



Biophysical response to the 1997-98 And 2009-10 El Niño events in the equatorial Pacific Ocean

Michelle M. Gierach¹, Tong Lee¹, Daniela Turk^{2,3}, and Michael McPhaden⁴

¹Jet Propulsion Laboratory / California Institute of Technology

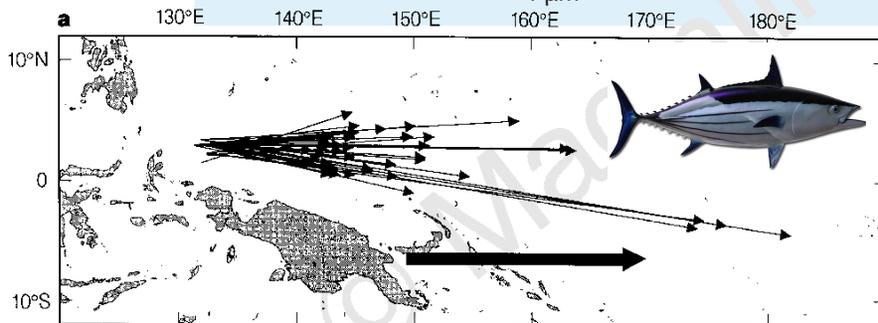
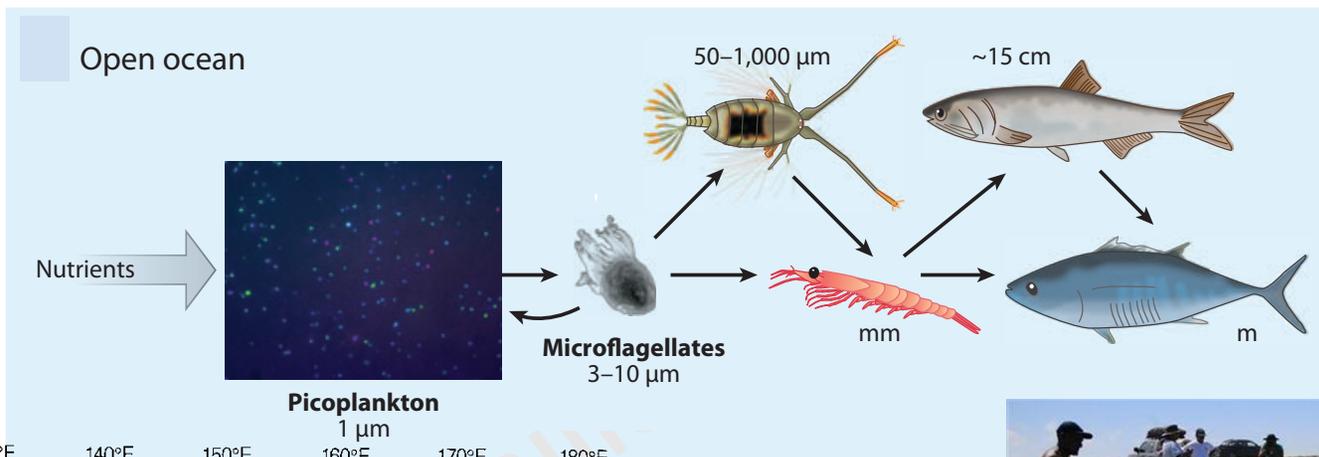
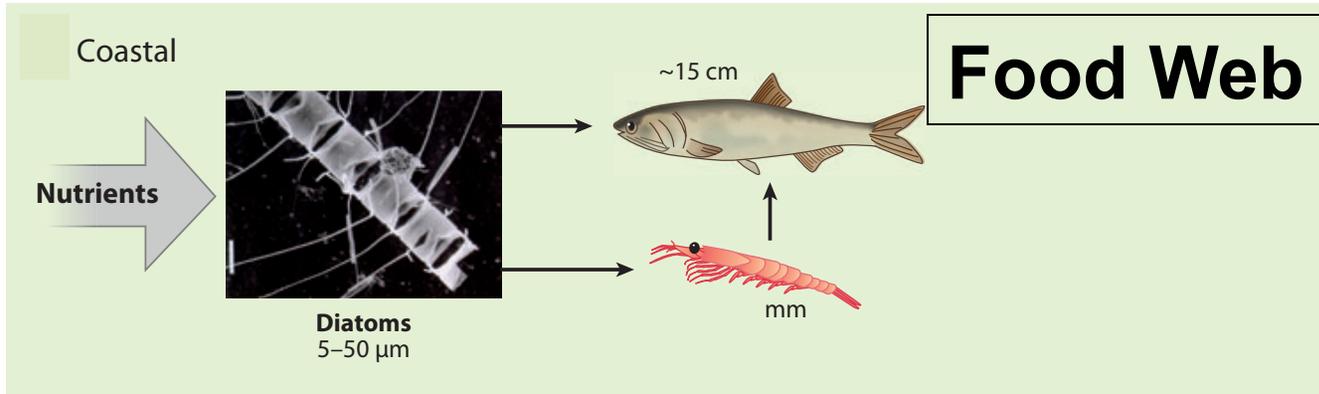
²Dalhousie University

