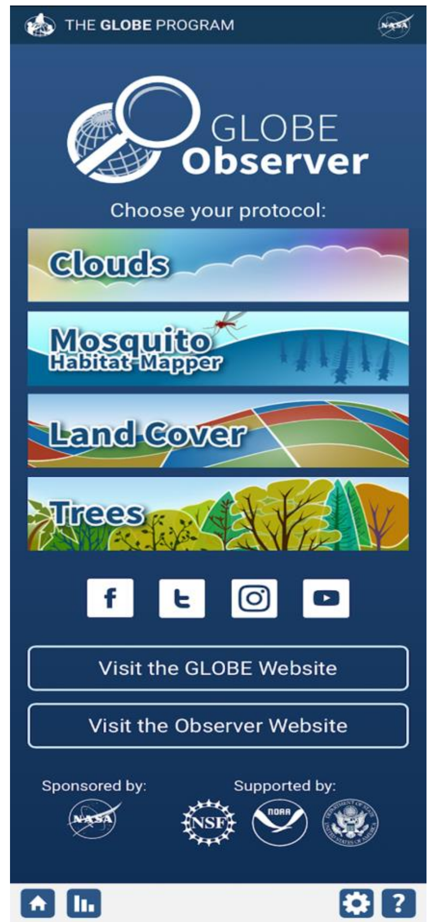
Extension - 4-H Youth Development

GLOBE Observer: Climate & Weather Science

Youth create educational posters or notebooks on weather and climate topics or display activities from the manuals for the Weather and Climate Science project. Collecting and analyzing weather data through the GLOBE program and other citizen science platforms provides opportunities to integrate data collection and analysis into 4-H Weather and Climate Science projects. Submitting measurements through GLOBE Observer also integrates youth into the scientific process, since NASA uses observations as ground-truth for remotely sensed data.

1. ***Cloud Data Collection through GLOBE Observer***

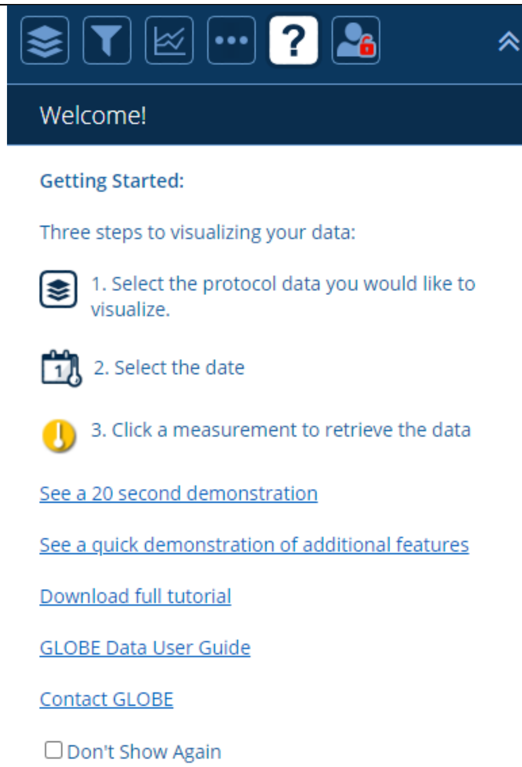
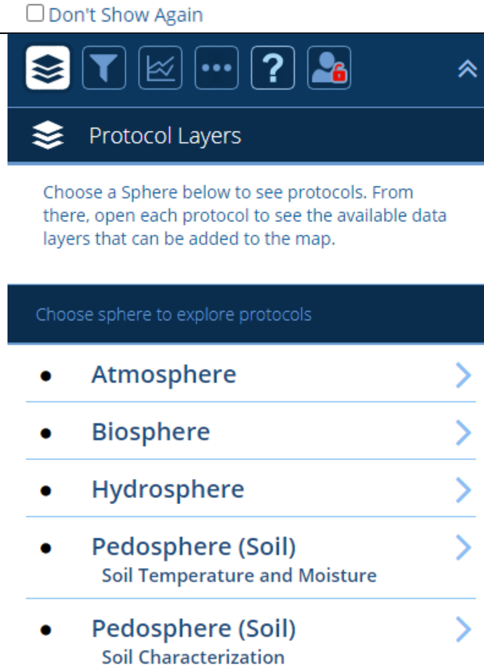
The *Clouds* data entry protocol on GLOBE Observer includes presence or absence of clouds, percentage of cloud cover, sky color, visibility, cloud types, precipitation, and ground cover. Tutorials during the data collection process will help youth learn about cloud types and contrails.

