

ARM

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U.S. Department of Energy Eastern North Atlantic

The U.S. Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) Research Facility provides the research community with continuous data about clouds, aerosols, energy, and precipitation from Graciosa Island in the Azores, Portugal. As ARM's newest observation facility, the Eastern North Atlantic, or ENA, site began operations in September 2013 and mirrors ARM's other long-term atmospheric measurement facilities around the world.

The Azores are an island group located in the northeastern Atlantic Ocean, a region characterized by marine stratocumulus clouds. Response of these low clouds to changes in atmospheric trace gases and aerosols is a major source of uncertainty in earth system models. Interactions between aerosols and clouds intricately involve the formation of precipitation and its effect upon cloud dynamics, turbulence, and entrainment. Scientists lack sufficient observations to accurately quantify the links among these processes.

For the evaluation of both earth system and process-based numerical models, statistically robust and physically accurate observational data sets obtained over long periods of time are needed. The ENA site provides a rare data set from the subtropical marine boundary layer, where earth system models show the greatest discrepancy in cloud responses.

Key Field Campaigns

Clouds, Aerosol, and Precipitation in the Marine Boundary Layer (CAP-MBL)

This site followed an extremely successful 20-month deployment of the ARM Mobile Facility—a portable atmospheric observatory—that took place on Graciosa Island during 2009–2010 for the CAP-MBL field campaign.

Data from the deployment resulted in the first climatology of the detailed vertical structure and precipitation properties of low clouds at a remote subtropical marine site. These data provided particularly important new information about the structure and variability of the remote marine boundary layer system and the factors that influence it. Scientific results from this campaign confirmed that the Azores have the ideal mix of conditions to study how clouds, aerosols, and precipitation interact.

Aerosol and Cloud Experiments in the Eastern North Atlantic (ACE-ENA)

The Gulfstream-159 (G-1) research aircraft flew near the ARM atmospheric observatory during the summer (June to July) of 2017 and in the winter (January to February) of 2018. The ACE-ENA field campaign studied both seasons to measure key aerosol and cloud processes under various meteorological and cloud conditions with different aerosol sources. During the summer, the Azores experience overcast stratocumulus clouds that transition to broken trade cumulus clouds, while the winter experiences maritime frontal clouds. The ARM Aerial Facility flew the G-1 into these clouds near the ENA atmospheric observatory to collect vertical profile data of aerosols and clouds.



Instrumentation and Data

The ENA observation site provides significant enhancements to instruments previously deployed with the ARM Mobile Facility. Key instrument systems include:

Aerosol and Trace Gas Systems

- humidified tandem differential mobility analyzer
- aerosol chemical speciation mass spectrometer
- cavity attenuated phase shift particle extinction monitor
- trace gas monitors
- ultra-high sensitivity aerosol spectrometer

Atmospheric and Boundary State Systems

- surface meteorological instrumentation
- weather balloons (launched twice each day)
- total sky imager
- weighing bucket rain gauge
- eddy correlation flux measurement system
- video and laser disdrometers

Lidars

- micropulse lidar
- Doppler lidar
- Raman lidar

Radars

- zenith cloud radar
- scanning cloud radars
- scanning precipitation radar
- radar wind profiler

Radiometers

- atmospheric emitted radiance interferometer



The location for the ENA fixed site is shown in relation to the original mobile facility deployment site near the airport on Graciosa Island, Azores.

- microwave radiometers
- multfilter rotating shadowband radiometer
- pyranometer
- pyroheliometer
- pyrgeometer
- blackbody calibration system.

- Propose and conduct a field campaign www.arm.gov/research/campaign-proposal
- Make an in-person or virtual visit to the ENA site www.arm.gov/capabilities/observatories/ena

User Information

Researchers can use the ENA'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

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www.arm.gov/capabilities/observatories/ena