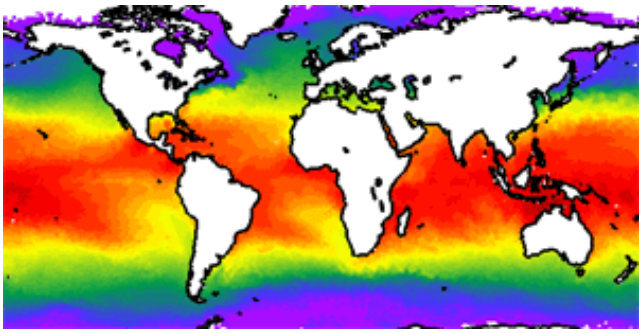
NAME:_____ DATE:_____ CLASS:_____

MY NASA DATA: Ocean Currents and Sea Surface Temperatures

http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

Ocean Currents and Sea Surface Temperature



Purpose: To discover the link between ocean temperatures and currents as related to our concern for current climate change

Grade Level: 8-12

Estimated Time for Completing Activity: 50 minutes

Learning Outcomes:

- Students know how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
- Students know the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
- Students will make predictions by linking current scientific satellite data to concerns about global climate change.

Prerequisite

- Students should be familiar with the idea that warmer air or water is less dense and that cooler air or water is more dense.
- Students need the background of the uneven heating of the Earth in order to understand the ocean-air interface, the boundary of sea and air at which an exchange of energy occurs between ocean and atmosphere.
- Students will be mapping so they need to understand longitude and latitude and be able to find a point on a map given those two numbers.
- Students need a basic understanding of the Coriolis Effect.

Tools

- Computer with printer
- Red and blue colored pencils
- World map with latitude-longitude grid

NAME:_____ DATE:_____ CLASS:_____

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National Standards:
Geography: The World in Spatial Terms
Math: Data Analysis and Probability
Science Content: D Earth and Space Science

Virginia Standards of Learning:
ES.1c: The student will plan and conduct investigations in which scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.
ES.2a: The student will demonstrate scientific reasoning and logic by analyzing how science explains and predicts the interactions and dynamics of complex Earth systems.
ES.11a: The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include physical and chemical changes (tides, waves, currents, sea level and ice cap variations, upwelling, and salinity variations).

Vocabulary:
Coriolis force
gyre
sea surface temperature
upwelling

Lesson Links:
Live Access Server (Advanced Edition)
Detailed image of Surface Ocean currents
Illustration of the Deep Ocean Conveyor Belt
Currents of the Ocean
Upwelling in the World Ocean
Fog Near the Atlantic Coast
Differential Heating of the Earth
Earth's Radiation Budget
Global Wind Patterns

NAME:_____ DATE:_____ CLASS:_____

MY NASA DATA: Ocean Currents and Sea Surface Temperatures

http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

Background:

Uneven heating of the Earth by the Sun causes the equatorial areas to have an excess of heat, while the polar areas have a heat deficit. The ocean, working with the atmosphere, moves the heat poleward and the cold equatorward to try to balance the temperature. Because of the rotation of the Earth and the Coriolis Effect, that movement becomes deflected, forming ocean gyres that turn clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

In these gyres, equatorial surface waters are carried poleward on the western sides of the ocean basins, and polar surface water is carried equatorward on the eastern sides of the ocean basins. These currents are wind-driven currents. Also, along the eastern basins, the cool waters bring nutrients to the surface. This is called upwelling, and it usually makes for good fishing grounds!

There is also the effect of a deep water circulation. In fact, a combination of surface and deep flow creates a giant global heat conveyor belt. These deep currents are caused by the temperature or density differences of the waters… they are temperature-driven currents, that is, density-driven currents. This is because cold water is denser than warm water and wants to sink.

In this lesson, we will focus our attention to the surface currents by examining a parameter called sea surface temperature. Although these are wind-driven currents, the water temperature marks the movement of surface heating, which can be seen and monitored by satellites. See Lesson Links above for further information.

Procedure:

Pre-activity:

1. Students will journal the question,'How do you think our concern for global climate change may be related to ocean temperatures and currents?' Discuss student answers.

2. Have students draw what they think the ocean current directions are using arrows on a global map. Use blue pencil for the cold currents and red pencil for warm currents.

