El Nino and La Nina

- **El Nino and La Nina** are complex weather patterns resulting from variations in ocean temperatures in the Equatorial Pacific Region. They are opposite phases of what is known as the **El Nino-Southern Oscillation (ENSO)** cycle.
    - The ENSO cycle describes the fluctuations in temperature between the ocean and atmosphere in the east-central Equatorial Pacific.
    - El Nino and La Nina episodes typically last nine to 12 months, but some prolonged events may last for years.
- **El Nino** is a climate pattern that describes the **unusual warming of surface waters** in the **eastern tropical Pacific Ocean.**
    - It is the “warm phase” of a larger phenomenon called the El Nino-Southern Oscillation (ENSO).
    - It occurs more frequently than La Nina.
- **La Nina, the “cool phase”** of ENSO, is a pattern that describes the **unusual cooling** of the tropical eastern Pacific.
    - La Nina events may last between **one and three years, unlike El Nino,** which usually lasts no more than a year.
    - **Both phenomena tend to peak during the Northern Hemisphere winter.**

El Nino

- El Nino was **first recognized by Peruvian fishermen** off the coast of Peru as the appearance of unusually warm water.
    - The Spanish immigrants called it **El Nino, meaning “the little boy”** in Spanish.
- El Nino soon came to describe irregular and intense climate changes rather than just the warming of coastal surface waters.
- The El Nino event is **not a regular cycle,** they are not predictable and occur irregularly at two- to seven-year intervals.
    - The climatologists determined that El Nino occurs simultaneously with the Southern Oscillation.
        - The Southern Oscillation is a change in air pressure over the tropical Pacific Ocean.
- When coastal waters become warmer in the eastern tropical Pacific (El Nino), the atmospheric pressure above the ocean decreases.
    - Climatologists define these linked phenomena as **El Nino-Southern Oscillation (ENSO).**

Monitoring El Nino and La Nina

- Scientists, governments, and non-governmental organizations (NGOs) collect data about El Nino using a number of technologies such as **scientific buoys.**

    - A buoy is a type of an **object that floats in water** and is used in the middle of the **seas as locators or as warning points for the ships.** They are generally bright (fluorescent) in colour.
    - These buoys measure ocean and air temperatures, currents, winds, and humidity.
    - The buoys transmit data daily to researchers and forecasters around the world enabling the scientists to more accurately predict El Nino and visualize its development and impact around the globe.
- The **Oceanic Nino Index (ONI)** is used to measure deviations from normal sea surface temperatures.

    - The intensity of El Nino events varies from weak temperature increases (about 4-5° F) with only moderate local effects on weather and climate to very strong increases (14-18° F) associated with worldwide climatic changes.

Oceanic Nino Index (ONI)

- The **Oceanic Niño Index (ONI),** is a measure of the departure from normal sea surface temperature in the east-central Pacific Ocean, is the standard means by which each El Nino episode is determined, gauged, and forecast.

Impact of El Nino

- In order to understand the concept of El Nino, it's important to be familiar with non-El Nino conditions in the Pacific Ocean.

    - Normally, **strong trade winds blow westward** across the tropical Pacific, the region of the Pacific Ocean located between the **Tropic of Cancer and the Tropic of Capricorn.**
- **Impact on Ocean:** El Nino also impacts ocean temperatures, the speed and strength of ocean currents, the health of coastal fisheries, and local weather from Australia to South America and beyond.
- **Increased Rainfall:** Convection above warmer surface waters brings increased precipitation.

    - Rainfall increases drastically in South America, contributing to coastal flooding and erosion.
- **Diseases caused by Floods and Droughts:** Diseases thrive in communities devastated by natural hazards such as flood or drought.

    - El Nino-related flooding is associated with increases in cholera, dengue, and malaria in some parts of the world, while drought can lead to wildfires that create respiratory problems.
- **Positive impact:** It can sometimes have a positive impact too, for example, El Nino reduces the instances of hurricanes in the Atlantic.
- **In South America:** As El Nino brings rain to South America, it brings droughts to Indonesia and Australia.

    - These droughts threaten the region's water supplies, as reservoirs dry and rivers carry less water. Agriculture, which depends on water for irrigation, is also threatened.
- **In Western Pacific:** These winds **push warm surface water** towards the western Pacific, where it borders **Asia and Australia.**

    - Due to the warm trade winds, the sea surface is normally about **0.5 meter higher** and **4-5° F warmer in Indonesia than Ecuador.**
    - The westward movement of warmer waters causes **cooler waters to rise up** towards the surface on the coasts of **Ecuador, Peru, and Chile.** This process is known as **upwelling.**

        - Upwelling elevates cold, nutrient-rich water to the euphotic zone, the upper layer of the ocean.

