LABORATORY THREE

Using ArcGIS Pro to Classify Imagery (Unsupervised)

University of Mississippi – Department of Geology and Geological Engineering

Purpose-

This exercise will attempt to accomplish the following goals:

- Obtain SENTINEL-2 imagery from EarthExplorer
- Familiarize the student with spectral profiling
- Use an ISO-Cluster algorithm to classify multispectral imagery

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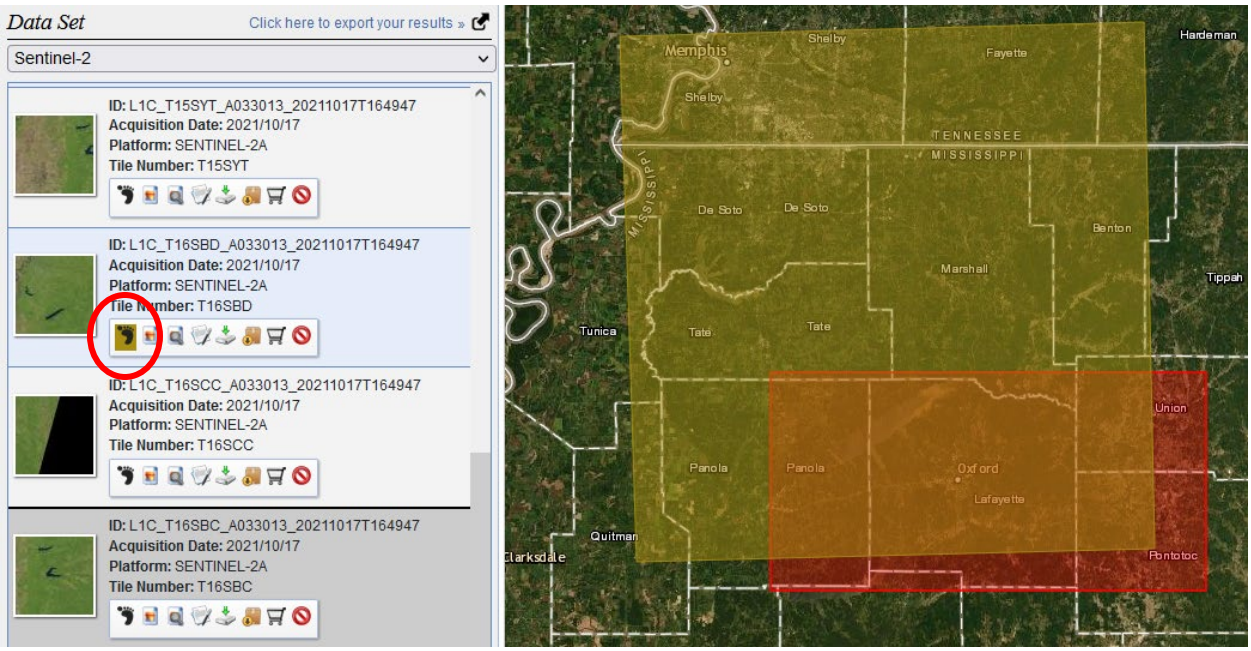
Laboratory introduction-

Image classification is the task of extracting information classes from a raster image. The results of an image classification can be used to create thematic maps, analyze landcover, examine spatial relationships and more. For example, if you have aerial imagery of some land that includes farmland, forest, ponds, and a city, you could assign a range of pixel values to each of these landcover types, classify the aerial images, and create a series of maps that display the change in landcover over time. Using the Sentinell-2 (S2) imagery you will perform an unsupervised classification. In addition, locate a polygon vector file containing the county or similar sized jurisdiction. You can use this polygon file to subset the imagery. If your scene is of an international location, clip using a polygon to an area of approximately Lafayette County, Mississippi or similar (approximately 1,700 km2). This clipping exercise of the laboratory is to build your skills for finding, managing and using vector data along with raster data. It is also a great way to reduce the computational time needed, make a clean, distinct final output and more importantly, have an area to compare total percent too.
To use the Image Classification Wizard and complete this tutorial, you must have an ArcGIS Desktop license (any level) with the Spatial Analyst Extension.

Download a Sentinel 2 (S2) L1C tile that is mostly cloud-free (<10%) and most recent of Lafayette County Mississippi. Since L1C tiles on EarthExplorer are smaller than a Landsat image so find a tile that covers most of the area of Lafayette County.



Use the Show Footprint tool to show the extent of the L1C tile. In the above example, this is the Sentinel-2A data captured on 17 October 2021.

In this exercise, you will perform an unsupervised classification of the DNs in a S2 image. ArcGIS desktop uses the ISO-Cluster algorithm to perform an unsupervised classification. ISO stands for "Iterative Self-Organizing." It is iterative in that it repeatedly performs an entire classification (outputting a thematic raster layer) and recalculates statistics. "Self-Organizing" refers to the way in which it locates the clusters that are inherent in the data.

The ISO clustering method uses the minimum spectral distance formula to form clusters. It begins with either arbitrary cluster means or means of an existing signature set, and each time the clustering repeats, the means of these clusters are shifted. The new cluster means are used for the next iteration. The ISO Cluster utility repeats the clustering of the image until either:

- a maximum number of iterations has been performed, or
- a maximum percentage of unchanged pixels has been reached between two iterations.

