

Palmer LTER: 1997 seasonal air temperature in context

Karen S. Baker, *Marine Research Division, Scripps Institution of Oceanography,
University of California at San Diego*

Surface air temperature records, as a measure of climate variability, are an important ecological consideration. Palmer Station weather observations provide the opportunity to consider the impact of climate on the antarctic ecosystem. In this paper, we examine air temperature data for 1997 in the context of historical data from Palmer Station, which are available as monthly data from May 1974 and as daily data from mid 1989 (Baker 1996). The data are also presented in annual summary panels along with selected Palmer Long-Term Ecosystem Research (LTER) core measurements such as water temperature, nutrients, biomass, bio-acoustics and penguin foraging and events (Baker et al, this issue).

Although long-term weather observations are subject to both equipment and observer changes, related weather data collected contemporaneously provide independent information for quality assurance. Previous work has demonstrated the correlation of daily mean air temperatures observed at Palmer Station with those from a nearby automatic weather station (Baker et al, 1995). A close relationship has also been found between the air temperature at Palmer and the air temperature at the nearby British Antarctic Survey Faraday Station (Smith et al, 1996). Using data from 1989 to present, we found this relationship remains relatively unchanged:

$$T(\text{palmer})=1.16 + 0.97*T(\text{faraday})$$

with a correlation coefficient of 0.97. The linear regression shows how much warmer the temperature at Palmer is compared to the temperature at Faraday. For example, when the temperature at Faraday is 0° C, the temperature at Palmer is calculated to be 1.16° C. A harmonic fit was imposed on these data to capture the seasonal variation in the historical record (Baker, 1996).

Figure 1 shows the historical record of monthly mean temperatures in comparison to the mean harmonic fit to data from 1974 to 1998. Figure 2 shows the monthly data for the individual years 1991 through 1998, which is the period that the Palmer LTER sampling program has been in progress. Although the summer months vary within a narrow range, the winter months typically show variance as large as 7° C or more. The daily air temperature for 1997 and the monthly averages are shown in figure 3. For reference, the harmonic fit from 1974 to 1998 along with the harmonic fit from 1991 to 1998 are plotted. The nonlinear shift in the latter is noteworthy in that it displays the largest temperature increase in winter with smaller increases in spring and summer which is consistent with earlier observations (Smith et al. 1996).

Palmer Station 1997

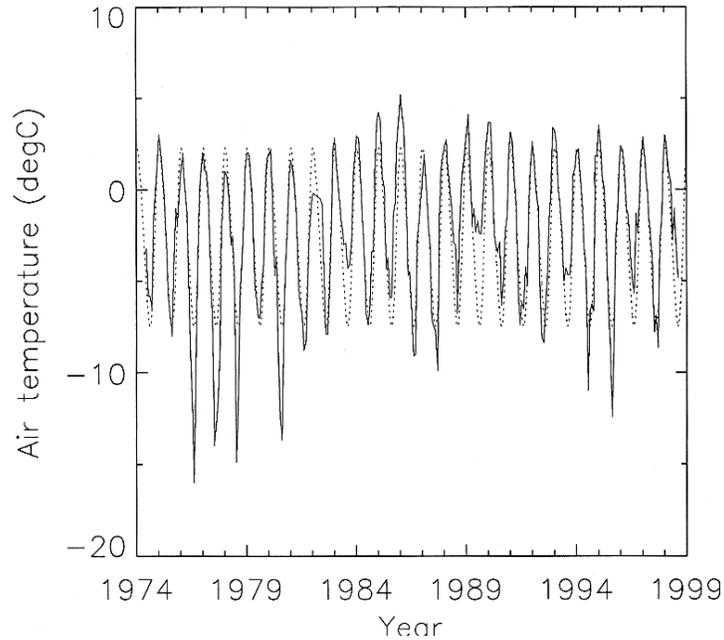


Figure 1: Monthly mean air temperature (° C) at Palmer Station versus time. The dotted curve shows the harmonic mean (1974-1997).

