LAB 4: CLASSIFICATION ACCURACY AND CHANGE DETECTION

THIS LAB IS DUE ON TUESDAY, APRIL 1ST AT THE BEGINNING OF CLASS

BACKGROUND

Determining the classification accuracy of your outputs is an important step in any image classification. It is generally the last step, however if there are substantial errors it is generally wise figure out why they occurred and to go back and try and improve them. For this class however, it is not necessary.

Post classification change detection is one of the most common change detection algorithms as it provides from to information on change. However, one of the major limitations is that it is based on the classification accuracy of both images. If there is error in one of the images, there will be "change" detected where there was actually no change. See how well you did!

OVERVIEW

For this lab you will be examining both your unsupervised and supervised classifications. In the first part, you will recode your images so that the classes are the same numbers in both. Once this is done you will be performing and accuracy assessment on your 2001 image to see how well you ding at the supervised classification. Once this is done you will then run a post-classification change detection to see what areas around Washington D.C. changed and what they changed from and to.

DATA REQUIREMENTS

`2001_superv.img`	***Your**** result of the final "supervised classification" exercise from lab 3 **(IT CAN BE A DIFFERENT NAME IF YOU NAMED IT DIFFERENTLY!)**. In order to successfully complete this exercise, your classification layers ***must*** be coded into 4 classes: urban, vegetation, water, and soil (with numeric codes 1, 2, 3 and 4). (If your classes are numbered differently, use **Raster, Thematic, Recode** to change the numbers).
`1994_unsuperv.img`	***Your**** result of the final "unsupervised classification" exercise from lab 3 **(IT CAN BE A DIFFERENT NAME IF YOU NAMED IT DIFFERENTLY!)**. In order to successfully complete this exercise, your classification layers ***must*** be coded into 4 classes: urban, vegetation, water, and soil (with numeric codes 1, 2, 3 and 4). (If your classes are numbered differently, use **Raster, Thematic, Recode** to change the numbers).
`Ikonos_dc.img`	An April 1, 2000, IKONOS 4 band multispectral image of a portion of downtown DC.
`change_model.gmd`	A model that calculates the change between the two classified images.

`Type_of_change.gmd` A model that determines the type of change between the two classified images.

PROCEDURES

In this step you will recode your final, classified output files from lab #3. If your output from lab #3 has the numeric codes as urban = 1, vegetation = 2, water = 3, and soil = 4, you can skip the RECLASSIFY STEP if not:

