Green-Up Protocol

Purpose

To observe plant green-up and report data that will be used by scientists to validate satellite estimates of the beginning of the plant growing season

Overview

Students monitor budburst and growth of leaves of selected trees, shrubs, or grasses. Species chosen should be native, deciduous, and dominant in your area.

Student Outcomes

Students will learn to,

- observe when buds burst open at the beginning of the growing season;
- observe how leaves grow to maturity;
- identify tree species native to your area;
- examine relationships among budburst, leaf growth and climate factors;
- predict the timing of budburst for upcoming seasons;
- compare the rate of leaf growth of different plant species;
- communicate project results with other GLOBE schools;
- collaborate with other GLOBE schools (within your country or other countries); and
- share observations by submitting data to the GLOBE archive.

Science Concepts

Earth and Space Sciences

Weather changes from day to day and over the seasons.

The sun is a major source of energy at the Earth's surface.

Life Sciences

Organisms have basic needs.

Organisms can only survive in environments where their needs are met.

Organisms' functions relate to their environment.

Organisms change the environment in which they live.

Earth has many different environments that support different combinations of organisms.

Plants and animals have life cycles.

Energy for life derives mainly from the Sun.

Living systems require a continuous input of energy to maintain their chemical and physical organizations.

Scientific Inquiry Abilities

Estimating dominant plant species

Identifying plant species (advanced level)

Observing leaf growth

Making leaf measurements

Identify answerable questions.

Design and conduct scientific investigations.

Use appropriate mathematics to analyze data.

Develop descriptions and predictions using evidence.

Recognize and analyze alternative explanations.

Communicate procedures, descriptions, and predictions.

Time

Field time: 20 minutes excluding travel time.

Level

All

Frequency

At least twice a week beginning two weeks prior to the anticipated start of green-up, if possible

Materials and Tools

Green-Up Data Sheet
Grass Green-Up Field Guide and/or *Tree and Shrub Green-Up Field Guide*
Tree and Shrub Green-Up and Green-Down Site Selection Field Guide and/or *Grass Green-Up and Green-Down Site Selection Field Guide*
Green-Up and Green-Down Site Definition Sheet
Ruler with mm marks
Flagging tape, 1 label per student
Pencil or pen
Dichotomous keys and/or other local species guides
Compass
Camera
Calculators (optional)

Preparation

Review dominant plant species of school's GLOBE Study Site.

Prerequisites

Knowledge of common plant species at the site

Green-Up Cards Learning Activity (suggested)

Budburst Sneak Preview Learning Activity (suggested)

Green-Up and Green-Down Site Selection

Before selecting your Green-up site, here are some things to consider. Green-down site selection has the same considerations.

1. Your plant phenology site should be in an area where green-up and green-down of native plants is due to climatic factors such as increased temperature or precipitation. Watering and fertilization alter plants' green-up and green-down cycles, and the data would not be representative of natural vegetation and local climate connections. Buildings absorb solar radiation and shelter sites from wind. Therefore, avoid sites near buildings or where watering or fertilization is done. For the phenology protocols, near means that the plant is closer to a building than the height of the building. 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.
2. Non-native species, called exotics, have green-up and green-down cycles that may not be tied to the local climate. Often this is because exotics have not evolved to survive in the local climate. If you are unsure which plants are natives or have evolved to grow in a climate regime similar to yours, ask a local greenhouse or agricultural extension agent, or the appropriate staff at a local college or university.
3. Your green-up and green-down site must be accessible so that students can visit the site at least twice a week. It may be the same as a Land Cover Sample Site or your Atmosphere Study Site. Be sure to determine the location of your site by identifying the latitude, longitude and elevation following the *GPS Protocol*.
4. Because the results of your green-up and green-down measurements may be related to temperature and precipitation data from the *Atmosphere Investigation* and soil moisture and temperature data from the *Soil Investigation*, it is better to choose a site close to the Atmosphere and Soil Moisture Study Sites. The local topography can cause weather to vary even within short distances. This is particularly true in mountainous and coastal regions. The horizontal distance between the Phenology and Atmosphere and Soil Moisture Sites should be less than 2 kilometers and the elevation differences less than 100 meters, so that you can see whether your atmosphere data correlates with your green-up and green-down data.
5. Green-up and green-down detected by satellites are influenced mostly by a few dominant overstory plant species. These will be the species with the largest share of canopy coverage. If you are using a Land Cover Sample Site, you already know the dominant species. If you are using a different site, use the one to three over-story species that are dominant for your region. These over-story plants may be coniferous trees, broadleaf trees, broadleaf shrubs, or grasses. For phenology measurements you should choose a deciduous plant so, if the dominant plant species are all evergreen conifers, use the under-story broadleaf shrubs as your green-up plants. For example, if your study site is 90 percent white pine (a coniferous tree) and 10 percent sugar maple (a broad leaf tree), use the sugar maple trees as the study plants.
6. Scientifically, it is most useful if the tree or shrub branch used for the *Green-Up Protocol* is the same as the one used for the *Green-Down Protocol*. However, you may do only the Green-Up or Green-Down measurements or you may use different branches or even different sites if this is necessary to match your educational requirements. If you use different sites for green-up and green-down, create a site definition for each.
7. Since a change in plant growing season may be due to a change in climate, students at your school should try to use the same site, the same plant species, and the same part of the plant consistently, year after year.

