

Geog 133 - Tropical Meteorology

Lab 4 - Non-Seasonal Variations of the Tropical Circulation

1. What does ENSO stand for (1pt)? ENSO is a coupling between oceanic and atmospheric systems. Which system (atmospheric or oceanic) is described by EN (1pt), and which for SO (1pt)?

ENSO = El Nino Southern Oscillation; “El Nino” refers to warm ocean currents & “Southern Oscillation” refers to the atmospheric pressure variations across the equatorial pacific.

2. What is the main feature of the Southern Oscillation (SO) phenomena in the atmosphere (i.e. what parameter is associated with SO)? (1pt)? What two geographic locations are used to measure the SO (1pt)? Write the equation for calculating the Southern Oscillation Index (SOI) (Hint: Think about the equation in terms of the two locations; 2pts).

The main feature of SO is Pressure variation. Darwin and Tahiti are on the western and eastern sides of the pacific basin where the greatest pressure variations exist.

$$\frac{[(\text{Pressure}_{\text{Tahiti}} - \text{Pressure}_{\text{Darwin}}) - (\text{Avg}(\text{Pressure}_{\text{Tahiti}} - \text{Pressure}_{\text{Darwin}}))]}{\text{Standard deviation of}(\text{Pressure}_{\text{Tahiti}} - \text{Pressure}_{\text{Darwin}})}$$

3. The goal of this question is to provide an *overview* of the *climatology* of sea surface temperature and sea level pressure to understand changes during ENSO events. Go to the CDC NOAA website (<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl>) and plot the Sea Surface Temperature (SST) and Sea Level Pressure in December for the last 30 years (1980-2009). **In your analysis: what does a positive SOI mean, and what does a negative SOI mean (2pts)? What are the “normal” pressure situations in the eastern and westerns Pacific (1pt)? In other words, which side of the Pacific usually has high pressure and which side usually has low pressure (1pt per plot; Include the figures in your lab answers)?**

Note: The SST is defined as Surface Skin Temperature, instead of Sea Surface Temperature. A skin surface temp is a way to accurately represent temperature of the surface whether it is land or sea.

Which variable? ____ (choose SST NCEP Reanalysis Model)

Beginning month of season: ____ Ending month: ____ (choose **Dec** for both)

OR Enter range of years: ____ (choose 1980 to 2009)

Color? ____ (choose color)

Shading: ____ (choose Shaded w/overlying contours)

Map projection: ____ (Choose Custom)

Lowest lat: ____ (choose -30)

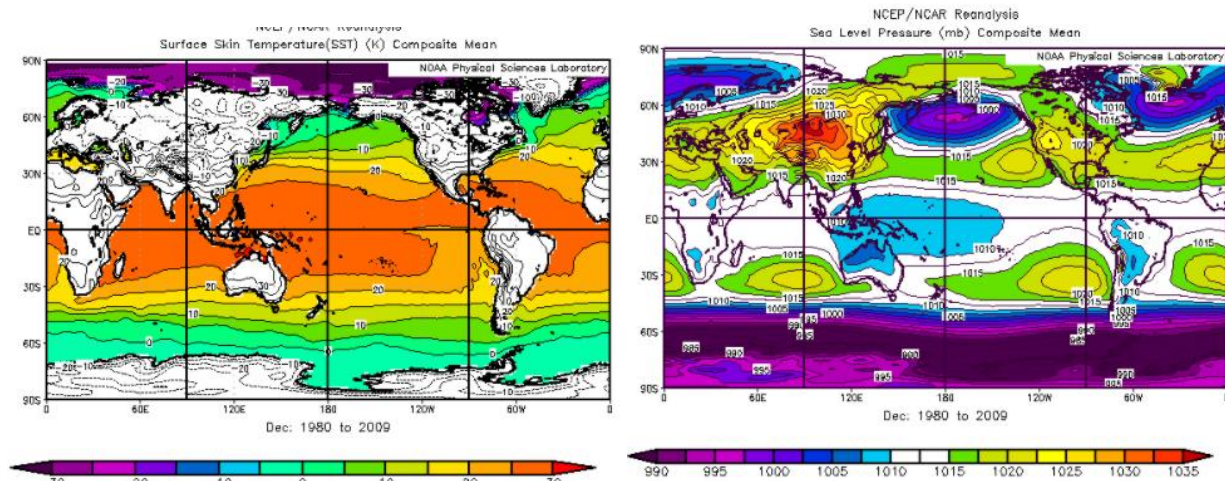
Highest lat: ____ (choose 30)

Western-most longitude: ____ (choose 100)

Eastern-most longitude: ____ (choose 290)

CUSTOM projection: ____ (choose Cylindrical Equidistant)

Now, repeat the procedure for the “Sea Level Pressure” variable.



Positive SOI: indicates a colder oscillation phase, representing La Nina

Negative SOI: indicates a warmer oscillation phase, representing El Nino

Normal pressure situations in the western pacific (Australia) are lower (~1007mb), and in the eastern pacific (Peru) are higher (~1017mb).

