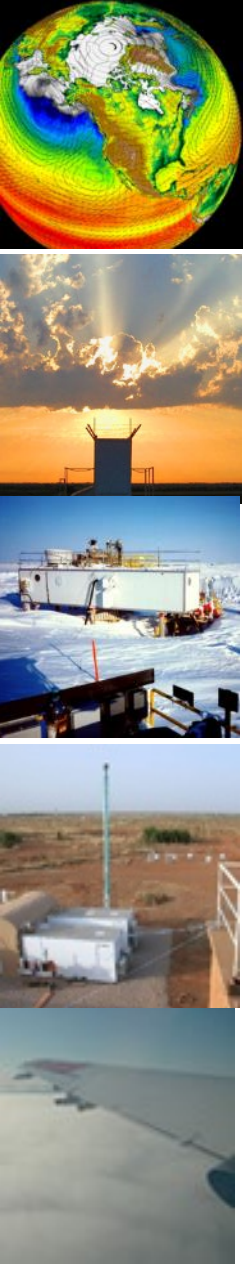
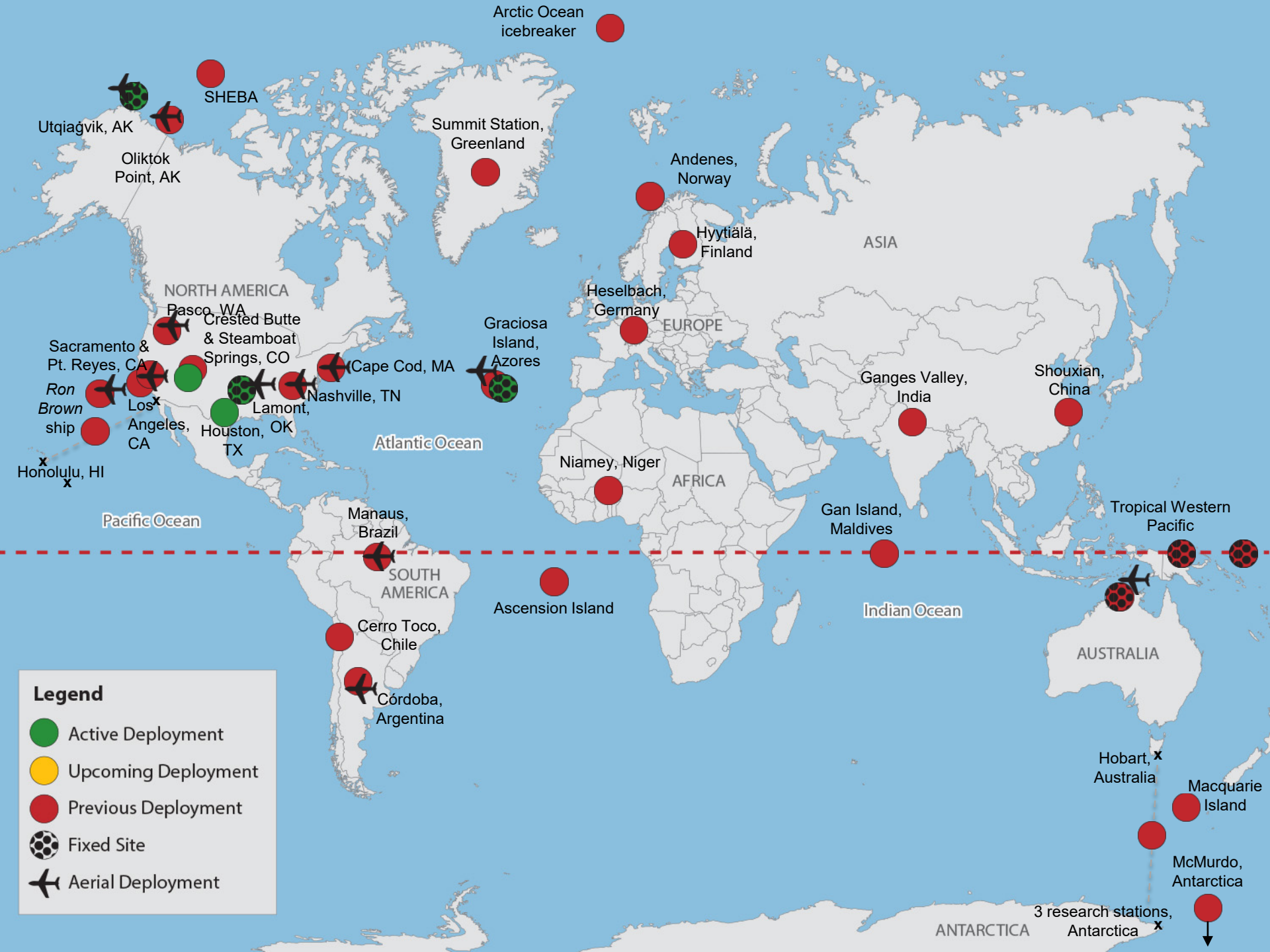