NAME:_____ DATE:_____ CLASS:_____

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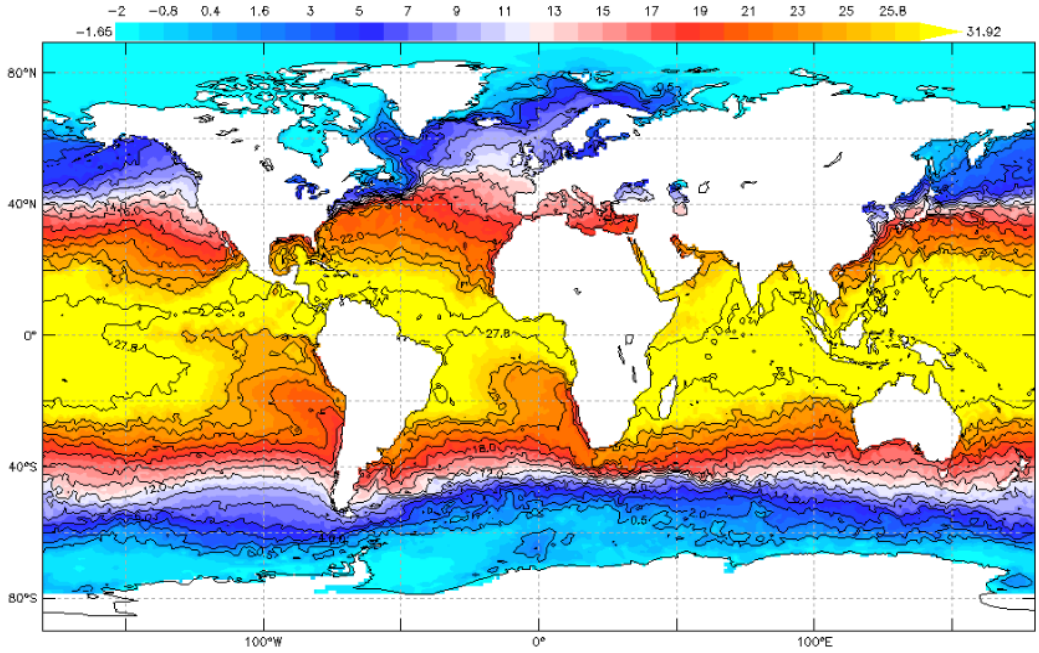
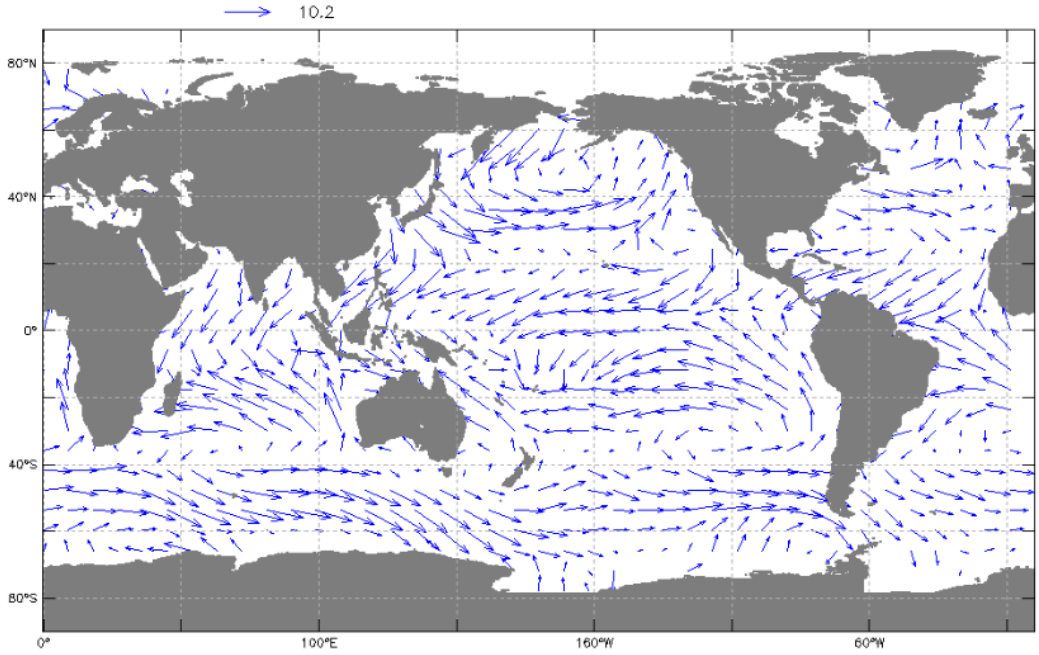
http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

Part 1: Use the following maps of sea surface temperature (SST) and ocean surface winds to answer the questions at the end of this packet.

