Measuring the Greenness Index

Using Picture Post and AnalyzingDigitalImages to
measure seasonal changes in vegetation

Introduction

A vegetation index is a single number that measures vegetation vigor or biomass. Vegetation indices are calculated from different combinations of spectral bands derived from digital images, often collected by satellites. They allow us to study the seasonality of vegetation growth, measure vegetation health, and assess whether an area has green vegetation or not.

Satellites often use infrared and red bands to derive information about vegetation, but digital cameras typically collect only red, green and blue bands. By calculating a vegetation index (in this case, the 'greenness index') from the red, green, and blue bands of a digital image, we can track similar seasonal trends in vegetation that are measured by satellites. Higher greenness values relate to increased presence of chlorophyll in the vegetation being monitored.

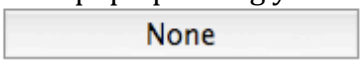
For this activity we have selected four images from the PicturePost website (http://picturepost.unh.edu) that were taken from 2008 to 2009 at Menotomy Rocks Park, in Arlington, MA. Each picture is from a different season of the year. Using the AnalyzingDigitalImages tool, you will be able to calculate a simple vegetation index from each picture to observe the change in greenness over time.

Initial Observations

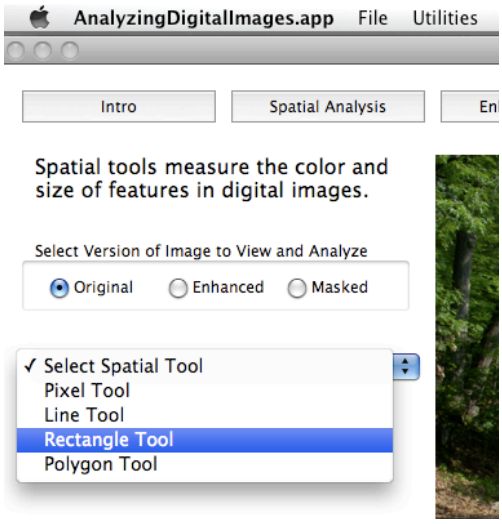
Take a look at each of the four pictures provided. What do you notice about the images? How do you think they will change in greenness over time? Which features in the picture will change the most? The least?

Calculating the Greenness Index using AnalyzingDigitalImages

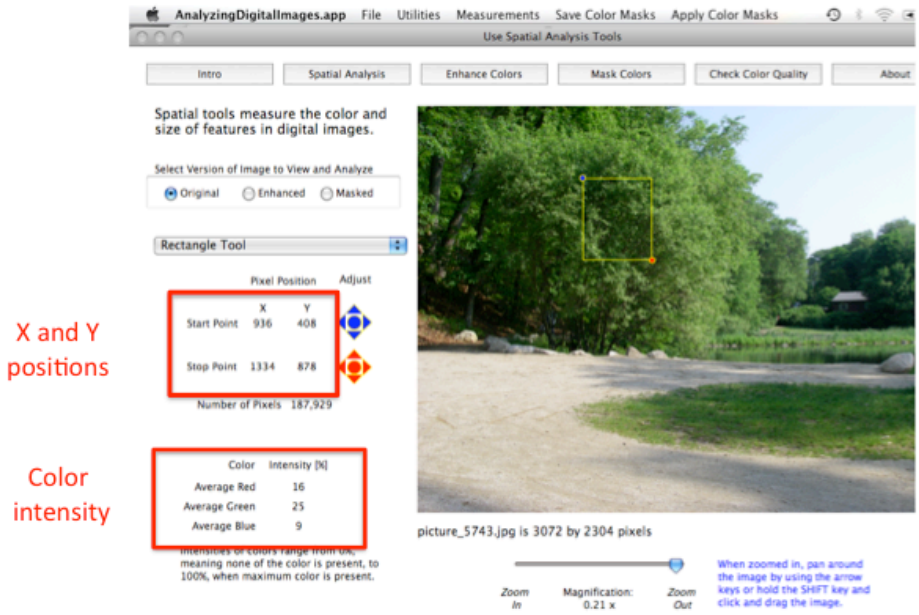
1. Open the AnalyzingDigitalImages software.
2. Click on the 

button on the bottom-left corner of the screen. In the 'open' window, choose the picture you would like to open.
3. A window will pop up asking you to "select method to calibrate the pixel size." Choose 

