAA Observatory modernization/expansion:
      - ARM coordination with NOAA (measurements, data, operations, etc.)
      - Use of new NOAA deck (ARM instruments/campaigns)
  - **AMF3/Oliktok Point**:
    - Measurements and field campaigns to complement MOSAiC
- AMF3 decommission and new site relocation
  - i. Looking for someplace a little warmer… like a "warming hole"…
  - ii. Pre-planning underway for major activities, procurements, contracts
  - iii. Opportunity to leverage Sandia and ARM team expertise in UAVs, TBS

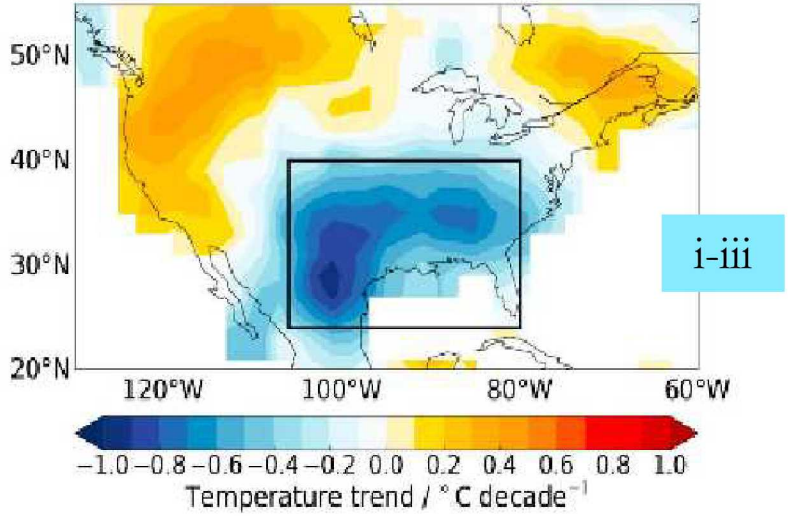


Figure 1. Map of the linear trend in near surface air temperature (°C decade $^{-1}$) in GISS Surface Temperature Analysis (GISTEMP) observations [*Hansen et al.*, 2010] over the U.S. between 1951 and 1975 (JJA). The boxed region represents the SE U.S. and encompasses the area within 24–40°N, 80–106°W.

Future Activities and Opportunities - 2

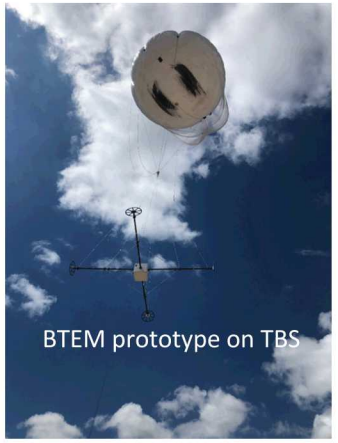
A. TBS 2020 flights for baseline data and instrument testing
   - Missions at SGP (not in clouds) and OLI (in clouds), others possible
   - Two ARM proposal periods for 2020 flights: Feb-May; June-Sep
   - Inquiries from other agencies and programs

B. Coordination for new HSRL window installation
   - Univ. Wisc., ANL, PNNL, SNL

C. SNL ARM Team Development:
   - Building a team to serve ARM into the future (logistics, operations, modeling, science)
   - Deepen our bench to provide support to the new AMF3 site
   - Personnel development with training and increased capabilities
   - Transition of Sites Management

D. Dual-use Opportunities Aligned with ARM Mission
   - e.g. BARC SACR imaging of sea ice
     - Factor: BARC SACR often not working, while demand for science and dual-use applications increases
     - Opportunity: Deep SNL radar expertise may be able to assist in SACR operation

HSRL being packed for shipment.

