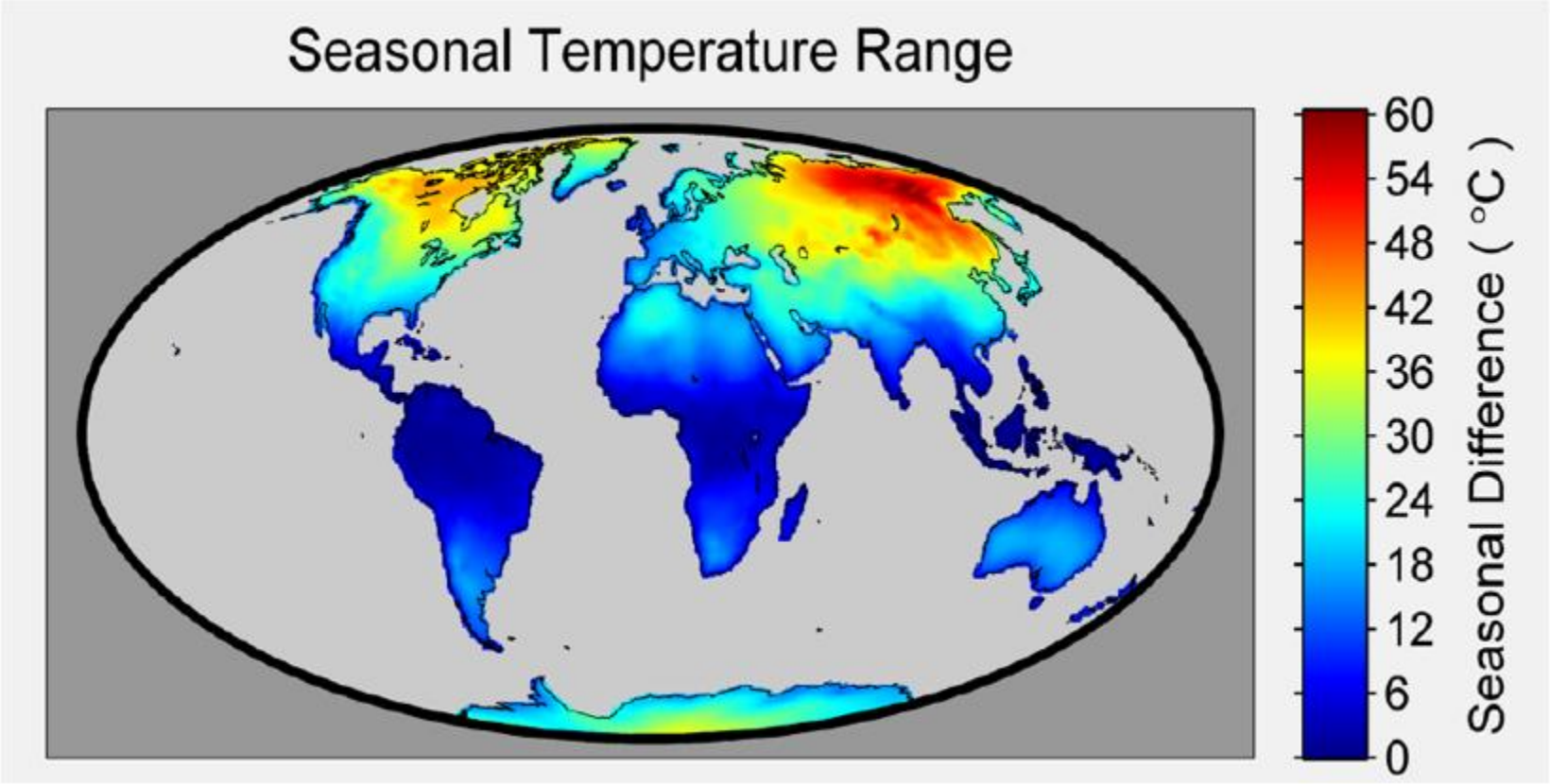
Protocol Training Slides
Air Temperature



Overview and Learning Objectives

Overview

This module:

- Describes how to take air temperature observations
- Provides instructions on how to enter your data using the GLOBE Observer Data Entry system

Learning Objectives

After completing this module, you will be able to:

- Describe what air temperature is
- List reasons why it is important to collect air temperature data
- Determine the correct locations to take air temperature readings
- Upload data to the GLOBE website
- Visualize data using GLOBE Visualization Site and formulate your own questions about weather

Estimated time to complete module: 1 hour

The Atmosphere

- Extremely thin blanket of air extending about 300 miles from Earth's surface to edge of space
- Protection from the blasts of radiation emanating from the Sun
- Composed of gases such as nitrogen, oxygen, argon, etc.

