SAND2011-1951C

ARM Climate Research Facilities on the North Slope of Alaska – Barrow, Atqasuk, and Oliktok

Marine Renewable Energy Workshop
NREL
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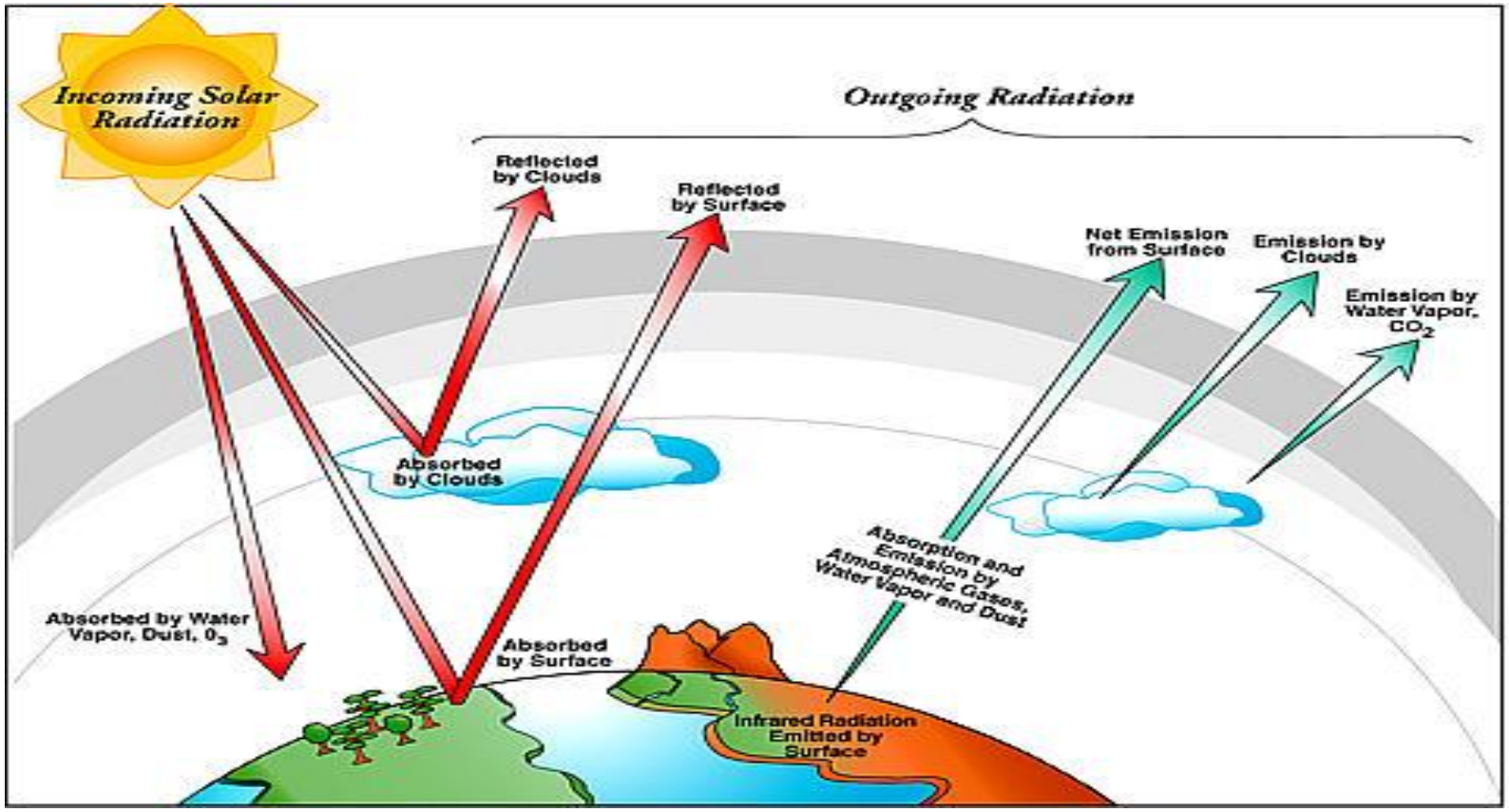
Sandia National Laboratories

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.

