

# Using GLOBE Data to Analyze Land Cover



Welcome

Introduction

Protocols

Learning Activities

Appendix

## **Purpose**

To develop hypotheses about which environmental factors are most important to plants growing in a local Land Cover Sample Site by comparing local GLOBE data to those of other GLOBE schools reporting the same MUC class

## **Overview**

Using GLOBE Visualizations, students will identify two other GLOBE schools that have reported the same MUC class and compare their temperature, precipitation and soil moisture to their own. They will try and identify which environmental factors are similar and which vary, suggesting which are more important in determining plant communities.

## **Student Outcomes**

### **Science Concepts**

#### *Geography*

- How to use maps (real and imaginary)
- The physical characteristics of place
- The characteristics and spatial distribution of ecosystems
- How humans modify the environment

### **Scientific Inquiry Abilities**

- Use GLOBE Web site to gather, analyze and interpret data.
- 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.

## **Level**

Middle and Secondary

## **Time**

1-2 class periods for data collection, 2 class periods for data analysis. Additional time will be necessary if a report is to be generated.

## **Materials and Tools**

- Internet access
- Paper
- Colored pencils
- Atlas
- Basic Information Work Sheet*
- Data Gathering and Organizing Work Sheet*
- Data Analysis Work Sheet*

## **Preparation**

Choose one of the natural cover MUC classes you have identified in a Land Cover Sample Site.

Make copies of the appropriate *Work Sheets*.

## **Prerequisites**

Complete measurements for at least one natural cover Land Cover Sample Site. This site should have a complete MUC class of at least 3 or 4 digits.

Your school system should have data for several months for Temperature, Precipitation, and Soil Moisture.

Basic understanding of ecosystems



## Introduction

An **ecosystem** is a major interacting system that involves both living organisms and their physical environment. As a science, ecology attempts to explain why particular plants and animals can be found living together in one area and not in others; why there are so many organisms of one sort and so few of another; what changes one might expect the interactions among them to produce in a particular area; and how ecosystems function, with particular reference to the flow of energy, the use of organic compounds, and the cycling of chemical elements.<sup>1</sup> It is important to consider the ecosystem as a whole when drawing conclusions about a particular component, such as vegetation type. This activity is an ecological approach to analyzing land cover.



### **What To Do and How To Do It**

This learning activity is organized according to the scientific method:

Scientific Method	This Learning Activity	Level
Research Question and Hypothesis Development	Which environmental factors are most important to plants growing in a local Land Cover Sample Site?	Intermediate and Advanced
Data Collection	Use GLOBE Visualizations and an atlas to obtain GLOBE data from other schools <i>Basic Information Work Sheet</i> <i>Data Gathering and Organization Work Sheet</i>	Intermediate and Advanced
Data Analysis and Results	Answer questions which analyze the data obtained to compile results or findings <i>Data Analysis Work Sheet</i>	Intermediate and Advanced
Conclusions	Summarize your results and explain what your findings mean in a report <i>Conclusions – Project Report</i>	Advanced



This activity is designed for both intermediate and advanced levels. To take this activity to an advanced level, there is a culminating section, *Conclusions - Project Report*, in which the students produce a report summarizing the interactions of the GLOBE measurements and how they affect the type of land cover. It is envisioned as a long-term assignment or final term project. This is a good learning activity to use GIS software if it is part of your school's software library.



### **Implementation Suggestions**

- Complete the *Basic Information Work Sheet* as a class.
- Organize the class into working groups.
- Have each group of students collect and interpret one particular set of data (e.g., Temperature) following the appropriate section of the *Data Gathering and Organizing Work Sheet*.
- Have each group report their results (perhaps photocopy a set for each group) to the whole class to complete the data analysis and conclusions.



<sup>1</sup> Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn. 1992. *Biology of Plants*, 5th ed. New York, NY: Worth Publishers.

## Helpful Hints

- Prepare students for this activity by doing a brief ecology unit, discussing the characteristics of your *natural cover* Land Cover Sample Sites.
- During data analysis, periodically pause to review the objectives of this activity and to share insights.
- For a more inquiry-based activity, considering what other measurements your school /school system has conducted, have students develop their own research questions about land cover. They can be questions specific to one other measurement (e.g., precipitation or soil characteristics). They can still follow the appropriate sections of the learning activity for data collection and analysis.

