

MY NASA DATA Lesson:

Does cloud type affect rainfall?

Purpose:

This lesson uses satellite data to compare precipitation (rainfall) to cloud type

Grade Level: 7-9

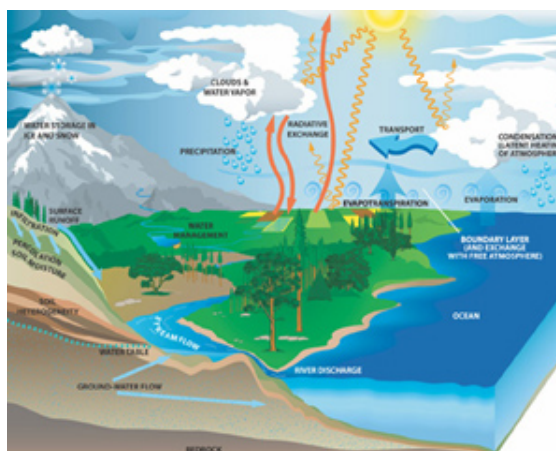


Image courtesy of NASA

Estimated Time for Completing Activity:

One 50-minute period

Learning Outcomes:

- The student will be able to use MY NASA DATA to obtain precipitation and cloud type data
- The student will be able to create graphs of data within MY NASA DATA
- The student will be able to compare different cloud types
- The student will be able to compare precipitation and cloud type data
- The student will be able to qualitatively describe graphs of the precipitation and cloud type data

Prerequisite

- General familiarity with cloud formation
- General understanding of causes and types of precipitation

Tools

- Computer with Internet access
- Graphing utility software (e.g. Microsoft Excel) for some of the extension exercises

Vocabulary:

- [cloud coverage](#)
- [cloud opacity](#)
- [GPCP](#)
- [ISCCP](#)
- [precipitation](#)

Lesson Links:

- [Cloud ID Form](#)
- [Live Access Server \(Advanced Edition\)](#)
- [Sample Image Cloud Cover Year 1](#)
- [Cloud ID Form \(Spanish\)](#)
- [Sample Image Precipitation Year 1](#)
- [Sample Image Cloud Cover Year 2](#)
- [Sample Image Precipitation Year 2](#)
- [Cumulonimbus](#)
- [The Hydrologic Cycle](#)
- [Nimbostratus](#)
- [Precipitation Climatology for Nashville, TN](#)
- [Description of nimbostratus and cumulonimbus clouds](#)

Background:

Water plays a major role in life on Earth. In fact, the surface of the Earth is about 70 percent water. Most of the water is salty, leaving a small portion for land, animal and human use. Much of this water is located beneath the ground, while other water is found in rivers, lakes, ponds, etc. It is from these latter sources that the water cycle begins; but, let us not forget that water is also found in the air as water vapor and clouds. Additionally, the more water vapor that is in the air, usually the more clouds there are. This water vapor condenses to form water droplets that eventually fall out of the cloud as precipitation. Precipitation has many different forms such as: rain, snow, hail, sleet, or ice. For people living in the southern US, rainfall is the most common form of precipitation

As mentioned before, clouds are the source of precipitation. If you look up in the sky on any given day, there can be many different types of clouds. We see clouds even when there is no rain. How can this be? The type of cloud determines what types of precipitation could fall from the cloud. The two cloud types that produce rainfall are Cumulonimbus and Nimbostratus. See the Links section for more information about cumulonimbus and nimbostratus clouds. Scientists have studied the physical properties of clouds and have developed instruments on board satellites to characterize the types of clouds they see below. Some satellites have instruments that allow them to measure rainfall as well.

For this lesson students will hypothesize what types of clouds they believe will create the most precipitation (rainfall) over Nashville, TN. Students will first access and plot cloud coverage data that represents what percentage of the sky is covered by a certain type of cloud (cirrus, stratus, cumulus, see the Cloud ID Form by Dr. Tina Cartwright for help). They will then compare the cloud coverage data to precipitation data for the same location and time period. Note: For more information on the hydrologic cycle and on the climatology of Nashville, TN, please see the Links section. You may want to investigate the climatology of your own local area.