Agenda

- DOE, Climate Modeling, Clouds, Atmospheric Systems Research Program
- North Slope of Alaska ARM Climate Research Facilities – observations over the past decade and plans for the next decade
- Oliktok Point Arctic Research Facility
- Challenges and Opportunities
- Wind Power on the North Slope of Alaska

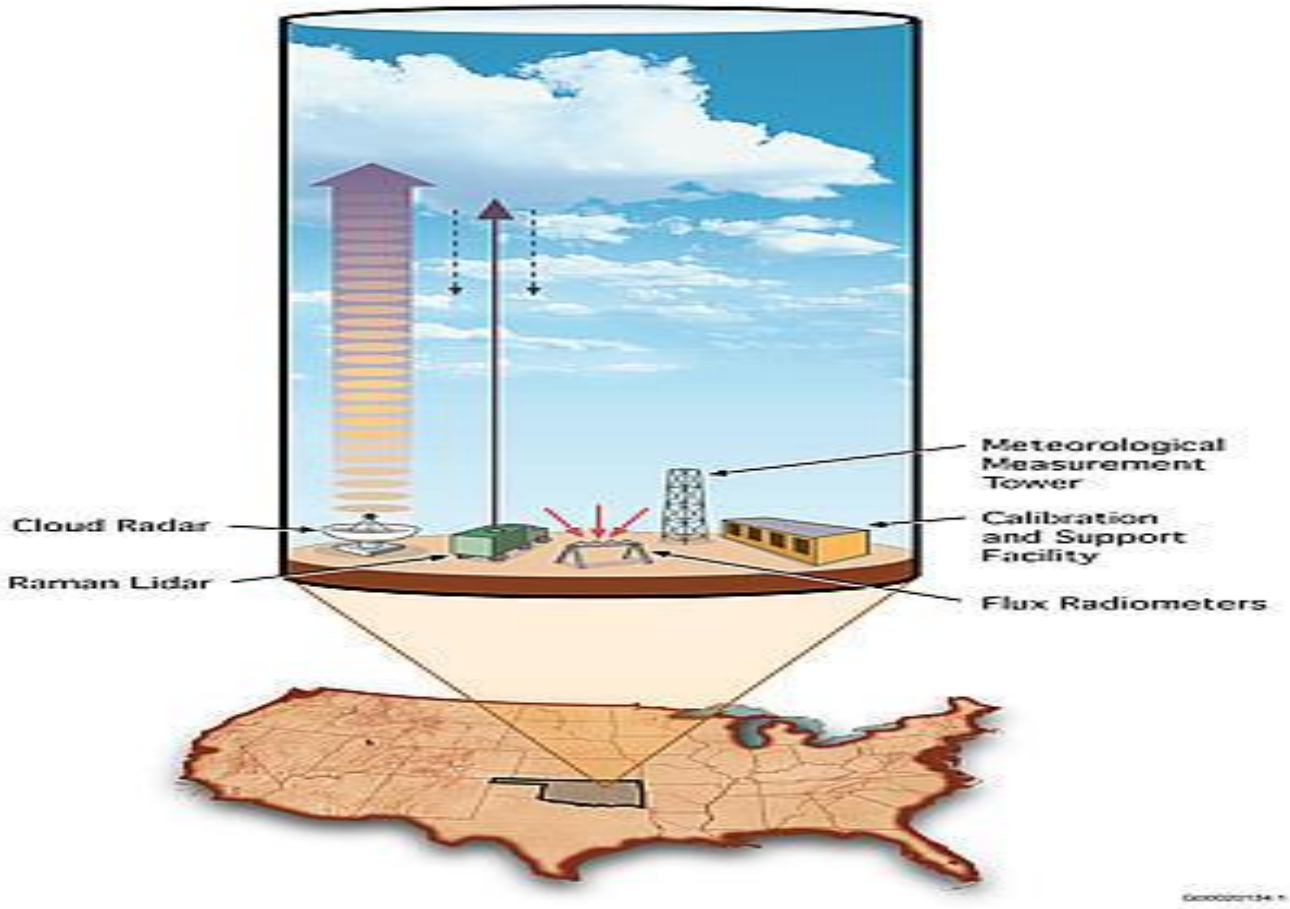
Atmospheric Radiation, Earth's Energy Budget, Clouds, and Climate



Why is the Arctic important to climate science?

- Large change in seasonal surface albedo
- High-latitude processes, including cloud processes, poorly understood
- Arctic warming expected to be roughly 2 times global average

