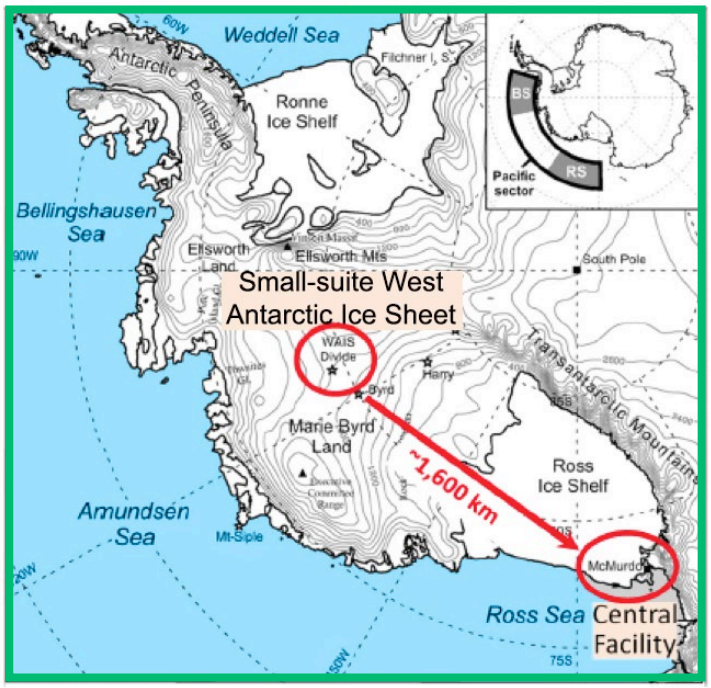
ARM West Antarctic Radiation Experiment

West Antarctica is one of the most rapidly warming regions on Earth, and this warming is closely connected to global sea level rise. With limited atmospheric observations in the remote region since the late 1950s, there has been no comprehensive explanation for the rapid warming of the West Antarctic Ice Sheet (WAIS). To find answers, there is a need to quantify the role of changing air masses on the surface energy balance, including all surface energy components and cloud radiative forcing. These data are needed to improve earth system models, which are known to perform poorly over the Southern Ocean because of a lack of cloud observations.

To gather these critical data, the Atmospheric Radiation Measurement (ARM) Climate Research Facility, a national scientific user facility managed by the U.S. Department of Energy (DOE) Office of Science, conducted a climate-related field campaign in West Antarctica that used some of the most advanced atmospheric research instrumentation for cloud, radiative, and aerosol observations.



One of the world's three great ice sheets—the WAIS—is situated in a relatively warm marine geologic basin that drains into the Weddell, Bellingshausen, Amundsen, and Ross seas through fast-moving ice streams and outlet glaciers.

The WAIS is experiencing rapid changes in temperature and stability, without any comprehensive explanation for the dramatic warming.

From fall 2015 to early 2017, the **ARM West Antarctic Radiation Experiment (AWARE)** gathered data from McMurdo Station at the southern tip of Antarctica's Ross Ice Shelf. Using a portable observatory, or ARM Mobile Facility (AMF), researchers measured clouds, aerosols, and energy coming from the sun and Earth. An additional, smaller suite of instruments on the WAIS was transported from McMurdo to operate for 56 days between November 2015 and January 2016.

Science Objectives

AWARE used the joint capabilities of the U.S. Antarctic Program, managed by the National Science Foundation, and the second AMF (AMF2) to provide quantitative data about energy components, changing air masses, and cloud microphysical data to improve model simulations of the ice sheet as influenced by earth system processes. These data will be vital in understanding the complex processes occurring in this remote area. The research team focused on three specific objectives:

1. Obtaining quantitative information on WAIS energy balance components and clouds as they related to changing air masses and warm air advection.

2. Providing cloud microphysical data to evaluate and improve earth system model performance in the coldest and most pristine environment on Earth.
3. Fully characterizing an annual cycle of aerosol properties by combining the microphysical information from AMF2 with chemical composition analysis of samples performed at the Scripps Institution of Oceanography at the University of California, San Diego.

The portable AMF2 consists of instruments, operations shelters, and data and communications systems.

Research Instrumentation

Onsite operators monitor and maintain the facility to assure the best and most complete data set is acquired. Data are collected 24 hours a day, every day, and provided free of charge online to scientists worldwide.

Measurement Capabilities. They include cutting-edge meteorological instrumentation, a broadband and spectral radiometer suites, and remote-sensing instruments, such as:

- W-Band Scanning ARM Cloud Radar
- High Spectral Resolution Lidar
- Micropulse Lidar and Laser Ceilometer
- X- and Ka-Band Scanning ARM Cloud Radar
- Microwave Radiometer
- Atmospheric Emitted Radiance Interferometer
- Multifilter Rotating Shadowband Radiometer
- Sky Radiation System – a collection of radiometers to measure visible diffuse, global, and direct visible and infrared solar radiation
- Ground Radiation System – a collection of radiometers to measure visible and infrared radiation coming from the ground
- Balloon-Borne Sounding System – sondes (weather balloons) launched each day at regular intervals
- Radar Wind Profiler
- Total Sky Imager
- Aerosol Observing System
- Surface Meteorology Station.

Collaborations

AWARE was one of the most challenging missions ever conceived for the ARM mobile facilities, and its success required close collaboration between the DOE's Office of Science and the National Science Foundation.

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www.arm.gov/research/campaigns/amf2015aware

DOE/SC-ARM-15-045
Revised December 2017

U.S. DEPARTMENT OF ENERGY | Office of Science

The ARM Research Facility is funded through the U.S. Department of Energy's Office of Science.
Additional information is available on the ARM website at www.arm.gov.