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OCEA10: introduction to oceanography

**Identifying patterns of change in the equatorial Pacific:
sea surface temperature and wind**

We can understand changes in the way that the ocean and atmosphere move by looking at changes in the ocean and atmosphere over several years. You’re going to look at some ocean and atmosphere data collected from the equatorial Pacific to try to understand how conditions in the Pacific Ocean change over time.

You have 10 years of January ocean surface temperature data and wind data (1992-2001). Focus on the top maps first. The top maps illustrate **average** January sea surface temperature and wind. There are three symbols on the map:

* The colors represent surface seawater temperature in degrees Celsius. If you are more comfortable thinking in Fahrenheit, 18 C is roughly 64 F, while 30 C is roughly 86 F.
* The lines are called contour lines and also represent temperature. For example, any point that lies on the line that says “29” is a point where the sea surface temperature is 29 C (~84 F).
* The arrows represent wind direction.

(1) In 1992, where do you find the warmest sea surface temperatures? (Specify with a range of latitude and longitude.) Where do you find the coolest sea surface temperatures?

Warmest:

Coolest:

(2) Scroll through the top maps for 1993-2001. Do these data look similar to the 1992 data with respect to sea surface temperatures and winds?

Now, focus on the bottom maps. For each year, the bottom map shows the **anomalies** in sea surface temperature and wind. As you thought about in preparation for today, an **anomaly** means a deviation (change) from “normal”. There are three symbols on the map:

* The colors represent temperature anomalies in degrees Celsius. For example,
6 C means that the sea surface temperature was 6 C (roughly 12 F) warmer than average. -6 C means that the sea surface temperature was 6 C (roughly 12 F) colder than average.
* The lines are called contour lines and also represent temperature anomalies. For example, any point that lies on the line that says “0.5” is a point where the water temperature was 0.5 C (~1 F) warmer than average.
* The arrows represent wind direction.

(3) Which color on the map is used to represent an anomaly of zero?

(4) Which color on the map is used to represent a strongly positive anomaly?

(5) Which color on the map is used to represent a strongly negative anomaly?

(6) In the 1992 **anomalies** (bottom graph), what is the range of temperature values across the Pacific? Where are the largest anomalies in this plot?

Scroll through the ten years of images, notice, especially, what happens in the plots of **anomalies** (bottom maps)**.**

(7) Which year(s) strike you as having the most anomalous (unusual) temperature data?

(8) In which area, and during which year, do you find the largest *positive* anomalies?

(9) In which area, and during which year, do you find the largest *negative* anomalies?

(10) In the years with the *weakest* anomalies, what direction are the prevailing winds?

(11) What happens to the winds in the years with the *largest* anomalies?

(12) In a couple of minutes, you will be teaching someone else about your data. To prepare for that, please write a few sentences in the space below about what you noticed about your data. This should be a summary of what you did in the previous questions., including what the SST and wind conditions look like for “normal” conditions, the year(s) that the most “anomalous” data occurred, and what SST and wind conditions looked like during these anomalous times.

Next, meet up with someone who looked at precipitation data in the equatorial Pacific and compare your data to their data.

(13) Which year was most anomalous for precipitation? Describe the anomalies.

(14) Do you see any connections between your sea surface temperature/wind data and their precipitation data? If so, please describe them.

**Part 2: Complete these questions after class discussion**

(15) I have projected a Hovmöller diagram on the white board. Notice that the y-axis on this plot is time in years. The first column shows the **average** equatorial sea surface temperature from 1992-2002, and the second column shows temperature **anomalies**. Tell me which year looks the most anomalous and the type of anomaly that you observe.

(16) Write a brief statement summarizing the connection between temperature, pressure, and precipitation in the tropical Pacific. Include a not-to-scale diagram.

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OCEA10: introduction to oceanography

**Identifying patterns of change in the equatorial Pacific:
precipitation**

We can understand changes in the way that the ocean and atmosphere move by looking at changes in the ocean and atmosphere over several years. You’re going to look at some ocean and atmosphere data collected from the equatorial Pacific to try to understand how conditions in the Pacific Ocean change over time.

You have 10 years of precipitation estimates from the equatorial Pacific (1992-2001). Focus on the top maps first. The top maps illustrate **average** precipitation rate (in millimeters/day) for the months of December, January, and February (DJF). There are two symbols on the map:

* The colors represent amount of precipitation in mm/day.
* The lines are called contour lines and also represent precipitation. For example, any point that lies on the line that says “14” is a point where the precipitation was 14 mm/day.

(1) In 1991-92, where do you find the highest precipitation rate? (Specify with a range of latitude and longitude.) How high is the precipitation here (in mm/day)?

(2) Scroll through the top maps for 1993-2001. Do these data look similar to the 1992 data with respect to precipitation?

Now, focus on the bottom maps. For each year, the bottom map shows the **anomalies** in precipitation. As you thought about in preparation for today, an **anomaly** means a deviation (change) from “normal”. There are two symbols on the map:

* The colors represent precipitation anomalies in mm/day. For example, an anomaly of 6 means that there were 6 mm/day more precipitation than average. An anomaly of -6 means that there were 6 mm/day less precipitation than average.
* The lines are called contour lines and also represent precipitation anomalies. For example, any point that lies on the line that says “6” is a point where there were 6 mm/day more precipitation than average.

(3) Which color on the map is used to represent an anomaly of zero?

(4) Which color on the map is used to represent a strongly positive anomaly?

(5) Which color on the map is used to represent a strongly negative anomaly?

Scroll through the ten years of images, notice, especially, what happens in the plots of anomalies.

(6) Which year(s) strike you as having the most anomalous (unusual) precipitation data?

(7) In which areas, and during which years, do you find the largest *positive* anomalies?

(8) In which areas, and during which years, do you find the largest *negative* anomalies?

(9) In which years do you find the largest anomalies (both positive and negative) directly on the Equator?

(10) In a couple of minutes, you will be teaching someone else about your data. To prepare for that, please write a few sentences in the space below about what you noticed about your data. This should be a summary of what you did in the previous questions, including what the precipitation conditions look like for “normal” conditions, the year(s) that the most “anomalous” data occurred, and what precipitation conditions looked like during these anomalous times.

Next, meet up with someone who looked at sea surface temperature and wind data in the equatorial Pacific and compare your data to their data.

(11) Which year was most anomalous for sea surface temperature and wind? Describe the anomalies.

(12) Do you see any connections between your precipitation data and their sea surface temperature/wind data? If so, please describe them.

**Part 2: Complete these questions after class discussion**

(13) I have projected a Hovmöller diagram on the white board. Notice that the y-axis on this plot is time in years. The first column shows the **average** equatorial sea surface temperature from 1992-2002, and the second column shows temperature **anomalies**. Tell me which year looks the most anomalous and the type of anomaly that you observe.

(14) Write a brief statement summarizing the connection between temperature, pressure, and precipitation in the tropical Pacific. Include a not-to-scale diagram.