Compared to a supervised classification method, there are few steps in training, but more work is needed during the interpretation phase of the process. See Figure 1.

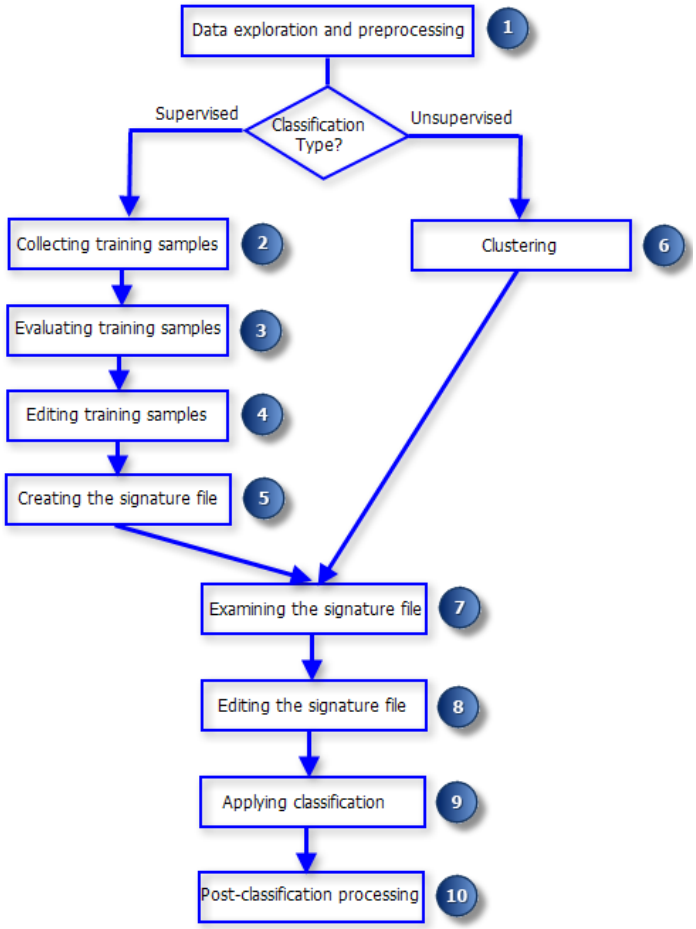


Figure 1 – Image classification workflow (from ESRI)

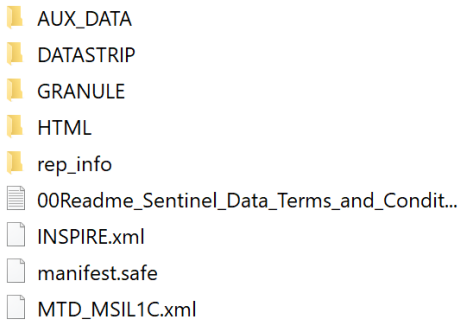
It would be best to use the Lafayette County S2 data, but if you decide to use another location be sure the subset of the scene contains all four (4) classes in the Table below.

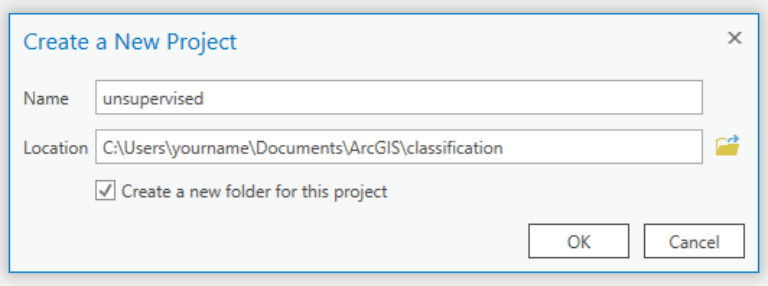
The deliverable for this laboratory is a single map that has an explanation of the colors/classes and a table reporting the % of total area of Lafayette County or similar-sized area you have chosen. The final number of classes will be four (4) and are in following table. Explore the statistical filtering and how it affects you results of your analysis.

Class name	Pixel Value	Pixel color
Urban/ built up/ transportation	1	red
Agriculture	2	yellow
Forest & Wetland	3	green
Open Water	4	blue

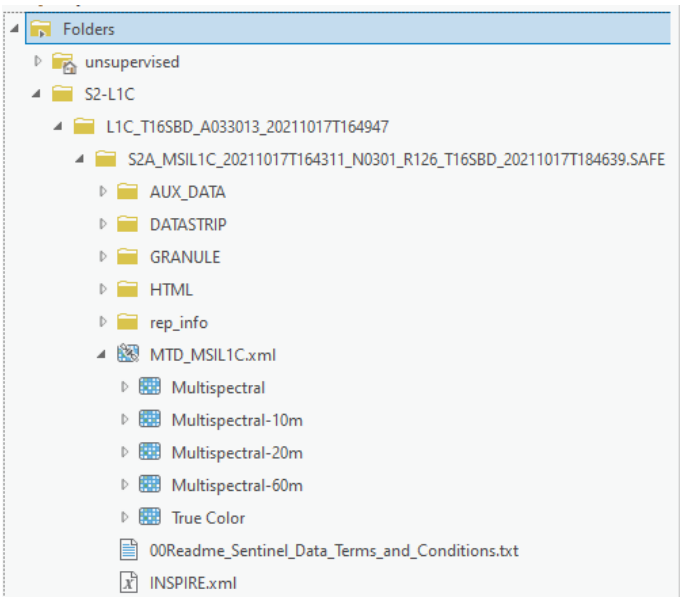
KEEP your data for the next laboratory. You will use these datasets again in the next laboratory so please choose wisely your tile.

