

## EL NIÑO

El Niño is a major reorganization of the equatorial climate system that affects regions far from its point of origin in the Western Equatorial Pacific

Occurs roughly every 6 years

### Onset recognized by climatic effects

- warm surface waters
- collapse of fisheries
- heavy rains in Peru/Ecuador/central Pacific
- droughts in Indonesia
- change in typhoon tracks

### Southern Oscillation

- Atmospheric pressure differential between Tahiti and Darwin
- Normally low pressure in Darwin, high in Tahiti
- El Niño: high pressure in Darwin, low in Tahiti
- Change in pressure differential results in weakening of easterly equatorial winds

### Normal conditions in the Equatorial Pacific

- Strong easterly winds:
  - Pile up warm water in the western Pacific-- thermocline deep in western Pacific, shallow in eastern Pacific
  - Drive equatorial upwelling-- as thermocline is shallow upwelling brings nutrients to surface waters along the equator
- Strong coastal winds:
  - Cause upwelling of nutrient-rich water along West coast of South America
  - Upwelled nutrients in coastal and equatorial regions support phytoplankton growth fisheries

### Onset of El Niño and the ocean's response

- Pressure at Darwin rises, pressure at Tahiti drops
- Easterly winds weaken
- Warm surface water surges back across central Pacific
- Thermocline drops in the east, rises in the west
- Equatorial upwelling decreases because of lower wind strength
- Coastal upwelling continues but deeper thermocline so only warm low nutrient water upwells
- Phytoplankton population collapses, fisheries collapse

### Effect on the winds and the rain

- Normal conditions:
  - Strong winds blowing over cold upwelled water too dense to rise
  - Rain occurs in western Pacific over warm ocean water
- El Niño conditions:
  - Warm water moves east across Pacific, warm moist air rises
  - Heavy rains in central and eastern Pacific

## How does it end?

- Atmosphere driving the ocean, ocean driving the atmosphere positive feedback loop, no end
- Atmosphere responds very quickly to the ocean, the ocean responds more slowly, "remembers" the past winds
- Thermocline moves across Pacific to the east as a sub-surface wave, another wave moves to the west
- Waves reflect off Asia and return to central Pacific raising thermocline and bringing cold water near the surface again
- Breaks the feedback loop
- El Niño and La Niña alternate every few years, frequency may be changing

## Consequences of El Niño

- Fishery collapse, seabird population collapse
- Lakes in desert region of S America lake fishery
- Coastal estuaries produce shrimp
- Coastal flooding malaria epidemics
- Crop failures:
  - wet regions have droughts
  - dry regions have floods
- Hurricane/typhoon tracks change Tahiti, Hawaii
- Cost 1982/83 El Niño ~ \$8 billion

## Prediction of El Niño

- Build up of warm pool in W Pacific and wind bursts from Asia initiates
- Currently can predict about 12 months in advance
- Allows farmers to plant appropriate crops
- Frequency of onset and severity may be increasing. Global climate change?