Palmer LTER: Palmer Station weather records

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Climate variability is of central importance in long-term ecological research. Data management objectives of the Palmer Long-Term Ecological Research (LTER) program include documentation, quality control, timely access, and long-term availability of important weather records within the Palmer area.

The Palmer Station weather record has recently been augmented by the addition of two automated weather stations (AWSs) (Bromwich and Stearns 1993) that provide a higher daily sampling frequency of selected weather parameters and a common link to the broad AWS coverage in the Antarctic.

The Bonaparte AWS (64°46'S 64°04'W; height approximately 8 meters) installed January 1992 is located at the entrance to Arthur Harbor some 750 meters west-southwest of Palmer Station. The Hugo AWS (64°57.87'S 65°40.15'W; height approximately 20 meters) installed December 1994 is located offshore on a small island within the Victor Hugo archipelago some 90 kilometers west-southwest of Palmer Station at a height of approximately 20 meters. The Hugo site was initially explored on the LTER January 1993 cruise. Tony Amos in communication with Charles Stearns joined with Langdon Quetin and Dave Karl to install the Hugo station during the LTER SANTA CLAµS [Studies in ANTarcticA: Coupled Linkages Among micro (µ) organismS] Cruise in December 1994. An AWS typically measures air temperature, pressure, and wind speed and direction; however, a water-temperature probe was added to the Bonaparte AWS and will be added to the Hugo AWS on the LTER January 1996 cruise. Because the original AWSs were designed for dry/cold environments, AWS platform redesign is ongoing for the Palmer LTER AWS units to accommodate the wet/salty marine environment.

AWS measurements are recorded once every 10 minutes and then broadcast through the Argos satellite system. The uploaded data typically provide a 50–81 percent daily sampling coverage as shown in figure 1*A*. In the last year, onsite postings of a subset of the data have permitted rapid discovery of both a battery malfunction and a connector failure, allowing needed repairs to be made in a timely manner. Thus, Bonaparte AWS has the important distinction within the AWS network that it is manned, which facilitates both direct monitoring and repair.

A time series of daily mean air temperatures from Bonaparte AWS is shown in figure 1*B*. Daily mean air temperature is typically determined by taking the mean of the daily maximum and minimum observed for that day. Given the much higher density of data available from AWSs, however, it is possible to determine the daily mean also from the arithmetic average of all of the available daily 10-minute temperatures. Figure 1*B* shows the extent of the difference between these two methods.

Preliminary comparisons of Hugo vs. Bonaparte AWS air temperatures have shown that daily mean air temperatures are similar, but daily extremes are much greater at Bonaparte. This suggests that the Bonaparte AWS is influenced by nearby glaciers and high mountains, whereas weather at the Hugo AWS is moderated by the surrounding ocean and is, thus, more representative of a maritime environment. Hugo AWS is a significant addition to the peninsula data record because most other Antarctic Peninsula records represent coastal regimes.

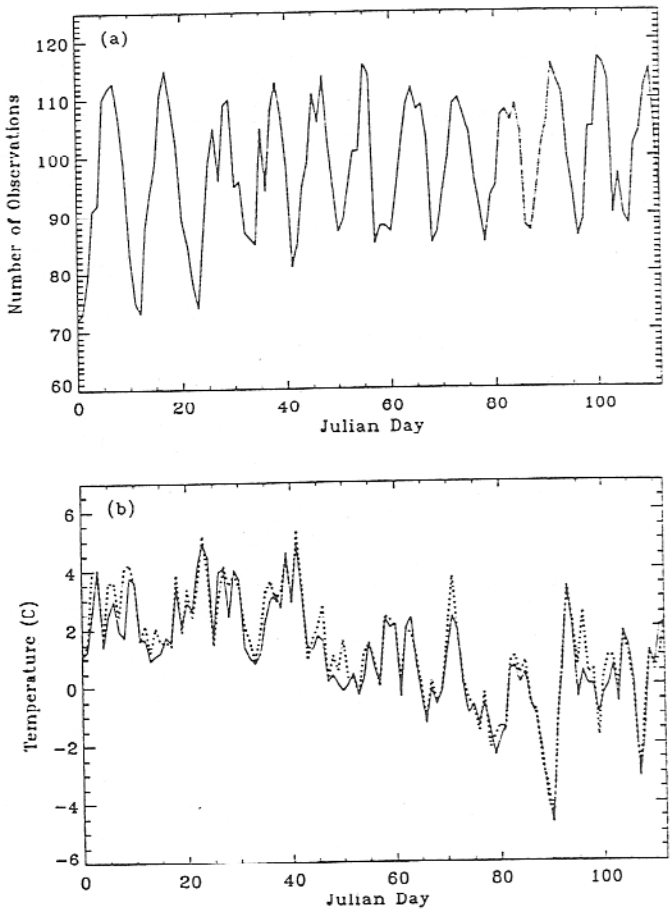

Figure 1. AWS Bonaparte 1995 daily data. *A.* The daily sampling coverage of uploaded AWS Bonaparte data for julian days 1–113. A total daily sampling coverage would equal 144 observations (6 records per hour for 24 hours). *B.* The time series of daily mean air temperature. The solid and dotted lines denote the daily means determined by an arithmetic average and by the average of the maximum and minimum air temperatures, respectively. Both mean calculations are based on the uploaded 10-minute-interval daily records.

