

# MY NASA DATA Lesson:

## Ocean Impacts of an El Nino Event

### Purpose:

To examine the relationships among sea surface height, sea surface temperature, and wind vectors in classifying the ocean characteristics of an El Nino

**Grade Level:** 9 – 12

### Estimated Time for Completing Activity:

Two 50 minute periods

### Learning Outcomes:

- Students will be able to analyze a sequence of images for changes.
- Students will be able to define the term El Nino.
- Students will be able to correlate sea surface temperature with sea surface height and explain the concept of thermal expansion (steric effect) as it pertains to the heating of water.
- Students will be able to correlate wind vectors with sea surface height and discuss why there is a correlation.
- Students will be able to describe the interplay between global winds and ocean water as a factor influencing the formation of El Nino and La Nina events.

### Prerequisite

- Students should be able familiar with the concept of El Nino.
- Students should be familiar with global wind patterns.
- Students should be familiar with downloading and saving images, or be able to copy images into a document or Powerpoint.

### Tools

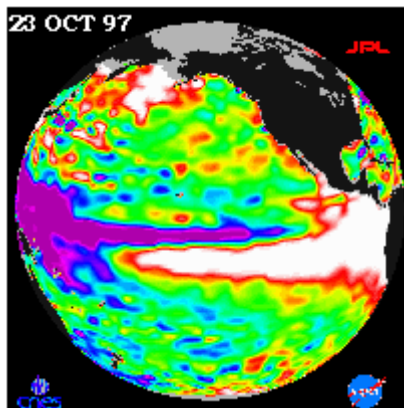


Image courtesy NASA JPL

- Computers with Internet access
- Ability to project images (LCD projector or overhead projector)
- Powerpoint or a word processing program that can be used to view multiple images at one time
- A globe or world map

**AP Environmental Science Topics**

- Atmosphere-ocean interactions
- El Nino – Southern Oscillation (ENSO)
- Fishing
- Global water problems
- Ocean circulation

**Vocabulary:**

- [El Nino](#)
- [La Nina](#)
- [thermal expansion](#)
- [Trade Winds](#)
- [wind vector](#)

**Lesson Links:**

- [Live Access Server](#)
- [SSH animation \(QuickTime\)](#)
- [Ocean Wind animation \(QuickTime\)](#)
- [TOPEX Poseidon Imagery](#)
- [Chemistry Extension Article](#)
- [El Nino Resource](#)
- [Lesson on Comparing the Effects of El Nino and La Nina](#)
- [El Nino Lesson \(introductory level\)](#)

**Background:**

While we inhabit land on the Earth we sometimes forget that we live on a water planet where 70 percent of the Earth is covered with water. The variation in the properties of the land versus the water contributes to our global circulation patterns. Sometimes these global circulation patterns are disrupted and we observe the effects of these disruptions in events such as El Nino and La Nina.

It is believed that El Ninos occur every two to eight years, and are sometimes stronger, sometimes weaker. This often happens when the southeast trade winds weaken or even reverse. As a result, large masses of water from the western Pacific Ocean migrate to the east to the coast of South America. This change in ocean circulation not only impacts the weather and climate in South America, but also affects locations all around the globe.

These effects can last for about a year, when the opposite conditions occur as the trade winds strengthen again, and the waters off the coast of South America are colder than normal from active upwelling occurring along the coast. This phase of the global circulation disruption is called La Nina.

We have been fortunate over the last 30 years to have satellite and buoy data to warn us if the El Nino phase is upon us. By measuring sea surface heights with satellites like TOPEX Poseidon, sea surface temperature with satellites like AVHRR, and wind vectors from buoys and satellites, we can monitor the Pacific Ocean for changes that may signal the onset of El Nino or La Nina. The sensitive altimeter on the TOPEX Poseidon satellite can measure small changes that create hills and valleys on the sea surface which is mostly caused by thermal expansion (steric effect), and the warming of the ocean during an El Nino event can be sensed by the altimeter.

