ARM

CLIMATE RESEARCH FACILITY

Plans for the Next-Generation ARM Climate Research Facility

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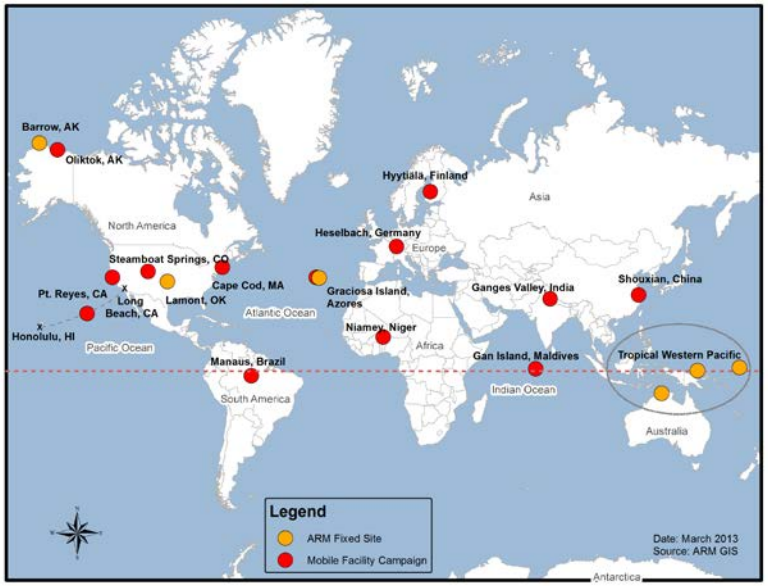
U.S. DEPARTMENT OF ENERGY | Office of Science

Enhancing the Impact of ARM on Model Development

Mission

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.



Increasingly, the research community served by ARM is focusing on processes such as the partitioning of water into liquid and ice in arctic clouds, the lifecycle of convective systems, or the evolution of aerosol properties and their impact on clouds. These process studies demand comprehensive and integrated data sets beyond the traditional demands on ARM.

Some things that are not changing

- Focus on process understanding and improvement of climate models
- Continuing to support long term operations at the Eastern North Atlantic (ENA; Graciosa) site
- Continuing to support periodic deployments of the ARM mobile facilities in response to ARM facility RFPs
- Use of field campaigns to augment continuous operations including aerial support

Combining Observation Data with High-Resolution Models

- Concentrate instruments into fewer locales to provide dense, but distributed “supersite” measurement grids, making use of multiple scanning remote sensors and surface stations.
- Run high resolution models (LES and/or Cloud Resolving Models) and Single Column Models over supersites on a routine basis (as computational resources allow and as appropriate to study science issues)
- Use gridded data to constrain model simulations to develop high-resolution integrated (observation/model) data sets for process studies and parameterization development.
- Take instruments for the new supersites from the TWP, which will be discontinued. Future tropical observations can be pursued using Mobile Facilities.
- In addition to providing higher density data sets, concentrating measurements will reduce operating costs freeing funds to improve reliability of remaining sites and for development of integrated data products for work with models.

