Western Region Technical Attachment
No. 90-09
March 6, 1990

EL NINO/SOUTHERN OSCILLATION (ENSO)

CLIMATIC ANALYSIS CENTER/NMC

[Editor's Note: The following Technical Attachment is a Diagnostic Advisory on the El Nino/Southern Oscillation (ENSO) situation, issued by the Climate Analysis Center of NMC. Since this advisory has already been released to the press, offices may be receiving increasing numbers of questions on ENSO.]

During the last several months, conditions in the tropical Pacific have once again been evolving towards a warm episode. Sea surface temperature (SST) anomalies have increased and low-level easterlies have decreased in the central equatorial Pacific. In January 1990, equatorial sea surface temperatures reached 0.5-1.0°C above normal in the vicinity of the date line. However, sea surface temperature anomalies in the eastern equatorial Pacific remained near or slightly below zero.

In a remarkable reversal from the warmer than normal sea surface conditions that occurred during 1986-87, below normal sea surface temperatures developed in mid-1988 and continued until early 1989. This reversal in the sign of sea surface temperature anomalies, which is a feature of the Southern Oscillation, was accompanied by changes in tropical and extratropical atmospheric circulation and precipitation that affected diverse sections of the globe.

In January 1990, for the first time since early 1988, the 28.5°C isotherm of sea surface temperature, considered to be the threshold temperature for the onset of strong convection, shifted east of the data line (Fig. 1). The depth of the 20°C isotherm, an index for the depth of the oceanic thermocline (the boundary between the warm well-mixed surface layer and the deep cold water in the ocean), has been deeper during the last few months in the central Pacific than it was at any time during the 1985-1989 period (Fig. 2). There was a fairly steady increase in the depth of this isotherm in the central and western equatorial Pacific from early 1988 through mid-1989, and a more gradual deepening during the last few months. The reservoir of warm water in the upper layer of the equatorial ocean in January 1990 is at least as great as that observed prior to the 1986-87 warm episode.

Since November, convective activity, as indicated by the outgoing longwave radiation (OLR) measured from the NOAA-11 polar-orbiting satellite, has increased and become stronger than normal in the region of the anomalously warm water in the central equatorial Pacific (Fig. 3). This is the first time since the latter stages of the 1986-87 warm episode that enhanced convection has developed in this region.

Consistent with the above changes in the patterns of sea surface temperature and tropical convection in the western and central equatorial Pacific, low-level (850 mb) equatorial easterly anomalies, which characterized the cold episode, have been

replaced by westerly anomalies during the last three months (Fig. 4). There have been several periods when actual westerlies were observed west of 180° longitude. A period of rather strong westerlies occurred in the western equatorial Pacific from mid-November to mid-December 1989. Westerlies in the western and central equatorial Pacific initiate oceanic Kelvin waves which propagate eastward towards the South American coast. These waves depress the oceanic thermocline, which in regions of strong oceanic upwelling results in higher sea surface temperatures. Kelvin waves initiated at that time began to reach the South American coast in late January. The increased depth of the thermocline associated with those waves is evident in Fig. 2. Recent observations from stations along the South American coast indicate that sea surface temperatures were rising during the last few days of the month.

The features described above have been observed during the onset of some warm episodes. However, most of the ENSO prediction models are indicating near normal conditions for the next several months. Given 1) that it has been nearly four years since the last warm episode, 2) that there has been a considerable build up in the volume of warm water in the equatorial zone, and 3) that low-level easterlies have weakened and convective activity has increased considerably in the central equatorial Pacific, the current situation deserves very close attention. The Climate Analysis Center will continue to monitor this situation and provide new information as it becomes available.

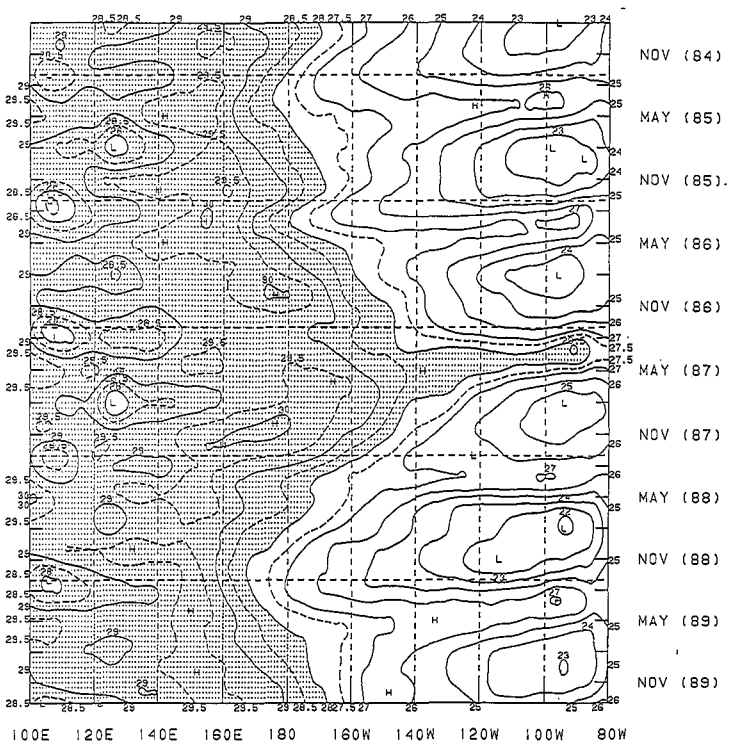

FIGURE 1 Time-longitude section of monthly sea surface temperature averaged over the latitude band 5°N-5°S. Contour interval is 1°C, with intermediate contours drawn for temperatures above 27°C. Sea surface temperature values greater than 28°C are shaded.

