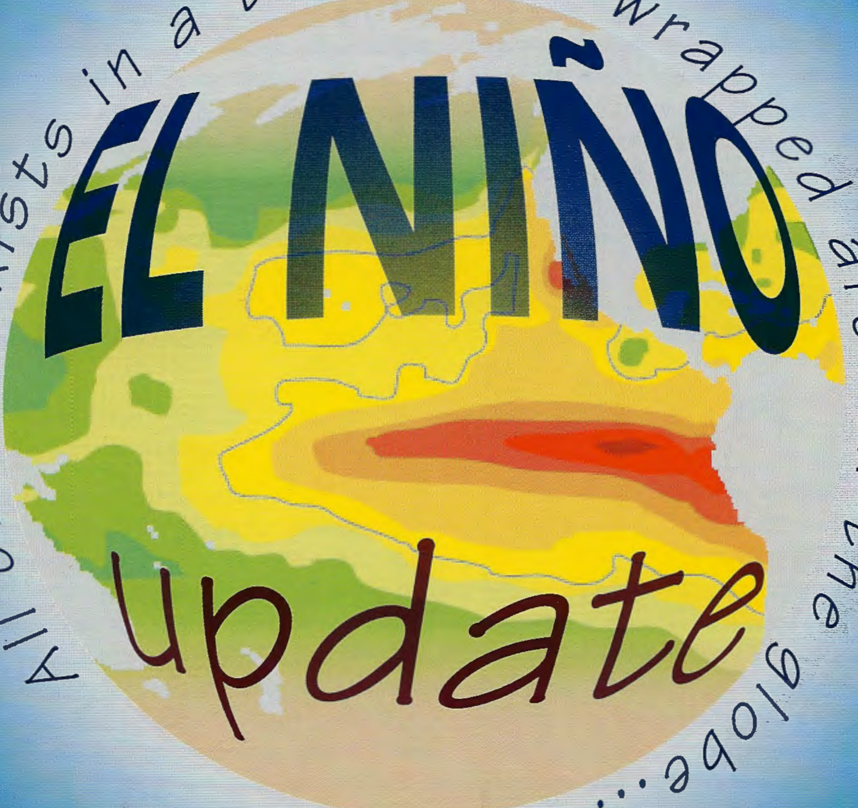
All of life exists in a thin layer wrapped around the globe...

EL NIÑO update



December 1997

World Meteorological Organization

Introduction

WMO has produced this El Niño Update in order to ensure that the most effective and accurate information is made available. It is a summary of: (i) our knowledge of the El Niño phenomenon, (ii) its associated impacts on a global scale, and (iii) forecast information for the coming months. This Update is compiled from a variety of scientific sources including several major global climate prediction centres, and is intended to address the questions and concerns of an audience that ranges from the general public to the policy maker.

Diagram A
THE USUAL SITUATION

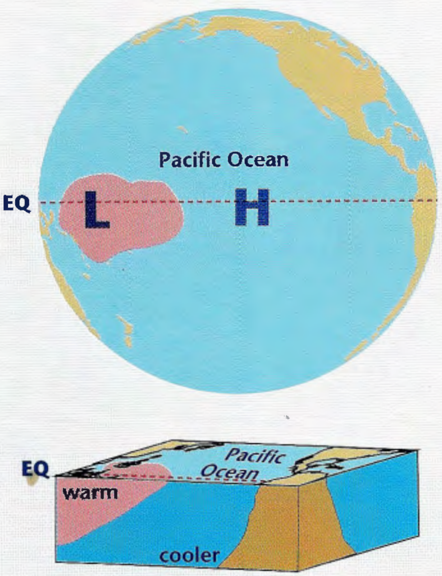
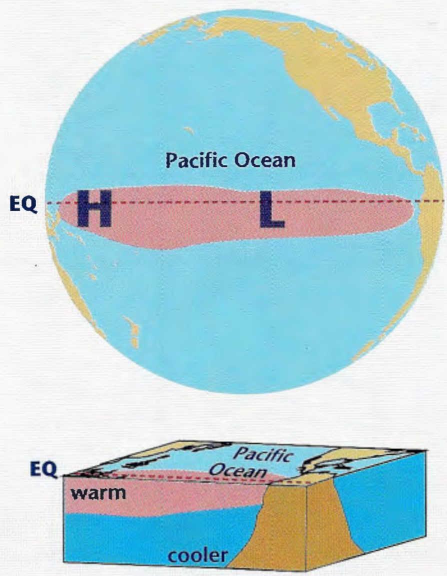