Tree and Shrub Green-Up and Green-Down Site Selection

Field Guide

Task

Define the site for green-up and green-down measurement of trees and shrubs.

What You Need

- ❑ *Green-Up and Green-Down Site Definition Sheet*
- ❑ *GPS Data Sheet*
- ❑ *GPS Protocol Field Guide*
- ❑ Flagging tape or other durable identification
- ❑ Dichotomous keys and/or other local species guides
- ❑ GPS receiver
- ❑ Compass
- ❑ Pencil or pen

In the Field

1. Complete the top of the *Green-Up and Green-Down Site Definition Sheet*.

2. Select one tree or shrub. The tree or shrub should be among the dominant native species in your area, deciduous, and easily accessible.

3. Select a healthy and relatively large branch on the south side of the plant in the Northern Hemisphere or the north side of the plant in the Southern Hemisphere. Use a compass or GPS receiver to determine direction. If a lower branch is chosen, it should be on the edge of the stand of trees or shrubs since branches inside a stand may experience a different microclimate due to shading.

4. Identify genus and species using field guides or the help of plant specialists. Record the genus and species on the *Green-Up and Green-Down Site Definition Sheet*.

5. Mark the branch with flagging tape or some other durable identification. Label the flagging tape with a unique number and your name/group name, school name and class.

6. Take a GPS measurement following the *GPS Protocol*.

Grass Green-Up and Green-Down Site Selection

Field Guide

Task

Define the site for green-up and green-down measurement of grasses.

What You Need

- ❑ *Green-Up and Green-Down Site Definition Sheet*
- ❑ *GPS Data Sheet*
- ❑ *GPS Protocol Field Guide*
- ❑ GPS receiver
- ❑ Pencil or pen
- ❑ Nails or stakes or other durable identifiers
- ❑ Meter stick or tape measure
- ❑ Dichotomous keys and/or other local species guides

In the Field

1. Complete the top of the *Green-Up and Green-Down Site Definition Sheet*.

2. Identify genus using field guides or help of plant specialists. Record the genus on the *Green-Up and Green-Down Site Definition Sheet*.

3. Select a one-meter square area dominated by grass plants. Mark your one-meter square plot with nails or stakes or other durable identifiers.

4. Take a GPS measurement following the *GPS Protocol*.

Teacher Support

Advance Preparation

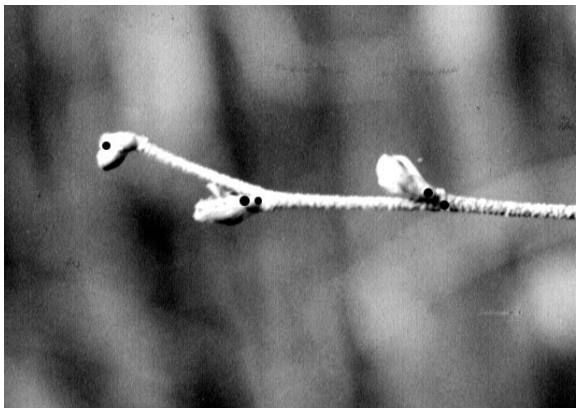
Students should complete the *Green-Up Cards* and *Sneak Preview of Budburst* learning activities prior to budburst and green-up.

Check with local sources for average green-up dates to help determine when to start observations. In areas where snow is common, observations should begin immediately after snow melt. For each visit where no green-up was observed for the study plant, students should fill in the observation date in the *Pre-Green-Up Section* of the *Green-Up Data Sheet*.

Frequency of Observations

Ideally, each student should visit his/her plant at least two times a week to check for the start of green-up and continue observing until leaf growth plateaus. For trees or shrubs, the start of green-up occurs when one of the four sample buds (selected for observation) swells and you can see tiny green leaves starting from the bud. Some of the buds on your branch may not green-up on exactly the same day. For grasses, the start of green-up occurs when any initial green grass shoot is first observed. See the *Green-Up Cards* learning activity for pictures of grass shoot initiation.

Figure EA-GU-1: Sample Buds Marked with Permanent Markings



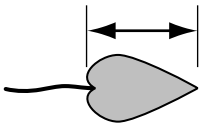
For most areas of the world, there is only one green-up and green-down cycle. However, there are places where multiple wet and dry seasons can occur in a single year, resulting in multiple green-up and green-down cycles. Because of this possibility, we are asking you to report which cycle you are observing. If there is only one cycle, then you report green-up cycle 1. The onset of the first green-up after 1 January is considered green-up cycle 1.

Sometimes green-up can last past the end of the school year. To be scientifically useful, measurements should be taken of the leaf until it reaches maturity. Enlisting the help of parents or other members of the community may encourage and support the students to continue taking the measurements after the school year ends.

Measurement Procedure

For green-up observations, it is important to measure leaf length is from the leaf base to the leaf tip. Do not include the leaf stem or petiole as part of the leaf length measurement.