Sea Surface Temperature (SST) January 2005



Monthly Ocean Wind Speed Vector January 2005



NAME:_____ DATE:_____ CLASS:_____

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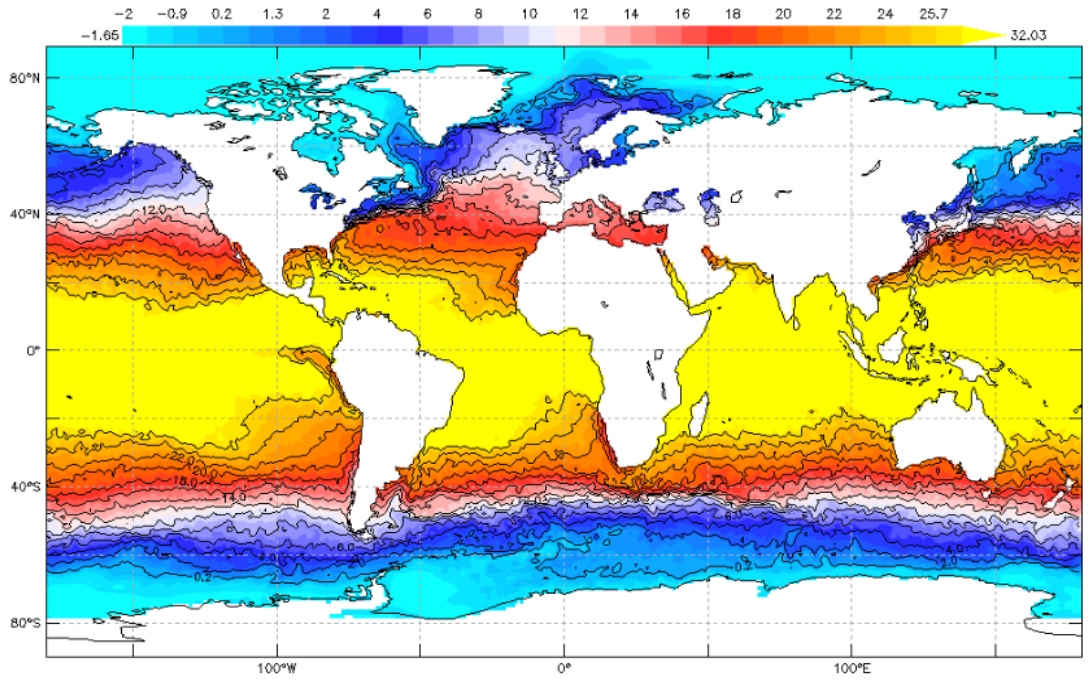
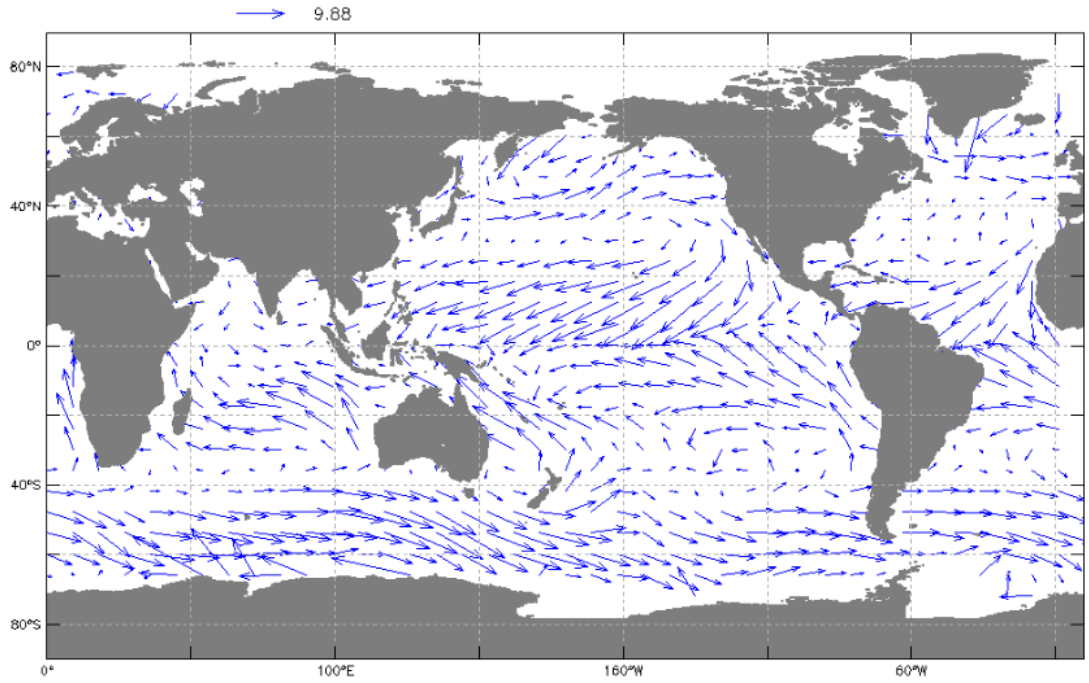
http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