This lesson explores El Nino by looking at sea surface temperature, sea surface height, and wind vectors in order to seek out any correlations there may be among these three variables. It employs group work where different teams work together to analyze a single variable, and then get together in different groups to compare all three variables. The lesson will guide students through data representing the strong El Nino from 1997 to 1998. By doing this, students will model the methods of researchers who bring their expertise to study integrated science questions. Depending on the classroom dynamics, available technology, and available time, this lesson may be modified.

**Procedure:**

Pre Lesson Inquiry Activity:

1. Ask students to think about and discuss (perhaps in their assigned teams-See Procedure below) what effect El Nino may have had on the ocean height, temperature, and wind currents.
2. Ask students to write a paragraph predicting the effect, if any.

Part I: Divide students into teams of three students to study one variable – sea surface height, sea surface temperature, or wind vectors.

1. Open the MY NASA DATA website and the Live Access Server Advanced Edition.
2. Select Oceans from the list of Dataset Variables.
3. Depending on which team you are on, you will be selecting either the Daily Sea Surface Temperature (GHR SST), the 5-Day Sea Level Height (TOPEX Poseidon), or Monthly Wind Speed Vectors (NOAA NOMADS).
4. Select the variable you have been assigned and click on Next.
5. Make sure that Longitude, Latitude map is selected for view and that Interactive Color Plot is selected for the output.
6. Change the Select Region to Equatorial Pacific from the pull-down menu. Click on Go. Change the date to July 1997 (For Daily data sets choose the 15th of the month), and click on Next.
7. You should receive an image of the variable you requested. Save your image as per your teacher's instructions using a file name and location that will make it easy to retrieve the image later.
8. Repeat this process for the following dates: September 1997, November 1997, January 1998, March 1998, May 1998, July 1998, September 1998, November 1998, January 1999.
9. Once you have acquired all the images, open either a word processor or PowerPoint to view the images next to each other. You may have to shrink the images a little so more than one image fits on one page. Take care to make sure the images are in the correct sequence. Save your document or PowerPoint presentation, and print out 3 sets of the images so that each member of the team has a set. Answer the questions below for Part I.

Part II: Make new teams so that there is one student from each variable in a team.

1. Each person in the new team takes 5 minutes to discuss the temporal variations they observed in their variable.
2. As a team, look for relationships among the three variables, and discuss the causes and effects of these relationships.
3. Answer the questions below for Part II.

### Questions:

Part I:

1. Looking at your variable, identify the characteristics of the image. What are the units, what do the colors mean, etc. Refer to the MY NASA DATA website if you need assistance.
2. Look closely at the image from July 1997 and list at least 3 observations. Repeat this for the other images. What can you infer from your observations?

3. Write a paragraph that summarizes the changes in your variable during our study period of July 1997 to January 1999.

Part II:

1. Select one month from the study period, and look closely at all three variables. List your observations. What can you infer from your observations?
2. Notice the amount of change that takes place over the study period. Which variable changes the quickest? Why do you think this is so? Which variable is the slowest to change? Why do you think this is so?
3. Use your knowledge of the Trade Winds to analyze the changes you see in the images over the course of study period.
4. Define El Nino. How are the three variables related to the presence of an El Nino? Prepare a paragraph that summarizes your group's efforts, and discuss your results with the class.
5. Visit the Lesson Link for TOPEX Poseidon imagery. Click on the text of any one of the images. It will bring you to a page where you can select a date and see the TOPEX Poseidon image for that date and also provide you with a discussion from the scientists. Select the dates we used for this lesson, and read what the scientists say about El Nino and sea surface height. How close were your observations to that of the scientists?

**Extensions:**

1. El Ninos are known to have local and global effects. Use the MY NASA DATA Live Access Server to study the effects of El Nino in your region.
2. La Nina is the opposite of El Nino. Search the Internet for the dates of a La Nina, and use the MY NASA DATA Live Access Server to study the characteristics of a La Nina.
3. With a social studies colleague, explore the social and economic implications of an El Nino event.
4. Visit the Lesson Link for a Chemistry Activity related to thermal expansion.

*Lesson plan contributed by Missy Holzer, New Jersey*

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