Figure EA-GU-2: Leaf Length Measured without



There are two *Data Sheets* for green-up; one for grasses, the other for trees and shrubs. *For each tree and shrub leaf*, here are the categories for the state of leaf from dormancy to maturity. Students report one of these for each observation.

- Report "dormant" if the bud is unchanged and still in its dormant state during cold or dry seasons.
- Report "swelling" if the bud is getting bigger.
- Report "budburst" when the bud first opens and the green tips of leaves can be seen.
- After budburst, students measure the length of each leaf and report the length in millimeters.
- Report "lost" if the leaf gets lost for some reason.

For grasses, here are the 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.

The following page shows examples of completed *Tree and Shrub Green-up Data Sheet* and a *Grass Green-up Data Sheet* you can show your students.

Questions for Further Investigation

Is there a relationship between air temperature and budburst dates reported for the GLOBE schools in your region?

How does plant green-up affect soil water?

What other animals (butterflies, waterfowl, songbirds) arrive after plants green-up, when, and why?

Does the timing of green-up occur earlier or later at higher elevations in your region? Why?

Does the timing of green-up occur earlier or later inland or near the coast in your region? Why?

Example of Completed Data Sheets

Tree and Shrub Green-Up

Date (day and month)	**Leaf 1** (Dormant, Swelling Budburst, Length (mm), Lost)	**Leaf 2** (Dormant, Swelling Budburst, Length (mm), Lost)	**Leaf 3** (Dormant, Swelling, Budburst, Length (mm), Lost)	**Leaf 4** (Dormant,Swelling, Budburst, Length (mm), Lost)	**Reported to GLOBE**
3 March	*dormant*	*dormant*	*dormant*	*dormant*	☑
6 March	*dormant*	*dormant*	*dormant*	*dormant*	☑
11 March	*swelling*	*swelling*	*swelling*	*dormant*	☑
14 March	*budburst*	*budburst*	*swelling*	*Swelling*	☑
18 March	*2*	*4*	*budburst*	*Budburst*	☑
22 March	*6*	*10*	*5*	*6*	❑
25 March	*12*	*15*	*10*	*12*	❑
29 March	*20*	*22*	*18*	*19*	❑
2 April	*30*	*32*	*25*	*28*	❑
5 April	*38*	*lost*	*36*	*38*	❑
8 April	*45*		*42*	*44*	❑
11 April	*45*		*44*	*44*	❑
14 April	*45*		*44*	*44*	❑
					❑

Grass Green-Up

Date (day and month)	**Leaf 1** (No shoot, length (mm), or lost)	**Leaf 2** (No shoot, length (mm), or lost)	**Leaf 3** (No shoot, length (mm), or lost)	**Leaf 4** (No shoot, length (mm), or lost)	**Reported to GLOBE**
10 April	*No shoot*	*No shoot*	*No shoot*	*No shoot*	☑
13 April	*2*	*3*	*No shoot*	*No shoot*	☑
17 April	*8*	*10*	*5*	*6*	☑
20 April	*18*	*20*	*15*	*18*	☑
24 April	*29*	*27*	*lost*	*30*	❑
27 April	*36*	*35*		*40*	❑
1 May	*48*	*50*		*55*	❑
4 May	*58*	*50*		*55*	❑
8 May	*58*	*50*		*55*	❑
					❑
					❑
					❑

Tree and Shrub Green-Up Protocol
Field Guide

Task

Observe and record green-up in trees and shrubs.

What you Need

First visit only

- ❑ *Green-Up Data Sheet*
- ❑ Pencil or pen
- ❑ Ruler with mm units
- ❑ Fine-tip permanent marker
- ❑ Camera
- ❑ Compass

Every visit

- ❑ *Green-Up Data Sheet*
- ❑ Pencil or pen
- ❑ Ruler with mm units

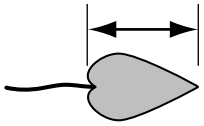
In the Field

First time only/getting started

1. Complete the upper portion of your data sheet.
2. For the selected tree or shrub, locate the bud at the end of the branch. Label this bud by marking one dot on the branch next to the bud.
3. Locate the three other buds closest to this bud. Label these buds by marking two, three, or four dots next to them.
4. Take a photograph from the center of your site looking in the north, south, east, and west directions.

Every visit

1. Examine each bud.
   - Record "dormant" if the bud is unchanged.
   - Record "swelling" if the bud is getting bigger.
   - Record "budburst" the first day you see the green tips of leaves.
   - Record "lost" if something happens to the bud and you cannot continue observations.
2. After each budburst, use a ruler to measure the length of the leaf or leaves. Do not include leaf stem or petiole in your leaf measurements.



3. Measure the leaves until the leaf length stops increasing. Different leaves may stop growing at different dates.

Grass Green-Up Protocol
Field Guide

Task

Observe and record plant green-up in grasses.

