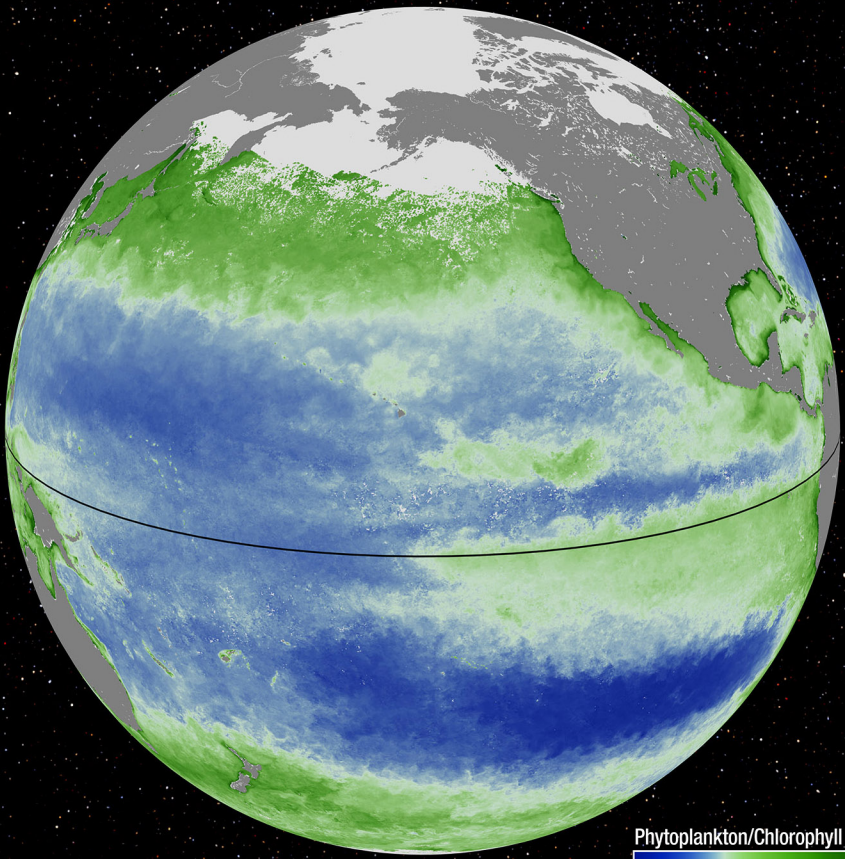
National Aeronautics and Space Administration

Ocean Phytoplankton

El Niño
December 2015



Phytoplankton/Chlorophyll a (mg/m^3)