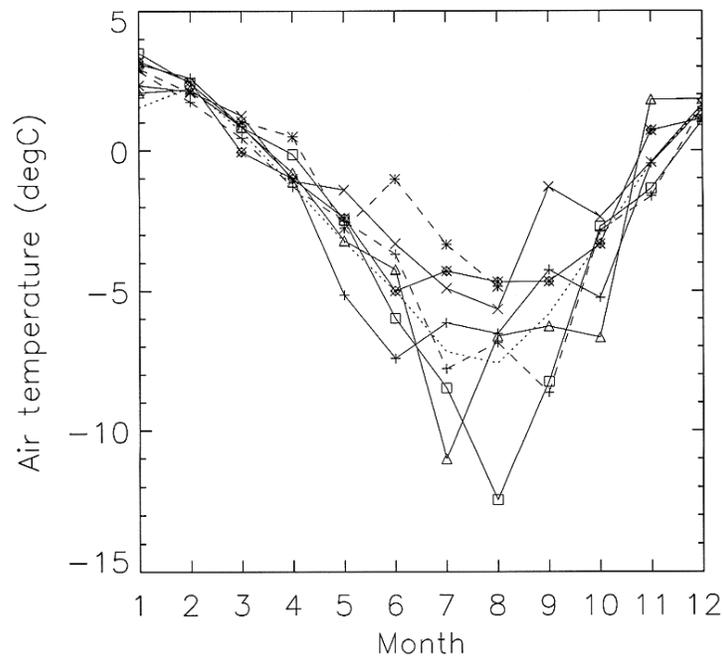


Figure 2: Monthly mean air temperatures (° C) at Palmer Station versus month for the years 1991 (plus, solid), 1992 (star, solid), 1993 (diamond, solid), 1994 (triangle, solid), 1995 (square, solid), 1996 (cross, solid), 1997 (plus, dashed), 1998 (star, dashed), and the mean air temperature over the period 1974-1998 (dotted line).

Air temperature and sea ice coverage (Stammerjohn et al., this issue) are two important indicators of major forcing functions for the antarctic ecosystem. Viewing each year's data with reference to historical averages provides a long-term context within which to interpret individual years or groups of years. Viewed within the context of the past 25 years, the Palmer LTER program, which began in 1990, has taken place during a time of relatively warmer air temperatures (figure 3).

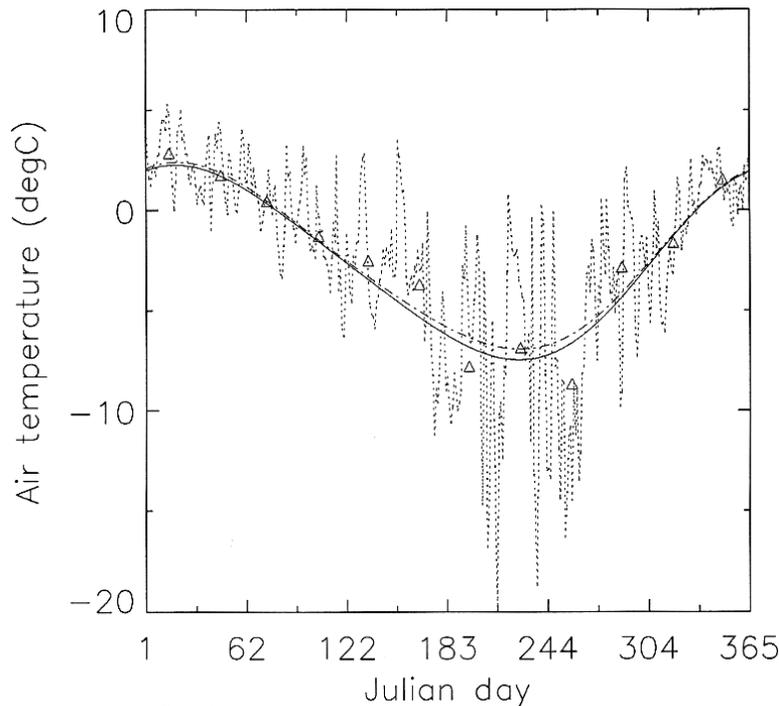


Figure 3: Palmer Station air temperature for 1997 for daily data (dotted line) as well as monthly mean (triangles) and mean air temperature harmonic fit for 1974-1998 (solid line) and for 1991-1998 (dash-dot line).

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References

- Baker, K.S., M. Vernet, W.A. Kozlowski, R.C. Smith, J.L. Jones, R.M. Ross, L.B. Quetin, and W.R. Fraser, (this issue). Palmer LTER: Annual Season October 1997-March 1998. *Antarctic Journal of the U.S.*
- Baker, K.S., 1996. Palmer LTER: Palmer Station air temperature 1974 to 1996. *Antarctic Journal of the U.S.*, 31(2), 162-164.

- Baker, K.S., S. Stammerjohn. 1995. Palmer LTER: Palmer station weather records. *Antarctic Journal of the U.S.*, 30(5), 257-258.
- Smith, R.C., S. E. Stammerjohn, and Karen S. Baker. 1996. Surface air temperature variations in the western Antarctic Peninsula region. In *Foundations for Ecological Research West of the Antarctic Peninsula*, R.M. Ross, E.E. Hofmann and L.B. Quetin (eds). AGU Antarctic Research Series, vol. 70:105-121.