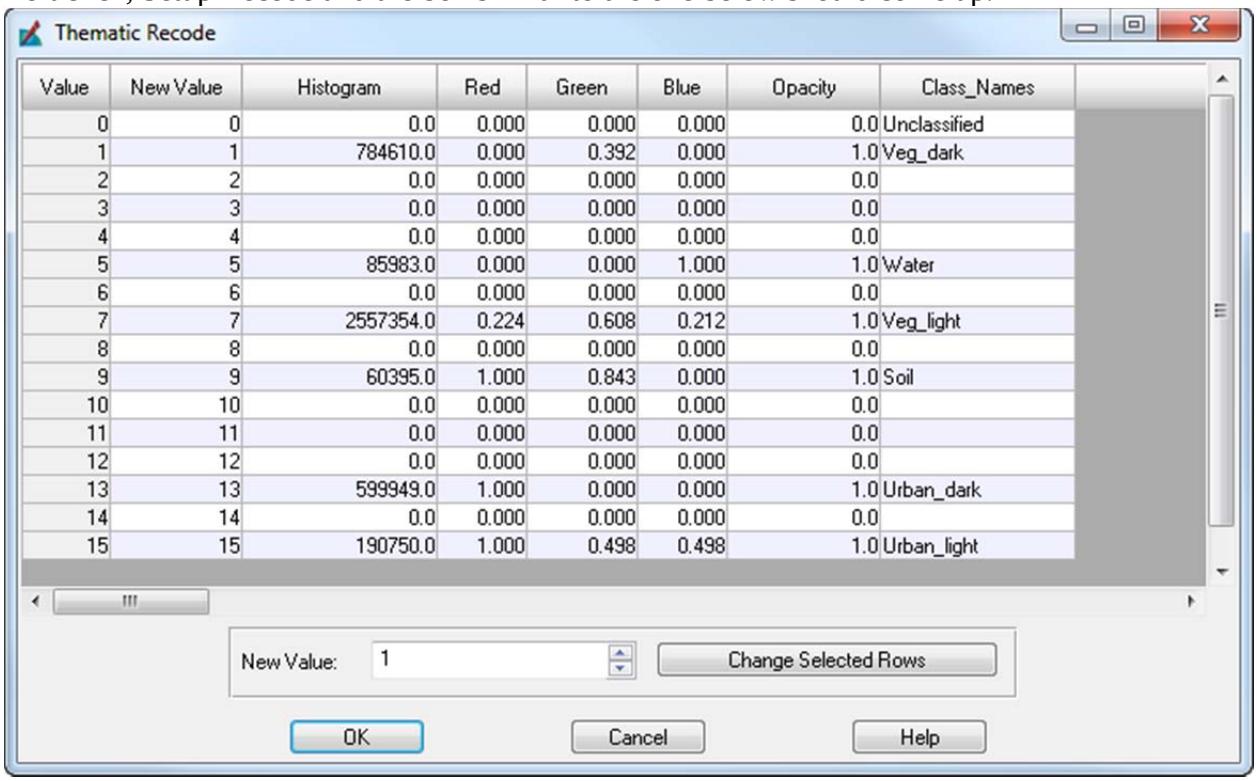
RECLASSIFY STEP

Open your `2001_superv.img` ***Your*** result of the final "supervised classification" exercise from lab 3 **(IT CAN BE A DIFFERENT NAME IF YOU NAMED IT DIFFERENTLY!)**.

On the main toolbar, click on **Raster, Thematic , Recode..**

As the input file, choose your `2001_superv.img` and as the output name it `2001_superv_rcd.img`.

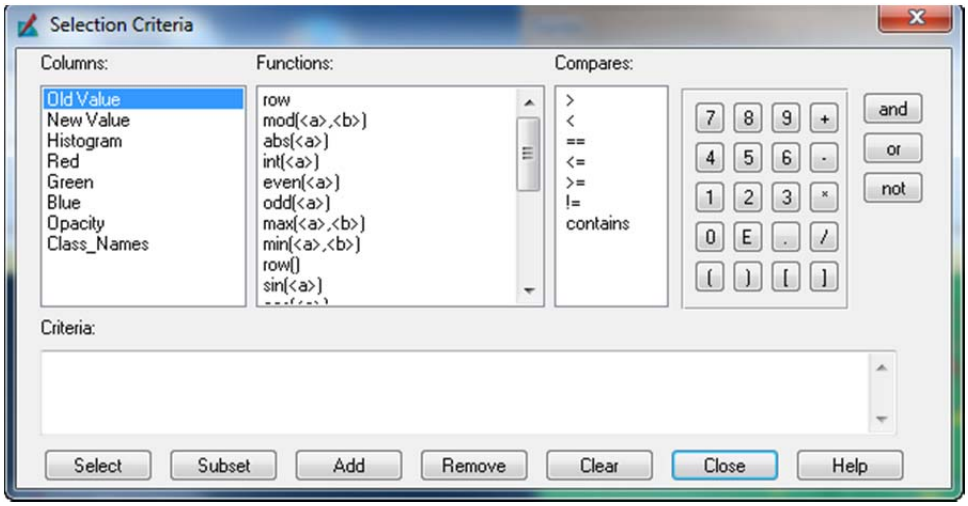
Left click, Setup Recode and the box similar to the one below should come up.



