ARM

CLIMATE RESEARCH FACILITY

ARM Next Generation Town Hall

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Town Hall Description

The Atmospheric Radiation Measurement (ARM) Climate Research Facility is defining its next generation strategy with a focus on combining more densely instrumented 'mega-sites' with high resolution models to better constrain atmospheric processes. This town hall will discuss the outcome of two workshops that gathered input from the scientific community on optimizing the measurement and modeling strategies for the Southern Great Plains (SGP) and North Slope of Alaska (NSA) sites.

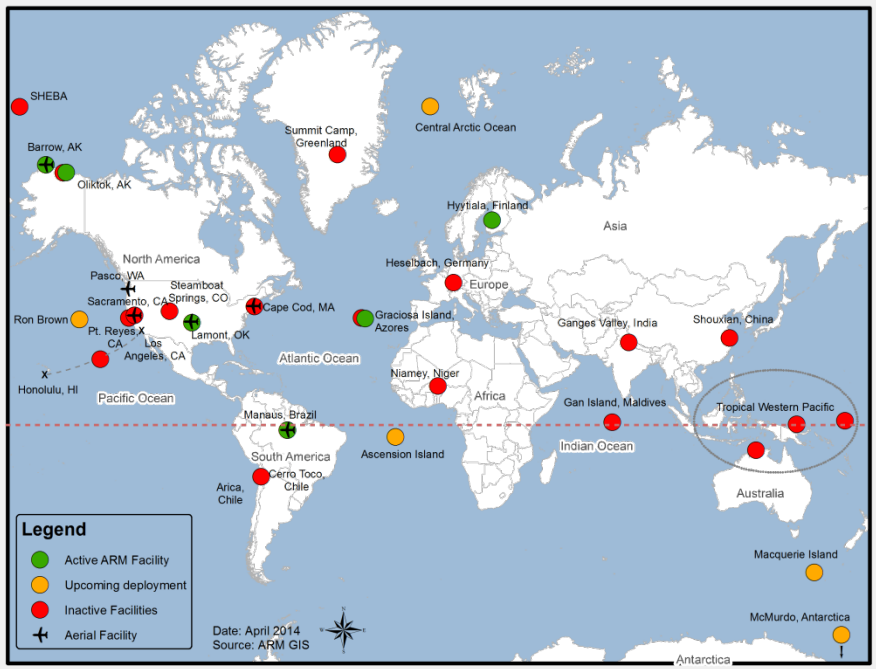
Agenda

- Dr. Sally McFarlane (ARM Program Manager)
  - ARM Next generation motivation
- Dr. Mark Ivey (North Slope of Alaska Site Manager)
  - North Slope of Alaska workshop
- Dr. James Mather (ARM Technical Director)
  - Southern Great Plains workshop & routine modeling
- Open Discussion

ARM Climate Research Facility

- ARM is a DOE Office of Science user facility
- ARM Mission is to provide research community with observations need to improve understanding and representation in climate models of clouds and aerosols, including their interactions, radiative impacts, and coupling with the Earth's surface.

- ARM facilities include:
  - Highly instrumented long-term fixed sites in different climate regimes
  - Mobile facilities available for 6 month – 2 year deployments
  - Aerial facilities for intensive or routine flight campaigns including two dedicated aircraft (G-1 and Cessna 206)



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ARM Next Generation Motivation

- ARM research community is increasingly interested in questions of scale and interactions between processes that cannot be fully addressed with observations alone.
- Next generation climate models with higher and/or variable spatial resolution require information on spatial variability within next generation climate model domains.
- Two workshops recommended that ARM couple a denser observational network with routine large-eddy simulation [LES] scale modeling to create integrated observational-modeling datasets to provide a strong constraint to process studies as well as a basis for parameterization development for the next generation of climate models.