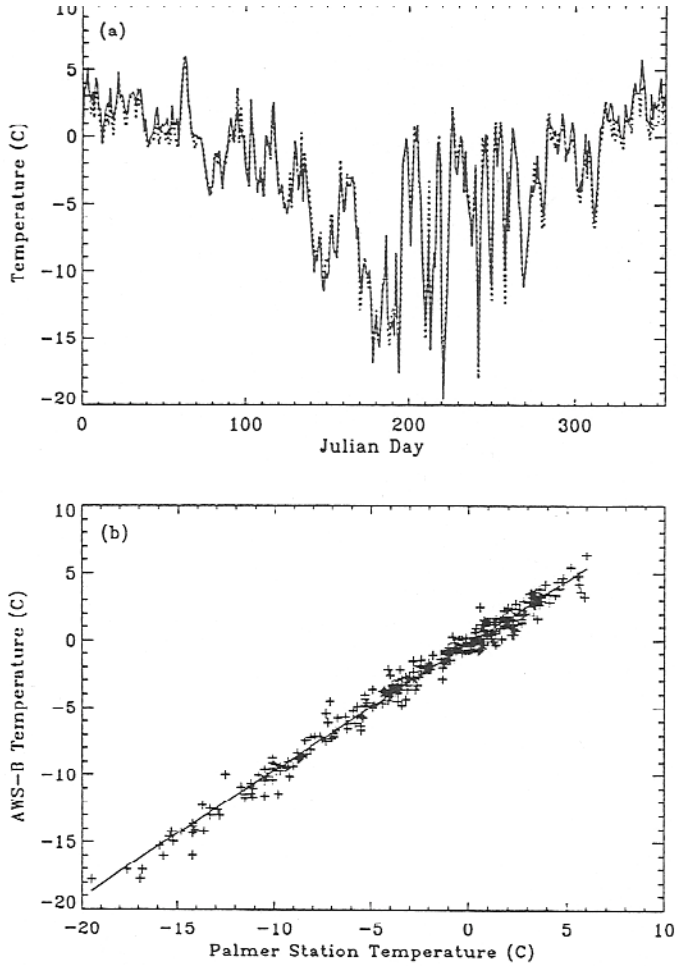

Figure 2. Comparisons of 1992 daily mean air temperatures observed at Palmer Station and recorded at AWS Bonaparte. Daily means were determined by the average of the maximum and minimum air temperatures observed for each day. *A.* The daily time series. The solid and dotted lines denote Palmer Station and AWS Bonaparte means, respectively. *B.* The linear regression of Palmer Station vs. AWS Bonaparte (AWS-B) daily means where AWS-B temperature is 0.94 (Palmer Station temperature) minus 0.25, with an R^2=0.98.

Currently, personnel at Palmer Station make weather observations, including measurements of daily maximum and minimum air temperature, wind speed, and wind direction, four times a day. A subset of these observations is archived through the National Climatic Data Center, and a daily average summary is available at the station. These data span 1989 to the present; earlier data, back to 1974, are available from published accounts in the *Antarctic Journal.*

One method to assure quality and validate data is to obtain two independent but duplicate sets of measurements of the same variable. Figure 2*A* compares the time series of Palmer Station and Bonaparte AWS daily means for 1992. The two time series are in very close agreement, as shown in figure 2*B*.

Weather records are one of the most basic data records pertinent to long-term study of an ecosystem. Both Palmer weather and related weather records have been placed within the Palmer LTER online data system (*http://www.icess.ucsb.edu/lter*). Also, pertinent data available online at other sites, such as the AWS data, are referenced from the Palmer LTER online system.

Thanks are given to Charles Stearns and his team at University of Wisconsin for their work with the two AWS stations. Thanks also to the teams that scouted and installed the AWS stations, and to Antarctic Support Associates for facilitating installation. Acknowledgment is given to Al Oxton who did some of the original maintenance and digital development of the Palmer Station weather record, and to the science technicians who have continued this record. This research was supported by National Science Foundation grant OPP 90-11927 and is Palmer LTER contribution number 63.

Reference

Bromwich, D.H., and C.R. Stearns (Eds.). 1993. *Antarctic meteorology and climatology: Studies based on automatic weather stations* (Antarctic Research Series, Vol. 61). Washington, D.C.: American Geophysical Union.