

## Lab 9 Unsupervised Classification

Utilizes Textbook's Remote Sensing Digital Database: Chapter 3 data.

The objectives of this lab are to learn about unsupervised classification techniques, including naming classes, combining classes, converting the raster thematic map to a GIS shapefile, and the importance of apply a mask to improve your classification map. The tasks are done with tools in the **ENVI Toolbox**.

Two digital files are to be uploaded to the instructor and five questions are to be answered on the last page of this handout.

### 1) Unsupervised Classification

We will return to the Exumas Islands in the Bahamas where in Lab 4 we created a Mask to eliminate the impact of water on our image processing of the islands. We want to use the spectral characteristics of the six Landsat VNIR-SWIR bands to generate an unsupervised classification map of the islands.

Unsupervised classification uses the computer program to cluster the pixels into natural groupings based on the spectral characteristics of the pixels with no direction from the analyst, except for setting basic parameters such as number of classes, number of iterations performed by the program, and minimum number of pixels per class. The analyst leverages his/her experience and knowledge about the features being classified so a land use/land cover name can be attached to each class and classes can be combined. Unsupervised classification is a very fast way to evaluate the spectral richness and mapping potential of your multispectral or hyperspectral data.

The textbook Chapter 9 has an extensive discussion on unsupervised classification.

The multispectral data is located in the "Remote Sensing Digital Database \ Ch\_3\_Landsat" folder, inside the "Plate\_9\_Bathymetry" subfolder.

1a) *Start-up* a new ENVI display. *File > Open* drive to the "Plate\_9\_Bathymetry" folder and *Open* the "Original\_Landsat\_Data" folder > *Select > "Exumas\_Bathy\_1984\_Landsat\_6-band\_clip\_GeoTIFF.tif"* > *Open*  
A natural color image should display (TM bands 3-2-1 as R-G-B)

*Zoom to Full Extent > Contrast stretch "Linear 2%"*

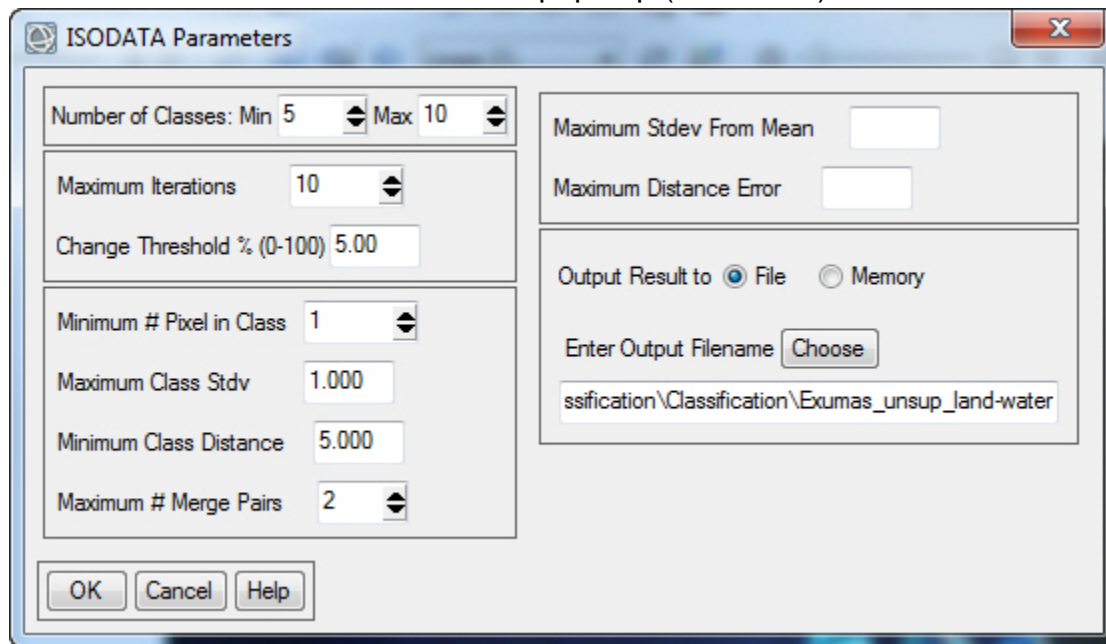
*Open* the "Data Manager" to see the six bands.