³Lamont-Doherty Earth Observatory, Earth Institute at Columbia University

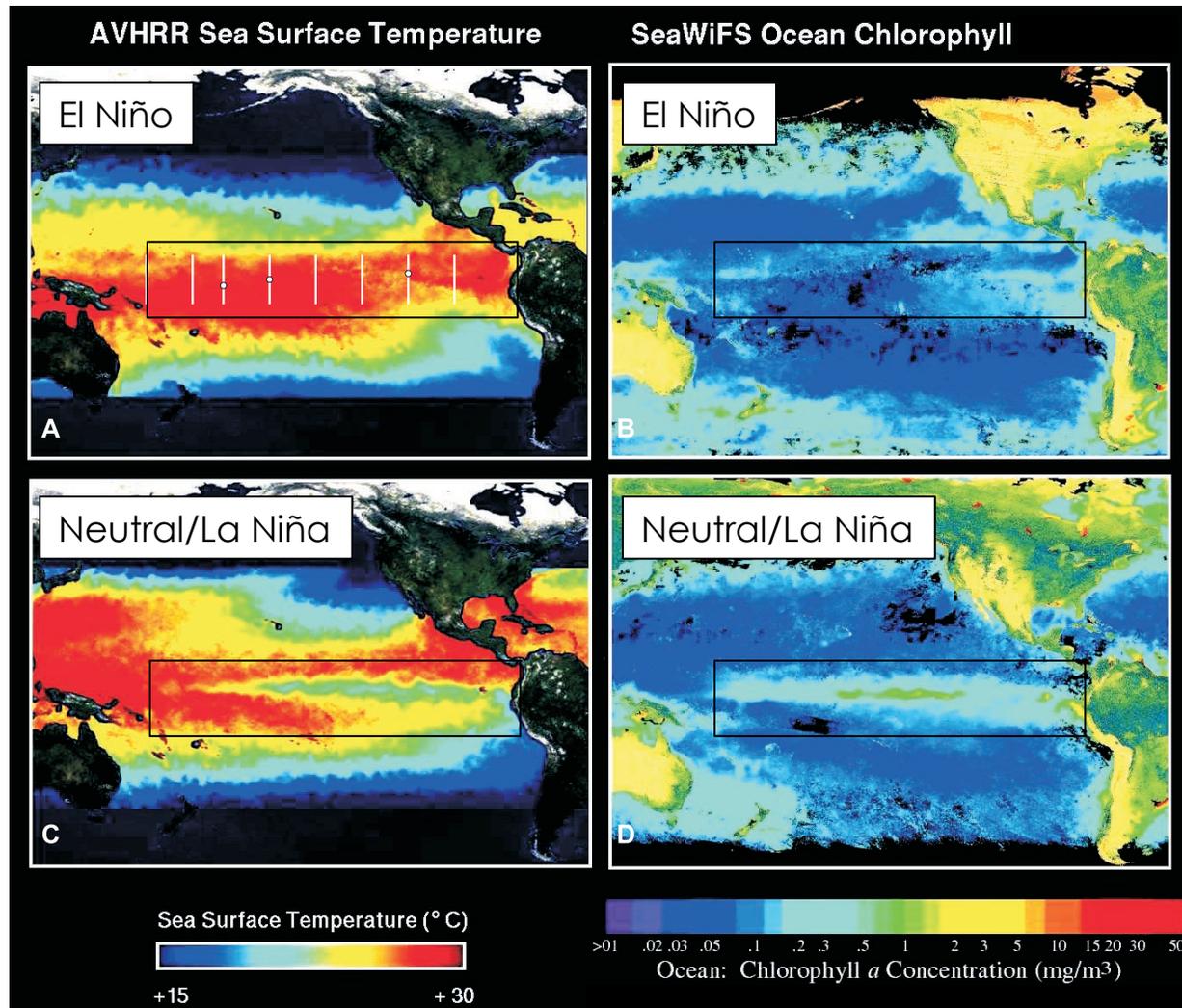
⁴NOAA Pacific Marine Environmental Laboratory

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Why is this important?