Sentinel-2 data file structure. Explore the data structure.





After adding the folder which contains your S2-L1C image tile, navigate the file structure to find and expand the MTD_MSIL1C.xml file. This is the metatdata for the tile and ArcGIS Pro recognizes it as such.

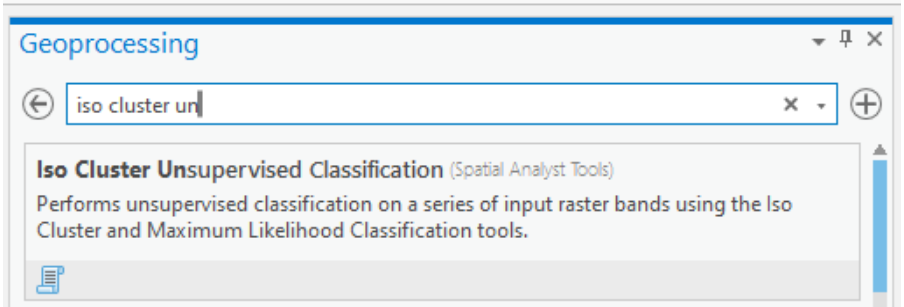


Drag and drop the Multispectral-10m data into the project View. Be sure to calculate statistics and build the pyramid files when prompted. This process can take a considerable amount of time, especially if your computer resources are low. Be sure you have more than 10% of the disk drive available.
SENTINEL-2, launched as part of the European Commission's Copernicus program on June 23, 2015, was designed specifically to deliver a wealth of data and imagery. The satellite is equipped with an opto-electronic multispectral sensor for surveying with a sentinel-2 resolution of 10 to 60 m in the visible, near infrared (VNIR), and short-wave infrared (SWIR) spectral zones, including 13 spectral channels. You can compare the Sentinel-2 MSI bands with those of Landsat 7 and 8.
The orbit is an average height of 785 km and the presence of two satellites in the mission allow repeated surveys every 5 days at the equator and every 2-3 days at middle latitudes.

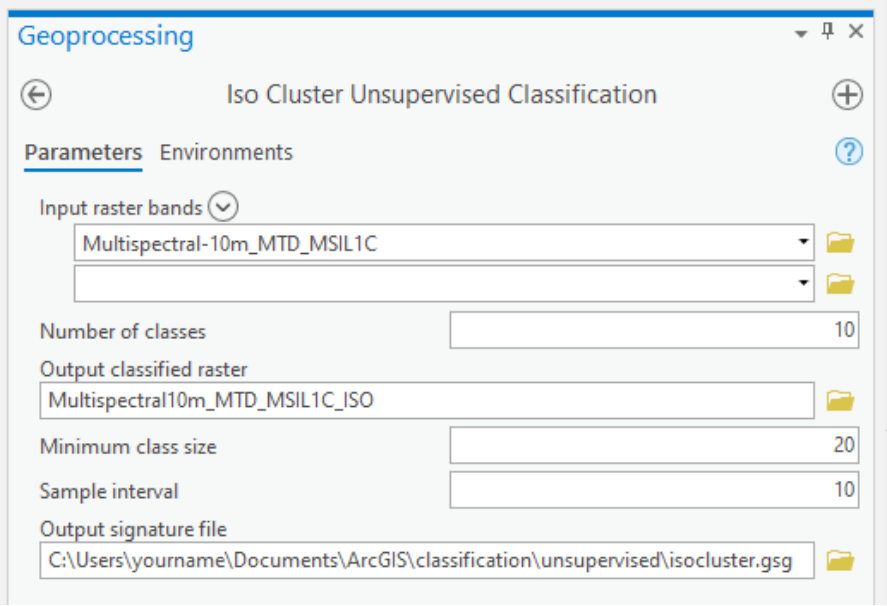
Classification Wizard

Click the Classification Wizard button on the Imagery tab to open and dock the wizard. The first page is the Configure page, where you set up your classification project. The parameters set here determine the steps and functionality available in the wizard tool.
After choosing a classification method, there are two (2) options for the type of classifications that focus on how the analysis will be performed. These types are pixel based and object based. The pixel-based classifies each pixel on a per-pixel basis. The pixel's feature space coordinate is classified using clustering algorithms The object-based methods take into account neighboring pixels. This is a more sophisticated method and takes into account the shape of the segmented image. The object -based methods results in classification that are less speckled with "island" classed pixels. Pixel-based methods can also be less speckled using a majority convolution filters but requires additional steps and does not take into account surrounding pixels DURING the classification process.

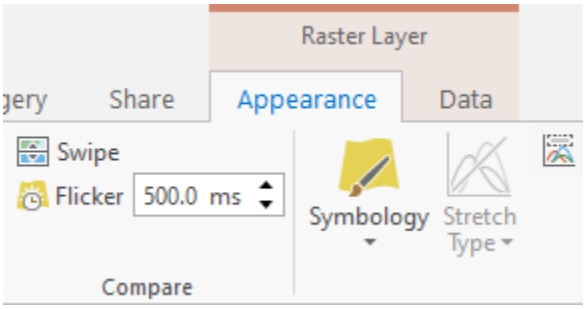
Using Analysis>Tools>Geoprocessing and search for iso cluster unsupervised classification tool.