Image: NASA Goddard

Link to the GLOBE Facilitator's Guide Atmosphere Protocols

Air Temperature

- Measures the heat in the air
- Varies: warmest at the surface and decreases with height
- Impacts the types of plants and animals that live in a certain location
- Impacts soil formation

Aerosols

Air Temperature

Albedo

Barometric Pressure

Clouds

Precipitation

Relative Humidity

Surface Ozone

Surface Temperature

Water Vapor

Wind

Recording air temperatures is important for many reasons:

- To observe patterns in temperature change
- To understand seasonal changes in Earth's air temperatures
- To compare temperature changes from year to year
- To provide climate change models data to predict future conditions
- To better understand Earth's weather and changing climate over time

Measuring Earth's Temperature

- Satellites and radiosondes record Earth's temperatures in the Troposphere and Stratosphere.
- Radiosondes measure air temperature using thermometers carried aloft by balloons.
- Satellites measure the energy given off by the Earth's atmosphere, from which scientists calculate the temperature.

NASA Radiosondes

NOAA weather satellite

Your Impact

Your observations are valuable contributions to the scientific community and may be used by educators, students, researchers, and the general public to increase environmental awareness and STEM literacy, as well as advance Earth system science.

- Weather (the air temperature, rain, relative humidity, cloud conditions, atmospheric pressure)
- Climate (the average and extreme conditions of the atmosphere)
- Energy Budget (Land-Atmosphere interactions)
- Atmospheric Composition (trace gases and particles in the air)

What I Need to Collect Air Temperature Data

Instruments	Max/Min Digital Thermometer or Alcohol-filled Thermometer*
Data Sheet	*Atmosphere Investigation Data Sheet*
When	Preferably within one hour of *local solar noon;* OK at other times.
Where	Instrument Shelter (See *Documenting your atmosphere study site)*
Other	Log book for data collection; Computer with internet connection to enter data.

***Use only for current air temperature**

Digital Thermometer

Instrument Shelter

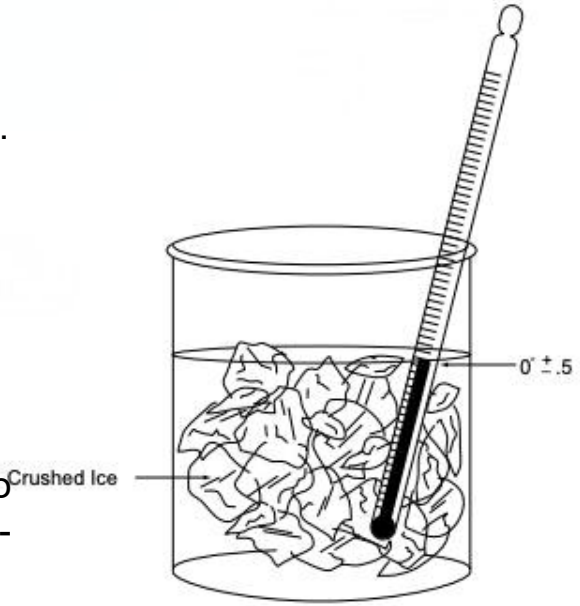
- Your digital thermometer is mounted to the rear wall of the instrument shelter.
- Your shelter should be located in an open area without obstructions such as trees or buildings and within walking distance.
- Your instrument shelter should be clean both inside and out.

Installed Instrument Shelter

Calibrating your Instrument

Calibration Thermometer

1) Prepare a mixture of fresh water and crushed ice with more ice than water in a container.
2) Put the calibration thermometer into the ice-water bath. The bulb of the thermometer must be in the water.
3) Allow the ice-water bath and thermometer to sit for 10 to 15 minutes Add more ice if needed.
4) Gently move the thermometer around in the ice-water bath so that it will be thoroughly cooled.
5) Read the thermometer. If it reads between -0.5˚C and +0.5˚C, the thermometer is fine.
6) If the thermometer reads greater than +0.5˚C, check to make sure that there is more ice than water in your ice-water bath.
7) If the thermometer reads less than -0.5˚C, check to make sure that there is no salt in your ice-water bath.
8) If the thermometer still does not read between -0.5˚C and +0.5˚C, replace the thermometer.