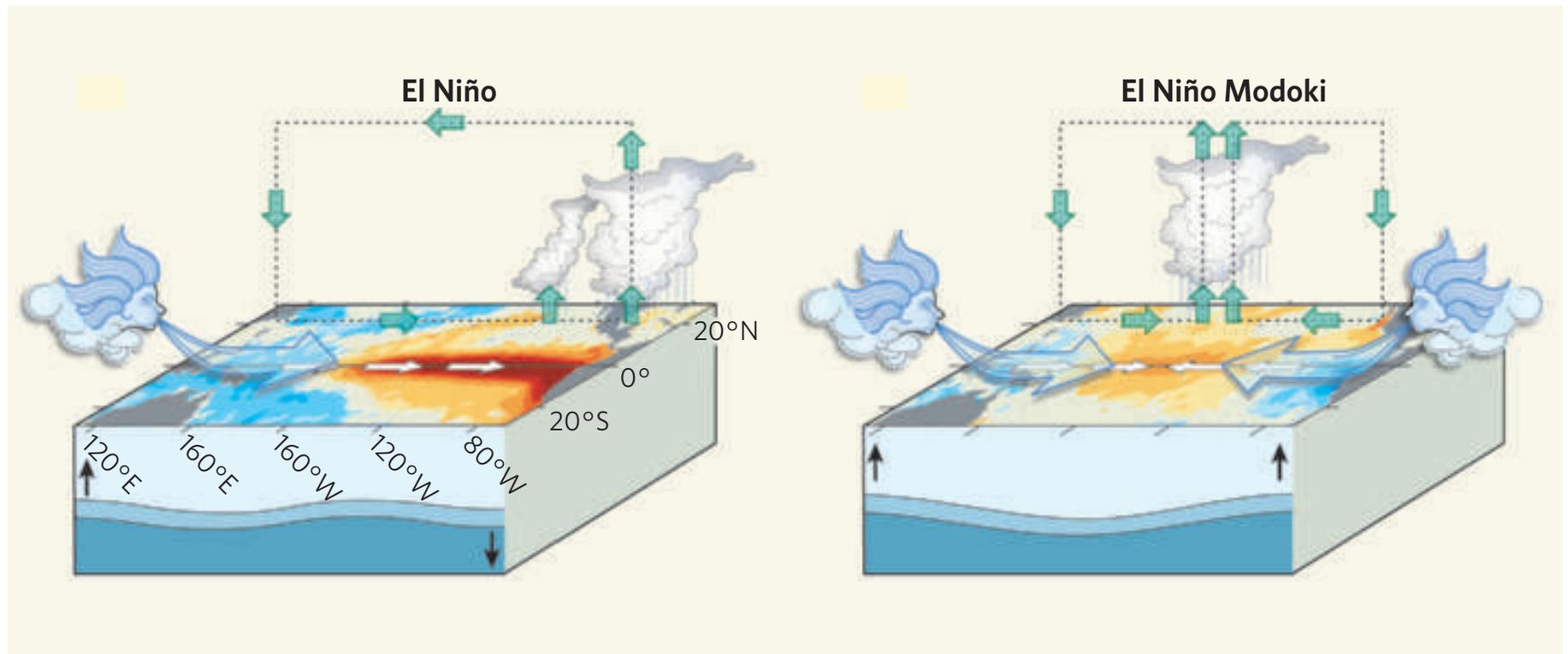


What is known?



