MY NASA DATA Lesson:

Scientist Tracking Network (Student LAS Version)

Image courtesy Janell Simpson

Purpose:
To correlate surface radiation with mean surface temperature of several geographic regions. By observing how these parameters change with latitude, students will construct an understanding of the relationship of solar radiation to seasonal temperature variation.

Grade Level: 8-9

Estimated Time for Completing Activity:
Eight 50-minute classes or five 90-minute blocks

Learning Outcomes:

- Consult NASA satellite data to pinpoint a geographic location.
- Build support for a hypothesis from data obtained through technology.
- Present an explanation of the change in temperature with season at a particular location.

Prerequisite

- Students should be familiar with the methods of heat transfer: radiation, convection and conduction.
- Students should be able to cite examples of heat transfer in the Earth system.
- 'Convection Activity' and 'Heating of Earth Materials Activity' in the student handouts are two great activities that can precede this unit.
- Students should know how to find the latitude and longitude of geographic locations.

Tools

- Internet access
- Atlas or other latitude-longitude tool (See Lesson Links)

AP Environmental Science Topics

- Latitude
- Seasons
- Solar intensity

Vocabulary:

- electromagnetic spectrum
- flux
- radiation budget or balance
- satellite
- sea breeze
- solar radiation

Lesson Links:

- Latiitude-longitude tool
- Earths shortwave surface radiation animation
- Earths shortwave surface radiation PowerPoint
- NASA Photos (PDF File)
- Live Access Server (Advanced Edition)
- Reason for the seasons
- Earths Energy Budget poster website
- Video tour of electromagnetic spectrum
- Tour of the Electromagnetic Spectrum video companion booklet

Background:

The seasons on Earth are caused by the tilt of the Earth on its axis as it revolves around the Sun. The 23.5-degree tilt of the Earth's axis results in changes in the angle of incident radiation. The surface shortwave downward flux has been measured by the Surface Radiation Budget project, SRB. For many locations, this monthly trend in surface shortwave downward flux will have a direct correlation with temperature, corresponding to seasonal changes. This change in surface radiation during the year can be visualized with animations and through satellite data collected at various latitudes. The differences in climate along similar latitudes can be explained by local variations in heat transfer, such as sea and land breezes. The absorption of solar radiation by different surface materials also contributes to variations in temperature along similar latitudes.

Procedure:

Note to instructor: Before beginning the lesson with students, please read the Scientist Tracking Network Unit Implementation Plan (Word document) found on the MY NASA DATA Unit Plans page. You may also want to refer to the list of Student Hand-outs provided at the end of the Extensions section below, and make copies as needed.

I. Arrange yourselves into 7 groups. Your instructor will distribute the Scientist Tracking Network (STN) Entry Document and the set of Monthly Surface All-Sky Shortwave Downward Flux (SRB) Data for your group's scientist. Consider possible choices of a geographic location using the animation or PowerPoint file of Earth's shortwave surface radiation (See Lesson Links. It may take a few minutes to load the files), visually observing any general changes in surface radiation with the seasons. Does this cycle correspond to the data provided for your scientist's possible location? After your group has narrowed the choices of possible location, write a hypothesis using a logical statement modeled after this pattern: If the scientist is located in _____, then that location will have the highest solar radiation during the month(s) of _____.

While you are testing your hypothesis, a STN representative may arrive with NASA Photos (scientist photo and satellite photo) for each location. Continue to discuss the correlation between changing radiation measurements and the tilt of the Earth's axis. By the end of the period, your group must submit a written hypothesis about your scientist's location.

In the next class period, your group will receive additional data on monthly near-surface air temperature and ozone (See Lesson Links: Monthly Near-Surface Air Temperature and Ozone Data) to further test your hypothesis. You will compile evidence to support your choice of location.

II. Using the Live Access Server to access data:

(1) To compare surface shortwave downward flux data (already provided for the location) with the data from the NASA Live Access Server choose:

Click on the lesson link to the Live Access Server (Advanced Edition)

If not automatically prompted, click on 'Choose Dataset' from the top menu and then select Atmospheric Radiation, Surface, Monthly Surface All-Sky SW Downward Flux (SRB).

From the menu to the left of the screen 'Time Series' from the 'Line Plots' menu

Change the time period to Jan 1994 – Sept 1997

Location–In the boxes to the right of the map, enter the latitude and longitude of the scientist's location.

Be sure to click the radio button nest to 'Update Plot' from the menu at the top of the screen to see your updated plot.

Compare this line plot with corresponding parameter data supplied for each location.

(2) To compare near-surface air temperature data, return to
DATASETS: Atmosphere, Atmospheric Temperature, Monthly Near-Surface Air Temperature (ISCCP).

Be sure to select the same parameters as before. Don't forget to compare the data with that supplied for each location.

(3) To compare total column ozone data, return to
DATASETS: Atmosphere, Air Quality, Monthly Total Column Ozone(ISCCP) and select the same settings as for the previous datasets.

III. After your group has successfully identified the location of your scientist, you will be provided with rubrics to guide you in constructing required products from your study. Your group will write a paper to discuss the evidence supporting your proposed scientist's location. Your group will also create a MISSING poster displaying the geographic coordinates, map of the scientist's location, and graphs of NASA data.

Questions:

1. How does the surface shortwave downward flux change with latitude for a given date?
2. Is there a correlation between the surface shortwave downward flux measurements and the near-surface air temperature for a given season? (even though years of data collection may be different)
3. How does total column ozone change with season and latitude?
4. Compare the variation in surface temperature of Sweden with Brazil.
5. Hawaii and the Sahara Desert are only a few degrees of latitude apart and have similar surface radiation measurements. How can we explain the differences in surface

temperature?
6. Does correlation between datasets necessarily mean that there is a cause and effect relationship?

Extensions:

STN follow up assessment requires each student to interpret graphs of surface radiation for all seven locations and synthesize the information into a coherent explanation of the cause and effect relationship between the tilt of the Earth's axis and the amount of surface shortwave downward flux received in a given location.

Lesson plan contributed by Janell Simpson

Click here for Teachers Notes

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