GEOG 4140/6140 – Winter 2021
Lab 7: Image Analysis
Due Thursday, March 18th by 11:59 PM

Overview

Remote sensing allows us to make a variety of observations over large areas of land. Without remote sensing, we would have to rely on field measurements that are few and far between. One major application of remote sensing has to do with evaluating land cover change, identifying where change has occurred, and quantifying the area of change. In this lab, we will use Landsat 8 imagery to analyze vegetation change during fall in the West Elk Mountains in Colorado. Image classification will also be briefly explored in this lab.

Although the imagery for this lab is provided, it is worthwhile to understand how to download data for yourself in the future. EarthExplorer can be used to find all Landsat 8 imagery that covers the point 38.7°N, 107.2°W during September and October 2017.

The following resource may be of use in completing this assignment:
Export or convert raster datasets
Raster To Geodatabase
NDVI function
How Raster Calculator works
Raster Calculator
Overview of image classification
The Image Classification Wizard

Required Data (*Sources*)

1. Labdsat 8 images (.tif) acquired on 19 September and 14 October 2017 (*Lab data on Canvas*)

Workflow

1. Open ArcGIS Pro and create a new project titled *Lab07YourLastName* in your working directory for this lab.
    a. Export the Landsat 8 TIFFs images to your Lab 7 geodatabase, and add these data to the map.
    b. They will default to displaying a true color image, an image representing the wavelengths of the color spectrum that looks like what you see with your eyes.

2. The two images for this lab were acquired during the fall of 2017 over Colorado's West Elk Mountains near Crested Butte, on 19 September and 14 October 2017.
    a. Note any changes in the land cover between the two dates.

3. Next, you will change the symbology to display both dates as false color composite images, this will better visualize vegetation health.
    a. Set Landsat's near infrared wavelength band (Band_5) to display as Red, the red wavelength band (Band_4) to display as Green, and the green wavelength band (Band_3) to display as Blue.
    b. This will produce an image where vegetation is a reddish color; the more vibrant the red color, the healthier the vegetation.

4. Produce a two-panel map of these false color images for each date. (Deliverable 1)
    a. Note differences in these images and think about what they could indicate about vegetation change between these two dates. (Deliverable 2)

5. Next, we will compute the Normalized Difference Vegetation Index (NDVI) for each image. The NDVI is used to estimate vegetation health, with values closer to 1.0 representing dense, healthy vegetation and values closer to -1 representing snow or water.
    a. There are multiple tools in ArcGIS Pro for calculating NDVI, make sure you use the one that allows you to specify the red wavelength and near infrared wavelength bands, which are bands 4 and 5, respectively. (Found under Imagery > Raster Functions > NDVI)
    b. When running **NDVI**, use the *Scientific Output* option to ensure that NDVI values will range from -1.0 to 1.0.

6. Create a raster that shows the extent of vegetation that was still relatively green in September but was no longer green by the time the October image was taken.
    a. Start by creating a binary map for each image using a threshold of 0.35. This can be completed using the **Raster Calculator** tool.
        i. For example, if you use the expression "September_NDVI > 0.35" in raster calculator, then a binary raster will be produced in which a value of 1 represents healthy vegetation and a value of 0 represents areas of unhealthy vegetation (or no vegetation at all).
    b. Run the **Raster Calculator** again to subtract the September binary raster from the October binary raster.
    c. Create a layout map of the difference raster produced in the previous step.
        i. In the symbology, only show the class that represents the extent of change from healthy vegetation in September to decaying vegetation in October. (Deliverable 3)

7. The approach in step 6 is an example of binary change detection, and can be used with the outputs of many different image analysis techniques, including image classification, which you will be introduced to in the next steps.
    a. Image classification uses an algorithm to group similar pixels of an image into classes (forest, developed, water, etc.). This can be either supervised where the user identifies examples of classes for pixels to be classified as, or unsupervised where the program groups pixels into many classes that are later aggregated by the user. For this lab we will perform a supervised classification.

8. Begin a supervised, object-based classification of the September image with the *default* NLCD2011 classification schema in the **classification wizard** (see Imagery tab).
    a. After segmenting the image, you will need to select examples of various classes.
        i. For this lab, only select examples of Water, Developed, Barren, Forest, and use Planted/Cultivated to represent Lowland Vegetation. Be sure to pick a few examples of each.
    b. After running the classification, create a layout map of your results (Deliverable 5). Note any inaccuracies in the classification and why those may have occurred.

<u>Deliverables</u>

1. A two-panel map of the 19 September and 14 October false color images from Step 4. (4 points)

2. What do the false color composites tell you about how vegetation changed between the two images? (1 point)

3. A map of your output from Step 6. (8 points)

4. A map of your classification results from Step 8. (8 points)

5. Where did your classification perform well and where did it struggle? Why do you think this is and how could the classification be improved? (4 points)