Troubleshoot: If the reading is outside this range, double check that you followed the instructions carefully and repeat the process. If the thermometer repeatedly does not capture the known value of ice, replace the thermometer. Please delay recording your data until you are able to acquire a properly functioning thermometer.

Calibrating Your Max/Min Digital Thermometer

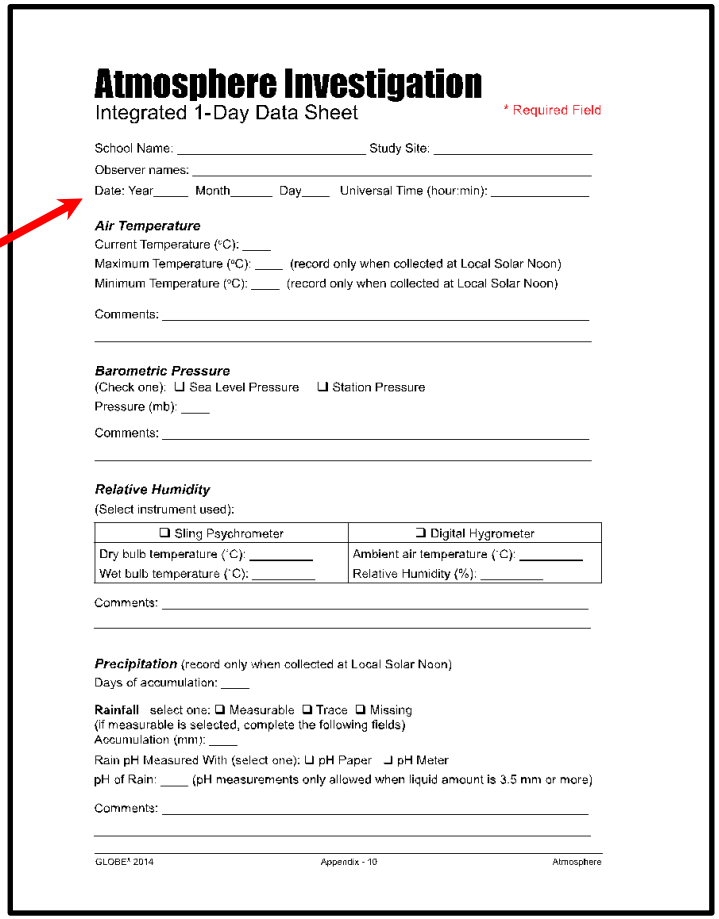
1) Open the door to the instrument shelter and hang the calibration thermometer, the digital thermometer, and the soil sensor in the instrument shelter (if using it) so that they have air flow all around them and do not contact the sides of the shelter.
2) Close the door to the instrument shelter.
3) Wait at least an hour. Open the door to the instrument shelter. Make sure that your digital thermometer is displaying the current temperature(s) (Neither 'MAX' or 'MIN' symbols should be displayed on the screen. If they are, press the MAX/MIN button until they disappear).
4) Read the temperatures reported by the air sensor and the soil sensor (if using it) of the digital thermometer and record them on your *Max/Min Thermometer Calibration and Reset Data Sheet*.
5) Close the door of the instrument shelter.
6) Repeat steps 2 to 5 four more times, waiting at least one hour between each set of readings. Try to space out the five sets of readings over as much of a day as possible.

Data Sheet

Enter the data on the Integrated 1-Day Data Sheet

Be sure to fill out the top: School Name, Study Site, Observer Names, Date and Time (local or UTC)

Atmosphere Data Sheet



Atmosphere Investigation
Integrated 1-Day Data Sheet
* Required Field

School Name: _____ Study Site: _____
Observer names: _____
Date: Year____ Month_____ Day____ Universal Time (hour:min): _____

Air Temperature
Current Temperature (°C): ____
Maximum Temperature (°C): ____ (record only when collected at Local Solar Noon)
Minimum Temperature (°C): ____ (record only when collected at Local Solar Noon)

Comments: _____

Barometric Pressure
(Check one): ❑ Sea Level Pressure ❑ Station Pressure
Pressure (mb): ____

Comments: _____

Relative Humidity
(Select instrument used):

