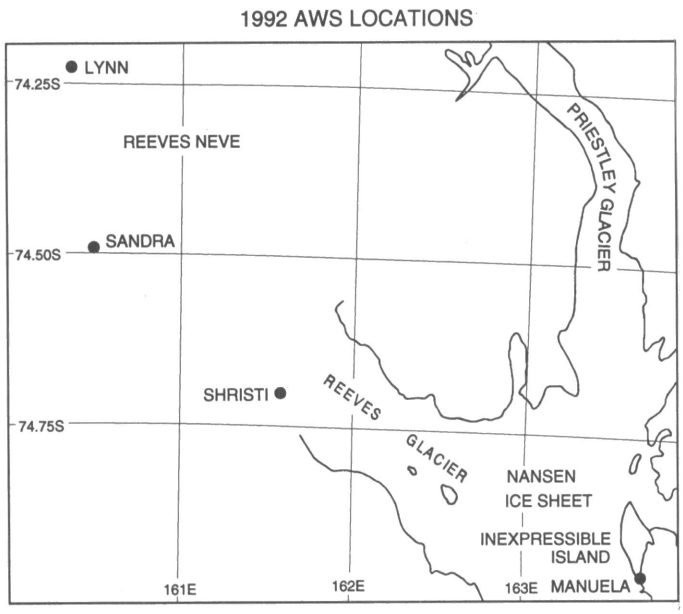

Figure 2. Map of the 1992 locations of the AWS units in the Reeves Glacier area of Antarctica, including Manuela site.

tion in 1990. The *Polar Duke* provided transportation to the site. In January 1992 Amos installed an AWS unit on Bonaparte Point in support of long-term ecological research.

On the *Polar Sea* cruise from Portland, Australia, to McMurdo, Antarctica, Stearns replaced the broken aerovane at Manuela site. Equipment and weather conditions were unfavorable for the installation of dog-house AWS units on Scott and Possession Islands. Stearns arrived at McMurdo on 4 January 1992; Weidner, R. Holmes, and R. Doornbos arrived at McMurdo Station on 6 January 1992.

Upon our arrival at McMurdo, a clamor arose requesting an AWS unit on the blue-ice area north of Mount Howe. The blue ice is being investigated as a potential blue-ice runway. We made a trip to the South Pole and then to the blue ice at Mount Howe on 11 January 1992. With the help of Bill Barber and the crew of the Twin Otter, we installed the AWS unit near the outhouse on the blue ice.

Weidner, Holmes, and Doornbos replaced the faulty aerovane and electronics at Linda site on 15 January 1992. Stearns, Doornbos, and Holmes replaced the aerovane, electronics, and antenna at Minna Bluff on 16 January 1993. We visited Pegasus North and Pegasus South sites on 22 January and found them to be in good condition. The anchors had not melted out of the ice.

We raised the tower 5 feet and replaced the aerovane and electronics at Lynn site on 23 January 1992. On the return flight to McMurdo we removed the AWS unit at Sushila site.

We installed an AWS unit at the west end of Williams Field to provide meteorological information throughout the year in anticipation of possible year-round operations and for comparison with the Pegasus sites.

We installed a Geoteck WS-201 wind system at Jimmy site to see if the system would withstand the annual season at a relatively peaceful site. The aerovanes currently used to measure wind speed and direction are not always functioning throughout the year. If an aerovane lasts an average of 5 years, then 7 aerovanes need replacement and repair each year.

Members of the British Antarctic Survey raised the Siple Station AWS unit one 5-foot tower section, reinstalled the Uranus Glacier AWS, and replaced the Butler Island and Larsen Ice Shelf aerovanes.

Expedition Polaris Francaises replaced the aerovane at Port Martin, and the electronics at D-47 and at D-10.

The marine science technicians of the U.S. Coast Guard icebreaker *Polar Sea* removed the AWS unit at Martha 2, because the unit was nearly buried with snow. The *Polar Sea* helicopter crew installed a dog-house AWS unit at Mount Siple.

