GST 105: Introduction to Remote Sensing Lab Series

Lab 5.1: Unsupervised Classification

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Introduction

The unsupervised classification method is one of the two commonly used "traditional" image classification routines. This method (and the supervised classification) is often used with medium (> 20m) and coarse (> 1km) resolution multispectral remotely sensed imagery. More commonly, the unsupervised and supervised classification methods are used together to form a hybrid image classification process to categorize pixels into land cover or land use types.

Your instructor may require that you provide screen captures, exported files and/or responses to review exercises. The review exercises included throughout the lab can also be found in the Review Exercises section. Please check with your instructor for the requirements specific to your class.

The **Spatial Analyst** Extension must be activated to use the Image Classification toolbar and the other image classification related tools found in the Spatial Analyst toolbox.

Objective: Perform an Unsupervised Classification

Students will be introduced to the unsupervised classification method (**IsoCluster Unsupervised Classification**) and the **Image Classification** toolbar.

A simple classification scheme will be used for the lab:

1. Water
2. Agriculture
3. Fallow
4. Grassland
5. Forest
6. Urban
7. Barren

Lab Settings

Required Virtual Machines and Applications

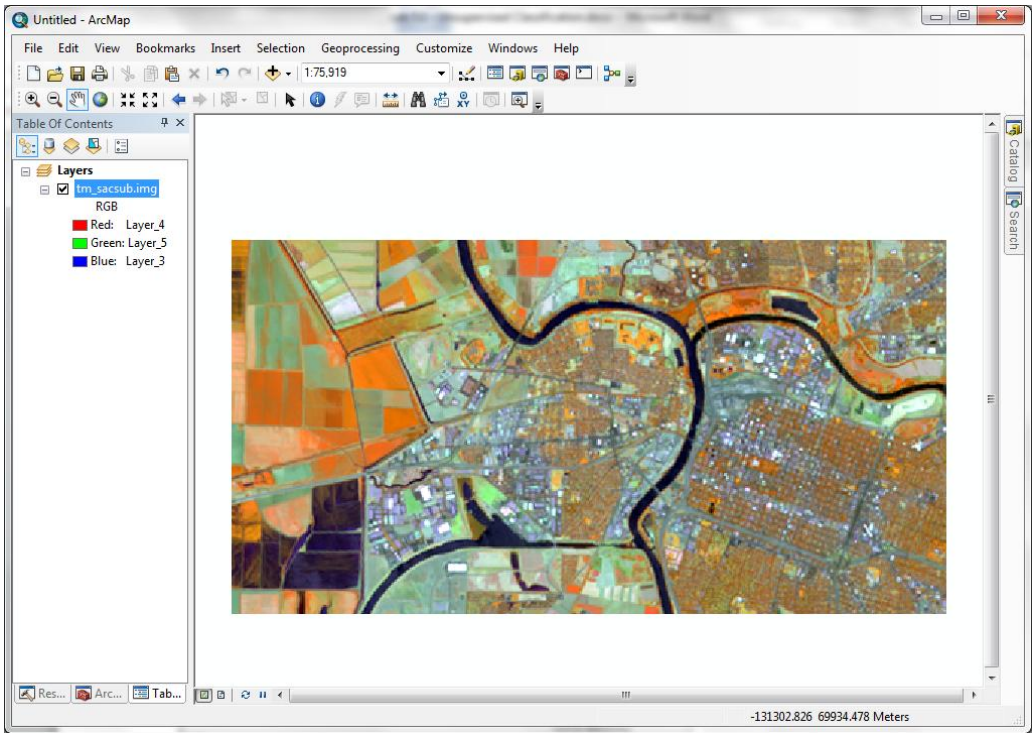
Windows Machine User Account	Train
Windows Machine User Password	Train1ng$

The image to be classified, **tm_sacsub.img** is available in the ***/Lab 5*** folder.

