Land Cover Classifications by Using ASTER Data

Introduction

Remote Sensing (RS) is a valuable tool used by people in many fields in an effort to better understand the world around them.

Land cover classification is one of the most important and typical applications of remote sensing data. Land cover corresponds to the physical condition of the ground surface, for example, forest, grassland, concrete pavement etc., while land use reflects human activities such as the use of the land, for example, industrial zones, residential zones, agricultural fields etc.

Classification is the process where pixels are grouped according to the similarities in their spectral properties, that is, the range and distribution of reflected electromagnetic radiation captured by the sensor. If a pixel satisfies a certain set of criteria, then the pixel is assigned to the class that corresponds to that criteria.

There are many different classification methodologies; the strategy that is adopted depends on the resources, type of ground truth and goals of the project.

There are two ways to classify pixels into different categories:
• supervised
• unsupervised

Supervised vs. Unsupervised Classification

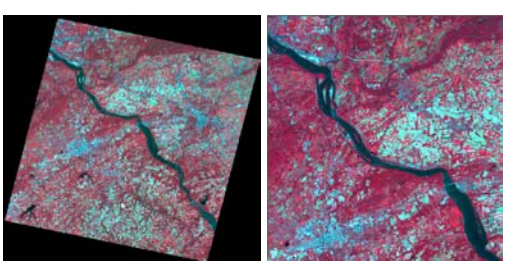
Supervised classification is more closely controlled by the user than unsupervised classification. In this process, you select pixels that represent patterns you recognize or that you can identify with help from other sources. Knowledge of the data, the classes desired, and the algorithm to be used are specified before you begin selecting training samples.

By identifying patterns in the imagery, you can train the computer system to identify pixels with similar characteristics. By setting priorities to these classes, you supervise the classification of pixels as they are assigned to a class value. If the classification is accurate, then each resulting class corresponds to a pattern that you originally identified.

Unsupervised classification is more computer-automated. It allows you to specify parameters that the computer uses as guidelines to uncover statistical patterns in the data.

In this exercise, you will perform both a supervised and an unsupervised classification of the same image file.

Data to be used in this exercise is ASTER L1B data of East Pennsylvania, York city and Lancaster City area (UTM zone 18). The data has been imported as ERDAS Imagine file format and is in UTM projection with datum of WGS84. We'll use subset image as input in the exercise for quick return.



3N, 2, 1in RGB

4, 3N, and 1

NLCD 2001 data can be used to evaluate your result (or not). The Land Cover class key will be provided.

Perform Supervised Classification

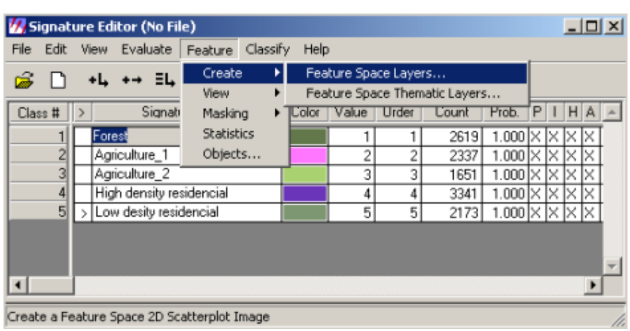
You perform the following operations in this section:
• define signatures
• evaluate signatures
• process a supervised classification

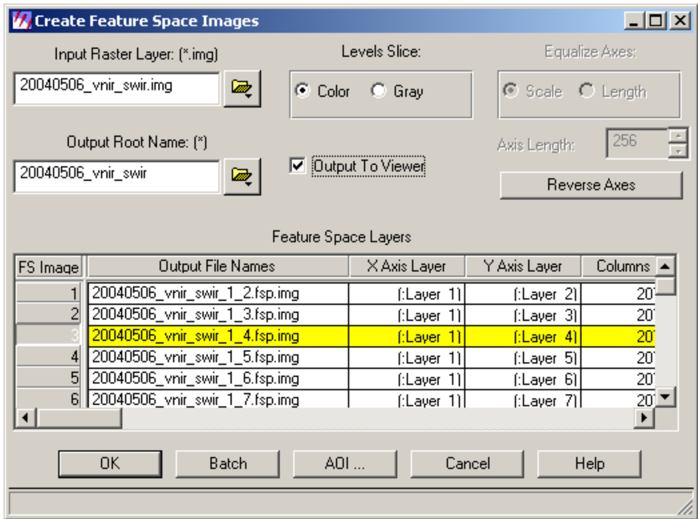
Suggested Land Cover Classes (you can name your classes):
Water Body
Agriculture_1
Agriculture_2
High Density Residential
Low Density Residential
Forest
Wetlands