❑ Sling Psychrometer	❑ Digital Hygrometer
Dry bulb temperature (°C): _____	Ambient air temperature (°C): _____
Wet bulb temperature (°C): _____	Relative Humidity (%): _____

Comments: _____

Precipitation (record only when collected at Local Solar Noon)
Days of accumulation: ____

Rainfall select one: ❑ Measurable ❑ Trace ❑ Missing
(if measurable is selected, complete the following fields)
Accumulation (mm): ____
Rain pH Measured With (select one): ❑ pH Paper ❑ pH Meter
pH of Rain: ____ (pH measurements only allowed when liquid amount is 3.5 mm or more)

Comments: _____

GLOBE® 2014 Appendix - 10 Atmosphere

Collecting Data with Max/Min Thermometer

1) Preferably within an hour of local *solar noon* open the instrument shelter being careful not to breathe on the thermometer.

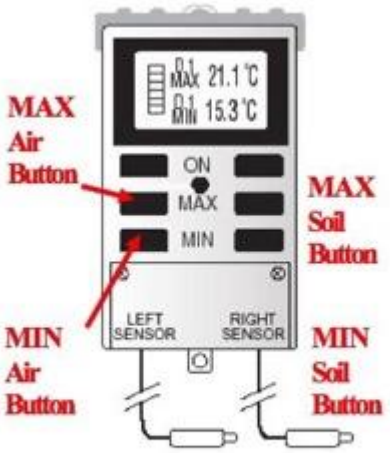
2) Record the time and date on your *Atmosphere Data Sheet* in both local and UT time. Note: GLOBE Website entry should be UT time.

3) Make sure that your thermometer is displaying the current temperature(s) (Neither 'MAX' or 'MIN' symbols should be displayed on the screen. If they are, press the *MAX/MIN* button until they disappear).

4) Record the current air temperature on your *Data Sheet*. If you are taking soil readings, also record the soil temperature.

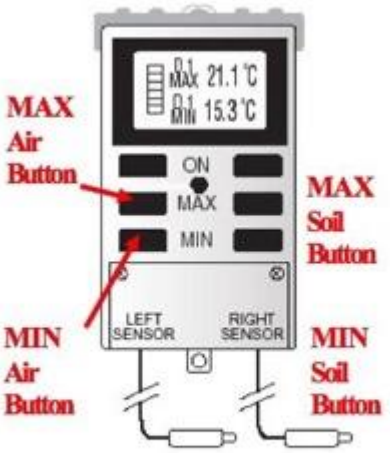
5) Press the *MAX/MIN* button once.

6) Maximum temperature reading(s) will now be displayed along with the 'MAX' symbol on the display screen.



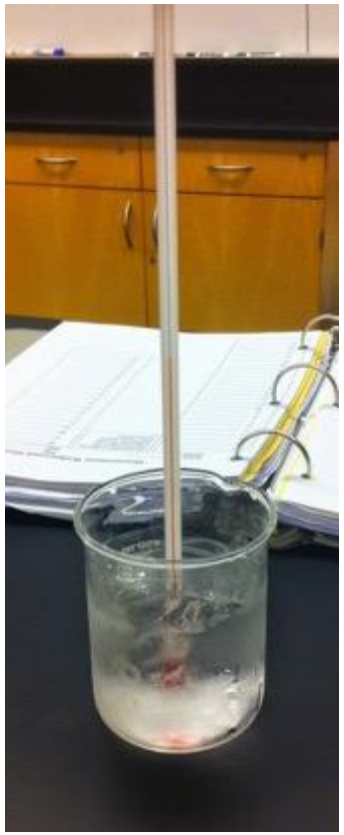
Collecting Data with Max/Min Thermometer-2

7) Record the maximum air temperature on your *Data Sheet*. If you are taking soil readings, also record the maximum soil temperature.
8) Press the *MAX/MIN* button a second time.
9) Minimum temperature reading(s) will now be displayed along with the 'MIN' symbol on the display screen.
10) Record the minimum air temperature on your data sheet. If you are taking soil readings, also record the minimum soil temperature.
11) Press and hold the *MAX/MIN* button for one second. This will reset your thermometer.
12) Close the instrument shelter.



When to Collect Data with Alcohol-filled Thermometer

- Use only when an instrument shelter is not available and a current temperature measurement is required in support of another GLOBE measurement.
- Your thermometer should be calibrated at least every three months as well as before its first use. Follow the procedure in slide 9.