1 Load the Image to Classify and the Classification Toolbar

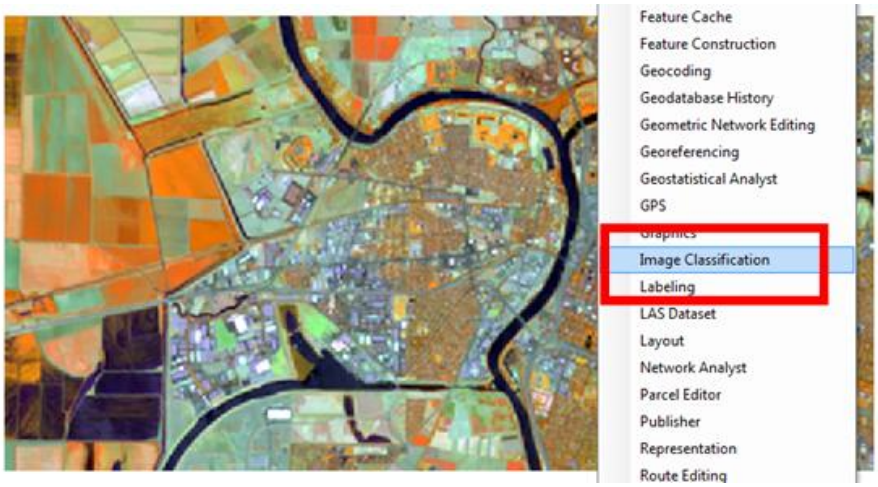
1. Log into the computer, using the information provided in the Lab Settings section.
2. Load the **tm_sacsub.img** image into ArcMap. Change the band combination of the R, G, and B color display planes to the values shown in the table below.

Color Display Plane	Band
Red	Band 4
Green	Band 5
Blue	Band 3

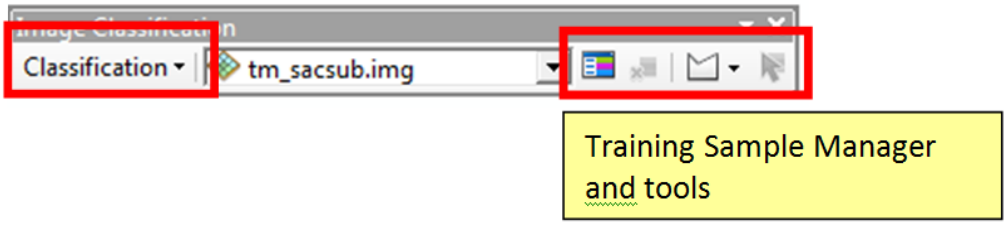


The Image Classification Toolbar is used for image classification and creating spectral signatures (Training Sample Manager).

3. Load the **Image Classification** toolbar by right-clicking in the toolbar area and choosing Image Classification.

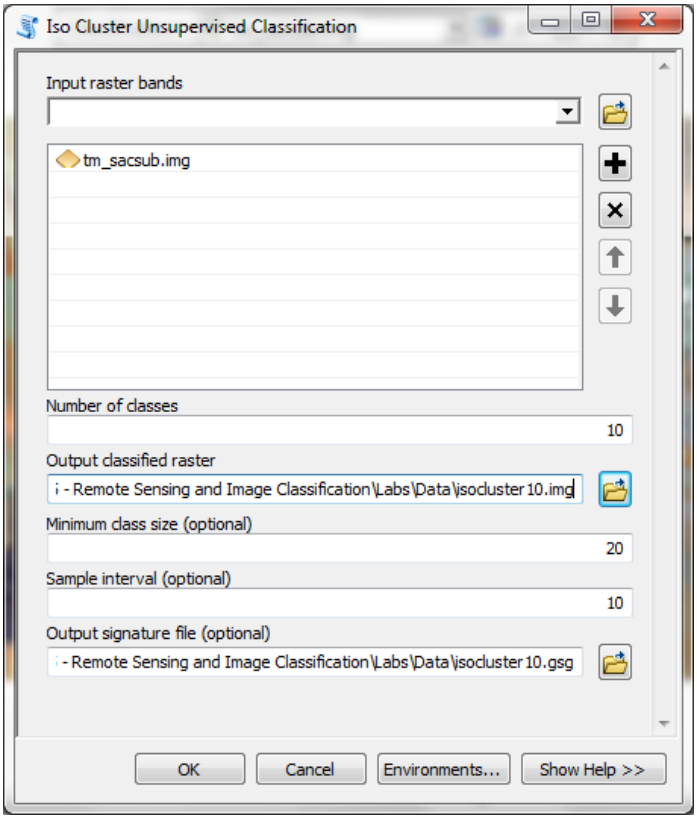


The Image Classification toolbar is shown below.