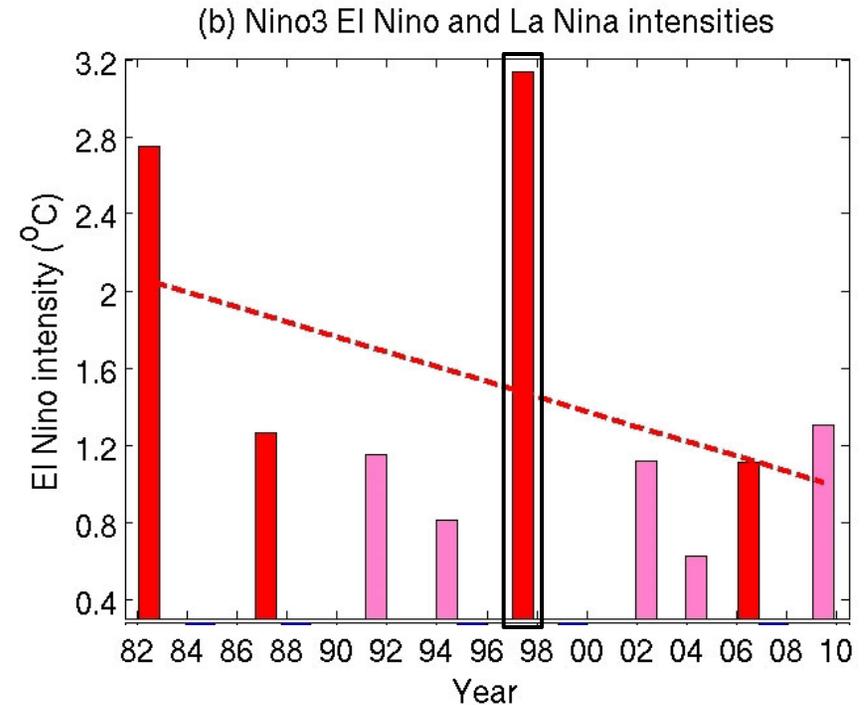
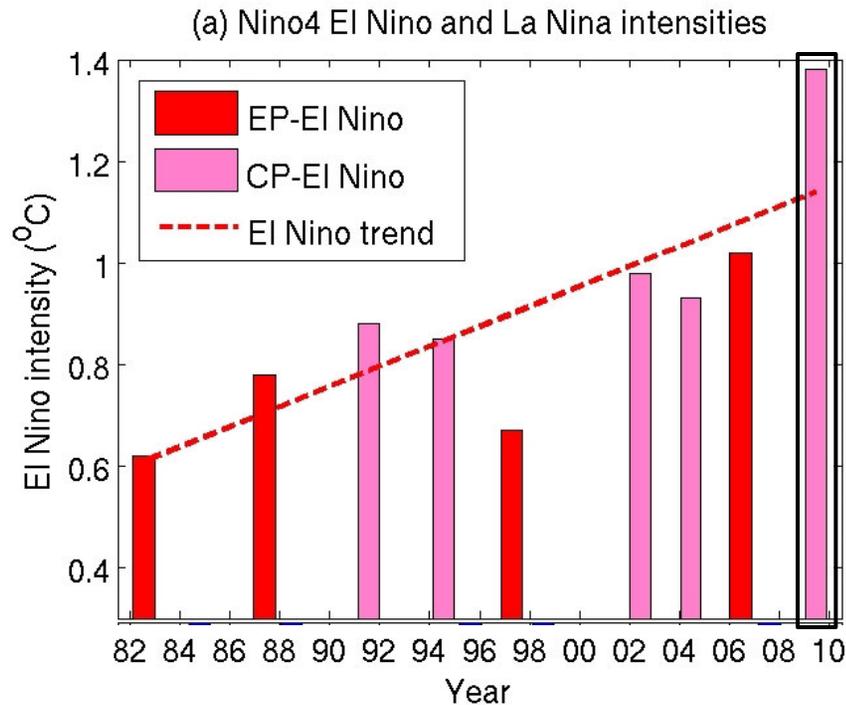
- El Niño has a significant impact on biology and ecosystem in the tropical Pacific
- Previous studies focused on the biological response to the classic eastern Pacific (EP) El Niño

