



# GLOBEPROGRAM®

A Worldwide Science & Education Program



Biosphere ● Grass Green-Up Protocol





- A. What is Grass Green-Up?
- B. Why Collect Grass Green-Up Data?
- C. How Your Measurements Can Help
- D. How to Collect Your Data
- E. Entering Data on GLOBE Website
- F. Understand the Data
- G. Quiz Yourself
- H. Additional Information

# Overview

## This module:

- Describes how to select and define a GLOBE Phenology Protocol Study Site
- Provides a step-by-step introduction of the protocol method

## Learning Objectives

After completing this module, you will be able to:

- Define phenology and what is meant by grass green-up
- Describe the importance of quality control steps in the collection of accurate data
- Describe why green-up data is important for understanding our changing Earth system
- Identify a grass green-up study site and conduct measurements in the field
- Upload data to the GLOBE database
- Visualize data using GLOBE's Visualization System

*Estimated time to complete module 1.5 hours*



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## The Biosphere

The Biosphere is Earth's zone of life. Every organism on Earth belongs to the biosphere. GLOBE has several ways to explore and measure components of the Biosphere through investigations in land cover, phenology, and carbon storage. Some GLOBE Hydrosphere investigations also include measurements of organisms: the macroinvertebrate and mosquito larvae protocols.

Grass Green-Up is one of the GLOBE **phenology** protocols.

More information can be found in the:  
**Biosphere Introduction**  
**Hydrosphere Introduction**

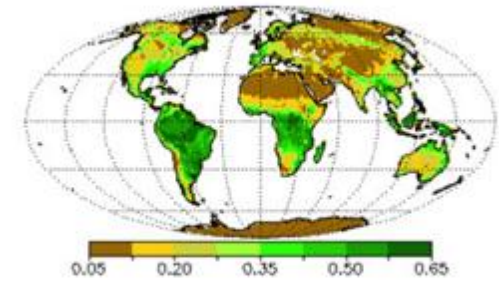




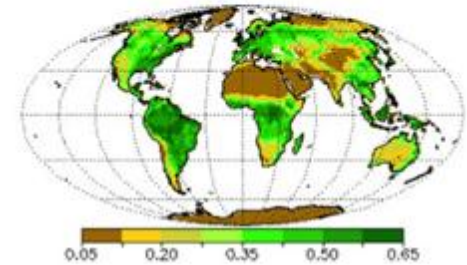
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## What is Green- Up?

- **Phenology** is the study of living organisms' response to seasonal and climatic changes in the environment in which they live. You can study the phenology of plants or animals.
  
- The plant growing season is the period between green-up and green-down.
  
- Plant green-up is initiated when dormancy (a state of suspended growth and metabolism) is broken by environmental conditions such as longer hours of sunlight and higher temperatures in temperate regions, or rains and cooler temperatures in desert areas.



March  
1987



May  
1987

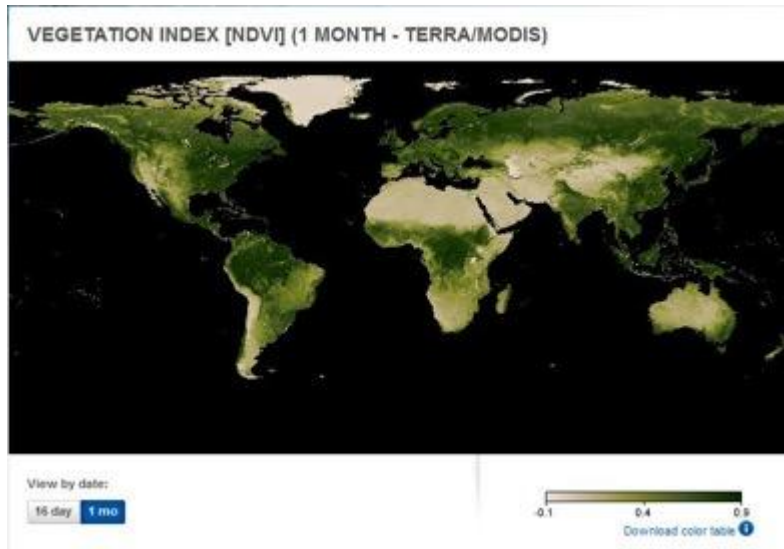
Image: NDVI, NASA



## Satellite Measurements of Phenology

Many scientists use data from a NASA sensor, the Moderate Resolution Imaging Spectrometer (MODIS), to monitor the seasonal dynamics of vegetation.