2 Perform a 10 Class Unsupervised Classification

1. Select **IsoCluster Unsupervised Classification** from the dropdown menu on the Image Classification toolbar.
2. Fill in the following parameters:
   a. Input Image: **tm_sacsub**
   b. Number of Classes: **10**
   c. Output Image: **Lab 5\isocluster10.img** (put the output raster in the *Lab 5* folder for the unit). Use the **.img** extension (ERDAS Imagine) format.
   d. Output Signature File: **Lab 5\isocluster10.gsg** (.gsg is the spectral signature file extension)
   e. The default values will be used for the remaining items.

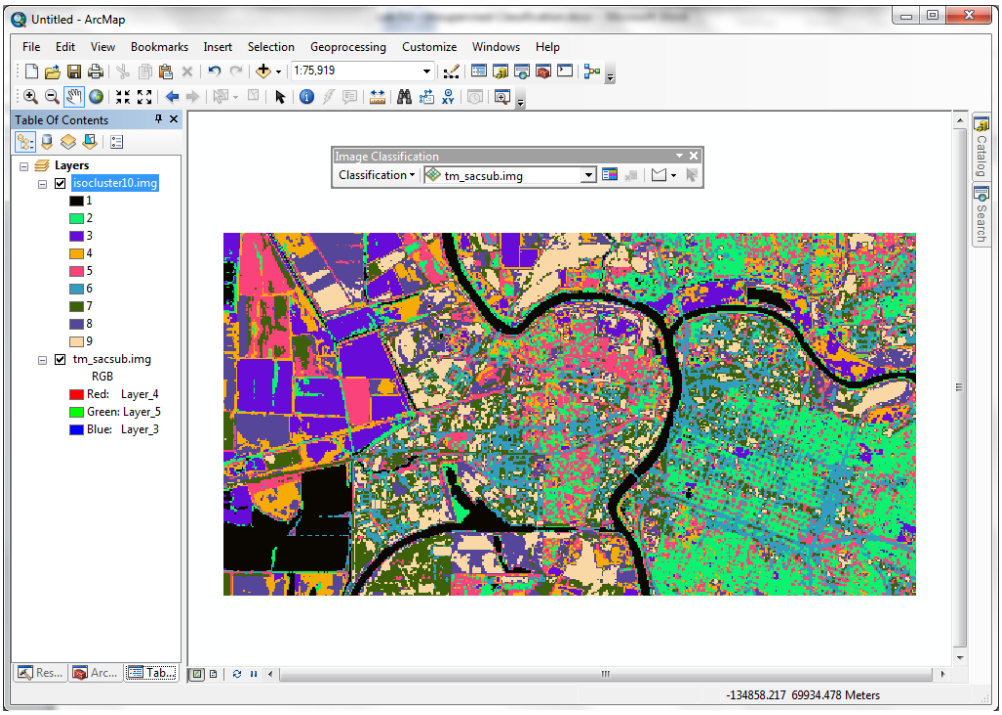


3. Click **OK**.

- The process will take only a few seconds to process, since the image is very small. For larger images, this process can take much longer.

- The result should be added to the Table of Contents and look something like the image below. The colors may be different.

- The spectral signature file will be located in the folder chosen in the Iso Cluster routine. This is a text file and can be opened in a text editor.



Exercise A: *H*ow many classes are created in the output?