A New Flavor of El Niño : Central Pacific (CP) El Niño



El Niño Modoki, CP-El Niño, warm-pool El Niño, or dateline El Niño

El Niño amplitudes in CP (Niño4) & EP (Niño3) regions

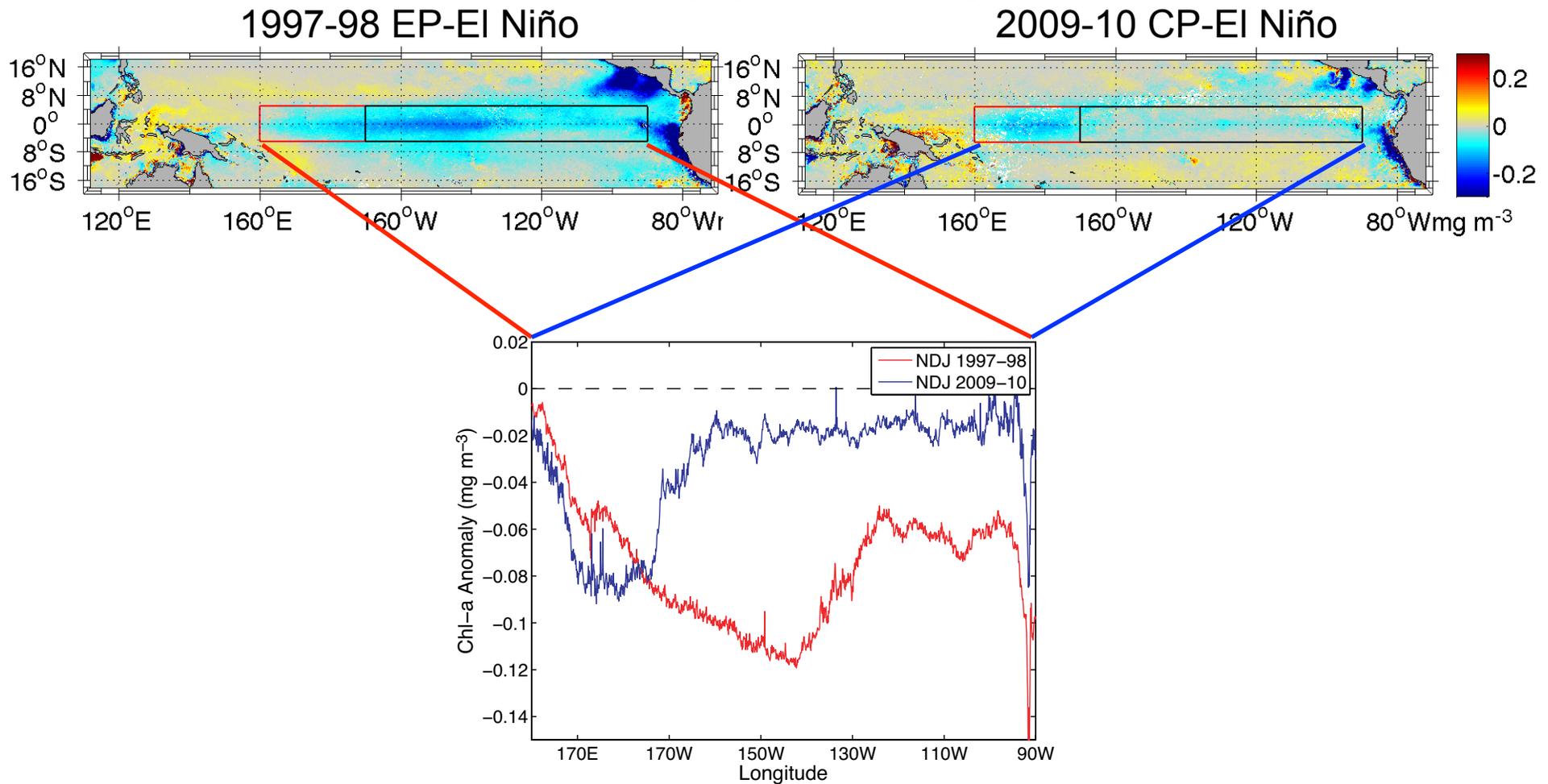


- More frequent occurrence of CP-El Niño
- Increasing amplitude of El Niño in the CP region (Lee & McPhaden 2010)

How does the biological response differ between CP- and EP-El Niño events?

Biological state associated with the two El Niño events

Chlorophyll-a Anomaly



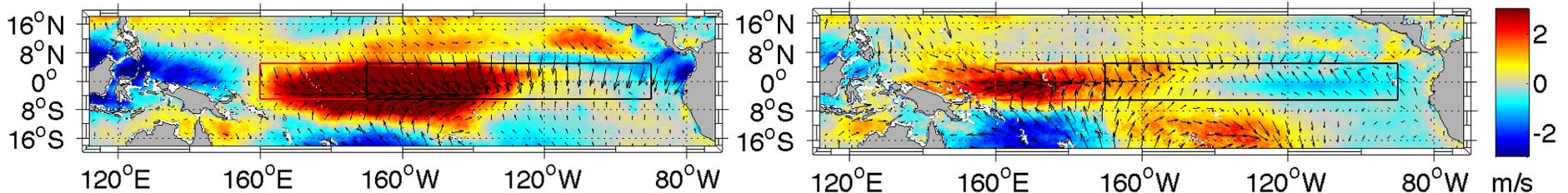
- Maximum chlorophyll-a (chl-a) reduction occurs in the EP region during the 1997 EP-EI Niño and CP region during the 2009-10 CP-EI Niño

