





ASR Science Team Meeting

11 March 2014 Bolger Center, Potomac, Maryland

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Office of Science

Office of Biological and Environmental Research

ARM Climate Research Facility

The ARM Climate Research Facility provides observations that are essential for addressing the role of clouds and aerosols in climate.

ARM operates *in situ* and remote sensing observatories in climatically distinct locations to sample continental and marine conditions in tropical, midlatitude, and Arctic environments.

- Four fixed sites (U.S. Southern Great Plains, Tropical Western Pacific, North Slope of Alaska, and the Azores)
- Three mobile facilities for experiments in under observed regions critical for model improvement.
- Aerial measurement capability complements the ground measurements.

DOE Scientific User Facility ARM Climate Research Facility



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Supporting Climate Research

- Continuously enhance the facility to provide better service
- Convene workshops for recommendations on site enhancements and use
- ASR working groups provide input on facility priorities
- ARM Science Board reviews all major resource requests for use of the sites
- OMB tracks operations and user metrics on quarterly basis

ARM Current Activities

- Instrumentation continues to be added to AMF3 at Oliktok and fixed site in the Azores
 - Radars and flux towers to be delivered in 2014,
 - AOS and Raman lidar for Oliktok
 - Raman lidar for ENA
 - Building partnerships with Conoco Phillips and U. Alaska and U. of Azores







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ARM Current Activities

- GOAmazon began operations in Brazil on January 1
- Hyytiälä, Finland Experiment (Biogenic Aerosols – Effects on Clouds and Climate) began February. Europeans will conduct lidar intercomparison during the experiment
- Flights continue to measure trace gases over and around the ARM Southern Great Plains site







ARM Current Activities

- Plans continue to deploy the AMF2 and G-1 along with NOAA resources to obtain measurements to characterize atmospheric processes over the Pacific – ARM Cloud Aerosol Precipitation Experiment (ACAPEX in Jan. 2015)
- Plans are underway to send the second mobile facility to Antarctica – ARM West Antarctic Radiation Experiment (Oct. 2015)
- Study nearing completion to have uniform AOS systems.
 This entails upgrade to older systems.







Implementing Plan for Unmanned Aircraft and Tethered Balloons at Oliktok

- **Tethersonde.** Finalizing procurements for tethersonde operations. Launch summer 2014 as a baseline component of the ARM facility
- Fixed-wing or multicopter UAS. Procuring a fleet of small UAS (Data Hawk) as a baseline component of the ARM facility
- Scientific Input. Continue ongoing means to solicit input from the climate research community on the use of unmanned aircraft and balloons in Arctic research.

Workshop Report DOE/SC-ARM-TR-135 September-2013

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Evaluation of Routine Atmospheric Sounding Measurements using Unmanned Systems (ERASMUS)

- Spring 2015: Use Data Hawk to evaluate UAS operations within RA-2204:
 - Met profiling from surface to cloud base.
 - Measurement of cloud properties, radiation, aerosol concentrations, etc.
 - Environmental constraints to operations
 - Wind
 - Visibility
 - Precipitation
 - Cloud cover
 - icing
 - Spatial variability





Next Generation ARM

- Building on success, ARM will implement the next generation ARM beginning in 2014.
- The next generation ARM will consist of two U.S. supersites (continental U.S. and the North Slope of Alaska), complemented by the marine site in the Azores and deployments of two mobile facilities to key locations around the globe. The ARM Aerial Facility is a key component.
- The supersites are intended to provide improved and higher density measurements for process studies and model evaluation and improvements.
- DOE will combine ARM data, LES-scale models, and data assimilation to create a 4D data cube.
- This data set will provide detailed observations of clouds and aerosols as well as variability of the surface and boundary layer at high temporal and spatial resolution.

Rationale

- This plan responds to suggestions that we institute operational LES at the ARM sites.
 - ASR scientists
 - 2012 European workshop
 - Testbed workshop
- The limiting factor has been the lack of budget.
- Thus, beginning this year we are closing the TWP sites and moving the instrumentation to the SGP.

Continental US Supersite

• In 2015 ARM will transform the TWP instruments into an enhanced mobile facility



Continental US Supersite

- Multiple scanning cloud radars to better sample 3D cloud field
- Multiple Doppler lidars to observe 3D boundary layer wind fields as well as vertical velocities
- Measurements for land surface/atmospheric interactions
- Long term strategy is to move enhanced mobile facility to other US locations

North Slope of Alaska Supersite

- Arctic environment is an important target for scientific investigation
- ARM will maximize impact of ongoing Barrow and Oliktok measurements by linking the near-coast facility measurements with over the adjacent ocean and linking these two sites together.
 - UAS (tethered sondes and unmanned aircraft) at Oliktok will provide vertical and horizontal sampling of important parameters
 - Routine manned flights between Barrow and Oliktok begin in 2015
 - Intermediate sites may be developed in future

Airborne Arctic Climate Observatory

Based on Federal Register Rules and Regulations / Vol. 75, No. 52 / Thursday, March 18, 2010 / page 12976, DOE's Restricted Area R–2204 was renewed by the FAA. **DOE** has requested Warning Area over International Waters adjoining Oliktok accommodating measurements over land, ocean, and sea ice.



Example Science Questions

- How are precipitation, water vapor and cloudiness coupled, and what roles does organization play in this coupling?
- What is the coupling among microphysics, aerosols, and cloud dynamics as a function of scale and regime (e.g., vertical velocity or stability)?
- How do cloud properties (formation, evolution and precipitation) couple with surface properties (e.g. fluxes, albedo, land-cover, orography)?

Next Steps

- Joint ARM/ASR high resolution modeling workshop in May (Graham Feingold and Jim Mather, co-chairs)
- This summer
 - Siting decisions
 - TWP instruments repaired and deployed
 - UAS platforms identified and procurement begun
- Continue to build stronger ties with Europe particularly for Azores site
- Highlight priority science questions as drivers for future AMF proposals
- Build stronger international collaborations around AMF deployments
- Build strong collaborations for ARM activities

Next Steps

- Tropical meteorology research will continue to be supported
 - The long term TWP data set will be highlighted for future research
 - Relevant AMF proposals will be accepted

ARM Data Sessions and Resources

- ARM data tutorial today at 1
- ARM Reorganization Discussion at 7:30 tonight