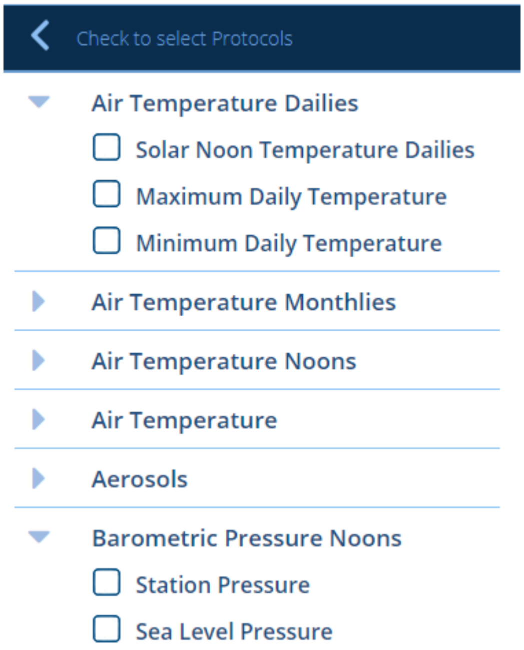


Before collecting data on cloud cover, it is helpful to calibrate your eyes to different percentages of cover. Use GLOBE's ***Estimating Cloud Cover: A Simulation*** activity will familiarize youth with what different levels of cloud cover look like. GLOBE also has an online version of this simulation (Atmosphere Cloud Cover Estimation).

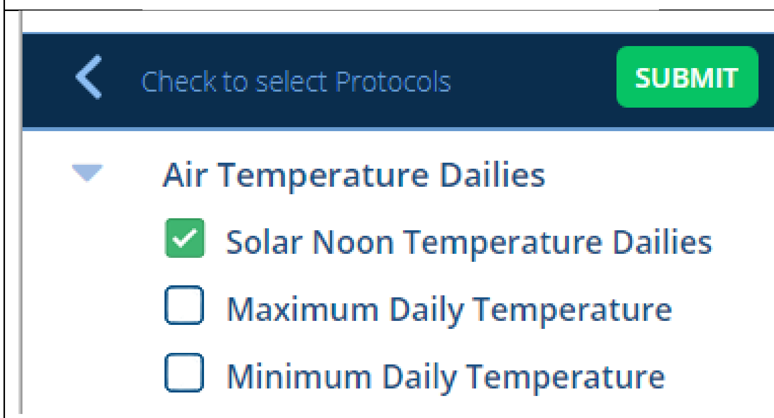
2. ***Using crowd-sourced weather data through the GLOBE platform***

Through the GLOBE program's online platform, youth can analyze atmospheric data from across the world that were collected by other GLOBE users, such as air and surface temperatures, water vapor, and aerosols (https://vis.globe.gov/GLOBE). The tutorial below details how to visualize data in GLOBE.

	The *Help* panel outlines the next steps and includes supporting tutorials.
	Click the ***Protocol Layers*** button ( ) in the top left corner. Click on the sphere from which you want to analyze data [Atmosphere, Biosphere, Hydrosphere, Pedosphere].