## Basic Data Collection

**Note:** The GLOBE Web site pages change in appearance from time to time and may not look exactly as they are pictured.

1. Review the MUC code and corresponding land cover type obtained for one of your natural cover Land Cover Sample Sites [MUC level 1, Closed Forest (0), Woodland (1), Shrubland (2), Dwarf-Shrubland (3), Herbaceous Vegetation (4), Barren Land (5), Wetland (6)]. Make sure your MUC is taken to the highest level possible (3 or 4 digits).
2. Obtain the name and location of two GLOBE schools who have reported the same MUC code:
  - a. Enter the GLOBE server as you normally do. There is no need to log in.
  - b. Go to GLOBE Visualizations.
  - c. Create a graph or map using the land cover MUC data. Use “Other Options” to map the specific MUC class to Level 2, 3, or 4.
  - d. Select the show table option to list schools with the same MUC class.

**Note: What To Do If There Are No Matching MUC Classes**

Find MUC codes with the highest level of agreement. For example, if your MUC code is 4133 (tall graminoid herbaceous vegetation with broad-leaved deciduous shrubs), you can use a MUC Code that matches to level 3, such as 413 (tall graminoid herbaceous vegetation with shrubs).

- e. Filling out the *Basic Information Work Sheet*, write down the MUC code, name of the school, city name, country, latitude, longitude, and elevation for the two schools.

## Research Question and Hypothesis Development

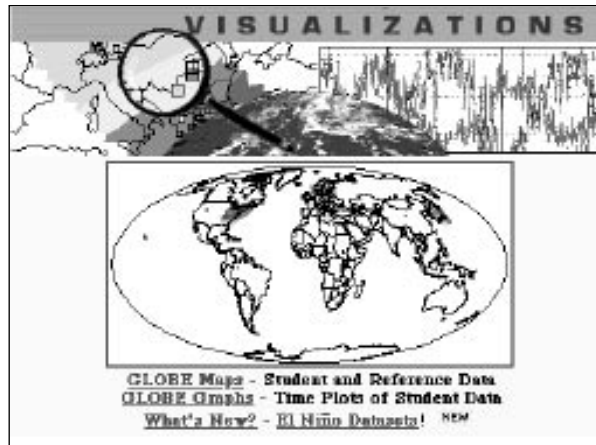
Discuss the research question: Which environmental factors are most important to plants growing in a local Land Cover Sample Site? Encourage the development of hypotheses that address this question.



**Obtain Other GLOBE Data for These Schools with the Same MUC Class.**

**Note:** If the schools chosen do not have all of the recommended data, try choosing a different school to analyze or work with the data you are able to obtain. Data gaps are a reality of ecosystem science.

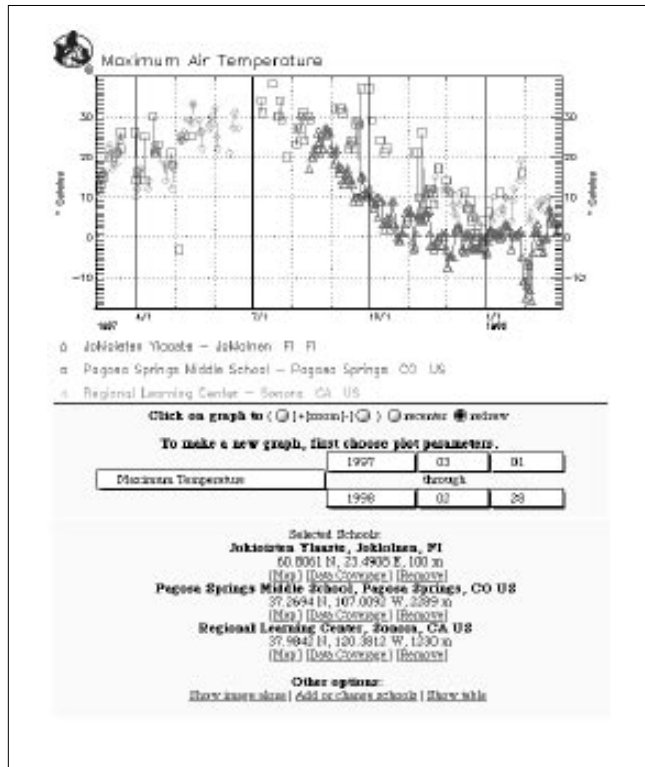
1. Enter the GLOBE server as you normally do.
2. Go to GLOBE Visualizations:



3. Add each of the schools you are studying to a single graph.



4. Select one of the GLOBE parameters and adjust the dates to create *Time Series Plots* for one full year. You can adjust the dates to analyze a few years, one year, one month, etc. Your graph should look similar to the one below.



5. Following the *Data Gathering and Organizing Work Sheet* questions, create *Time Series Plots* for current temperature, maximum temperature, minimum temperature, rainfall, snowfall, and soil moisture (30 cm).