Collecting Data with Alcohol-filled Thermometer

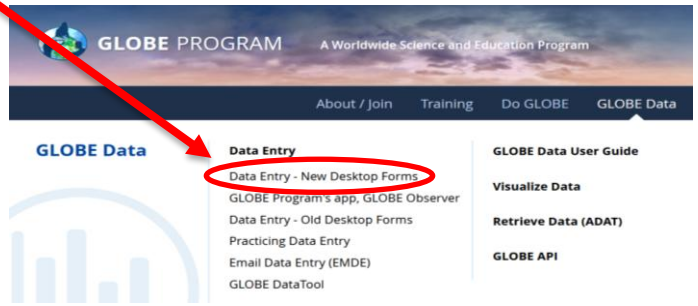
1) Tie one end of a piece of string securely to the end of the calibration thermometer and the other end to a rubber band.
2) Slip the rubber band around your wrist so that the thermometer is not broken if it is accidentally dropped on the ground.
3) Hold the thermometer at chest height, in your shadow, and away from your body for three minutes.
4) At the end of three minutes, record the temperature reading in your science log.
5) Hold the thermometer the same way for another minute.
6) At the end of the minute, record the temperature once again. If the temperature is within 0.5˚C of the previous reading, record the reading on your *Data Sheet*.
7) If the two temperature readings differ by more than 0.5˚C, repeat steps 5 and 6 again.
8) If two consecutive temperature readings are not within 0.5˚C of one another after 7 minutes, record the last measurement on the Data Sheet and report your other four measurements in the comments section along with a note that your reading wasn't stable after 7 minutes.

Entering Air Temperature Data in the GLOBE Observer Data Entry System

Two Options for Uploading Data:

These methods all allow users to submit environmental data – collected at defined sites, according to protocol, and using approved instrumentation – for entry into the official GLOBE science database.

1. Download the GLOBE Observer mobile app from the App Store.
2. Data Entry: Visit globe.gov, click on the "GLOBE Data" tab, then underneath "Data Entry" click on "Data Entry – New Desktop Forms".



Note 1: You will need a GLOBE teacher, trainer, or scientist account to submit GLOBE data.

Note 2: It may take some time after you enter your data for it to appear in the GLOBE data visualization system.

Entering Air Temperature Data – Step 1&2

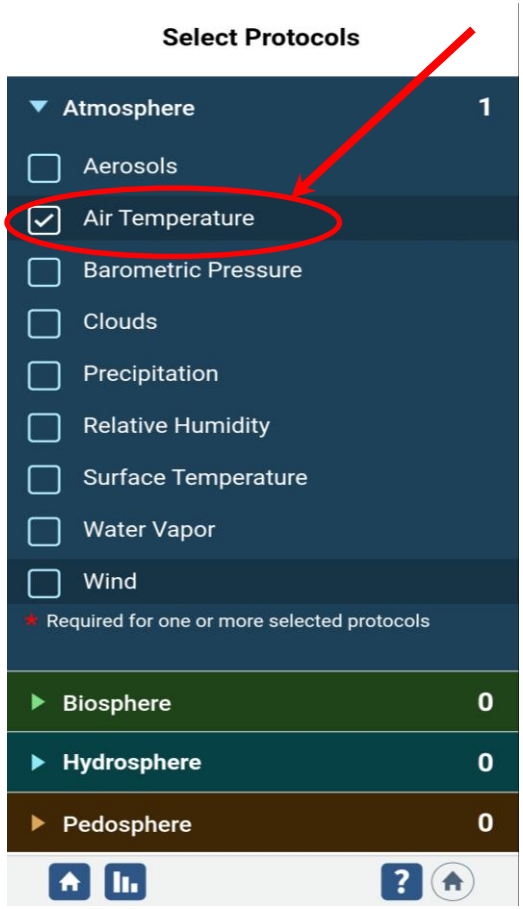
The steps below will walk you through entering your Atmosphere Study Site Information in the GLOBE Observer App, which you can access using your GLOBE or GLOBE Observer login.