What You Need

First visit only

- ❑ *Green-Up Data Sheet*
- ❑ Pencil or pen
- ❑ Fine-Tip Permanent Marker
- ❑ Ruler with mm units
- ❑ Camera
- ❑ Compass

Every visit

- ❑ *Green-Up Data Sheet*
- ❑ Pencil or pen
- ❑ Ruler with mm units
- ❑ Fine-Tip Permanent Marker (until four new grass shoots have been marked)

In the Field

First time only/getting started

1. Complete the upper portion of your *Data Sheet.*
2. Before new grass shoots emerge, take a photograph in the north, south, east, and west directions.

Every visit

1. Look for new green grass shoots.
2. Mark the base of the first grass shoot with a single dot.
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 until the leaf length stops increasing.

Frequently Asked Questions

1. Will the marker hurt the bud?
Do not mark the bud itself. Mark the woody branch next to it. That way you will not hurt the plant.

2. What do you mean by a relatively large branch?
Use your judgement. Each branch should be healthy and large relative to the other branches on the tree or shrub. You want the branch to still be there next year. Be careful not to damage the branch during the labeling and measurements.

3. What if a branch breaks during the study?
Continue your observations by teaming up with other students and observing their branch.

4. Will all the buds start to swell at the same time?
No. Some of the buds on your branch may not green-up on exactly the same day as the terminal bud.

5. Should I look at the same buds from year to year?
You should observe the same branch, which will typically have new terminal buds each year.

6. What if needle-leaved trees are the abundant vegetation?
Usually there are understory deciduous shrubs that can be used instead. For example, Snowberry in Douglas Fir, Gamel Oak in Ponderosa Pine. Typically these deciduous plants are what the satellites are detecting as Green-up. The Green-up of conifers is a subtle process and not easily observed.

7. What if multiple leaves emerge from a single bud after the bud bursts open?
Choose one of the leaves and mark it with the permanent marker. Take measurements of the marked leaf.

8. 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.

9. 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.

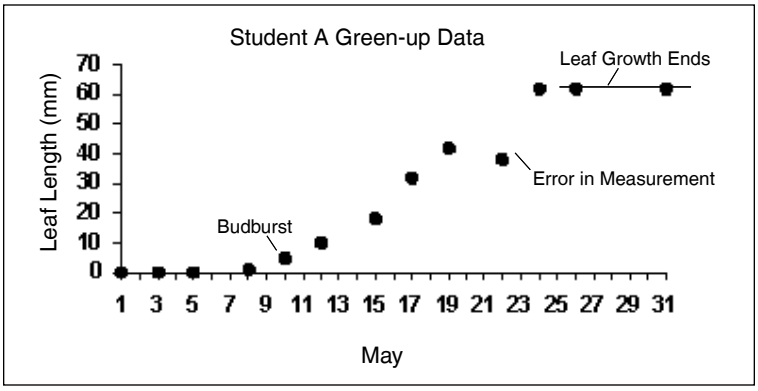
10. How long will it take for a leaf to mature?
That depends. It may take a week in Alaska with 18 hours of sunlight during green-up. In other locations it may take a month or more.

11. 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.

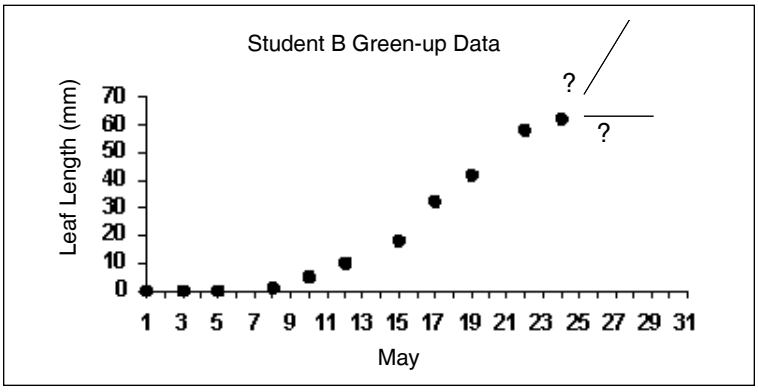
Plant Phenology: Green-up – Looking At the Data

Are the data reasonable?

The first step in looking at plant phenology data is to see if the data seem reasonable and make sense. Is the green-up leaf length always greater than or equal to previous measurements? Looking at a graph of green-up data, such as shown in Figure 1, makes it easy to check. Notice from the following figure that leaf length on May 22 is less than May 19. Either the leaf measurement on May 19 or May 22 is probably an error.

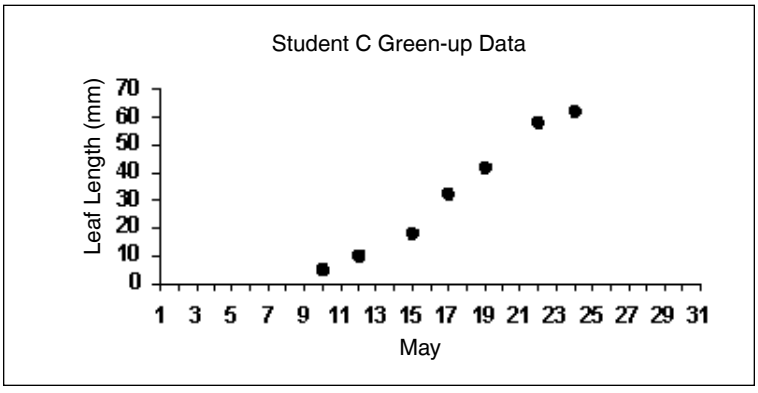


Another potential problem is illustrated using Student B's data in the following figure.