Diagram B
EL NIÑO YEARS



Warmest water

H/L = **Higher/Lower atmospheric pressure**

What are El Niño, ENSO and La Niña?

"El Niño" is the term that is used for an oceanographic phenomenon: an extensive warming of the upper ocean in the tropical eastern Pacific lasting three or more seasons. The negative or cooling phase of El Niño is called La Niña. El Niño events are linked with a change in atmospheric pressure known as the Southern Oscillation (SO). This is characterized by a see-saw in the atmospheric pressure between the western and central regions of the Pacific Ocean, with one centre of action located in the vicinity of Indonesia and the other centre located over the central Pacific Ocean. The index that measures the magnitude of the SO is known as the Southern Oscillation Index (SOI) and it is obtained by calculating the difference in atmospheric surface pressure between Tahiti and Darwin, Australia. Because the SO and El Niño are so closely linked with each other, they are collectively known as El Niño-Southern Oscillation, or "ENSO".

The El Niño Update refers to the coupled atmosphere-ocean phenomenon as "El Niño," as the public has adopted that broader definition.

Why does El Niño occur?

El Niño results from interaction between the surface layers of the ocean and the overlying atmosphere in the tropical Pacific. It is the very complex interaction between the ocean and the atmosphere that determines the onset and termination of El Niño events. The system oscillates between warm (El Niño) to neutral (or cold) conditions with a natural periodicity of roughly 3-4 years between El Niño events. External influence (also known as "forcing") from volcanic eruptions (submarine or terrestrial) and sunspots have not conclusively been shown to have an influence on El Niño events. In addition, a connection between the occurrence of El Niño events and possible global warming has not been confirmed by research.

Is El Niño a new phenomenon?

El Niño is not a new phenomenon. Evidence suggests that El Niño events have existed for thousands of years in the past. However, it is only in the last decade that satisfactory understanding of how they form and are maintained has been gained.

During the last three decades there has been a great deal of investment in monitoring and research to enhance the capacity to predict El Niño. It wasn't until the advent of high-speed computers, though, that the complex interactions and massive amounts of data could be put together to provide a relatively clear picture of the phenomenon.

Even so, the 1982-83 El Niño, widely recognized as perhaps the most severe of the 20th century, caught scientists by surprise. Unlike the El Niño events of the previous three decades, it was not preceded by a period of stronger than normal easterlies on the Equator, and it took place later in the calendar year than usual. Even though it wasn't recognized as an El Niño until it was half over, it was responsible for extreme impacts on the global climate. North America experienced highly unusual weather throughout 1983; Australia experienced massive drought and devastating bushfires; it was one of the worst periods for drought in the sub-Sahelian countries; and the monsoons failed in the Indian Ocean. Total damages were estimated at somewhere between $8 billion and $13 billion (US dollars), and approximately 2 000 lives were lost.

How are El Niño events detected?