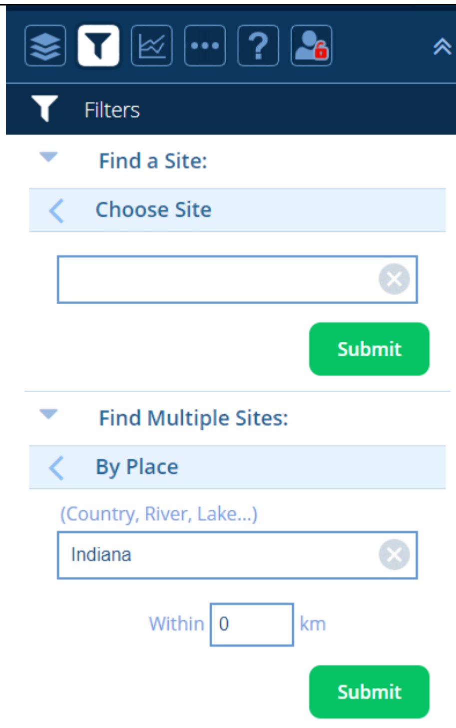


Within a sphere, different types of data, such as daily air temperatures or barometric pressure, are available. Click on the data type that you want to visualize to see a drop-down list of available metrics.



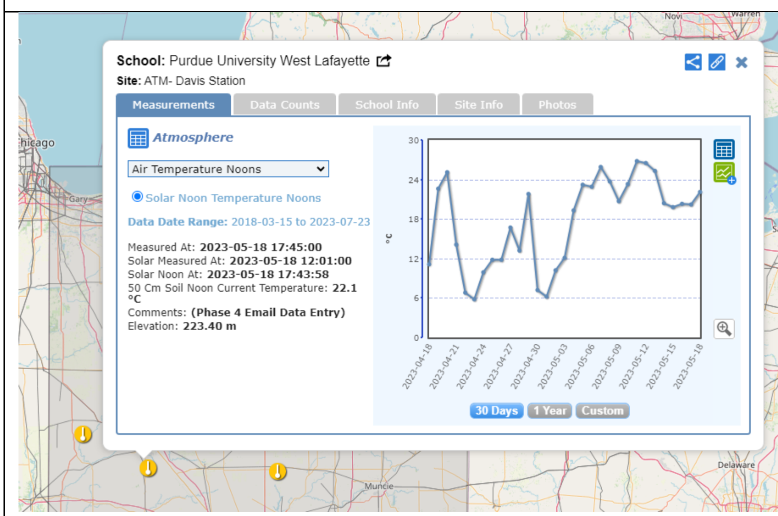
There might be multiple protocols within a data type. These protocols represent different methods for collecting data or different metrics for representing data (e.g., representing by mean or maximum). Check the box on the left to select which protocol or protocols you want to use for visualization. In this example, daily air temperatures based on the Solar Noon Temperature Dailies protocol are selected for visualization.

Click green ***Submit*** button once you have selected your protocols. To simultaneously visualize protocols from other sphere, click ***Check to select Protocols*** to return to other spheres. Hit ***Submit*** only once finished with selecting protocols from other spheres.



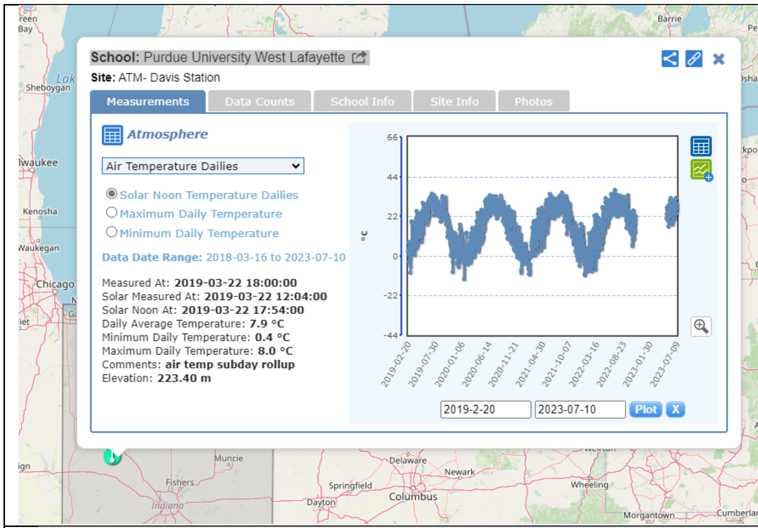
The GLOBE Visualization System includes data from across the world and many years. Select the *Filters* pane () to limit the geographic extent based on data collection sites, elevation, or observer. Click the green ***Submit*** button to confirm your filters.

