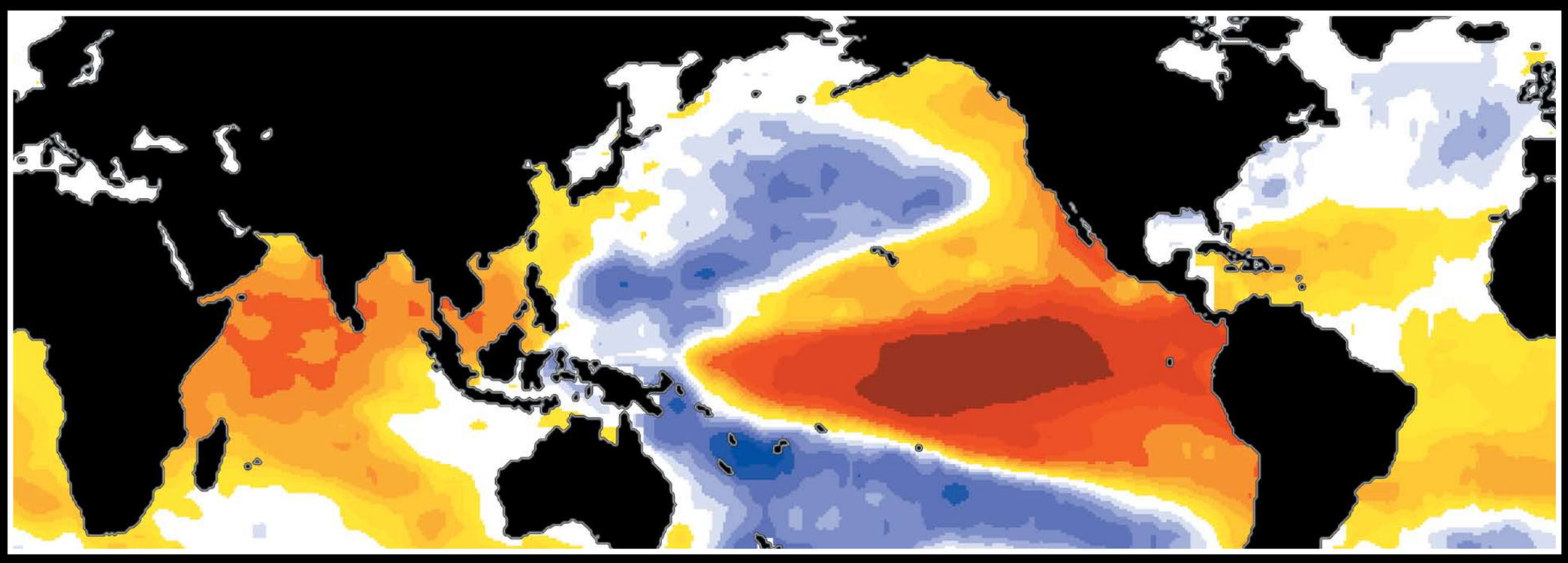
El Niño



"What is El Niño ?"

El Niño is a phrase now applied to the abnormal warming of the sea surface along the equator from South America to the Dateline. The phenomenon typically lasts 12-18 months, and occurs irregularly with a 4-7 year recurrence interval.

During El Niño, there tends to be an increase in the number of tropical storms and hurricanes in the eastern Pacific and a decrease in the tropical Atlantic.

Areas such as equatorial Peru, Equador, Southern California, and the Gulf of Mexico Coast may experience an abundance of rainfall during El Niño which can contribute to flooding.

Some areas (such as Indonesia, Eastern Australia, New Guinea, Southern part of west Africa, and Northern South America) experience drought during El Niño. This dryness can contribute to large-scale burning by uncontrolled wildfires.

Abnormal ocean currents during El Niño bring warm waters eastward from the western Pacific and leave low tides in the western Pacific. Both events can cause "bleaching" and death of corals, damaging the balance of these ecosystems.