4. Your image should now appear on the screen. Under 'Select Spatial Tool' dropdown menu, choose the 'Rectangle Tool.'



5. This tool allows you to select a small section of the picture. Click on the picture and hold the mouse down while dragging it across the screen to select the rectangle. Choose one feature in the picture to focus on (something that you think will change in 'greenness' over time) and record what feature you chose on your worksheet. Place the rectangle over that feature, you don't need to encompass the whole feature in the rectangle; just a small section of it is enough! Once you have your rectangle, the screen should look like this:



6. Record the X and Y start and stop positions for your rectangle in the table below:

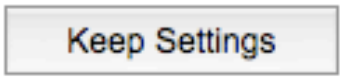
	X	Y
Start Point		
Stop Point		

7. At the bottom left corner of the screen there is a chart of color intensities. Record the red, green, and blue color intensity in your data table.

8. Without moving the rectangle or clicking on the picture again, go to File → Open Picture. If you accidentally move the rectangle, you can use the X and Y points you recorded above to recreate it.

9. Choose a new picture from a different season and click 'Open.'

10. A window will pop up asking if you would like to keep the same settings. YES! Click



Your new image will now appear with the SAME rectangle you already created.

11. Again, record the red, green, and blue color intensities in your data table.

12. Repeat steps 8 through 11 for the remaining two pictures.

Measuring Greenness Index - Activity Worksheet

1. What feature of the image did you choose to measure? Why did you choose that feature?

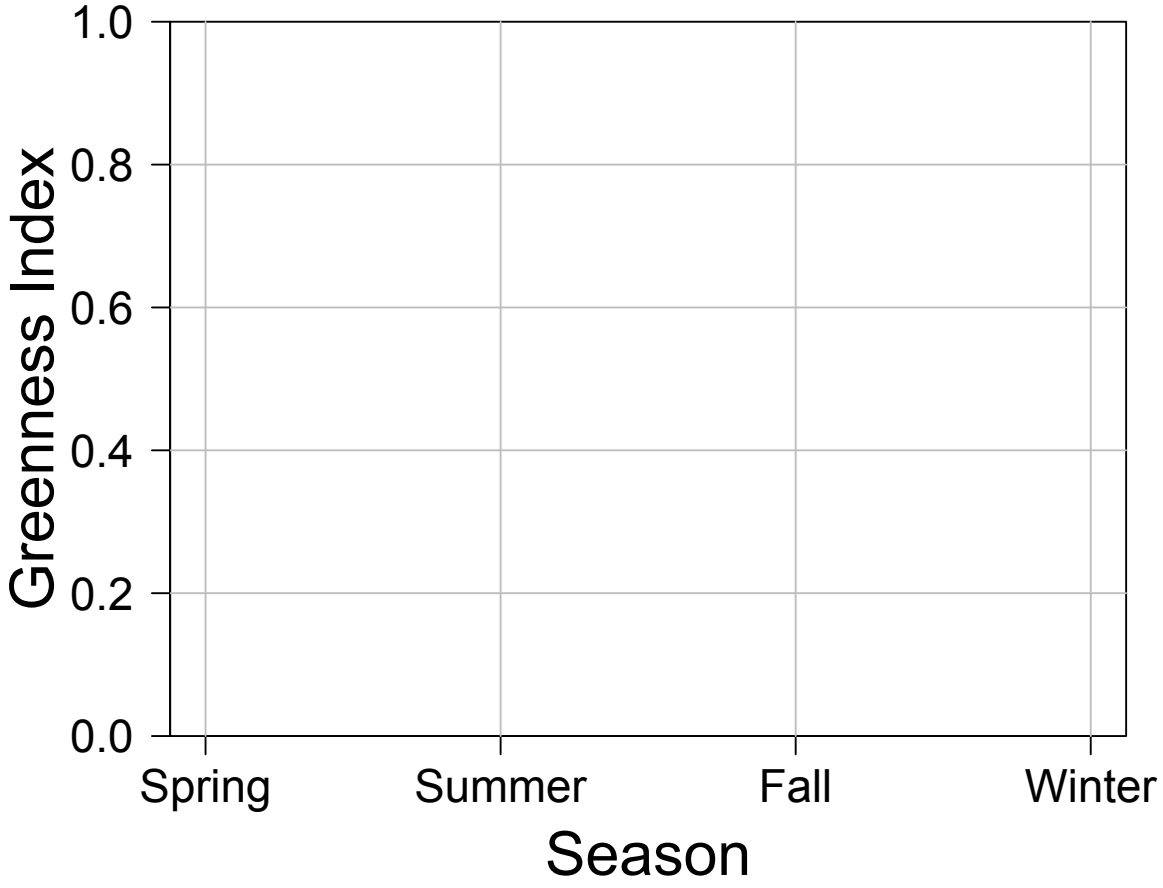
Greenness Index Data Table

Picture Date	Red Intensity	Green Intensity	Blue Intensity	Greenness Index

2. Once you have recorded the red, green, and blue intensities for all pictures, use the space below to calculate the greenness index for each date, and record the values in your table. Greenness index is calculated by using the equation below:

$$Greenness\ Index = \frac{Green}{Red + Blue + Green}$$

3. Make a graph of the Greenness Index over time using the template provided below.



4. Many satellites also measure vegetation indices. One of these indices is the Normalized Difference Vegetation Index or **NDVI**, which also measures the 'greenness' of an area, but is calculated using a combination of infrared and red bands. In the table below, we have provided the NDVI values measured by the MODIS (**Mod**erate-Resolution **I**maging **S**pectroradiometer) satellite for the same area and dates that these PicturePost images were taken. **Using these NDVI values (and a different color pen!), plot NDVI for each date on the graph above.**