Previous El Nino Events:

- El Nino events of **1982-83 and 1997-98** were the **most intense** of the 20th century.
- During the **1982-83** event, sea surface temperatures in the eastern tropical Pacific were 9-18° F above normal.
- The El Nino event of **1997-98** was the first El Nino event to be **scientifically monitored from beginning to end.**
- The 1997-98 event produced drought conditions in Indonesia, Malaysia, and the Philippines. Peru and California experienced very heavy rains and severe flooding.
- The Midwest experienced record-breaking warm temperatures during a period known as **"the year without a winter."**

La Nina

- La Nina means The Little Girl in Spanish. It is also sometimes called El Viejo, anti-El Nino, or simply "a cold event."
- La Nina events represent periods of **below-average sea surface temperatures** across the **east-central Equatorial Pacific.**
    - It is indicated by sea-surface temperature decreased by more than 0.9℉ for at least five successive three-month seasons.
- La Nina event is observed when the **water temperature in the Eastern Pacific gets comparatively colder than normal,** as a consequence of which, there is a **strong high pressure over the eastern equatorial Pacific.**

The Conditions of La Nina.

- La Nina is caused by a build-up of **cooler-than-normal waters in the tropical Pacific,** the area of the Pacific Ocean between the Tropic of Cancer and the Tropic of Capricorn.
- La Nina is characterized by **lower-than-normal air pressure over the western Pacific.** These low-pressure zones contribute to increased rainfall.
- La Nina events are also associated with **rainier-than-normal conditions** over **southeastern Africa and northern Brazil.**
    - However, strong La Nina events are associated with catastrophic floods in northern Australia.
- La Nina is also characterized by **higher-than-normal pressure** over the **central and eastern Pacific.**
    - This results in decreased cloud production and rainfall in that region.
- **Drier-than-normal conditions** are observed along the **west coast of tropical South America,** the **Gulf Coast of the United States,** and the **pampas region of southern South America.**

Impact of La Nina

- **Europe:** In Europe, El Nino reduces the number of autumnal hurricanes.
    - La Nina tends to lead to **milder winters in Northern Europe** (especially UK) and colder **winters in southern/western Europe** leading to snow in the Mediterranean region.
- **North America:** It is continental North America where most of these conditions are felt. The wider effects include:
    - **Stronger winds along the equatorial region,** especially in the Pacific.
    - **Favourable conditions for hurricanes** in the Caribbean and central Atlantic area.
    - **Greater instances of tornados** in various states of the US.

    - **South America:** La Nina causes **drought in the** South American countries of **Peru and Ecuador.**
        - It usually has a **positive impact on the fishing industry** of western South America.
- **Western Pacific:** In the western Pacific, La Nina increases the **potential for landfall** in those areas most vulnerable to their effects, and especially into **continental Asia and China.**
    - It also leads to **heavy floods in Australia.**
    - There are **increased temperatures** in Western Pacific, Indian Ocean and off the Somalian coast.

La Nina in 2010

- The 2010 La Nina event correlates with one of the worst floods in the history of Queensland, Australia.
- More than 10,000 people were forced to evacuate, and damage from the disaster was estimated at more than $2 billion.

ENSO and India

- **El Nino:** Strong El Nino events contribute to weaker monsoons and even droughts in India Southeast Asia.
- **La Nina:** The cold air occupies a larger part of India than the El Nino cold air.
- In the 'La Nina year', **rainfall associated with the summer monsoon** in Southeast Asia tends to be **greater than normal,** especially in **northwest India and Bangladesh.**
    - This generally **benefits the Indian economy,** which depends on the monsoon for agriculture and industry.
- It usually brings in **colder than normal winters** in India.
- La Nina influences the Indian subcontinent by piping in **cold air from Siberia and South China,** which interacts with the tropical heating to produce a north-south low-pressure system.
- The **cold air of La Nina** associated with this north-south trough **tends to extend much further south into India.**
    - This is remarkably different from the more northwest-southeast blast of cold air associated with El Nino.
    - The pressure pattern going north-south means lesser impact of western disturbances.
    - The **cold temperature can go down as far as Tamil Nadu,** but **may not affect the North East that much.**