Scientists also use a metric called the Normalized Difference Vegetation Index (or NDVI) to quantify the Earth's greenness. NDVI is calculated from satellite data of red and near-infrared light, and can help monitor vegetation health, ecosystem disturbances, and changes in vegetation density over time. [Learn more about NDVI in this My NASA Data Mini-lesson.](#)



[Watch an animation of NDVI from the NASA Visualization Studio to see the changes in greenness over time!](#)

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## Why Collect Green-Up Data?

Scientists are very interested the timing of spring green-up and fall green-down. These plant phenological events are directly related to global carbon fixation and the amount of carbon dioxide in the atmosphere. They also affect and are affected by air temperature and humidity and soil moisture. Green-Up data are used by scientists to:

- calculate growing season length
- determine how environmental conditions such as air and soil temperature, precipitation, soil moisture, and day length affect plant growth
- monitor the effect of climate change on plants and animals
- help interpret satellite observations of greenness
- use in climate and ecological models
- predict forested or grassland area susceptibility to fire.





## Why Collect Green-Up Data?

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.



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## Let's do a quick review before moving onto data collection! Question 1

1. What part of the Earth system is known as the zone of life?

- A. Atmosphere
- B. Biosphere
- C. Lithosphere
- D. Hydrosphere

**Do you know the answer?**

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## Let's do a quick review before moving onto data collection! Answer to Question 1

1. What part of the Earth system is known as the zone of life?

A. Atmosphere

**B. Biosphere- correct 😊**

C. Lithosphere

D. Hydrosphere

**Were you correct?**

A. What is Tree and Shrub Green-Up?

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## Let's do a quick review before moving onto data collection! Question 2

True or False: In every part of the world, there is one green-up and green-down cycle.

**Do you know the answer?**



## Let's do a quick review before moving onto data collection! Answer to Question 2

True or False: In every part of the world, there is one green-up and green-down cycle. **False**

**Were you correct?**

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## Let's do a quick review before moving onto data collection! Question 3

**Why are scientists interested in green-up data? The data can be used:**

- a) to help interpret satellite observations of greenness, such as imagery of the Normalized Difference Vegetation Index (NDVI)
- b) to determine how environmental conditions affect plant growth
- c) to calculate changes in growing season length and onset over years
- d) to monitor the nature and extent of climate change and its effects on plants and animals
- e) all of the above
- f) only A and B

**Do you know the answer?**

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## Let's do a quick review before moving onto data collection! Answer to Question 3

**Why are scientists interested in green-up data? The data can be used:**

- a) to help interpret satellite observations of greenness, such as imagery of the Normalized Difference Vegetation Index (NDVI)
- b) to determine how environmental conditions affect plant growth
- c) to calculate changes in growing season length and onset over years
- d) to monitor the nature and extent of climate change and its effects on plants and animals
- e) **all of the above –correct 😊**
- f) only A and B

**Were you correct? Let's now look at data collection.**

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# Overview of the Grass Green-Up Protocol

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<b>When</b>	Select your site at least 2 weeks before green-up begins. For grasses, the start of Green-Up occurs when any initial green grass shoot is first observed.
<b>Where</b>	You will need to make your observations in a one-meter square that is dominated by grass plants.
<b>Time Needed</b>	10-15 minutes per measurement. Frequency of observations: Ideally, visit plant at least two times a week to check for the start of green-up and continue observing until leaf growth plateaus.
<b>Prerequisites</b>	None
<b>Primary Instrument</b>	Metric ruler
<b>Skill level</b>	All
<b>References</b>	<u><a href="#">Site Definition Sheet</a></u> <u><a href="#">Grass Green-Up Protocol Field Guide</a></u> <u><a href="#">Green-up data sheet</a></u>

\* Because of the possibility of multiple growing seasons in a year, we are asking you to report which cycle you are observing. If there is only one cycle, then you report green-up cycle 1. The onset of the first green-down after 1 January is considered green-up cycle 1.



