

**Breakout Session Report**  
**ARM/ASR User and PI Meeting**  
**March 16-20, 2015**

**Session Title:** Land-Atmosphere-Cloud Interactions (LACI)

**Session Date:** Thursday, March 19, 2015

**Session Time:** 8:00–10:00 a.m.

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## Description

This session focused on developing a research plan and identifying a list of scientific goals that the group would like to address in the next few years. There also was discussion about soil moisture measurements and how to improve them.

## Main Discussion

The Land-Atmosphere-Cloud Interaction (LACI) breakout session covered two main topics:

- Discussion of a draft white paper prepared before the meeting
- Discussion of measurement needs related to LACI.

The first 90 minutes of the session were devoted to the first topic and 30 minutes were spent discussing measurement needs.

The draftwhite paper prepared by the LACI committee was circulated among a number of participants that were explicitly invited to the session prior to the ARM/ASR Joint User and Principal Investigator (PI) Meeting. The white paper was designed with different goals in mind. The first was to provide a framework for organizing LACI research in ASR. The second goal was to present science issues that are at the interface of several different U.S. Department of Energy (DOE) programs that have an interest in LACI. The steering committee set four goals in the frame of questions for the breakout session:

1. Are there science questions that we are missing that are relevant to DOE and ASR?
2. How do we strengthen the links to all of the DOE sites, including NSA and relevant AMF deployments?
3. How can we address the intersection of the various DOE programs?
4. Are we missing important steps in the path forward?

Overall, the group was able to address aspects of each of these goals and summaries of the discussion are included below.

## Key Findings

### Goal 1: Science Questions

The group was supportive of the list of science questions that was presented. There were, however, additional topics suggested during the session that should be included in the white paper as it evolves. The white paper will be modified to better highlight the role of advection on the state of the atmosphere above both the Southern Great Plains (SGP) and North Slope of Alaska (NSA) ARM Facility sites and to better account for sub-surface and surface flows of water. One participant pointed out that the triggering of convection is a function of both processes in the planetary boundary layer as well as the atmosphere

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above (i.e., free troposphere). The ability to observe the planetary boundary layer structure and the free troposphere over the diurnal cycle is very important for land-atmosphere work. The spatial extent of study areas was also discussed. The Accelerated Climate Model for Energy (ACME) model is focusing on the watershed scale, and it would be helpful for the LACI team to work on a closed watershed study. High-resolution models could be used to scale up the limited measurements that are made within the domain, and detailed subsurface models could also be useful. It was pointed out that the science questions should be expanded to explore the full range of planetary boundary layer processes that impact aerosol concentration, as well as issues related to the lofting of dust and pollen. In addition, the impact of diffuse and direct radiation on carbon dioxide and energy fluxes should be included in sections outside of that devoted to aerosol. Other topics of discussion included the impact of small-scale variability in soil moisture and/or land-use on the circulation patterns, which could be explored with ARM data.

**Goal 2: Links to DOE Sites**

The Next-Generation Ecosystem Experiments (NGEE) session earlier in the week at the meeting showed potential synergy with the LACI research, and the timing of the preparation of the LACI white paper is good because the second phase proposal for NGEE-Arctic is in preparation. It was pointed out in both the plenary and NGEE breakout session that there are large uncertainties about the impacts of climate change on the Arctic. The new NSA science team encouraged the LACI group to look for additional science questions that could be added that are relevant to the NSA.

**Goal 3: DOE Programs**

Some time was spent discussing how the white paper could be expanded to address topics related to ecosystem function and the carbon cycle in a more explicit way; both are topics of interest in TES and SBR. The white paper should also point to high-resolution soil models that are commonly used in other DOE programs. The group also discussed relevant programs outside of DOE. For example, National Science Foundation has a large network that could be deployed to augment the ARM network. NGEE is focusing on the surface and subsurface and largely ignoring key parts of the atmosphere. It was suggested that some key members of the LACI team should consider attending an upcoming meeting focused on sub-surface processes.

**Goal 4: Path Forward**

Relatively little time was spent discussing the path forward presented in the document. Suggestions by the group included synergy with NGEE, as well as reaching out to non-DOE programs such as those supported by National Aeronautics and Space Administration (NASA) or U.S. Department of Agriculture. Some of these other programs could also be important sources of data about crops and vegetation, which is needed at a yearly resolution.

**Needs**

While the intent was to focus this part of the breakout session on the soil moisture measurements, the discussion was wide ranging. Suggestions were made that high spatial-resolution measurements of surface fluxes in the vicinity of the SGP would be helpful to better understand sub-grid variability. Other suggestions included measurements of leaf area index, as well as the vegetation types, and to provide a ground truth for Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra

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satellite data products. It was also pointed out that the existing multifilter radiometer and multifilter rotating shadowband radiometer units might be useful for these calculations and would include additional spectral information. Portable eddy correlation flux measurement systems from the ARM Facility could be used to check assumptions related to the scaling of eddy correlation fluxes to match energy balance bowen ratio station data. In addition, there is a need for soil moisture measurements in the fields and in the root zone. Soil texture at different depths was also requested. New satellite tools can provide additional information on both the crops and soil moisture that has not been available in the past. The group also discussed the need to set both long-term and short-term goals.