Title:	Using MODIS to Analyze the Seasonal Growing Cycle of Crops
	Part I: Understand and locate MODIS images
	Part II: Understand the spectral signature of vegetation
	Part III: Seasonal change in Normalized Difference Vegetation Index (NDVI)
Product Type:	Curriculum
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Target audience:	Undergraduate
Format:	Tutorial (pdf document)
Software requirements*:	ArcMap 9 or higher (ArcGIS Desktop) (Part I), ERDAS Imagine 2010 or higher (Parts I, II, III), Microsoft Excel 2003 or higher (Parts II, III)
Data:	MODIS images are provided for this exercise. Also provided is a model to calculate NDVI from these.
Estimated time to complete:	All parts: 5 hrs.
	Part I: 1 hr.
	Part II: 2 hrs.
	Part III: 2 hrs.
Alternative Implementations:	• Part I provides a standalone exercise to project a MODIS image on top of a basemap • Part II provides a standalone exercise to plot the spectral signature of a corn field over a growing season • Part III provides a standalone exercise to calculate the NDVI of a corn field and plot its change over a growing season
Learning objectives:	Part I: • Understand MODIS image data • View and locate MODIS images on a map using ArcGIS
	Part II: • Understand and Analyze the spectral signature of vegetation • Plot a spectral signature using ERDAS Imagine • Understand how the spectral signature of vegetation changes with its health
	Part III: • Understand the Normalized Difference Vegetation Index (NDVI) • Interpret and run a model in Imagine • Create an NDVI image from MODIS data • Use the NDVI to monitor the seasonal cycle of crops

*Tutorials may work with earlier versions of software but have not been tested on them

Using Satellite Imagery to Analyze the Seasonal Growing Cycle of Crops

Part III: Seasonal change in Normalized Difference Vegetation Index (NDVI)

Objectives:

- Understand the Normalized Difference Vegetation Index (NDVI)
- Interpret and run a model in Imagine
- Create an NDVI image from MODIS data
- Use the NDVI to monitor the seasonal cycle of crops

In this exercise you will be using a series of six MODIS images to look at the phenological cycle of a crop using the reflectance spectra and the Normalized Difference Vegetation Index (NDVI)

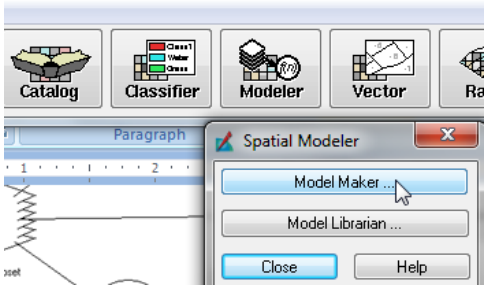
A model is provided to compute the NDVI from a MODIS image for you. (It is modis_ndvi_final.gmd). The model calculates (band 2 - band 1)/ (band 2 + band 1). Only the input and output image names need to be provided.

What wavelengths (colors) do bands 1 and 2 correspond to? Why is "band 2- band 1/ band 2 + band 1" useful for assessing vegetation?

1. Open and run a model in Imagine.

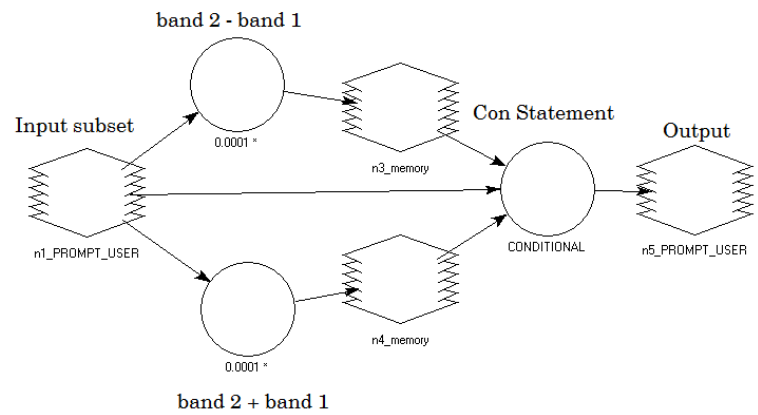
You will create six NDVI Imagine files- one for each of the MODIS subset images (August thru' October) using this model. To do this, select the “Modeller” icon in the top menu bar:

Choose File -> Open -> and navigate to the model (modis_ndvi.gmd) provided.