Exercise B: *Read the ArcGIS Help on the Iso Cluster Unsupervised Classification routine and then provide definitions for the following terms:*

1. *Minimum Class size*
2. *Sample Interval*

Exercise C: *What is the recommended minimum class size?*

Exercise D: *How many bands are considered when running the Iso Cluster Unsupervised Classification method?*

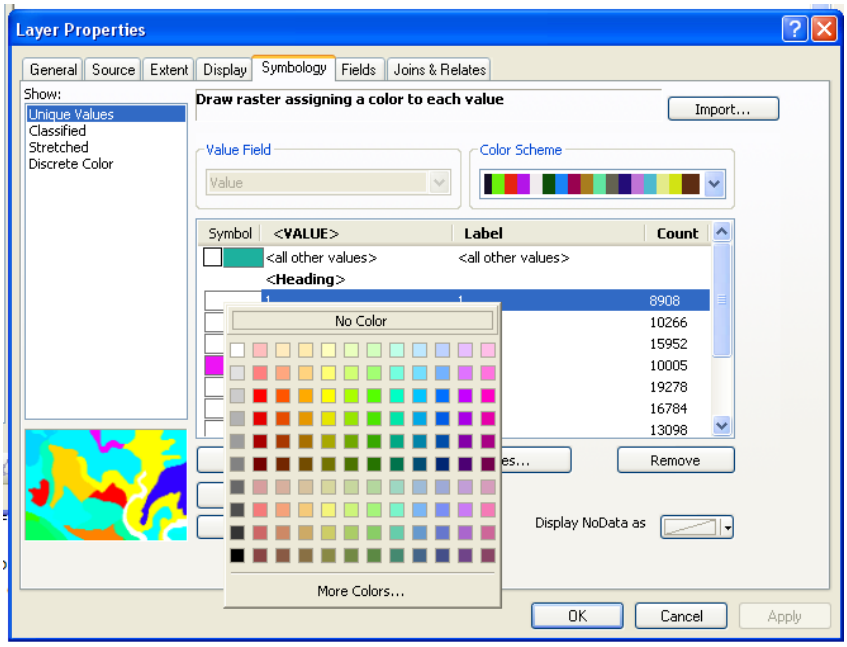
3 Interpret the Results

The resulting image (and optional spectral signature file) from the previous task should be reviewed to determine next steps for the classification process.

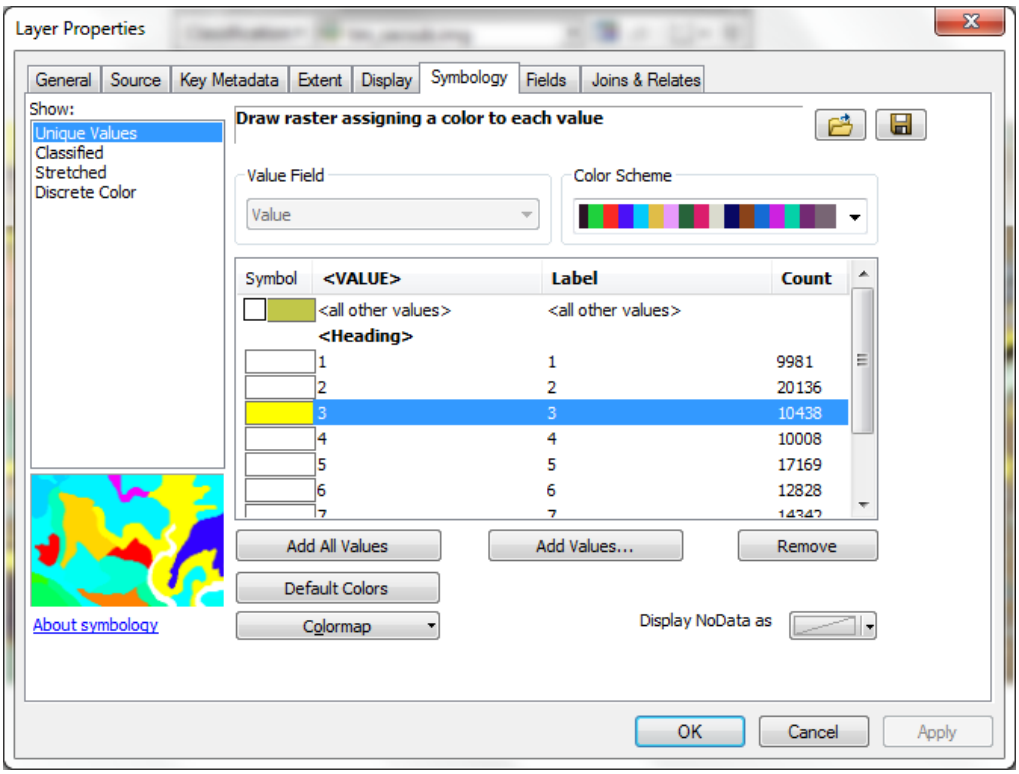
3.1 Review the Unsupervised Classification Image

