ENSO – Video Tutorial

ENSO, the El Niño Southern Oscillation, is a cyclic climate phenomenon that has a big impact on California. The "oscillation" of this phenomenon is between two end member climate states – El Niño and La Niña – which swing back and forth with a varying interval and varying intensity. Imagine being on a seesaw that goes back and forth – with a somewhat erratic frequency – and raises you a varying amount of height each time. The middle or ***normal*** state was discussed in previous air circulation and current videos: the trade winds blow across the equatorial Pacific from a high pressure system in the east towards a low pressure in the west. These winds drag on the surface water and create the equatorial currents: water that moves westward and piles up off the eastern coasts of northern Australia and Indonesia, supporting some of the largest distribution of coral reefs in the world's oceans. Most of this dome of water is funneled north and south as part of the western boundary currents and continues its movement through the world's surface gyres. However, some water slides back eastward and creates a small trickle of warm water called an equatorial **countercurrent** that runs between the main northern and southern gyre equatorial currents. Under normal circumstances, this countercurrent is weak and small in comparison to the equatorial currents. What's happening in the eastern equatorial Pacific as a result of all this water being pushed west? Because so much surface water is removed, deep water wells up to take its place and brings with it nutrients and cold temperatures. We end up with one of the biggest zones of upwelling in the world's oceans, and those high nutrients support a large ecosystem and highly productive fisheries. The high pressure air system that drives the trade winds sits over the eastern equatorial Pacific, and with the low water content of this high-pressure air, the coastlines of northern Peru and Ecuador and Central America are deserts. During their journey across the Pacific, these same trade winds pick up lots of moisture; and by the time they reach the islands and continents in the west, these air masses are warm and wet; they collide with the rainforests of Indonesia and Northern Australia and dump their water there.

So that's the ***normal*** situation. One end-member of the oscillation happens when the pressure systems that produce the Trade Winds increase; the strength of the winds increase; and the rains are greater in the west; and the land is drier in the east; and the upwelling is even more intense, and we call that a **La Niña**.

An **El Niño** occurs when the pressure systems that cause the Trade Winds weaken or reverse. The normal trickle of a countercurrent intensifies as the entire dome of water in the west slides back over the water in the east. Air masses now move eastward, picking up moisture, and dumping it in the desert regions of the Eastern Pacific. These winds and storms increase wave energy and coastal erosion. Upwelling stops and with it the nutrients that sustain the food web in this area. Without the autotrophs at the base of the chain, the heterotrophs migrate to find new food sources or die. In the western Pacific, the rainforests lose much of their water and suffer droughts and fires.

ENSO is the regular oscillation back and forth between the El Niño and La Niña states. A quick way to determine what state we are in at any given time is to look at the sea surface temperatures in the eastern equatorial Pacific. During El Niño the eastern equatorial Pacific shows warm surface waters as upwelling has stopped. During La Niña the eastern equatorial Pacific has even colder surface water than normal as upwelling intensifies.

How frequent is this oscillation? This graph of past records of ENSO events shows that each state can last 1 to 7 years and be of varying intensities.

How does ENSO affect California? This image shows the sea-surface temperature off of the Los Angeles Basin during January 1982, on the left, and January 1983, on the right – an extreme El Niño year, as indicated by the much warmer surface water. This is water that moved up the coast northward from the equatorial regions where upwelling had stopped. The region from Los Angeles to San Francisco sits just on the northern edge of the desert belts of normal or La Niña conditions. Our normal condition therefore is to have limited rainwater and colder ocean surface currents coming from the poles. During El Niño, that changes, and the weakened or reversed trade winds bring us increased rain storms along with warm water that pushes eastward along the equator and funnels north and south up the coasts. That water changes the fish populations we find off our coast. Bird, sea lion, and seal populations diminish with the fish. During the 1983 El Nino event, California experienced high mortality rates for marine mammals and significant coastal erosion and flooding.

Pause now.

[End credits]

Ocean Circulation Series:
Part 1: Thermohaline Currents
Part 2: Surface Currents
Part 3: Ocean Mixing & Pollution
Part 4: ENSO

ENSO
Geoscience Video Tutorial
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