Date	**NDVI**
April 2008	0.46
June 2008	0.64
October 2008	0.50
January 2009	0.53

Discussion Questions:

Firstly, take a look at the line you graphed that represents the **Greenness Index**. What patterns do you see in greenness over time? Is this what you expected from your initial observations?

Now look at the line you graphed that represents **NDVI**. Does it follow the same pattern as the Greenness Index? Why or why not?

Why do you think it is important to calculate vegetation indices? How could this type of information be more useful than simply looking at the pictures?

Extensions

There are many different variations on this activity that can be done using PicturePost and the AnalyzingDigitalImages software. For example, using the same format above, you could compare different features of one image (How does greenness differ between the grass and a tree? What about the road?); or you could investigate how different features change over time (will you see the same patterns in greenness if you look at a deciduous versus a coniferous tree?), or look at the differences between images taken in different parts of the country or different ecosystems.

Once your students have completed this activity, take a look at the Picture Post Animation (http://globecarboncycle.unh.edu/climate/ppost_new/picturepost6.html), linked under the Picture Post heading of the Climate Resource Directory page. This animation uses pictures from the same site used in this activity, but also includes satellite data of albedo (the reflectance of a given surface). Use the tool to explore the relationship between albedo, and greenness, and what the high and low values on the graphs look like in the images.

Implementing this tool in your classroom

If you plan on setting up a Picture Post in your classroom, this activity is a great way to measure changes in the landscape over time, and to make the connection between what you observe in your local landscape and what is measured by satellite data. Have a poster board or excel data table and graph of the greenness index in your classroom that your students can add to each time you make a new Picture Post. For more information on implementing PicturePost in your classroom, see the 'Overview of Picture Post Learning Progression' document and the PicturePost website (http://picturepost.unh.edu).

The AnalyzingDigitalImages software is part of the Digital Earth Watch (DEW), and is available at http://mvh.sr.unh.edu/software/software.htm#download. More resources are also available at http://www.lawrencehallofscience.org/gss/rev/ip.