Notice that there are not enough measurements showing that leaf growth stopped. Has leaf growth reached 100 percent by May 24, or will it continue for weeks? It is impossible to tell unless there at least 3 measurements showing that leaf length has reached a constant.

Student C's data have 2 problems: 1) it is impossible to estimate when budburst occurred because the student did not record at least 3 dates prior to budburst. 2) it is impossible to estimate percent of leaf growth from the data since there are not at least 3 measurements showing that leaf growth has stopped at the end of May.



What do scientists look for in the data?

Scientists are very interested in when leaves appear in spring and how quickly they expand. The timing and rate of fall leaf changes, such as color changes and leaf drop, are also important. It may seem strange that such easy to observe and common events are important for Earth System Science, but they are.

For example, many scientists use data from a NASA sensor, the Moderate Resolution Imaging Spectroradiometer (MODIS), to monitor the seasonal dynamics of leaves. Green-up/green-down data gathered by GLOBE students, using consistent methods all over the world, are one of the best tools with which to verify the accuracy of these satellite products.

Computer models are one of the main research tools used by scientists to predict the future climate of the planet. Seasonal vegetation activity is an important component of this research. Many models contain programs that are used to predict the expansion of plant leaf material. Without data against which to compare these models, we cannot believe the model predictions. By using GLOBE green-up/green-down data to help develop these models, scientists will be able to better predict our future climate.

Some applications of GLOBE data can be very specific, in particular when plant phenology is linked to other events. Many plant pests like gypsy moths appear during certain leaf developmental stages. By linking GLOBE green-up data with the appearance of gypsy moths, scientists are working to develop better pest treatment approaches.

In short, by participating in the GLOBE *Green-Up/Green-Down Protocols,* you will be helping to gather data that scientists will use in many fields Earth System Science, sometimes in unpredictable ways!

An Example of Student Research

In a science class, a teacher introduced the topic of phenology. No one in the class had heard of the word "phenology", much less knew what it meant. So she explained what phenology meant and asked students for examples of seasonal change. The school year started a little over a month ago, and the class discussed some observations they noticed about fall. One student noticed that the air temperature was getting colder so they were putting on thicker sweaters and jackets to keep warm. Another remarked that it was starting to get dark when they were walking home after school. A third student mentioned that the leaves on the trees were changing color and that some trees turned red while others turned yellow or brown. Another student mentioned that many local farmers had food stands selling their fruits and vegetables.

As an assignment, the teacher asked the students to think of more examples. She encouraged them to ask their parents, grandparents and others in their community for examples as well.

After the students became comfortable with the concept of phenology and specific examples for their area, the teacher introduced the students to the GLOBE *Green-up Protocol* and told the students that they would be doing the *Green-up Protocol* next spring. They were instructed to design one or more research projects to do next spring. The teacher encouraged them to look at the student data on the GLOBE Web site to get some ideas.

The students were somewhat familiar with the GLOBE maps and graphs and realized that sites are defined for all the data students collect. So, they wanted to see if there were any nifty maps or graphs for phenology sites. After clicking on *Maps and Graphs* on the navigation bar, they clicked on *GLOBE Sites* and then, *Green-up/Green-down Site Visualization. The* new page listed phenology sites organized by country. GLOBE schools at many countries are collecting green-up and green-down data! They scrolled through the list of countries and schools and decided to look at Osaka Prefectural Higashisumiyoshi Technical High School in Japan. Students at this school have 9 phenology sites with lots of data at each site!

After they clicked on a phenology site, a graph and a table of data would show for that site. After looking at the data for each site, they discovered that students at Osaka Prefectural Higashisumiyoshi Technical High School are observing green-up and green-down for three different tree species – *Liquidambar styraciflua, Cornus florida*, and *Acer palmatum*.

They were curious to see if there were any patterns or differences in the green-up data for the different species. Graphs for the different tree species are shown in Figures EA-GU-3, EA-GU-4 and EA-GU-5. Figure EA-GU-3 shows data for *Liquidambar styraciflua* at site 1 (GRN-01); Figure EA-GU-4 shows data for *Cornus florida* at site 2 (GRN-02); Figure EA-GU-5 shows data for *Acer palmatum* at site 3 (GRN-03). Looking at the graphs the students made a number of observations:

1. Budburst for all the leaves for all three species occurred about the same time.
2. There was a longer time that the buds showed swelling for the tree, *Liquidambar styraciflua*, at site GRN-01 (Figure EA-GU-3).
3. The final lengths of the leaves for *Liquidambar styraciflua* (Figure EA-GU-3) and *Acer palmatum* (Figure EA-GU-5) were about the same, but the maximum leaf length for *Cornus florida* (Figure EA-GU-4) was much longer (almost twice the length of the other tree species).
4. *Liquidambar styraciflua* and *Acer palmatum* reached the maximum length earlier than *Cornus florida.*
5. One of the leaves for *Liquidambar styraciflua* fell off at site 1. That was curious and they wanted to know if there were any comments to explain why the leaf fell off. They looked at the comments section in the table of data and unfortunately there were no comments.

