ARM Climate Research Facility

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The ARM Climate Research Facility, a DOE scientific user facility, provides the climate research community with strategically located in situ and remote sensing observatories designed to improve the understanding and representation, in climate and earth system models, of clouds and aerosols as well as their interactions and coupling with the Earth’s surface.
Current Mobile Facility Deployments

Layered Atlantic Smoke Interactions with Clouds (LASIC)
Ascension Island in the Southeast Atlantic (8S, 14W) experiences high frequency of marine stratocumulus coupled with biomass plumes from the African content providing a laboratory to study aerosol-cloud interactions.

ARM West Antarctic Radiation Experiment (AWARE)
Observations at McMurdo & the West Antarctic Ice Sheet to study clouds & their impact on the surface energy balance.
Upcoming Deployments/Campaigns

- Measurements of Aerosols, Radiation and Clouds over the Southern Ocean (MARCUS) – September 2017
- Clouds, Aerosol, and Complex Terrain Interactions (CACTI) – September 2018
- Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAIC) - September 2019
Aerial Measurements

ARM Aerial Facility (AAF) provides extensive in situ measurements using a broad array of platforms:

- Gulfstream G-1 aircraft; assessing succession
- *DataHawk* small unmanned aerial systems (UAS)
- *Arctic Shark* mid-size UAS (2017)
- Tethered balloon systems (TBS; managed by Sandia)

The G-1 is deploying this summer to the Azores in 2017/18.
Integrating Observations and Models

Decadal vision outlines strategy to address next-generation science questions.

- Optimize measurement facilities to better support high-resolution modeling
- Implement high-resolution modeling at ARM sites
- Develop diagnostic data products to bridge observations and models

Comprehensive strategy to integrate ARM observations and model simulations.

Other Measurement Developments

- X-band radar about to go-online in Azores
- Deploying new solid precipitation sensors at Oliktok and Barrow
- Developing photogrammetry measurements at the SGP
- 3-λ lidar technique for aerosol profiling tested using observations from SGP (Raman + HSRL; CHARMS)
- Reviewing/improving complex instrument ops
  - Six months into intensive radar plan
  - Reviewing aerosol measurement strategy
  - Reviewing segregation of core and episodic measurements
Data Product Activities

- Best estimate cloud retrieval + associated framework
- Scanning radar products including quasi-vertical profiles of polarimetric variables
- Radar – higher-order radar spectral moments
- Drivers (e.g. moisture tendencies) and diagnostics (e.g. liquid water path) for the model-observation framework
ARM Best Estimate (ARMBE)

Hourly Averages of Core Parameters Currently Available at SGP, NSA, TWP, ENA

- **ARMBE-ATM**
  - P, T, RH, U Profiles
  - Surface sensible and latent heat fluxes
  - Surface precipitation

- **ARMBE-CLDRAD**
  - Cloud fraction profiles (Radar/lidar)
  - Integrated cloud fraction
  - Liq. Water Path/Precipitable Water
  - Surface radiative fluxes

- **ARMBE-LAND (SGP only)**
  - Soil temperature and moisture

Xie et al. 2010, BAMS
ARM Web Site

- Updated site to be released in December
- Reorganized to support reconfiguration
- Better support for collecting feedback and sharing current activities
- Virtual tours for SGP, NSA, and ENA
- Other improvements in process including:
  - Search
  - Instrument pages
Data Discovery Tool
Data Discovery Tool
Summary

- Continuous observations available at Oliktok and Azores
- AMF deployments
  - Current: Antarctica and Ascension Island
  - Upcoming: Southern Ocean, Argentina (deep convection), Arctic (marine)
- Implementing UAS operations at Oliktok (and elsewhere)
- Implementing joint observation/high-resolution modeling system
- Push to optimize operation of/and data processing for complex instruments (esp. scanning radars and aerosol systems)
- ARM Best Estimate family of products is more autonomous and configurable
- Updates to ARM website and Data Discovery interface
Development of framework for routine high-resolution (~100 m) model simulations over the Southern Great Plains site is being led by Bill Gustafson at PNNL.

These simulations will:

- Provide the basis for an integrated observation-simulation description of the atmosphere for improved process-study analysis
- Enable the larger modeling community to more readily run their own models over ARM sites

In process of expanding computing capabilities to support model simulations and complex data processing.
Comprehensive Measurements of Climate-Relevant Parameters

- **Background Atmospheric State:** Temperature, humidity, wind, precipitation
- **Surface Energy Balance:** Radiation, latent, and sensible heat fluxes
- **Aerosol and Hydrometeor Profiles:** Remote sensing of aerosol, cloud, and precipitation optical and microphysical properties
- **Near-Surface Aerosol Properties:** In situ optical, microphysical, and chemical aerosol properties and trace gases
- **Upper-Air Parameters:** Aerial measurements of background state, aerosol, trace gas, cloud properties

Scanning Cloud Radar

In situ probes on the G1