Physical state associated with the two El Niño events

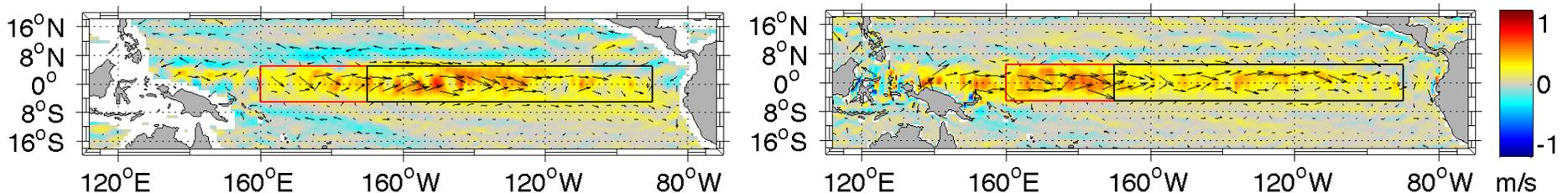
1997-98 EP-El Niño

2009-10 CP-El Niño

Zonal (Eastward) Surface Wind Anomaly



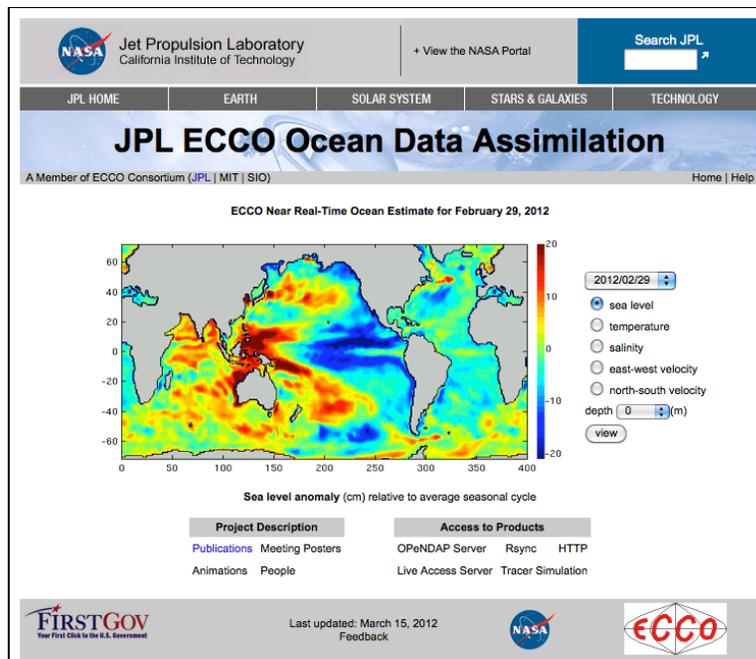
Zonal (Eastward) Surface Current Anomaly



- The extent and magnitude of physical responses between the two types of El Niño is governed by westerly wind anomalies, wherein responses are confined to the CP region during CP-El Niño and EP region during EP-El Niño

Using ECCO to investigate physical processes that cause difference in biological responses

- An adjoint passive tracer tool based on ECCO state estimation was used to assess the relative contributions of horizontal and vertical processes (Fukumori et al., 2004; Wang et al. 2004)
 - A uniform tracer was initialized in Dec. 1997 & 2009 in the top 50 m of the EP & CP regions
 - The tracer was integrated backwards in time to trace water mass (nutrient supply) origin



<http://ecco.jpl.nasa.gov/external/>

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Submit Request for Passive Tracer Integration

Please fill in the form (all fields are required)

Your Name:

Email:

Longitude: Western End Eastern End
(deg E) 210 270

Latitude: Southern End Northern End
(deg N) -5 5

Depth: Top Bottom
(in meter) 0 50

Time: Start End
(yyyy-mm-dd) 1997-12-31 1997-01-01

submit

Please provide your name and email address.

This is an experimental web-based tool allowing users to conduct passive tracer simulations to study pathways of ocean circulation using ECCO's time-variable circulation estimates. Tracers will be initialized to a unit value (in an arbitrary tracer unit) in a user defined region and will be integrated over a time period, both entered in the fields at left. Adjoint tracer integrations will be carried out otherwise. The resulting tracer and adjoint tracer evolutions describe where the tracer-initiated water goes to and comes from, respectively (Fukumori et al., 2004, J. Phys. Oceanogr., 34, 582-604). A link will be e-mailed following the user's request, where the resulting tracer evolution (binary fields at 10-day intervals) will be available upon completion of the integration. This is an autonomous calculation. Integration times will depend on demand. Use the feedback link below for further assistance.

