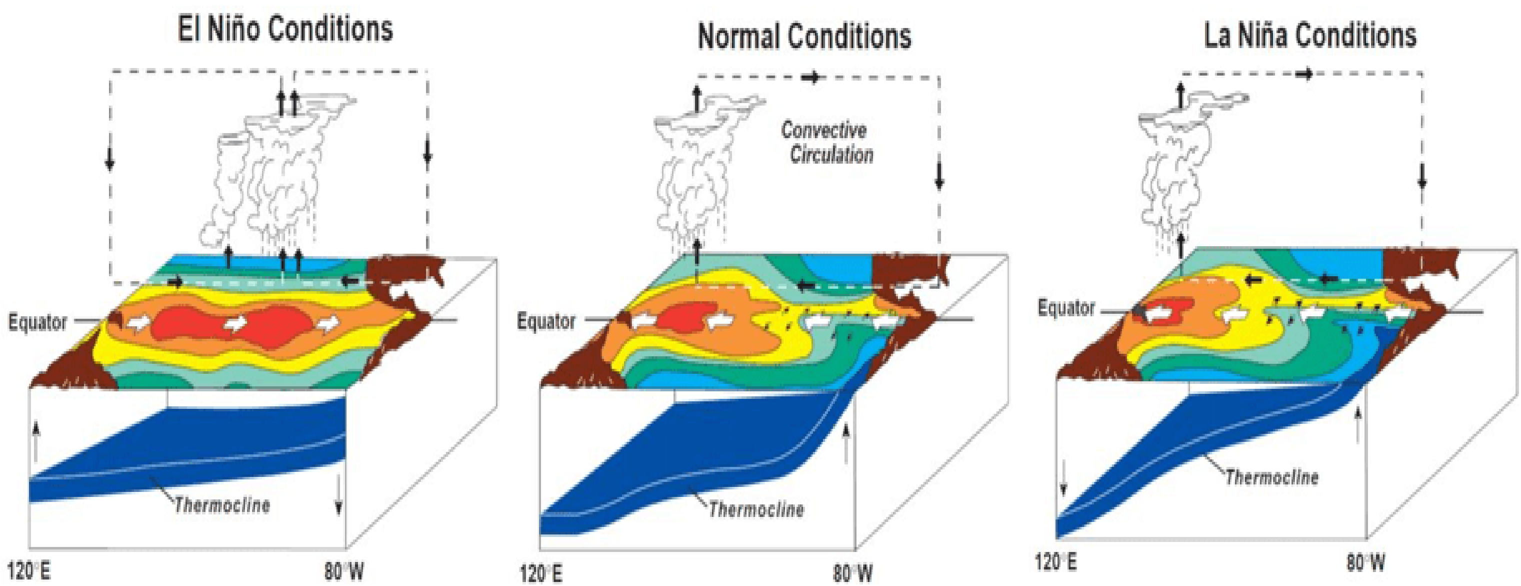
OCEA90 Week 7 activity

1. The figure below is showing the El Niño Southern Oscillation phenomena in Neutral, Niño and Niña conditions.



Compare the three conditions in terms of the winds, temperature, thermocline and air surface pressure differences in the western and eastern Pacific.

Winds:

1. **El Niño Conditions**: The trade winds weaken or change direction, leading to decreased upwelling and eastward movement of warmer water toward South America's coast.
2. **La Niña Conditions**: The trade winds strengthen, causing increased upwelling and the eastward flow of cooler water.
3. **Neutral Conditions**: The trade winds maintain their typical strength and direction.

Temperature:

1. **El Niño Conditions**: Eastern Pacific sea surface temperatures rise above average, while the western Pacific experiences a slight cooling.
2. **La Niña Conditions**: Eastern Pacific sea surface temperatures drop below average, while the western Pacific warms up.
3. **Neutral Conditions:** Sea surface temperatures remain close to average in both the western and

Thermocline:

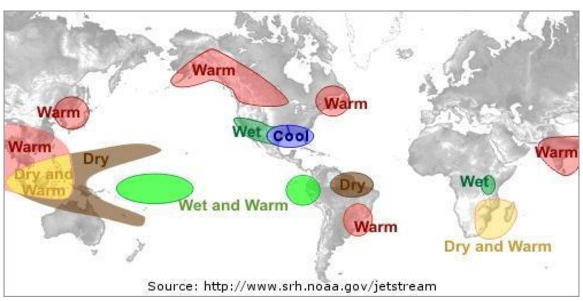
1. **El Niño Conditions**: The eastern Pacific's thermocline becomes shallower, reducing the temperature contrast between surface and deeper waters. Meanwhile, the western Pacific's thermocline deepens, leading to cooler water temperatures.
2. **La Niña Conditions**: The eastern Pacific's thermocline deepens, while the western Pacific's thermocline becomes shallower.
3. **Neutral Conditions**: The thermocline remains relatively flat, with no significant differences between the western and eastern Pacific.

