

Cloud And Precipitation Experiment at Kennaook

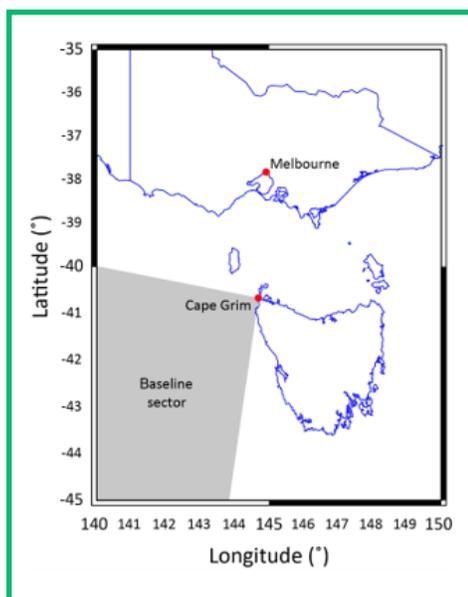
The remote Southern Ocean is an area of great interest to atmospheric scientists because of its influence on global atmospheric and oceanic circulation. With less influence from aerosols produced by human activities than most areas on Earth, the region provides a view into preindustrial conditions.

Climate projections for the entire Earth are sensitive to the aerosol-cloud-precipitation interactions in the Southern Ocean atmosphere. This is particularly true of the ubiquitous low-level clouds that control the amount of sunlight absorbed at the ocean surface. Satellite data suggest that cloud properties co-vary with the seasonal cycle of aerosols in the region. Seasonal variations in Southern Ocean aerosol properties are strong and well documented, but detailed vertically resolved measurements of clouds and precipitation in the marine boundary layer are lacking.

To help fill this gap, the Atmospheric Radiation Measurement (ARM) user facility will deploy a set of instruments for the **Cloud And Precipitation Experiment at Kennaook (CAPE-K)** from April 2024 to September 2025 in northwestern Tasmania.

ARM, a U.S. Department of Energy (DOE) Office of Science user facility, plans to run its instruments at the Kennaook/ Cape Grim Baseline Air Pollution Station.

ARM instruments for CAPE-K will be located on the northwestern tip of Tasmania. The baseline sector represents clean air that has not passed over land.



From April 2024 to September 2025, ARM plans to conduct the CAPE-K campaign at the Kennaook/Cape Grim Baseline Air Pollution Station in Tasmania. Photo: Australian Bureau of Meteorology.

The station is jointly managed by the Australian Bureau of Meteorology (BOM) and Commonwealth Scientific and Industrial Research Organisation (CSIRO). Established in 1976, this station has produced the longest and most consequential record of aerosol and gas-phase chemistry in the Southern Hemisphere. However, extensive cloud and precipitation measurements have not been collected there.

Science Objectives

CAPE-K will enable three science objectives:

1. Document the seasonal cycle of Southern Ocean low-cloud and precipitation properties and examine how they co-vary with aerosol and with dynamical and thermodynamical factors.
2. Compare and contrast these relationships with observations from other surface sites and campaigns, including other ARM sites.
3. Study aerosol-cloud-precipitation interactions in pristine marine low clouds and explore how these interactions can best be represented in models at various scales.

Together, data from ARM and the Kennaook/Cape Grim station are expected to improve knowledge of Southern Ocean cloud and precipitation properties and their dependence on aerosols and environmental conditions. This is especially important in a warming climate, where all are likely to change.

Research Instrumentation

This campaign will use components of an observatory known as the second ARM Mobile Facility (AMF2), operating 24 hours a day, seven days a week. Onsite technicians monitor and maintain the instruments to ensure that the best and most complete data set is acquired.

Key AMF2 instruments for CAPE-K are expected to include a vertically pointing Ka-band radar, micropulse lidar, multifilter rotating shadowband radiometer, microwave radiometers, and disdrometers. These instruments will provide data on cloud and precipitation properties.

ARM measurements will augment routine aerosol data from the Kennaook/Cape Grim station, including aerosol size distribution, particle number concentration, light absorption and scattering, and mass and chemical composition. The station also includes a 70-meter (230-foot) tower to support meteorological measurements.

In addition to twice-daily weather balloon (sonde) launches, the CAPE-K team is planning at least two monthlong intensive operational periods with launches every three to six hours to obtain detailed information on boundary-layer structure. These data could be used for high-resolution modeling case 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: <https://www.arm.gov/research/campaign-proposal>.



For CAPE-K, ARM will deploy components of the second ARM Mobile Facility, which operated on a research vessel that traveled across the Southern Ocean between Tasmania and Antarctica in 2017 and 2018.

Collaborations

Contributions from important collaborations will support CAPE-K objectives and expand the scientific scope.

The collaboration with BOM and CSIRO includes a planned shipborne campaign off Tasmania in July and August 2025, during austral winter. The *R/V Investigator* will be stationed off Kennaook, and it will travel into the climatically typical air masses that flow from the prevailing southwesterly winds to collect data on clouds, precipitation, and aerosol chemical and microphysical properties.

All ARM data from the CAPE-K campaign will be freely available to the scientific community. ARM welcomes additional collaborations in CAPE-K and encourages interested scientists to reach out to the contacts below.

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CAPE-K Web Page