NOAA Research Science Education

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U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

Visit our websites: www.noaa.gov, www.oar.noaa.gov,

"El Nino"

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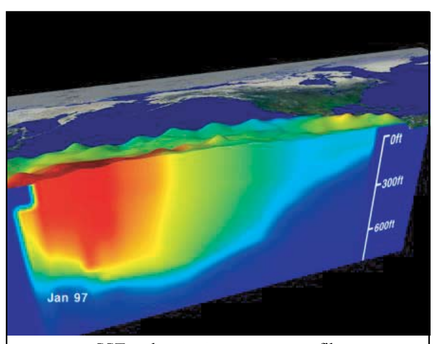
www.esrl.noaa.gov/psd

NOAA Pacific Marine Environmental Laboratory
7600 Sand Point Way NE
Seattle, WA 98115-6349
www.pmel.noaa.gov

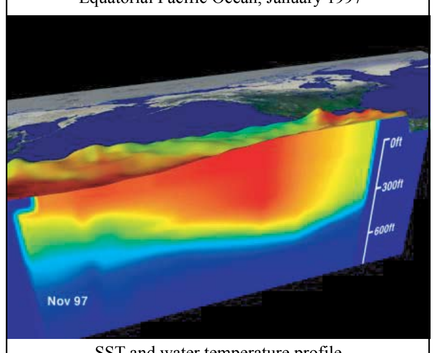
NOAA Atlantic Oceanographic & Meteorological Laboratory
4301 Rickenbacker Causeway
Miami, FL 33149
www.aoml.noaa.gov

Images courtesy of NOAA, NOAA/ESRL, NOAA/NCEP/CPC and the U.S. Forrest Service.

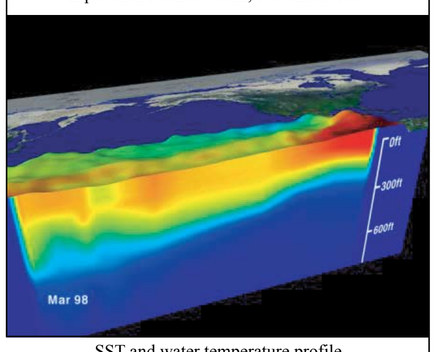
Educational materials courtesy of Louise Belnay, Adams County School District 50, Colorado; Martin Hoerling and Barb DeLuisi, NOAA Earth System Research Laboratory. 2008 update contributors: Debra Dailey-Fisher – NOAA Earth System Research Laboratory and Al Romero – NOAA Buildings Management Branch-Boulder.



SST and water temperature profile, Equatorial Pacific Ocean, January 1997



SST and water temperature profile, Equatorial Pacific Ocean, November 1997



SST and water temperature profile, Equatorial Pacific Ocean, March 1998

El Niño associated with change in sea level

The images show sea surface topography from NASA's TOPEX satellite, sea surface temperature's from NOAA's AVHRR satellite sensor and sea temperature below the surface as measured by NOAA's network of TAO moored buoys. The three dimensional relief map shows a sea level rise along the Equator in the eastern Pacific Ocean of up to 34 centimeters with the red colors indicating an associated change in sea surface temperature of up to 5.4 degrees Celsius. The sea temperature below the surface illustrates how the thermocline (the boundary between warm and cold sea water at 20 degrees Celcius) is flattened out by El Niño.

These images are beneath Sea Views of sea surface height (represented by the bumps) and sea temperature (represented by the color). Red is 30 degrees C and blue is 8 degrees C. The thermocline is the border between the dark blue at the bottom and the cyan. The thermocline exists at 20 degrees C. (This El Niño event was choosen as this El Niño was the most extreme to-date.)

Data from 1/1/97 to 3/10/98. Images and text from NASA Goddard Space Flight Center.

NOAA RESEARCH SCIENCE EDUCATION

"El Niño"

(To be used with the El Niño Poster)

Interesting Facts about El Niño

- In normal years, the cold water in the eastern Pacific Ocean off the coast of Peru and Equador is blown west by trade winds. As it makes its way toward Australia, it is warmed by the tropical sun. By the time it gets to the western Pacific, it is a few degrees warmer. The water warms the air above it, the air rises and creates clouds that bring rain. During El Niño, the trade winds are weaker, the sea surface temperatures are warmer over the equatorial east Pacific, and the rains shift from the western to the central Pacific.

- El Niños were originally recognized by fisherman off the coast of South America as the appearance of usually warm water in the far east Pacific Ocean, occurring near the beginning of the year. El Niño means The Little Boy or Christ child in Spanish. This name was used for the tendency of the phenomenon to arrive around Christmas.

- Recent years in which significant El Niño events have occurred are 1957-1958, 1965-1966, 1972-1973, 1982-1983, 1986-1987, 1991-1992, 1994-1995, 1997-1998 and 2006-2007. The first year listed refers to the time the event first developed , typically in spring. The second year listed refers to the time of decay, typically summer. Every El Niño is somewhat different in magnitude and in duration.

