SAND2015-7041C

Sandia Labs, DOE-ARM Program Science Mission, Alaska Sites, Operational Challenges and Future Plans

31 Aug 2015
Alaska UAS Interest Group

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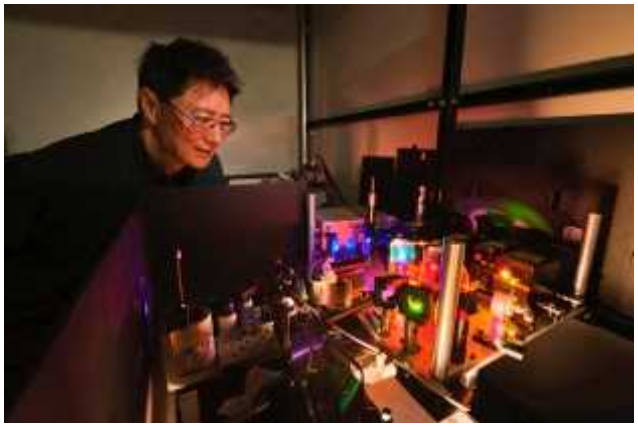
Sandia National Labs

Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin company, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

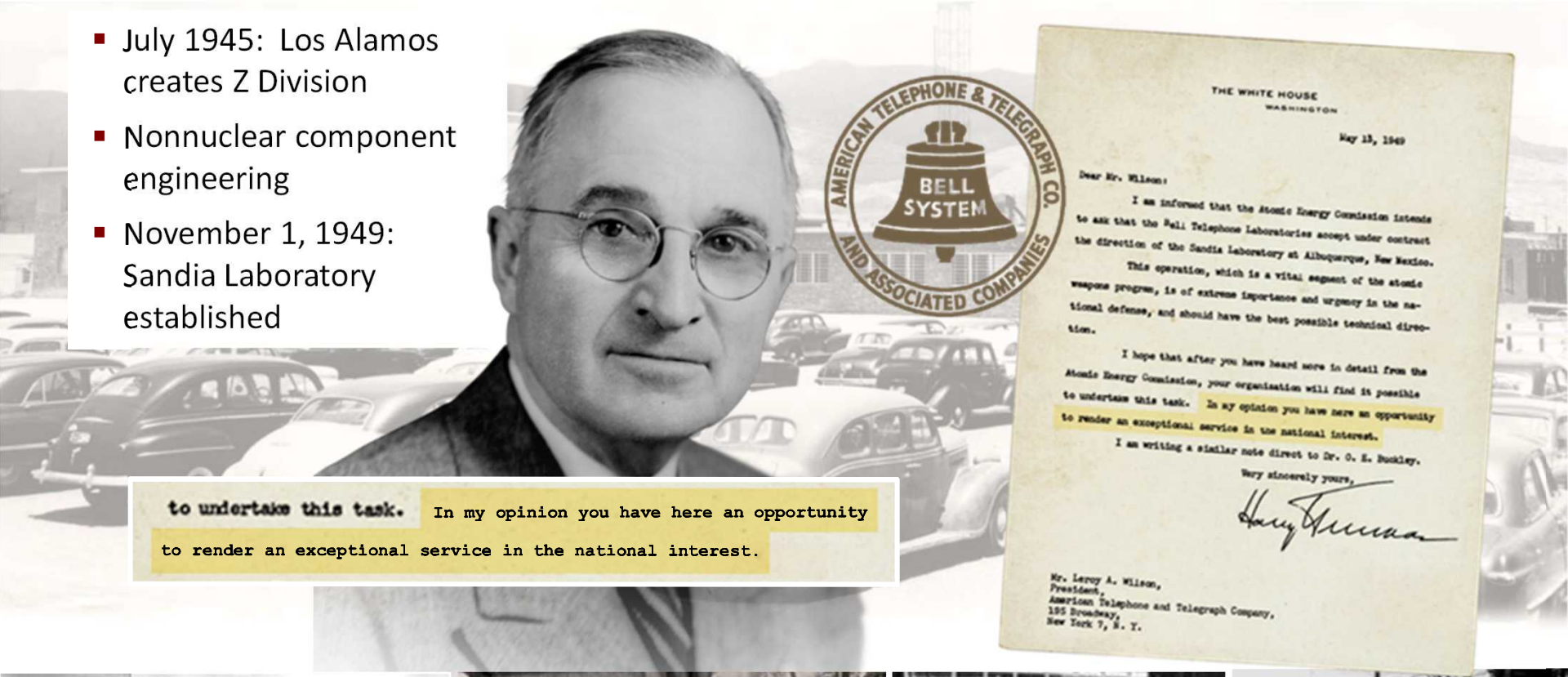

Sandia National Laboratories

An Overview

Sandia's History

Exceptional service in the national interest

- July 1945: Los Alamos creates Z Division
- Nonnuclear component engineering
- November 1, 1949: Sandia Laboratory established



to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

Sandia Addresses National Security Challenges

1950s	1960s	1970s	1980s	1990s	2000s	2010s
Nuclear weapons	Development engineering	Multiprogram laboratory	Missile defense work	Post–Cold War transition	START Post 9/11	Nuclear Life Extension Programs, Cyber, biosecurity proliferation
Production and manufacturing engineering	Vietnam conflict	Energy crisis	Cold War	Stockpile stewardship	National security	Evolving national

Sandia Atmospheric Monitoring Capabilities
Developed in Parallel with our Defense Work