The AWS program is currently supported by National Science Foundation grants DPP 88-21894 and DPP 90-15586. The British Antarctic Survey installs and services the AWS units in the Antarctic Peninsula area. Expeditions Polaires Francaises installs and services the AWS units along and inland from the Adelie Coast.

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Maximum and minimum temperature trends at McMurdo Sound Station

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We have obtained copies of daily surface weather observation sheets for McMurdo Sound Station, Antarctica from the National Climatic Data Center. These data span a 35-year period from March 1956 through October 1990. The data obtained lack 16 months during the last 3 years (1988-1990). These data sheets contain weather observations generally taken at 3-hour intervals and include sky condition, temperature, humidity, wind, pressure, and precipitation, as well as daily summaries of maximum and minimum temperature, precipitation, and peak wind. For this investigation, we took the daily maximum and minimum temperatures manually from either paper or microfiche and entered them into a desktop computer for analysis. We conducted extensive error checks on the digitized data before analysis; this included checks for consistency and outliers.

The monthly mean of the daily maximum and minimum temperatures at McMurdo Station between 1956 and 1990 are shown in figures 1 and 2, respectively. The greatest maximum and minimum temperatures occur in January, and the lowest maximum and minimum temperatures occur in August. Both the maximum and minimum temperatures vary more during the months without sunlight than during periods with sunlight; this

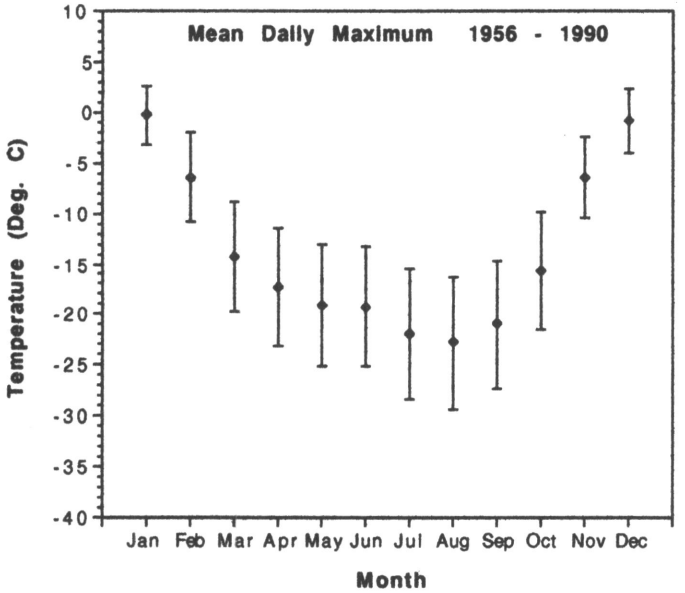

Figure 1. Mean daily maximum temperature by month between 1956 and 1990. *Error bars* indicate the standard deviation.

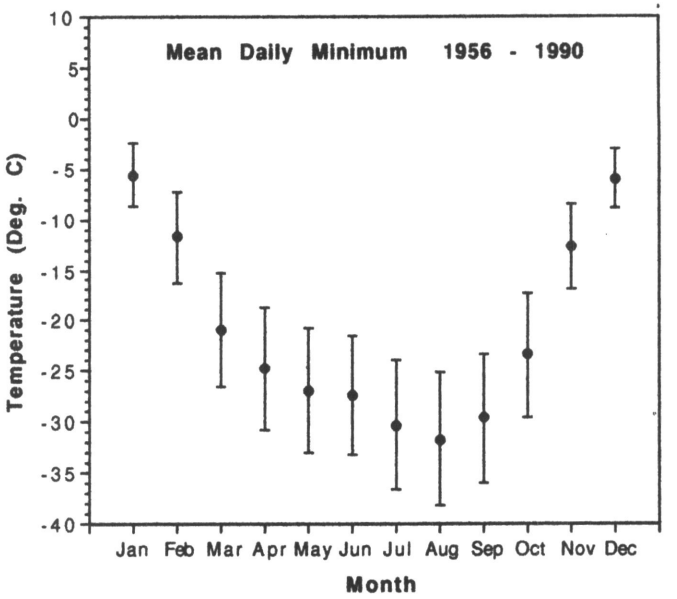

Figure 2. Mean daily minimum temperature by month between 1956 and 1990. *Error bars* indicate standard deviation.

finding is similar to that of Hanson (1990) for hourly and/or 3-hourly temperatures at the South Pole.