# Using GLOBE Data to Analyze Land Cover

## Basic Information Work Sheet

### ***Our School***

MUC Code \_\_\_\_\_ Land Cover Type \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_ Elevation \_\_\_\_\_

### ***Comparison School #1***

MUC Code \_\_\_\_\_ School Name \_\_\_\_\_

City \_\_\_\_\_ Country \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_ Elevation \_\_\_\_\_

### ***Comparison School # 2***

MUC Code \_\_\_\_\_ School Name \_\_\_\_\_

City \_\_\_\_\_ Country \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_ Elevation \_\_\_\_\_

# Using GLOBE Data to Analyze Land Cover

## Data Gathering and Organizing Work Sheet-1

These questions are organized to help you record the data from GLOBE Visualizations. You might want to download and plot data instead of sketching the graphs from the GLOBE Web site. You can also click on the graph and save it as a graphics file to disk.

### **Temperature**

1. Sketch the graph from the *Time Series Plot* for the current temperature of your school and the others using a different color for each school.
2. Estimate the highest temperature for each school you chose using the maximum temperature *Time Series Plot*.
3. Estimate the lowest temperature for each school you chose using the minimum temperature *Time Series Plot*.

### **Precipitation (Rainfall and Snowfall)**

1. Sketch the graph from the *Time Series Plot* of the rainfall for the schools using a different color for each school.
2. Estimate which school has the most rainfall.
3. Estimate which school has the least amount of rainfall.
4. If applicable, sketch a graph from the *Time Series Plot* of the snowfall for the schools using a different color for each school.
5. If any of the schools receive snowfall, which school receives the most snow? Which school receives the least amount of snow?
6. How do the schools compare in their amounts of snow?

### **Soil Moisture (30 cm)**

1. Sketch the graph from the *Time Series Plot* of soil moisture for the schools, using a different color for each school.
2. Which schools have the wettest soil? Which schools have the driest soil?

### **Soil Data Extension**

Soil scientists highly recommend the use of additional soil properties for ecosystem analysis of land cover. Soil characterization data can be obtained by retrieving the soil data archive for each school. Additional basic properties you can consider include slope, texture, structure, and pH. For advanced level analysis, you can consider nitrogen, phosphorus, and potassium measurements.

# Using GLOBE Data to Analyze Land Cover

## Data Gathering and Organizing Work Sheet-2

### ***Geography and Topography***

Creating a table of this information will help you to summarize this data so you can see likenesses and differences clearly.

Locate the schools on an atlas using the information on the *Basic Information Work Sheet* (latitude, longitude, and country).

1. On which continent is each school located?
2. Which schools, if any, are located near coastlines? Describe each school's direction from the coastline.
3. Which schools, if any, are located near large water bodies? Give the name of the water body and describe each school's direction from the water body.
4. Which schools, if any, are located near mountain ranges? Give the name of the mountain range(s) and describe each school's direction from the mountain range.
5. What is the direction of the prevailing winds for each area?
  - a. Does the prevailing wind direction in any of the locations blow so it is likely to cross a mountain range?
  - b. Does the prevailing wind blow directly in from the ocean before it comes to the school site?
  - c. Does the prevailing wind blow across a large inland waterbody or dry land before it reaches the school sites?
6. Which schools, if any, are located in an area with an arid or wet climate? Indicate these schools and the type of climate.
7. Which schools, if any, are located in heavily urbanized areas?



# Using GLOBE Data to Analyze Land Cover

## Data Analysis Work Sheet-1

This section of the investigation is intended to help you learn how to analyze your data, summarize your results or findings, and interpret your findings to arrive at some conclusions. These may include new research questions or hypotheses. You will also have an opportunity to organize your new knowledge so you can present it for further discussion.

Answering these questions will help you apply the scientific method so you can learn a systematic approach for analyzing and making sense of data. This will help you to understand how the type of land cover in your school's GLOBE Study Area may be related to weather, climate, soils, and geographical location.

1. What are the temperature ranges (min-max), on average, for each of the schools?
2. Are there any patterns in these current temperature graphs for each school? Are the temperature patterns for each school similar? How are the patterns different?
3. Using an atlas, try to identify what the average temperature ranges might be in areas where your land cover class (MUC class) is found.
4. Analyze your rainfall graph.
  - a. Identify the differences and similarities in total rainfall amounts for the period studied. Did all the schools receive the same amount? If not, what are the differences?
  - b. Identify the patterns. When did rain fall? Were rain or storm events concentrated in a particular time period with dry periods, or was precipitation fairly evenly spread over the time period? In which locations did such patterns prevail?
  - c. Make a table to compile this data so you can look at it and begin to think about what it might mean.
5. Using an atlas or climate database, identify what average rainfall is reported for similar land cover classes.
6. Do the schools' rainfall patterns differ from the average precipitation for their area? If so, are there deserts, mountains, or waterbodies between the area of prevailing winds and the schools?
7. If applicable, describe the snowfall graph and explain how the temperature affects snowfall.
8. If applicable, how does snowfall affect the land cover type for your school?