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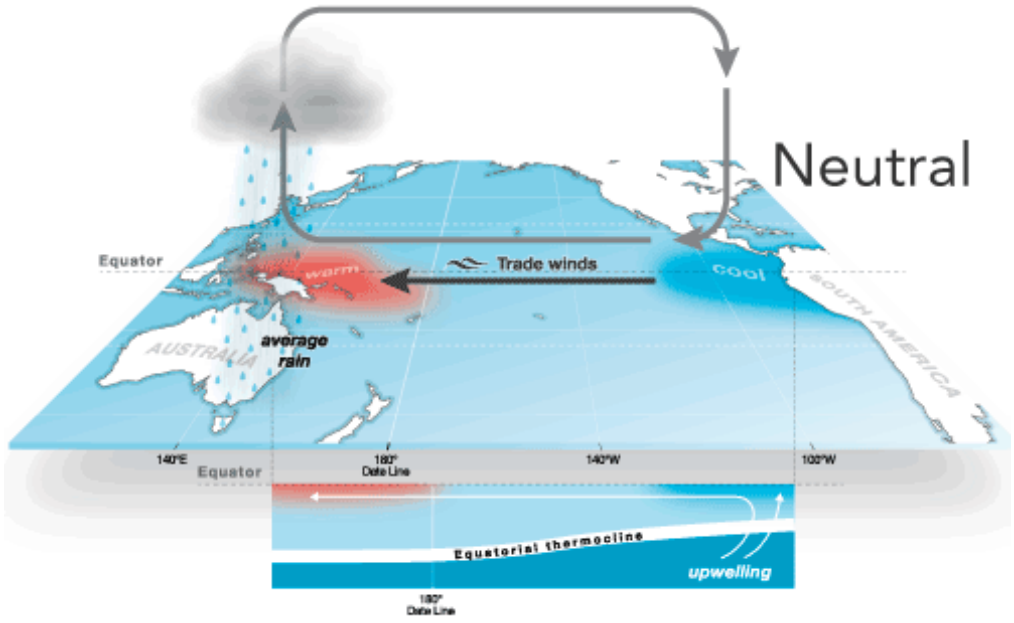
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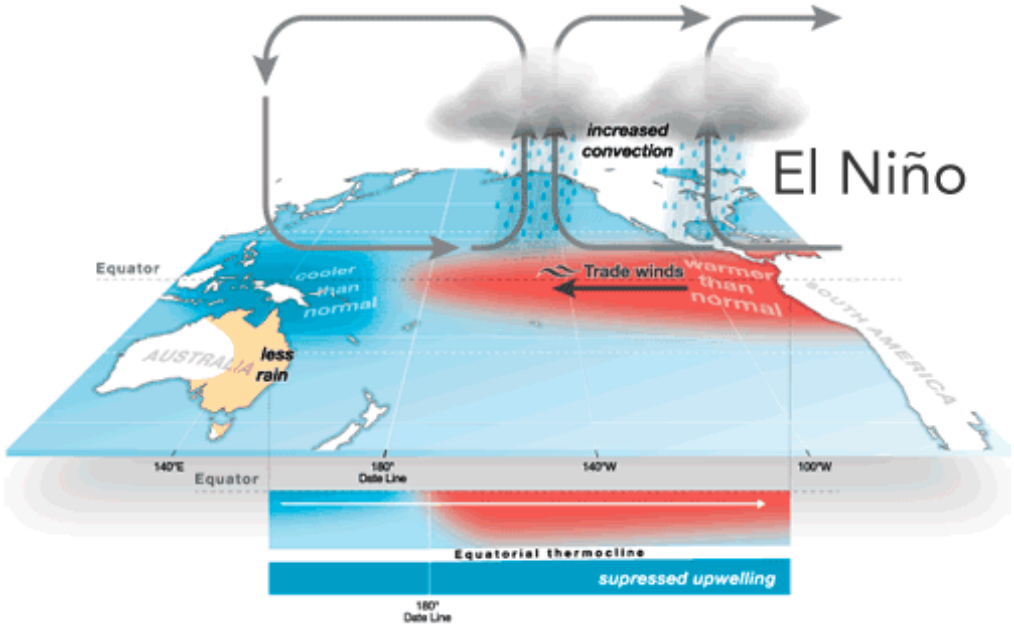
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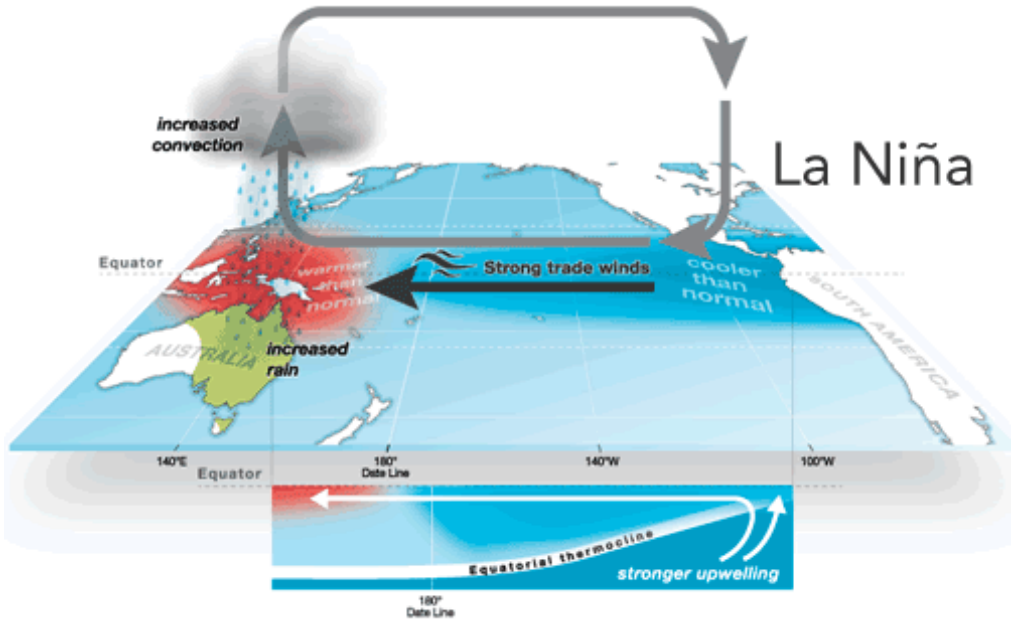
La Niña
increased convection
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Strong trade winds
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increased rain
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