

MY NASA DATA Lesson:

A Comparison of Land and Water Temperature

Purpose:

To examine NASA satellite observations of surface temperature and to investigate the seasonal changes of land and water temperature



Image courtesy Lin Chambers

Grade Level: 7 – 12

Estimated Time for Completing Activity:

50 minutes

Learning Outcomes:

- Students will become familiar with the concept of specific heat capacity.
- Students will discover seasonal changes in land and water temperature.
- Students will explain the differences in land and water heating and cooling.

Prerequisite

- Discussion of seasons, temperature or heat
- Familiarity with reading line graphs
- Familiarity with Kelvin and Celsius temperature scales.

Tools

- Computer with Internet access
- Printer
- LCD projector if presenting to the class

Vocabulary:

- [heat](#)
- [ISCCP](#)
- [radiation](#)
- [temperature](#)

Lesson Links:

- [Live Access Server \(Advanced Edition\)](#)
- [Earth's Big Heat Bucket](#)
- [More Specific Heat](#)
- [Sample Graph](#)

Background:

Specific heat is the amount of heat required to raise the temperature of one gram of a substance by one degree Celsius. As the Earth's surface materials absorb energy radiated from the sun, they gain thermal energy and their temperatures rise. The rate of temperature rise varies based on the material. This relationship is described by what is called the specific heat of a substance. This lesson compares the specific heat of land, water and air. The wide range of heat capacities is extremely important to the operation of our climate system because it affects how solar energy is put to use, transformed, transferred, stored, and released. See Lesson Links for more information on Specific Heat and its effect on our climate.

Procedure:

1. Click the link above to access the Live Access Server (Advanced Edition).
2. If not automatically prompted, click on 'Choose Dataset' then Select Land Surface, Surface Conditions, Monthly Surface Clear-sky Temperature (ISCCP) and then click Next on the right side of the screen.
3. From the menu to the left of the screen select 'Time series' found under 'Line Plots'.
4. Click the radio button next to 'Update Plot' to see your new data plot and to have the ability to select a time range.
5. Set the Time range dropdown boxes for Jan 2000 through December 2000.
6. Enter in the coordinates for the first location. This will be done under the navigation map to the left of the screen. In the north position, enter '44 N'. In the west position, enter '72 W'. Click in the east position box, and the south and east positions will automatically change. This should be a point over land.
7. Save the plot as an image to your computer to compare to the second location. To do

this you can wither right click or hold down control and click on the plot and select 'Save image as' and then choose a location to save the plot.

8. Repeat Step 6 above, except enter '52 W' in the west position. This should be a point over water.
9. A graph showing the land and water temperatures for the year 2000 should appear.
10. Save this graph or print out the graph to use for answering the questions.
11. Analyze the graph and answer the Questions below.

Questions:

1. What changes occur on the graph from January to December for your water location? What changes occur for your land location? Compare the two graphs and list ways in which they are the same or different. How might the changes be related to the changing seasons?
2. When is the highest temperature obtained for your water and land location? When is the lowest temperature obtained for your water and land location? What is the lag time (if any) between these maxima and minima? Explain the reasons for the lag times or differences in values between maxima and minima in terms of specific heat of water and land.
3. What causes one material to heat up or cool down faster than the other? Which has the greater capacity to store heat? Which do think has the higher specific heat?

Extensions:

1. Examine data for the air temperature over your water and land locations. Return to the Live Access Server and change one of the variables to Atmosphere, Atmospheric Temperature, Monthly Near-Surface Air Temperature. Do you see the same seasonal variations and lag times? What conclusion can you draw about the heat capacity of air?
2. Select a land location and a water location at the same latitude, but in the southern hemisphere. Compare the graphs to those of the northern hemisphere. List ways in which they are similar or different, and discuss possible explanations.
3. Repeat the procedures for regions that are farther apart, i.e., the center of the continent vs further out in the ocean. Compare the graphs and discuss possible explanations.
4. Repeat the procedures for a coastal location and a location in the center of the continent. Compare the graphs and discuss possible explanations.

Lesson plan contributed by Emma Medina, Elmhurst, NY

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