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EL NINO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC ADVISORY 86/2

Editor's Note: The following article on the potential for a 1986 ENSO episode was taken from the February 1986 Climate Diagnostics Bulletin. It should provide forecasters, public service units, and station managers with sufficient background information to discuss this subject with the news media and other interested parties, and to answer the many questions that will undoubtedly arise.

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1. CURRENT SITUATION

Routine monitoring of climatic conditions in the tropical Pacific shows that for the first time since the major 1982/83 El Niño/Southern Oscillation (ENSO) episode, the pattern of sea surface temperature (SST) anomalies in the eastern tropical Pacific is evolving in a manner resembling the incipient stage of an El Niño event. Specifically, ship and satellite observations over the waters west of Peru indicate that SSTs in that region have gradually changed from below normal values in late 1985 to above normal in January and February, 1986. In February, this region of above normal temperatures expanded northward, then westward along the equator to around 120°W. While the SST anomalies are still relatively small, their rate of increase during the past few months, in both magnitude and areal coverage (See Figs. A22 and A23), is worthy of note. As can be seen from Fig. A19, a sharp upward trend in anomalies between OCT/NOV and the following JAN/FEB along the shipping lane which parallels the Peru coast is characteristic of El Niño years. Satellite observations indicate that during February, rainfall was also above normal south of the equator, over the region of above normal SST.

While these conditions were observed west of Peru, data from two northern Peruvian coastal stations showed sharp upward trends in SST anomalies to positive values in January and February. At Talara (4.6°S) SST changed from near normal in January to 2.4°C above normal in February. At coastal stations farther south, SST remained near or below normal. Although periods of heavy rainfall have been observed over the southern interior during the past two months, the typical El Niño pattern of recurrent heavy rains in the desert regions of northwest Peru had not developed by the end of February.

These changes in eastern Pacific SST reflect a slow but consistent evolution of the SST pattern across the entire equatorial Pacific during the past 2 years. Viewed on an even larger scale, the associated global Southern Oscillation surface seesaw in pressure between the Australian-Indonesian region and the southeast Pacific also swayed during February in a direction consistent with the development of an ENSO episode, i.e., an increase in the pressure gradient driving westerly wind anomalies. At Darwin, Australia, which is representative of the western end of the pressure seesaw, surface pressure averaged above normal during February. At the opposite end, the key southeast Pacific index station at Tahiti, French Polynesia, showed a sharp fall in pressure. The above normal pressure at Darwin was accompanied by below normal rainfall over large portions of Australia and, based on satellite observations, over western Indonesia and Malaysia.

In the western equatorial Pacific, between 150°-170°E, anomalously high SSTs have developed during the past few months. Ocean surface temperatures in this region are normally quite high, but current SSTs, which have reached levels near 86°F (30°C, more than 1°C above normal), are rarely exceeded. There are indications that this area of positive SST anomalies has migrated slowly and irregularly eastward during the past few months. As this took place, anomalous westerly surface winds developed to the west of the area of warmest water. These features are also consistent with the early stages of an ENSO episode.

While these developments are positive indicators of an event, other important oceanic features often associated with the initial stages of an ENSO episode are not yet in evidence. In particular, the subsurface thermal structure and sea-level slope across the equatorial Pacific do not appear to be far from normal at this time.

2. ENSO EPISODES

El Niño is an anomalous warming of the eastern equatorial Pacific that takes place at irregular intervals of 2-7 years and lasts for 1-2 years. The Southern Oscillation is a global-scale seesaw in surface pressure with centers of action around Indonesia-North Australia and the southeast Pacific. The two phenomena were discovered and for decades studied as separate entities. However, in 1969 Professor Jacob Bjerknes of UCLA showed that the two phenomena are simply parts of a single elegant and pervasive global system of climate fluctuations.

The ENSO phenomenon is the most notable and pronounced example of year-to-year global climate variability. A major ENSO episode, such as that which occurred during 1982/83, leads to massive dislocations of the rainfall regimes of the tropics, bringing drought to vast areas and torrential rains to otherwise arid regions. The related atmospheric circulation anomalies extend deep into the extratropics, where they are associated with unusual wintertime conditions over regions as far apart as the United States and New Zealand. Because ENSO is global in nature, a strong occurrence leads to the nearly simultaneous appearance of severe climatic conditions over a variety of regions around the world, as well as major disruptions of the marine ecosystems along the west coast of South and sometimes North America.

Individual ENSO episodes generally follow a similar evolution over a period of 18-24 months. The anomalous ocean warming in the Pacific normally begins near the Ecuador-Peru coast early in the year, then spreads westward into the central equatorial Pacific. The coastal warming usually peaks during April-June, but the warming in the central equatorial Pacific normally continues for several more months, as the high SSTs of the western Pacific spread eastward. The global atmospheric climate anomalies are most widespread and intense near the end of the first year and during the early months of the second year of the episode, i.e., during the Northern Hemisphere cold season. This period, approximately one year following the initial appearance of warm water in the eastern Pacific, is often referred to as the "mature phase" of the episode. Following the mature phase, the anomaly patterns enter a period of decay that usually spans several months.

Although most ENSO episodes follow a generally similar evolution, each occurrence has a personality of its own, with individual episodes differing in both strength and behavior. For example, the 1982/83 episope was slow in developing, and had a rather unusual evolution. In the end, however, it developed into the most intense episode of the century. The 1972 ENSO was rather typical, except for its unusually devastating effect on the Peruvian Anchovetta fishery. In contrast, what appeared to be an incipient El Niño development in the eastern Pacific in early 1975 aborted abruptly between

February and April, but was subsequently followed by a moderate ENSO episode in 1976.

During unusual episodes, regional climate anomalies can also depart substantially from the "normal" El Niño pattern. In some areas, such as California, the ENSO response, while often quite pronounced, varies markedly from episode to episode. During the 1982/83 winter, east Pacific storms were displaced hundreds of kilometers south of their normal path, bringing strong winds, heavy rainfall and high tides to the California Coast. In contrast, California remained in the throes of a severe drought during the 1976-77 episode.

3. EVALUATION AND OUTLOOK

The developing pattern of climate anomalies in the tropical Pacific is in many ways consistent with the early stages of an ENSO episode. Therefore, it seems prudent to call attention to the possibility of such a development during 1986.

There are a variety of techniques under development for prediction of ENSO. Some of these give positive indications of a 1986 episode. For example, a series of experimental forecasts for research purposes produced by Drs. Mark Cane and Stephen Zebiak of Lamont-Doherty Geological Observatory, Columbia University, using a coupled ocean-atmosphere model of the tropical Pacific gives an unambiguous forecast of a moderate El Niño event during 1986. A Climate Analysis Center statistical model based on the SST change from October through February west of Peru, indicates a high probability of an ENSO episode this year. Other experimental prediction techniques developed by experts in this area give more ambiguous results at this time. Therefore, no consensus yet exists in the U.S. scientific community on the likelihood of a 1986 ENSO episode.

The situation should be clarified during the next 2-4 months. During this period NOAA will provide data and information needed to evaluate developments. The Climate Analysis Center will continue to closely monitor conditions in the equatorial Pacific and provide early dissemination of information on the evolving anomaly patterns through its monthly Climate Diagnostics Bulletin.

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