



El Niño, La Niña, and ENSO

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Jet Stream

NATIONAL WEATHER SERVICE

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What are El Niño, La Niña, and ENSO?

Near the end of each calendar year, ocean surface temperatures warm along the coasts of Ecuador and northern Peru. In the past, local residents referred to this annual warming as “El Niño,” meaning “The Child,” due to its appearance around the Christmas season. The appearance of El Niño signified the end of the fishing season and the arrival of the time for Peruvian fishermen to repair their nets and maintain their boats. Every two to seven years a much stronger warming appears along the west coast of South America, which lasts for several months and is often accompanied by heavy rainfall in the arid coastal regions of Ecuador and northern Peru. Over time the term El Niño began to be used in reference to these major warm episodes. During the 1960s, scientists began to link the abnormally warm waters along the west coast of South America with abnormally warm waters throughout the central and east-central equatorial Pacific. In addition, the warmer than average waters were shown to be closely related to a global atmospheric pressure oscillation known as the Southern Oscillation.

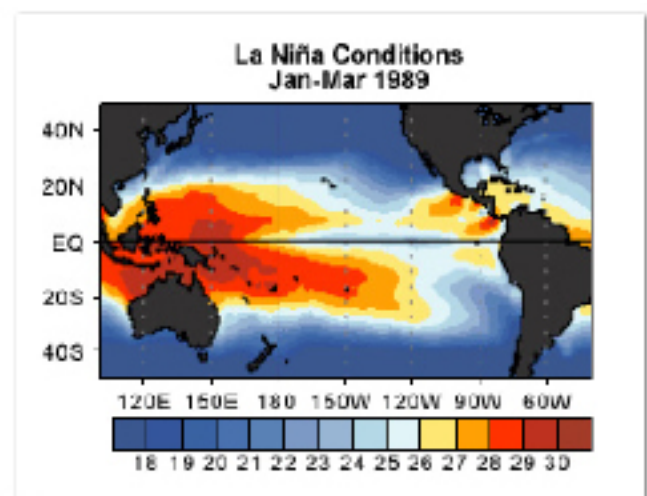
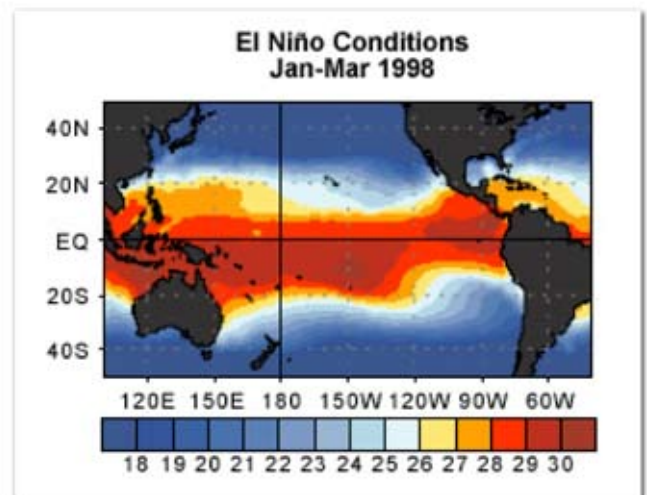
The term El Niño now refers to the coupled ocean-atmosphere phenomenon characterized by:

- ▶ Abnormally warm sea surface temperatures from the date line (180W) east to the South American coast
- ▶ Changes in the distribution of tropical rainfall from the eastern Indian Ocean east to the tropical Atlantic
- ▶ Changes in sea level pressure throughout the global Tropics (low-index phase of the Southern Oscillation)
- ▶ Large-scale atmospheric circulation changes in the Tropics and portions of the extratropics in both hemispheres.

Other terms commonly used for the El Niño phenomenon include “Pacific warm episode” and “El Niño/ Southern Oscillation (ENSO) episode.”

In contrast to El Niño, La Niña is characterized by anomalously cool water in the central and east-central equatorial Pacific. It also results in changes in the intensity and distribution of rainfall in the Tropics and in changes in the patterns of sea level pressure (corresponding to the “high-index” phase of the Southern Oscillation) and atmospheric circulation that affect many areas worldwide. Another term commonly used for the La Niña phenomenon is “Pacific cold episode.”

Maps showing latitudes, longitudes, and ocean temperatures (in degrees Celsius)
(NOAA/NCEP/CPC)





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The El Niño/ La Niña phenomena are the main sources of year-to-year variability in weather and climate for many areas of the world. El Niño and La Niña tend to alternate in an irregular cycle, which is often referred to as the ENSO cycle. The transition between El Niño and La Niña tends to be more rapid than the transition from La Niña to El Niño. El Niño episodes tend to:

- ▶ Develop during the Northern Hemisphere spring season
- ▶ Occur every 3-5 years
- ▶ Usually last for 9-12 months.

In contrast, La Niña may last 1-3 years; however, there is considerable event-to-event variability in the timing, intensity and evolution of both El Niño and La Niña. Periods when neither El Niño nor La Niña is present are referred to as ENSO-neutral.