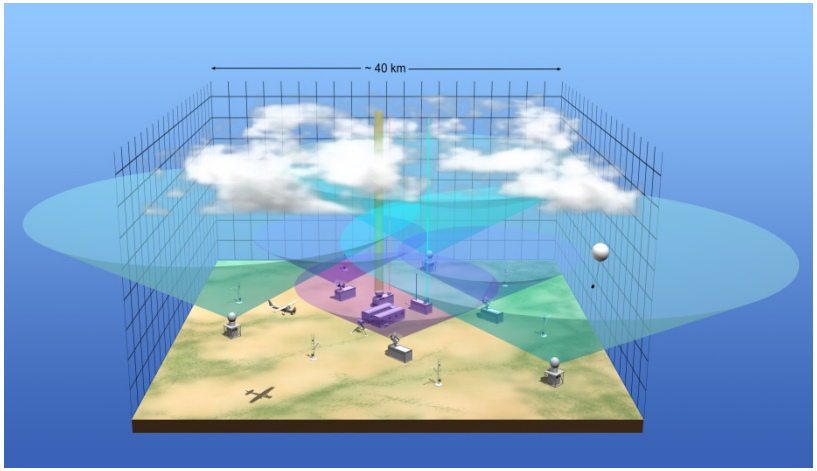
- Long-term, routine high-resolution modeling, rather than case studies, will take advantage of ARM observational strengths and examine processes covering a broad range of atmospheric regimes

Next Generation ARM

Next-Generation ARM will better integrate high density observations and high-resolution modeling with the continued goal of improving climate models

The reconfiguration includes:

- Optimization of the ARM measurement facilities for process studies, model evaluation, and development
- Implementation of 2 “mega-sites” at Southern Great Plains and North Slope of Alaska with focus on observing spatial variability of cloud, boundary layer, and surface properties
- Closure of the TWP sites and use of instrumentation for the mega-sites
- Development of a routine high resolution modeling strategy for mega-sites
- Development of a data processing strategy to bridge measurements and models



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Input to ARM Reconfiguration Strategy:

- Two Science Workshops:
  - Identify high priority scientific questions that could be addressed with routine high-resolution model simulations at the ARM SGP and NSA sites
  - Identify key measurement needs at SGP and NSA to improve observational constraints on high resolution models
  - Identify high priority model configurations/frameworks and associated computational challenges in running, storing, and processing the model simulations

North Slope of Alaska

Science questions were identified in four categories:

- Clouds (incl. interactions with aerosols, radiation and the surface)
- Aerosols (incl. black carbon and controls on vertical distribution and temporal variability
- Vertical Structure (incl. relation of vertical structure with surface)
- Large-Scale (incl. feedbacks and coupling of large scale on local structure)

The NSA Megasite will include:

- The Barrow and Oliktok sites (looking for auxiliary ground sites)
- Unmanned Aircraft Systems and tethered balloons
- Manned aircraft to link the two primary facilities

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Aerial Systems

Near-term emphasis on NSA

- Tethered Balloons
- Mini Aerial Vehicles
- Manned Routine Flights
- Unmanned Routine Flights

Multiple aerial tools to augment ground-sites.

NSA Measurement Needs

Measurement needs cited to support the NSA science goals include:

- Spatial distribution of energy and water fluxes over the heterogeneous surface
- Spatial distribution of surface spectral albedo
- Surface snow properties (including crystal shapes and black carbon content)
- Profiles of aerosol properties (e.g. size, CCN, IN, and hygroscopicity)
- Upwind sampling of aerosol profiles (periodic)
- Vertical profiles and spatial distributions of cloud properties
- Spatial distribution of precipitation

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Southern Great Plains

The SGP will be the testbed for integrating high-density measurements with high-resolution models.

The initial focus is on shallow convection with an eye to working toward deep convection.