## Equipment and Documents Needed

### First Visit Only

- Fine tip permanent marker
- Camera
- Compass

### Every Visit

- Pencil or pen
- Ruler with mm units

### Documents Needed in the Field

- [Site Definition Sheet](#)
- [Tree and Shrub Green-Up and Green-Down Site Selection](#)
- [Grass Green-up Protocol Field Guide](#)
- [Green-up data sheet](#)





## Site Selection

- Site selection is important. Choose a site that contains plants indicative of the surrounding climate. You will need to make your observations in a one-meter square that is dominated by grass plants.
  - Native species
  - Not watered or fertilized
  - Away from buildings
  - Choose a site that is accessible and can be visited repeatedly.



***NOTE: To determine if the plant is too close to a building, stand at the plant and sight the top of the building through your clinometer. If the angle is greater than 45°, the building is too close. You do not want the plant to be closer to the building than it is tall.***

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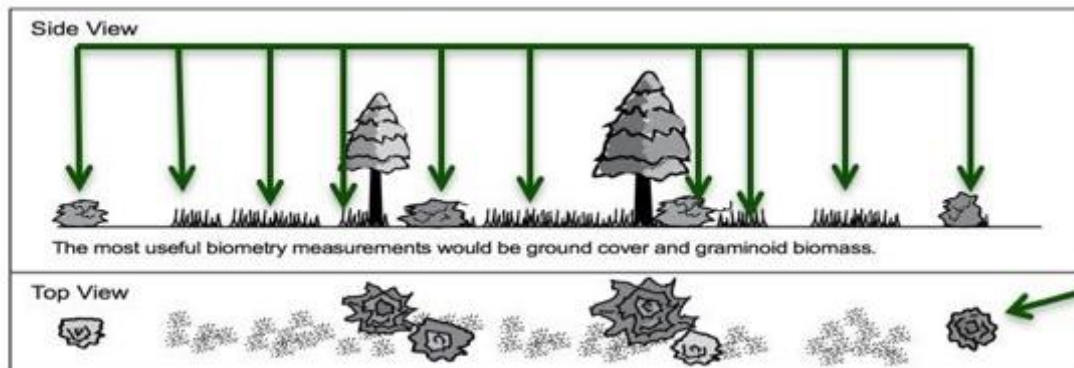
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## Other Site Selection Considerations

Select one or more species that is common in your area. Think from the perspective of a satellite – what is the satellite “seeing”?



Satellite View

If you are also doing atmospheric or soil moisture protocols, select a site **less than 2 km** from your atmosphere or soil moisture site, and **an elevation difference less than 100 meters**. This is important because local topography affects weather significantly.

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# Grass Green-Up Site Selection-1

## In the Field

- Complete the Greening portion of the Site Definition Sheet.
- Identify genus using field guides or help of plant specialists. Record the genus on the Site Definition Sheet.

**Greening**

Are there multiple dominant species?  Yes  No

Primary Plant  
Is this plant in the understory?  Yes  No

Vegetation Type (Select one):  Grass Genus: \_\_\_\_\_  
 Tree Genus: \_\_\_\_\_ Species: \_\_\_\_\_  
 Shrub Genus: \_\_\_\_\_ Species: \_\_\_\_\_

Label: \_\_\_\_\_

Secondary Plant  
Is this plant in the understory?  Yes  No

Vegetation Type (Select one):  Grass Genus: \_\_\_\_\_  
 Tree Genus: \_\_\_\_\_ Species: \_\_\_\_\_  
 Shrub Genus: \_\_\_\_\_ Species: \_\_\_\_\_

Label: \_\_\_\_\_

**Site Definition Sheet** \* Required Field

School Name: \_\_\_\_\_ Site Name: \_\_\_\_\_  
Choose a unique name based on location, e.g. "Grassy area - Front of School"

Names of students completing Site Definition Sheet: \_\_\_\_\_

Date: Year \_\_\_\_\_ Month \_\_\_\_\_ Day \_\_\_\_\_ Check one:  New Site  Metadata Update

\*Coordinates: Latitude: \_\_\_\_\_ ° N or S Longitude: \_\_\_\_\_ ° E or W  
 Elevation: \_\_\_\_\_ meters