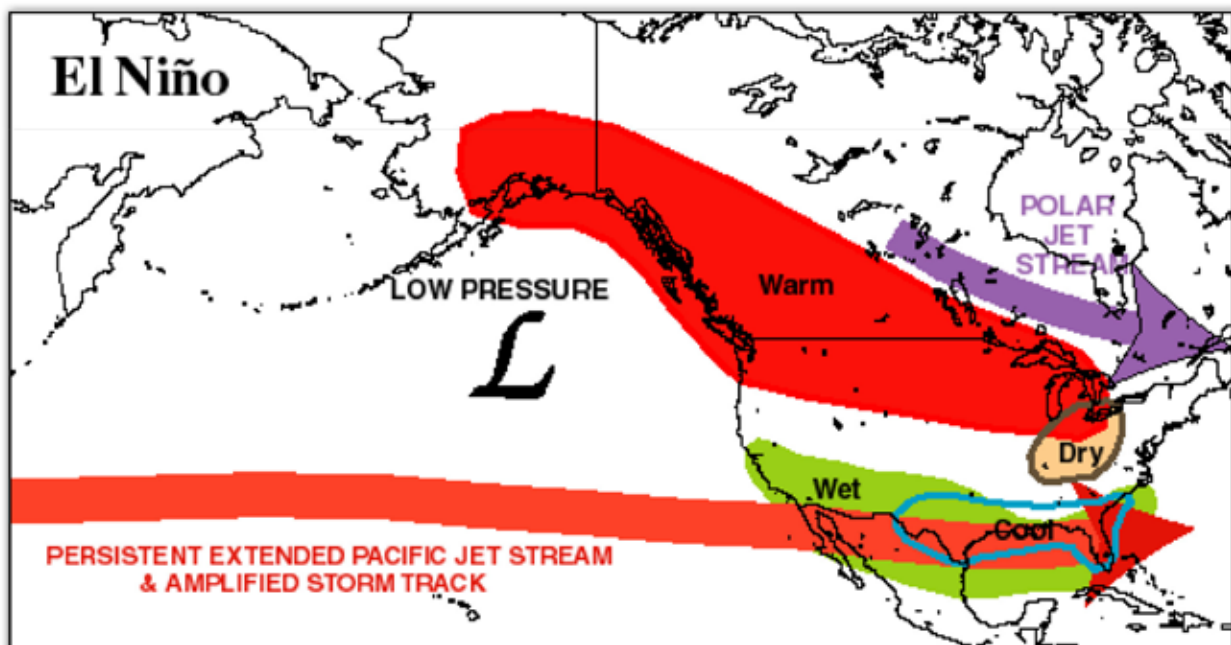
Why do we have ENSO?

ENSO appears to be a necessary mechanism for maintaining long-term global climate stability by transporting heat from the Tropics to the higher latitudes.

What are the Effects of El Niño and La Niña on the United States?

Effects of El Niño

El Niño conditions influence wintertime atmospheric flow across the eastern North Pacific and North America. There is considerable event-to-event variability in the character of El Niño episodes and in some areas, impacts can vary substantially from



Typical Winter Patterns during El Niño (NOAA/NCEP/CPC)



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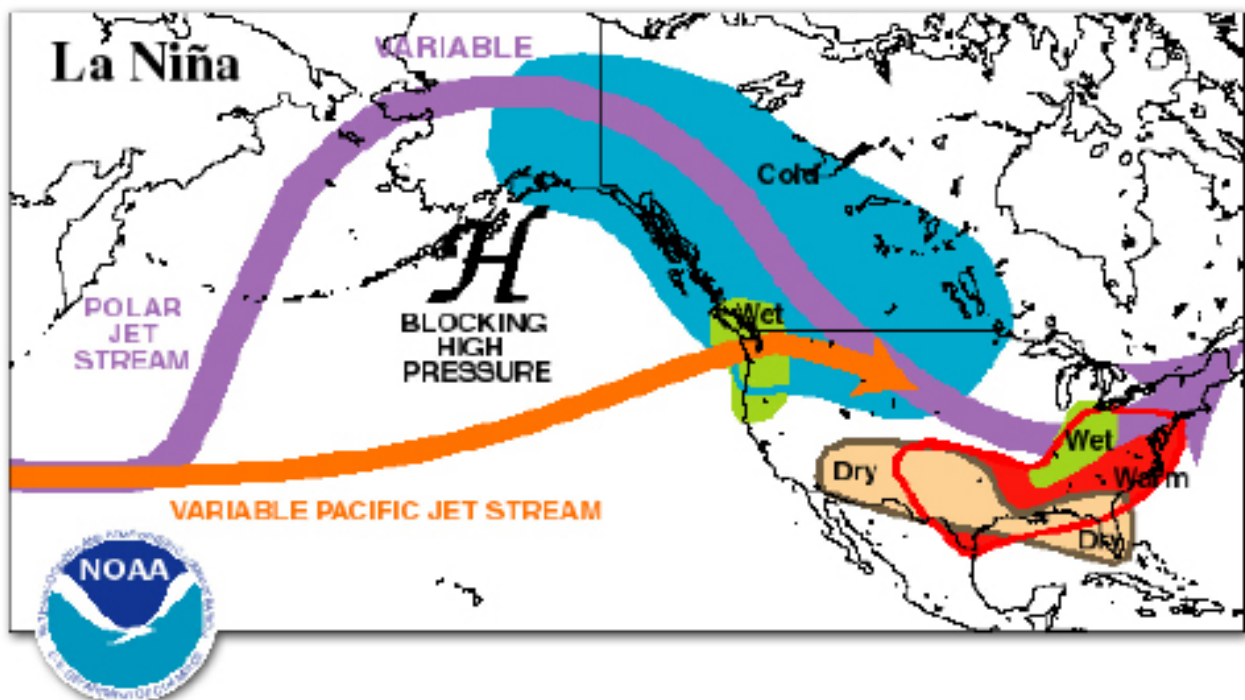
one event to another. However, there are some sections of the United States where impacts are fairly consistent and predictable, especially when associated with strong El Niño episodes.