Science Drivers

A general goal is to improve basic understanding of shallow convection and their representation in GCMs. Specific issues include:

- Warm biases and diurnal biases over the SGP in GCMs
- Coupling of shallow clouds to soil moisture
- Aerosol effects on warm clouds

For deep convection systems – science drivers include:

- The diurnal cycle
- Precipitation organization including the influence of cold pools
- Wet scavenging of aerosols

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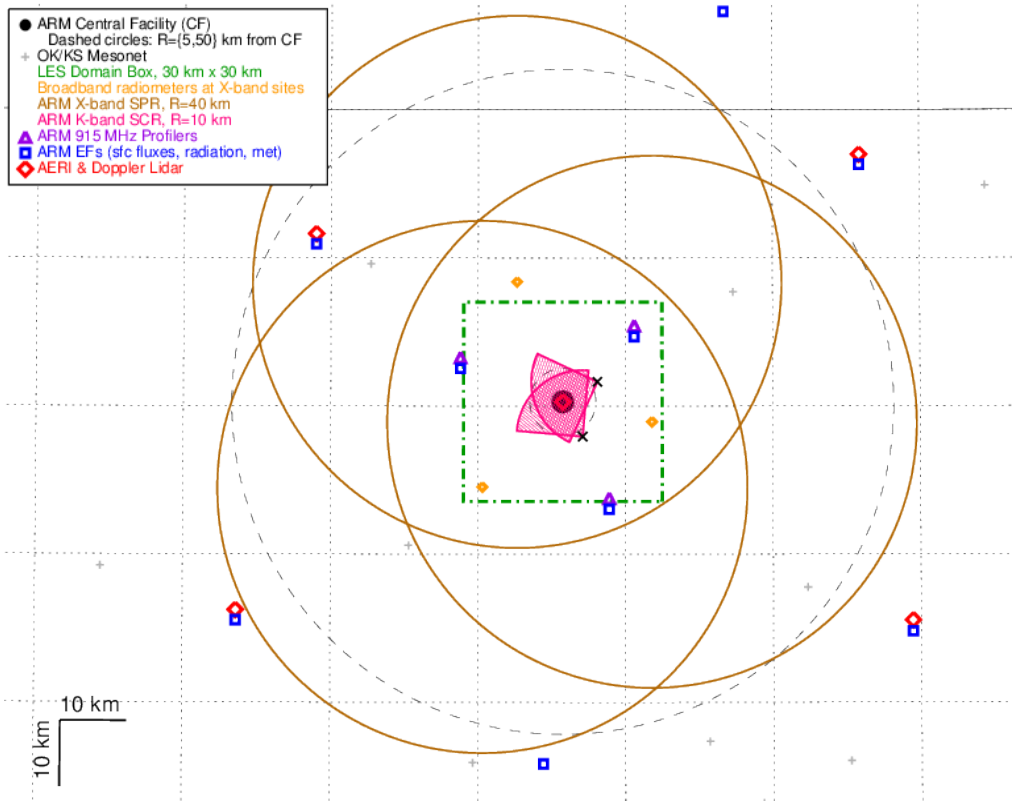
Southern Great Plains

New measurements at the Southern Great Plains site is expected to include:

- T/RH/U profiling sites
- Additional scanning cloud radars
- Improved characterization of the land-atmosphere interface
- Other enhancements to be specified – e.g. aerosol profiles

Interested in input on this network or other measurement needs.