Atmospheric test chamber

Cloud research & monitoring innovations to plan high altitude and ballistic tests

Leading edge Raman spectroscopy laser diagnostics developed for studying gas transfer systems critical to the Nuclear Weapons program

Atmospheric research (Salton Sea and Tonopah) to permit AG testing

As a result of the Energy Crisis, Combustion Research Facility (CRF) established based on laser diagnostic and computing capabilities for analyzing gas mixing

Sandia recognizes opportunity to apply CRF diagnostic capabilities to remote atmospheric monitoring and assists in planning ARM program

Established Arctic site in Alaska (at former Early Warning site)

Sandia competes successfully for ARM program support, develops and deploys Raman LIDAR for tropospheric water vapor studies and first ARM cloud stations

Sandia actively manages ARM program arctic site; latest generation Raman LIDAR deployed in 2010

In partnership with LANL, Sandia now operates an advanced mobile atmospheric monitoring lab deployed in CONUS; Climate remote sensing work in turn led to advances in remote sensing for other national security domains, e.g. CALIOPE, Raman LIDAR

1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 2011

Sandia National Labs Sites

Albuquerque, New Mexico

Livermore, California

Kauai, Hawaii

Waste Isolation Pilot Plant, Carlsbad, New Mexico

Pantex Plant, Amarillo, Texas

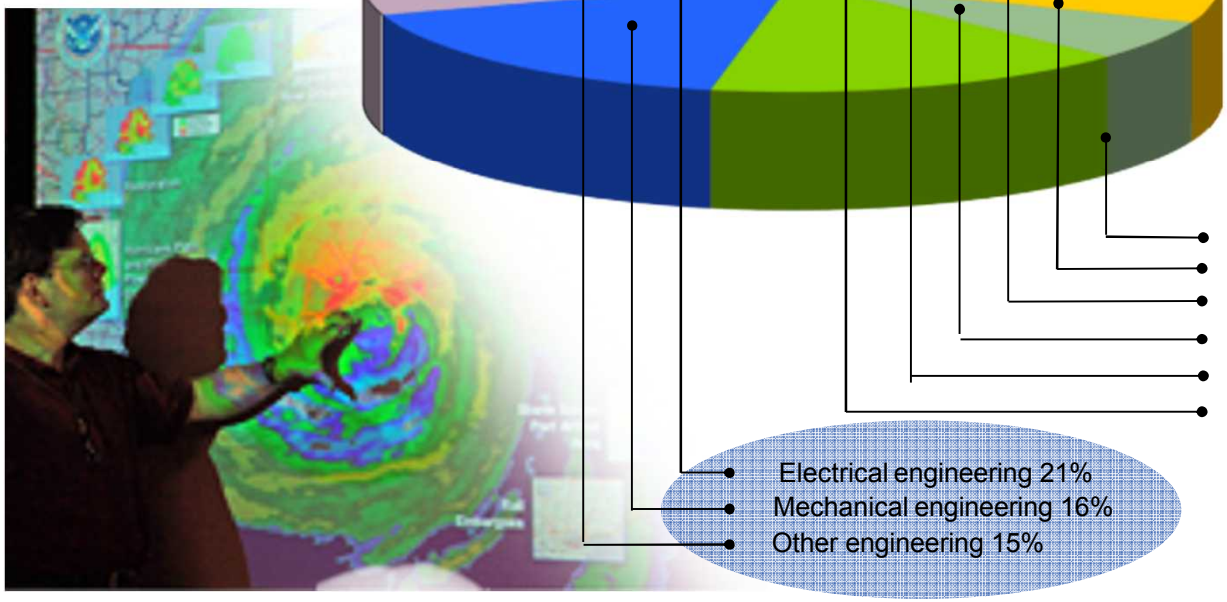
Tonopah, Nevada

Sandia National Labs Workforce

- *WE ARE SCIENTISTS & ENGINEERS*
  - Established relationships in global science and engineering community
  - Experience with research & development
  - Fundamental and applied sciences
  - Analytical skills

Spring 2015:

- On-site workforce: 12,123
- Regular employees: 10,177
- Advanced degrees: 6,097

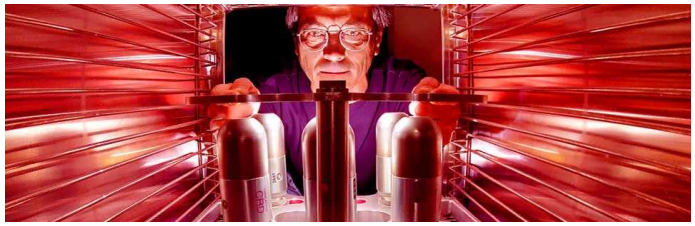


Technical staff (>5,000) by discipline:

Four Program Areas Steward our Projects

1. Nuclear Weapons

- Maintains current US nuclear weapons stockpile and stewards long-term vitality of capabilities, infrastructure and operations

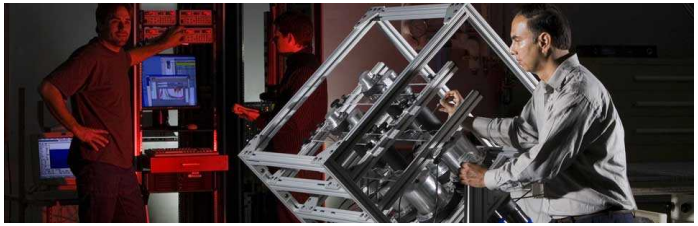


2. Defense Systems & Assessments

- Includes Surveillance & Reconnaissance and Remote Sensing & Verification

3. International, Homeland, & Nuclear Security

- Includes Homeland Security and Counterterrorism, Decontamination, Emergency Preparedness and Nonproliferation

