

Eastern Pacific Cloud Aerosol Precipitation Experiment

Marine stratocumulus clouds, like those that form off the California coast, occur where cold deep seawater rises to the ocean surface and cools the air. The northeastern Pacific Ocean is home to one of the most persistent stratocumulus layers in the world, but long-term observations of these clouds are scarce. Coastal cities provide the unique opportunity to observe these clouds and to study the substantial effects that manmade aerosol particles have on their properties and processes.

The Atmospheric Radiation Measurement (ARM) user facility will deploy for the Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE) from February 2023 to February 2024 in northern San Diego, California. EPCAPE will explore aerosol indirect effects on stratocumulus clouds to help improve their representation in earth system models. Researchers will also investigate how pollution from the nearby Los Angeles metropolitan area affects marine aerosols and, by extension, the clouds near San Diego.

ARM, a U.S. Department of Energy (DOE) Office of Science user facility, will operate instrumentation at two sites in La Jolla as part of EPCAPE: the Ellen Browning Scripps Memorial Pier, a coastal research facility adjacent to the Scripps Institution of Oceanography; and Mount Soledad less than a mile inland.



The Ellen Browning Scripps Memorial Pier will host ARM instruments during the EPCAPE field campaign in northern San Diego, California.

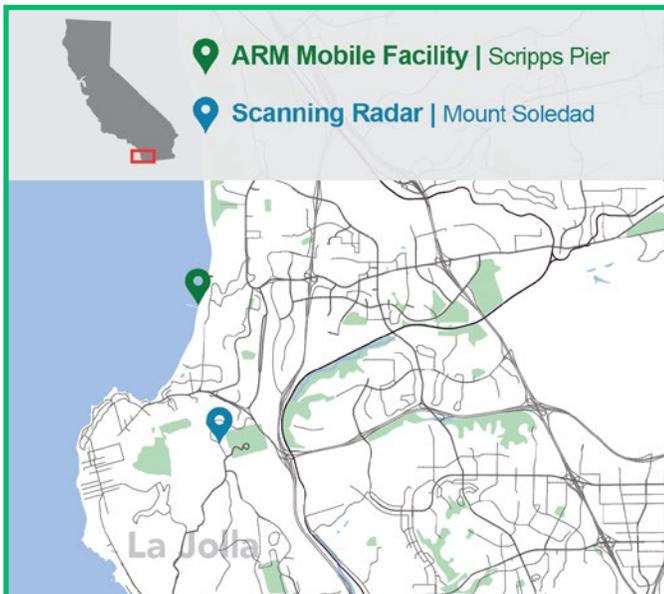
EPCAPE will feature two intensive operational periods (IOPs). The first (April through June 2023) will focus on the characterization of low clouds and their chemistry at Mount Soledad. The second IOP (July through September 2023) will feature the characterization of higher clouds and their radiative properties.

Science Objectives

EPCAPE's focus is to characterize the cloud cover, cloud thickness, cloud altitude, radiative properties, aerosol interactions, and precipitation of stratocumulus clouds in the eastern Pacific across all four seasons at a coastal location. An important enhancement to this study will be the collection of simultaneous in-cloud aerosol and droplet measurements to investigate the differences in these cloud properties during regional polluted and clean marine conditions.

The combined observations will provide an unprecedented set of constraints for the following three questions:

1. Cloud and aerosol climatology: What are the seasonal and diurnal cycles of marine stratocumulus cloud and aerosol properties on the northeastern Pacific coast?



During EPCAPE, Scripps Pier (top) will host the primary components of an ARM Mobile Facility, and Mount Soledad (bottom) will host additional ARM instrumentation, including a scanning radar.

2. Cloud radiative fluxes: How do cloud properties, including the ratio of direct-to-diffuse radiation, change as winds push coastal clouds inland?
3. Aerosol-cloud interactions: Will retrieved cloud properties reflect the regional signatures of aerosol?

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 Ka-band radar to measure properties of cloud and precipitation particles. An instrumentation suite for aerosols will collect measurements of their cloud-nucleating properties, radiative properties, and composition, as well as information on key trace gases.

Measurements from a scanning mobility particle sizer, included in the aerosol instrumentation suite, will be critical to characterizing aerosol climatology and to understanding the aerosol effect on cloud microphysical and radiative properties. In addition, researchers plan to use measurements from an aerodynamic particle sizer to characterize sea-spray aerosol contributions.

Weather balloon (sonde) launches will assist researchers in characterizing the diurnal cycle of coastal clouds.

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: <https://www.arm.gov/research/campaign-proposal>.

Collaborations

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

Scientists funded by DOE's Atmospheric System Research (ASR) will collect surface and airborne measurements of aerosol properties, including chemical characterization at a range of sizes.



For EPCAPE, this ARM Mobile Facility will return to California, where it went on its first field campaign deployment in 2005 at Point Reyes National Seashore, north of San Francisco.

Funded by the National Science Foundation, researchers from the University of California San Diego, University of California Los Angeles, and North Carolina State University will characterize cloud chemistry at the Mount Soledad site.

Ground-based sampling of cloud droplets, volatile organic compounds, and aerosol absorption properties will be provided by Environment and Climate Change Canada and Dalhousie University.

In addition, two airborne campaigns will be flown in June 2023. The Southern California Investigation of Low cloud and Land Aerosol (SCILLA), sponsored by the Office of Naval Research and ASR, will study aerosol-cloud interactions upwind of the EPCAPE sites. NOAA researchers plan to collect measurements of marine cloud chemistry as part of the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) campaign.

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EPCAPE Web Page