Air surface pressure:

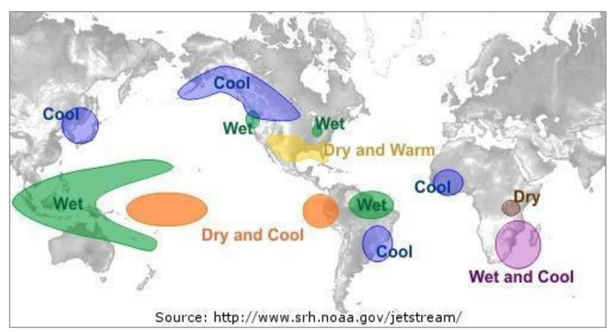
1. **El Niño Conditions**: Air surface pressure decreases in the eastern Pacific and increases in the western Pacific.
2. **La Niña Conditions**: Air surface pressure increases in the eastern Pacific and decreases in the western Pacific.
3. **Neutral Conditions**: There are no significant differences in air surface pressure between the western and eastern Pacific.

2. The figures below show the global influences of ENSO on climate during Niño years and Niña years.

Niño



Niña



What temperature/precipitation conditions are likely to be prevalent in the western United States and Canada during Niño years? During Niña years?

*Note that these are potential influences that may happen, but will not necessarily happen for **every** Niño/Niña events.*

El Niño and La Niña, In the western United States and Canada, these phenomena exert significant influence on temperature and precipitation.

1. **During El Niño years, the region typically experiences warmer and drier conditions as the southward shift of the jet stream forms a high-pressure ridge, blocking storms and reducing precipitation.**
2. **La Niña years, cooler and wetter conditions prevail due to the northward shift of the jet stream, leading to the formation of a low-pressure trough that allows storms to bring increased precipitation and cooler temperatures to the area.**

3. The table below presents average SST (°C) in the Nino 3.4 region for the year 2019. The "climatology" for that region is also presented, i.e., SST averages for each month for the period of 1981-2010.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	27.1	27.4	28.1	28.4	28.5	28.3	27.6	27.1	26.9	27.3	27.3	27.1
Mean 1981-2010	26.6	26.8	27.3	27.8	27.9	27.7	27.2	26.9	26.8	26.7	26.7	26.6
Anom 2019												

a) Calculate the anomalies for each month during 2019 and fill the last row in the table.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	27.1	27.4	28.1	28.4	28.5	28.3	27.6	27.1	26.9	27.3	27.3	27.1
Mean 1981-2010	26.6	26.8	27.3	27.8	27.9	27.7	27.2	26.9	26.8	26.7	26.7	26.6
Anom 2019	***0.5***	***0.6***	***0.8***	***0.6***	***0.6***	***0.6***	***0.4***	***0.2***	***0.1***	***0.6***	***0.6***	***0.5***

b) Using a threshold of an anomaly above 0.5 °C corresponds to Niño years and below -0.5 °C corresponds to Niña years, tag the different months as either Niño, Niña or neutral.

Niño: Feb, Mar, Apr, May, Jun, Oct, Nov

Niña: Jul, Aug, Sep

Neutral: Jan, Dec

c) Note that often climatologies are calculated with reference to a base period (1981-2010 here). Can you think of an advantage for using a base period as opposed to the continuously growing overall record?

In my opinions, I think using a base period like 1981-2010 for calculating climatologies provides a stable reference point for comparing current climate conditions. It helps in identifying long-term trends and anomalies by providing a consistent baseline for analysis. This approach allows researchers and climate scientists to assess deviations from typical climate patterns and better understand variations in weather and climate over time.

4. The CDF of the Nino 3.4 index for the period 1870-2019 is plotted in the figure below. Based on this CDF, estimate the probabilities of

a) a Niño event (anomaly > 0.5)

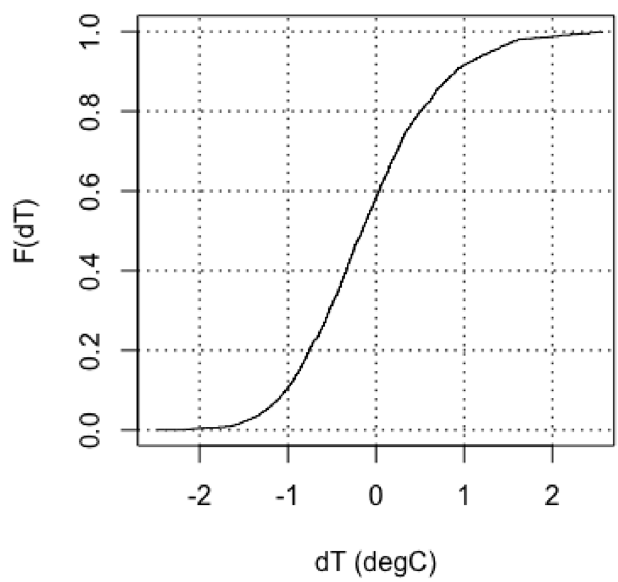
1 - 0.6 = 0.4

b) a Niña event (anomaly < -0.5)