Use 10 classes to “prime” the algorithm and be sure to output the signature file (.gsg). It will be used again. Name the output file with “ISO” in the name so you can identify in the database.

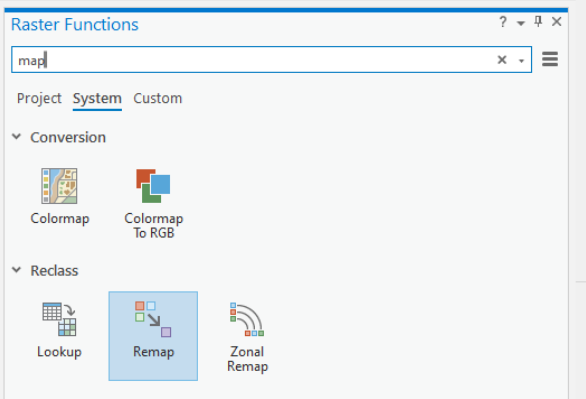


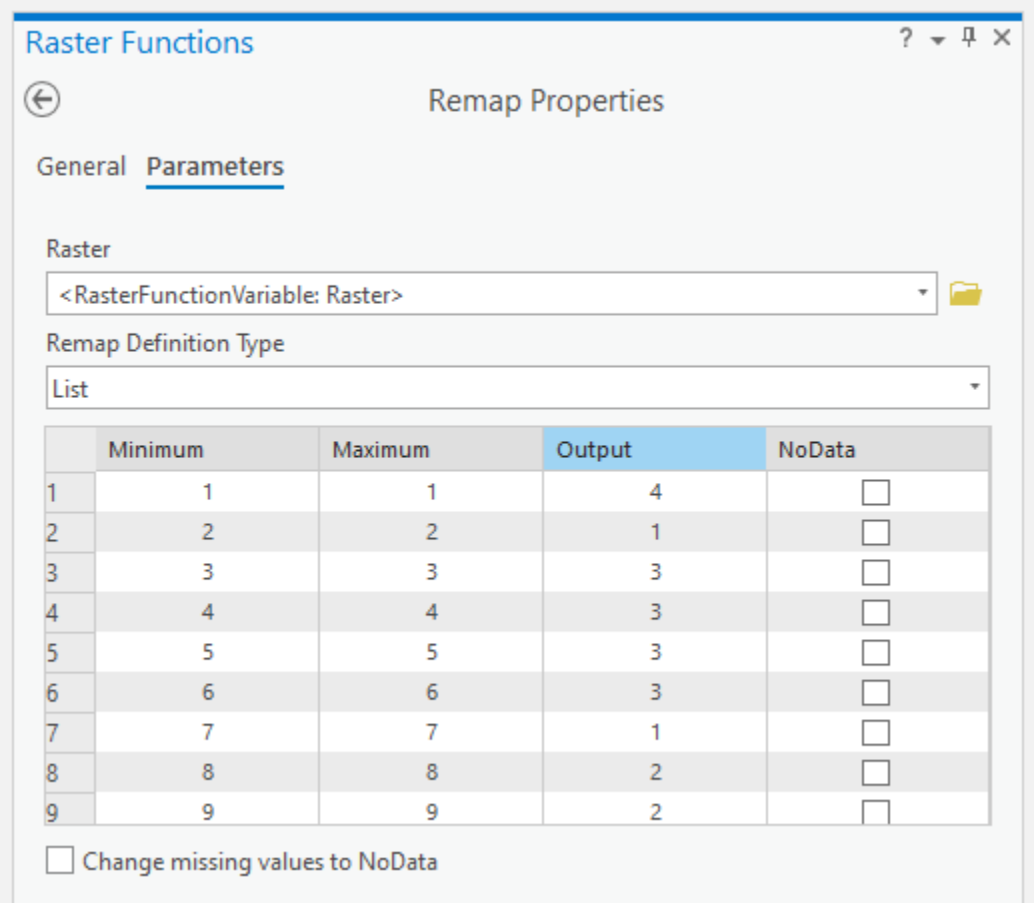
Select Run. This process will take a long time to process when using an entire L1C tile.