\*Source of Location Data (check one):  GPS  Other \_\_\_\_\_

Comments: \_\_\_\_\_

**Site Type** (select all that apply based on intended measurements, then complete the necessary fields below):  Atmospheric  Surface Temperature  Hydrology  Land Cover  
 Greening  Soil Characteristics  Soil Moisture and Temperature

**Atmosphere**  
 List any obstacles (Check one):  No obstacles  Obstacles (describe below)  
(Obstacles are trees, buildings, etc. that appear above 1ft elevation when viewed from the site)  
 Description: \_\_\_\_\_

Buildings within 10 meters of instrument shelter (Check one):  
 No buildings  Buildings (describe below)  
 Description: \_\_\_\_\_

**Other Site Data:**  
 Steepest Slope: \_\_\_\_\_ Compass Angle (facing up slope): \_\_\_\_\_

Rain Gauge Height: \_\_\_\_\_ cm Ozone Clip Height: \_\_\_\_\_ cm Thermometer Height: \_\_\_\_\_ cm

\*Thermometer Type (Check one):  
 Other, Soil or Air  
 Liquid-filled Max/Min (J-tube)  
 Liquid-filled, Current Temperature Only  
 Digital Single-Day Min/Max  
 Digital Multi-Day Min/Max  
 Reset Digital Multi-Day Min/Max Thermometer Note: reset is required before data collection and entry, when batteries are changed or every 6 months  
 Date: Year \_\_\_\_\_ Month \_\_\_\_\_ Day \_\_\_\_\_ Universal Time (hour:min): \_\_\_\_\_  
 Was this reset due to a battery change?  Yes  No

AWS Weather/Flag Station (Automated Station ID: \_\_\_\_\_)  
 Davis Instrument (Davis Thermometer Type: \_\_\_\_\_)  
 Data Logger (HOBO)  
 Rainwise  
 WeatherHawk  
 No Thermometer

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## Grass Green-Up Site Selection-2

### In the Field

- Select a one-meter square area dominated by grass plants. Mark your one-meter square plot with nails or stakes or other durable identifiers.
- Locate coordinates using your phone or the **GPS Protocol**.



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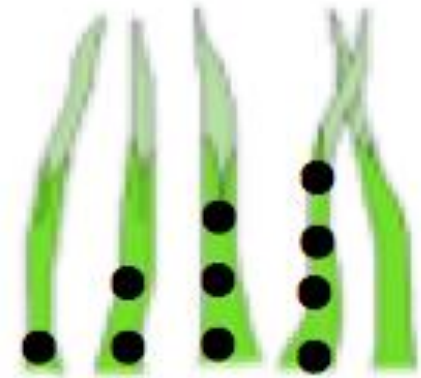




## Grass Green-Up: Every Visit-1

### Here are the steps:

1. Look for new green grass shoots.
2. Mark the base of the first grass shoot with a single dot, using a permanent felt marker.
3. Mark the second shoot with two dots, the third with three dots and the fourth shoot with four dots.
4. Use the ruler to measure the length of the shoots to the nearest millimeter.
5. Measure the leaves at regular intervals until the leaf length stops increasing.



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## Grass Green-Up Every Visit-2

### Options for state of leaf:

- Report “no shoot” before the leaves of grass can be seen.
- Measure the length in millimeters after the shoot appears.
- Report “lost” if something happens to the marked leaves.



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# Example of Completed Data Sheet

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**Grass Green-Up**

Date (day and month)	Leaf 1 (No Shoot, Length (mm), Lost)	Leaf 2 (No Shoot, Length (mm), Lost)	Leaf 3 (No Shoot, Length (mm), Lost)	Leaf 4 (No Shoot, Length (mm), Lost)	Reported to GLOBE Database <input checked="" type="checkbox"/>
10 April	No shoot	No shoot	No shoot	No shoot	<input checked="" type="checkbox"/>
13 April	2	3	No shoot	No shoot	<input checked="" type="checkbox"/>
17 April	8	10	5	6	<input checked="" type="checkbox"/>
20 April	18	20	15	18	<input checked="" type="checkbox"/>
24 April	29	27	lost	30	<input type="checkbox"/>
27 April	36	35		40	<input type="checkbox"/>
1 May	48	50		55	<input type="checkbox"/>
4 May	58	50		55	<input type="checkbox"/>
8 May	58	50		55	<input type="checkbox"/>
					<input type="checkbox"/>
					<input type="checkbox"/>