Sea Surface Temperature (SST) April 2005



Monthly Ocean Wind Speed Vector April 2005



NAME:_____ DATE:_____ CLASS:_____

MY NASA DATA: Ocean Currents and Sea Surface Temperatures

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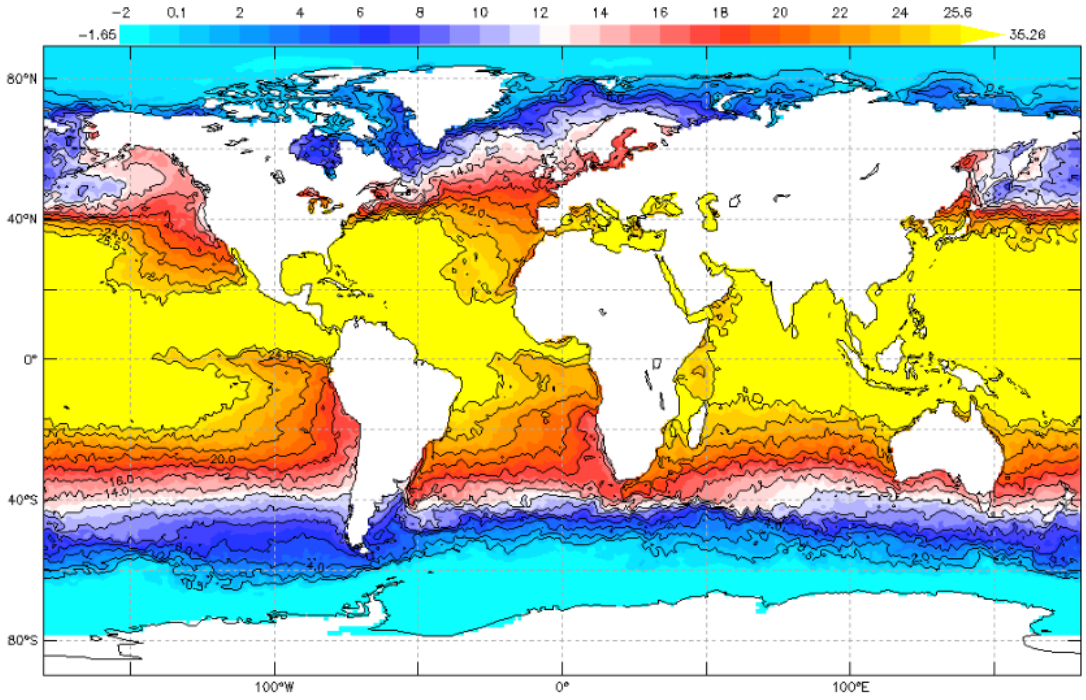
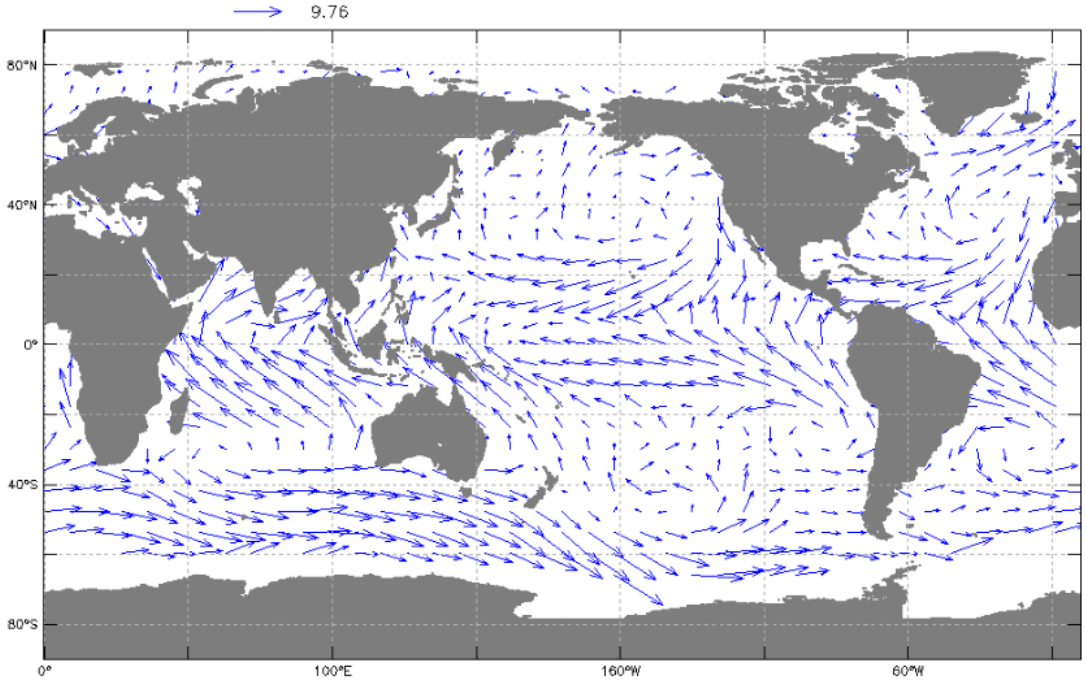
Sea Surface Temperature August 2005