In this example, visualizations outside of Indiana were filtered out of the visualization.



Click on a data collection site to view available data. Site should include the date range over which observations are available, latitude, longitude, and elevation. Surface cover, photographs, and other information may also be available.

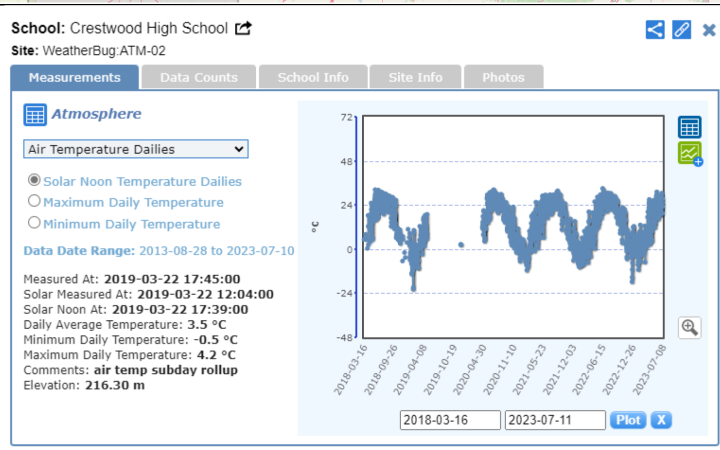
On the *Data Counts* tab, there is a bar chart with the number of observations, and the x-axis of this bar chart can be customized to display certain date ranges. If you are seeking data for a specific time period, the data counts visualization can inform whether this data collection site is viable for your investigation.



Click the gray *Custom* button to input a specific data range. Data are only available within the listed data date range for the site.

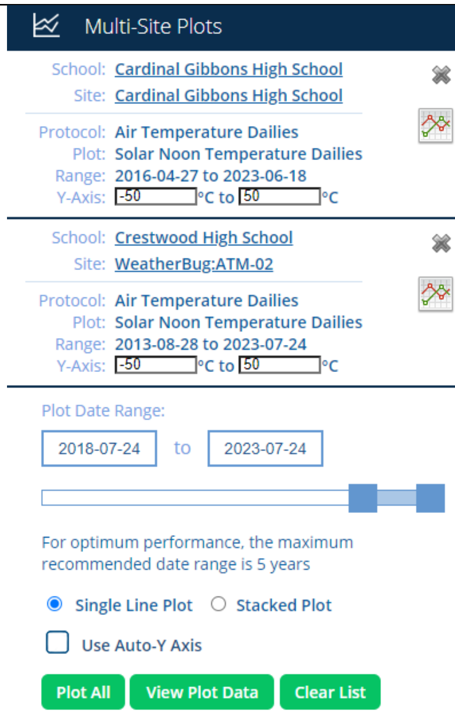
If you selected multiple protocols, use the radio button to select which parameter should be visualized.

In this example, the data range was edited to include multiple years of daily solar noon temperatures.