*Use* the Data Manager to display a total IR color composite (4-5-6 as R-G-B) and color IR (4-3-2 as R-G-B) > *Stretch* both "Linear 2%"

1b) We will first do an unsupervised classification on the entire 6-band scene.  
*ENVI Toolbox > Classification > Unsupervised Classification > IsoData Classification*

ISODATA unsupervised classification calculates class means evenly distributed in the data space then iteratively clusters the remaining pixels using minimum distance techniques. Each iteration recalculates means and reclassifies pixels with respect to the new means.

The Classification Input File window pops-up > *Select the 6-band clip > OK*  
 The ISODATA Parameters window pops-up (see below)



We will accept all the defaults,  
 except *change* the “Maximum Iterations” from “1” to “10”.

*Click-on **Help*** to learn what each parameter means in the ISODATA menu.  
 (this is highly recommended for class discussion in the lab)

*Name* the output file “Exumas\_unsup\_land-water” > *OK*

The ISODATA Classifier window pops-up and you will see the iteration count being posted. The classification stops at the 10<sup>th</sup> iteration.

*Examine* the classification map. Use the “Swipe” tool to compare the classification map with the color images.

Question 1: How many classes do you see on the islands?

1c) The ocean water and seafloor captured most of the classes in our map. We have generated a very poor (*unacceptable*) spectral classification map for the islands.

Remove our very poor classification map from the Data Manager.

Now we will apply the water mask that we built in Lab 4. The water mask for this scene is in the **Lab\_9\_Data** folder.

First we will load our water mask into the Layer Manager.

*File > Open > drive to the "Lab\_9\_Data" folder >*

*Select "Water\_Mask\_0-1\_Off" > Open*

The Black and White Mask is displayed.

*Use the "Cursor Value" tool to query the DN values for the black and white pixels.*

Question 2: What are the DN values for Black and White pixels in the Mask?

*ENVI Toolbox > Classification > Unsupervised Classification > IsoData Classification*

The Classification Input File window pops-up > *Select the 6-band clip*

*Click-on the "Select Mask Band"*

*Select "Mask Band" under the "Water\_Mask\_0-1\_Off" file name > OK > OK*

The ISODATA Parameters window pops-up (see picture above)

We will accept all the defaults,

*except change the "Maximum Iterations" from "1" to "10".*

*Name the output file "Exumas\_unsup\_water-masked" > OK*

The ISODATA Classifier window pops-up and you will see the iteration count being posted. The classification stops at the 10<sup>th</sup> iteration.

*Examine the classification map. Use the "Swipe" tool to compare the classification map with the color images. Y*

You may see the new classification map swiping with the B-W water mask image. Move the "Water\_Mask\_0-1\_Off" to the bottom of the files listed in the Layer Manager so that the color IR or other color image directly under the new classification will be displayed in the Swipe tool.

*Zoom-in on the larger islands.*

1d) Let's look at the statistics of this classification map.

*Right-click on the "Classes" folder in the Layer Manager >*

*Select "Statistics for All Classes" > the "Data Selection" window pops-up >*

Select our new classification map “Exumas\_unsup\_water-masked” > OK

The “Classification Statistics View” window pops-up

Question 3: A. What percentage of our classification map is unclassified (this is the area in the scene covered by our water mask)?