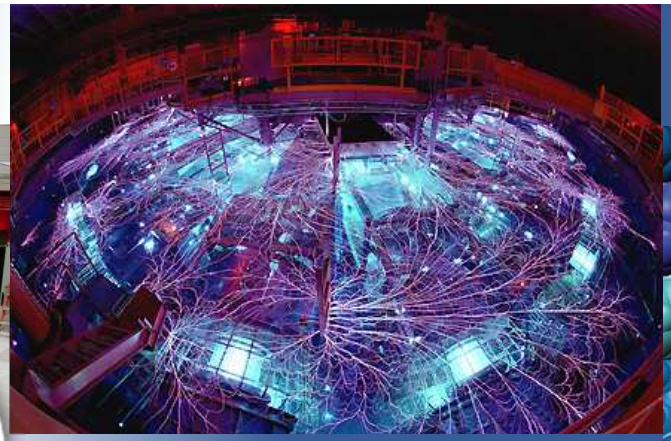


4. Energy and Climate

- Includes Energy Security, Transportation Systems, Infrastructure Resilience, Renewables Integration, Water Resources, Biofuels, Carbon Sequestration and Atmospheric Sciences

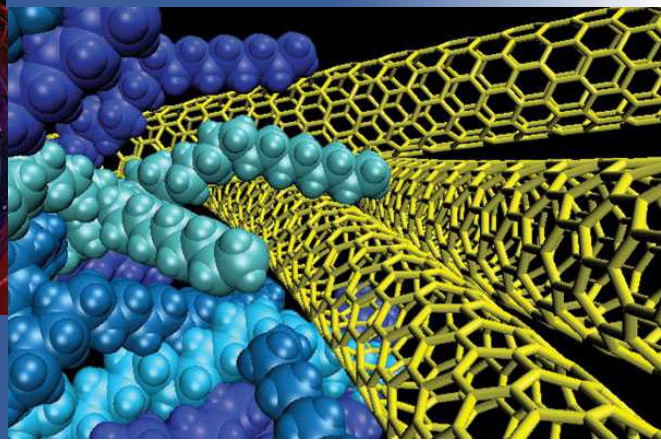
Seven Research Foundations Guide Lab-Directed Research Efforts