# Using GLOBE Data to Analyze Land Cover

## Data Analysis Work Sheet-2

9. What soil moisture patterns do you see for each school?
10. If precipitation events are not evenly distributed across the time period, what do the reported soil moisture data look like during and after these events?
11. Location.
  - a. Are all the schools on the same continent? How far apart are they in degrees of latitude and longitude?
  - b. Where are they in relation to the equator (include N or S of the equator in your description)?
  - c. How much do they differ in elevation above sea level?
12. Which of the areas within the school sites or nearby are likely to have a MUC class that signifies developed land cover, especially urban (MUC 9)?

Answers to the above questions will represent your findings. Summarize these in a short paragraph. Attach the tables you created and refer to them in your summary to help explain your findings.

# Conclusions - Project Report

What do your findings mean? What can we say about the relationship between the MUC class, temperature, precipitation, and soil moisture at the three school locations?

In a well organized report, use your data and data analysis to describe how the environmental parameter(s) of an ecosystem (temperature, precipitation and soil moisture) relate to the land cover type in that area. Formulate hypotheses about which environmental parameter(s) are the most important in determining the type of land cover in an area. Justify your answers using the data obtained in this activity.

Remember that your conclusions are based on the data you used.

Be sure to answer the following questions in your report.

- What do your data suggest about possible relationships between precipitation and soil moisture for the study sites?
- What do your data suggest about possible relationships between temperature and precipitation?
- Explain how the amount of soil moisture can influence the type and condition of the land cover.
- If you determined what the prevailing winds in the study areas were, how do you think these might affect precipitation, temperature, or both? Is this explanation likely to account for some differences in data among the study sites?
- What does your data tell you about topographic or other locational differences between the sites?
- How might these differences relate to temperature or precipitation patterns at the various sites?
- What does your data tell you about the likely conditions necessary to support the MUC land cover class which are at the three study sites?
- Are there any major differences in the amount of precipitation, temperature ranges, or soil moisture across the sites for the time period studied? If there were some differences, what hypothesis might explain these differences?
- If there are differences in the amount of precipitation, temperature ranges, or soil moisture across the sites, how could you explain why these areas have the same land cover type?
- How does your data compare with “average” data found in an atlas or other source for these geographic locations? How might local conditions in your study area (topography, location near a water body, direction of prevailing winds) account for the differences?
- What does your data tell you about the relationships between location, precipitation, soil moisture, temperature, and land cover class?
- Are there any questions you feel that you haven’t been able to answer or new ideas (hypothesis) that might need further study to fully answer the above questions? If so, what are they? Do you think you might learn more about this relationship if you were able to compare data over a longer time period?

## Some Ways To Share Your Results and Conclusions

- Display on a school bulletin board.
- Submit to the local newspaper.
- Use GLOBE mail to send your report to the other schools you studied.
- Submit to the Land Cover/Biology Team:

Dr. Russell Congalton and  
Dr. Mimi Becker  
215 James Hall  
University of New Hampshire  
Durham, NH, USA 03824

## Adaptation

### Graphing

Instead of sketching the time series plots, students can use the actual GLOBE temperature, precipitation, and soil moisture data recorded by each school to create their own graphs. Following the instructions provided to create time series plots, you can retrieve the data for the schools and time period selected by selecting “**show table.**” It will show all the data reports of the selected parameter for the time period you selected. Scroll down to view the data table

Date YYYYMMDD	Jakloinen deg C	Pagosa Springs deg C	Sonoma deg C
19971101	7.0	--	--
19971102	6.0	--	--
19971103	6.0	--	--
19971104	-1.0	--	--
19971105	-3.0	21.0	--
19971106	-2.5	--	--
19971107	1.0	--	--
19971108	5.0	21.0	--
19971109	6.0	10.0	--
19971110	4.1	5.0	--
19971111	5.0	5.0	--
19971112	4.0	26.0	--
19971113	4.0	8.0	--
19971114	6.0	--	--
19971115	6.0	--	6.0
19971116	6.0	--	10.0
19971117	6.5	11.0	11.0

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