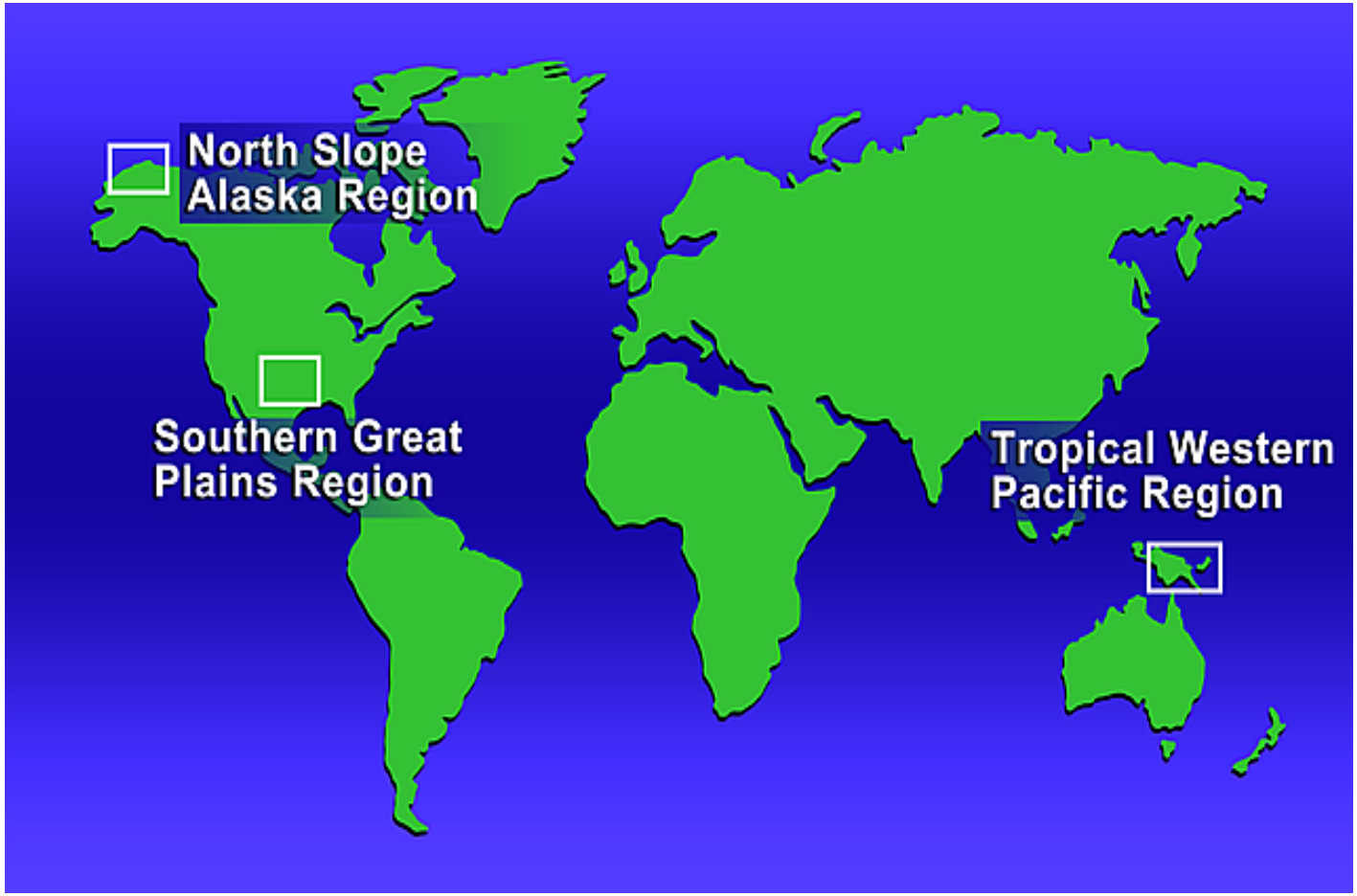
Initial ARM Site: Southern Great Plains CART Site