Computing & Information Sciences

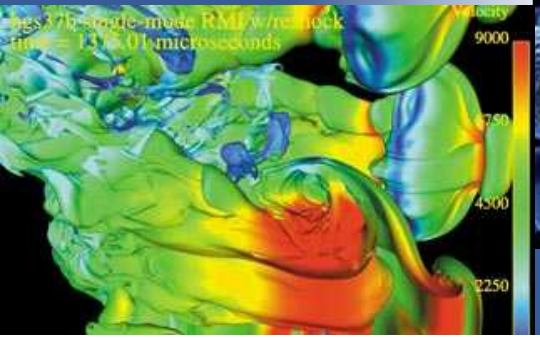


Radiation Effects & High Energy Density Science

Materials Sciences

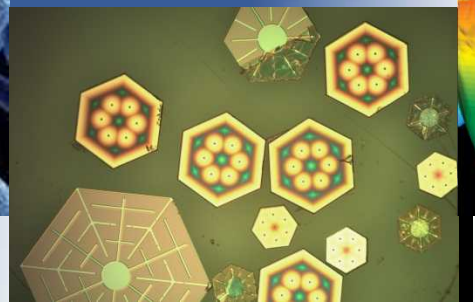


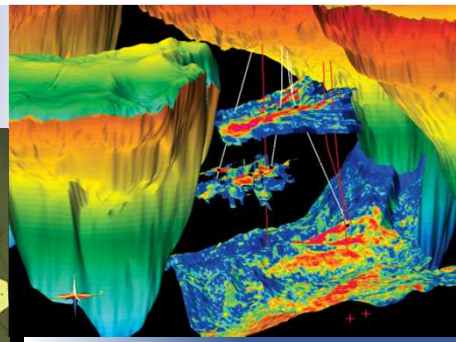
Engineering Sciences



Bioscience

Nanodevices & Microsystems

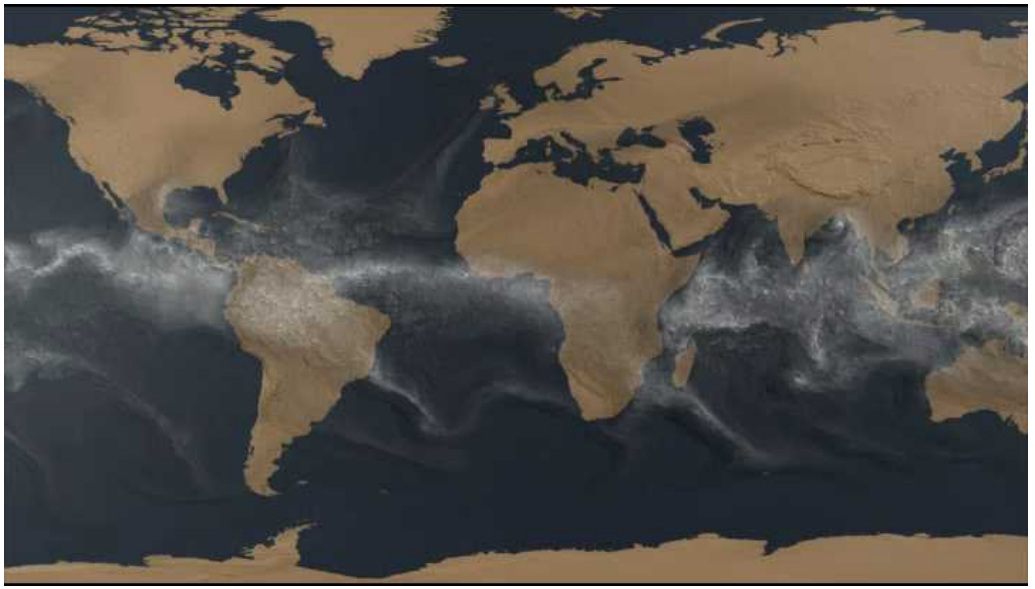




Geoscience

Sandia Role in Transforming Atmospheric Models and Computations

- Driven by US Nuclear Weapons simulation needs, Sandia pioneered development of massively parallel computing systems and methods.
- Sandia led the multi-lab effort to develop the Community Earth System Model's petascale-ready dynamical core.
  - Sandia atmospheric modeling capability is now very highly sought.
- Accelerated Climate Modeling for Energy (ACME) project
  - 8 National Labs + 6 partner institutions for next generation models





Sandia National Laboratories

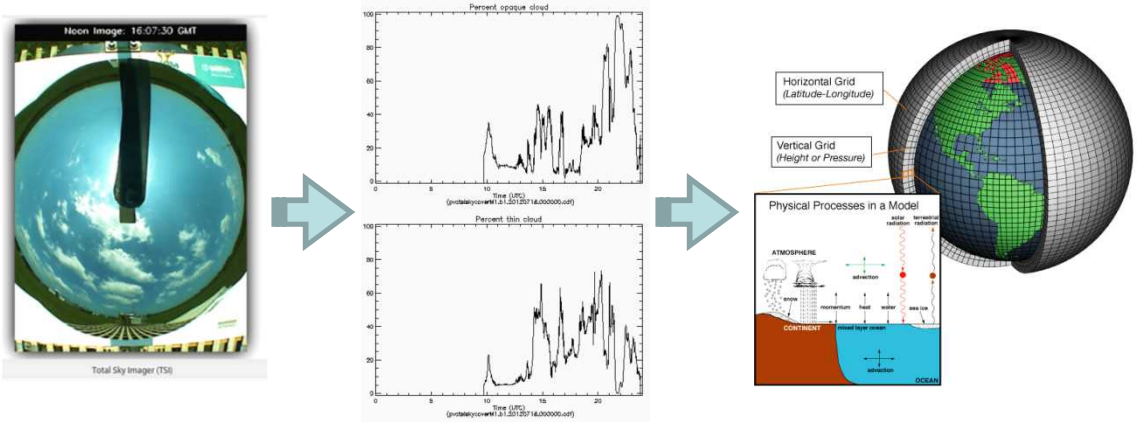
The DOE-ARM Program

DOE ARM Science Mission

- **ARM Science Mission** is to provide researchers *with strategically located in situ and remote sensing observatories* to improve the understanding of clouds and aerosols as well as their interactions with the Earth's surface in atmospheric/earth system models.
- **ARM Vision** is to provide an accurate description of the earth atmosphere in diverse climate regimes *to resolve the uncertainties in atmospheric/earth system models* to develop solutions for US national challenges.

- **Summary:** Provide Data to Improve Atmospheric/Earth Models.
- **Overall goal:** More accurate global and regional predictions.

- **Research Themes:**
  1. Aerosol Life Cycle
  2. Cloud Life Cycle
  3. Cloud Aerosol Interactions
  4. Radiative Processes



ARM Users and Sites Use - Recent

- **Recent Use (FY14-15):**

FY 2015 Statistics at a Glance

= Goal Met

FY 2015	Q1	Q2	Q3	Q4
Goals (hrs)	1987.20	1944.00	1965.60	1987.20
Actual (hrs)	2075.52	2102.40	2103.92	

FY 2014 Statistics at a Glance

= Goal Met

FY 2014	Q1	Q2	Q3	Q4
Goals (hrs)	1987.20	1944.00	1965.60	1987.20
Actual (hrs)	1950.40	1994.40	2067.52	2053.44

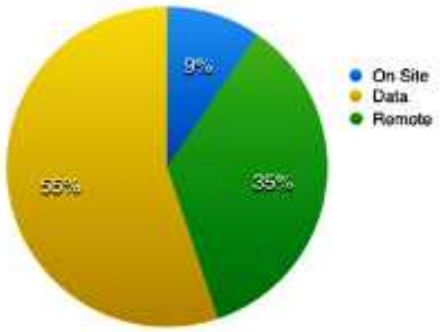
- **Current Use (Q3-FY15):**

Operational Statistics for the ARM Sites for the Period of April 1, 2015 - June 30, 2015

	Hours of Operation			Data Availability (%)	
SITE	**TARGET**	**ACTUAL**	**VARIANCE**	**GOAL**	**ACTUAL**
NSA	1965.60	2096.64	0.0667	0.90	0.96
SGP	2074.80	2074.80	0.0000	0.95	0.95
ENA	1856.40	2140.32	0.1529	0.85	0.98
Site Average*	**1965.60.00**	**2103.92**	**0.0704**	**0.90**	**0.96**