Monthly Ocean Wind Speed Vector August 2005



NAME:_____ DATE:_____ CLASS:_____

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Instructions and Questions:

1. Select a map for a particular month of the year 2005. Draw arrows on your map, using blue pencil for the cold currents and red pencil for the warm currents. Discuss within your group any similarities or differences on your maps for the different months of the year. Discuss the following questions with others in your group.

2. What clues help you decide how the ocean water is moving?

3. How is this ocean water movement helping even out the Sun's uneven heating of the Earth?

NAME:_____ DATE:_____ CLASS:_____

MY NASA DATA: Ocean Currents and Sea Surface Temperatures

http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

4. What drives the surface currents in these ocean basins?

5. Where will the fishing be very good, due to upwelling?

6. Along what coastal margin will you commonly find fog? Why?

7. If global weather change (warming) continues, predict how the Sea Surface Temperature (SST) and Ocean surface maps will look in the year 2100? Draw the maps using color markers.

NAME:_____ DATE:_____ CLASS:_____

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http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

Extensions:

1. Why would the ocean circulation in the Indian Ocean be different from other large ocean basins? What do you notice about the changes throughout the year regarding the SST in the Indian Ocean?

2. How is SST related to El Nino? Why were the Peruvian fishermen the first to notice and name the El Nino?

3. Why do the west coasts of the continents have colder water than the corresponding east coastal latitudes? To answer this question, examine a time series of Near Surface Temperatures of a west and east coast position at the same latitude. (The west coast position is much more influenced by the boundary current compared to the east coast).

4. From MY NASA DATA homepage, students will select Data Access,Live Access Server(Advanced), Atmosphere, Clouds, Cloud Coverage, Monthly Cloud Coverage, then select region and date to create cloud coverage maps. How do global Sea Surface Temperature (SST) patterns relate to clouds and precipitation? Speculate what happens in an El Nino year.

NAME:_____ DATE:_____ CLASS:_____

MY NASA DATA: Ocean Currents and Sea Surface Temperatures

http://mynasadata.larc.nasa.gov/?page_id=474?&passid=9

5. From MY NASA DATA homepage, students will select the Data Access, Live Access Server(Advanced), Oceans, 5-day Sea Level Height, then select region and date to create the required map. Is there any correlation between ocean currents and ocean surface height?

6. For a particular region, assign each group or student a different month. For the assigned month, students will find and record values for Weekly Sea Surface Temperatures. The values may be entered into an Excel spreadsheet or calculator. After all 52 values have been recorded, calculate the annual mean of SST for that location. Students may also calculate the seasonal mean of SST.

Lesson plan contributed by Joan Carter, San Jose, CA