

MY NASA DATA Lesson:

Seasonal cloud cover variations

Purpose:

To determine the seasonal cloud coverage and the type of clouds that make up the coverage, by percent, in the North Carolina (or other) area. Students will graph the data and make correlations between types, seasons and percentages.



Grade Level: 9-12

Image courtesy Kathy Bosiak, Denver, NC

Estimated Time for Completing Activity:

Five 90 minute class periods

Learning Outcomes:

- Students will be able to recognize different cloud types. They will be able to determine the seasonality of various types of clouds. They will be able to graph the data and determine if there is a correlation between season, cloud cover and finally type of cloud most prevalent during each season.

Prerequisite

- Familiarity with basic cloud types and the altitudes at which they are located.
- Locate the longitude and latitude of Lincolnton, NC (or your town) using your GPS.
- Record that information.

Tools

- atlas or globe
- cloud sheet with cloud types and corresponding altitudes-see list below
- spreadsheet program
- GPS and recording sheet or other resources for looking up longitude or latitude

Vocabulary:

- [contrail](#)
- [Coriolis force](#)
- [Hadley Cell](#)
- [ITCZ](#)
- [Trade Winds](#)

Lesson Links:

- [GLOBE Contrail Education website](#)
- [Cloud definitions and pictures](#)
- [CloudSat](#)
- [EarthKam photos](#)
- [GOES](#)
- [ISCCP](#)
- [LITE](#)
- [MY NASA DATA homepage](#)
- [SeaWiFS](#)
- [video links of Aqua satellite constellation](#)
- [Weather glossary](#)
- [Aqua - MODIS](#)
- [Calipso](#)
- [Altostratus](#)
- [Altostratus](#)
- [Cirrocumulus](#)
- [Cirrostratus](#)
- [Cirrus](#)

- Cumulonimbus
- Cumulus
- Nimbostratus
- Stratocumulus
- Stratus

Background:

Clouds are collections of water vapor in the atmosphere. Moisture collects in the atmosphere due to the evaporation of water, thus evaporation plays an essential role in the water cycle. Earth's oceans are huge sources of water for evaporation.

On and near the Equator, where average solar radiation is greatest and moisture plentiful, air is warmed at the surface and rises (convection). This creates a band of low air pressure which draws in surface air from the subtropics (23.5 – 30 degrees N and S). When this subtropical air reaches the Equator, it converges and rises into the upper atmosphere (convergence). The rising air leads to the formation of large towering cumulus clouds. The air attains a maximum vertical altitude of about 14 kilometers (top of the troposphere), and then begins flowing horizontally to the North and South Poles. This rising air comprises one segment of a circulation pattern called the Hadley Cell. The Hadley Cell eventually returns air to the surface of the earth, near 30 deg N and S.

The descending portion of the Hadley Cell produces a band of high air pressure at these latitudes called the subtropical high. Winds are generated between the subtropical high and the equatorial band of low pressure because air moves from high pressure toward low pressure. The Coriolis effect makes the winds easterlies.

Frequent cloud cover and precipitation occur along this band of convergence and convection which is called the Intertropical Convergence Zone (ITCZ). The descending air at the subtropical high inhibits cloud formation. Because of the Earth's tilt, and thus the latitude of maximum solar radiation, there are seasonal shifts northward and southward of the location of the ITCZ and subtropical high.

Procedure:

Assign students to teams of four. (Teacher will assign the teams).Have your 7-10 questions ready to discuss with your group. Brainstorm a final set of questions illustrating what you would like to discover, what you expect to discover, what problems you might encounter etc. Put these in a safe place and proceed to the following directions.

1. Click on the Live Access Server (Advanced Edition) in the lesson links section above
2. If not automatically prompted, click on 'Choose Dataset' in the upper left hand corner and choose, Atmosphere, Clouds, Cloud Coverage, and then Monthly Cloud Coverage (ISCCP)
3. In the menu to the left of the screen under 'Line Plots' choose 'Time Series'
4. Enter in the Latitude and Longitude in the Compass Rose below the navigation map or use the circle and zoom tools above the navigation map to choose a location.
5. Set your range: Jan 1998 to Sept 2001
6. Click on the radio button next to 'Update Plot' to see your data plot.
7. From the menu at the top of the screen, select 'Save As', select ASCII, verify the time range and click 'OK'.

When you are prompted click 'your ASCII file'. This will give you a data list.

You will be looking at months that are representative of each season.

Use the following months and track the percent cloud cover for the 3 years worth of data:

March

June

September

December

You may import this data into a spreadsheet at this point or work from the data as is. Create a graph showing the percent cloud cover for your month over the three year period.

Locate visual pictures of average days in your month and year to see how accurate the data are. Find representative days for your chosen months. You should try to find photo documentation for at least half of the days in your month(s). Note: this paragraph applies only to a classroom that is doing a digital photo essay project and has a collection of local photographs from which to choose.

Questions:

1. Do you see any trends in the amount of cloud cover for certain months over the three year period? Explain your answer.
2. Do you see any correlation between the amount of cloud cover and the type of clouds over the same three year period? Explain your answer.
3. Do you see any correlation between the type of cloud cover and the amount of precipitation, which occurred at your location over the three year period you examined? Explain your answer.

Extensions:

Extension 1.

Once you have all your mean cloud cover data, we need to determine if there is one type of cloud or another that is more prevalent during each season.

Go to MY NASA DATA website- see link

Click on the Live Access data link

Click on the Live Access Server

Click on Atmosphere

Click on Clouds

Click on Cloud Coverage

Click on Monthly Cloud Coverage for Cirrus (ISCCP)

Click Next

Follow the procedure for mean cloud coverage

When this is finished, repeat for the Stratus (liquid) and Cumulus (liquid) cloud data

Graph your data using each cloud type's information.

Extension 2: Research and create a poster and Powerpoint presentation on one of the following:

ISCCP,GOES,CLOUDSAT,CALIPSO,AQUA (MODIS),SeaWiFS

You may use the link to start gathering information.

Extension 3.

Over the course of the semester, pick two days with similar cloud coverage type percentages to those you graphed. Also pick a clear day with similar temperatures as your test days. Make sure that one day is fairly cold and one day is quite warm. I would suggest either picking a warm day in August-September or May-June and a cool to cold day in Dec-Feb. Using the GLOBE ozone detecting device, measure the ozone using the instructions listed with the device. Speculate on whether temperature and cloud cover have a bearing on ozone.

Extension 4.

If you live under or near a major air traffic route, you may have a problem with human induced cloud cover. Whether you realize it or not, this is becoming a big issue in some regions with lots of air traffic. Can you make a connection between flight and human-induced clouds (contrails) on the one hand, and cloud cover and precipitation on the other hand? How would you go about getting the information which would allow you to begin to examine this question?

Once you have brainstormed the answers to this question, contact your nearest airport and see if they will give you information about the number of flights over your area for the months that you have already looked at.

Now, re-evaluate the above questions using the information about contrails and numbers of flights. Is there a possible connection with excess or minimal cloud cover when considering contrail data?

Consider becoming part of a contrail observation network (see the GLOBE Contrail link above).

Lesson plan contributed by Kathy Bosiak, Denver, NC

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