- **Users (past 12 months):**

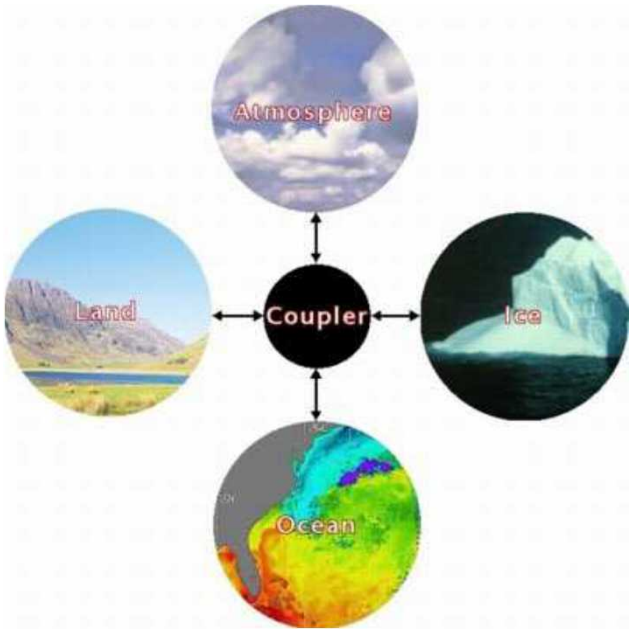
FY 2015 Q3 Summary of Last 12 Months	
Facility Access Type	**Unique Scientific Users**
On Site	112
Remote	417
Data	651
Total	**1,180**



ARM-North Slope Alaska (NSA) Science Mission

- NSA Science Mission is *to collect high latitude data to refine atmospheric/Earth models as they relate to the Arctic*.
- Scientific reasons for atmospheric studies *at high latitudes* are:
  - Ice/snow is the predominant form of water. Ice and snow scatter, transmit, and absorb sunlight and radiant heat differently than liquid water.
  - The Arctic is arid. Very little water vapor in the atmosphere affecs atmospheric propagation of radiant energy, and performance of some instruments.
  - The major "pumps" for global ocean currents are at high latitudes, and it is expected that those pumps are affected by changes in the atmosphere.
  - High latitude atmospheric processes over land and sea must be characterized for incorporation into global earth models.

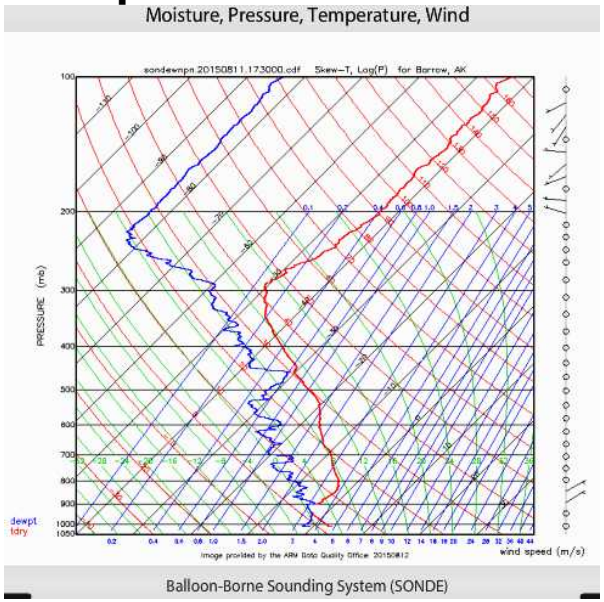
- **Summary:** Provide Data to Improve atmospheric/Earth Models *of high latitudes*.
- **Overall goal:** More accurate *global and arctic region* predictions.

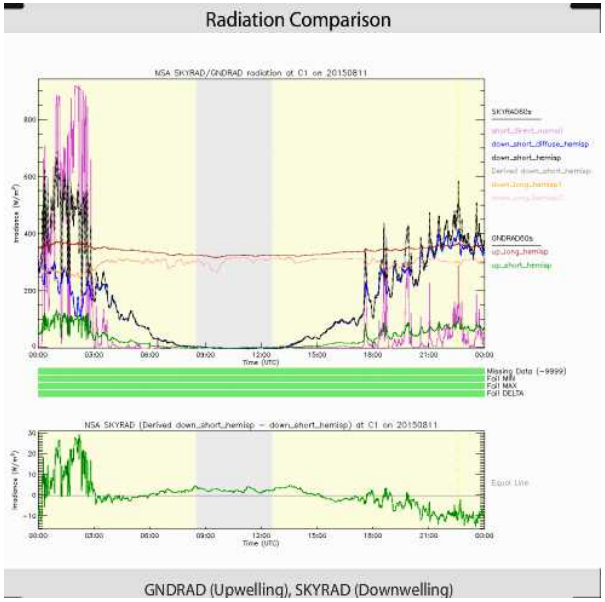


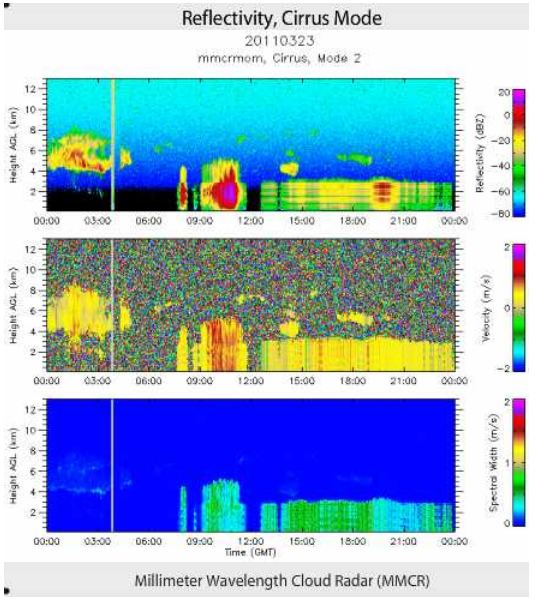
ARM-North Slope Alaska (NSA) Atmospheric Data

