

ARM

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U.S. Department of Energy Southern Great Plains

The Southern Great Plains (SGP) atmospheric observatory, which began collecting data in Oklahoma in May 1992, was the first field measurement site established by the Atmospheric Radiation Measurement (ARM) User Facility. SGP data support basic science research to improve understanding of the Earth's atmosphere by providing comprehensive details about temperature, moisture, wind, aerosols, clouds, and radiative energy. Scientists use these data to improve the representation of physical, chemical, and radiative processes (such as cloud and precipitation formation) in earth system models. These models are important for understanding atmospheric conditions that could affect the nation's energy supply.

With substantial measurement capabilities, the SGP is the premier research observatory of the ARM User Facility, funded by the U.S. Department of Energy's (DOE's) Office of Science. As such, the SGP has served as ARM's testbed observatory throughout its history to explore new and efficient measurement strategies while supporting ARM's other observatories with technical staff and warehousing facilities.

SGP instruments operate 24 hours a day, seven days a week. With its broad array of continuous measurements, the SGP provides invaluable records at unprecedented scales. These records track minute-by-minute details, hourly weather events, season-to-season variability, year-to-year changes, and long-term conditions in the atmosphere.

The popularity of SGP data is evident in publications. Out of the approximately 5,000 ARM-related journal articles that have been published in the last 30-plus years, SGP data have informed over one-third of them.

Laboratory Without Walls

Currently, the SGP observatory consists of in situ and remote-sensing instrument clusters arrayed across approximately 2,900 square miles in north-central Oklahoma. ARM also supports spatial sampling over the region with the recent addition of tethered balloon and uncrewed aerial system flights.

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, technicians, and support staff monitor data from the Central Facility instruments, and from smaller, unstaffed facilities throughout the site. The Central Facility also hosts an electronics repair lab for all ARM equipment as well as a radiometric calibration facility that calibrates all of ARM's radiometers to the World Radiometric Reference at set intervals to ensure top-tier data quality.

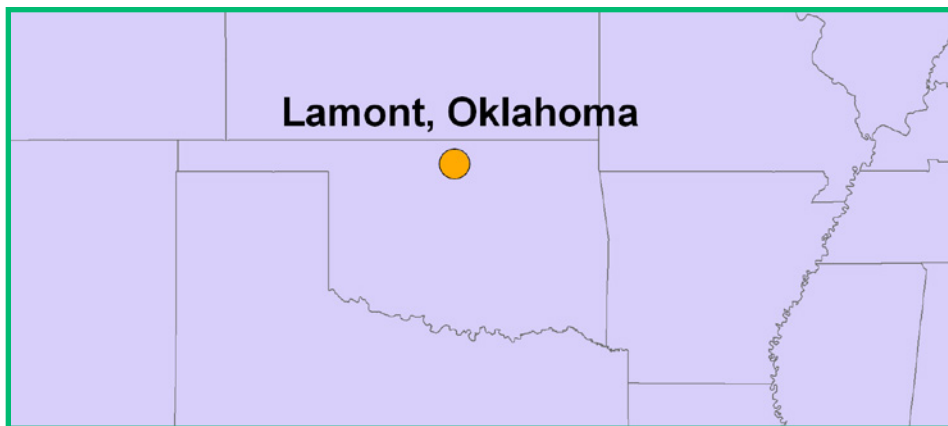
Data collected routinely throughout the SGP are supplemented by short-term field campaigns designed by researchers to address specific science questions. The SGP also hosts a facility for guest researchers to operate their own instruments complemented by ARM capabilities. Both routine and field campaign data, including data from guest instruments, are transmitted to the ARM Data Center and made available online to the global scientific community.

All historical data from the SGP, including previously active sites and field campaigns, remain available in the ARM Data Center.

Varied Applications

The SGP has a fairly uniform geography and experiences widely varying atmospheric, aerosol, and cloud conditions, as well as strong seasonal temperature and humidity changes. As a result, the collected data support a large range of scientific investigation.





Since 1992, the SGP has conducted more than 300 field campaigns—the most of any ARM observatory—ranging in length from a few weeks to multiple years. During these campaigns, researchers have investigated topics such as cloud processes, shallow and deep convection, land-atmosphere interactions, and aerosol properties.

Scientists have also used the SGP to deploy crewed and uncrewed research aircraft, validate satellite retrievals with radiosonde data, and test instruments for ground-based and aerial operations.

The SGP has been a central focus of ARM's aerial efforts for much of its history. Currently, nearly 40% of ARM's airborne data products come from flights of crewed aircraft, uncrewed aerial systems, and tethered balloon systems above and around the SGP. The collection includes aerosol profiles and other atmospheric data assembled across multiple years.

In 2021, ARM and another DOE Office of Science user facility, the Environmental Molecular Sciences Laboratory (EMSL), began offering collaborative research

opportunities at the SGP. This unique partnership enables researchers to collect aerosol particles on ARM's tethered balloon system and analyze their properties using advanced laboratory techniques at EMSL. Since then, ARM and EMSL have joined together for over a dozen campaigns.

Instrumentation and Data

Baseline instrumentation at the SGP consists of about 85 different instruments, including radiometers, radars, lidars, surface meteorological instrumentation, aerosol instrumentation, an all sky imager, a ceilometer, and radiosondes. These instruments collect data on atmospheric properties and the land surface.

In situ and profiling instruments have helped capture the spatial variability of clouds and boundary-layer structure to support ARM high-resolution modeling work at the SGP. Another key contributor to this work is a network of stereo cameras that provides three-dimensional boundaries for shallow cloud fields.



Modeling Capabilities

ARM's curated data sets, particularly those from the SGP, have led to improvements in models supported by DOE and other entities. SGP observations of heating and cooling rates and other factors have greatly improved representations of radiation in earth system models. Data from the SGP have also been critical in evaluating model simulations of unresolved cloud and radiative processes within a single atmospheric column.

As model resolution improved over time, ARM expanded its focus to large-eddy simulation (LES) modeling of atmospheric air currents and cloud processes. The LES ARM Symbiotic Simulation and Observation (LASSO) activity, which ran over the SGP from 2015 through 2019, enhances ARM observations by using LES modeling to provide context and a self-consistent representation of the atmosphere surrounding the SGP and other ARM sites. Combining simulations with detailed observations, LASSO is one of a few instances in which a major observational facility has supported its own large, systematic modeling activity.

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
- Access LASSO SGP shallow convection data adc.arm.gov/lassobrowser
- Propose and conduct a field campaign www.arm.gov/research/campaign-proposal
- Visit the SGP in person www.arm.gov/capabilities/observatories/sgp

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www.arm.gov/capabilities/observatories/sgp