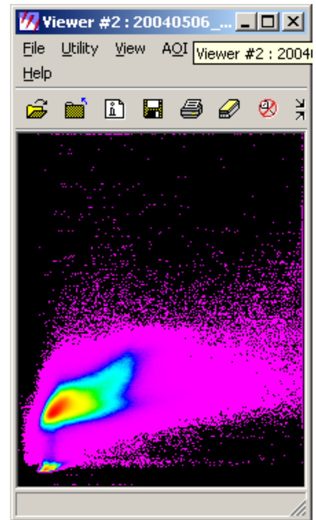
Steps (Outline):

Note: Please reference detailed step by step procedure from **http://support.erdas.com/documentation/files/85TourGuide.pdf** page 455 - 502 (Chapter 17).

1. Display and examine the images (three telescope, 15m, 30m, and 90m), 20040506_vnir_swir.img includes total of 9 bands in 15m resolution. **20040506_vnir_swir.img** is used in the example.
2. Use Signature Editor to define signatures --- start it from “Classifier” →”Signature Editor”
    a. use AOI tools collect signature --- draw polygons, add to signature editor use +L button,
    b. use seed growth tool (*seed growth neighbor 10000 pixels set for this exercise*) to collect signature--- select neighborhood options, create an AOI,
    c. arrange layers--- take out AOI layer,
    d. create feature space image, (used 1, 4 bands)

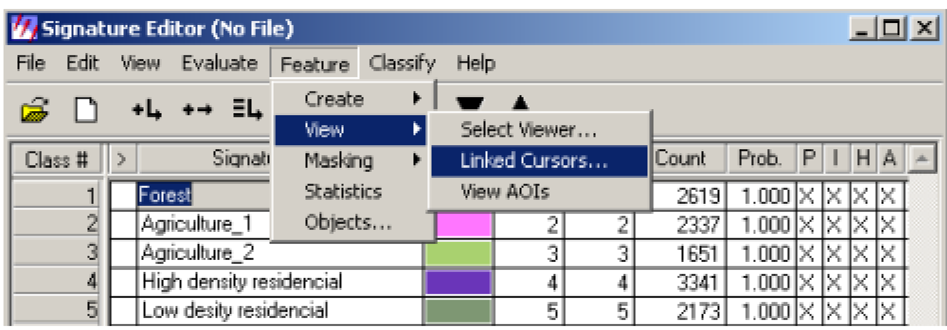


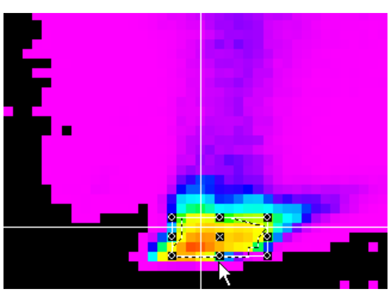




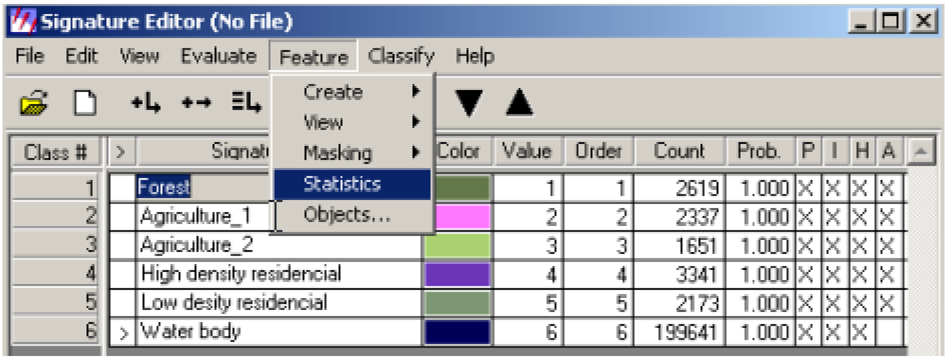
Layer one and four of the 20040506_vnir_swir.img are selected because water is spectrally distinct in this band combination.