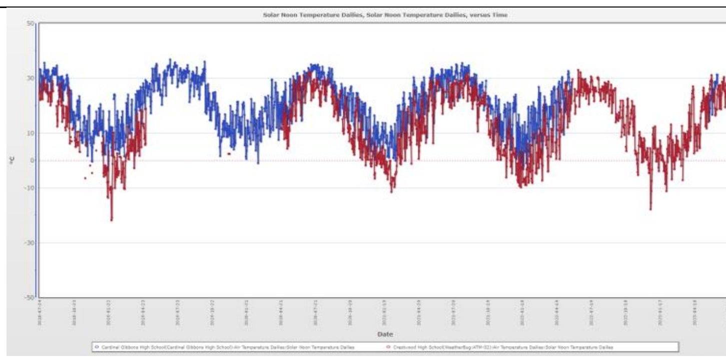
To compare multiple sites on the same plot, click the green *Multi-site Plots* button ()in the upper right corner of each site visualization.

This example explores the impacts of latitude on daily temperatures. The Multi-site Plots button was used to add time series data from Crestwood High School in Detroit, Michigan and Cardinal Gibbons High school in Raleigh, North Carolina to the same visualization.



On the *Multi-Site Plots* pane, selected stations, date ranges, and environmental parameters are listed. The Plot Date Range can also be modified on this pane.

Click the green *Plot All* button to display multiple sites on the same visualization.



In the resulting time series plot, time is on the x-axis, and temperature is on the y-axis. Locations are represented by different colors in the time series plot.

Note: GLOBE permits user to plot different measures (e.g., precipitation and temperature) on the same time series plot by using secondary axes. Charts with two different y-axes are often misinterpreted by readers and do not effectively summarize the relationship between the two measures, so many data scientists are moving away from using secondary axes.

PURDUE UNIVERSITY EXTENSION – 4-H YOUTH DEVELOPMENT
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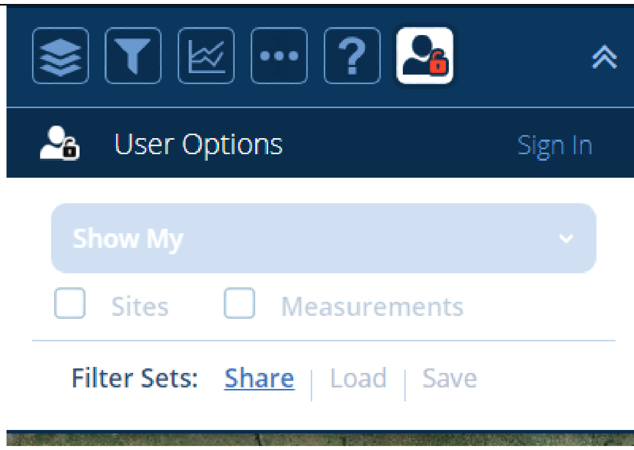

To visualization measurements taken by your account, navigate to the *User Options* pane and sign in to visualize your measurements.

For more advanced user who want to create their own visualizations in other software, use the GLOBE Program Advanced Data Access Tool to select and download data in CSV format.

In this example, data collection sites with monthly air temperature and precipitation in Indiana were queried. The date range was also customized.

Estimating Cloud Cover: A Simulation

Purpose

To help students better understand percent cloud cover and to take more accurate cloud cover observations

Overview

Working in pairs or small groups, students use construction paper to simulate cloud cover. They estimate the percentage of cloud cover represented by torn pieces of paper on a contrasting background and assign a cloud cover classification to the simulations created by their classmates.

Student Outcomes

Students understand the difficulties of visually estimating the percentage of cloud cover and gain experience estimating cloud cover, evaluating the accuracy of estimates, and using fractions and percentages.

Science Concepts

Earth and Space Science

Clouds can be described by quantitative measurements.
Clouds change over different temporal and spatial scales.

Geography

The nature and extent of cloud cover affects the characteristics of the physical geographic system.

Scientific Inquiry Abilities

Estimate cloud cover.
Design and conduct scientific investigations.
Use appropriate mathematics to analyze data.
Communicate results and explanations.

