DOCUMENTOS VARIOS

*NOAA / PMEL / TAO Project Office / **El Nino Theme Page***

El Nino Theme Page: Frequently Asked Questions about El Nino

Linking El Nino related data from distributed research institutes.

1. What is an El Nino?

- NOAA Reports to the Nation - El Nino and Climate Prediction
- El Nino instructional module from The Daily Planet
- About El Nino from The Australian Bureau of Meteorology
- What is El Nino? from USA Today
- El Niño and the Southern Oscillation: A Reversal of Fortune
- Southern Oscillation Index: *a good explaination*
- El Nino Scenario
- In sea level measured by the TOPEX/POSEIDON satellite
- In the tropical Pacific Ocean measured by the TAO buoy network
- In CO2 Fluxes in the tropical Pacific
- In the Indian Ocean: *articles from the AGU and Scripps press release*
- In climate anomalies in the US
- In climate anomalies in Florida
- Dial-a-Scientist Studying El Nino

2. Why does El Nino occur?

El Nino results from interaction between the surface layers of the ocean and the overlying atmosphere in tropical Pacific. It is the internal dynamics of the coupled ocean-atmosphere system that determine the onset and termination of El Nino events. The physical processes are complicated, but they involve unstable air-sea interaction and planetary scale oceanic waves. The system oscillates between warm (El Nino) to neutral (or cold) conditions with a natural periodicity of roughly 3-4 years. External forcing from volcanic eruptions (submarine or terrestial) have no connnection with El Nino. Nor do sunspots as far as we know.

3. How often does El Nino occur?

El Nino's usually occur irregularly, approximately every two to seven years. Look at the CAC SST Anomalies for the Eastern Equatorial Pacific Ocean. The region named "Nino 3", which is 150W to 90W, 5N to 5S. The El Nino years 1976-1977, 1982-1983, 1986-1987, and 1991-1994 are distinguished by large SST anomalies. The first half of the 1990's is unusual in that the past four years have all been unusually warm in the equatorial Pacific. See The 1990-1995 El Nino-Southern Oscillation event: Longest on record. Kevin E. Trenberth and Timothy J. Hoar. Geophysical Research Letters, Vol. 23, No. 1, pp 57-60. January 1, 1996. and The Record Setting 1990-95 El Nino: Harbinger of a Changing Climate? UCAR News Release, 5 January 1996. Here is a list of El Nino and La Nina years.

4. Are all El Nino's the same?

Every El Nino is somewhat different in magnitude and in duration. The graphs in the on-line ENSO Montitor, show El Nino's from 1982 to the present, including the 1982-1983 El Nino, ENSO Montitor, show El Nino's from 1982 to the present, including the 1982-1983 El Nino, which is the largest El Nino of this century.

A longer historical perspective is available in plots of the CAC SST Anomalies for the Eastern Equatorial Pacific Ocean, in the region named " Nino 3", which is 150W to 90W, 5N to 5S. The El Nino in 1982-1983 was far larger in SST anomalies than those in 1976, 1987, and 1991.

In a plot of Sea Surface Temperature along the Equator from 1986-present, you can see that warm water (red) penetrated further to the East in the 1986 El Nino than it did during the 1991-1993 El Nino's.

5. Do El Nino events occur only in the Pacific Ocean?

The great width of the Pacific Ocean is the main reason we see El Nino Southern Oscillation (ENSO) events in that ocean as compared to the Atlantic and Indian Oceans. Most current theories of ENSO involve planetary scale equatorial waves. The time it takes these waves to cross the Pacific is one of the factors that sets the time scale and amplitude of ENSO climate anomalies. The narrower width of the Atlantic and Indian Oceans means the waves can cross those basins in less time, so that ocean adjusts more quickly to wind variations. Conversely, wind variations in the Pacific Ocean excites waves that take a long time to cross the basin, so that the Pacific adjusts to wind variations more slowly. This slower adjustment time allows the ocean-atmosphere system to drift further from equilibrium than in the narrower Atlantic or Indian Ocean, with the result that interannual climate anomalies (e.g. unusually warm or cold SSTs) are larger in the Pacific.

There is another way in which the width of the Pacific allows ENSO to develop there as compared to the other basins. In the narrower Atlantic and Indian Oceans, bordering land masses influence seasonal climate more significantly than in the broader Pacific. The Indian Ocean in particular is governed by monsoon variations, under the strong influence of the Asian land mass. Seasonally changing heat sources and sinks over the land are associated with the annual migration of sun. Heating of the land in the summer and cooling of the land in the winter sets up land-sea temperature contrasts that affect the atmospheric circulation over the neighboring ocean. This land influence competes with ocean and atmosphere interactions which are essential for generating ENSO.