B. Which class on the islands has the highest percent coverage?

C. How many pixels are in the class with the highest percent coverage?

1e) Let’s evaluate the patterns on the classification map with different color image band combinations (and contrast stretches) to help us interpret the features on the map

Let’s start with the color IR image in View #2 and link the two views to help interpret the classification map. *Views > Two Vertical Views >*

*Drag the color IR image in View #2 in the Layer Manager*

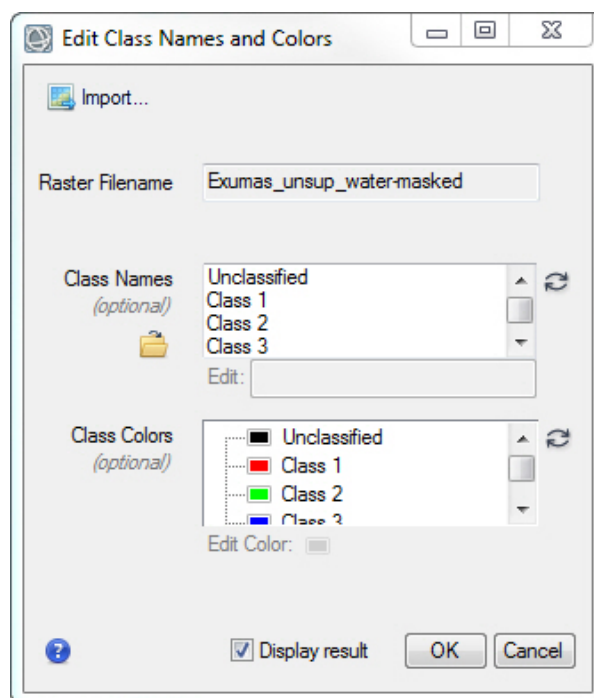
*Views > Link Views > Link All > OK*

Contrast stretch the Color IR image with different stretches.

*Right-click* on the “Classes” folder in the Layer Manager >

Select “Edit Class Names and Colors” >

the “Edit Class Names and Colors” window pops-up (see below)



Use the “Cursor Value” tool to query the Class number. In the “Cursor Value” tool menu *Click* on the “Link” and the “Display Information for Views” icons

Click on different colors in your classification map with the “Cursor Value” tool to decide what feature they represent.

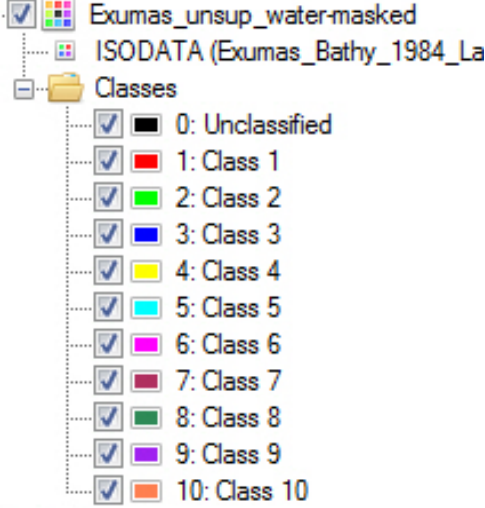
Zoom-in and pan to different islands.

Use the *Flicker* tool to compare classified map pixels to color image pixels.

Change the band combinations in View #2 and try different stretches on the images that bring out different patterns - these patterns may correlate with your classification map

**NOTE:** This is a very good class exercise with the instructor writing the class answers on a White Board so everyone participates in the decision-making.

Build a small chart and write down what you think the class represents.

|  | Class interpretation                                                                                                                                                                                    |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                    | <ol style="list-style-type: none"> <li>1. Mask</li> <li>2. Saturated/underwater beach sands</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> <li>8.</li> <li>9.</li> <li>10.</li> </ol> |

a) Where do you see Class 5, 6, 7, 9, and 10 pixels most often?

b) There are only 378 pixels in Class 8 (dark green). Tough to find! Do you see this class in areas with very bright white sand? Maybe this is dry sand – sand on a topographic high?

c) In the color IR and total IR images is there a trend in vegetation vigor (redder pixels may indicate more vigorous vegetation, denser vegetation cover, or different plant communities) that you can correlate with the patterns of Class 2 (green), Class 3 (blue), and Class 4 (yellow) on the islands?