DOE/SC Atmospheric Systems Research Program

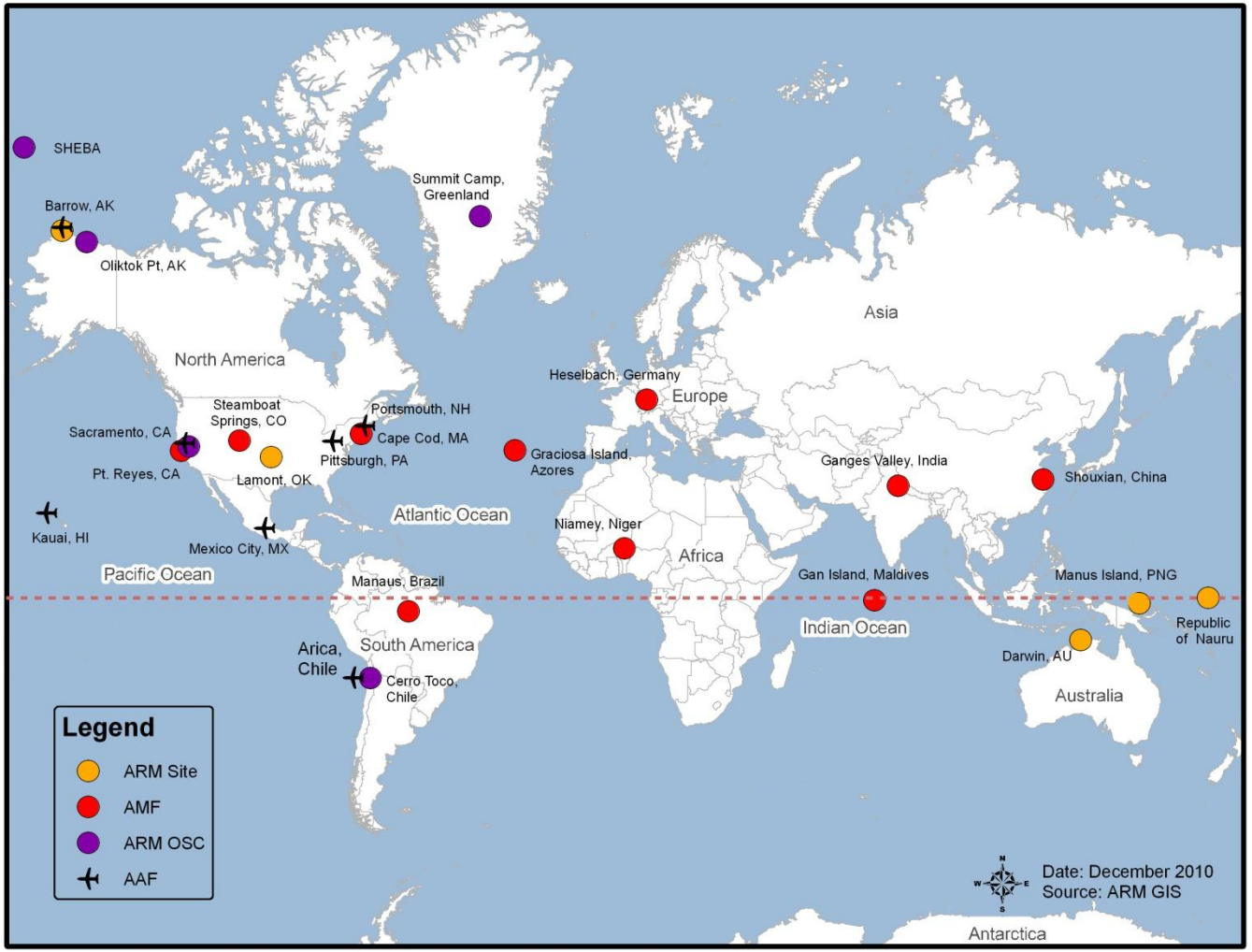
Formerly Atmospheric Radiation Measurements Program