6. What is a La Nina?

La Nina is characterized by unusually cold ocean temperatures in the equatorial Pacific, as compared to El Nino, which is characterized by unusually warm ocean temperatues in the equatorial Pacific. Global climate anomalies associated with La Nina tend to be opposite those of El Nino. La Nina is also sometimes called El Viejo.

At higher latitudes, El Nino is only one of a number of factors that influence climate. However, the impacts of El Nino and La Nina at these latitudes are most clearly seen in wintertime. In the continental US, during El Nino years, temperatures in the winter are warmer than normal in the North Central States, and cooler than normal in the Southeast and the Southwest. During a La Nina or El Viejo year, winter temperatures are warmer than normal in the Southeast and cooler than normal in the Northwest. You can see this graphically in plots of anomalies of temperature and precipitation in El Nino and La Nina years from Florida State University. An El Nino anomaly is the value normally observed subtracted from the value in an El Nino year.

7. What is the current El Nino Forecast or Advisory?

The Climate Analysis Center at the U.S. National Meteorological Center provides an El Nino Advisory, which is updated every month. They also publish a monthly Climate Diagnostics Bulletin. See http://www.pmel.noaa.gov/toga-tao/el-nino/forecasts.html for links to El Nino advisories from several forecasting centers located throughout the world.

Realtime Pacific Ocean data from the NOAA network of moored buoys is updated daily to show the current conditions in the Equatorial Pacific Ocean.

8. What is the present climate in different countries in the world?

The Climate Analysis Center at the U.S. National Meteorological Center provides up to date Reginal Climate Monitoring information from many parts of the world.

The National Climatic Data Center (NCDC) publishes the monthly CLIMATE VARIATIONS BULLETIN, which puts current monthly climate anomalies into historical perspective using climate databases archived at the NCDC. Supplemental sections are included which address seasonal and annual perspectives, when appropriate.

The Climate Prediction Center issues special climate summaries which monitor current and developing climate variations. For example, El Nino winter impacts, such as California flooding and Eastern North American climate, and their relation to El Nino (ENSO) are described for 1995.

9. How do we detect El Nino's?

In the tropical Pacific Ocean, El Nino's are detected by many methods, including satellites, moored buoys, drifting buoys, sea level analysis, and XBT's. Many of these in situ ocean observing systems are part of the Tropical Ocean Global Atmosphere (TOGA) program. Large computer models of the global ocean and atmosphere, such as those at the National Centers for Environmental Prediction are used to predict El Nino. Others are used for El Nino research, such as those at NOAA's Geophysical Fluid Dynamics Laboratory. El Nino research is also conducted at the Center for Ocean-Land-Atmosphere Studies.

10. What is the relationship between hurricanes and El Nino?

It is believed that El Nino conditions suppress the development of tropical storms and hurricanes in the Atlantic; and that La Nina (cold conditions in the equatorial Pacific) favor hurricane formation. The world expert in this area of study is Prof. Bill Gray of Colorado State University. Please see their Web pages, including Frequently asked Questions about Hurricanes, Typhoons and Tropical Cyclones, from the Tropical Meteorology Project at Colorado State University. They also maintain Web pages on Forecasts (Hurricanes, ENSO, African Sahel Rainfall, etc.). The effect of El Nino on US landfalling hurricanes is described in Web Pages maintained by COAPS at FSU. Other effects of El Nino (ENSO) on climate are detailed in the Impacts of El Nino Web pages.

11. What are some sources of information about El Nino and Global Climate Change Research?

- The US Global Change Research Program seminars on climate topics.
- Our Changing Planet: The FY 1998 Global Change Research Program - *a report to Congress*
- Links to Climate-Related Web Sites *from NOAA's Office of Global Programs*
- *from the NOAA Central Library*
  - Bibliographies on El Niño
  - El Niño Publications from the International Forum on Forecasting