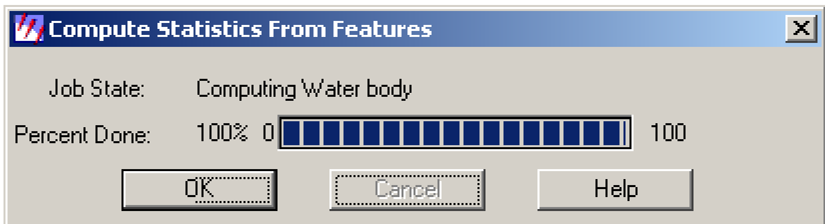
e. link cursors in Image/feature space,





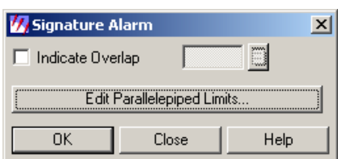
f. define feature space signature

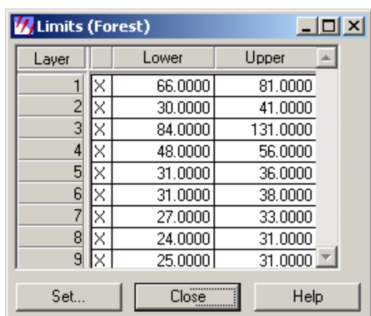


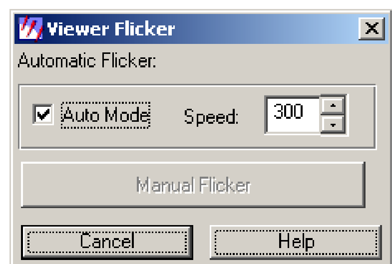


Save your signature file.

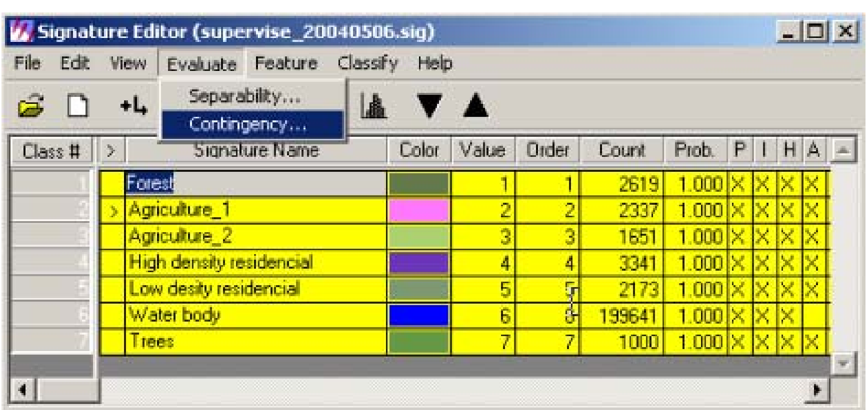
3. Evaluate signature using set alarms from Signature Editor “View” →”Image Alarm”,

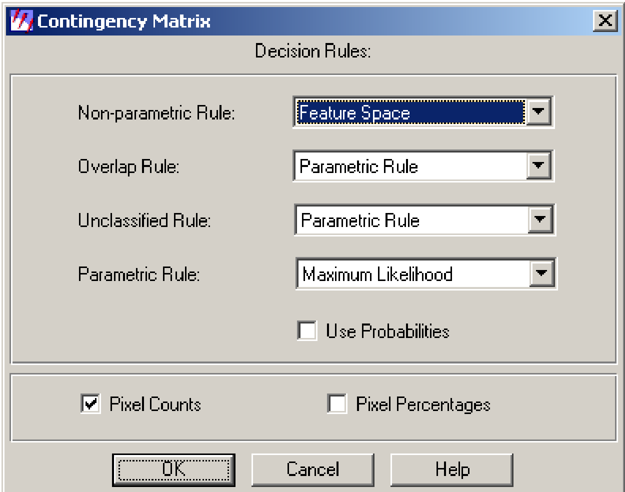






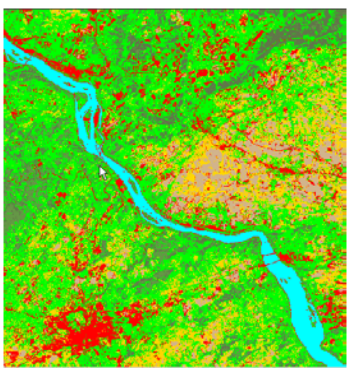
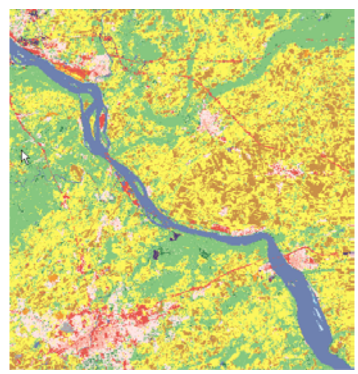
evaluate contingency





4. Summary report
5. Create distance image
6. Classify image

   Either "classify" the image from Signature Editor click "Classify" → "Supervised" or from ERDAS Main Manu bar "Classifier" → "Supervised Classification"

 the result without using distance image, 

Perform Unsupervised Classification:

In unsupervised classification (also known as clustering), the computer groups together pixels having similar spectral properties into distinct classes. Only the spectral characteristics of the pixels are used in defining their class membership. The process of clustering is often performed using an algorithm called ***ISODATA*** (Iterative Self-Organizing Data Analysis Technique).