Question 4: What types of other imagery, maps, and other ancillary information would help you interpret the classes with more confidence?

1f) Let's name the classes and combine those that maybe represent the same feature.

We will use the "Edit Class Names and Colors" menu.

In the "Class Name" window in the center of this menu, select Unclassified >

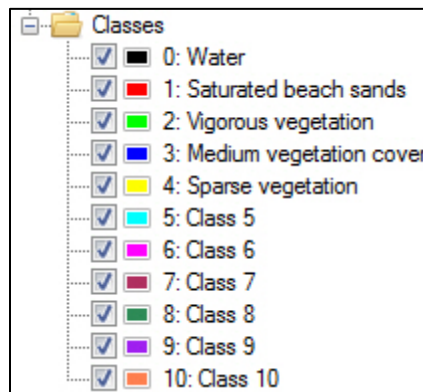
Edit: enter the name "Water" and follow this with the next 3 entries

Unclassified = Water

Class 1 = Vigorous vegetation

Class 2 = Medium vegetation cover

Class 3 = Sparse vegetation > OK You will see the new names show up in the classification map legend (see below)



To open up the Edit menu again,

*Right-click* on the "Classes" folder in the Layer Manager >

Select "Edit Class Names and Colors" >

the "Edit Class Names and Colors" window pops-up

Change the name of Class 8 to "Dry sand on elevated beach" > OK

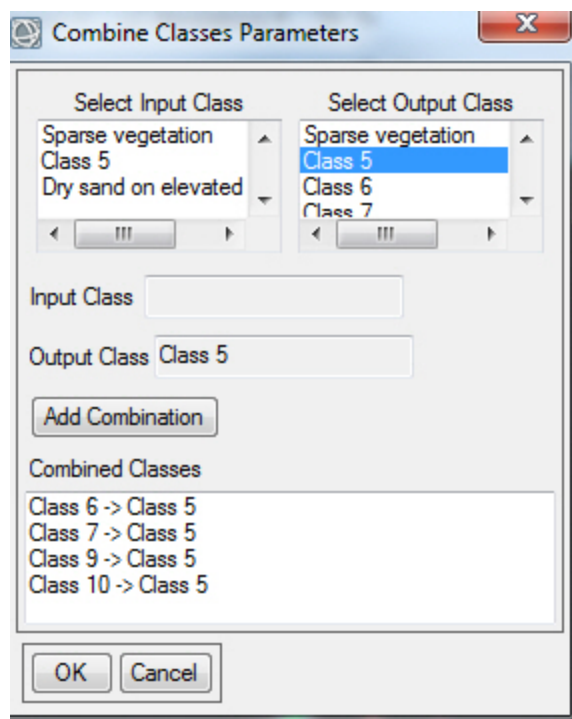
1g) Now let's combine classes 5, 6, 7, 9, 10 into one class.

*ENVI Toolbox > Classification > Post Classification > Combine Classes*

The "Combine Classes Parameters" window pops-up.

We want to sequentially *Select* Class 6, 7, 8, 10 in the "Select Input Class" list and assign each one to the "Output Class" 5. After we fill in the Input and Output windows we press "Add Combination" and the combined classes show up in the bottom window. (see below)

Your Combine Classes Parameters menu should look like is shown below.

