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
Developer:	Helen Cox (Professor, Geography, California State University, Northridge): helen.m.cox@csun.edu Laura Yetter (Research Asst., Institute for Sustainability, California State University, Northridge)
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 MODIS to Analyze the Seasonal Growing Cycle of Crops

Part I: Understand and locate MODIS images

Objectives:
- Understand MODIS image data
- View and locate MODIS images on a map using ArcGIS

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)

Below are photographs of crop fields in Colby, Kansas. We will be looking at pixel locations in a corn field and investigating the change in spectral response and NDVI over a period of 3 months (from August to October).

Corn field, May 1, 2012 (by Kansas AG Network News)   Corn field near Colby Kansas, August 24, 2012

You will be provided with the MODIS images you will be using in this exercise. They were captured between August and October 2011 with two images per month on the following dates: Aug 9 and 24, Sept 8 and 22, and Oct 6 and 24. MODIS product MOD09GA was used. These are 'level 2' images of surface reflectance (effects of atmosphere removed). A description of this product can be found at: https://lpdaac.usgs.gov/products/modis_products_table/mod09ga.

Refer to the website to answer the following questions.

1. *What is the spatial resolution of the images?*

2. *What bands of radiation are available, and to what wavelengths do these bands correspond?*

3. *What are the units of the data? How does one convert the file values into reflectance (decimal value)?*

4. *What band combination for RGB would you use to generate a true color image?*

MODIS image files are large. The ones provided to you for this exercise have been subsetted to the corn fields and surrounding area. One of the original images is provided for you to view as an example. Open

it (aug9.img) in an Imagine Viewer and set the bands to produce a true color image. Take a snapshot of the image and turn it in.

5. *What is the projection used for this image?*

The subsetted images focus on the corn fields in particular but with the coarse resolution of the instrument you may find it hard to pick them out.

The subsets are zoomed in on a corn field at the approximate coordinates **39˚20' 0.06 N 101˚ 08' 38.60 W** or **-8699015.315442 X, 4373673.827825 Y** in map units . Zoom in on this area in your full (Aug 9) image, also open Google Earth to get a better look at the corn field.

Center pivot irrigation corn fields near Colby, Kansas as seen in Google Earth.
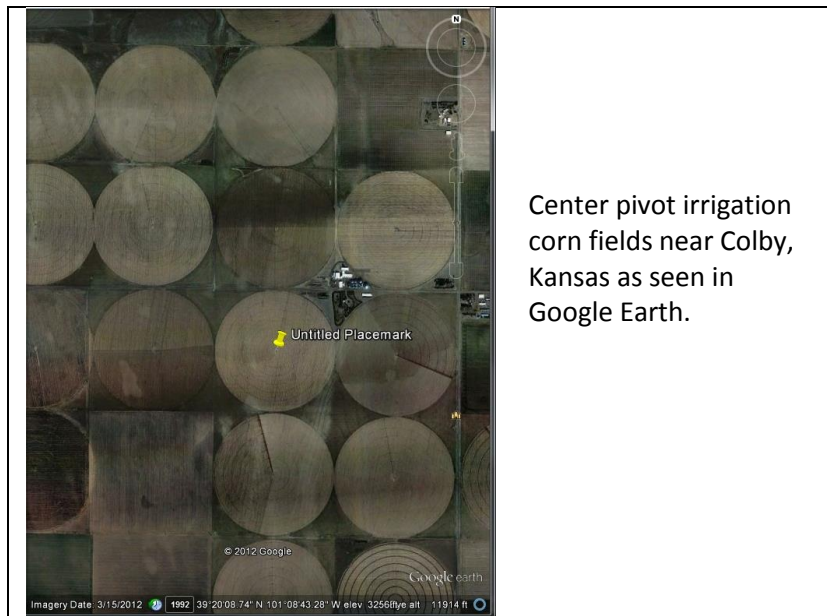
1. Locate the area of the subset image in ArcGIS and mark it with a polygon

First create a new shapefile of type polygon using ArcCatalog. Then open ArcMap with a subset image. Then open your (empty) new shapefile. Define the projection of your new shapefile to be the same as that of the subset image using Data Management Tools -> Projections and Transformations -> Define Projection. Select the polygon as your Input feature class. Under Coordinate System -> Import from the subset image.

After setting the projection, you will now outline the boundary of the subset image.

ArcMap 10: Click on Editor -> Start Editing. The Create Features box will come up with your polygon in the upper box. Select the polygon and the Construction Tools will display below. Select polygon. Click on the corners of your subset. Double click on the last point. Save Edits. Stop editing. Now your polygon shows the boundary of the image.

ArcMap 9.3: After setting the projection, you will now outline the boundary of the subset image. Click on Editor -> Start Editing. Click on the pencil. Click on the corners of your subset. Double click on the last point. Save Edits. Stop editing. Now your polygon shows the boundary of the image.

2. Project it over a basemap in ArcGIS by "Adding a basemap" from ArcGIS online.

Take a screenshot of your map and turn it in.