Two U.S. Supersites

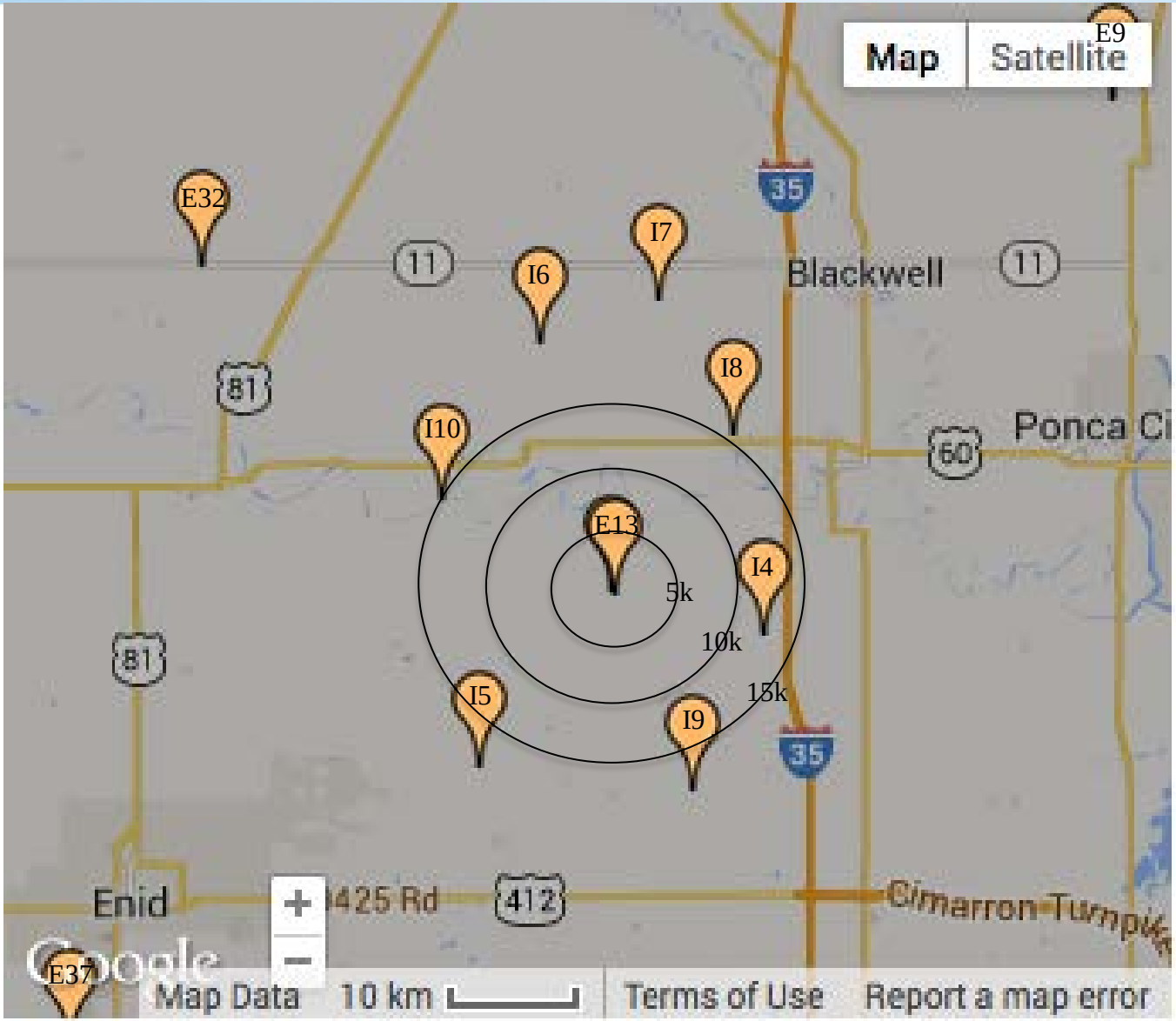
ARM is preparing to develop two supersites. The first over the continental US and the second along the North Slope of Alaska.

The continental US site will initially be at the current SGP location.

Characteristics of the Continental US site:

- Multiple scanning cloud radars will provide dense sampling over a central facility and a constraint on lateral advection over a spatial scale of ~10-20 km
- Additional in situ and profiling instruments will constrain the volume and boundaries – specification of the instrument array is under development
- Aerial measurements to support remote sensors and fill in gaps
- Transportable with a plan to relocate on a time-scale of approximately 3 years