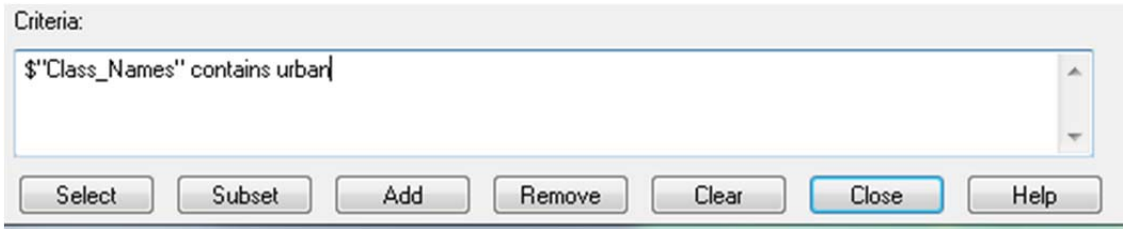
Value	New Value	Histogram	Red	Green	Blue	Opacity	Class_Names
0	0	0.0	0.000	0.000	0.000	0.0	Unclassified
1	1	784610.0	0.000	0.392	0.000	1.0	Veg_dark
2	2	0.0	0.000	0.000	0.000	0.0	
3	3	0.0	0.000	0.000	0.000	0.0	
4	4	0.0	0.000	0.000	0.000	0.0	
5	5	85983.0	0.000	0.000	1.000	1.0	Water
6	6	0.0	0.000	0.000	0.000	0.0	
7	7	2557354.0	0.224	0.608	0.212	1.0	Veg_light
8	8	0.0	0.000	0.000	0.000	0.0	
9	9	60395.0	1.000	0.843	0.000	1.0	Soil
10	10	0.0	0.000	0.000	0.000	0.0	
11	11	0.0	0.000	0.000	0.000	0.0	
12	12	0.0	0.000	0.000	0.000	0.0	
13	13	599949.0	1.000	0.000	0.000	1.0	Urban_dark
14	14	0.0	0.000	0.000	0.000	0.0	
15	15	190750.0	1.000	0.498	0.498	1.0	Urban_light

Right click in the grey area under the Column Value and select **Criteria**.

The following box, should appear:



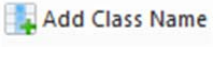
Left click on **Class_Names**, then contains, and then type in urban (or the name you used for the urban class) as below:



Then hit the Select button. All Class_Names with Urban in them should be highlighted in Blue. You'll have to close the selection criteria box. **Make sure the New Value is on 1** and then click on Change Selected Rows

Repeat the Criteria step for Vegetation, once selected, Change the New Value to 2, and click Change Selected Rows, for Water, perform the selection using Criteria, change the New Value to 3, then click on Change Selected Rows, do this for Soils and make sure it is number 4.

Once all of the New Values have been changed to Urban=1, Vegetation=2, Water=3, and Soil=4, then Click **OK**. Then Click **OK** on the Recode dialogue and your new output should be created.

Open up the new file. **Right click on the File in the Contents Folder** and Select **Display Attribute Table.** The attribute table will have to be edited. **Left Click** on the class names and rename them as below, also change the colors by **right clicking** on the color and change it to something similar as below. If you do not have the Class_Names field, Click on **Table then click on Add Class Name** 