Coherent research efforts on El Niño developed during the 1970s, motivated in part by the disruptive effects in the Americas from climate variations thought to be associated with El Niño. The intense El Niño of 1982-1983 served as an impetus for the organized international monitoring and research programme that resulted in the development of the Tropical Ocean Global Atmosphere (TOGA) programme (1985-1994), under the World Climate Research Programme (WCRP). Mainly as a result of TOGA, El Niño events in the tropical Pacific Ocean can now be detected by many methods, including satellites, moored buoys, drifting buoys, sea-level analysis and expendable bathythermographs (XBTs). This research observing system is now evolving into an operational climate observing system. Large computer models of the global ocean and atmosphere use data from this observing system as input to predict El Niño. Other models are used for El Niño research to further the understanding of the phenomenon.

Are all El Niño events the same?

Although El Niño events share many general characteristics, every one is somewhat different in magnitude, duration and the resulting global climatic impacts. Magnitude can be determined in different ways, such as variations in the Southern Oscillation Index (SOI). Another measure of the magnitude of El Niño events is sea surface temperature averaged over specific regions of the Pacific Ocean, such as the Niño 3 region in the Eastern Equatorial Pacific Ocean, which extends from 150°W to 90°W and 5°N to 5°S. The El Niño in 1982-1983 and the current El Niño are associated with far greater abnormalities in the sea surface temperatures in the Niño 3 region than those in 1976, 1987 and 1991.

Why do the tropical Pacific Ocean temperatures affect global weather patterns?

During El Niño, the tremendous concentration of excess heat in the eastern tropical Pacific Ocean modifies the atmosphere immediately above it, and the effects are carried around the globe by the modified circulations in the atmosphere, resulting in changes in the normal weather patterns in many regions. The sea-surface temperatures in the Indian and Atlantic Oceans are also modified, which in turn affects the climate over them and in adjacent continental regions. The atmospheres over these oceans cooperate with the corresponding water masses beneath them to magnify the initial sea-surface temperature deviations even further. The result is climatic response that is truly global. At higher latitudes the effects are more variable from one El Niño to another and the long-range climate forecasts are generally not as reliable as in the tropics.

What is the relationship between tropical cyclones and El Niño?

It is believed that El Niño conditions suppress the development of tropical storms and hurricanes in the Atlantic; and that La Niña (cold conditions in the equatorial Pacific) favour hurricane formation. Over the eastern and central Pacific Ocean, El Niño tends to increase the numbers of tropical storms.

What are the typical global impacts of El Niño events?

By studying past warm and cold episodes, scientists have discovered precipitation and temperature anomaly patterns that are highly consistent from one episode to another. Within the tropics, the eastward shift of thunderstorm activity from Indonesia into the central Pacific during warm episodes usually results in abnormally dry conditions over northern Australia, Indonesia and the Philippines in both seasons. Drier than normal conditions are also usually observed over southeastern Africa and northern Brazil. During the northern summer season, the Indian monsoon rainfall tends to be less than normal, especially in the northwest. Wetter than normal conditions during warm episodes are usually observed along the west coast of tropical South America, and at subtropical latitudes of North America (Gulf Coast) and South America (southern Brazil to central Argentina).

What are some regional impacts of the 1997-1998 El Niño?

Tropical Australasia Region: The region has been very dry since June, with large-scale wildfires and drought. Many areas have already experienced rainfall deficits of 400-500 mm (16-20 inches) in the last several months.

Southern Part of West Africa: The region has also received abnormally low rainfall since July. The region also received an extended period of suppressed rainfall during the 1982-83 El Niño.

Southern Africa: The onset of the rainy season has not begun for most of the region.

Eastern Africa: As of the first part of November, the region had experienced abnormally intense rainfall along the coast, and generally higher than normal precipitation.

Central Europe: Experts do not claim with confidence that impacts of El Niño reach the European continent, and there is no evidence at this time that the heavy rain and catastrophic floods that occurred in July are related to El Niño.

Tropical Storm and Hurricane activity: There was a nearly complete shut-down of Atlantic tropical storm and hurricane activity after July, and an expanded area of favourable conditions for hurricane activity over the eastern North Pacific. This is due in part to an El Niño-related pattern of abnormally strong upper-level westerly winds extending from the eastern North Pacific to the southwestern Sahel area of Africa.