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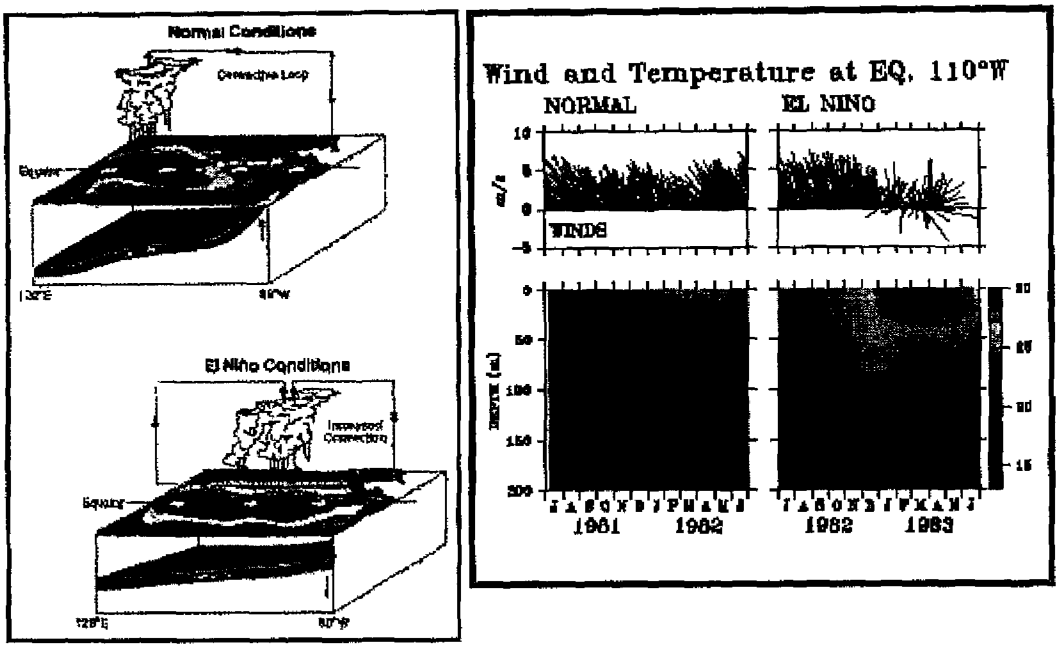
What is an El Nino?

Illustrated with realtime graphics from the TAO array of moored buoys in the Equatorial Pacific Ocean. For more information, see the El Nino Theme Page.

Normal and El Nino conditions in the tropical Pacific Ocean



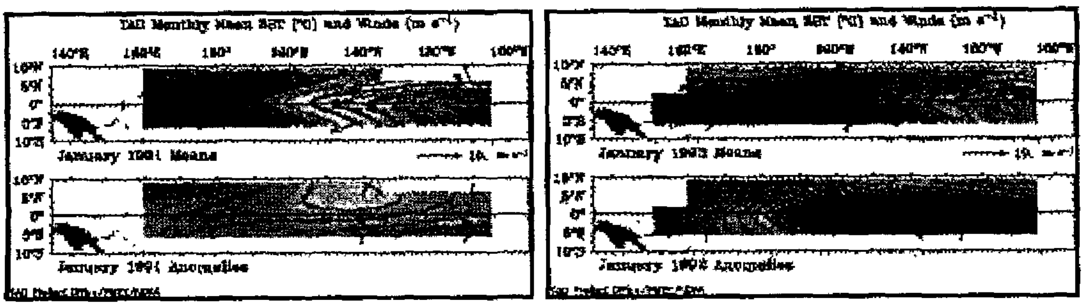
(a)Schematic diagram of normal and El Nino conditions in the Pacific Ocean, and (b) wind and temperature on the Equator at 110W

El Nino is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe. Among these consequences are increased rainfall across the southern tier of the US and in Peru, which has caused destructive flooding, and drought in the west Pacific, sometimes associated with devastating brush fires in Australia. Observations of conditions in the tropical Pacific are considered essential for the prediction of short term (a few months to 1 year) climate variations. To provide necessary data, NOAA operates a network of buoys which measure temperature, currents and winds in the equatorial band. These buoys daily transmit data which are available to researchers and forecasters around the world in real time.

In normal, non-El Nino conditions (top panel of schematic diagram), the trade winds blow towards the west across the tropical Pacific. These winds pile up warm surface water in the west Pacific, so that the sea surface is about 1/2 meter higher at Indonesia than at Ecuador. The sea surface temperature is about 8 degrees C higher in the west, with cool temperatures off South America, due to an upwelling of cold water from deeper levels. This cold water is nutrient-rich, supporting high levels of primary productivity, diverse marine ecosystems, and major fisheries. Rainfall is found in rising air over the warmest water, and the east Pacific is relatively dry. The observations at 110 W (left diagram of 110 W conditions) show that the cool water (below about 17 degrees C, the black band in these plots) is within 50m of the surface.

