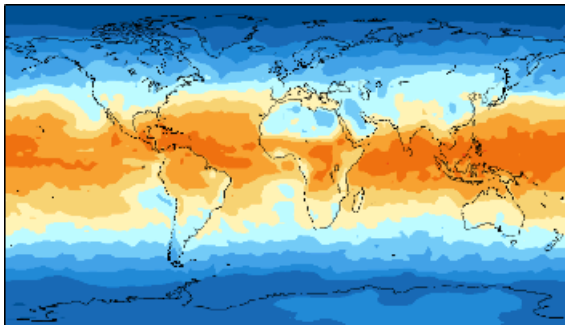
MY NASA DATA Lesson:

Earths Energy Budget- Seasonal Cycles

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



Purpose:
To use CERES radiation data to understand seasonal variations in the pattern of net energy input to the Earth system.

Grade Level: 6,9 – 12

Estimated Time for Completing Activity:
One 50-minute class period

Learning Outcomes:

- Understanding how Earth's tilt causes seasonal differences in incoming solar energy
- Using the Live Access Server to investigate the Earth's radiation budget
- Locating map locations using latitude and longitude coordinates
- Understanding how features of the Earth system, such as clouds and deserts, modulate the reflection of energy from the Sun

Prerequisite

- Familiarity with accessing websites on the Internet
- Familiarity with locating given geographical locations using latitude and longitude and a world map
- Prior lesson about seasons and Earth's tilt

AP Environmental Science Topics

- Atmospheric circulation
- Latitude
- Seasons

- Solar intensity
- Weather and climate

Vocabulary:

- flux
- latitude
- longitude
- radiation

Lesson Links:

- Animation of Earth Net Radiative Flux as Observed by the CERES Instrument
- Monthly TOA All-Sky and Clear Sky Net Flux for December 2003
- Monthly TOA All-Sky and Clear Sky Net Flux for March 2004
- Monthly TOA All-Sky and Clear Sky Net Flux for June 2004

Background:

The net amount of energy received by different parts of the Earth at different times of year determines the type of weather and climate they will experience. The net radiative flux shows the combined effect of the Sun's location and the conditions in the Earth system. The two primary components of the Earth system that affect the net radiative flux are: 1) the type of surface and 2) clouds. This lesson will allow students to explore these variations.

Procedure:

Open the image of Monthly Top-of-Atmosphere All-sky Net Flux for December 2003.(see Links section) Discuss whether the patterns you observe are consistent with your prior knowledge about seasons and Earth's tilt. Based on this, write down a prediction of how the pattern would be different in March.

Open the image of Monthly Top-of-Atmosphere All-sky Net Flux for March 2004. (see Links section) Does the pattern in this image fit your prediction? If not, revisit your earlier discussions and write down a prediction for the pattern in June.

Open the image of Monthly Top-of-Atmosphere All-sky Net Flux for June 2004. (see Links section) Does this pattern agree with your prediction?

Open the animation of Earth's net radiative flux (see Links section) as observed by the CERES instrument during March 2000 through Feb 2001. The file is a Windows Media clip. Observe the seasonal shifts in the net energy received by the Earth. Does the annual cycle agree with your previous understanding and predictions?

Questions:

1. Looking back at the images for December, March and June, write down two locations where you think the surface has a noticeable impact on the pattern of net radiative flux, and two locations where you think clouds have a noticeable impact.

2. Open the images for Clear-sky Net Flux (Note – these images are created by taking only the satellite observations during the month when an area is cloud-free. White areas denote areas of persistent cloud cover where no clear-sky information could be obtained.). Compare these images to the All-sky images and, for the four locations you selected in question 1, discuss whether your prediction was correct. Support your arguments by comparing the patterns in the All-sky versus Clear-sky image.

Extensions:

Ask the students why they think net radiation would be negative over the Saharan Desert. Discuss the possible effects of clouds in the tropics.

Note that the units of net radiation are Watts per square meter. This can be compared to light bulbs. A net radiation of 60 Watts per square meter means the amount of energy actually being received by the Earth is equivalent to having a 60 W light bulb over each square meter of the Earth. Have your students calculate the area of your classroom or their room at home, then figure out how many lightbulbs would be equivalent to the net solar radiation for each season. You may want to use the LAS to get the value of the net radiation at your latitude and longitude location.

Lesson plan contributed by the MY NASA DATA team

Click here for Teachers Notes

View lesson without Standards

Data Notes from Dr. Brad (12/2018):

If you want to explore the data further in the Earth System Data Explorer, the CERES net radiative flux is found under Atmosphere->All Data->Net Atmospheric Radiation->Monthly Net Flow of Energy towards Earth by Longwave and Shortwave Radiation with (without) Clouds.