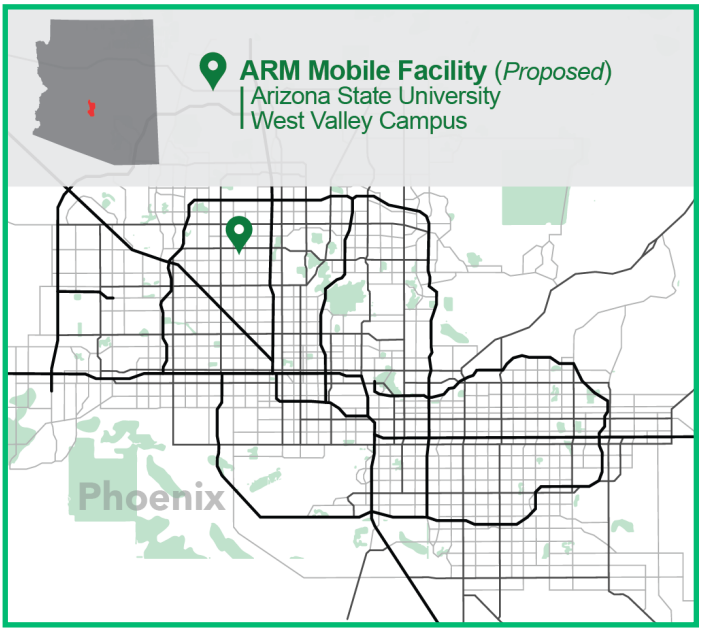
Desert-Urban SysTem IntegratEd AtmospherIc Monsoon (DUSTIEAIM) in the Southwestern United States

Phoenix, Arizona, is the fifth-largest city in the United States with about 1.6 million residents. It is also considered to be the hottest major city in the country, having set a record of 31 consecutive days with temperatures above 110 F (43 C) in summer 2023. Phoenix depends on the Colorado River for over a third of its water supply, but there are questions about how much water will eventually be available to serve the rapidly growing metropolitan area, especially in such extreme heat. Current earth system models struggle to accurately capture precipitation in the Southwestern United States, especially in relation to the summertime North American Monsoon.

The Atmospheric Radiation Measurement (ARM) user facility will support a field campaign in the Phoenix area that aims to study how the urban and desert environments influence convection and precipitation. The **Desert-Urban SysTem IntegratEd AtmospherIc Monsoon (DUSTIEAIM, pronounced "dusty-aim")** campaign is expected to operate from April 2026 to September 2027.



The ARM core facility proposed site at Arizona State University's West Valley campus.

From April 2026 to September 2027, ARM plans to conduct DUSTIEAIM in Phoenix, Arizona. Photo is courtesy of Arizona State University.

ARM, a U.S. Department of Energy (DOE) Office of Science user facility, plans to deploy one of its mobile observatories at Arizona State University's West Valley campus in northwest Phoenix.

Data from DUSTIEAIM will complement measurements from the Southwest Urban Integrated Field Laboratory (SW-IFL, pronounced "swiffle"). SW-IFL is one of four DOE Urban Integrated Field Laboratories that are operating in cities across the United States to study urban climate change.

Science Objectives

The DUSTIEAIM team seeks to characterize interactions between the atmosphere and urban and desert land surfaces. The team also wants to quantify the response of the Southwestern U.S. water cycle to changes in regional airmasses, sources, and meteorological patterns, particularly during the rainy winter and summer seasons.

During the campaign, the team will test four hypotheses within each of the following three science objectives:

1. **Land-Atmosphere Interactions and Impacts:** Determine how the urban-rural interface of the Phoenix metropolitan area affects atmospheric processes within the Sonoran Desert.

2. **Aerosol Processes and Interactions with Clouds and Radiation:** Identify which aerosol sources and processes dominate seasonally in Phoenix and evaluate how well earth system models capture their local and regional impacts on clouds and radiation.

3. **Precipitation Processes:** Evaluate how orographic, surface, and aerosol processes intersect with larger-scale meteorological variability to affect spatial and temporal precipitation patterns in and around the Phoenix metropolitan area.

Research Instrumentation

This campaign will use an ARM Mobile Facility (AMF), 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. All collected data will be freely available to the scientific community.

Key AMF instruments include a vertically pointing Ka-band radar, a ceilometer, and a microwave radiometer to estimate the properties of shallow clouds, including cloud boundaries, macrophysical properties, and liquid water path. An instrumentation suite for aerosols will characterize aerosol microphysical properties and processes across the urban-agricultural atmospheric environment.

Measurements from a scanning mobility particle sizer, included in the aerosol instrumentation suite, are critical to characterizing aerosol size distributions to provide a constraint on aerosol dynamics and sources including dust. In addition, researchers will use two condensation particle counters to measure both fine and ultrafine aerosol particle number concentrations.

Two intensive operational periods are planned. One will focus on winter precipitation from November 2026 to March 2027. The other will focus on the North American Monsoon from July to September 2027.

ARM Field Campaign Proposals. ARM field campaigns, including mobile facility deployments, are determined through a user proposal process. Scientists interested in proposing future campaigns, including guest instrument deployments as part of DUSTIEAIM, can find more information at: ***www.arm.gov/research/campaigns***.

DUSTIEAIM will deploy this ARM Mobile Facility, pictured during a 2021–2022 field campaign exploring convective cloud life cycles in Texas.

Collaborations

Contributions from important collaborations will support DUSTIEAIM objectives and expand the scientific scope.

Led by Arizona State University, SW-IFL brings together observationalists, modelers, and resilience experts to improve our understanding of how extreme heat, air pollution, and limited water are interacting to affect the region's rapidly growing population.

NOAA NEXRAD radar data will complement coverage from ARM scanning radars. Monitoring stations operated by the U.S. Environmental Protection Agency and Department of Defense, the National Weather Service, the Federal Aviation Administration, and Arizona State University will enhance DUSTIEAIM data collection efforts.

Additional DUSTIEAIM agency collaborations are planned, and ARM welcomes all interested collaborators and scientists to reach out to the contacts below.

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DUSTIEAIM Web Page

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