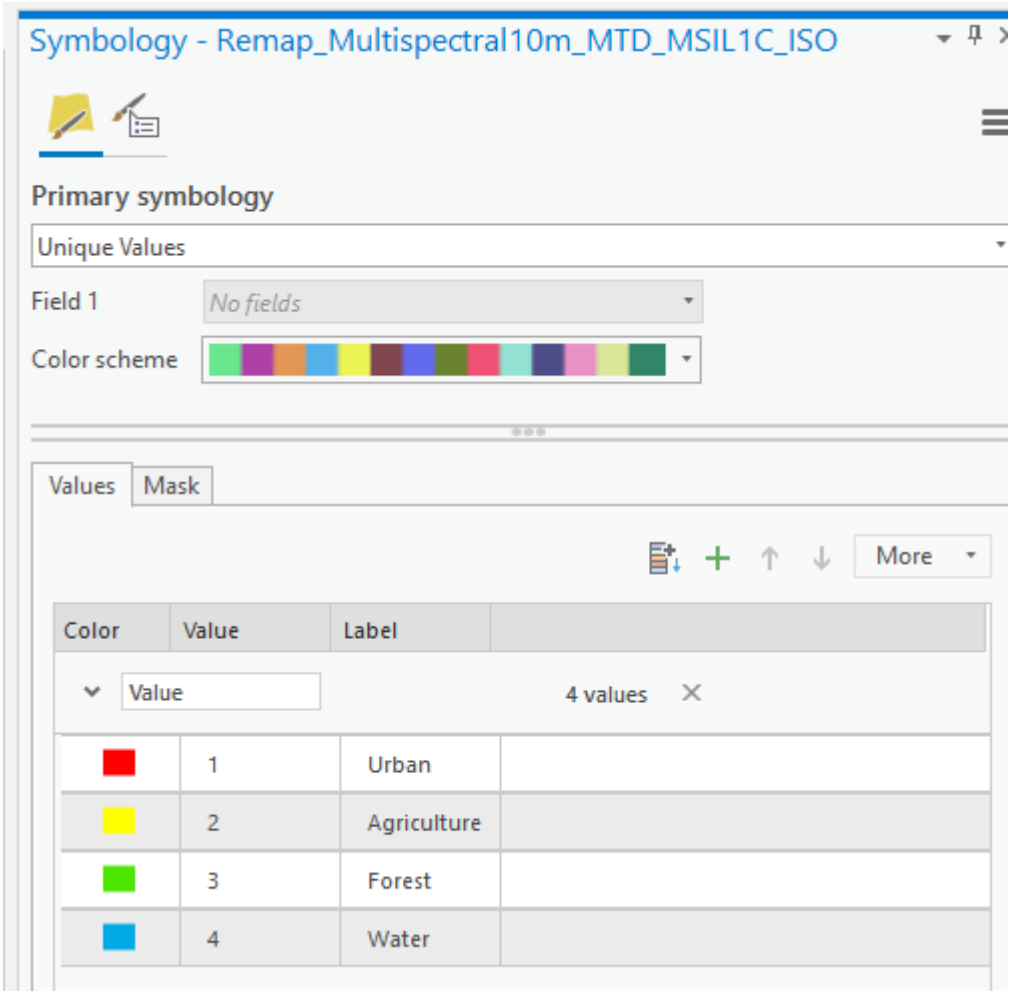


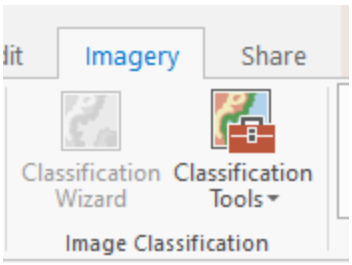
You can now explore the ISO image to determine what each class represents.

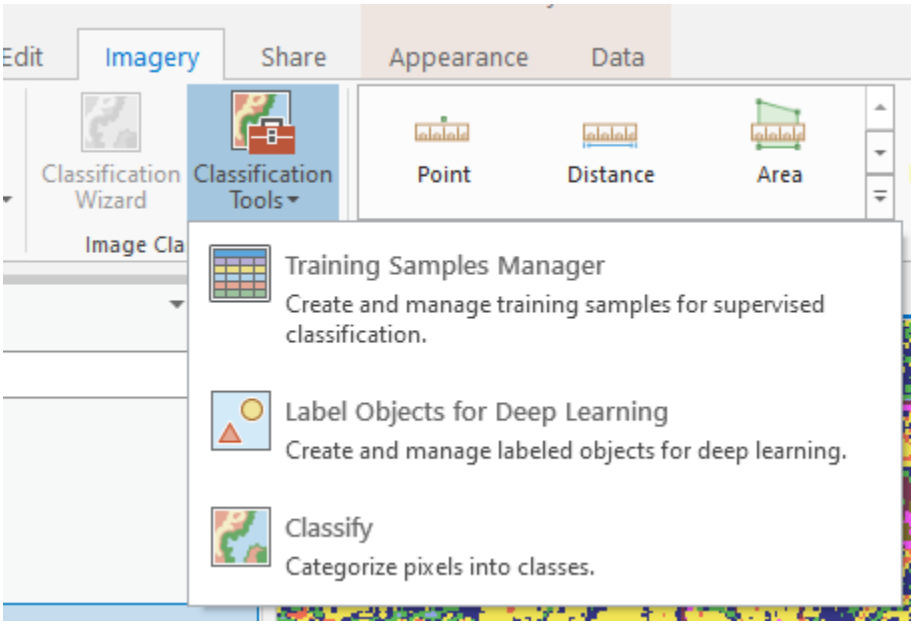
Next you will Remap the ten classes in the ISODATA classified image to the four shown at the introduction of this laboratory. Using Analysis>Tools>Raster Functions.

