Antarctic Automatic Weather Stations

by
Jonathan Thom
George Weidner
Charles R. Stearns

The National Science Foundation Office of Polar Programs Automatic Weather Station project places automatic weather station (AWS) units in remote areas of Antarctica in support of meteorological research and operations. The AWS data are collected by the ARGOS Data Collection System (DCS) on board the National Oceanic and Atmospheric Administration (NOAA) series of polar-orbiting satellites.

The Antarctic continent is 97% covered with ice with an average elevation of 2300 meters and an average annual temperature of -35 degrees C, making Antarctica the highest and coldest continent on Earth. Maintaining occupied sites for collecting meteorological observations is expensive, and the locations may not be appropriate for the collection of meaningful meteorological data. The capabilities of an automatic weather station allow for the retrieval of important weather information without having to have a person on duty at each site. These stations have proven to be an invaluable resource for researchers, forecasters, as well as the general public, as they yield gathering important meteorological information about the Antarctic.

The AWS units are placed for meteorological experiments and for operational purposes. Any one AWS may contribute to several experiments and all contribute to operational reasons. The units help prepare weather forecasts for aircraft flights to and from New Zealand and within Antarctica. Some areas of support are:

a. The Ross Ice Shelf Air Stream
b. Barrier wind flow along the Antarctic Peninsula and the Trans-Antarctic Mountains
c. Katabatic wind flow down Reeves Glacier, Byrd Glacier, Beardmore Glacier, and the slope to the Adeile Coast
d. Mesoscale circulation and the sensible and latent heat fluxes on the Ross Ice Shelf
e. Climatology of Byrd and Dome C Stations
f. Boundary layer meteorology around the South Pole
g. Research in Antarctic Coastal Ecosystem Rates along the Antarctic Peninsula
h. Long Term Ecological Research along the Antarctic Peninsula
i. Meteorological support for flight operations at McMurdo Station, Antarctica
j. Monitoring for possible manned station locations and aircraft landing sites

Figure 1. Antarctic Automated Weather Station at Willie Field

Figure1 shows the AWS unit at Willie Field near McMurdo, Antarctica. Paroscientific pressure instruments are integrated into AWS by University of Wisconsin technicians. There is a custom-made small computer that operates our AWS. The AWS in the photo has an operational temperature range of -50 deg C to 5 deg C. Units such as Clean Air and Dome Fuji have an operational temperature range of-85 deg C to -10 deg C. The lowest temperature observed on Earth is at Vostok station; our Dome C unit also recorded a temperature close to the Vostok temperature. As we have AWS units all over Antarctica at various elevations, the operational temperature range varies greatly, but the above temperature ranges illustrate the temperature extremes. Some of the AWS units in the Antarctic Peninsula region get slightly warmer temperatures. We measure the gauge temperature so that we can make the required temperature correction.

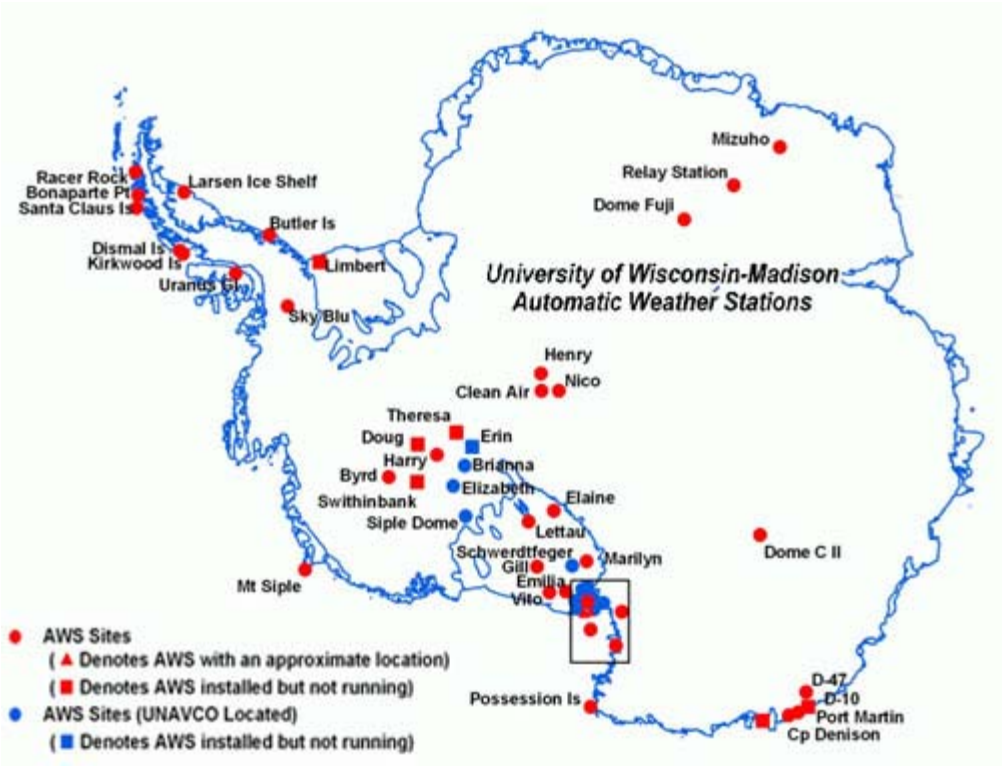

Figure 2. Antarctic Automated Weather Station Map

The University of Wisconsin Antarctic automatic weather stations program has been installing automatic weather stations in Antarctica and Greenland since 1980. After initial tests the Paroscientific Digiquartz pressure gauge Model 215A was selected for use in our weather stations. The initial four gauges are still in operation and at present we have 60 gauges. There are about 600 gauge-years of operation in the extreme environments of Antarctica and Greenland. The gauges have operated reliably at gauge temperatures as low as -80 Deg C. The oldest gauges have drifted about 2 millibars in 20 years. There were failures in our weather stations, but only one gauge failure. Meanwhile, other sensors like wind speed, wind direction, air temperature and relative humidity sensors have failed more often. The gauges are sufficiently accurate to calculate the horizontal pressure gradient force over distances of 100 km.

At the end of the 2003-2004 field season, just under sixty stations were operational in the Antarctic. Three new sites, Wanderer, Vito, and Emilie, were added during the 2003-2004 field season.

The AWS unit is powered by six to twelve 40 ampere-hour 12 volt gel-cell batteries charged by one or two 10 Watt solar panels. At the South Pole, 12 batteries and two solar panels are sufficient to operate the AWS unit through the year, while six batteries and one solar panel are adequate on the Ross Ice Shelf. Several of the AWS units have operated on the same batteries and solar panel for 6 to 10 years.

Submitted by
Space Science and Engineering Center
University of Wisconsin - Madison
Madison, Wisconsin 53706