

ARM

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U.S. Department of Energy Southern Great Plains



The Southern Great Plains (SGP) atmospheric observatory, which stretches across north-central Oklahoma and southern Kansas, is the world's largest and most extensive atmospheric facility. SGP data are providing details about cloud, aerosol, and atmospheric processes that have never before been available for computer models that simulate Earth's atmosphere. Scientists use these data to dramatically improve the representation of radiative and cloud processes in earth system models. Being able to understand and accurately predict these kinds of fundamental yet complex atmospheric processes is critical to the nation's ability to address current and future energy and environmental challenges.

With substantial measurement capabilities, the SGP is the premier research observatory of the Atmospheric Radiation Measurement (ARM) user facility, funded by the U.S. Department of Energy's Office of Science.



The SGP was reconfigured to meet next-generation science questions about the complex interactions among atmospheric circulations, thermodynamics, aerosols, clouds, and the land surface. These changes created a megasite-like observatory, resulting in even more comprehensive scientific data and the processes and tools for scientists to more easily integrate them into earth system models.

Laboratory Without Walls

When data collection began in the spring of 1992, the SGP became ARM's first field measurement site. Today, the SGP observatory consists of in situ and remote-sensing instrument clusters arrayed across approximately 9,000 square miles (23,310 square kilometers) in north-central Oklahoma and southern Kansas.

The heart of the SGP is the heavily instrumented Central Facility, which occupies 160 acres of cattle pasture and cultivated land near Lamont, Oklahoma. Scientists and technicians collect and monitor data from Central Facility instruments, as well as from the smaller, unstaffed "extended" facilities throughout the site. The Central Facility also hosts an instrument calibration center and a guest instrument facility.

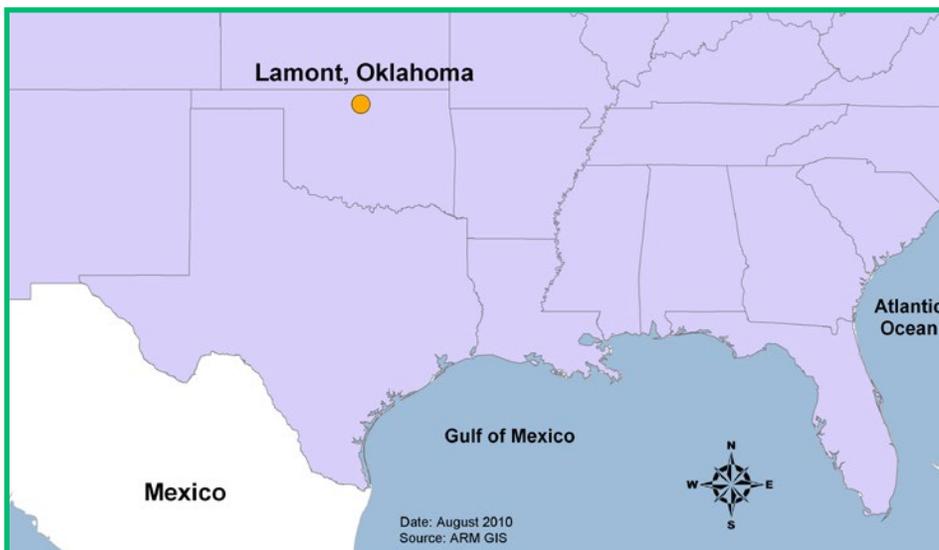
Data collected routinely throughout the SGP are supplemented by short-term field campaigns designed to address specific science questions. Both routine and field campaign data are transmitted to the ARM Data Center and are made available at no cost to the global scientific community.

Diverse Applications

The SGP is an exceptional research observatory because it has a fairly uniform geography and experiences widely varying atmospheric, aerosol, and cloud conditions, and strong seasonal temperature and humidity changes. As a result, the collected data support a large range of scientific investigation.