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Routine Modeling

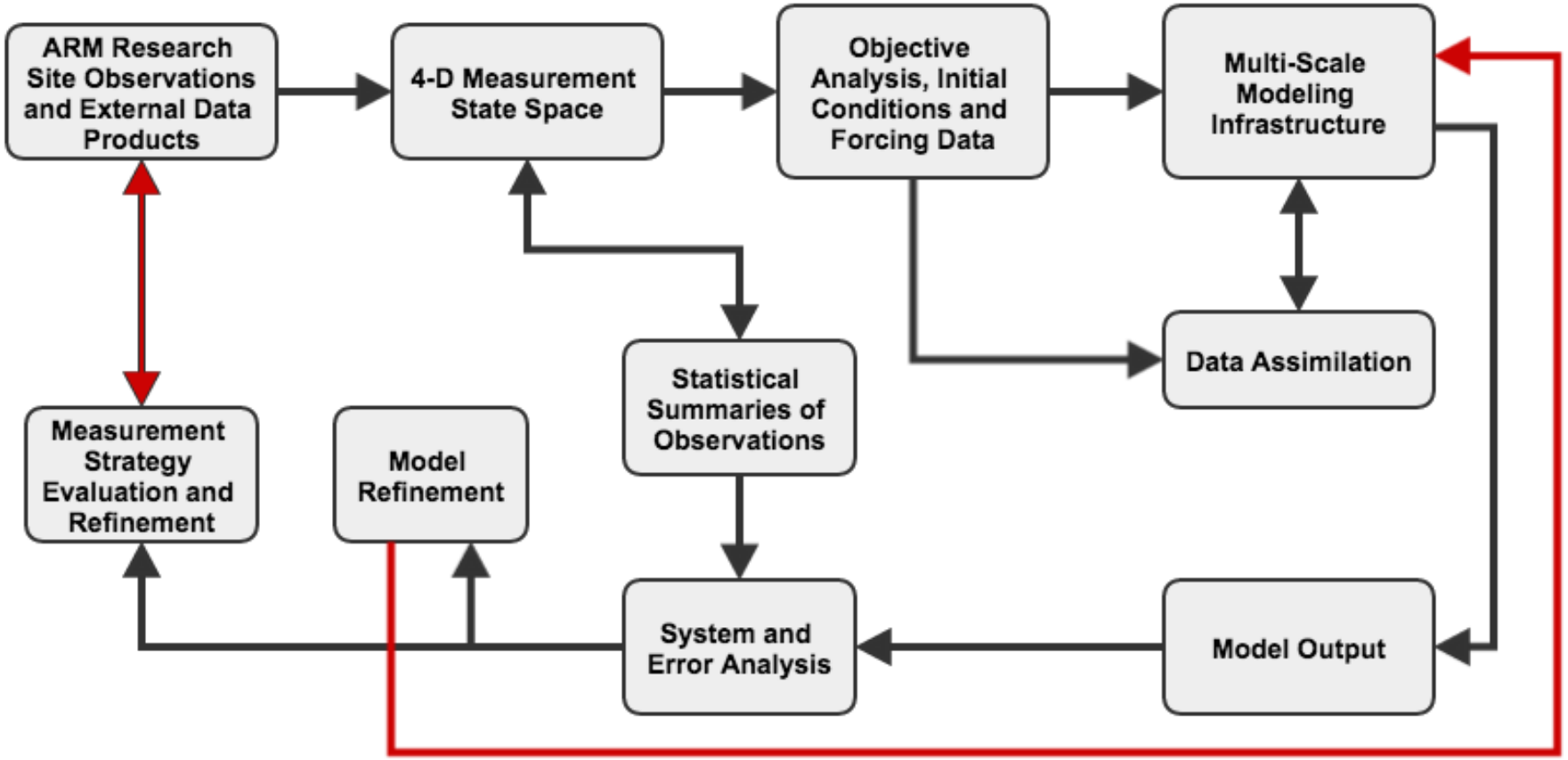
In addition to changes in ARM observations, the facility reconfiguration will include routine model simulations. Initial focus on the SGP – but working toward the NSA – and possibly other sites.

Purpose of the LES pilot study is to develop the modeling framework and address questions such as:

- What model should be used?
- What domain? What resolution? What frequency?
- How should the model be forced?

This study is intended to be tightly coupled with the ARM facility and lead directly to routine model operations over ARM sites.

Integrating ARM Observations and Models



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Data Activities

Currently, ARM engages with the user community primarily through the distribution of routine and Value Added data Products. To more directly confront models with data we will have to develop some new capabilities. Some on-going or potential activities:

- Better coordination among Value Added Product activities/priorities
- Shifting from Value Added Products to Processes – for example:
  - Flexible/on-demand integrated data products
  - Centralized analysis and visualization tools including support for community development (e.g. through frameworks like the Python ARM Radar Testbed (PyART))
  - Instrument Simulators
  - Automated quality assessment of complex instruments
  - Uncertainty quantification of core measurements
- Model output constrained by ARM observations via data assimilation

Timeline

Reconfiguration milestones over the next three years:

Call for LES study	October 2014
End of operations in Darwin	December 2014
UAS/TBS flights at NSA	Summer 2015/on-going
Augmented observations at SGP	mid-2016
Begin routine model simulations	mid-2017