The resulting image (which represents spectral classes) was created without much involvement. The next steps involve making sense of the result. Generally, some of the spectral classes might make sense, but others are likely a mix of cover types. Normally, some field work would be conducted or other data is available to help make some determinations in land cover types. In addition, some manual processes to change groups of pixels should be expected. The interpretation and revision of the results are often involved and can easily take weeks or months of time, not just days. The following includes steps you would take to refine the classification.

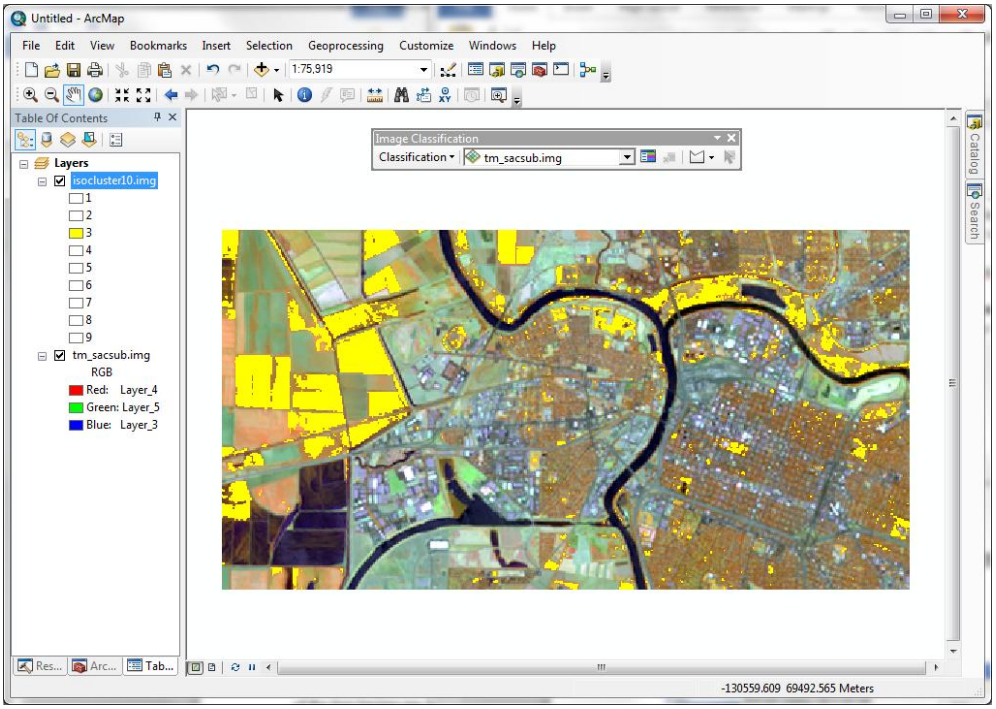
1. Look at the obvious, for example, water is often represented as a single class or maybe two classes. (Class 1, in this output). Is the water found in areas you would expect?
2. Review specific classes. One approach can be to "hide" all classes except one to get a better idea of what that spectral class represents.
    a. Right-click on the image dataset and then click **Properties**.
    b. Select the **Symbology** tab of the classified image and assign "**No Color**" to all of the classes except one. Do this by double-clicking on the color for a respective class and selecting "No Color." To see a spectral class, change the color so that it can easily be seen on the image (for example, yellow).



