Climate Lesson – Tracking El Nino Conditions

Intended Audience – Advanced Juniors & Seniors
Expected Duration – 2 Hours
Robert R. Dedrick – Canandaigua Academy

Background:

The ocean-atmospheric relationship is best illustrated via El Nino / La Nina events. Changes in ocean water temperatures not only influence the direction of global oceanic circulation, but atmospheric conditions as well. These events occur when sea-surface temperatures change in the Pacific Ocean off the coast of Peru, which leads to changes in both the surface circulation as well as the upwelling currents in the basin. These oceanic changes then lead to major atmospheric changes. Additionally, these changes can bring drastic consequences, such as droughts or flooding, to normally calm regions around the world.

Standards:

National

CONTENT STANDARD G: As a result of activities in grades 9-12, all students should develop understanding of

- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

International Baccalaureate – Environmental Systems

3.6.5 - Outline the role of ocean currents in the regulation of climate.

The rate at which water absorbs and releases heat relative to the land, and the consequent moderating effect on climate, should be understood. The transport of heat by ocean currents and the influence on climate should also be understood, e.g. the North Atlantic Drift moderating the climate of north-western Europe which, in the absence of this current, would otherwise have a sub-arctic climate; the Humbolt current off Peru and the Benguela current off Namibia.

3.6.4 - Describe the El Niño Southern Oscillation (ENSO) phenomenon and its impacts.

Students should make reference to relationships among trade winds, ocean surface currents, nutrient upwelling, productivity of fish stocks (eg those off the Peruvian coast) and more distant climatic effects.
Periodic disruption of tropical easterly trade winds results in a mass of warm water in the Pacific expanding eastwards towards South America. This raises the surface temperature of the ocean and prevents nutrient-laden waters from upwelling, thus limiting productivity. Reasons for the disruption in trade winds are not required. Descriptions of climatic effects elsewhere should be limited to correlations between El Niño and atypical weather patterns in, for example, the western USA, Australia, Indonesia and southern Africa.

NYS Earth Science Standards

2.2d Temperature and precipitation patterns are altered by:

¥ natural events such as El Nino and volcanic eruptions

¥ human influences including deforestation, urbanization, and the production of greenhouse gases such as carbon dioxide and methane.

Lesson Objectives:

1) Allow students to examine real datasets to observe oceanic conditions both during and following El Nino events
2) Students will identify the major changes in ocean parameters using the ARGO buoy network during El Nino events.
3) Quantify changes that occur in the Pacific Ocean during El Nino events.

Relevant Vocabulary

ARGO Buoys
El Nino
Halocline
La Nina
Sea-Surface Temperature (SST)
Temperature Profile
Thermocline
Transect

Materials

1) Computers with internet connection & GoogleEarth
2) Students will be accessing two datasets
    a. Vertical Oceanic Data - http://w3.jcommops.org/FTPRoot/Argo/Status/status.kmz
    b. Horizontal Oceanic Data - http://neo.sci.gsfc.nasa.gov/Search.html
        i. This website also has a graphical analyzer tool which can be used to compare data sets. A brief explanation on how to use the ICETRAY tool can be found below.

Procedure:

1) Following the lecture on Oceanic-Atmospheric systems, briefly (without giving the lab concept away) discuss El Nino events. Discuss how they lead to changes in the oceanic circulation, specifically sea-surface temperatures. Also explain that these changes occur on a short-term cyclic pattern.
2) Introduce the two datasets to the students
    a. Provide instruction on how to access GoogleEarth and open the ARGO data in GoogleEarth