Fixed ARM Climate Research Facilities and Regions

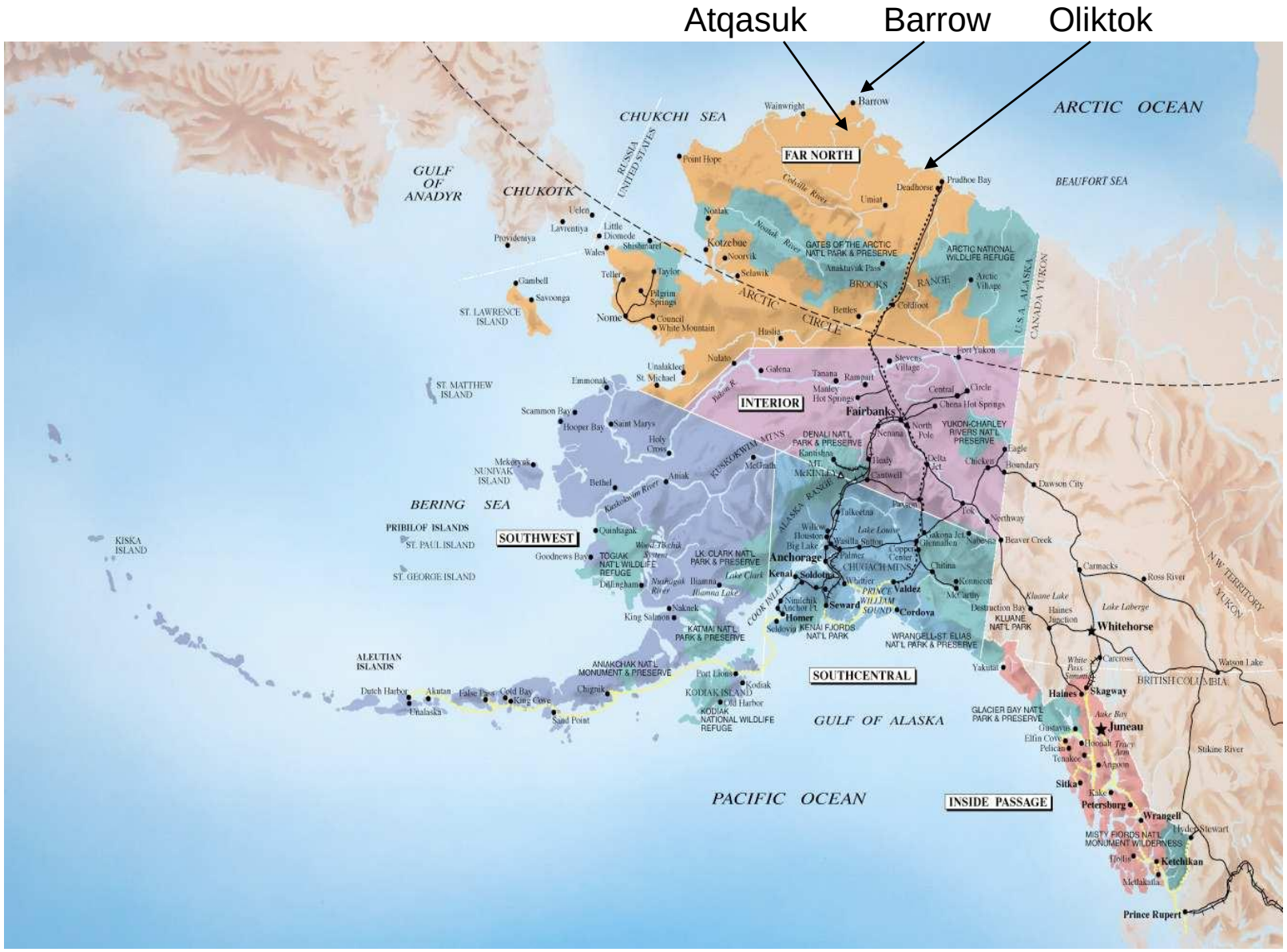


Three of Five Fixed Sites (Locales) Proposed ca. 1990 Were Implemented

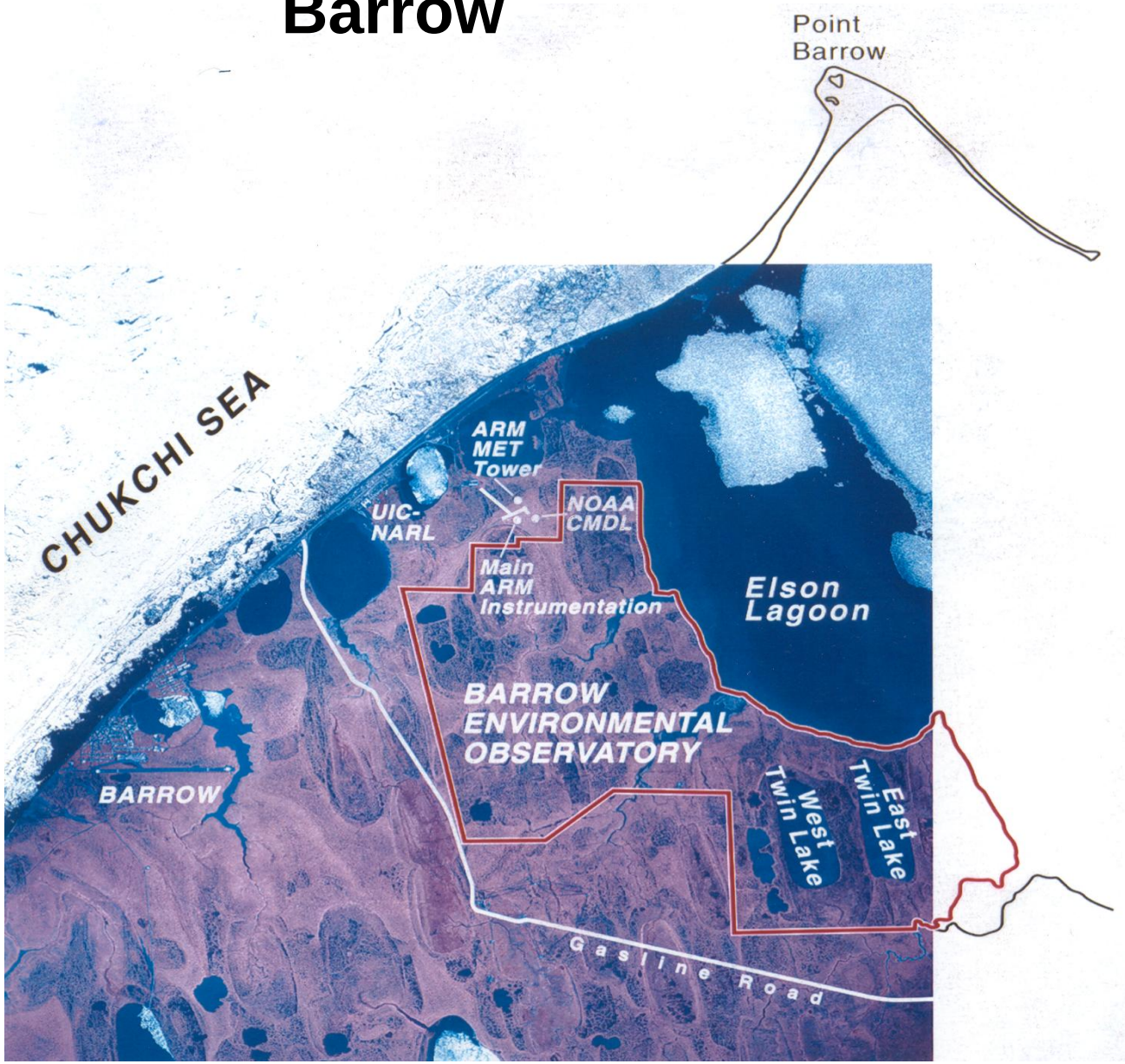
Mobile Sites and Field Campaigns



ARM Climate Research Facilities in Alaska



Barrow

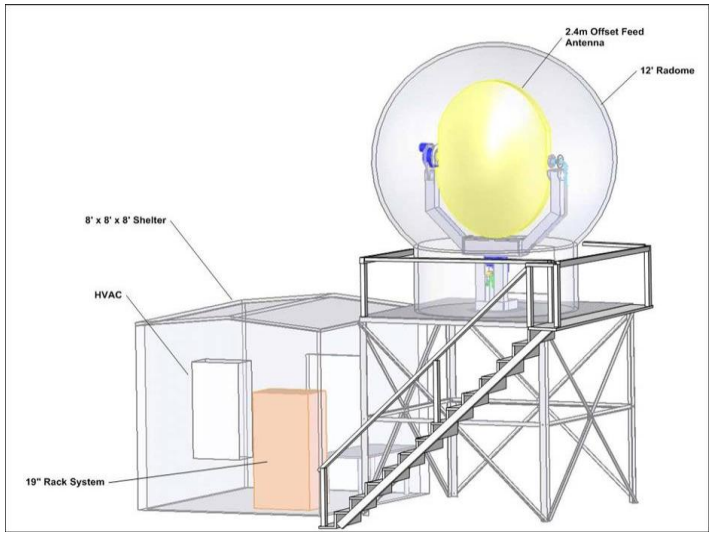

Point
Barrow
CHUKCHI SEA
ARM
MET
Tower
UIC-
NARL
NOAA
CMDL
Main
ARM
Instrumentation
Elson
Lagoon
BARROW
ENVIRONMENTAL
OBSERVATORY
BARROW
West
Twin Lake
East
Twin Lake
Gasline Road

Categories of Instrumentation at Barrow

-Surface Meteorological Sensors
-Wind, Temperature and Humidity Profilers
-Cloud Observation Instrumentation
-Downwelling Radiation Sensors
-Upwelling Radiation Sensors
-Aerosol Instrumentation
-Gas Instrumentation

Emphasis for the next decade:
Scanning instruments,
3D and 4D cloud profiles

Barrow ARM Climate Research Facilities
Existing Facilities and ARRA Additions



Recovery Act-Funded Additions to North Slope ACRF

New Instruments and Systems

- X-band Scanning Precipitation Radar – dual polarization, doppler
- Dual Frequency W-band and Ka-band Scanning Cloud Radar
- High Spectral Resolution Lidar
- Automatic Balloon Launcher
- Eddy Correlation Flux Systems

Upgrades and Replacements

- Ceilometer
- Atmospheric emitted radiance interferometer
- Millimeter Cloud Radar
- Micropulse Lidar