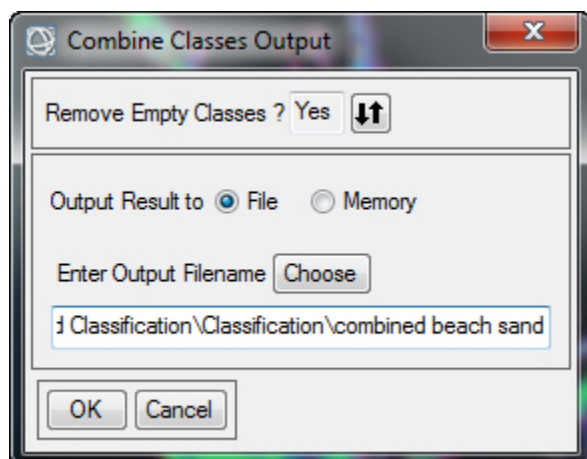


> OK

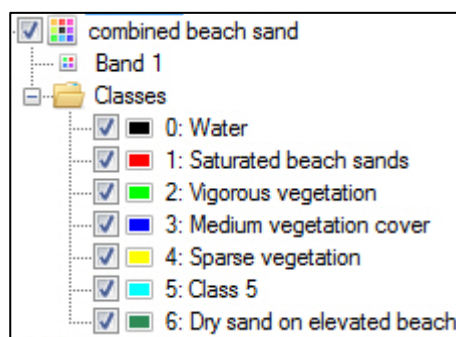
The “Combine Classes Output” window pops-up.

Remove Empty Classes? Yes

Name the output file “combined beach sand” (see below)



> OK



Automatically ENVI displays the classification map with the updated legend in the Layer Manager (see above).

1h) Now we want to rename “Class 5” to “beach sand” and change colors on our map.

To open up the Edit menu again,

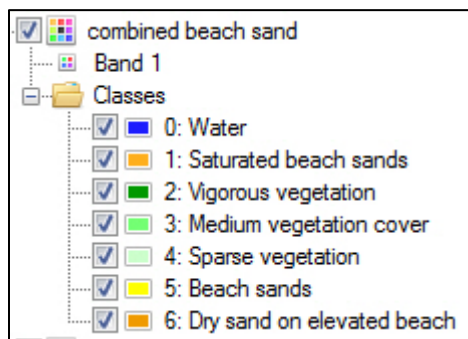
*Right-click* on the “Classes” folder in the Layer Manager >

Select “Edit Class Names and Colors” >

the “Edit Class Names and Colors” window pops-up  
Rename “Class 5” as “beach sand”

Let’s change colors in the lower window  
Just select the class and touch the color box that appears  
Check “Display Result” > OK

- 1i) The new legend pops-up in the Layer Manager. Let’s rename this map  
*Right-click* on “combined beach sand” > “Rename Item” >  
*Rename* “Exumas Landsat Land Cover Map” > *click on* Green Checkmark  
Your map name and legend should look like this in the Layer Manager



- 1j) Our map has a “salt and pepper” appearance with isolated pixels and narrow strings of pixels. Land cover maps are typically generalized with a “Majority” filter (see textbook Chapter 9 for explanation). The Majority filter provides a more visually appealing map.

*ENVI Toolbox > Classification > Post Classification > Majority/Minority Analysis*

The Majority/Minority Parameters window pops-up.

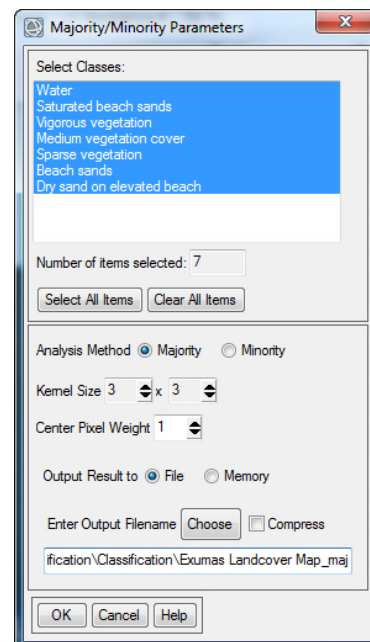
*Select All Items*

*Accept Defaults*

*Name the output file*

“Exumas Landcover Map\_maj”

> OK





The majority-filtered classification map is displayed on top of the original “salt and pepper” map.

Use the “Flicker” tool and *zoom in* on larger islands to compare the two maps.