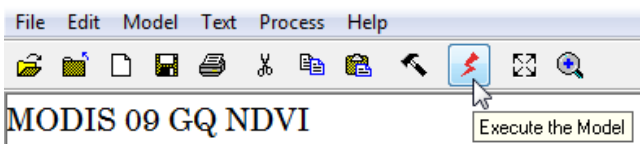


It should look like this:

MODIS 09 GQ NDVI



Click the lightning bolt to run the model:



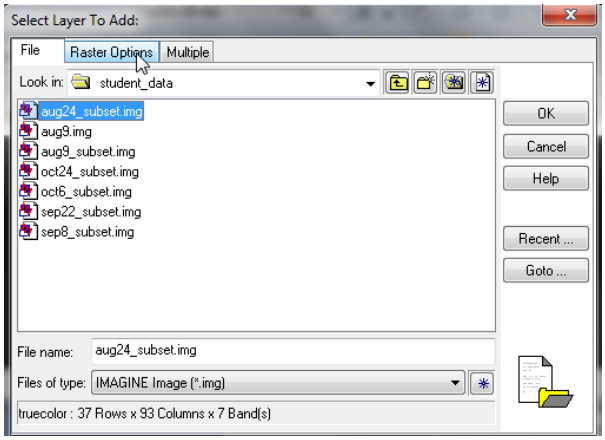
You will be prompted for the file input name (your subset image) and your file output name (a new file that will be created to store the NDVI image that the model will generate). Run the model for each of your six subset images, saving the NDVI output image each time. You should name these appropriately (e.g. aug9_subset_NDVI etc.).

2. Record the NDVI value in each image

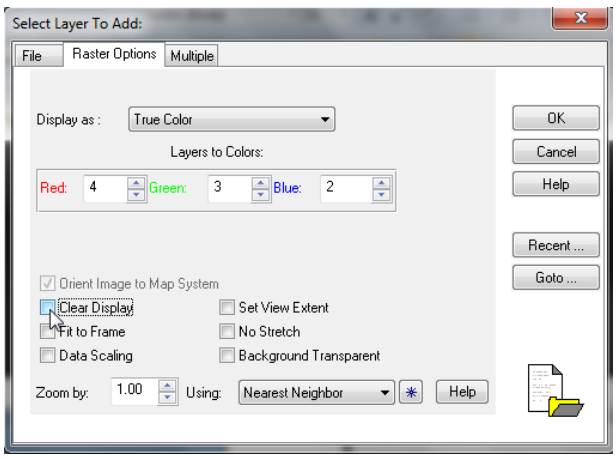
Once you have the 6 NDVI images saved you will examine the seasonal change in NDVI of individual pixels in the images. It is important that the same pixel is used in each of the images in the sequence. This can be done by linking six viewers, each of which contains one NDVI image, and then using the Inquire cursor to query the pixel value. If the viewers are linked, the crosshair will be positioned at the same pixel in each of the images. (See Pt II of this exercise for instructions.)

Another way to do this is to use one Viewer for all the images and arrange them in layers on top of each other. The Inquire cursor can be used to read the pixel values of the top layer, and then by re-arranging the order of the layers, the other images can be brought to the top one at a time. To do this, open a new Viewer with the first image (Aug 9 subset). To place another raster in a layer on top of this, choose File -> Open -> Raster Layer within this Viewer. Navigate to your second image (Aug 24 subset).

Before pressing OK, click on the Raster Options tab.