They decided to download the data from the GLOBE data archive and put the data into a spreadsheet program. To do this, they went to the table of data for each site and followed the instructions to download the data as a text file. They had three files, one for each site (GRN-01, GRN-02, and GRN-03).

Next, the students followed the instructions for the spreadsheet program to open a text file. When opening up the data, they followed the instructions so that the column for dates was recognized as dates (year, month and day) and not large numbers.

The column for LI (Leaf ID) has four values (1, 2, 3, and 4) – a number for each leaf that was measured. When they looked at the data in the spreadsheet, the data were ordered by date. They were interested to create graphs for each leaf like that shown on the GLOBE web site (see Figures EA-GU-3, EA-GU-4, and EA-GU-5). So, they used the spreadsheet tool to sort the columns of data by the Leaf ID. This then allowed them to graph each leaf more easily.

They organized the data for each site (GRN-01, GRN-02, and GRN-03) by the Leaf ID. One student suggested that they look at green-up data for each species on the same graph. This was easy to do since the data were now organized by Leaf ID. They created a new spreadsheet with data from each site. To do this, they copied and pasted the data from the original files. The compiled data from the three sites are shown in Table EA-GU-1.

Next, they made a graph of the data comparing the leaf lengths of the three species, shown in Figure EA-GU-6. For each species, they graphed one of the four leaves just to see how the data compared. It was interesting to see the data on the same graph and in more detail than what the GLOBE web site offered. From the GLOBE graph it looked as if all three species had budburst around the same date, but this graph shows that budburst for *Liquidambar styraciflua* occurred later. They also noticed that the leaves grew at about the same rate. In other words, after the buds burst open, the amount the leaves grew each week was about the same. However, since the final length of *Cornus florida* is much longer, it took longer to reach the length of a mature leaf.

They were very excited about this observation. Is this typical? In the same location, do leaves on different plants in the same area grow similarly? They decided that this was a good research question to ask for next spring. They decided to find out what are some native tree species in the area and select three like the school in Osaka, Japan, and compare the way the leaves grow. They predicted that the tree species with longer leaf lengths at maturity will take longer to reach the length at maturity.

In addition, they wanted to look at other GLOBE school data and see how fast leaves grow in the spring in different climates. Does the length of the growing season affect how fast leaves grow? After exploring the GLOBE data archive, they may have other research questions they want to ask for their research next spring.