- **Examples of data:**

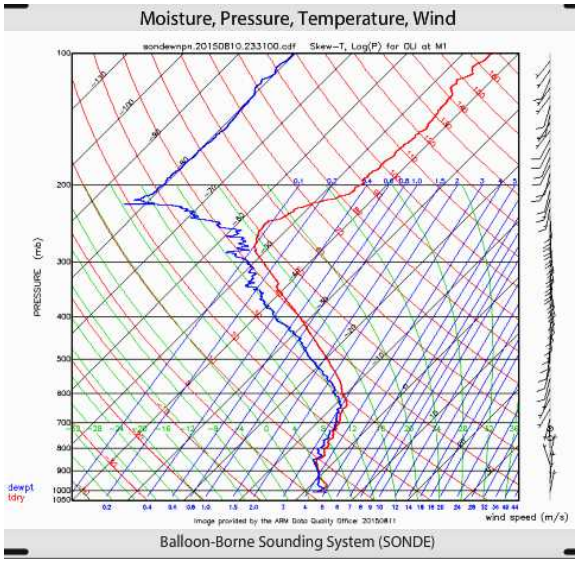
Barrow:

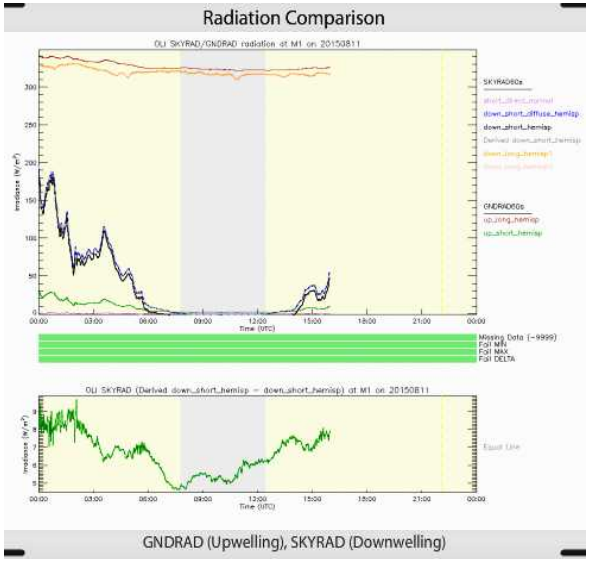


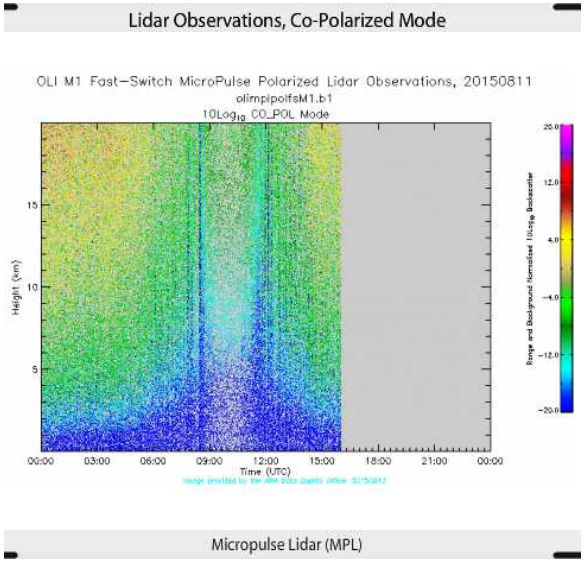




Oliktok:







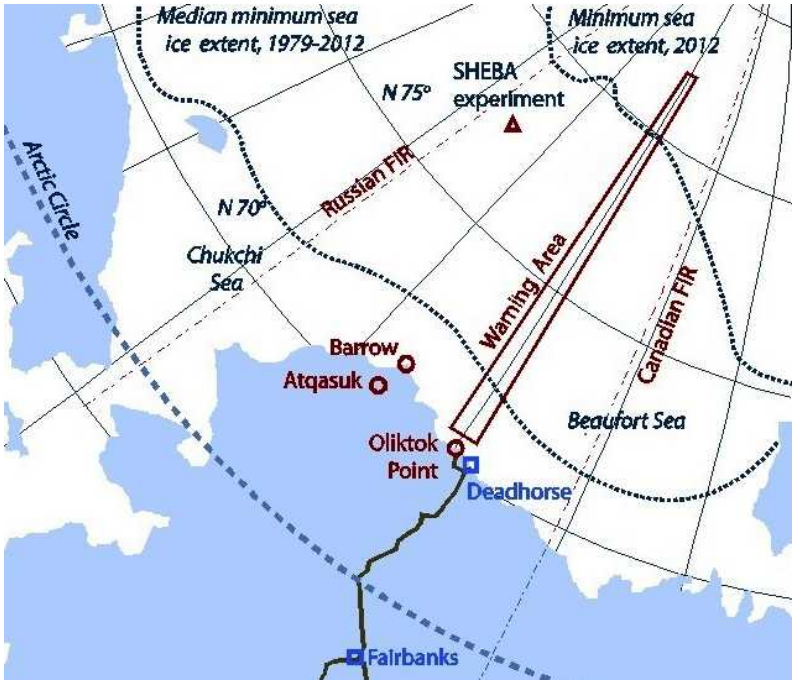
ARM Regional & Global Climate Modeling program (RGCM)