- The El Niño of 1982-83 was responsible for the loss of nearly 2,000 lives and displacement of hundreds of thousands from their homes. The losses were caused by droughts and fires in Australia, Southern Africa, Central America, Indonesia, the Philippines, South America and India. There were floods in the United States, Peru, Ecuador, Bolivia, and Cuba. More hurricanes than usual affected Hawaii and Tahiti.

- El Niño is now widely studied and its predictability climate has increased since climate researchers were caught off-guard by the 1982-1983 event. Once an El Niño gets going in late spring/early summer, it usually sticks around for at least 6 months.

- El Niño cycles cause a small fluctuation in the "length of day" (it gets longer), The reason this happens is that the entire Earth system (land, air, and water) must conserve its total angular momentum (related to the speed of rotation around the earth's axis), like a spinning top, or a twirling ice skater. During El Niño, the average eastward speed of the winds around the globe increases. Since the angular momentum of the air increases, the rotational speed of the solid earth must decrease, in compensation. Of course, the resulting increase in the length of the day is very small, but still quite important for applications such as global satellite positioning and navigation.

- Many different ecosystems are impacted due to El Niño. For example, the red kangaroo of Australia has adapted so well over time to the changes brought about by El Niño that it can put off reproduction until conditions are more favorable.

- Believe it or not, not everything about El Niño is bad: Temperature warming over North America in the winter is beneficial for consumers of energy; rain-bearing storms, when not severe, are beneficial; severe weather (i.e., tornados) over the interior U.S. are reduced in El Niño springs.

Web Sites

For Teachers

www.elnino.noaa.gov/
www.pmel.noaa.gov/toga-tao/el-nino/
www.cdc.noaa.gov/ENSO
www.aoml.noaa.gov/
www.cpc.ncep.noaa.gov/
www.pbs.org/wgbh/nova/elnino/
sos.noaa.gov

For Kids

www.oar.noaa.gov/k12/
globe.fsl.noaa.gov/

Build your own El Niño

MATERIALS

- Glass Pyrex loaf pan (or other glass pan approx. 4" deep)
- Hot water
- Cold water
- A funnel
- Container
- Red food coloring
- Blue food coloring
- Hair dryer or fan

PROCEDURE

1. Half-fill the glass loaf pan with very hot water. Add 3 drops of red food coloring to the water.

Note: Add more food coloring if using larger pan.

2. In a separate container, add 3 drops of blue food coloring to very cold water.

3. Using the funnel, slowly add the cold water to the bottom of the loaf pan until it is full.

– Observe how the hot and cold water do not mix.

Note: This represents a typical stratification of ocean temperatures with depth.

4. Direct a stream of air from the hair dryer (or fan) over the surface of the water.

– This sets up the conditions of a normal year, with no El Niño.

– As the air blows across the surface of the water, the hot water will move to the other side of the loaf pan.

– The cold water will rise to the surface near the fan, replacing the hot water.

Note: This represents the usual blowing of the winds that drive the warm water west to Australia.

5. Turn off the fan and watch the slope between the warm and cold water.

– Observe what happens to the water.

Note: In reality the ocean's water is not exactly half hot and half cold. The warm layer is really a very thin layer at the surface. While this model helps you to understand the process at work, it doesn't really give an accurate representation of El Niño. However, it provides a visual model to help\ understand what goes on between the ocean and the atmosphere during normal years and an El Niño event. For scientists to really understand what's happening in real life, they have to closely monitor the oceans and the atmosphere over a long period of time.

ANALYSIS QUESTIONS

1. Which are the two main parts of the Earth system involved in an El Niño?
2. Which wind belt is responsible for water moving across the Pacific?
3. In a normal year, which way do those winds blow?
4. In an El Niño year, what happens to those winds?
5. What happens to the upwelling of cool water during an El Niño?
6. When the cold water was added to the pan of hot water, what happened? Why?
7. What property of matter is the reason that the warm and cold water don't mix?
8. What does the hair dryer/fan represent?
9. What happens to the surface layer of water when the hair dryer is turned on?
10. Where does the cold-water layer go when the surface layer moves?
11. When the hair dryer is turned off, what happens to the slope between the hot and cold water? Why?