## Let's review so far! Question 4

When selecting a phenology site, you want to be sure it is accessible and easy to visit, and that you collect data that can be examined in the context of other GLOBE data you might collect. GLOBE recommends you place your site as close to your other study sites as possible, and no further than:

- a) 2 km from your Atmosphere or Soil (Pedosphere) investigation sites
- b) 100 m difference in elevation from your Atmosphere or Soil study sites
- c) Both A and B
- d) Neither A nor B: you must collect your data at your Biosphere Land Cover study site.

**What is the answer?**

A. What is Tree and Shrub Green-Up?

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## Let's review so far! Answer to Question 4

When selecting a phenology site, you want to be sure it is accessible and easy to visit, and that you collect data that can be examined in the context of other GLOBE data you might collect. GLOBE recommends you place your site as close to your other study sites as possible, and no further than:

- a) 2 km from your Atmosphere or Soil (Pedosphere) investigation sites
- b) 100 m difference in elevation from your Atmosphere or Soil study sites
- c) **Both A and B- correct 😊**
- d) Neither A nor B: you must collect your data at your Biosphere Land Cover study site.

**Were you correct?**

A. What is Tree and Shrub Green-Up?

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## Let's review so far before – Question 5

How many grass blades do you need to observe when applying the Grass Green-up Protocol?

- a) All the blades in a 1 m sample grid
- b) 10 blades of grass within the sample grid
- c) 4 blades of grass within the sample grid
- d) 1 blade of grass within the sample grid

**What is the answer?**

A. What is Tree and Shrub Green-Up?

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## Let's review so far before- Answer to Question 5

A. What is Tree and Shrub Green-Up?

B. Why Collect Tree and Shrub Green-Up Data?

C. How Your Measurements Can Help

**D. How to Collect Your Data**

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How many grass blades do you need to observe when applying the Grass Green-up Protocol?

- a) All the blades in a 1 m sample grid
- b) 10 blades of grass within the sample grid
- c) 4 blades of grass within the sample grid – correct 😊**
- d) 1 blade of grass within the sample grid

**Were you correct?**



## Report Your Data to GLOBE

1. Desktop Data Entry: Log environmental data directly on the GLOBE website.

1. Email Data Entry: If connectivity is an issue, data can also be entered via email.

1. GLOBE Observer App: The app allows users to enter data directly from an iOS or Android device for any GLOBE protocol.



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# Entering your data via the GLOBE website or GLOBE Observer App


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Click "New Observation(s)"



Atmosphere • Hydrosphere • Biosphere

# Data Entry



Welcome,  
**haley.wicklein@unh.edu**

Not haley.wicklein@unh.edu?  
[Click here to sign in.](#)

**New Observation(s)**

Edit/Delete Measurements

Create/Edit My Sites

My Observations



# Entering your data via the GLOBE website or GLOBE Observer App

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Select "Greening: Green Up"



## Select Protocols

▶ Atmosphere	0
▼ Biosphere	1
<input type="checkbox"/> Biometry: Graminoid Biomasses	
<input type="checkbox"/> Biometry: Trees	
<input type="checkbox"/> Biometry: Vegetative Covers	
<input type="checkbox"/> Carbon Cycle	
<input type="checkbox"/> Greening: Green Down	
<input checked="" type="checkbox"/> Greening: Green Up	
<input type="checkbox"/> Phenological Gardens: Autumn	
<input type="checkbox"/> Phenological Gardens: Spring	
▶ Hydrosphere	0
▶ Pedosphere	
▶ Earth as a System Bundles	
▶ My Protocol Bundles	

What is a bundle and how/why do I name it?



Click Continue





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On the location page, scroll down to select your site OR choose “New Site Location” to add a new site.

Tutorials are available on how to add a new site.

Select your site from this list of sites shown on the map:

Select from all available sites. Narrow the list by typing into the search field.