- The RGCM Mission is to advance the predictive understanding of Earth's climate by focusing on scientific analysis of the dominant sets of governing processes that describe climate change *on regional scales*.
- Priorities include investigation of regions that are climatically sensitive or vital to climate assessments, including the Arctic:
  - Analyze interactions between *sea ice*, *ice sheets*, *cold oceans*, regional climate, and *permafrost stability* in the context of both high-resolution regional and global models.
  - Other priorities include *severe weather* event modeling, model testing, Earth/atmosphere feedback processes.

- **Summary:** Provide Data to Improve Climate *Models of Regions*.
- **Overall goal:** More accurate *global and regional* climate predictions.

ARM-NSA Sites

- ARM-NSA Sites:
  - **Barrow**: to measure ocean-land-atmosphere interface conditions
  - **Atqasuk**: to measure land-atmosphere interface for comparison of Barrow measurements for differences between land and shore conditions
  - **Oliktok (AMF-3)**: to measure ocean-land-atmosphere interface; use of R-2204 and W-220 for aerial atmospheric measurements



Barrow
1997 - present

Atqasuk
1999 – 2010

Oliktok (AMF-3)
2013 - present

ARM Partners and Collaborators

- ARM collaborates extensively with other DOE programs and labs, agencies, universities, and private firms in gathering and sharing data. This allows ARM to leverage its investment in instruments, sites, data, and science to provide the greatest benefits.
  - National Labs* across DOE (Argonne, Brookhaven, LANL, Berkeley, LLNL, NREL, Oak Ridge, PNNL)
  - NOAA*, NASA*, USGS*, NSF, FAA*, USAF*, DOC (commerce)
  - North Slope Borough, local communities and authorities
  - UAF*, Penn State*, UC Boulder*, NMSU*, many universities* worldwide
  - Canada*, Australia*, France*, Russia*, UK*, Japan*, other countries*
  - Insitu*, Vaisala*, many commercial partners*

  * Are involved in use of UASs for atmospheric study and other purposes.
- ARM also works the oil industry* (Conoco Phillips, Shell, ENI, etc.) to coordinate use of resources and conduct research of mutual interest.

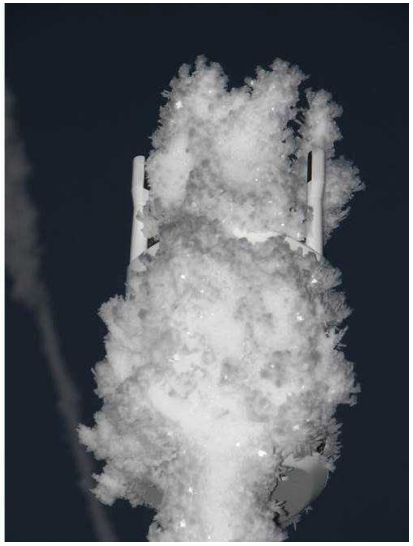
Argonne NATIONAL LABORATORY · BROOKHAVEN NATIONAL LABORATORY · Los Alamos NATIONAL LABORATORY · NREL · OAK RIDGE National Laboratory · Pacific Northwest NATIONAL LABORATORY · Sandia National Laboratories

ARM-NSA Operational Challenges

- Operational Challenges:
  - cold*
  - wind*
  - bears*
  - oil rigs
  - logistics
  - ice build-up*
  - tundra/swamp
  - ice fog, ice rain*
  - blowing/drifting snow
  - other wildlife (mosquitos)*
  - lost aircraft in tundra/ocean*
  - extended daylight/dark hours
  - damage from rough UAV landings*
  - remote, limited resources/facilities*
  - roads/infrastructure/energy availability/reliability

* These challenges all directly impact use of UASs at NSA sites.

