MY NASA DATA Lesson:

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

Analyzing Tree Rings to Determine Climate Change

Image courtesy NOAA Paleo Slide Sets

Purpose:
To utilize monthly average precipitation data to strengthen conclusions about periods of drought or abnormal rainfall from analysis of tree rings

Grade Level: 6 – 8

Estimated Time for Completing Activity:
50 minutes

Learning Outcomes:

- Students will learn how to locate, access and utilize data sets to support a selected physical phenomenon.
- Students will learn how to import data into Excel and produce an appropriate graph of that data.

Prerequisite

- Completion of a lesson on tree ring structure and analysis (Three possible lessons are offered in the Lesson Links below)
- Familiarity with using Excel or other spreadsheet software
- Some knowledge of graphs and their interpretation
- General understanding of weather, particularly precipitation
- General understanding of requirements for plant growth, especially the need for water.

Tools

- Computer with Internet access

- Excel or other spreadsheet software

AP Environmental Science Topics

- Climate shifts
- Paleoclimatology

Vocabulary:

- climate
- GPCP
- NOAA
- precipitation
- weather

Lesson Links:

- A Guide to Reading Tree Rings
- Elementary Lesson on Tree Rings
- Tree Ring Worksheet
- NOAA Paleoclimatology Web Site
- Live Access Server (Advanced Edition)
- Jackson Tree Ring drawing
- Columbia Tree Ring drawing
- Boston Tree Ring drawing
- Seattle Tree Ring drawing

Background:

Researchers such as paleoclimatologists or dendrochronologists use tree ring analyses as one tool to reconstruct climate information about the past. They will often reference data from other sources such as historical weather records, and ice core or ocean core samples to support their findings.

Since the successful launch of the first weather satellite, TIROS-I in 1960, weather and climate data have been collected from space on a continual basis. More and more scientists in a wide variety of research fields are coming to rely on data gathered by these Earth observing platforms.

Tree-ring analysis is considered a method of studying precipitation that occurred during the life of the tree. In this lesson, students compare authentic precipitation data to width of tree-rings (either real or simulated) to determine similarities and differences in precipitation patterns as indicated by tree-rings, and precipitation patterns indicated by satellite data for the same time period.

Note: This lesson is designed to facilitate student acquisition of the skills and knowledge necessary for accessing and utilizing NASA data sets to further their science and math competencies while engaging them in activities that reflect the processes of scientific inquiry as conducted by individuals in a growing number of careers.

Procedure:

Part I: Collect tree-ring data

1. Gather tree-ring samples, or use the simulated tree-rings (drawings found in the Links section). Record the location of the tree and the year in which it was cut.
1a. On the tree-ring sample, carefully look at the rings in the slice. Notice that there are both dark and light rings. The light rings indicate the spring growing season, and the dark rings indicate growth in the late summer and fall seasons.
1b. To determine the age of the tree, begin counting only the dark rings from the center of the tree, working toward one edge. Count each dark ring only once. Don't count the bark (outer coating of the tree) as a ring. Record the number of rings you have counted. This corresponds to the number of years the tree was alive. To determine the year in which the tree was planted, subtract the number of dark rings from the year in which it was cut.
1c. Notice the thickness of the rings. The thickness of the rings indicates the quality of the growing conditions during that season. For example, a thicker ring would most likely indicate that water was plenteous during that growing season.
2. Complete the Worksheet for Tree Ring Analysis, Question 1 as you analyze the samples (or drawings). To complete the remainder of the worksheet, complete Part II below.

Part II: Compare tree ring data to satellite data.

1. Click the Lesson Link for the Live Access Server.
2. If you are not automatically prompted with parameter choices click on 'Choose Data Set' in the upper left hand corner of the screen then, click on Atmosphere, then Precipitation and then Monthly Precipitation (GPCP) box.
3. From the menu to the left of the screen, select 'Time Series' from the LINE PLOTS

options. Then click on the radio button next to 'Update Plot' found at the top of the screen above the navigation map.
4. Change your time range to suit your tree ring. For many tree rings this may be the full time range available.
5. Use the Zoom button to zoom in on North America or enter in your latitude and longitude for your selected area.
6. TO find your location you can also adjust the position of the cursor until the coordinates match the area where the tree grew; or, you can enter the coordinates directly in thecompass box to the right.
7. Save it or print it out for future use.
Note: The remaining steps guide students in plotting Excel graphs. If time is not available, students may use their results from Step 10, then skip to Step 17.

Optional Steps 7- 17: Plotting data in Excel
8. Close the graph window which takes you to the previous window and this time in the Select Output window, choose text file (ASCII).
9. Click the link and save the text file to the desktop or a folder.
10. Close out of the MY NASA DATA Site and then open Excel.
11. Under the Data menu, scroll down and select Get External Data.
12. Select your saved text file (ASCII) and import into Excel.
13. Adjust rows and columns to fit your desired outcome.
14. Select Chart Wizard, scroll down and choose the type of chart best suited to your data.
15. Follow the Chart Wizard instructions to create your chart in Excel.
16. Save or Print your table and chart.

17. Compare the LAS results with your findings from the tree ring analysis

Questions:

1. Did the satellite data confirm your tree ring analysis? If not, what might account for the differences between the two measurements?

2. Can you suggest data sets for other parameters that you could check that might support either the tree ring or the satellite data, if they do not agree?

3. Which of your results (the tree ring analysis or the satellite data) best reflects year-long changes in precipitation? Explain your answer in terms of your data.

Extensions:

1. Have students research via news sources any strong indicators in the data of drought or exceptional periods of precipitation to determine their impact on people and the environment.

2. Expand the time range indicated in your query of the LAS and have students predict tree ring growth patterns for rings not included in the original analysis.

3. Instruct students to locate archives of publications that include past weather conditions to check on the accuracy of their predictions.

Lesson plan contributed by Patrick Daugherty, Columbia, Missouri

Click here for Teachers Notes

View lesson without Standards

Teacher Feedback

Data Notes from Dr. Brad (12/2018):
Up-to-date monthly GPCP precipitation data can be found on the Earth System Data Explorer at Hydrosphere->All Data->Precipitation->Monthly Precipitation.