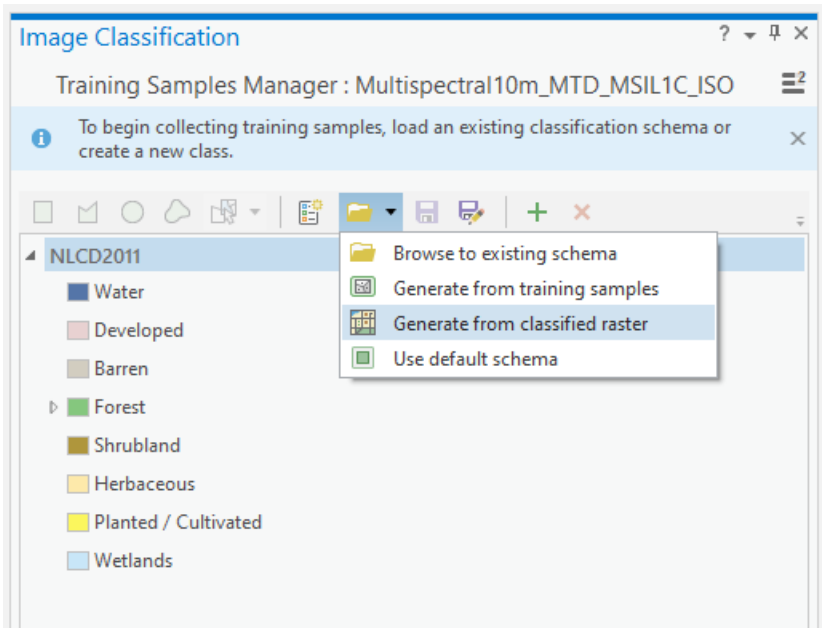












Deliverable:
Provide a map in PDF format of your results. The map can be 8.5x11inches (page) or 11x17 inches (tabloid). The map must have the classification and a table of the areas of each class and a % of the total area. You must have this table ON the map with the proper calculations for area. You are not allowed to list the total number of pixels. It MUST be in area units (e.g., hectares, acres, square miles).

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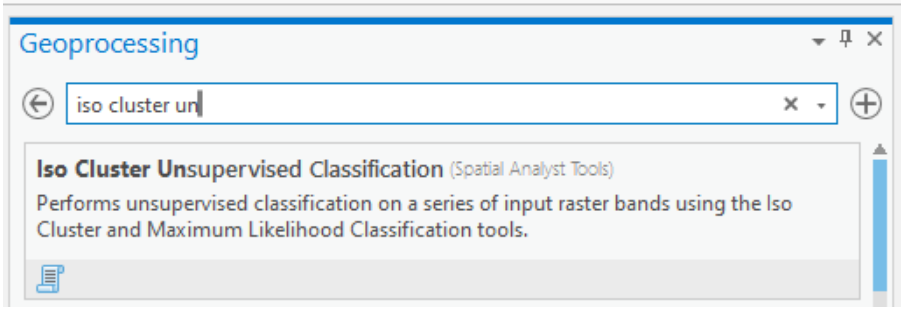

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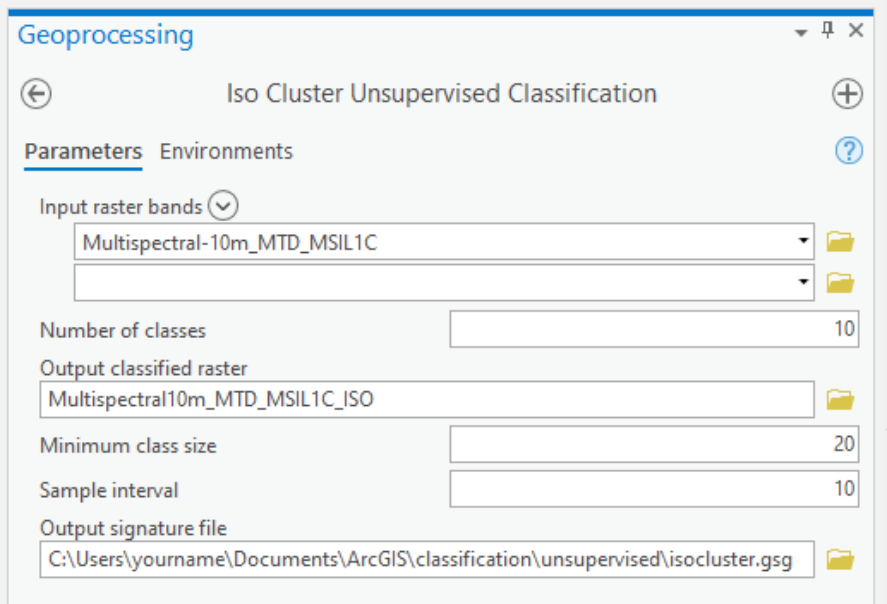

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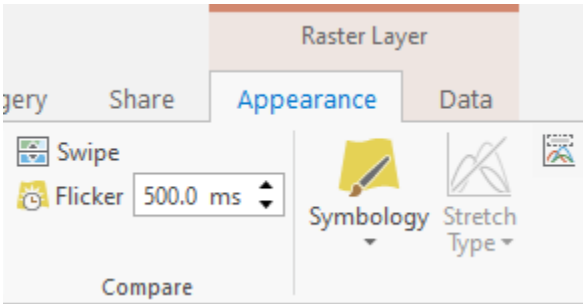

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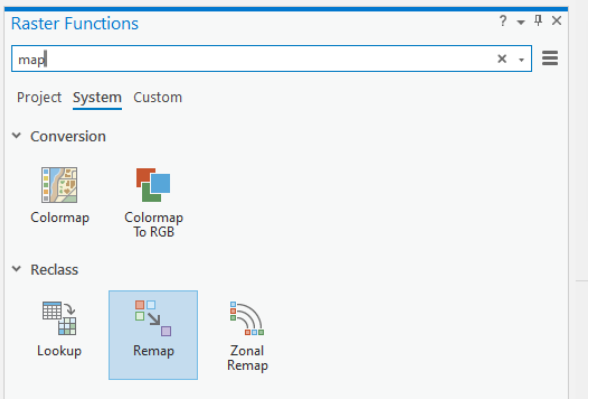