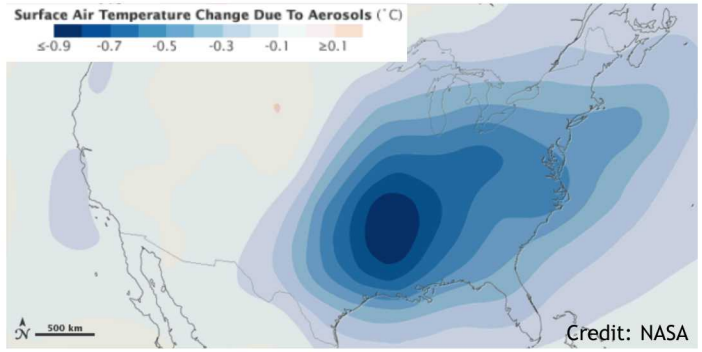


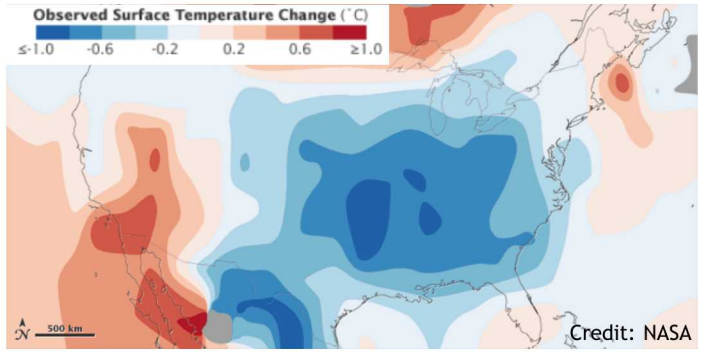
Thank You

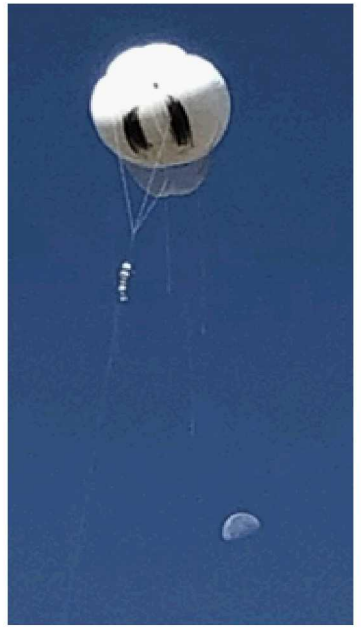
Sandia Atmospheric Sciences provides engineering capabilities that support ARM facilities while offering engineering and science innovation toward integrated operations, measurements, modeling and scientific research, by drawing on complementary capabilities at Sandia and with partners elsewhere.

We value the ARM Mission and look forward to contributing and working with our partners towards ARM's vision.

We look forward to serving both high and low latitudes!







TBS aloft at SGP with moon.
Photo credit George Sawyer

Presentation Outline: 25 min (*15 min presentation, 10 min Q&A*)

1. **VALUE: Sandia Atmospheric Sciences engineering capabilities allows support for ARM while offering science & engineering innovation toward integrated operations, measurements, modeling and scientific research, by drawing on complementary capabilities at Sandia and with partners elsewhere.**
2. Current SNL Support for ARM Climate Measurements
   - NSA and AMF3 facilities Operations
   - Controlled DOE Arctic airspaces management
   - ARM Field Campaigns support
   - Tethered Balloon Systems Mentorship, Operations and Campaigns
   - ARM/OAM advising for UAS/TBS Standards, Approvals, Guidelines
   - Radar Technical Support
   - Lidars Mentorship
3. 2019 Accomplishments
   - Unified/coordinated operations at both AK sites
   - Smooth transition of Lidars Mentorship
   - Improved primary and backup power systems at AMF3
   - Expansion and integration of TBS platform ← keep here… what is below?
   - Coordination and completion of OAM documents for UAS/TBS operations, approvals, guidance
   - Support of ARM radars for campaigns CACTI, MOSAIC (Todd Houchens)
   - Coordination with ARM and PNNL for Todd Houchens support of ARM radar team (move from NM to WA)
   - Coordination with ARM, LLNL, and AVI for emergency support of MOSAIC ARM radars by Todd Houchens
   - Coordination for NWS use of ARM autosonde
   - VIP visits: DOE Office of Science, SNL Leadership, ARM IMB
4. 2019 Management Responses/Successes
   - SNL ARM Team Development, Integrating new staff capabilities (Ben Bishop – radar and power systems training, Garth Rohr – electronics/controls engineering, George Slad – experienced aviator, understudy to Al Bendure)
   - Responding to Arctic Ops (shipping, lodging, field support, power systems, harsh conditions, wildlife, etc.)
   - TBS as a baseline platform ← needed here?... Keep above.
   - Navigating/establishing new DOE requirements for UAS operations and approvals
   - Maintaining radars and Lidars, change of mentor for Lidars
5. Future Plans and Opportunities
   - AMF3 Relocation
   - Support complimentary activities for MOSAIC
   - TBS Flights and Platform Development – inquiries from other agencies, researchers and programs
   - Planned Site Operation Activities and Collaboration
   - Coordination for new HSRL window (Univ. Wisc., ANL, PNNL, SNL)
   - Dual Use Opportunities Aligned with ARM Mission

TBS impactor aloft with smoke plume at SGP