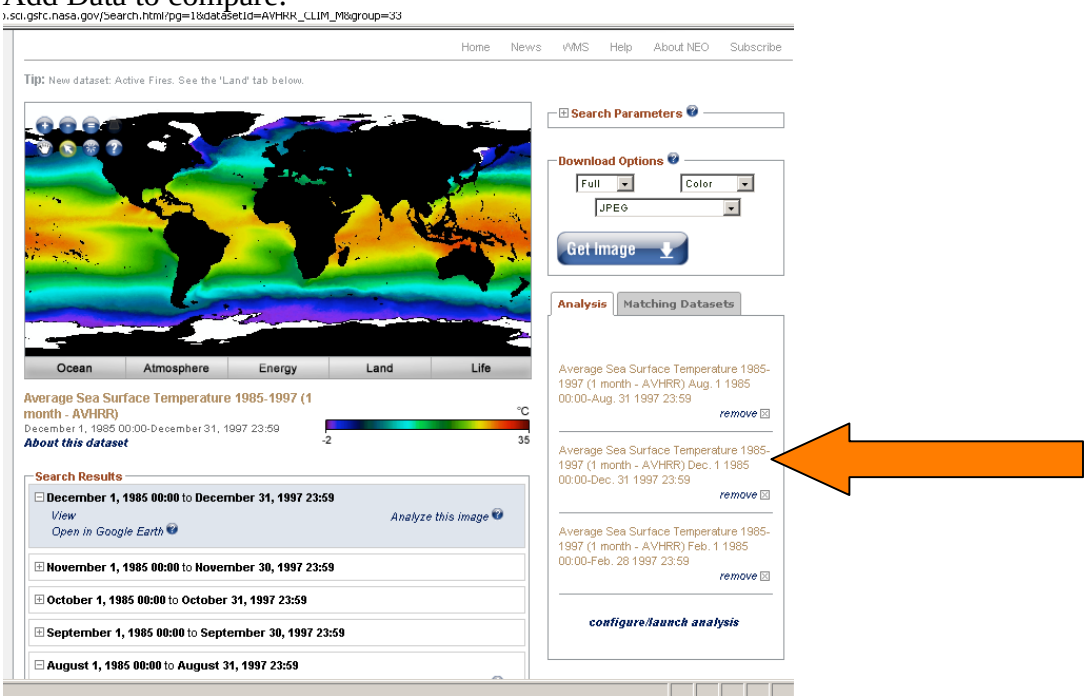
b. Provide instruction on how to compare the NEO datasets using the ICE TRAY (see below)

3) Select one NEO sea-surface temperature data set and illustrate what information is provided in the dataset
4) Complete a similar discussion of with one ARGO buoy.
5) Allow the students to review the datasets searching for trends, patterns, or general changes.
6) Encourage students to think not only temporally, but also in three dimensions (i.e. vertical changes in the ocean)
7) Allow the students time to draw conclusions from their data review.