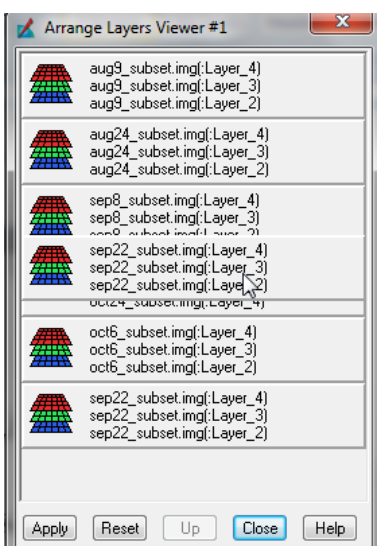


Uncheck the Clear Display option:



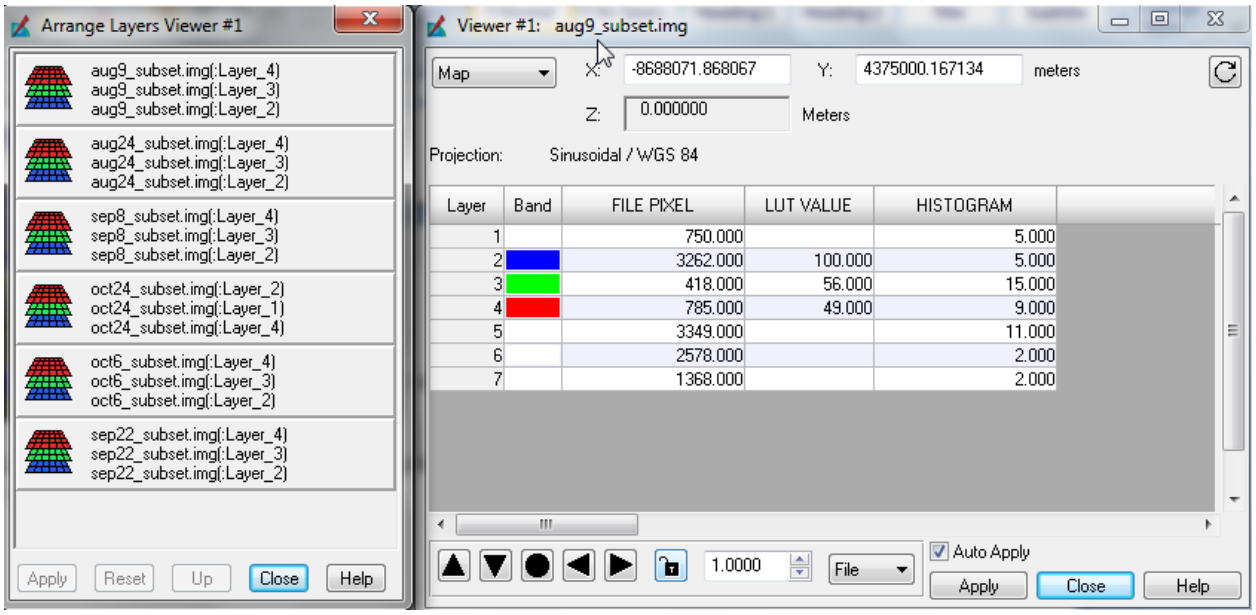
Then click OK. Repeat until all subset images are added.

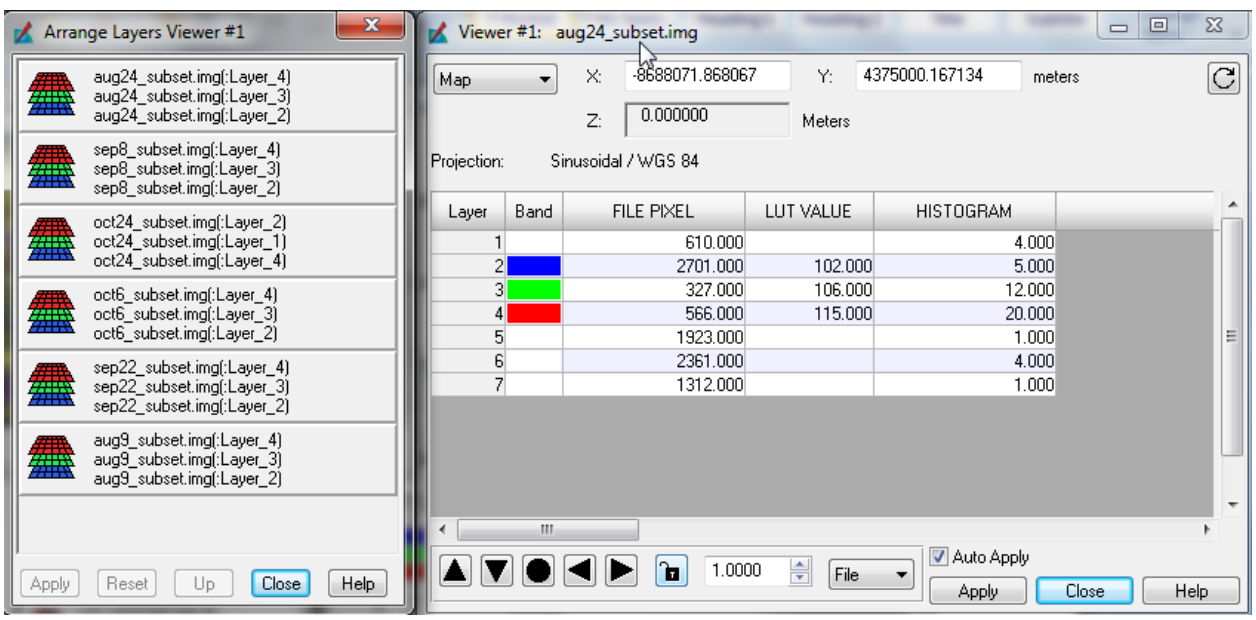
You can see the layers from View -> Arrange Layers and can re-arrange them by clicking on one and dragging it to its correct position in the stack:



To move an image to the top so you can see it displayed just click on it and drag it to the top. Press Apply to make the change.

Now you can use the Inquire cursor to see the pixel values in each image by moving each to the top layer one after another.

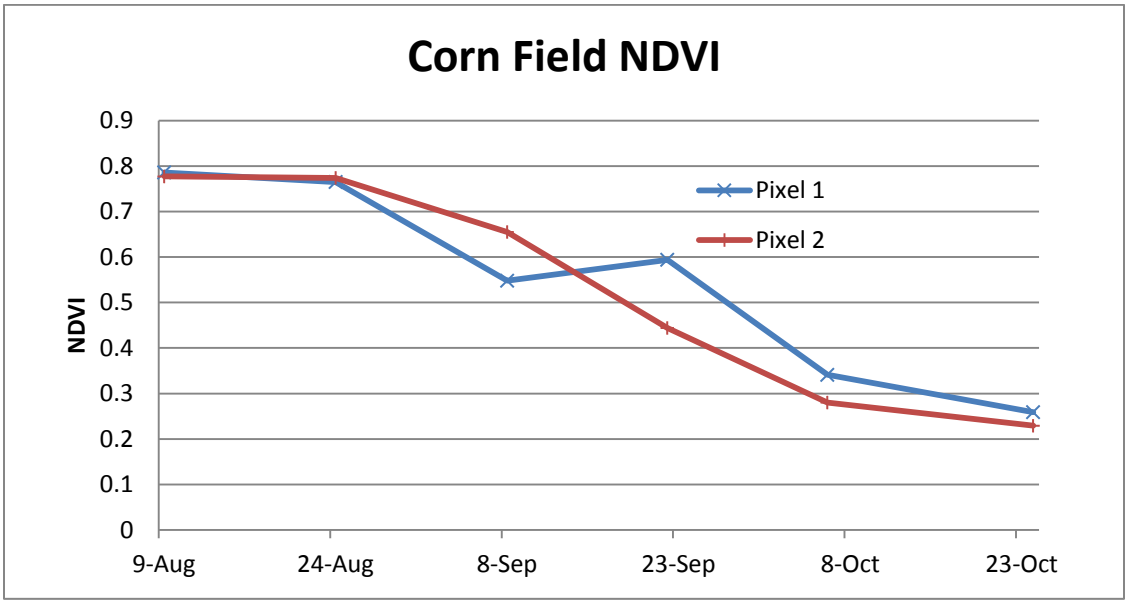




Record the band values for each date in Excel (or other plotting software).

3. Make a plot of the seasonal change in NDVI. Record (write down) the NDVI (pixel) values on each date. Repeat for a second pixel in the field. Then use Excel (or some other plotting program) to plot the temporal change in NDVI between August and October.

Your graph should look something like the one below.



What changes in vegetation is the NDVI displaying? Why is it a good measure of vegetation health or greenness?