During El Nino (bottom panel of the schematic diagram), the trade winds relax in the central and western Pacific leading to a depression of the thermocline in the eastern Pacific, and an elevation of the thermocline in the west. The observations at 110W show, for example, that during 1982-1983, the 17-degree isotherm dropped to about 150m depth. This reduced the efficiency of upwelling to cool the suface and cut off the supply of nutrient rich thermocline water to the euphotic zone. The result was a rise in sea surface temperature and a drastic decline in primary productivity, the latter of which adversely affected higher trophic levels of the food chain, including commercial fisheries in this region. The weakening of easterly tradewinds during El Nino is evident in this figure as well. Rainfall follows the warm water eastward, with associated flooding in Peru and drought in Indonesia and Australia. The eastward displacement of the atmospheric heat source overlaying the warmest water results in large changes in the global atmospheric circulation, which in turn force changes in weather in regions far removed from the tropical Pacific.

El Nino can be seen in Sea Surface Temperature in the Equatorial Pacific Ocean



(a) January 1991 (a normal year), and (b) January 1992 (an El Nino Year).

El Nino can be seen in measurements of the sea surface temperature, such as those shown above, which were made from the TAO Array of moored ATLAS buoys and PROTEUS buoys. In January 1991, the sea surface temperatures and the winds were near normal, with warm water in the Western Pacfic Ocean (in red on the top panel of January 1991 plot), and cool water, called the "cold tongue" in the Eastern Pacific Ocean (in green on the top panel of the January 1991 plot). The winds in the Western Pacific are very weak (see the arrows pointing in the direction the wind is blowing towards), and the winds in the Eastern Pacific are blowing towards the west (towards Indonesia). The bottom panel of the January 1991 plot shows anomalies, the way the sea surface temperature and wind differs from a normal January. In this plot, the anomalies are very small (yellow/green), indicating a normal January.

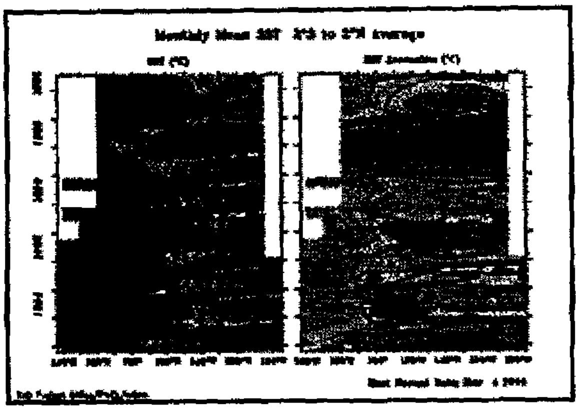
January 1992 was the peak of an El Nino year. In January 1992, the warm water (red in the top panel of the January 1992 plot) has spread from the western Pacific Ocean towards the east (in the direction of South America), the "cold tongue" (green color in the top panel of the January 1992 plot) has weakened, and the winds in the western Pacific, usually weak, are blowing strongly towards the east, pushing the warm water eastward. The anomalies show clearly that the water in the center of Pacific Ocean is much warmer (red) than in a normal January.

An animation of El Nino

If you have an MPEG animation viewer, and sufficient memory, you can view an animation of El Nino which shows the changes in monthly sea surface temperature in the tropical Pacific Ocean. The animation is about 1 Megabyte in size. As you view this animation, you will see the warm water spreading from the western Pacific to the eastern Pacific during 1991. The bottom panel in the animation, labeled anomalies, shows how much the sea surface temperature for each month is different from the long term average for that month. The red color in the anomalies plot indicates that the temperature of the water is much warmer than is normal for that month. Blue color indicates that the water is much cooler than is normal for that month.

Several recent El Ninos can be seen in Pacific Sea Surface Temperature

In the left hand panel, you see the sea surface temperature at the Equator in the Pacific Ocean (Indonesia is towards the left, South America is towards the right). Time is increasing downwards from 1986 at the top of the plot, to the present, at the bottom of the plot. The first thing to note is the blue "scallops" on the right of the plot, in the eastern Pacific. These indicate the cool water typically observed in the Eastern Pacific (called the "cold tongue"). Cold tongue temperatures vary seasonally, being warmest in the northern hemisphere springtime and coolest in the northern hemisphere fall. The red color on the left is the warm pool of water typically observed in the western Pacific Ocean. El Nino is an exaggeration of the usual seasonal cycle. During the El Nino in 1986-1987, you can see the warm water (red) penetrating eastward in the Spring of 1987. There is another El Nino in 1991-1992, and you can see the warm water penetrating towards the east in the northern hemisphere spring of 1992.