Time

One class period

Level

All

Materials and Tools

Sheets of colored construction paper, one blue and one white per student
Glue stick, glue, or tape

Preparation

None

Prerequisites

Familiarity with fractions and percentages

Background

Even experienced observers have difficulty estimating cloud cover. This seems to derive, in part, from our tendency to underestimate the open space between objects in comparison to the space occupied by the objects themselves, in this case the clouds. Students have an opportunity to experience this perceptual bias themselves, to reflect on its consequences for their scientific work, and to devise strategies to improve their ability to estimate cloud cover.

What To Do and How To Do It

Introduce students to the idea of observing and quantifying cloud cover. Explain that they will simulate cloud cover using construction paper and estimate the amount of cloud cover represented by white scraps of paper on a blue background. Demonstrate the procedures covered in steps 3 - 6 below so that students understand how to proceed.

You may review the *Cloud Cover Protocol* with students before doing this learning activity or use the activity as a first step in presenting the protocol to students. Step 7 below requires you to explain the classification categories that are used – no clouds, clear, isolated, scattered, broken, and overcast.

1. Organize students into pairs.
2. Provide each pair with the necessary materials:
   - one sheet of light blue construction paper
   - one sheet of white construction paper divided into 10 equal segments
   - GLOBE Science Log
   - glue stick, glue, or tape.
3. Have each student pair choose a percentage of cloud cover that they wish to represent. They must choose a multiple of 10% (i.e. 20%, 30%, 60%, etc. not 5% or 95%). They should not reveal the percentage they have chosen to anyone else.
4. Have each pair cut their white paper so that it represents the percentage of cloud cover they have chosen. For example, if they have chosen 30%, they should cut out 30% of their white piece of paper and recycle the remaining 70%.
5. Students should then tear their white paper into irregular shapes to represent clouds.
6. Have students paste or tape the cloud pieces onto the blue paper, taking care not to overlap the pieces of white paper. On the back of the blue paper, record the percentage of cloud cover.
7. Have students take turns visiting each others' simulations and estimating the percentage of cloud cover. For each simulation they should classify the sky as "clear, isolated, scattered, broken, or overcast using Table AT-CO-1." They should then record their estimates in their GLOBE Science Log, using a table similar to that shown in Table AT-CO-2.

   Have all students visit all the simulations, or divide the class in some way so that students visit only some of the simulations.
8. When students complete their estimates of cloud cover, create a table on the board to compare the estimates with the actual percentages. See Table AT-CO-3.
9. Create a second table that compares correct classifications with incorrect classifications. See Table AT-CO-4.
10. Discuss with the class the accuracy of their estimates.

    Which were more accurate — the percentage estimates or the classifications?

    Where did the greatest errors occur?

Table AT-CO-1

Percentage	If less than	If greater or equal to
10%	Clear	Isolated
25%	Isolated	Scattered
50%	Scattered	Broken
90%	Broken	Overcast

Table AT-CO-2

Name	Estimated percent	Classification
Jon & Alice	40%	scattered
Juan & Jose	70%	broken

Table AT-CO-3

Name	Actual %	Underestimates	Correct estimates	Overestimates
Jon & Alice	60	4	5	12
Juan & Jose	70	6	9	6

Table AT-CO-4

Name	Correct classification	Classified too little cover	Classified correctly	Classified too much cover
Jon & Alice	Broken	4	9	8
Juan & Jose	Broken	7	12	2

Can students come up with a quantitative measure of their collective accuracy?

Does the class have a tendency to overestimate or underestimate cloud cover?

What factors influenced the accuracy of the estimates (e.g. size of the clouds, clustering of the clouds in one part of the sky, the percentage of sky that was covered)?

Do students feel that making these estimates is something they have a talent for, or is it something that they can learn?

Where else might such spatial estimation skills be valuable?

Which cloud classifications were the easiest and most difficult to identify?

What strategies enabled students to correctly estimate cloud cover?

What strategies might produce more accurate classifications?