FirstGov Your First Click to the U.S. Government

Last updated: July 20, 2004 Feedback

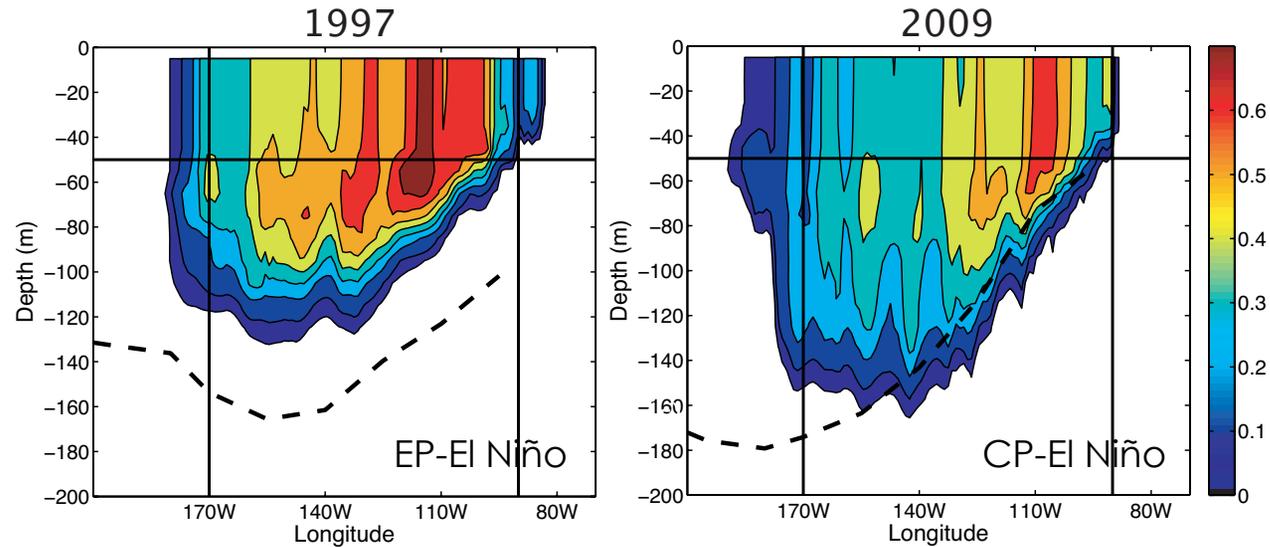
NASA ECCO

<http://ecco.jpl.nasa.gov/tracer/>

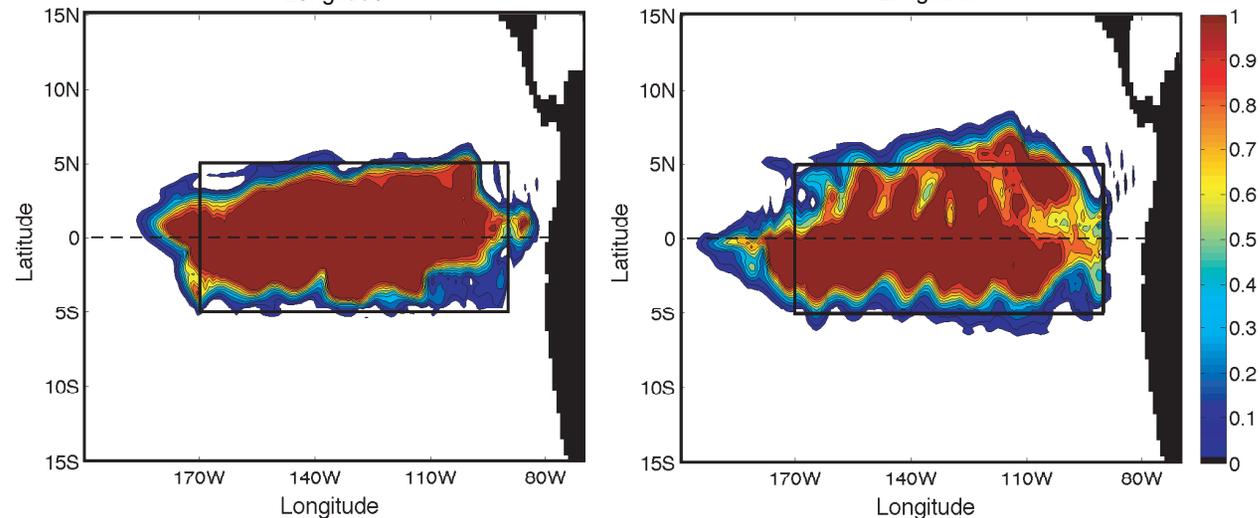
EP region: adjoint tracer distribution in October (3 months after the backward tracing)