For instance, the field campaign Midlatitude Continental Convective Clouds Experiment (MC3E) used the comprehensive array of ground-based instruments at the SGP and two instrumented aircraft over a two-month period to gather an important data set for studying convective cloud systems. A smaller example of a field campaign is the Lower Atmospheric Boundary Layer Experiment (LABEL). This campaign used only four instruments at the SGP to characterize different vertical turbulence profiles in the air layer near the ground at various locations around the observatory. Turbulence is an important process that is parameterized, or simplified, in most atmospheric numerical models.



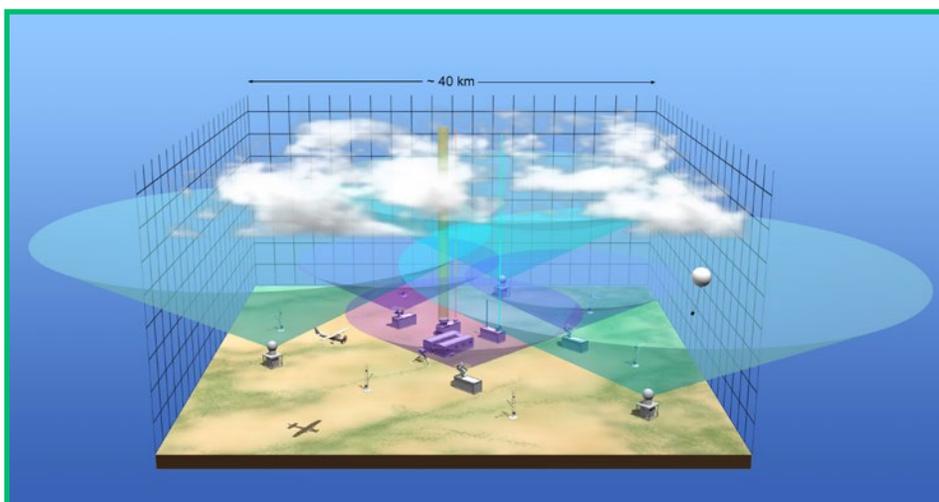


As part of its reconfiguration, ARM expanded the SGP's measurement capabilities and developed processes to use these new data to constrain a large-eddy simulation (LES) model, a mathematical model for turbulence used to simulate atmospheric air currents and cloud processes. The LES ARM Symbiotic Simulation and Observation (LASSO) activity enhances ARM observations by using LES modeling to provide context and a self-consistent representation of the atmosphere surrounding the SGP. LASSO is helping to connect processes and facilitate improved understanding.

Instrumentation and Data

Baseline instrumentation at the SGP consists of about 50 different instruments, including radiometers, radars, lidars, surface meteorological instrumentation, aerosol instrumentation, a total sky imager, a ceilometer, and radiosondes. These instruments automatically collect data on atmospheric properties, greenhouse gases, and the land surface.

The SGP expansion included the addition of in situ and profiling instruments that capture the spatial variability of clouds and



This illustration depicts the new Southern Great Plains observatory configuration, incorporating a network of instruments to support model development and evaluation.

boundary layer structure. ARM expanded the range of measurable soil moisture content across the observatory by replacing its soil moisture network. A network of stereo cameras installed at the SGP provides three-dimensional boundaries for the shallow cloud fields that have been LASSO's focus.

More recently, ARM broadened its capabilities at the SGP by adding tethered balloon flights.

New Modeling Capabilities

LASSO started continuous operation after the pilot phase ended in 2017. LASSO is one of a few instances in which a major observational facility has supported its own large, systematic modeling activity. Combining simulations with detailed observations, ARM is providing powerful new research capabilities for atmospheric researchers and modelers.

User Information

Researchers can use the SGP's facilities and data in a number of ways:

- Access data gathered during normal operations or field campaigns through the ARM Data Center www.arm.gov/data
- Propose and conduct a field campaign www.arm.gov/research/campaign-proposal
- Visit the SGP in person or virtually www.arm.gov/tour/southern-great-plains.html

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www.arm.gov/capabilities/observatories/sgp