In general, El Niño results in increased precipitation across California and the southern tier of states, and decreased precipitation in the Pacific Northwest and in the Ohio and Tennessee Valleys. A milder than normal winter across the northern states and western Canada is also a common effect. In the eastern United States, El Niño episodes favor more coastal storms at the expense of Alberta Clippers (fast eastward-tracking storms across the northern states) in winter and early spring. During the warm season, El Niño influences hurricane development, resulting in more eastern Pacific hurricanes and fewer Atlantic hurricanes.

Effects of La Niña

La Niña conditions tend to influence wintertime atmospheric flow across the eastern North Pacific and North America, as shown in the figure below. La Niña episodes display considerable event-to-event variability and the overall effects tend to be less predictable than those for El Niño.

Seasonal precipitation impacts are generally opposite to those of El Niño. During La Niña winters, large portions of central North America experience increased storminess, and an increased frequency of significant cold-air outbreaks, while the southern states experience less storminess and precipitation. There also tends to be considerable month-to-month variations in temperature, rainfall, and storminess across central North America during the winter and spring seasons, in response to the more variable atmospheric circulation throughout the period. In the



Typical Winter Patterns during La Niña (NOAA/NCEP/CPC)

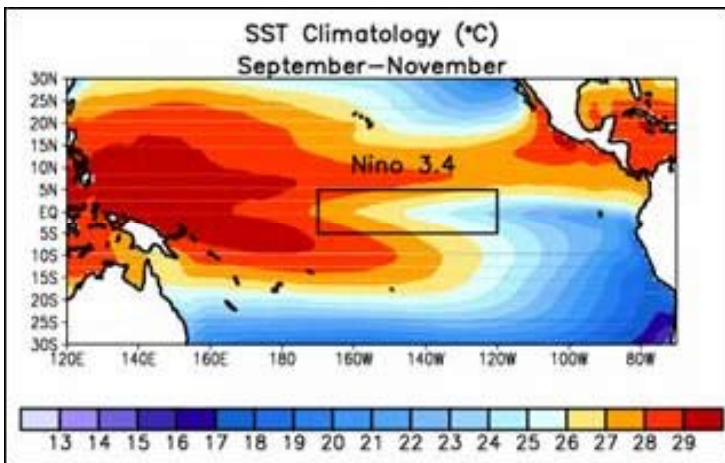


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eastern U.S., during the winter, there are generally fewer coastal storms and more Alberta Clippers (fast eastward-tracking storms across the northern states) than normal. In the summer and autumn, La Niña can influence hurricane development, often resulting in fewer eastern Pacific hurricanes and more Atlantic hurricanes.



Map showing latitude, longitude, sea surface temperature in degrees Celsius, and the area known as Niño 3.4.

How do Scientists Monitor and Predict ENSO

Collection of Data

NOAA operates a network of 70 stationary buoys in the equatorial Pacific, called the Tropical Atmosphere/Ocean (TAO) array, which provides data about upper-ocean and sea surface conditions. Other important data come from satellites, radiosondes, and the high-density U.S. surface data network.

Use of Indicators and Indices

One of the primary indicators of ENSO events, Sea Surface Temperature (SST), is closely monitored throughout the Pacific Ocean, including Niño 3.4, a region stretching along the equator from 170°W to 120°W longitude and from 5°N to 5°S latitude. An index for monitoring and assessing the oceanic state of ENSO, known as the Oceanic Niño Index (ONI), is based on this region and represents the sea surface temperature departure from a long-term average.

Use of Computer Models

Numerical models have been developed to study and predict ENSO events and their effects on weather patterns throughout the world. Though by no means perfect, under certain conditions, these models can indicate which climatic conditions are likely to prevail during the next season or two.

Where Can I Find More Information?

The NOAA Climate Prediction Center web site has myriad resources, including educational materials, information on current conditions and outlooks, and links to other informative sites:

<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml>

NOAA has created one primary web site that allows access to many other resources:

<http://www.elnino.noaa.gov>