MY NASA DATA Lesson:

See notes at the end of the lesson for data updates with the new Earth System Data Explorer

The Reason for the Seasons

Purpose:
To correlate surface radiation with mean surface temperature of several geographic regions. By observing the graphs of these parameters, students will construct an understanding of the reason for the seasons.

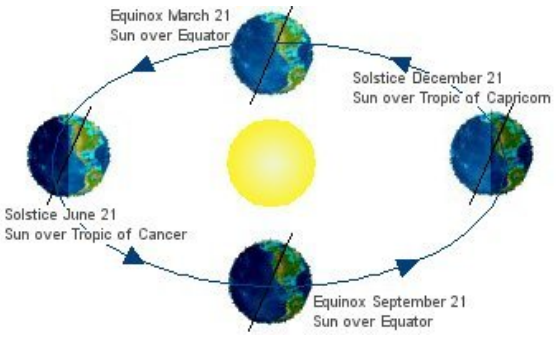

Image courtesy NOAA

Grade Level: 8 – 9

Estimated Time for Completing Activity:
90 minutes

Learning Outcomes:

- Students will select a point on the globe and correlate the trend in monthly surface flux with the mean surface temperature.
- Students will compare graphs of the data generated by the Live Access Server of the MY NASA DATA website.
- Students will explain anomalous trends based on their understanding of local climates.

Prerequisite

- Students should be able to navigate the Live Access Server on the MY NASA DATA website.

Tools

- Computer with Internet access
- World Atlas
- Microsoft PowerPoint

Vocabulary:

- climate
- flux
- irradiance
- latitude
- longitude
- net radiation
- shortwave radiation
- solar radiation
- solstice
- SRB
- temperature

Lesson Links:

- animation of earth radiation
- Live Access Server
- Reason For the Seasons 1
- Reason For the Seasons 2

Background:

The seasons on Earth are caused by the tilt of the Earth as it rotates on its axis and revolves around the Sun. The 23.5 degree tilt of the Earth's axis results in changes of the angle of incident sunlight. A common misconception among students is that the seasons are caused by the distance between the Earth and Sun. In fact, summer in the Northern Hemisphere occurs at aphelion, the farthest distance between the Earth and Sun, and follows summer solstice when incident sunlight is most concentrated along the Tropic of Cancer,23 degrees 26 minutes 22 seconds. The shortwave surface flux (irradiance) for many areas on the Earth has been measured by SRB, the Surface Radiation Budget project. For some locations, the monthly trend in surface flux will have a direct relationship with mean surface temperature.

As a general rule of thumb you can look at incoming solar radiation as less energy in equals lower temperatures and vice versa. It could also be said with less incoming SW radiation, there will be lower amounts of energy in the system and there will also be less heat in the system

For more information on the reason for the season before beginning the lesson, refer to the lesson links – The Reason for the Seasons 1 and the Reason for the Season

Procedure:

1. Open the animation of Earth's net radiation as observed by the CERES instrument during March 2000 – Feb 2001. The file is a Windows Media clip. Observe the seasonal shifts in the total energy.

2. Discuss: Does the monthly trend in surface flux correlate with mean surface temperature at any latitude and longitude?

3. Select a point of the Earth's surface to investigate with the Live Access Server.

4. Identify the city nearest that point by geographic features. For example, London is an urban area in the Northern Hemisphere 75km from the English channel and 50km from the North Sea.

5. Go to the MY NASA DATA website and select DATA ACCESS from the task bar. Choose the Live Access Server (Advanced), or simply click the Lesson Link above. Choose Land Surface, Surface Radiation, Monthly Surface All-Sky SW Downward Flux (SRB).

6. Set these radio button options – Line Plots: Time series, . Within your region, use the cursor to identify a continental location on the map to the left of the screen. To select a region use the double arrow that is pointing down button above the map to the left of the screen. After you have selected Time Series make sure to click on update plot at the top of the screen. You will then be able to click the button with a small circle in it on the world map on the left. This will allow you to click a location with in your chosen region. To be more accurate with your choice you can use the zoom in and out features of the map represented my the magnifying glasses above the map. Note the latitude and longitude so that you can look up those coordinates in the atlas. Put some thought into the climate of that region to include in your discussion.

7. Select update plot to view your graph. Save your radiation graph in your school file.

8. Return to LAS Datasets and select Land Surface, then Surface Conditions, Monthly Surface Clear-sky Temperature (ISCCP). Choose the same pull-down task bars as above. The coordinates should stay the same. Select three years for the time range, unfortunately these years will not overlap with the previous years. Save the temperature graph in your school file.

9. Prepare a class presentation in PowerPoint to show your graphs for your location. Include answers to the questions below.

Questions:

1. What is the correlation between peaks in temperature and radiation for your region? Estimate from each graph the date of each peak and organize into a data table.

2. How do you explain the correlation or lack thereof?

3. Does correlation necessarily mean cause and effect?

4. Is the same correlation present for every geographic region represented in the class presentations?

5. What is the reason for the seasons?

Extensions:

1. How would you expect the daily temperature readings to change following the day of maximum surface flux? Would this lag time be the same in the Northern and Southern Hemisphere?

2. What is the effect of bodies of water on temperature maximums compared to surface flux?

Lesson plan contributed by Janell Simpson, Harahan, LA

Click here for Teachers Notes

View lesson without Standards

Teacher Feedback

Data Notes from Dr. Brad (12/2018):
The radiation data is now found on the Earth System Data Explorer under Atmosphere->All Data->Longwave and Shortwave Radiation at Earth's Surface->Monthly Flow of Energy into Surface by Shortwave Radiation. The ISCCP data is no longer available. Instead, use the surface skin temperature (Geosphere->All Data-> Daytime Skin Temperature).