ARM-NSA Operational Challenges



ARM-NSA Future Plans

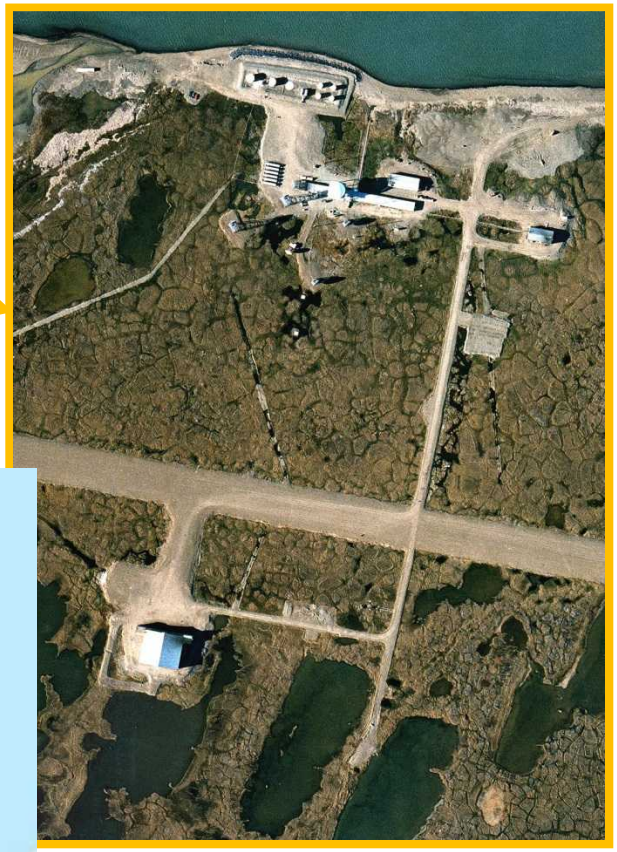
- Future Plans:
  - Severe Weather hardening/procedures
  - Infrastructure improvements/backups
  - Sprung structure for equipment, UASs, prep space
  - Improve/streamline process for UAS safety reviews/approvals
  - Improve air traffic information and coordination
  - Extend partnerships/collaborations
  - Oliktok Point Science Camp

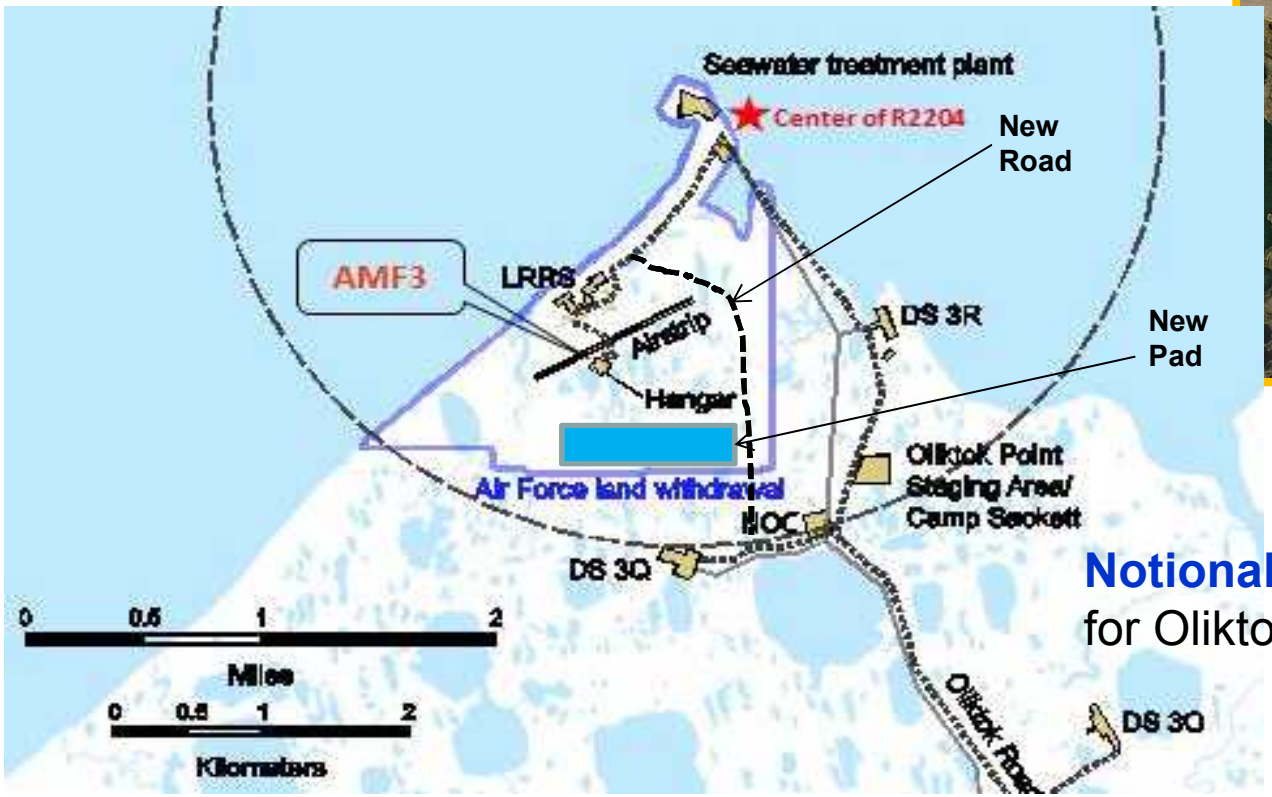
ARM-Oliktok Science Camp

Oliktok point Science Camp Overview:

- Discussions with Air Force/USAF have been favorable for development of Oliktok Science Camp concept.
- Includes facilities and infrastructure (roads, power, user accommodations, shelters, equipment/data, etc.)
- Schematic plans recently developed.
- Win-win-win… for USAF, Sandia, DOE-ARM, ENI, CP, NASA, NOAA, UAF, State of Alaska, others…
- The Oliktok Point Science Camp could benefit the arctic research community, government agencies, North Slope Borrough, etc.
  - Establishes a site on the Arctic Ocean that has road access to/from the lower 48 states.
- Extend collaborations and partnerships for Arctic security, research, commercial and related interests.

ARM-Oliktok Point Science Camp





Notional/preliminary concept
for Oliktok Point Science Camp

More Information

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Happy Flying!

Thank You