See below that all of the spectral classes have "No Color" except, Spectral Class 3.

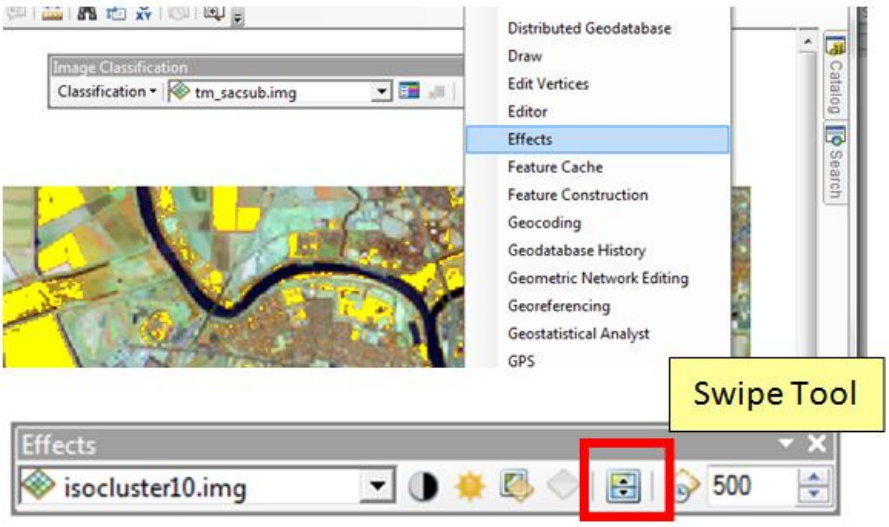


Shown below is spectral class 3 shown in yellow. All of the other spectral classes' colors have been set to “No Color.”



3. Review different parts of the image to determine if a single land cover type can be assigned or if more than one land cover type represents the spectral class. You may need to pan and zoom and turn the image classification on or off.

4. Another tool that can be used to help review and determine what land cover types are represented in the unsupervised classification is the **Swipe** tool. Recall that this can be found on the **Effects** toolbar. Load the Effects toolbar in a similar manner as you did with loading the Image Classification toolbar.



The Swipe tool is shown in the image below where it is being used to "hide" the spectral class shown in yellow. Remember, the other spectral classes are not being shown because they are turned off (that is, "No Color" was chosen in the Symbology tab). The Swipe tool can be used to quickly show/hide the unsupervised classification on top of the raw image data.

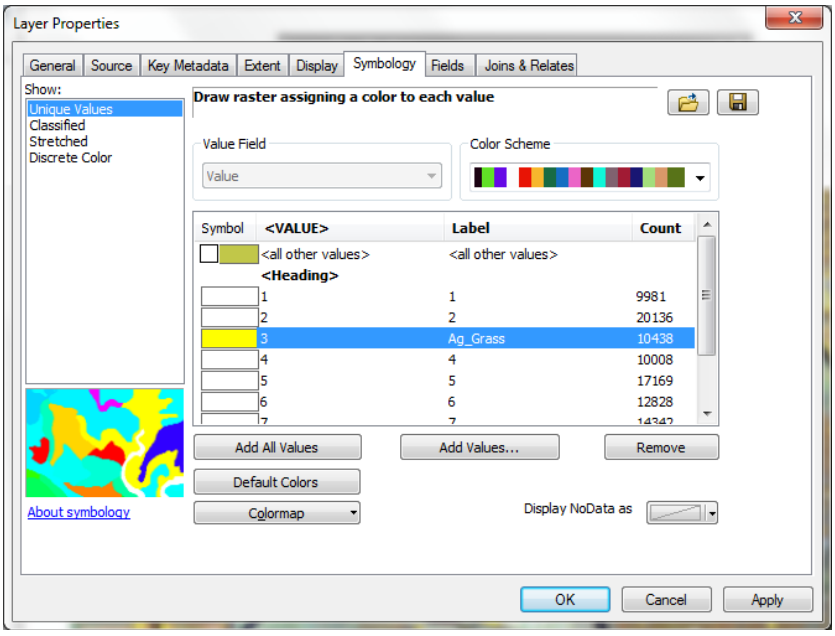
Most of the Spectral Class 3 falls on the west side of the image (in and around West Sacramento; Sacramento is on the east side) are likely agriculture fields; however, some pixels in class 3 fall around the center part of Sacramento (actually a park) and on the north side of the American River and are likely not agriculture fields.