1. Click “Data Entry”

2. Click "Create/Edit My Sites"

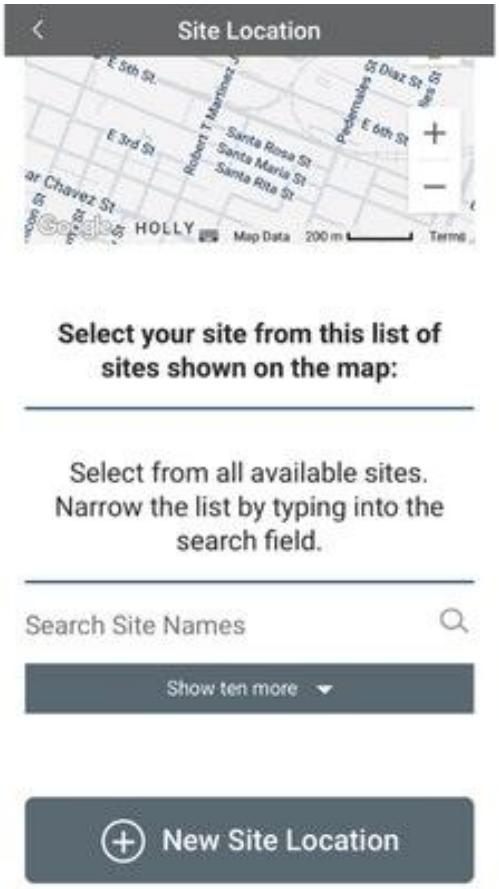
Entering Air Temperature Data – Step 3

3. Click on the arrow next to "*Atmosphere*" and select "*Air Temperature*"



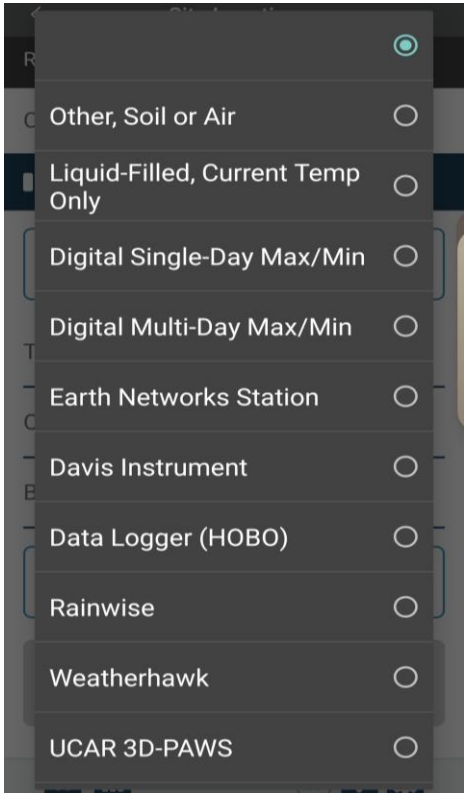
Entering Air Temperature Data – Step 4

4. At the bottom of the screen, click "*Continue*". When prompted, enter site location details (latitude, longitude, and elevation). Choose an existing site or identify a new site by clicking "*+ New Site Location*"



Entering Air Temperature Data – Step 5&6

5. Select *Thermometer Type*.



6. Enter *Thermometer Height* (cm) and be sure to note any obstacles or buildings near the thermometers. Select the type of surface cover (artificial turf, asphalt, concrete, etc.)