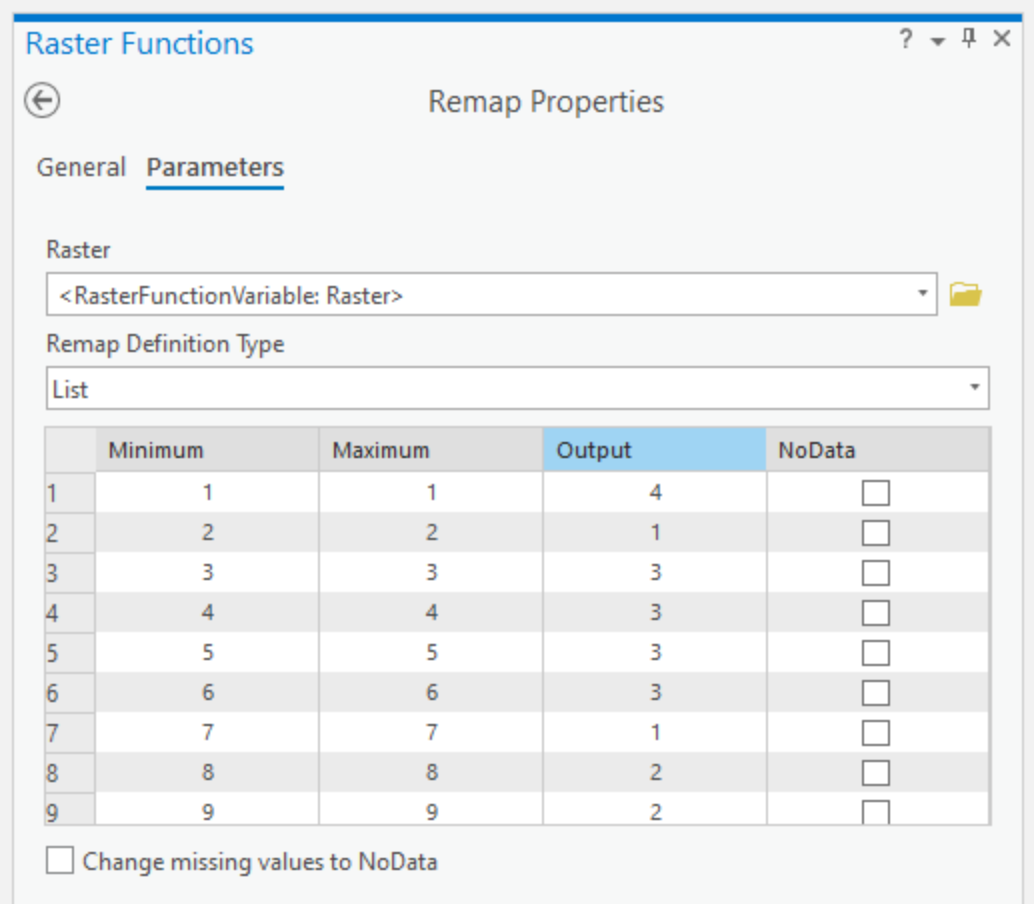

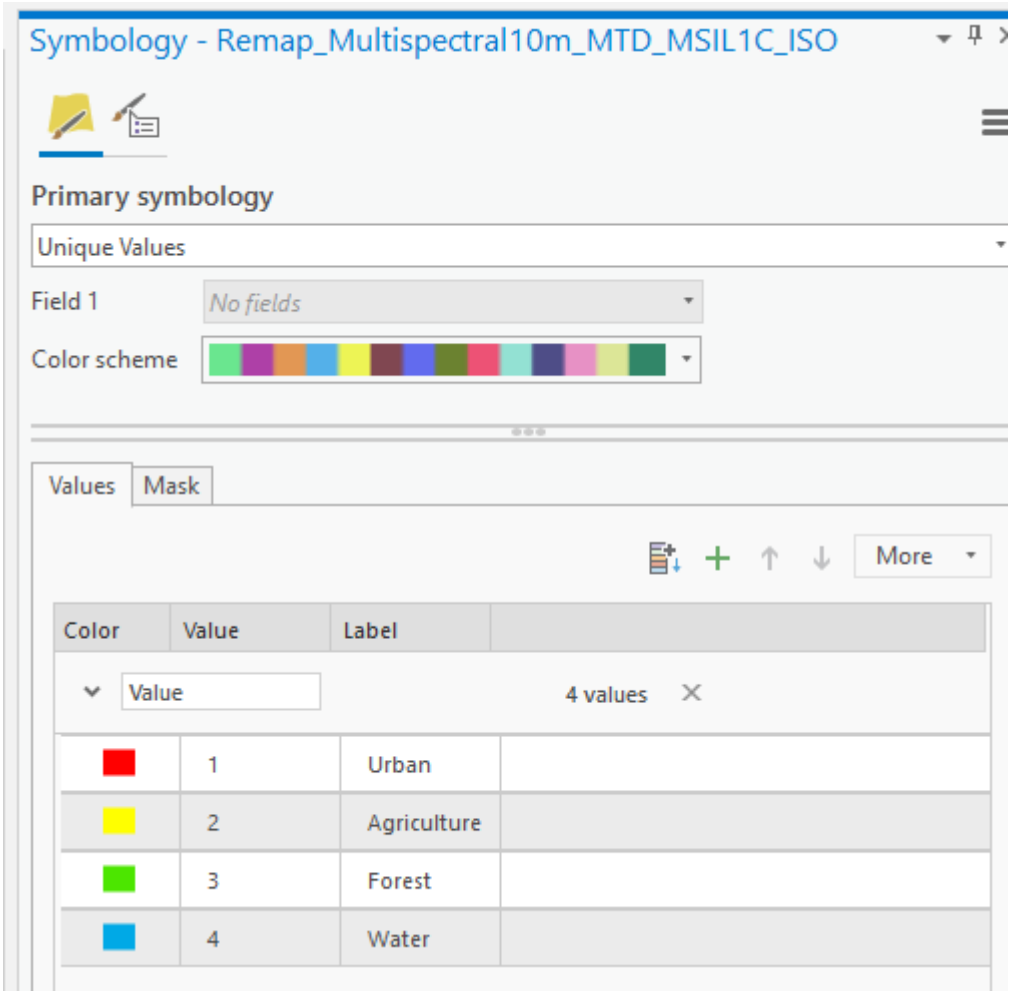

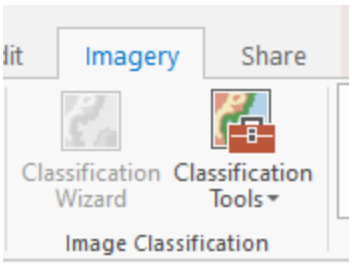