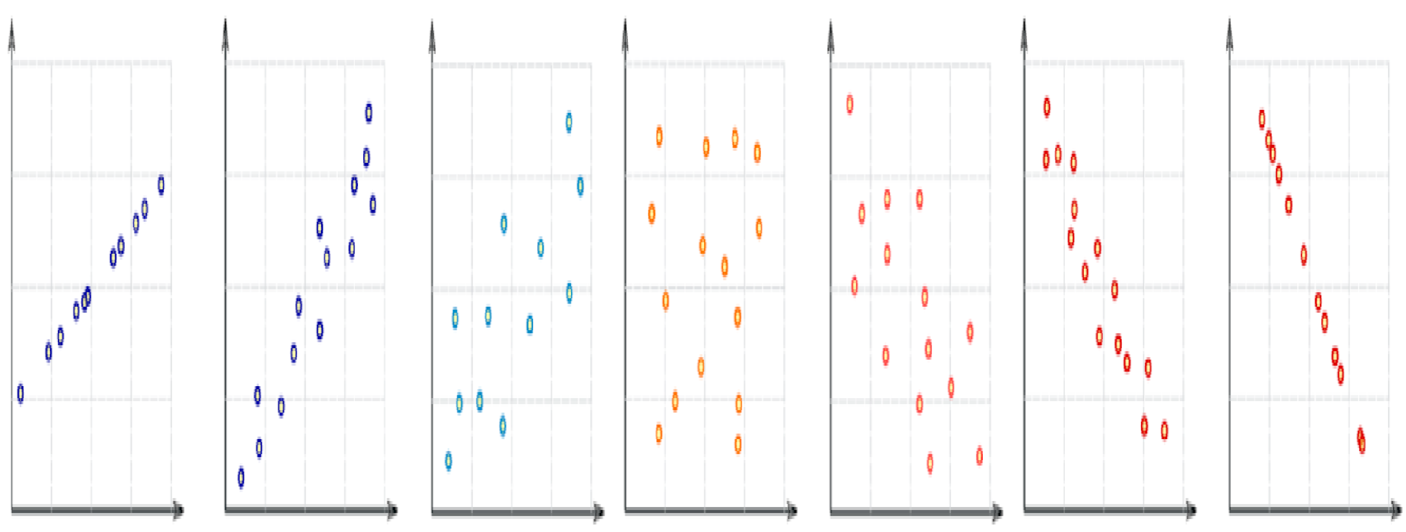
0.1 or 0.2

c) neutral conditions (-0.5 < anomaly <0.5)

0.6



5. Look at the different scatterplots below. Which correlation coefficient best fits each scatterplot? A. -1, B. 1, C. 0, D. -0.9, E. -0.5, F. 0.9, G. 0.5



B. 1 F. 0.9 G. 0.5 C. 0 E. -0.5 D. -0.9 A. -1

6. The table below presents pairs of points representing temperatures at two neighbor locations, say *x* and *y*

$\overline{x}$ = ***20.0+21.3+19.0+18.9+20.5/ 5 = 99.7/5 = 19.94***

$\overline{y}$ = ***3.4+26.5+22.8+22.5+24.6 / 5 = 119.8 / 5 = 23.96***

i	1	2	3	4	5
x_i	20.0	21.3	19.0	18.9	20.5
y_i	23.4	26.5	22.8	22.5	24.6
$x_i - \overline{x}$	*0.06*	*1.36*	*0.94*	*-1.04*	*0.56*
$y_i - \overline{y}$	*-0.56*	*2.54*	*-1.16*	*1.46*	*0.64*
$(x_i - \overline{x})(y_i - \overline{y})$	*-0.0336*	*3.4544*	*-1.0904*	*-1.5184*	*0.3584*
$(x_i - \overline{x})^2$	*0.0036*	*1.8496*	*0.8836*	*1.0816*	*0.3136*
$(y_i - \overline{y})^2$	*0.00001129*	*6.4516*	*1.3456*	*2.1316*	*0.4096*

Calculate the correlation coefficient between the two variables, such that

$$r = \frac{\sum_{i=1}^{N}(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{N}(x_i - \overline{x})^2 \sum_{i=1}^{N}(y_i - \overline{y})^2}}$$

The table has blank rows to help you carry out the different steps, one at a time.

$\boxed{\sum (x_i - \bar{x})(y_i - \bar{y})}$ $=$ −0.0336+3.4504-1.0904-1.5184+0.3584= 6.380

$$\sum (x_i - \bar{x})^2 = 5.132$$

$$\sum (y_i - \bar{y})^2 \quad 10.652$$

Hence

$\sqrt{5.132 \cdot 10.652}$

The radical cannot be simplified, but it can be approximated.

Exact Form:

$\sqrt{54.666064}$

Decimal Form:

$7.39365024\ldots$

Tap to view steps...

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{(5.132 \times 10.652)}} = \frac{6.380}{7.397} = 0.863$$