EL NIÑO/LA NIÑA

The El Niño/Southern Oscillation (ENSO) refers to the fluctuations in both sea surface temperatures (SSTs) in the eastern equatorial Pacific and in sea-level pressures in the southern Pacific at time scales of two to seven years. El Niño develops off the western coast of South America when ocean currents and winds shift, bringing warm water westward, displacing the nutrient-rich cold water that normally wells up from deep in the ocean (Figure 1). La Niña is the counterpart of El Niño and represents the other extreme of the ENSO cycle (Figure 2). In this event, the sea surface temperatures in the equatorial Pacific drop well below normal levels and advect to the west while trade winds are intense rather than weak.

El Niño and La Niña are disruptions of the ocean-atmosphere system that have important consequences for weather around the globe. Many researchers are studying the relationships between ENSO (and La Niña) events and weather anomalies to determine where links exist. In some regions, the teleconnections between climate and ENSO have been thoroughly investigated and established. In others, the relationship is still being researched to learn more about how ENSO cycles affect regional weather anomalies.

In the United States, the impacts of El Niño are most dramatic in the winter. El Niño produces winters that are generally mild in the Northeast and central United States and wet over the South from Florida to Texas. This might be a result of the forcing caused by a Pacific–North American (PNA) pattern that is typified by a high-pressure ridge over northwestern North America and a low pressure trough in the southeastern United States. This serves as an upper-level steering mechanism for moisture and temperature changes at the surface. Once the pattern is entrenched, regions under the ridge can expect little in the way of precipitation while those in the trough can't turn it off and are prone to frequent flooding. Research on North American precipitation and temperature patterns associated with ENSO conditions show that in the southeastern United States, above-normal precipitation was recorded for 81% of the cases for the "season" that began in October of the El Niño year and concluded in March of the following year.

The influence of La Niña on weather patterns in the Southeast is not as well-documented. According to some researchers, 10 of the 13 La Niña events examined experienced dry Palmer Drought Severity Index anomalies indicating below normal precipitation for parts of the Gulf of Mexico region; however, the area including South Carolina showed no statistical signal. Despite the lack of referenced literature or conclusive analysis on the impact of La Niña on the southeastern United States rainfall, many climatologists and forecasters attribute the 1998-2002 Southeast drought to the La Niña. This is supported by the timing of the drought corresponding to the La Niña. The continuation of the drought into 2002, however, does not correspond given that the La Niña ended in mid-2001 and the drought lasted into late summer 2002.

The strongest El Niño on record occurred during late 1997 through early 1998. This El Niño was responsible for the very wet conditions in the Southeast including the second wettest winter on record for South Carolina. The very wet fall of 2002 and winter 2003 that almost completely alleviated the four-year drought in five months corresponded to the return of the El Niño.

References:

National Drought Mitigation Center

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Ropelewski, C.F., and M.S. Halpert, North American Precipitation and Temperature Patterns Associated with the El Niño–Southern Oscillation (ENSO), *Monthly Weather Review,* 114, 2352–2362, 1986.

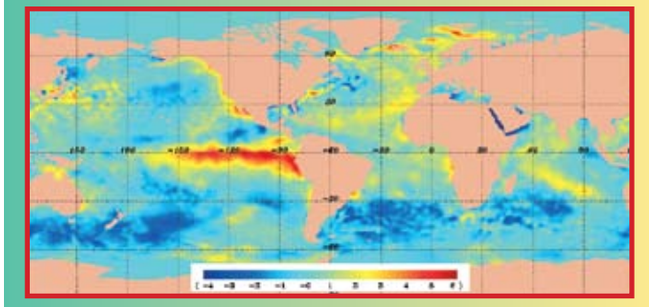


*Figure 1: Sea Surface Temperature Anomaly Map obtained from Fleet Numerical Meteorology and Oceanography Center showing warm (red) sea surface temperatures in the equatorial Pacific during 1997-1998 El Niño event.

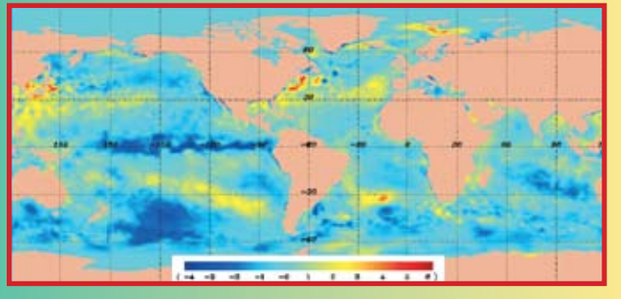
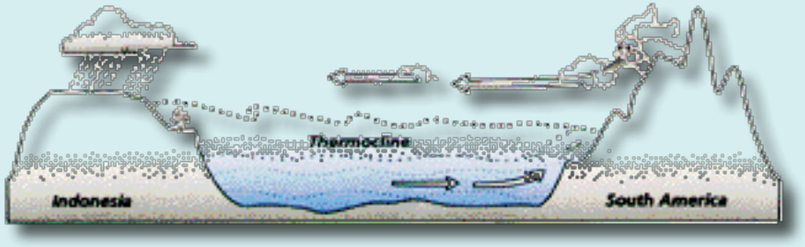


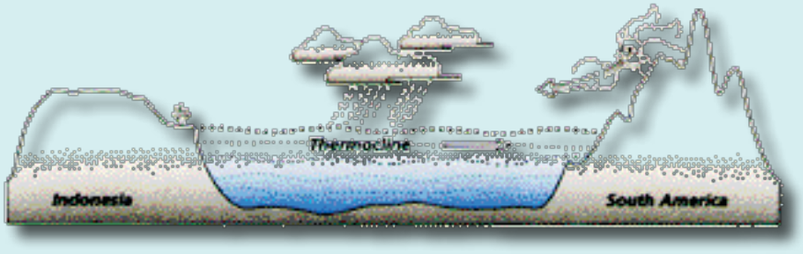
*Figure 2: Sea Surface Temperature Anomaly Map obtained from Fleet Numerical Meteorology and Oceanography Center showing cool (blue) sea surface temperatures in the equatorial Pacific during 1998-2001 La Niña event.

Normal Conditions



Normally, strong trade winds blow from the east along the equator, pushing warm water into the Pacific Ocean. The **thermocline** layer of water is the area of transition between the warmer surface waters and the colder water of the bottom. Because the trade winds push surface water westward toward Indonesia, the sea level is roughly half a meter higher in the western Pacific than in the east. Thus you have warmer, deeper waters in the western Pacific and cooler, shallower waters in the east near the coast of South America.

El Niño Conditions



An El Niño condition results from weakened trade winds in the western Pacific Ocean near Indonesia, allowing piled-up warm water to flow toward South America. The different water temperatures of these areas affect the types of weather these two regions experience. Moreover, the Earth's atmosphere responds to the heating of El-Niño (or cooling of La Niña) by producing patterns of high and low pressure that can have a profound impact on weather around the globe.

*Graphics provided by NASA