Mean and anomalies of sea surface temperature from 1986 to the present, showing El Nino's in 1986-1987, 1991-1992, 1993 and 1994.

El Nino years are easier to see in the anomalies on the right hand panel. The anomalies show how much the sea surface temperature is different from the usual value for each month. Water temperatures significantly warmer than the norm are shown in red, and water temperatures cooler than the norm are shown in blue. In the right-hand plot of sea surface temperature anomalies, it is very easy to see El Nino's, with water warmer than usual (red) in the eastern Pacific, during in 1986-1987, 1991-1992, 1993 and 1994. Notice the very cool water (blue), in the Eastern Pacific, in 1988-1989. This is a La Nina, which occurs after some (but not all) El Nino years. It is unusual for El Ninos to occur in such rapid succession, as has been the case during 1990-1994.

For the current forecasts and most recent El Nino conditions, you can read the U.S. National Meteorological Center's El Nino Advisory for this month, and you can look at the present conditions in the tropical Pacific, as measured by NOAA's TAO network of moored buoys.

Selected References

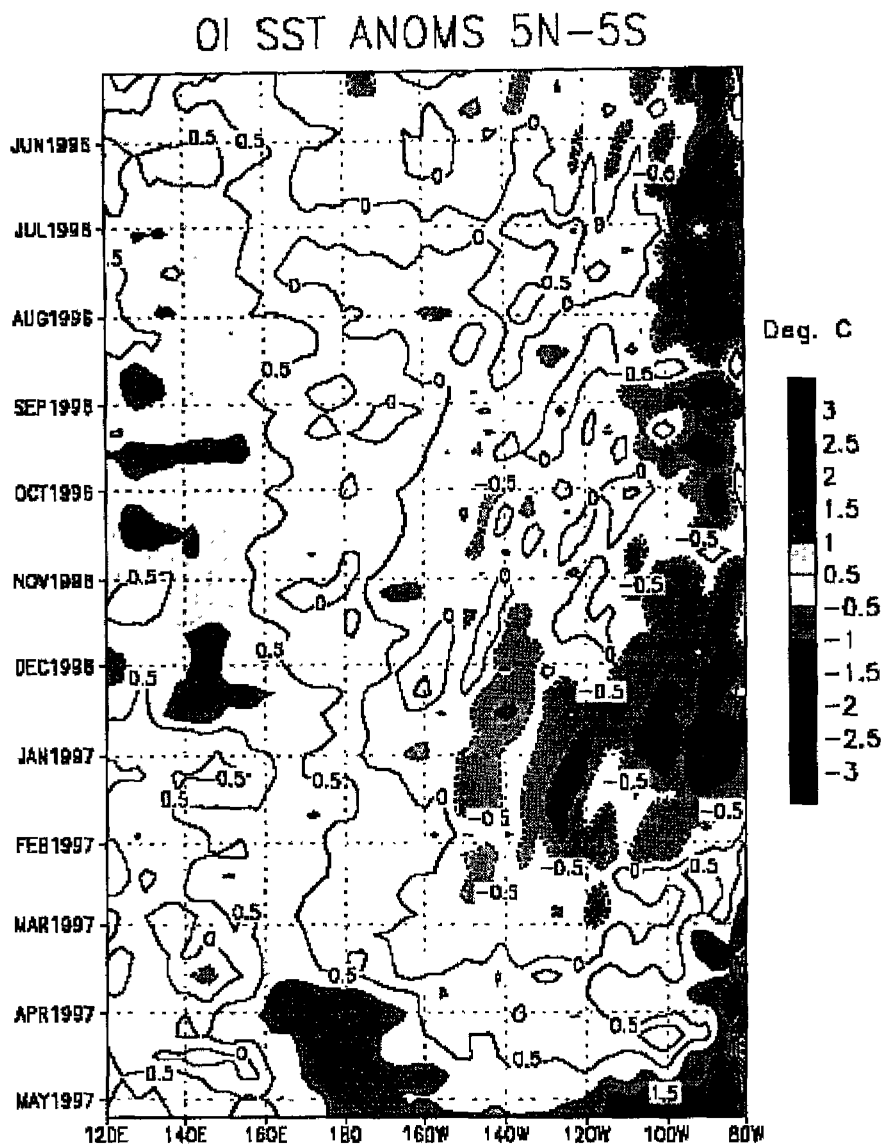


FIGURE 1. Time-longitude section of sea surface temperature anomalies for the latitude band 5N-5S. Anomalies are departures from the adjusted OI climatology (Reynolds and Smith 1995, J. Climate, 8, 1571-1583).