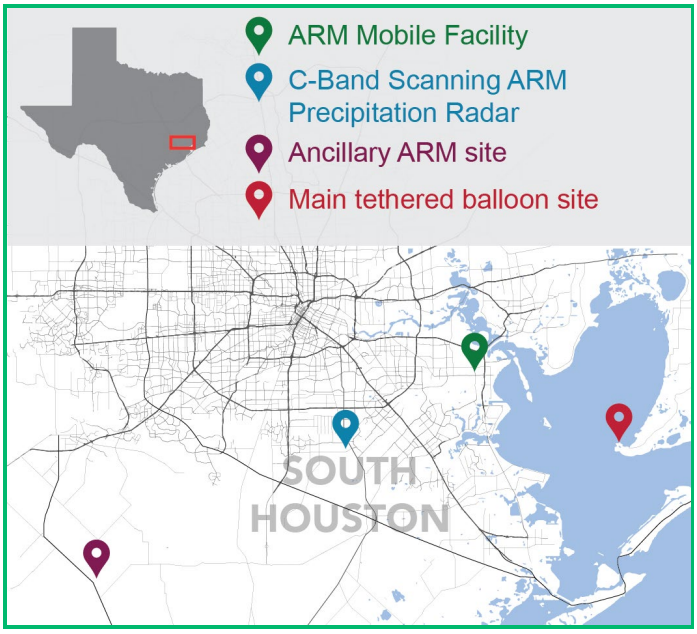
TRacking Aerosol Convection interactions ExpeRiment

Deep convective clouds, which often pack lightning and pour rain, occur nearly everywhere in the world. They are an important feature of the atmosphere but are difficult to represent in models. Researchers need more information about the processes that drive the life cycle of these clouds. For example, how do aerosols—tiny particles in the air—influence the physics of convective clouds?

The Atmospheric Radiation Measurement (ARM) user facility will support a field campaign aimed at finding out what happens inside deep convective clouds. The **TRacking Aerosol Convection interactions ExpeRiment (TRACER)** is scheduled from October 2021 through September 2022 in and around Houston, Texas. The area is unique because it commonly experiences numerous isolated convective systems and a spectrum of aerosol conditions.

ARM, a U.S. Department of Energy (DOE) Office of Science user facility, will deploy one of its three mobile facilities southeast of downtown Houston and a scanning precipitation radar south of downtown.



The map shows TRACER locations for the ARM Mobile Facility, second-generation C-Band Scanning ARM Precipitation Radar, ancillary site, and main tethered balloon system site.

The TRACER field campaign will study convective clouds that commonly appear over the skyline of Houston, Texas.

The second-generation C-Band Scanning ARM Precipitation Radar (CSAPR2) will track convective cells during a four-month intensive operational period (IOP) from June to September 2022. This tracking will provide important details on the rapid evolution of precipitation microphysics in the storm under a range of environmental conditions.

For the IOP, ARM will deploy an ancillary site southwest of Houston, in an area less affected by urban emissions than the mobile facility site. ARM will deploy a tethered balloon system at this ancillary site and at Smith Point, on the eastern shoreline of Galveston Bay. Together, these ARM measurements will help researchers understand the variability of aerosols and meteorology between the urban Houston area and surrounding rural environments.

Science Objectives

TRACER's main objective is to provide convective cloud observations with high space and time resolution over a broad range of environmental and aerosol conditions. These observations will help to constrain high-resolution numerical model simulations, advance fundamental process-level understanding of convective motions and microphysics, and improve the representation of deep convection in multiscale models.

Specifically, TRACER aims to provide the following field data:

- routine, high-resolution, four-dimensional (4D) radar observations of convective cells spanning their life cycle over a wide range of environmental thermodynamic and aerosol conditions
- evolution of the environment in which the convective cell initiates, grows, propagates, and decays, including the thermodynamics, winds, and aerosol characteristics
- a full annual cycle of aerosol, cloud, and radiative observations in a variably polluted, subtropical, humid coastal environment that experiences a wide range of meteorological influences.

Research Instrumentation

This campaign will use the observatory known as the first ARM Mobile Facility (AMF1), operating 24 hours a day, seven days a week. Onsite technicians monitor and maintain approximately 50 instruments to ensure that the best and most complete data set is acquired.

Key AMF1 instruments include a vertically pointing Ka-band radar and a scanning dual-frequency Ka- and X-band radar to measure properties of cloud and precipitation particles. High-frequency radiosonde (weather balloon) launches will capture quickly evolving thermodynamic and kinematic conditions near convective cells—a requirement for isolating aerosol effects on clouds. An instrumentation suite for aerosols will collect measurements of their cloud-nucleating properties, radiative properties, composition, and size distribution, as well as information on key trace gases.

The CSAPR2 will provide high-resolution polarimetric and velocity observations. Combining measurements from the CSAPR2 and a NASA S-band radar deployed alongside it during the IOP will allow for dual-wavelength precipitation retrieval studies.

Using an ARM Mobile Facility (AMF). Mobile facility deployments are determined through a user proposal process. An AMF can be deployed for stand-alone campaigns or for collaboration with interagency experiments. Scientists interested in using an AMF are encouraged to submit proposals at the following web page: *www.arm.gov/research/campaign-proposal*.

Collaborations

Contributions from important collaborations will support TRACER objectives and expand the scientific scope:

The main TRACER observatory will be the first ARM Mobile Facility, seen here during a 2018–2019 field campaign exploring the life cycles of large convective storms in north-central Argentina.

- Scientists funded by DOE's Atmospheric System Research will collect surface and aerial measurements of thermodynamics and winds along with more detailed aerosol characterization.
- Air quality and meteorological measurements will be gathered from the Texas Commission on Environmental Quality operational network.
- In summer 2022, the National Science Foundation's Experiment of Sea Breeze Convection, Aerosols, Precipitation and Environment (ESCAPE) will collect aircraft-based observations of cloud and aerosol properties. ESCAPE also will provide additional radar and radiosonde data and measurements of lightning occurrence.
- The TRACER-Air Quality (TRACER-AQ) project, led by NASA, will bring aircraft- and surface-based remote sensing of aerosol, ozone, and trace gases in September 2021.

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Additional information is available on the ARM website at www.arm.gov.**