Search Site Names



Deerfield Ballfield



Deerfield Forest



Fish Hatchery Stream Site #4 - New Hampton, NH



New Hampton ARC



Coe Brown Eclipse Site



Show ten more

New Site Location




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Add the time and date that you collected your data



Enter the local date and time of the observation:

Local Date: 2024-09-25 

Local Time (24hr): 12:43:00 

Get Current Time

Observation Date: **2024-09-25 UTC**  
 Observation Time: **16:43 UTC**  
 Solar Noon: **16:35 UTC**

Click Greening: Green Up



Greening: Green Up



# Entering your data via the GLOBE website or GLOBE Observer App

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Choose your growing season cycle number.

If you can measure the length of the grass leaf, enter the length in mm.

If the grass leaves have not appeared yet, enter "No Shoot".

Growing season cycle number  
1

**Plants**

At least one leaf is required for one plant. \*

G1  
Grass (Abarema)

Leaf 1

Leaf State  
Length Measurable

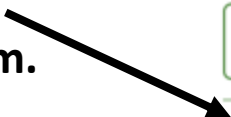
Leaf Length \*  
5 mm

Leaf 2

✓  
No Shoot  
Length Measurable  
Lost

Leaf 3

Leaf State





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Review the data you entered



Click send observation and wait for the message that your observation was successfully sent!



The screenshot shows the GLOBE Observer app interface. At the top, there is a dropdown menu for 'Biosphere' with a count of '1'. Below it is a section for 'Green Up' with an edit icon and a dropdown arrow. The main content area contains a list of observations for 'G1 Grass (Abarema)'. Each observation has a 'Leaf #' and 'Leaf State' field. The first two leaves are 'No Shoot', the third is 'Length Measurable' with a 'Leaf Length' of '5mm', and the fourth is also 'Length Measurable' with a 'Leaf Length' of '5mm'. At the bottom of the form, there are two expandable sections: 'Hydrosphere' with a count of '0' and 'Pedosphere' with a count of '0'. A large grey button labeled 'Send Observations' is positioned at the bottom of the screen.



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## Visualize and Retrieve Data

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

Click the layers icon.

The screenshot shows a web interface for the GLOBE visualization tool. At the top, there is a dark blue navigation bar with several icons: a layers icon, a funnel, a line graph, a menu, a question mark, and a user profile. Below this is a section titled "Protocol Layers" with a sub-instruction: "Choose a Sphere below to see protocols. From there, open each protocol to see the available data layers that can be added to the map." Below this is a "Check to select Protocols" section with a "SUBMIT" button. A list of protocols is shown with expandable arrows: "Biometry - Tree Heights", "Green-Up" (which is expanded to show a checked box next to "Green-Up"), "Green-Down", "Land Cover", "Phenological Gardens", and "Carbon Cycle".

Select Green-up under the Biosphere drop down

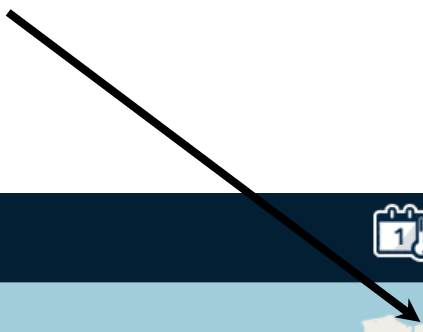
See [video tutorials on using the GLOBE Visualization system.](#)



# Visualize and Retrieve Data

Select the date for which you need Green-up data.

