MY NASA DATA Lesson: *See notes at the end of the lesson for data updates with the new Earth System Data Explorer*

Ocean Currents and Sea Surface Temperature

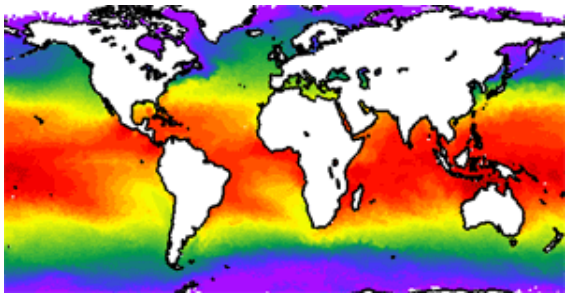

Image courtesy MY NASA DATA Live Access Server. Weekly Sea Surface Temperature

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

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

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.

Part I: Obtain maps of sea surface temperature (SST) and ocean surface winds from the Live Access Server.

1. Click on the link for the Live Access Server.
2. Click on 'Choose Dataset' if it does not automatically appear. Select Oceans, Daily Sea Surface Temperature (GHRSST).
3. For region, have students select their own from the drop-down menu. This menu can be found above the navigation map to to the upper left of the screen. Click on the double downward arrow and select your region of choice. Students will then be able to report back on different areas of the globe.
4. For time, students could select any date of interest. A variety throughout the year would be interesting to compare.
5. Select Next to obtain an image of the data. Click on the 'Update Plot' radio button and print or save your map.
6. Repeat this process selecting Oceans, Monthly Ocean Wind Speed Vectors for the same region and time.

Part II: Students discuss in groups the relationship between the movement of the water and the resulting Sea Surface Temperature.

6. Draw arrows on your map, using blue pencil for the cold currents and red pencil for warm currents.
7. Students discuss any similarities or differences on their maps.
8. Students discuss and answer the Questions.

Questions:

1. What clues helped you decide how the ocean water is moving?

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

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

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

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

6. 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.

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.

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

Click here for Teachers Notes

View lesson without Standards

Data Notes from Dr. Brad (12/2018):
Up-to-date data is available for this lesson on the Earth System Data Explorer:
Daily SST: Hydrosphere->All Data->Sea Surface Properties->Daily Sea Surface Temperature
Wind Vectors: Atmosphere->All Data->Wind Speed and Vectors->Vectors->Monthly Near-Surface Wind Vectors
Cloud Cover: Atmosphere->All Data->Clouds->Monthly Total Cloud Coverage
Sea Level Height: Hydrosphere->All Data->Sea Surface Properties->Sea Level (Sea Surface Height) Anomaly