Procedure:

Part I Generate a line-plot of Cirrus cloud coverage (Year 1)

1. Click on link to Live Access Server (Advanced Edition) in the Lesson Links.
2. Click on the blue 'Choose Dataset' tab, located in the left corner of the top menu.
3. Select Atmosphere, then Clouds, then Cloud Coverage.
4. From the pull-down menu, click on the radio button for Monthly Cloud Coverage for Cirrus (ISCCP).
5. In the compass rose, located below the navigation map on the left, type 36N into the North and South positions, and type 86W into the East and West positions. (These are coordinates for Nashville, TN. You may want to study a different location, for which you would enter coordinates.)
6. Under 'Line Plots', click the radio button for Time Series.
7. For the 'Date Range', from the pull-down menu, select August 2004 as the beginning date, and May 2005 as the ending date.
8. Click on the 'Update Plot' tab, which is the second button from the left of the top menu bar. A line-plot should appear. Check title, labels, and dates to be sure this the data-set you wish to study.

Part II Plot additional cloud-types on same graph (Year 1)

9. Click on the blue 'plus-sign' located in the top left corner, above the navigation map, under the question mark.
10. From the pull-down menu, select Monthly Cloud Cover for Deep Convective Clouds (ISCCP).

11. Click on 'Update Plot'. Two lines should now be visible on the line-plot.
12. Once again, click on the blue 'plus-sign'.
13. From the pull-down menu, select Monthly Cloud Cover for Stratus (liquid)(ISCCP).
14. Click on the 'Update Plot' tab. Three lines should now be visible on the line-plot.
15. Save this image to your computer. This can be done by clicking on 'Set Plot Options' from the top menu, then selecting 'GIF' from the drop down menu for 'Image Format', and then clicking on 'Ok'. Next click on 'Print' in the menu above the plot. This will open a second window with the GIF image of your plot. You can 'right click' or 'control click' on this image and 'save as' to save the image to your computer for later use.

Part III Generate the Precipitation line-plot (Year 1)

16. Repeat Part I, except choose Atmosphere, then Precipitation, then Monthly Precipitation (GPCP). A line plot should appear. Verify that this is the data-set that you wish to study.
17. Save on your desktop for later use (See Step 15).

Part IV Generate Cloud Coverage and Precipitation plots for Year 2

18. Repeat Parts I – III, except for 'Date Range', select August 2005 as the beginning date, and May 2006 as the ending date.
19. Save both Year 2 plots on your desktop (See Step 15). You should now have four total graphs, Year 1 Cloud coverage and Year 1 Precipitation, then Year 2 Cloud coverage and Year 2 Precipitation.

Inquiry based: In the Links section are the actual outputs for both Year 1 and 2. Present the graphs to students first and ask them to hypothesize about what the graph represents. Use their input as a lead-in to a brief discussion on clouds and the different cloud types. To wrap up, ask them questions from the Questions section or create your own!

Questions:

1. Compare the Year 1 graphs (Cloud Coverage plot and Precipitation plot). Describe their similarities and differences.
2. Describe any pattern that you see in both Year 1 graphs.
3. Looking at the Year 1 plots–What is the range of cloud cover that has the most precipitation? The least precipitation?
4. Describe any seasonal changes that occur. For example, during which months do the dry and wet seasons occur?
5. Answer questions 1 – 4 for the Year 2 plots.
6. Comparing the Year 1 plots to the Year 2 plots, describe any similarities and differences between the two years of data.

Extensions:

1. Compare precipitation to cloud opacity (variable name – cloud optical depth). Answer the questions found in the Questions section. The outputs are provided in the Links section.
2. Have students choose different locations around the world. Allow them to hypothesize about what they expect to see in different locations. Allow them to compare the same variables (precipitation and cloud coverage). Ask students to report on whether their hypothesis was correct.
3. If your school is a GLOBE school, go to the GLOBE website and download your school's precipitation data. GLOBE data are daily, so have students calculate monthly means (averages) for the months where there is data reported. Have the students use a spreadsheet program to graph monthly precipitation means from MY NASA DATA compared with their school's monthly precipitation means. Answer the following questions:
 - a. Compare the graphs and list way in which they are similar or different
 - b. Are there patterns in one graph that are not seen in the other graph?
 - c. If your school has a small number of observations, how do think having additional data would affect the results?
 - d. Develop a list of the pros and cons of measuring rainfall from satellite versus rain gauges on the ground.

Lesson plan contributed by Chris Spiegl edited by MY NASA DATA Team

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