In the ISODATA method, clustering is done whereby the computer selects initial classes based on statistics, classifies the pixels, and then modifies the criteria for each class. This process repeats iteratively until the spectral distances between classes are maximized.

In supervised classification the image analyst selects pixels that represent patterns or land cover features that are recognizable or that can be identified with help from other sources. You then instruct the computer to place these pixels, and ones with similar characteristics, into a classification.

Each class defined in either supervised or unsupervised classification will have a spectral "signature" associated with it. The signature assigned to each class is based on the statistics of the pixels that are in the cluster (unsupervised) or in the training sample (supervised). It uses the mean and covariance of those pixels in multispectal space.

Classification decision rules

A decision rule is a mathematical algorithm that is used to put pixels into distinct classes once the signature for each class has been decided upon. When using parametric signatures the mean and covariance of every pixel in the data file is used and so every pixel in the file is assigned to a class. With non-parametric signatures, the decision rule must decide whether or not a pixel is located inside the signature boundary.

For your assignment…

Create a classified image using the ISODATA unsupervised classification

Unsupervised classification
Data source: ASTER image *20040506_vnir_swir.img*
In *Classifier* (on the Icon Panel), select *Unsupervised Classification…* Set the parameters as follows:

Input Raster File: 20040506_vnir_swir.img
Output Cluster Layer: 20040506_iso.img (set path to your home directory)
Output Signature Set: Off (uncheck box)
Initialize from Statistics: On
Number of Classes: 20 (or set numbers depends on your experience)
Color scheme options: approximate true color
Maximum Iterations: 10 (or set numbers depends on your experience)

The *Maximum Iterations* is the maximum number of times that the ISODATA algorithm will re-cluster the data. Its function/purpose is to prevent the algorithm from running too long (or potentially being stuck in an infinite cycle, therefore being unable to reach the convergence threshold).

Convergence Threshold: 0.950
Click on 'OK' to run

Evaluate classification
Display *20040506_vnir_swir.img* with either the default color assignment or with RGB (4,3N, 1), later color combination seems to show more variety in color and saturation, and therefore is better for visual interpretation.

Add *20040506_iso.img* to the same viewer (make sure you uncheck the option *Clear Display*). Now check the image information of *20040506_iso.img*. Notice that it is of *Thematic* type – so that the pixels' DNs represent categories, instead of variation in physical parameters.

By *Raster/Attributes*… we can access the attribute table that stores information about the categories. In the *Raster Attribute Editor* choose *Edit/Column Properties*… Arrange *Columns* so that the first four columns are *Color, Histogram, Opacity, and Class Names* …

Now we'll examine individual classes and find out what types of ground features they represent. First, make all categories transparent: select column *Opacity* by left clicking on the column header. Then right-click on column *Opacity*, choose *Formula…,* type 0 in the dialog box *Formula*: that has popped up, click *Apply*. All categories now become transparent, so you can see the source image – *20040506_vnir_swir.img* in the Viewer window.

Select first record, right-click on the column *Color* cell of *Class 1*; pick a distinguishable color – for example yellow. Then change its opacity from 0 to 1. What ground features do you think class 1 (yellow in the image) represents? Change the class name from *Class 1* to an appropriate class name, then change color to some other more representative color for this type of ground feature.

Apply this procedure to the next category. Again, first pick a distinguishable color, change the opacity, and notice where the pixels are located. Then find out the feature they represent. To do this you may need to turn the category on and off several times (set *Opacity* to 1 to make the category opaque, 0 to transparent). (If other existing categories visually interfere with the current one, you can temporarily make other existing categories transparent too). Also, you can make any category partially transparent (for example, set opacity to 0.5) – the resulting color will be the combination of the category color and the pixel colors of the source image. Don't forget to save attributes often.

Discipline Exercise Presentations

Please reflect on the overall land cover classification results and share your thoughts.

Which of the 2 methods do you think produces the best results?

How would you refine your final land cover classification image?

What in your opinion are the limitations and issues involved in using ASTER data in land cover classification?