When an image analyst is evaluating and trying to determine the land cover types in an unsupervised classification, it can be useful to label the spectral classes to prospective land cover types.

Most of the spectral classes will not represent a single land cover class. This is because a human creates the land cover classification scheme whereas the unsupervised classification is categorizing pixels into similar spectral groups (which may or may not relate to specific land cover types).

Since the land cover types are not known when the unsupervised classification is completed, additional work and investigation is required to refine the spectral classes into specific land cover types. To make a "first attempt" at determining the land cover types, the analyst can label possible land cover types for each spectral class.

5. For Spectral Class 3, since this category seems to represent Agriculture and Grassland cover types, this spectral class can be labeled **Ag_Grass**. To label the class, double-click on the **isocluster10.img** image to bring up the Symbology tab, click on the label for class 3, and change the name.



6. The other classes can be assigned in a similar fashion. Use the methods above to turn on/off other layers and review the geographic extent to determine if one or more land cover types make up the spectral class. Assign a meaningful name for each spectral class. This process can be time consuming and often takes some serious review, visual analysis, consultation of "ancillary" or reference data and often fieldwork.
7. To get more practice, work on some of the other classes using the same methods to label the spectral classes at this point.

Additional ancillary information may be needed in order to complete this exercise. Students not familiar with the Sacramento area can use Google Maps or Google Earth to review high-resolution image data that can help assign the spectral classes to prospective land cover types.

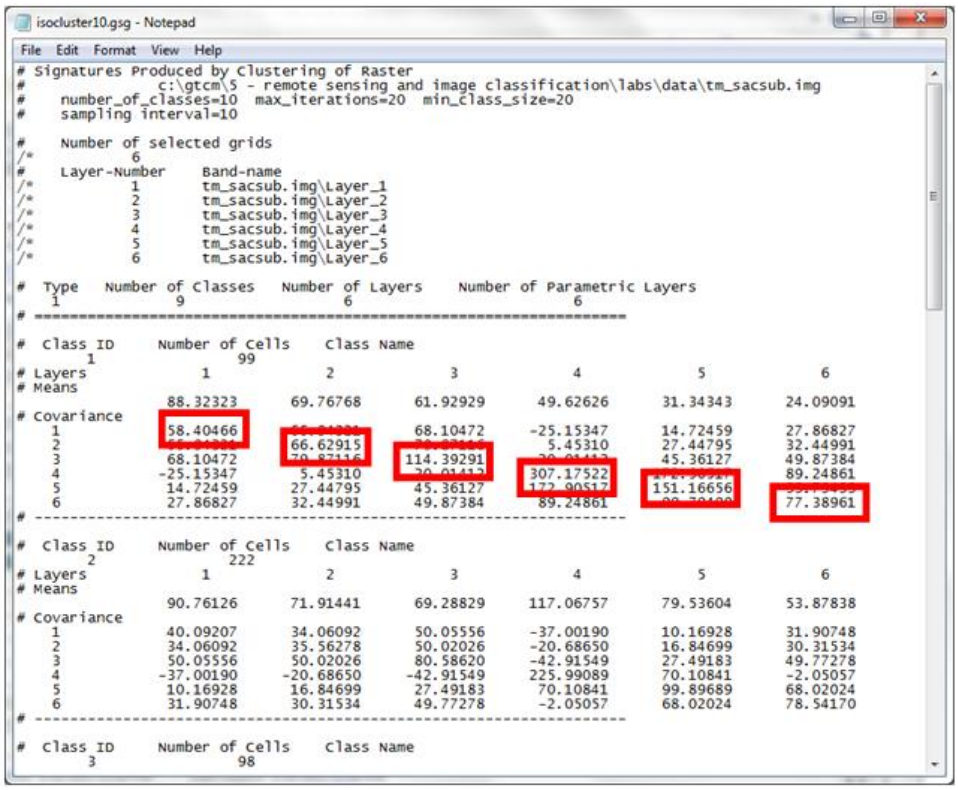
Exercise E: *Provide a list of land cover types assigned to the isocluster10.img file.*