BARC Building in Barrow

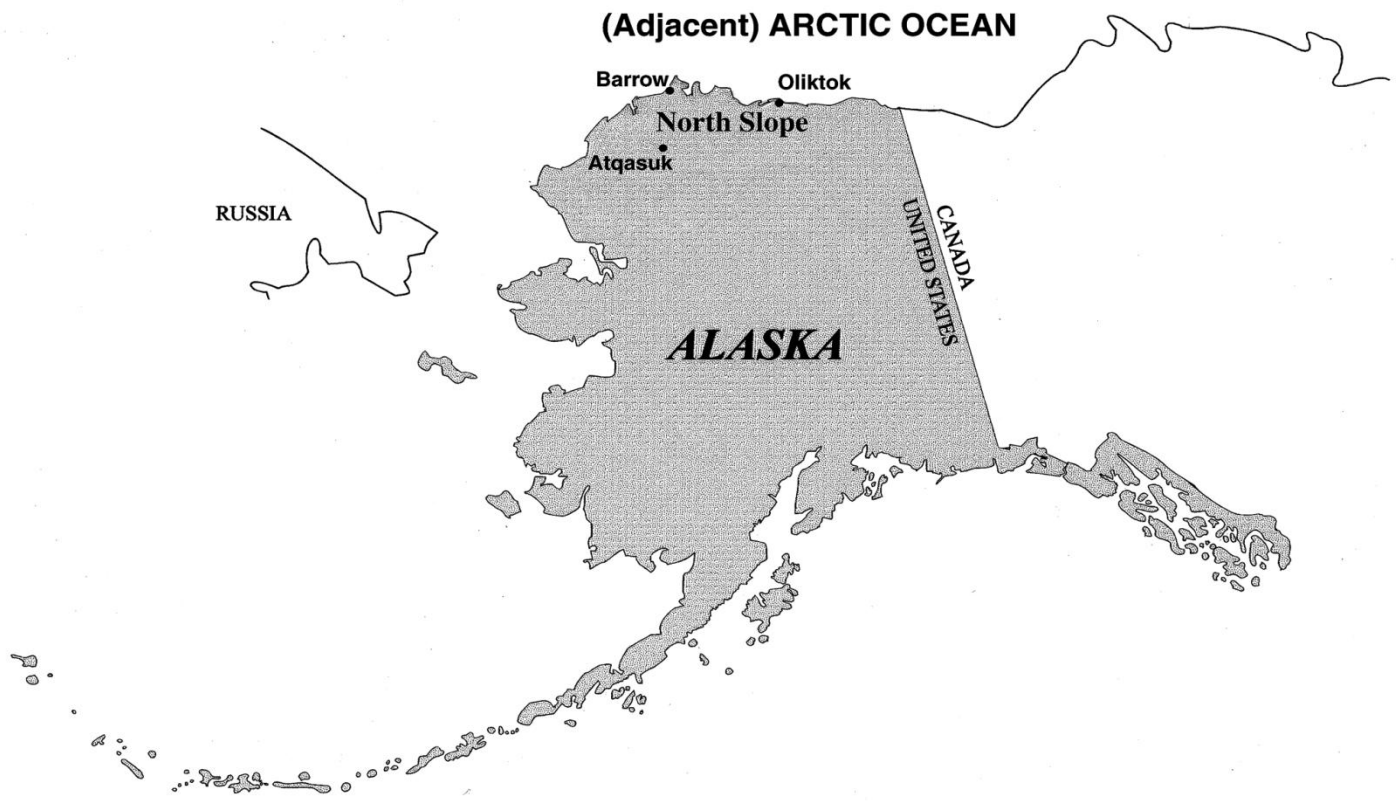
Lab Leased by ARM Program

AUTOSONDE Launcher

ARM Duplex, Barrow

Atqasuk

Oliktok Point Arctic Research Facility (OPARF)



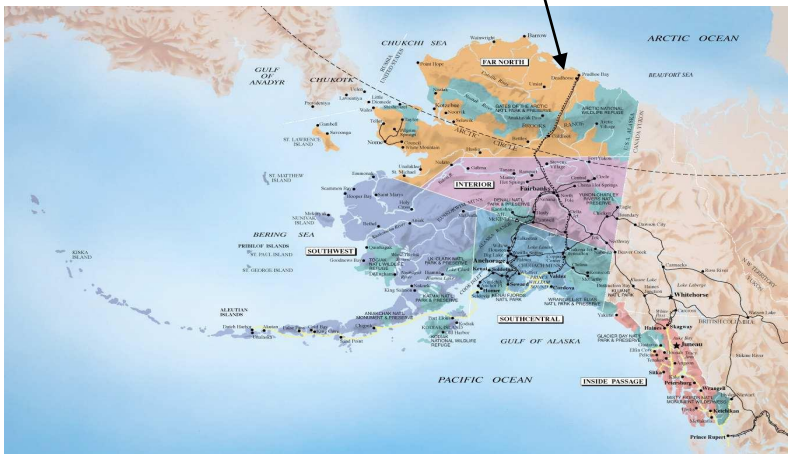
Oliktok Point, Alaska

We are pursuing establishment of a designated DOE User Facility at Oliktok Point

Oliktok Point Alaska

USAF Oliktok Point Long Range Radar Station: Sandia has a permit from the USAF for use of selected facilities at Oliktok Point, just as Sandia has a permit for use of selected areas on Kirtland AFB; Oliktok is one of several old Distant Early Warning (DEW Line) radar stations that are still active.