Eastern Equatorial Pacific

X-Z distribution:
integrated from
5S-5N



X-Y distribution:
integrated from
0-160m

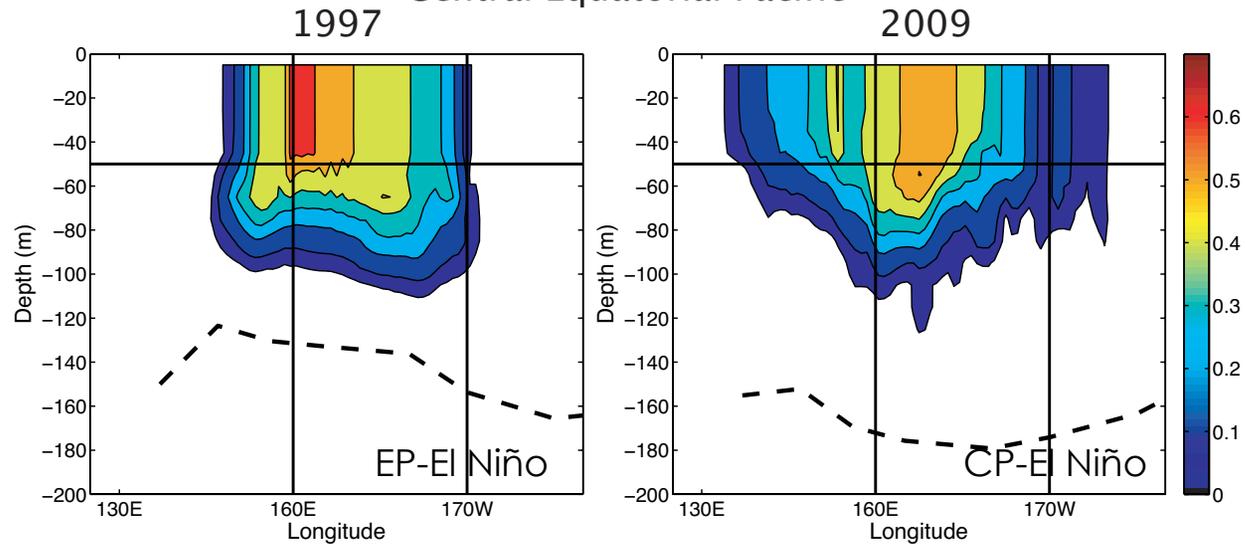


Main difference: The 1997 event had a significant reduction in nutrient influx due to weakened wind-driven upwelling and vertical mixing (vertical processes)

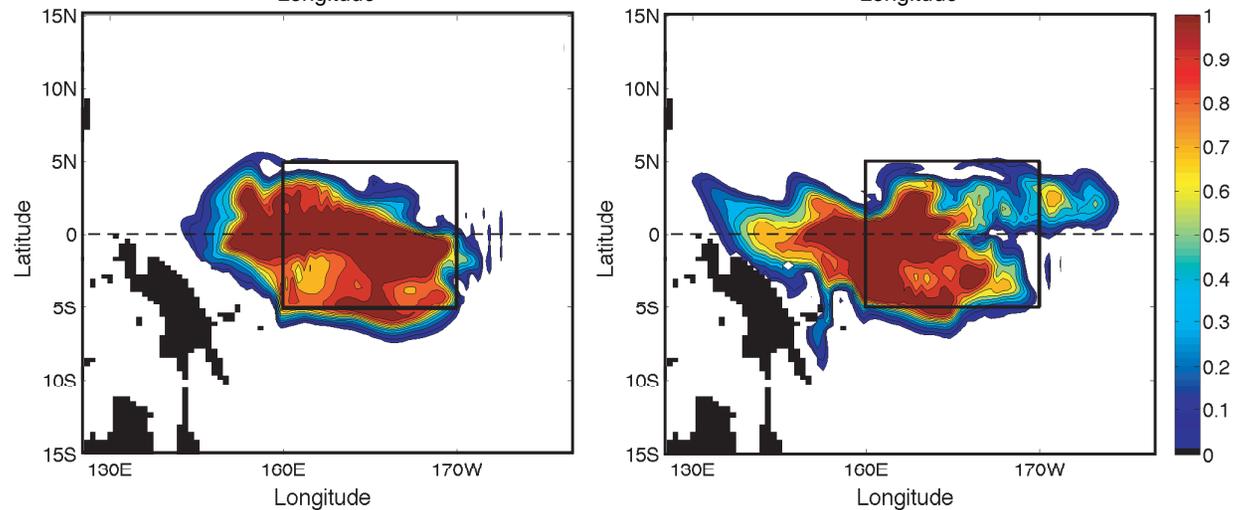
CP region: adjoint tracer distribution in October (3 months after the backward tracing)

Central Equatorial Pacific

X-Z distribution:
integrated from
5S-5N



X-Y distribution:
integrated from
0-160m



Main difference: The 2009 event had greater advection of nutrient-depleted waters from the western Pacific by anomalous eastward surface currents (horizontal process)

Summary

- Chl-a reduction was large in the EP region during the 1997 EP-El Niño because of decreased wind-driven upwelling & vertical mixing that inhibited the subsurface nutrient supply
- Chl-a reduction was large and confined to the CP region during the 2009 CP-El Niño because of strong advection of nutrient-depleted water by anomalous eastward surface currents
- Realistic vertical and horizontal processes of the physical state, in particular, property conservation, is important to the interpretation of biological response

Questions...