Current SGP Layout



I4,5,6: XSAPR

I7: CSAPR

I8,9,10: RWP

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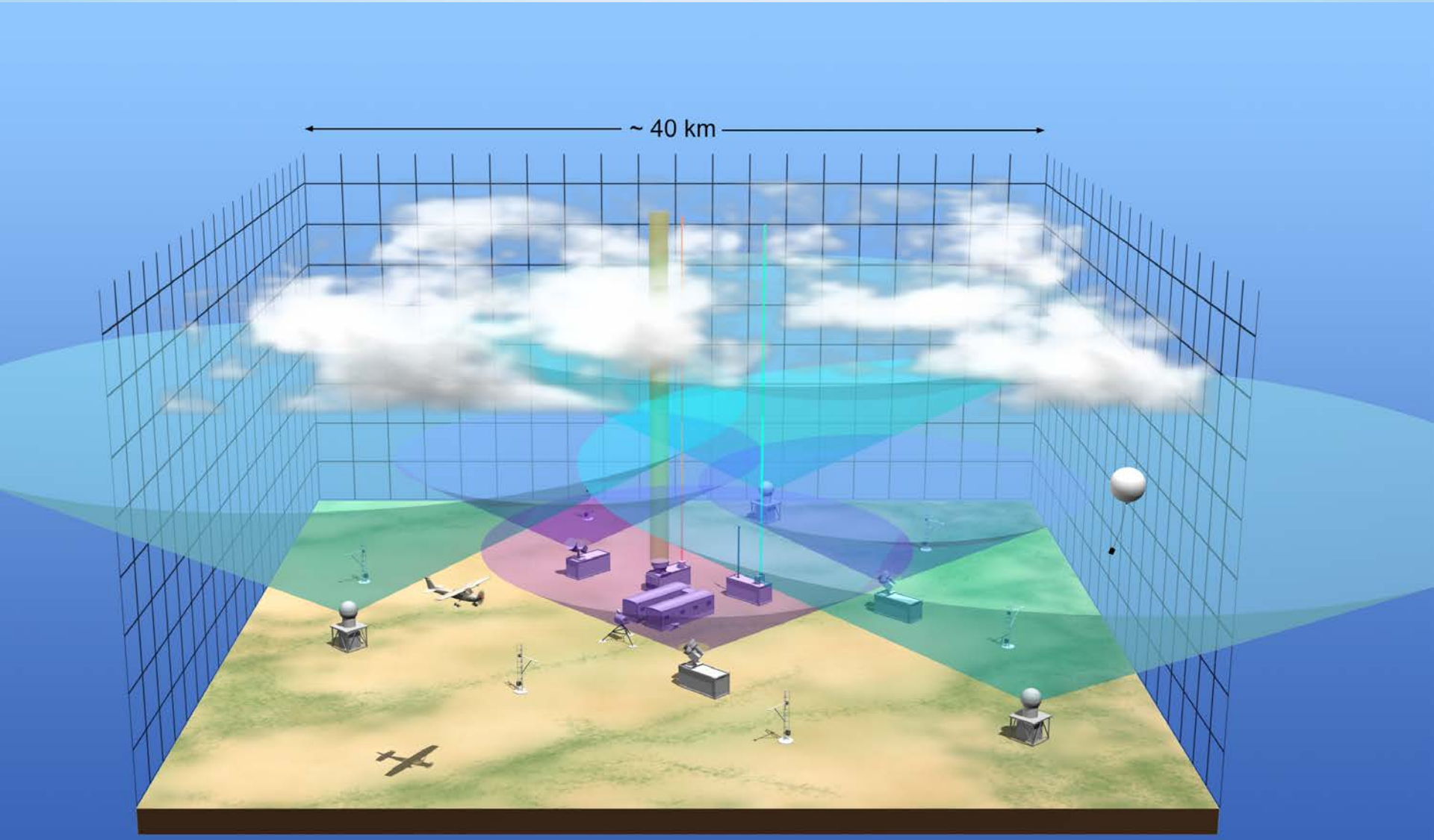
The Supersite Concept



North Slope of Alaska (NSA)

The NSA Supersite will:

- Include the Barrow and Oliktok sites
- Make use of UAS and Tethered Balloon Systems to observe the adjacent arctic ocean, heterogeneity over the tundra, and frequent vertical profiles
- Make use of manned aircraft to link the two primary facilities
- Make use of additional observation sites as appropriate and available

Questions

- What phenomena are most appropriate for study with a densely sampled, limited area domain?
- Given these science targets – what are some key missing measurements (thinking first of the SGP)? What are appropriate spatial scales?
- The NSA presents very different constraints than the SGP – what are the most critical measurement needs there?
- What are the most critical measurement needs for the aerial facility – including manned and unmanned missions?
- We're planning to run models routinely – we want to get beyond the 1-2 days/year case study – but what would be an ideal study period? Is 24/7/365 practical or desirable? Seasonable intensive periods?
- What are the most effect methods to bring together multiple observations and model simulations?
- How do we tackle the issue of scale interactions?
- The plan is to move the bulk of the SGP facility to a new location in ~4-5 years to a new location within the continental US. What are science targets of interest?

A few measurement options

- Multiple scanning radars (mm- and cm-wavelength) to map out clouds in the volume and constrain advection across the study domain boundaries
- Multiple Doppler lidars for boundary layer structure
- Boundary sites to provide continuous constraints on T/RH/Wind profiles
- Improved/higher density surface flux and surface property (e.g. soil moisture) characterization combining in situ measurements and integrated path (e.g. from scintillometers)
- Multi-frequency lidar for aerosol (and other parameter) profiles
- NOx, Ozone and other gas species
- Gridded water vapor (e.g. from multiple GPS or scanning microwave)
- T/RH/Wind profiling at boundary sites