Central America: Abnormally dry conditions covered the region during June-October.

Northern South America: Abnormally dry conditions developed across the region, with dryness extending northeastward to western Africa.

Southern South America: Much of central and southern South America was wetter than normal during June-October, with most of the central portion of the continent also warmer than normal. Some locations in central Chile received their normal annual rainfall total in a single day. These conditions have resulted from an El Niño-related increase in jet stream winds and storminess across the central and eastern South Pacific, and a pronounced eastward extension of this storminess into the continent.

North America: North America typically receives its strongest El Niño impacts during the winter and early spring. However, the current episode started earlier than normal, and has already affected the continent in several ways. The persistence of abnormally warm ocean waters off the west coast has resulted in the appearance of unusual marine species from the Baja Peninsula to the Pacific Northwest. Another impact has been reduced tropical storm and hurricane activity across the eastern and Gulf coasts of the USA, with only one system (Danny) entering the country this year. At the same time, the expanded area of favourable conditions has led to several eastern Pacific hurricanes that turned north and went into Mexico with disastrous results.

How strong is this El Niño?

Strong warm episode (El Niño) conditions have persisted in the tropical Pacific since July 1997. Sea surface temperatures throughout the equatorial east-central Pacific increased during April and May, when temperatures normally decrease in this region. During August and September ocean surface temperatures reached near-record levels in many sections of the equatorial Pacific. Departures from normal exceeded +4°C along the Equator east of 120°W, and were greater than+5°C near the Galapagos Islands and along the coast of northern Peru.

What is the current forecast of the El Niño of 1997-1998?

Recent model forecasts indicate that strong warm episode oceanic conditions, comparable to those observed during 1982-83, will continue throughout the remainder of 1997 and into early 1998. Over the past few seasons several of the statistical and coupled model predictions have consistently indicated the development and persistence of a strong warm episode. These forecasts indicate that strong warm episode conditions will continue into the March-May 1998 season. Thereafter, several coupled model forecasts indicate the re-establishment of the normal conditions which are characterized by a cold tongue of water in the eastern equatorial Pacific.

Where can I learn more about El Niño?

The WMO Home Page has an "El Niño Information" button, which provides links to a number of the major climate prediction centres and to the WMO Members with Web and Gopher servers that have notified us of the existence of their Home Pages. These sites give information about the climatological characteristics of El Niño, including the corresponding rainfall and temperature patterns; observed evolution of the sea-surface temperatures over the Pacific Ocean; the outlook for the Pacific Ocean sea-surface temperatures (SSTs), rainfall and temperature during the coming months, and other related information. The WMO site is found at the following location: http://www.wmo.ch.

Inquiries concerning a specific country should be directed to the WMO Permanent Representative (PR) in that country who will provide details and specific information on the local-scale manifistations of ENSO.

More scientific information on the global patterns of abnormal precipitation and temperature related to warm and cold episodes in the tropical Pacific can be found in Ropelewski and Halpert (1987, *Mon. Wea. Rev.*, 115, 1606-1626); 1989, *J. Climate*, 2, 268-284), and Halpert and Ropelewski (1992, *J. Climate*, 5, 577-593). A general description of a warm (El Niño) episode and its composite evolution can be found in Rasmusson and Carpenter (1982, *Mon. Wea. Rev.*, 110, 517-528). Upper-tropospheric circulation features that accompany extreme phases of the Southern Oscillation are discussed in a paper by Arkin (1982, *Mon. Wea. Rev.*, 110, 1393-1404). A comprehensive discussion of the objectives and lessons that resulted from the international Tropical Oceans and Global Atmosphere (TOGA) research programme, and citations of recent El Niño research, are contained in *Learning to Predict Climate Variations Associated with El Niño and the Southern Oscillation* (1996, National Academy Press).

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