4. The goal of this question is to interpret patterns of anomalies in sea surface temperatures and sea level pressure during El Niño events. Go to the CDC NOAA website (<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl>) and plot the Sea Surface Temperature Anomalies and Sea Level Pressure in December for the last 11 El Niño years (Include the figures in your lab answers)

Which variable? ____ (choose SST NCEP Reanalysis Model)

Beginning month of season: ____ Ending month: ____ (choose **Dec** for both)

Enter years for composites (from 1 to 20): (input each year into a separate box: 1982, 1986, 1987, 1991, 1994, 1997, 2002, 2004, 2006, 2009, 2015)

Plot type? (choose Anomaly)

Color? ____ (choose color)

Shading: ____ (choose Shaded w/overlying contours)

Map projection: ____ (Choose Custom)

Lowest lat: ____ (choose -30)

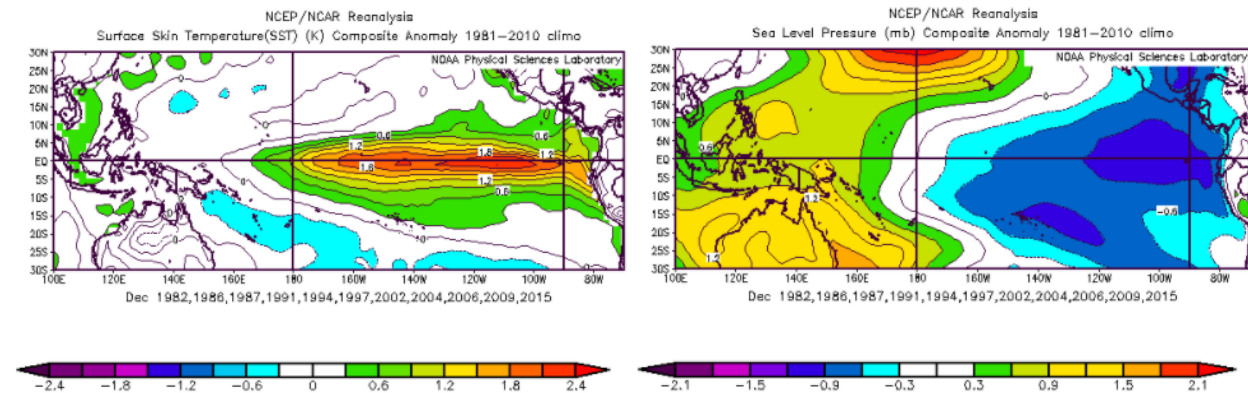
Highest lat: ____ (choose 30)

Western-most longitude: ____ (choose 100)

Eastern-most longitude: ____ (choose 290)

CUSTOM projection: ____ (choose Cylindrical Equidistant)

Now, repeat the procedure for the “Sea Level Pressure” variable.



a. What does the term “El Niño” refer to in ENSO (i.e. what happens to sea surface temperatures near the central/eastern Pacific) (2pts)?

Sea-surface temperatures during ENSO warm (increase), the temperature increases affect the eastern pacific more than the western basin.

b. During an El Niño event, what part of the Pacific Ocean becomes warmer than normal? What are the main reasons for the observed change in sea surface temperatures? (Discuss the coupling between ocean and atmosphere, with focus on variations in the anticyclones, trade winds and changes in the Walker cell) (4 pts for analysis, and 2pts for plots).

The eastern section of the southern pacific typically becomes warmer than normal during ENSO. The main reason of the changes in temperature is the drop in the SOI, representing not only lower pressure and potential anticyclones, but also higher surface temperatures. The surface heat of the ocean is transferred into the atmosphere, creating more cloud coverage and precipitation.

5. The goal of this question is to train students to interpret the present climatic conditions associated with ENSO.

Go to the *Tropical Atmosphere Ocean Project (TAO) data display website* (<http://www.pmel.noaa.gov/tao/jsdisplay/>). Click on “Depth Section”. On “Date” choose the latest data available.

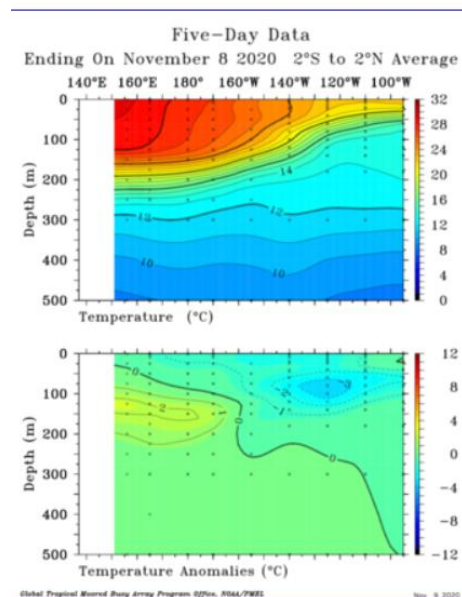
Make sure that that “One Date” is selected and the “Temperature” variable is selected for both the left-hand and right-hand sides of the page. Make sure “Mean” is checked for the left hand side of the page and that “Anomaly” is checked for the right hand side. Also on the right-hand side of the page, make sure “5-Day” is selected from the dropdown box. Keep the depths on both sides of the page to be “0m” and “500m”. Lastly, select the most recent date possible. Then click on “Display”. **Save the figure and include it on your lab answers.**

The figure presents a vertical section of sea temperature (longitude by depth) over the Equatorial Pacific Ocean (2°S to 2°N). The top figure shows the mean (5-day) temperature and the bottom figure shows sea temperature anomalies.

Based on these figures and on your knowledge about the ENSO phenomenon, identify whether we are currently trending toward an El Niño or La Niña and briefly discuss the expected impacts in the USA.

You can explore more about the phenomenon by looking at the expert discussions at <http://www.cpc.noaa.gov/products/precip/CWlink/MJO/enso.shtml>

(2 pts for plot, 4 points for describing what present condition we are in and the future projection for the fall and winter, and what weather conditions this may bring to regions of the US.)



Currently, we are approaching a colder phase, El Niño is ending. The eastern Pacific is cooling, and will not have as much cloud generation and rain, thus a La Niña phase is upcoming.

6. What are the expected impacts (precipitation, winds, etc.) of El Niño (2pts) and La Niña (2pts) events on the west coast of the USA, and particularly over southern California?

El Nino typically brings rains, floods, and higher winds to southern California.

La Nina typically brings cooler air, water, and a drier climate to southern California