Restricted Airspace R2204 at Oliktok Pt; originally obtained by Sandia for a field experiment at Oliktok in 2004 (Mixed-Phase Arctic Cloud Experiment [M-PACE]); It's airspace that, when activated (at DOE discretion), DOE controls; Restricted Airspace is the mechanism through which FAA keeps non-participating aircraft out of an area.



Existing Hangar at Oliktok Point

Presently, we have access to the hanger and the area around it, as well as to lodging and other services at Oliktok LRRS. Note that Oliktok is embedded in the Prudhoe Bay Oil Fields, and is about 40 miles from Deadhorse/ Prudhoe Bay Airport.

Tethered Balloon Operations at Oliktok

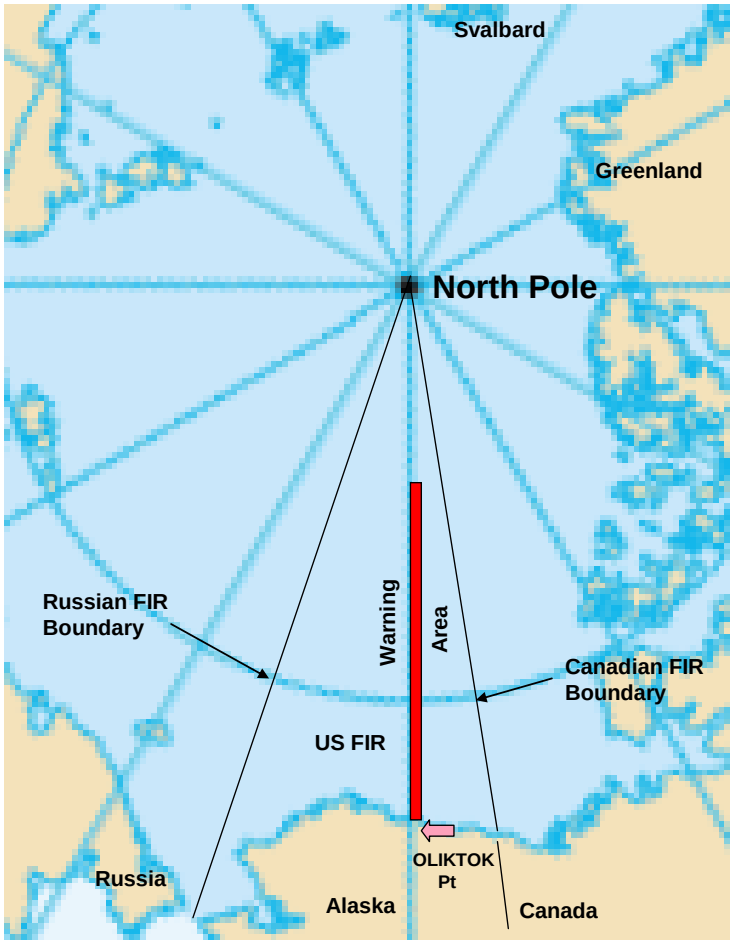
Flying an instrumented tethered balloon in cloud was the activity that required Restricted Airspace during M-PACE, and that also requires it during the upcoming ALTOS field experiment. Restricted Airspace also makes flying unmanned aircraft much easier under FAA rules.

A Step Towards an Arctic Climate Observatory for Unmanned Aerial Systems Operations

DOE has requested from the FAA the creation of a Warning Area over International Waters adjoining Oliktok to accommodate unmanned aircraft flights and other research activities out over the Arctic Ocean focused on the rapid retreat of the sea ice; Warning Areas confer similar advantages to Restricted Airspace.

Proposed Warning Area (in red)

FIR = Flight Information Region (relevant country controls flight in that region)



Challenges and Opportunities

Doppler Lidars at SGP, TWP(Darwin), AMF1 Sites

- Operates at 1.5 microns
- Wind Velocities and Attenuated Backscatter
- Operates in Clear Sky Conditions
- Precision ~ 10 cm/sec
- All-sky scanning

Ultrasonic Anemometers

Fuel Costs,
North Slope Villages

Kotzebue Wind Energy Project

Photos: Kotzebue Electric Association and www.bigthaw.eu

ARM/NREL Collaboration at Cape Cod?

- ARM “IOP” Field Campaign
- Cape Cod Area
- AMF1 Mobile Facility
- Start of Summer or Fall 2012 Deployment, 12-month duration
- Possible Doppler Lidar
- Two Aircraft Sampling Periods