Figure EA-GU-3

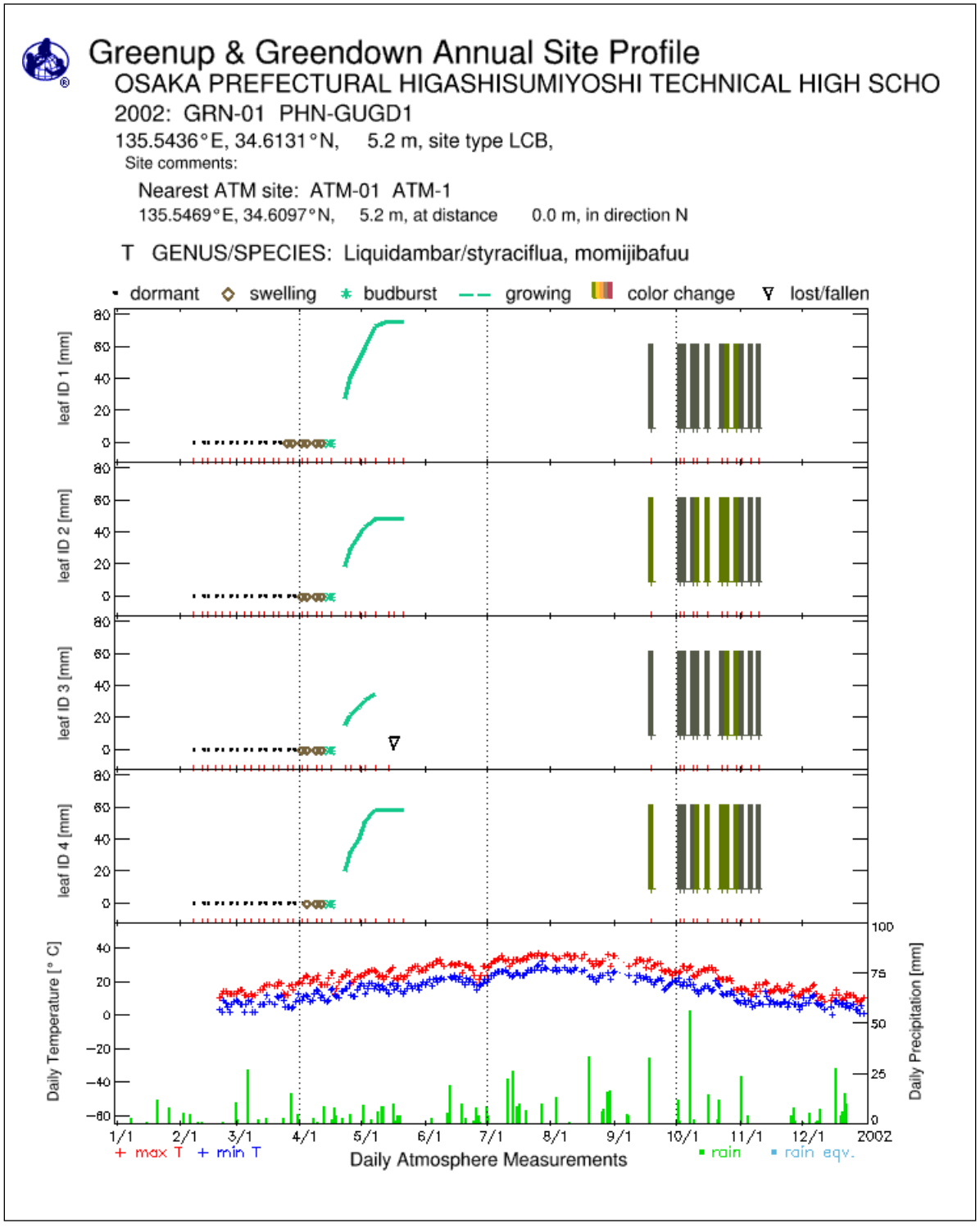


Figure EA-GU-4

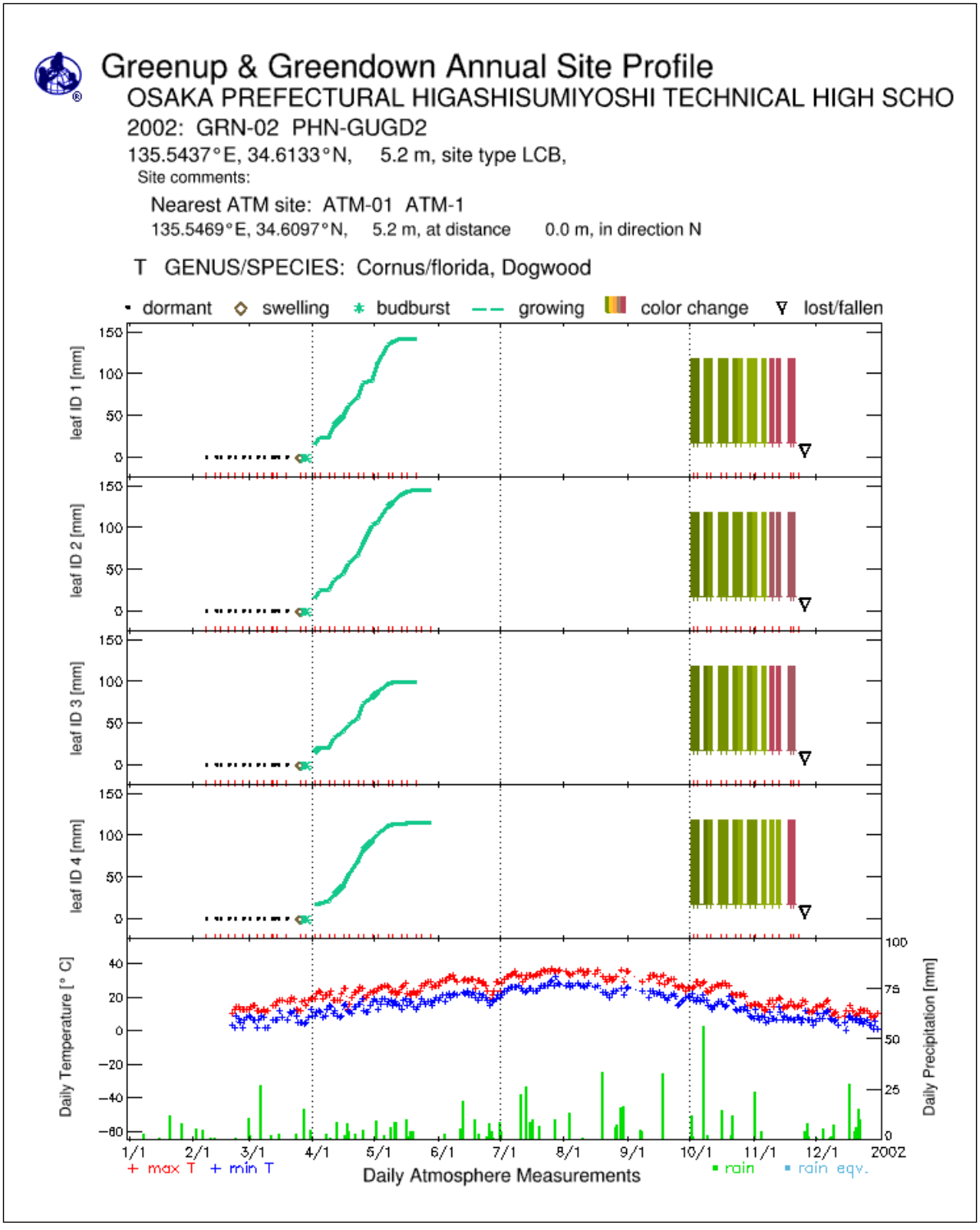


Figure EA-GU-5

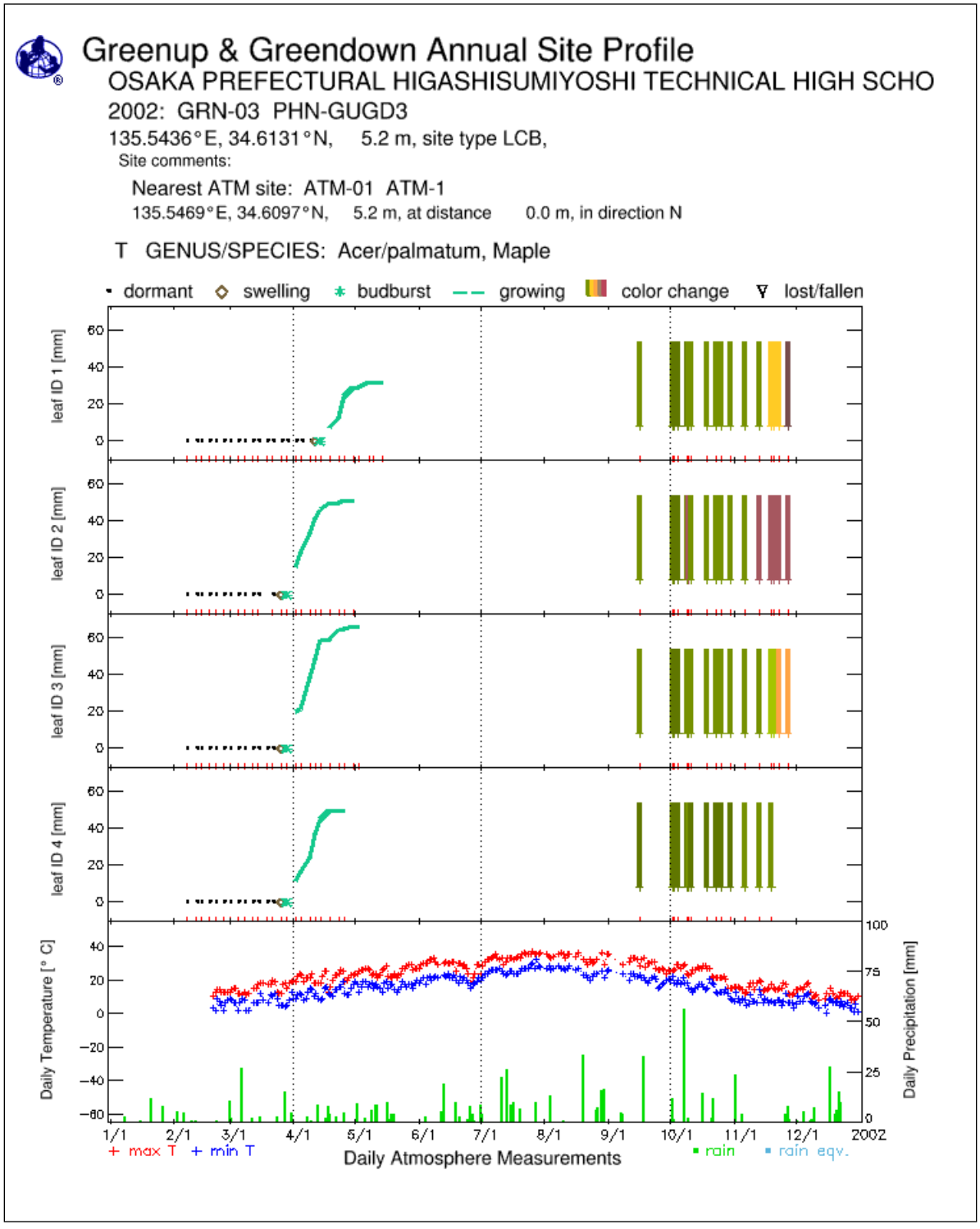


Table EA-GU-1

Date	GRN-01	GRN-02	GRN-03
	Liquidambar styraciflua	Cornus florida	Acer palmatum
7-Feb	0	0	0
12-Feb	0	0	0
14-Feb	0	0	0
18-Feb	0	0	0
21-Feb	0	0	0
25-Feb	0	0	0
28-Feb	0	0	0
4-Mar	0	0	0
7-Mar	0	0	0
11-Mar	0	0	0
14-Mar	0	0	0
18-Mar	0	0	0
21-Mar	0	0	0
25-Mar	0	0	0
28-Mar	0	0	0
1-Apr	0	15	20
4-Apr	0	25	21
8-Apr	0	26	38
11-Apr	0	38	48
15-Apr	0	46	59
18-Apr	28	58	59
22-Apr	41	67	65
25-Apr	52	82	65
29-Apr	59	103	66
2-May	73	107	66
7-May	76	126	
9-May	76	131	
13-May	76	140	
16-May		144	
20-May		146	
23-May		146	
27-May		146	

Figure EA-GU-6