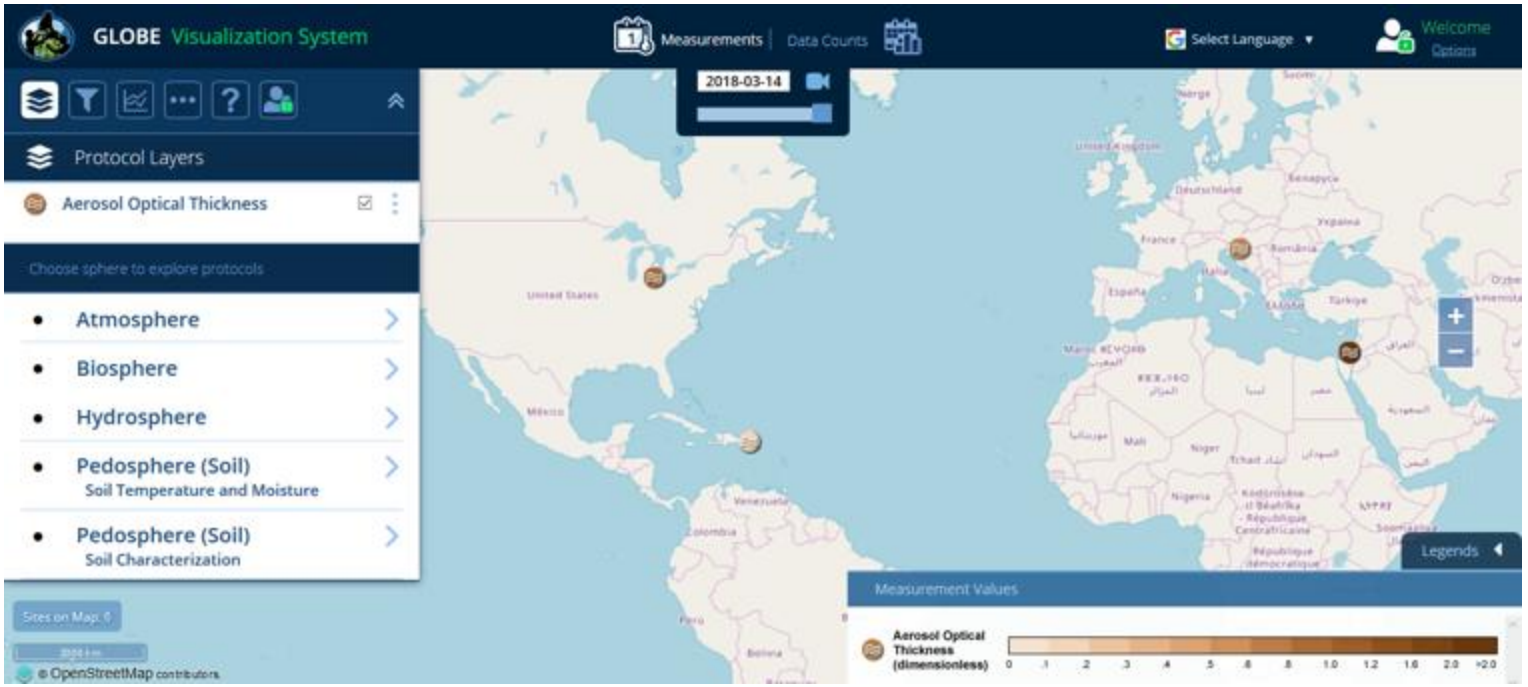
Entering Air Temperature Data – Step 7

7. Enter the *Current Temperature* (°C). Document site conditions, timing, and any other information about the site or air temperature measurement clearly using the "*Comments*" section.

Visualize and Retrieve Data

GLOBE provides the ability to view and interact with data measured across the world. Select our *visualization tool* to map, graph, filter and export data that have been measured across GLOBE protocols since 1995.

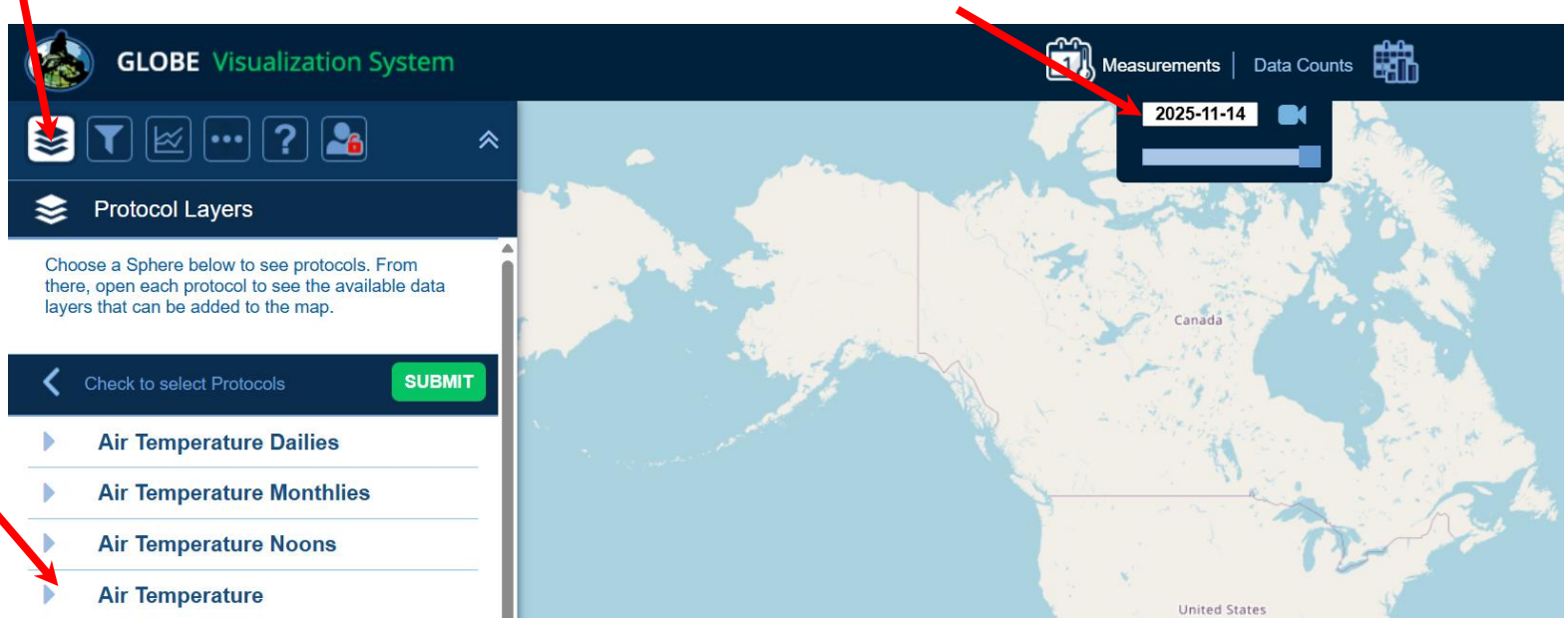
These step-by-step tutorials on using the visualization system will assist you in finding and analyzing data: *PDF version* *PowerPoint version*