Question 5: Which map (original or majority-filtered) do you like the most? Why?

In the Layer Manager, select (highlight) the majority filtered classification map.

*File > Chip to File > File* The “Chip to File Parameters” window pops-up

Select output format “JPEG”

Name the output “Your Name\_unsup map\_maj”

uncheck the Display result > Save

Upload the jpg file to the instructor.

1k) Raster classification (thematic) maps are converted to vector polygon maps to make them more useful in GIS applications. You can add more attributes to the vector polygon map and it is a much smaller file compared to a raster thematic map.

First we convert the raster map to an ENVI .evf vector file, and then we convert that .evf file into the universal shapefile format (.shp).

*ENVI Toolbox > Classification > Post Classification > Classification to Vector*

Select the Input file “Exumas\_Landcover\_Map\_maj” > OK

Select All Items in the “Raster to Vector Parameters” menu that pops-up

Accept Defaults (Output as Single Layer)

Name the ENVI vector file “Exumas\_Landcover\_Map\_maj\_evf” > OK

The evf vector file may show up in the Data Manager. *Load* into the View.

*ENVI Toolbox > Vector > Classic EVF to Shapefile*







The “Select Input EVF files” menu pops- up.

Locate and select your “Exumas\_Landcover\_Map\_maj\_evf.evf” *File > Open*

The “Output EVF Layer to Shapefile” window pops-up.

Name the shapefile “Exumas\_Landcover\_Map\_maj\_vec\_GIS” > *Open > OK*

The .evf and .shp vector files should look like this in the folder where you are saving images and these vector files.

|                                                                                                                    |                    |          |        |
|--------------------------------------------------------------------------------------------------------------------|--------------------|----------|--------|
|  Exumas_Landcover_Map_GIS         | 4/20/2019 12:06 PM | DBF File | 147 KB |
|  Exumas_Landcover_Map_GIS         | 4/20/2019 12:06 PM | PRJ File | 1 KB   |
|  Exumas_Landcover_Map_GIS.shp     | 4/20/2019 12:05 PM | SHP File | 311 KB |
|  Exumas_Landcover_Map_GIS.shx     | 4/20/2019 12:05 PM | SHX File | 7 KB   |
|  Exumas_Landcover_Map_maj_evf     | 4/20/2019 12:00 PM | DBF File | 147 KB |
|  Exumas_Landcover_Map_maj_evf.evf | 4/20/2019 12:00 PM | EVF File | 309 KB |

11) With ENVI, you can superimpose the GIS shapefile on your final classification raster map.

*File > Open* drive to your folder that has the shapefile  
*> select the file that has “.shp” as the type > Open*

*Right-click on the shapefile in ENVI's Layer Manager > View/Edit Attributes*  
*Use the slider to scroll across the fields in the attribute table.*

*Turn off (unclick) all the layers in the View with the shapefile*  
*Zoom to Full Extent*

In the Layer Manager, select (highlight) the majority filtered classification map.

*File > Chip to File > File* The “Chip to File Parameters” window pops-up  
*Select output format “JPEG”*

*Name the output* In the Layer Manager, select (highlight) the majority filtered classification map.

*File > Chip to File > File* The “Chip to File Parameters” window pops-up  
*Select output format “JPEG”*  
*Name the output “Your Name\_unsup map\_maj\_shp”*  
*uncheck the Display result > Save*

Upload the jpg file to the instructor.

If you have access to a GIS, display your final, majority-filtered classification raster map and the vector shapefile. Right-click on the shapefile and look at the attributes.

You can import your shapefile into Google Earth and compare you map to the imagery Google Earth streams over the Exumas Island

**Lab 9 Unsupervised Classification      Name:**

Upload the following files to the instructor:

(13j) "Your Name\_unsup map\_maj" jpg

(1l) "Your Name\_unsup map\_maj\_shp" jpg

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Question 2: What are the DN values for Black and White pixels in the Mask?

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