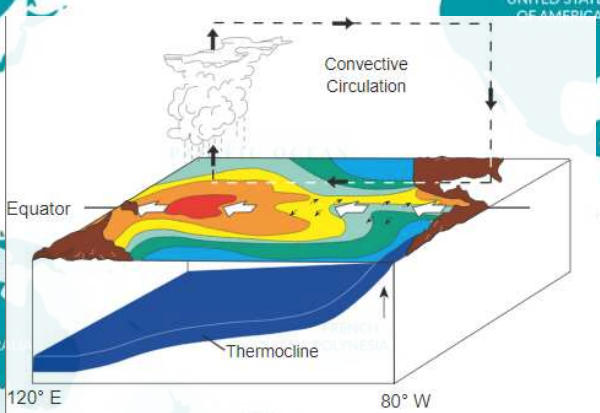
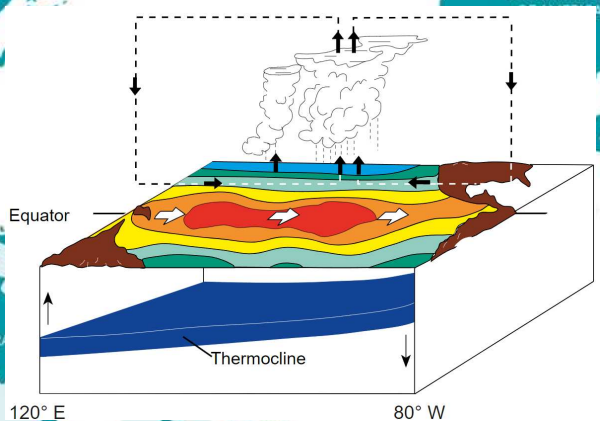
Southern Oscillation



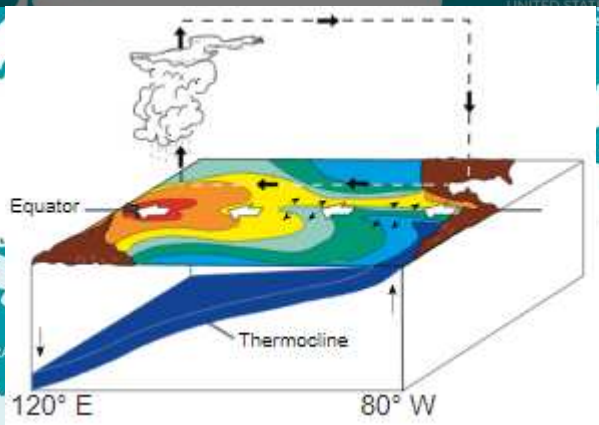
Under normal conditions:
In the tropical Pacific Ocean, the Walker circulation (atmospheric circulation) leads to the presence of upwellings (vertical movements of cold nutrient-rich water from the deep ocean to the surface) on the South American coast. The wind created by the Walker circulation moves the warm water westwards which creates an area of heavy rainfall in Australia.

El Niño



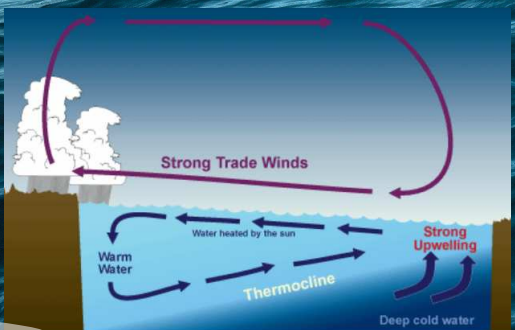
Under El Niño conditions:
In the tropical Pacific Ocean, the Walker circulation is disturbed. Trade winds blowing from the East to the West are weakened causing a reduction in upwellings on the South American coast. The precipitation zone is also affected because it has moved eastwards leading to a wetter climate in South America and a drier climate in Australia.

La Niña



Under La Niña conditions:
In the tropical Pacific Ocean, the Walker circulation is disturbed. Trade winds blowing from the East to the West are strengthened causing an increase in upwellings on the South American coast. The precipitation zone is also affected because it is enhanced leading to a drier climate in South America and a wetter climate in Australia.