http://vis.globe.gov/GLOBE/

Visualize and Retrieve Data

Select the date for which you need data, add the protocol layers, and you can see where data is available.



Questions for YOU to investigate

- When does temperature change the most from day to day?
- What are the latitudes and elevations of other GLOBE schools with air temperature data similar to yours?
- How does vegetation in your area respond to changing temperature?
- Is your local environment affected more by average temperature or temperature extremes?
- Is there a difference between air temperature readings taken by students and satellites?
- How does a large body of water affect air temperature?

What have YOU learned?

- What is air temperature?
- Why it is it important to collect air temperature data?
- What instrument(s) is/are needed to collect air temperature data?
- Where can I purchase the instrument(s)?
- Where should I take my air temperature measurements?
- What data do I need to collect?
- How do I submit my data to GLOBE?
- What can I do with the data submitted to GLOBE?

Frequently Asked Questions (FAQs)

1. If we missed reading the maximum/ minimum thermometer for a day or more (over the weekend, holiday, vacation, etc.), can we still report the temperature for today?

You can and should report the current temperature. You may not report the maximum and minimum temperatures as they are the maximum and minimum temperatures for more than one day. Reset the indicators and tomorrow you can report the maximum, minimum, and current temperatures.

2. What should we do if our maximum/ minimum thermometer does not agree with the calibration thermometer and we can not adjust the scales so that they agree?
This is rare, but there are some maximum/ minimum thermometers that cannot be calibrated successfully. In this case, contact the supplier or manufacturer, explain that the calibration of the thermometer is off, and request a new thermometer.

Frequently Asked Questions (FAQs)-2

3. The maximum temperature reading on our thermometer today is less than the current temperature reading yesterday. Is this wrong?

Yes, this is a problem if the difference is more than 0.5˚C. Sometimes the maximum indicator slips. Report your readings anyway so that GLOBE can track these errors. If this problem occurs often (more than one day in 20 or 5% of the time), check to see that your instrument shelter is mounted firmly and securely and that there are no routine sources of vibration shaking the shelter. If your shelter is securely mounted and there are no sources of vibration, contact the supplier and replace your maximum/minimum thermometer and also inform GLOBE of your problem.

4. The minimum temperature reading on our thermometer today is greater than the current temperature reading yesterday. Is this wrong? See #3 answer.

Further Resources

- GLOBE Learning Activities
- NASA Weather and Climate
- For information on purchasing GLOBE supplies go to: link for finding suppliers of GLOBE instruments
- Questions? GLOBE Website

Please provide us with feedback about this module. This is a community project and we welcome your comments, suggestions and edits!
Comment here: eTraining Feedback
Questions? Contact help@nasaglobe.org

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