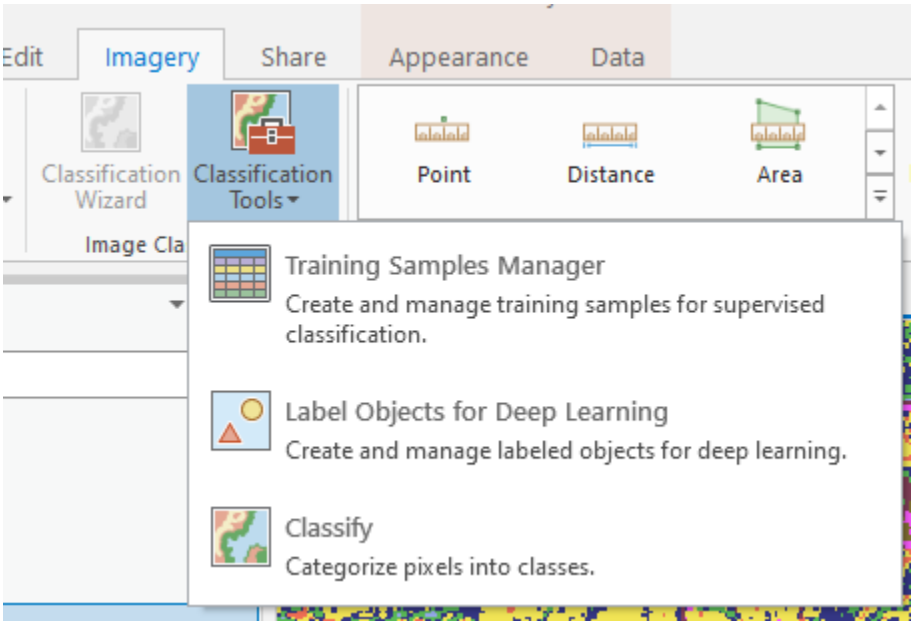

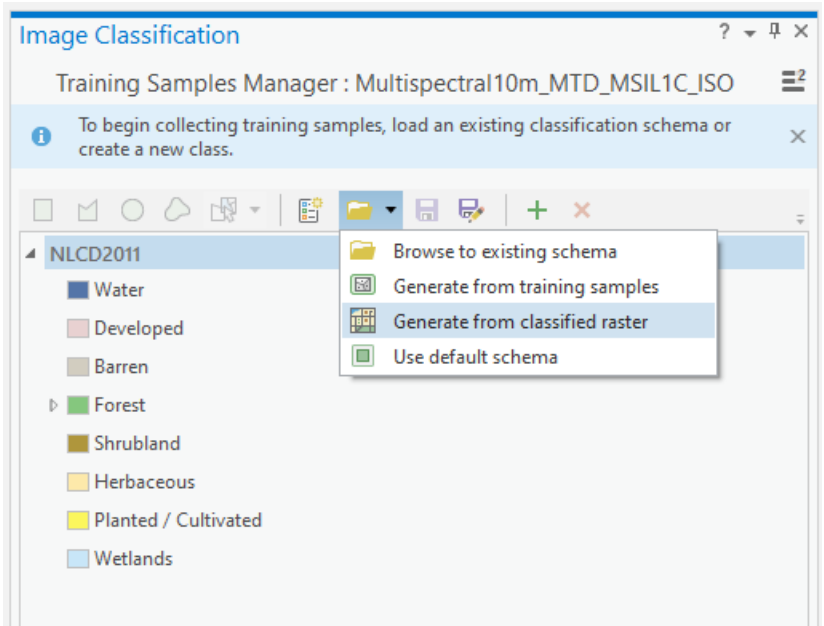

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