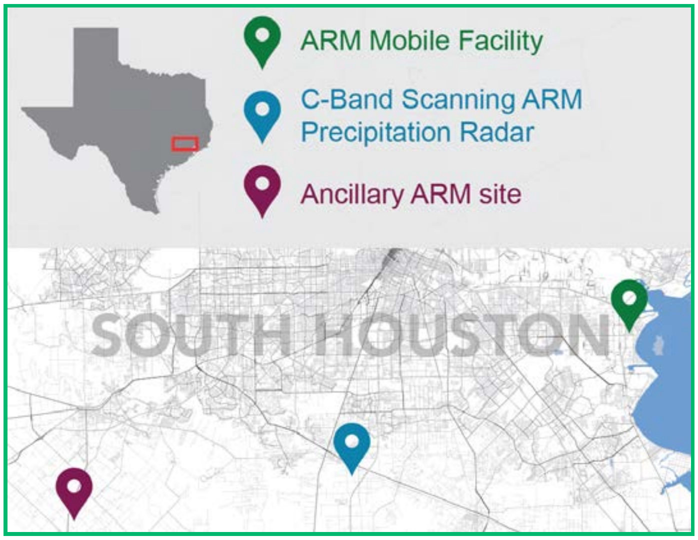
TRacking Aerosol Convection interactions ExpeRiment

Deep convective clouds, which often pack lightning and pour rain, occur nearly everywhere in the world. They are an important feature of the atmosphere, especially in storm systems that dominate the tropics and midlatitudes, 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 to run from April 2021 to April 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) scientific 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 deployment sites for the ARM Mobile Facility and C-Band Scanning ARM Precipitation Radar, and the proposed location for the ancillary ARM 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) is expected to track convective cells during a four-month intensive operational period from June to September 2021. The cell tracking will provide important details on the rapid evolution of precipitation microphysics in the storm updraft under a range of environmental conditions.

For the intensive operational period, ARM also plans to deploy an ancillary site southwest of Houston, in an area less affected by urban emissions than the ARM Mobile Facility site. These measurements, combined with the mobile facility data, 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 better constrain high-resolution numerical model simulations, advance fundamental process-level understanding of updraft motions and microphysics, and improve the representation of deep convection in multiscale models.

Specifically, TRACER aims to provide these field data:

- routine, high-resolution, four-dimensional (4D) radar observations of isolated convective cells spanning their full life cycle over a relatively 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 be used to 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. A NASA S-band radar partly supported by ARM will be deployed alongside the CSAPR2 during the intensive operational period. Combining measurements from the CSAPR2 and the S-band radar will allow for dual-wavelength precipitation retrieval studies.

Collaborations

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

- Scientists funded by DOE's Atmospheric System Research will collect surface and aerial measurements of thermodynamics, winds, and aerosol characteristics along with more detailed aerosol characterization.

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.

- Air quality and meteorological measurements will be gathered from the Texas Commission on Environmental Quality operational network.
- 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.

The TRACER team aims to further enhance the campaign's scientific impact with additional collaborations as the campaign planning continues.

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