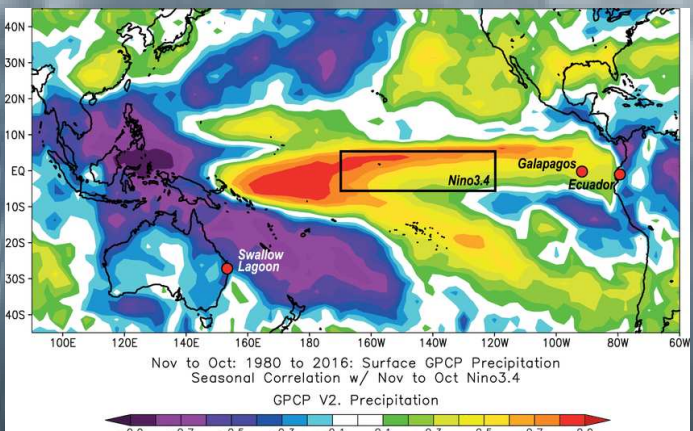
Disruption of the upwelling mechanism



Under El Niño conditions, upwellings decrease on the South American coast, reducing the amount of nutrients and cold water brought to the surface. This mechanism results in a lack of resources for marine biodiversity and an increase in the temperature of surface seawater.

Under La Niña conditions, upwellings increase on the South American coast. This mechanism results in a decrease in the temperature of surface seawater.

Precipitations



Under El Niño conditions, due to weaker winds, the warm water mass moves towards the center of the ocean. The upwellings of cold water along the coasts of South America is greatly reduced, causing an increase in water temperature. The amount of precipitation increases in South America and the climate becomes more arid on the other coast of the ocean.

During La Niña event, the warm water mass moves towards the Asian and Australian coasts due to stronger winds. The amount of precipitation increases on the Australian coast.

Rising Water Temperature

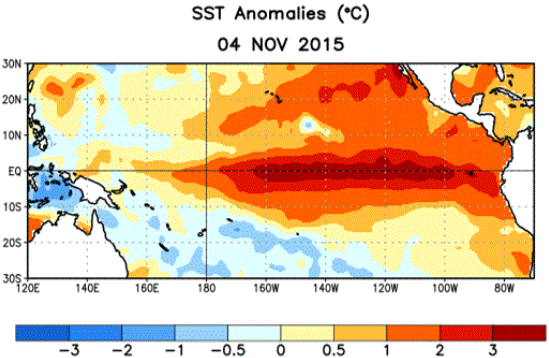


Figure 1. Average sea surface temperature (SST) anomalies (°C) for the week centered on 4 November 2015. Anomalies are computed with respect to the 1981-2010 base period weekly means.

Under El Niño conditions, the sea surface temperature increases significantly in the East coast due to the reduction in the intensity of upwellings. This rise affects marine biodiversity.

Under La Niña conditions, the phenomenon is reversed, so the sea surface temperature is colder than usual.

Marine Biodiversity

The marine biodiversity is impacted when upwellings change. During El Niño events, the quantity of fish and other species is significantly reduced due to unfavorable living conditions for these animals. This depletion causes a drop in fish stocks and a reduction in the food resources available to the coastal population.

Droughts

During La Niña events, the climate becomes drier, particularly in Peru and to the north of Chile, due to the upwelling of cold water and therefore the distance from the hot water mass. This leads to a drop in agricultural yields.

During El Niño events, in South-East Asia, the lack of rainfall in some regions can cause long periods of drought and, particularly in Australia, the risk of fire.

Flooding

On the South American coast, under El Niño conditions, precipitations are more abundant than usual which can cause flooding in years when the El Nino is strong.

During La Niña conditions, the phenomenon is reversed, so the risk of flooding increases in south-east Asia and Australia.

Decline in Agricultural Yields

The extreme climates, caused by ENSO, have a direct impact on crop production, particularly in the case of drought and flooding.

Hunger

The decline in agricultural yields and in fish stocks generates a lack of food resources for the coastal population, which could lead to periods of famine.

Climate change

“It was also reported that the frequency and intensity of El Niño events in the period from 1951–2000 was high relative to 1901–1950”, but according to the IPCC, there is no indication that the frequency of high-amplitude events can be associated to climate change or a simple decadal variability already observed earlier.

Source: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter02.pdf