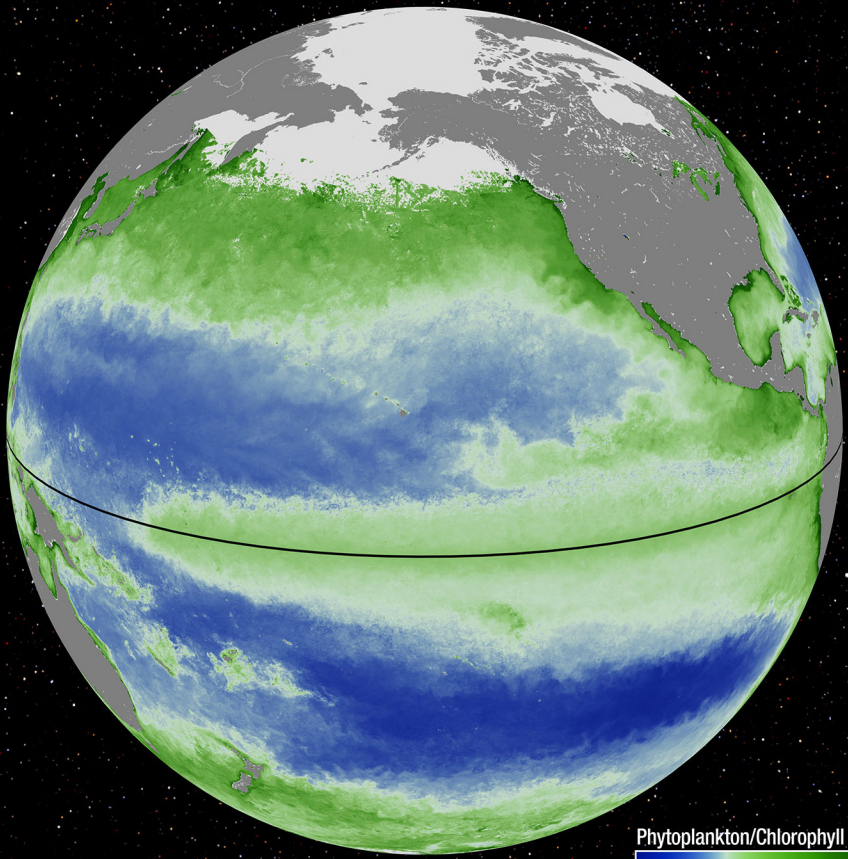
0.01 0.15 20.0

Ocean Phytoplankton

National Aeronautics and Space Administration

NASA

Neutral
December 2013



Phytoplankton/Chlorophyll a (mg/m^3)

0.01 0.15 20.0

Ocean Phytoplankton

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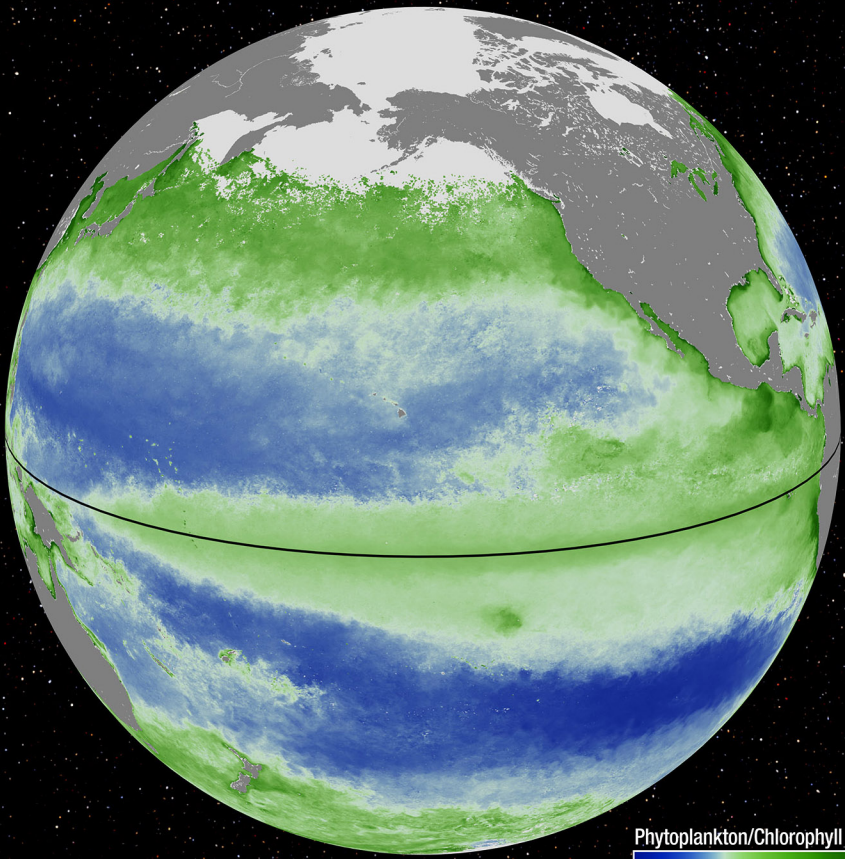
La Niña
December 1999



Phytoplankton/Chlorophyll a (mg/m^3)