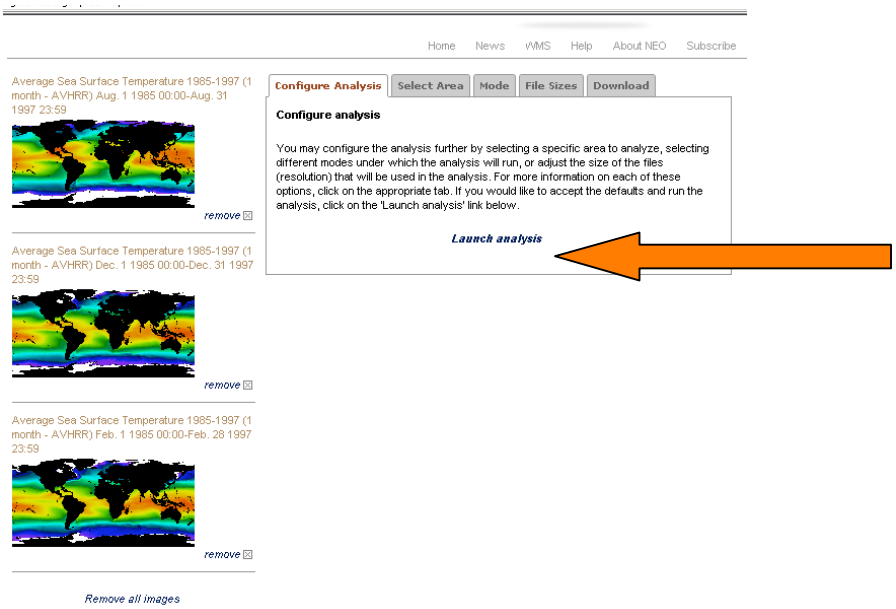
<u>Reference materials for teachers</u>

Using NEO ICE TRAY for quantifying satellite data

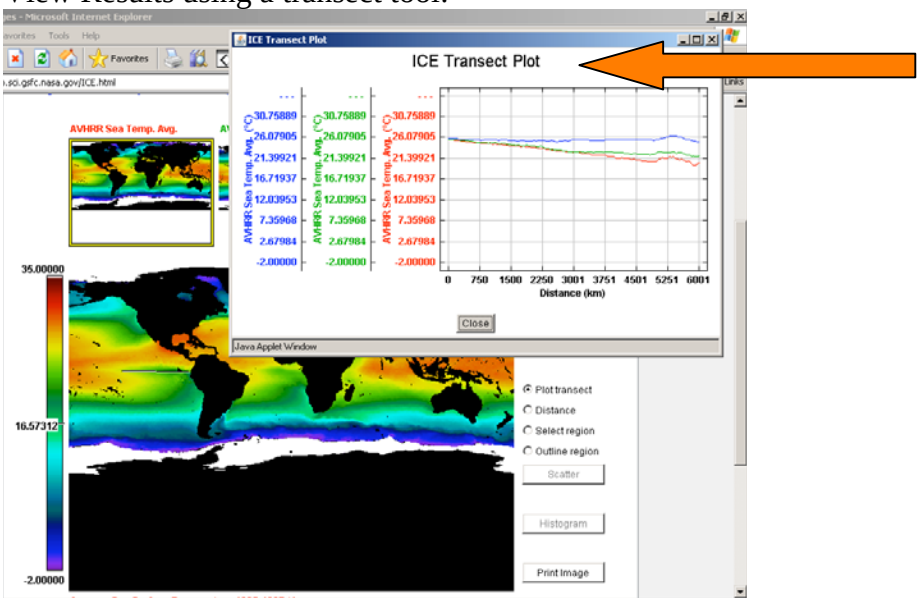
Add Data to compare:



Launch Analyzer:



View Results using a transect tool:



Assessment:

Students will create a two-typed page summary of the relationships they found in reviewing their data. Students should be encouraged to make copies of their charts / tables they used when analyzing the data and specifically refer to the diagrams in their conclusion.

IB Environmental Systems – Mr. Dedrick
Systems – El Nino Dynamics

Name:
Date:

Planning A	Planning B	Data Collection	Data Processing & Presentation	Conclusion & Evaluation	Manipul. Skills	Personal Skills (a)	Personal Skills (b)
PL(a)	PL(b)	DC	DA	EV	MS	PS(a)	PS(b)
	✓	✓	✓	✓	✓		

Introduction

El Nino events have become well document events in the Pacific Ocean which have global consequences. These events occur when sea-surface temperatures change in the Pacific Ocean off the coast of Peru, which leads to changes in both the surface circulation as well as the upwelling currents in the basin. These oceanic changes then lead to major atmospheric changes.

Task

- Determine periods of El Nino events
- Analysis satellite data to support the changes in El Nino events
- Graphically support the changes seen in your satellite data comparison
- Create a conclusion summarizing your data. Be sure to address all components in the oceanic system related to El Nino

Misc.

- The following resources will be helpful for your data analysis (but don't feel limited to just these..)
  - NEO Satellite Data - http://neo.sci.gsfc.nasa.gov/Search.html
  - ARGO Ocean Buoy Data - http://w3.jcommops.org/FTPRoot/Argo/Status/status.kmz (you will need to download the data and open it in GoogleEarth)