Western Region Technical Attachment
89-08
March 7, 1989

THE COLD EPISODE CONTINUES

The December 1988 Climate Diagnostics Bulletin notes that the current "cold episode", or high Southern Oscillation Index, continues to be observed throughout the tropical Pacific Ocean. This situation, which displays tropical oceanic and atmospheric anomalies which are essentially opposite from those during an El Nino/Southern Oscillation (ENSO) episode, has dominated the tropical Pacific since this past spring, when last winter's ENSO event expired.

Figure 1 shows a time-longitude cross-section of sea surface temperature (SST) anomalies (averaged across latitudes 5°S to 5°N) since early 1986. The positive SST anomalies in the tropical eastern Pacific associated with the latest ENSO event are obvious, lasting from late 1986 until early 1988. These anomalies rapidly became negative during the spring of 1988 and have lasted into early 1989.

The reflection of these SST anomalies on convection, as inferred from satellite-derived outgoing longwave radiation (OLR), is shown in the Figure 2 time-longitude cross-section. Since OLR is relatively low in tropical convective areas (the cold cloud tops emit less radiation), the OLR fields are considered good indicators of time-averaged tropical weather regimes. During the ENSO episode, convection was greater than normal where the equatorial waters were warmer than normal, resulting in an OLR minimum. As the positive SST anomalies abated, the negative OLR anomalies also diminished. During 1988, when the waters were cooler than normal, the OLR anomalies have been greater than normal, indicating the suppression of cloudiness throughout the eastern equatorial Pacific.

Tropospheric circulation at 850 mb and 200 mb (Figures 3a,b) as of December 1988 are also opposite in phase to those which occur during an ENSO event. At 850 mb, anomalous easterlies exist in the tropical eastern Pacific, supporting the colder than normal water temperatures with increased near-equatorial upwelling. At 250 mb, the tropical Pacific westerlies are greater than normal. This is not surprising, since it is typical for the 250 mb zonal wind anomaly to be in the opposite direction of the 850 mb zonal wind anomaly. Subtropical easterly anomalies in both hemispheres at 250 mb contrast strongly the subtropical westerly anomalies which were observed during most of 1987 (in the midst of the ENSO event; figure not shown).

It should be clear that there is a strong coupling between the oceanic and atmospheric anomalies which have existed during this past warm (ENSO) event/ cold event sequence. Numerous journal articles (i.e., Bjerknes, 1969; Kousky, et al., 1984; Wright, 1985) have previously discussed this coupling; the examples shown above also show the ocean-atmosphere relations quite clearly.

Over the past decade, there has also been a great deal of concentration on the effects of an ENSO event on the general circulation. Some of this work has found application in long range forecasting, especially during the winter season. At this point, not a lot is known about the impact of cold events on circulation anomalies. Recent work by Trenberth, et al. (1988) suggests that cold events may also impact the circulation, even to the point of contributing to the 1988 drought. However, this work is quite preliminary. We are likely to hear much more about this subject over the next few years.

References:

Bjerknes, J., 1969: Atmospheric Teleconnections from the Tropical Pacific. Mon. Wea. Rev., **97,** 163-172.

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Trenberth, K.E., G.W. Branstator and P.A. Arkin, 1988: Origins of the 1988 North American Drought. Accepted in Science.

Wright, P.B., 1985: The Southern Oscillation: An Ocean-Atmosphere Feedback System? Bull. Amer. Meteor. Soc., **66,** 398-412.

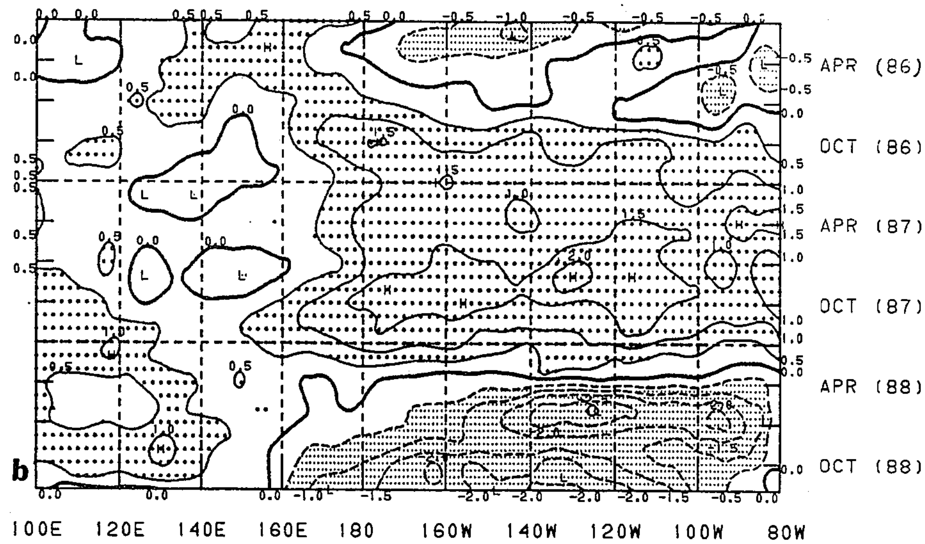

Figure 1. Time-longitude section of sea surface temperature (SST) anomalies for $5^{o}S$-$5^{o}N$. Contour interval is $0.5^{o}C$. SST anomalies less than $-0.5^{o}C$ are shaded; anomalies greater than $0.5^{o}C$ are stippled (from CAC, 1988).