0.01 0.15 20.0

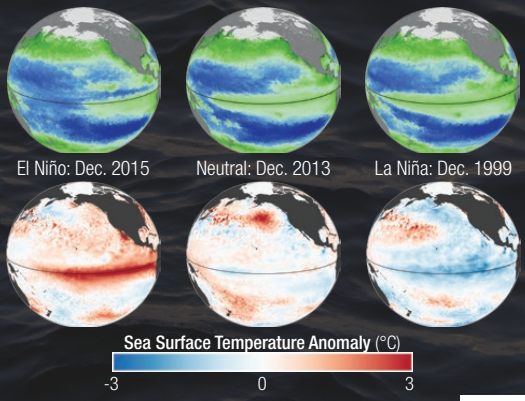
About the Images

The globes show monthly sea surface *chlorophyll a* in the Pacific Ocean as observed during El Niño, neutral, and La Niña conditions. Chlorophyll a is a proxy for phytoplankton abundance. Phytoplankton are primary producers and support ocean food webs. The El Niño and neutral images are derived using data acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite, while the La Niña image is derived from data acquired by the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS). Darker shades of green indicate more chlorophyll, or more phytoplankton. Darker shades of blue indicate less chlorophyll, or less phytoplankton.

How Do El Niño and La Niña Influence Ocean Chlorophyll?

During neutral, or "normal," conditions in the equatorial eastern Pacific, prevailing easterly winds, called *trade winds*, drive warm surface water westward, away from South America. This causes cold, nutrient-rich water to well up to the surface, called *upwelling*. Cold, upwelled waters have more nutrients than the warmer surface waters, therefore, fertilizing blooms of *phytoplankton*—microscopic marine plants. Like plants on land, phytoplankton use chlorophyll and other light-harvesting pigments to carry out photosynthesis.

El Niño and La Niña represent departures from the average, or neutral, conditions. With the onset of El Niño, a drop in air pressure over the equatorial eastern Pacific causes the trade winds to weaken and sometimes even reverse, driving warm water eastward, towards South America. Below the ocean's surface, the eastward migration of the warm pool deepens the *thermocline*—the level that separates warmer surface waters from cooler deep ocean waters. This deeper pool of warm water in the equatorial eastern Pacific curtails the usual upwelling of deep-water nutrients to the surface, causing declining concentrations of sea surface chlorophyll, the green pigment that indicates the presence of phytoplankton. The opposite phase, La Niña, is characterized by strong trade winds, which causes upwelling to intensify in the equatorial eastern Pacific. More intense upwelling generally coincides with higher chlorophyll and phytoplankton concentrations.



These images compare monthly surface chlorophyll concentrations [*top*] and sea surface temperature anomalies [*bottom*] during El Niño, neutral, and La Niña conditions. Image credits: *oceancolor.gsfc.nasa.gov* [*top*]; *www.ncdc.noaa.gov/oisst* [*bottom*]

2015 El Niño Disrupts the Marine Food Web

After five consecutive months with sea surface temperatures 0.5 °C above the long-term mean, the National Oceanic and Atmospheric Administration (NOAA) issued an El Niño Advisory in July 2015 declaring the arrival of the phenomenon. A strong El Niño (with sea surface temperatures more than 2 °C warmer than normal) developed through the Northern Hemisphere fall months, similar to events in 1997–98 and 1982–83.

Due to warmer-than-normal sea surface temperatures, increased stratification, and a decrease in upwelled ocean nutrients, El Niño conditions cause the local marine food web to experience loss of its usual food supply (phytoplankton). Historic observations from impacted coastal areas have shown that with less phytoplankton available, plankton have less to eat, as do the fish that feed upon plankton, and larger marine animals have a greatly reduced food supply. Past El Niños reduced fish stocks and have led to the decline of many marine animal populations.

During the 1997-98 El Niño, there were large population declines within the eastern Pacific marine food web. However, the strong La Niña that followed in 1998–99 had the opposite impact: stronger east-to-west trade winds that increased nutrient upwelling and fertilized one of the biggest phytoplankton blooms detected in the satellite record. The bloom ignited a dramatic increase in fish populations.

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