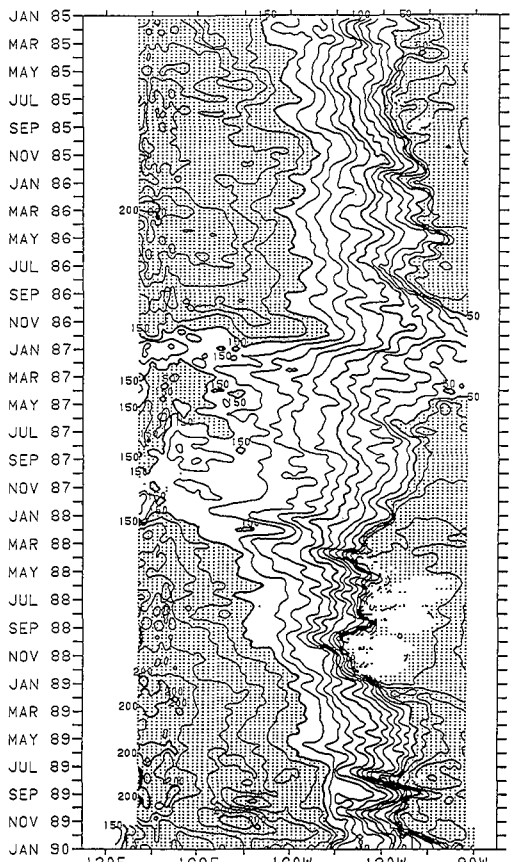

FIGURE 2 Time longitude section of the depth of the 20°C isotherm along the equator in the Pacific Ocean. The contour interval is 10 m with shading for values less than 50 m and for values greater than 150 m.

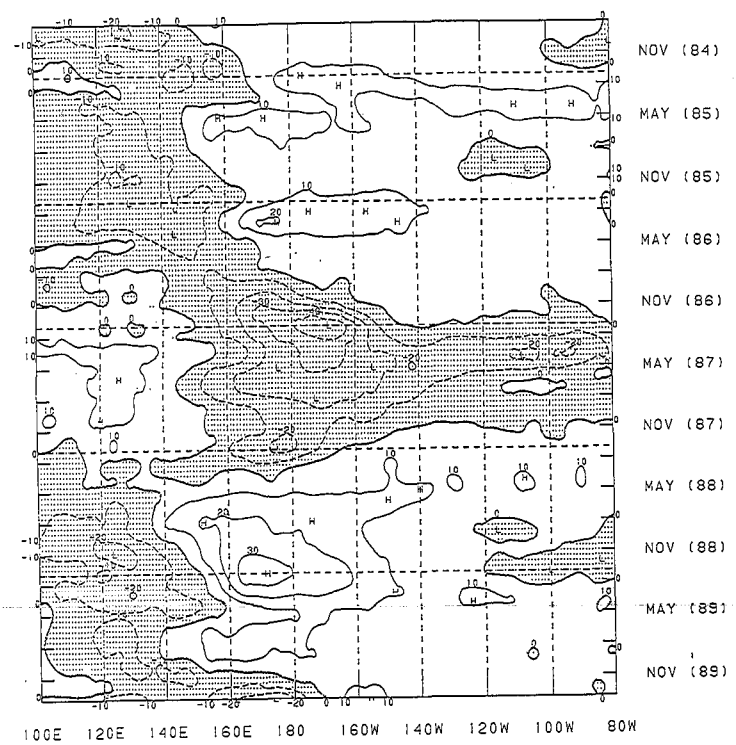

FIGURE 3 Time-longitude section of monthly outgoing longwave radiation anomalies averaged over the latitude band 5°N-5°S. Negative anomalies (shaded values) indicate stronger than normal convection. Contour interval is 10 Wm^{-2}.

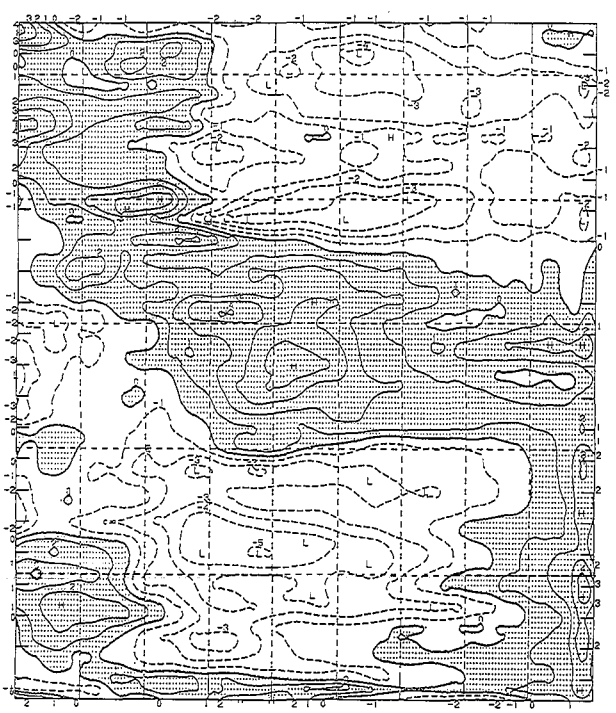

FIGURE 4 Time-longitude section of monthly 850 mb zonal wind anomalies averaged over the latitude band 5°N-5°S. Negative anomalies (anomalous flow from the east) are indicated by dashed lines and positive anomalies (anomalous flow from the west) are shaded. Contour interval is 1 ms^{-1}.