

MY NASA DATA Lesson:

Surface Air Temperature Trends of the Caribbean

Purpose:

Students will use real satellite data to determine the changes in near-surface air temperature at different times of the year over the Caribbean Sea.

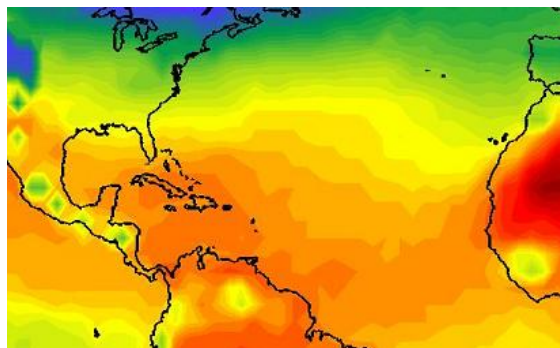


Image courtesy MY NASA DATA Live Access Server. Near-surface air temperature, October 1999.

Grade Level: 6 – 12**Estimated Time for Completing Activity:**

50 minutes

Learning Outcomes:

- Students will learn how Earth's tilt causes seasonal differences in incoming solar energy.
- Students will explore satellite data to investigate the near-surface air temperature.

Prerequisite

- Introduction to Earth's climates or seasons
- Familiarity with accessing websites on the Internet
- Familiarity with finding latitude and longitude positions
- Knowledge of temperature scales (Kelvin, Celsius, Fahrenheit)

Tools

- Atlas or Globe
- Computer with Internet access

AP Environmental Science Topics

- Atmospheric circulation
- Energy concepts and forms
- Latitude
- Seasons
- Weather and climate

Vocabulary:

- [conduction](#)
- [convection](#)
- [coordinates](#)
- [Hadley Cell](#)
- [insolation](#)
- [ISCCP](#)
- [Kelvin](#)
- [latitude](#)
- [longitude](#)
- [surface temperature](#)

Lesson Links:

- [Live Access Server \(Advanced\)](#)
- [Compare-two sample plot](#)

Background:

Because Earth is tilted on its axis and orbits around the Sun, there are seasonal changes to incoming solar radiation at Earth's surface. (For additional information about seasons and angle of the Sun, see the Links section for a tutorial.) However, near the Equator, the strong insolation is nearly constant, and the transport (balance) of heat energy toward the poles is continuously being accomplished by ocean and air currents. (See the Hadley cell link in the Vocabulary). In this lesson, we will focus on the seasonal effect on air temperature near Earth's surface, that is, the bottom 10 meters of the atmosphere where we live.

Due to their differences in density, water and air will heat and cool at much different rates. Just think of how long it takes to boil a pot of water, yet air will heat almost immediately. Also, it takes much more solar energy to heat the ocean's water than the land. Since air is much less dense than water or land, surface air temperature will

generally correspond to the temperature and character of the surface below it (due to conduction and convection). In fact, an air mass will often be categorized as continental or marine, polar or tropical, based on its source region. As the air moves and mixes to help achieve global temperature equilibrium, heat energy is transported and released, often in the form of fronts and storms.

Usually water temperature, or sea surface temperature, lags behind air temperature during seasonal changes, keeping coastal climates milder in winter than interior continental climates. In this lesson, you will analyze near-surface air temperature data of the Caribbean Sea, a tropical marine region, from the International Satellite Cloud Climatology Project (ISCCP). You may also compare the data to the underlying sea surface temperature during the change in seasons.

Procedure:

Pre-lesson inquiry activity:

- (1) Ask students to locate the Caribbean Sea area on an atlas or map, and identify in which hemisphere this area is located.
- (2) Based on their previous knowledge about seasons in each hemisphere, ask students to predict the seasonal patterns of the air-temperature near the surface for this location.
- (3) Ask students to predict if this pattern is the same for sea-surface temperature.
- (4) Ask students to share predictions with the group or class.

Part I: Line plot of near-surface air temperature

1. Click on the link above to the Live Access Server (Advanced).
2. Click on 'Choose Dataset' if you are not automatically prompted and then click on Atmosphere, Atmospheric Temperature, Monthly Near-Surface Air Temperature (ISCCP).
3. On the left side of the screen select 'Time Series', under the Line Plots section.
4. Select time range as Jan 2000 through Dec 2000.
5. Using the text boxes, type in the latitude and longitude of a location within the Caribbean Sea area. The atlas used in the pre-lesson activity may be helpful to locate a specific point to investigate. For example, in the North box,, type 17.8 N and in the W box, type in 66.0 W. Click in the South and East boxes, which will automatically change to these values.
6. Be sure to click the radio button next to 'Update Plot' from the menu at the top of the page.
7. To convert the temperature from Kelvin to Celsius (to make the temperature scales consistent), use the Evaluate Expression. This can be found under 'Set Plot Options' at the top of the screen. then click on the question park next to 'Evaluate Expression' for instructions on this conversion.
8. Click 'Ok' to see your new plot.

Part II: Comparing near-surface air and sea surface temperatures.

1. Click on the link to the Live Access Server (Advanced) in the lesson links section of this lesson.
2. Click on 'Choose Dataset' if you are not automatically prompted with it and then Click Atmosphere, Atmospheric temperature, Monthly near-surface air temp (ISCCP).
3. On the left side of the screen select 'Time Series', under the Line Plots section.
4. Select time range as Jan 2000 through Dec 2000.
5. To convert the temperature from Kelvin to Celsius (to make the temperature scales consistent), use the Evaluate Expression. This can be found under 'Set Plot Options' at the top of the screen. then click on the question park next to 'Evaluate Expression' for instructions on this conversion.
6. Be sure to click 'Update Plot' to view and save/print your line plot for comparison after you produce your next plot.

7. Go back to the top of the screen and click on 'Choose Dataset'
8. Then Click Oceans, Daily Sea Surface Temperature (GHRSSST).
9. On the left side of the screen select 'Time Series', under the Line Plots section.
10. Select time range as Jan 1, 2000 through Dec 31, 2000.
11. To convert the temperature from Kelvin to Celsius (to make the temperature scales consistent), use the Evaluate Expression. This can be found under 'Set Plot Options' at the top of the screen. then click on the question park next to 'Evaluate Expression' for instructions on this conversion.
12. Enter the same location as in Part I.
13. Be sure to click 'Update Plot' to view and save/print your line plot for comparison after you produce your next plot.
14. Now that you have produced both of your line plots you can compare the two. be sure to make note of the min and max values on the x and y axis of the plots.

Questions:

1. Track the changes of the near-surface air temperature over time. What happens to the near surface air temperature as you go from August to November?
2. Find the minimum and maximum temperature for the year. What is the temperature range for your location?
3. Describe the relationship between the temperature change and the change in season.
4. Do the results support your prediction about seasonal patterns at this location in the Caribbean Sea? Explain to your group or class, using examples from the plots.
5. From analyzing the plot from Part II, describe the trends in near-surface air and sea surface temperatures. Describe the relationship between these two variables.

Extensions:

1a. Following the Procedure Part II, to compare near-surface air temperature to another climate variable in LAS (cloud type, cloud coverage, or precipitation, for example) for the same region. What conclusions can you draw from comparing near-surface air temperature to the selected variable?

1b. Describe any seasonal changes which occurred in the two variables, and whether both followed the same patterns of seasonal change.

Lesson plan contributed by Rex Roettger, Aguadilla, Puerto Rico

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