DOE Atmospheric Radiation Measurement (ARM) User Facility and Atmospheric System Research (ASR) Program

Sally A. McFarlane
ARM Program Manager

ARM – DOE Office of Science User Facility

- Provides the climate research community with long-term in situ and remote sensing observations of aerosol, clouds, radiation
- Goal: improve representation of aerosol & cloud impacts on radiation budget in climate models
- Observatories:
  - 3 fixed sites (Oklahoma, Alaska, Azores) in different climate regimes
  - 3 mobile facilities for 6 months – 5 year deployments
  - Aerial facility including manned aircraft, UAS, tethered balloon systems
  - All data freely available to scientific community at https://adc.arm.gov/discovery/
- Atmospheric System Research (ASR) – sister research program – funds academic and National Lab scientists to use ARM or laboratory data to study aerosol, cloud, radiation processes


Arctic Ocean icebreaker
SHEBA
Utqiaġvik, AK
Oliktok Point, AK
Summit Station, Greenland
Andenes, Norway
Hyytiälä, Finland
ASIA
NORTH AMERICA
Pasco, WA
Crested Butte & Steamboat Springs, CO
Heselbach, Germany
EUROPE
Graciosa Island, Azores
Sacramento & Pt. Reyes, CA
Cape Cod, MA
Ganges Valley, India
Shouxian, China
Ron Brown ship
Los Angeles, CA
Nashville, TN
Lamont, OK
Houston, TX
Atlantic Ocean
Niamey, Niger
AFRICA
Honolulu, HI
Pacific Ocean
Manaus, Brazil
Gan Island, Maldives
Tropical Western Pacific
SOUTH AMERICA
Ascension Island
Indian Ocean
Cerro Toco, Chile
AUSTRALIA
Córdoba, Argentina
Hobart, Australia
Macquarie Island
McMurdo, Antarctica
3 research stations, Antarctica
ANTARCTICA
Legend
Active Deployment
Upcoming Deployment
Previous Deployment
Fixed Site
Aerial Deployment

ARM ground-based observatories

- ~50 instruments at each ground-based site
- Surface meteorology
- Radiosondes (2 or 4 times/day)
- Ceilometer, micropulse lidar, Doppler lidar, Raman or HSRL
- Vertically pointing Ka-band radar and radar wind profiler
- Scanning cloud radar or scanning precipitation radars at some sites
- Broadband and spectral radiometers – SW, LW, and microwave
- Disdrometers, rain gauges
- Surface fluxes; soil moisture
- Aerosol in situ instruments; atmospheric carbon and trace gases

ARM aerial observatories

- Manned aircraft
  - Previously flew a G-1 turbo-prop for atmospheric research; retired in 2019
  - Procured Bombardier Challenger 850 Regional Jet; currently being modified for research; hope to deploy 2023
  - Over 60 research instruments including meteorology, aerosol, cloud probes
- Unmanned aerial systems
  - Group 3 UAS – modified Tiger Shark
  - Integrating atmospheric instruments including meteorology, cloud droplet sizes, multispectral camera, aerosol instruments
  - Science flights planned in 2022
- Tethered balloon systems
  - Payload capacity ~80 lbs
  - Have flown aerosol instruments, anemometers, sondes, distributed temperature sensing optical fibers, supercooled liquid water sensors, ice particle samplers

ARM/ASR Research Relevant to Aviation Weather

- Mixed phase cloud microphysics
  - Significant research on mixed phase cloud microphysics using radar and aircraft data
- Ice fog
  - Recent ice fog study using tethered balloon measurements at Oliktok Point, AK
- Convective research
  - Multiple studies on convective formation in Oklahoma and tropical regions
  - 2018-2019 mobile facility campaign on orographic convection in Argentina
  - Current campaign on aerosol-deep convection in Houston
- Boundary layer research
  - Turbulence; cloud formation; low level jet