We examined long-term changes in maximum and minimum temperature at McMurdo for evidence of global warming. The time interval used in this analysis is from 1957 to 1987, the years for which we obtained complete temperature records. For each data set, we first averaged the temperatures for each year and then transformed them to temperature anomalies by subtracting the long-term average temperature from the period 1957-1980. Figure 3 is a plot of the maximum and minimum temperature anomalies for the 31-year period. These temperatures are positively correlated with a correlation coefficient of 0.81. Also shown on figure 3 are linear least squares regressions to the two data sets. The slope of these regression lines indicates the temperature trend over the period investigated. The trend of temperature minima is nearly zero with a temperature increase over this period of only 0.01 °C. The trend of temperature maxima has a strong positive slope with a temperature increase over this period of 1.51 °C.

The maximum and minimum temperature trends observed at McMurdo Station are the exact opposite of those in regional, mid-latitudes studies of maximum and minimum temperature climatology between 1950 and 1990 conducted by Karl et al. (1991). Karl et al. found that maximum temperatures over the past 40 years have been nearly constant while minimum temperatures have been increasing. The differences in these trends have been attributed to the role of atmospheric aerosols, which reduce the temperature at the surface during the day by scattering direct solar radiation but which have no effect on surface temperature at night. Although the McMurdo data are confounded with periods without a diurnal cycle, the increasing maximum temperature trend observed at McMurdo is consistent with the conclusions of Karl et al. since Antarctica is a pristine environment with low concentrations of atmospheric aerosols in the troposphere. The minimum temperature trend at McMurdo cannot be reconciled, since this is also expected to increase.

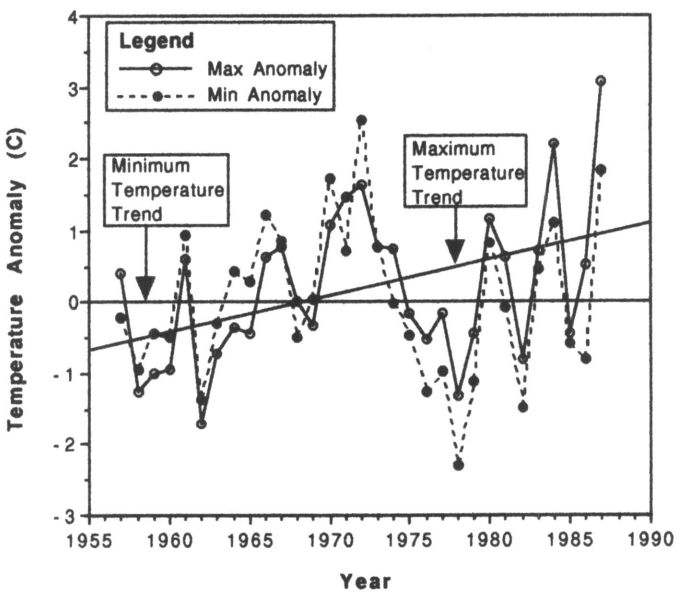

Figure 3. Annual average daily maximum and minimum temperature anomaly for McMurdo Sound Station, Antarctica, for 1957-1987. *Trend lines* are a linear regression to the respective data. All data were normalized to the average of 1957-1980.

We are grateful to Andy Ward for his careful work in exacting climatological data from copies of handwritten weather observation sheets and inputting the data to a computerized data base.

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