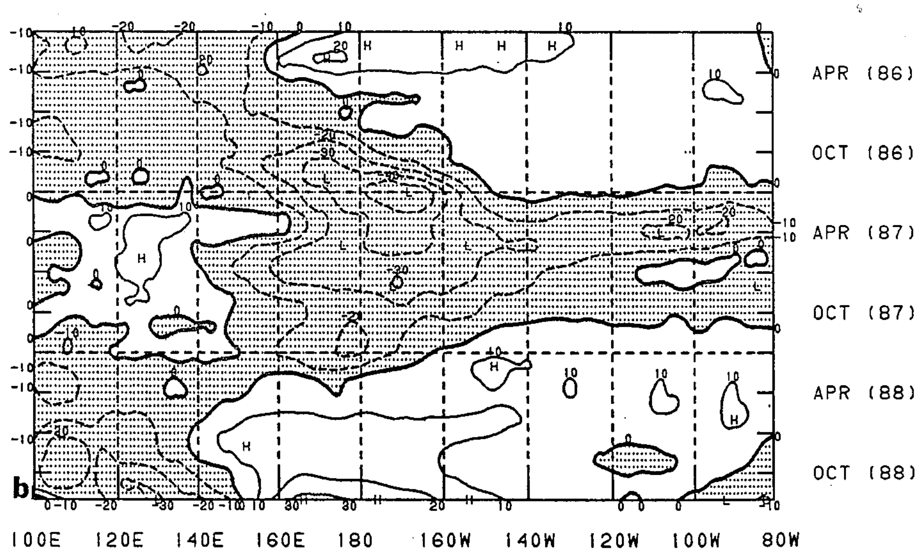

Figure 2. As in figure 1, except for outgoing longwave radiation (OLR) anomalies. Contour interval is 10 Wm^{-2}. Negative OLR anomalies are shaded (from CAC, 1988).

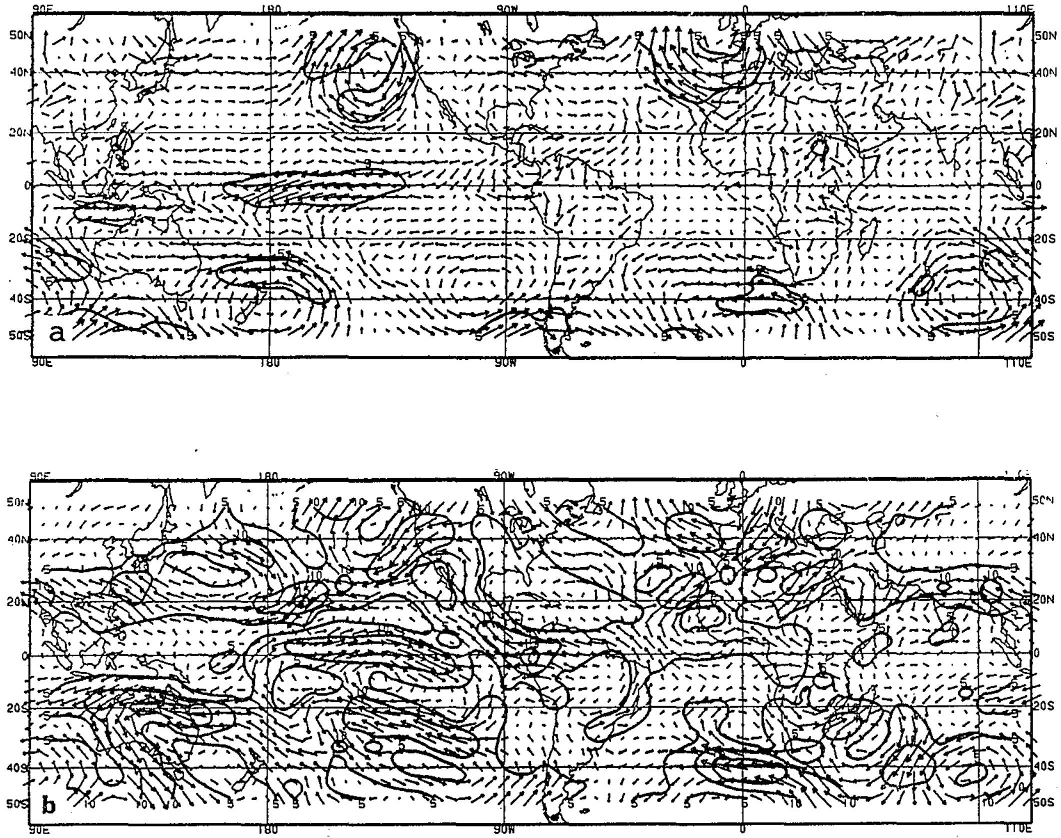

Figure 3. Vector wind anomalies at a) 850 mb and b) 250 mb for December 1988. Vector length of 5^{o} represents anomalous wind speed of 6.25 ms^{-1}. Contour interval for isotachs is 5 ms^{-1} (from CAC, 1988).