Exercise F: *Briefly summarize the observations discovered when assigning the spectral classes to the information classes.*

3.2 Review the Spectral Signature File

Another task to perform once the unsupervised classification is complete, is to review the spectral signature file (if one was created during the classification process).

1. The spectral signature file can be opened in a text editor. NOTE: You may have to associate the **.GSG** extension with a text editor (e.g. Notepad).



The spectral signature file can be reviewed to see the signature statistics for each of the spectral classes that were created from the unsupervised classification process.

2. The spectral signature file shows a Class ID (the spectral class number, which are unknown cover types at this point), the means for each set of pixels that make up the spectral class and an associated covariance matrix. Locate and review the Class ID information in your spectral signature file.

3. The covariance matrix is a set of values that compare how similar or different the pixel values that make up the spectral class are between the image bands. The diagonal values shown above represent the variance for a set of pixels for the specific band number. Large values indicate that the pixel values are different; small variance values indicate that the pixels values that make up the spectral class are similar (or are homogeneous). Locate and review the covariance matrix in your spectral signature file.

The spectral signature file can be used in conjunction with reviewing different spectral classes within the image to help determine what other steps might need to be taken to make further refinements on the image classification. The spectral signature file may help determine that a different unsupervised classification is needed that contains a larger number of spectral classes to be created. The spectral signature file may also provide some insight on how similar or different some spectral classes are from one another and provide some insight where the individual spectral classes need to be merged. The spectral differences between some cover types may not be large enough to separate out or identify one of the unique land cover types in the classification scheme.

One important use of the spectral signature file from the unsupervised classification process is that it can be used with a signature file created from the Training Sample Manager, which is often used in the supervised classification process. Although this lab does not address this, creating a spectral signature file from the unsupervised classification method can be useful in some image classification procedures

4 Perform a 15 Class Unsupervised Classification

1. Perform another unsupervised classification by following the steps in Task 2, but this time, use 15 classes instead of 10.
2. Save this to a new ERDAS Imagine format file.
3. Assign land cover classes in the same manner shown in Task 3.

Exercise G: *Briefly describe your observations of assigning land cover types to the spectral classes.*

Exercise H: *Compare the two image classification results (after the land cover types have been assigned). Assign useful colors to each classified image and provide screenshots of each of your colorized image classifications. Use the first land cover type to assign a color if you have multiple land cover labels for a single spectral class. Describe some of the similarities and differences. Do you think either resulting image classification is better than the other is? Describe.*

Conclusion

This completes the unsupervised classification process. Students have learned how to implement the unsupervised classification as well as observe some of the issues and additional work that is required to refine and improve the unsupervised classification.

Review Exercises

The review exercises included throughout the lab are listed in this section. You may click the name of each exercise to link to the exercise's location within the lab.

Exercise A: How many classes are created in the output?

Exercise B: *Read the ArcGIS Help on the Iso Cluster Unsupervised Classification routine and then provide definitions for the following terms:*

1. *Minimum Class size*
2. *Sample Interval*

Exercise C: *What is the recommended minimum class size?*

Exercise D: *How many bands are considered when running the Iso Cluster Unsupervised Classification method?*

Exercise E: *Provide a list of land cover types assigned to the isocluster10.img file.*

Exercise F: *Briefly summarize the observations discovered when assigning the spectral classes to the information classes.*

Exercise G: *Briefly describe your observations of assigning land cover types to the spectral classes.*

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