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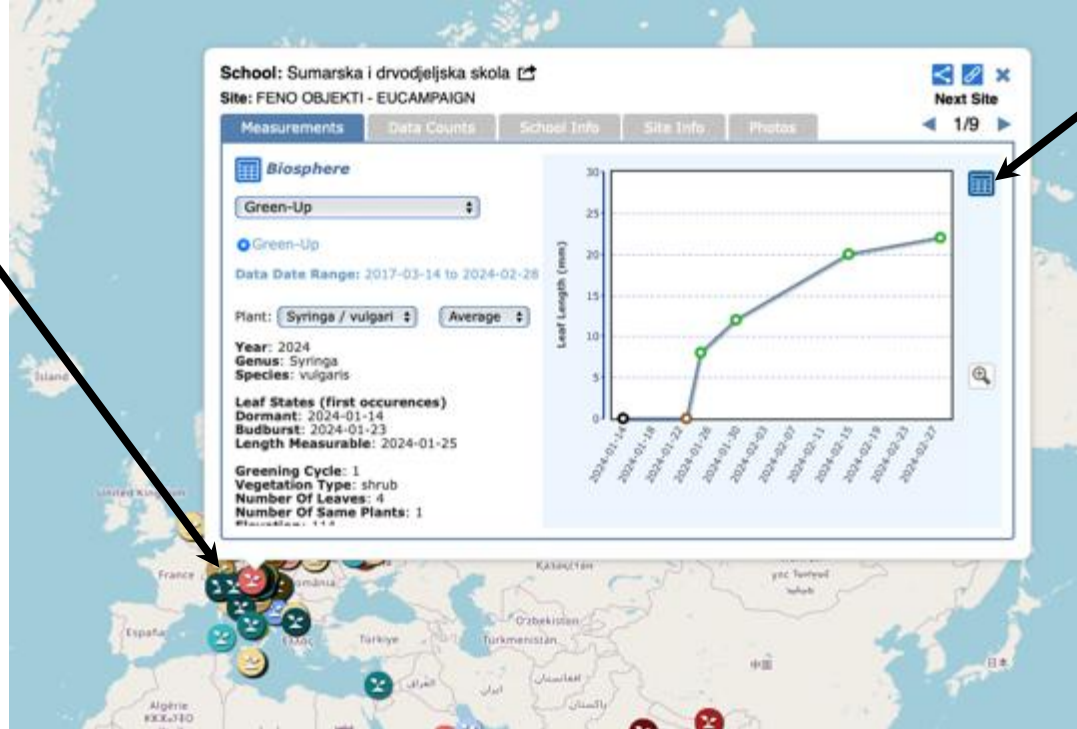


# Visualize and Retrieve Data

Select the sampling site for which you need Green-Up Data, and a box will open with a data summary for that site.

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Clicking on a location will open to a map note providing data for that location and time.



Click on the table icon to view the data in a table and download it as a .csv for analysis.



## Review questions to help you prepare to do the Grass Green-Up Measurements associated with the GLOBE Biometry Protocols

1. Grass Green-Up measurements are part of what GLOBE Protocol area or Earth system sphere?
2. What is phenology?
3. Why is it important for scientists to know when Green-Up takes place in a location, year by year?
4. With respect to Green-Up and Green-Down, when is the plant growing season?
5. If there is more than one Green-Up season during the year in your region, how do you decide when to measure Green-Up?
6. How soon before green-up should you identify and prepare your study site?
7. How often should you monitor your grass shoots during green up?
8. When do you stop monitoring your grass shoots?
9. How do you mark the grass leaves so you know to measure the same leaves throughout the green-up season?

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# Congratulations!

You have now completed the slide stack. Sign on to the GLOBE website and take the assessment corresponding to **Grass Green-Up Protocol**.

When you pass the assessment, you are ready to take **Grass Green-Up** measurements!

Welcome to the **Green-Up GLOBE community!**

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# Research Questions for Investigation:

- How long does green-up take for a given species?
- How does green-up differ among different species within a forested study area?
- How does green-up relate to precipitation? To soil moisture?
- Does temperature influence the rate of green-up?

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## FAQ: Frequently Asked Questions

### **How do I mark the grass shoots if they start on the same day?**

Mark the base of the four longest grass shoots that appear at the earliest date.

### **What do I do if on the first day I see shoots, I see more than four?**

#### **How do I select the shoots to study?**

Mark the base of the four longest grass shoots that appear on the first day.

### **What if there are grass shoots the first day when I go to take a picture of the site?**

Mark the base of the four longest grass shoots that are present on this day.



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Questions about the content of this module? Contact GLOBE: [training@nasaglobe.org](mailto:training@nasaglobe.org).

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### More Information:

- [The GLOBE Program](#)
- [NASA Wavelength](#) NASA's Digital Library of Earth and Space Education Resources
- [NASA Global Climate Change: Vital Signs of the Planet](#)

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