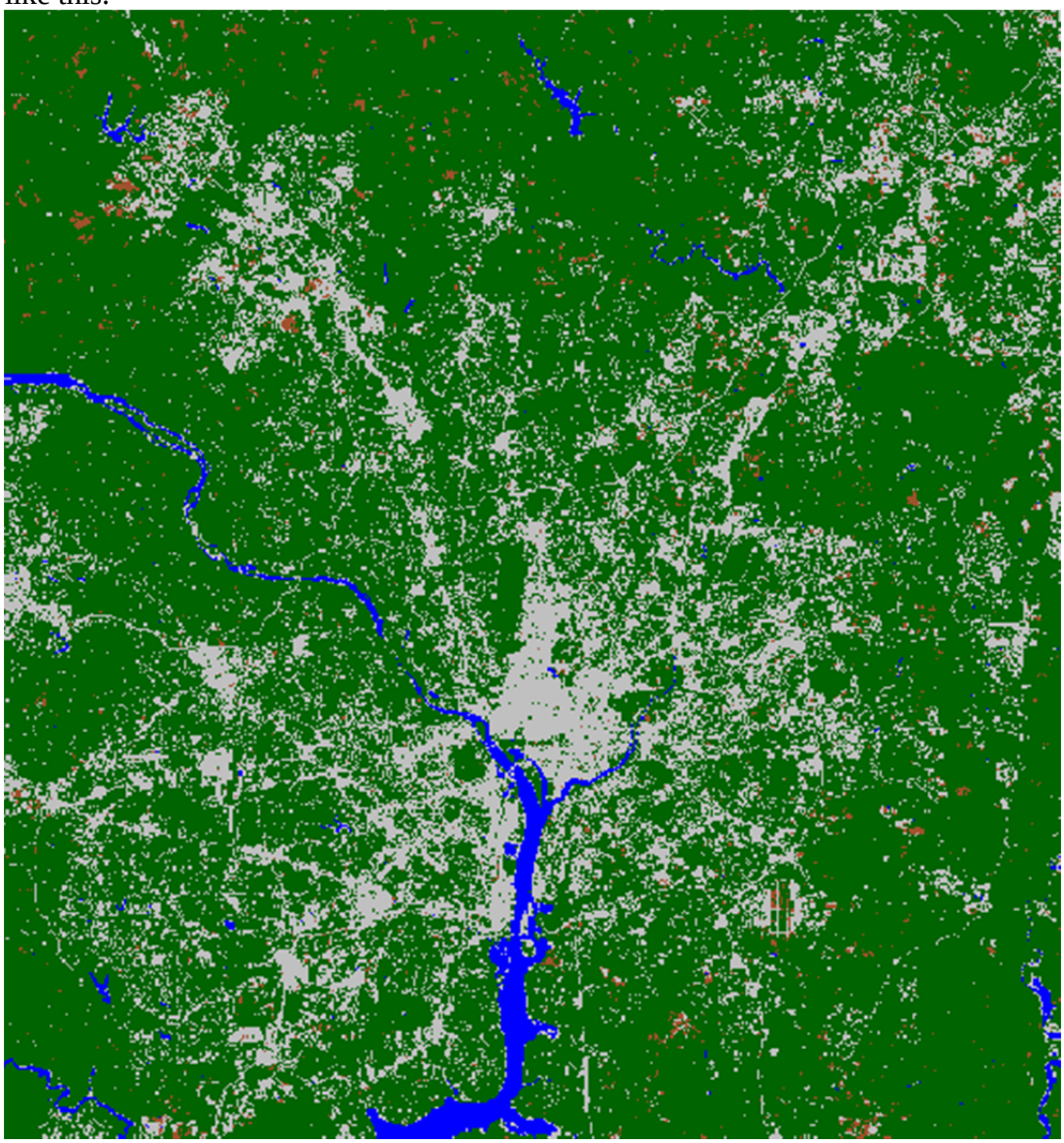
. If your class is not displaying, make sure the Opacity is set

to 1. If it is set to zero it will not display. Also, change the color as it may be black. To change the colors, just Click on the color and select the color you want.

2001_superv_rcd.img

Row	Color	Red	Green	Blue	Opacity	Class_Names
0		0	0	0	0	Unclassified
1		0.75	0.75	0.75	1	urban
2		0	0.39	0	1	vegetation
3		0	0	1	1	water
4		0.63	0.32	0.18	1	soil

After Changing these and making sure your opacity is set to 1, your image should look something like this:



Now do the same procedures to Reclassify the `1994_unsuperv.img`.

Both Images, should have only 4 classes, with Urban=1, Vegetation=2, Water=3, and Soil=4.

Written Assignment Part 1:

1. With the two images reclassified and side by side, where do the largest changes appear to be? Also, which class seems to change the most?

ACCURACY ASSESMENT

In this part of the lab you will be performing an accuracy assessment of your 2001, supervised classification image using the 2000 Ikonos image.

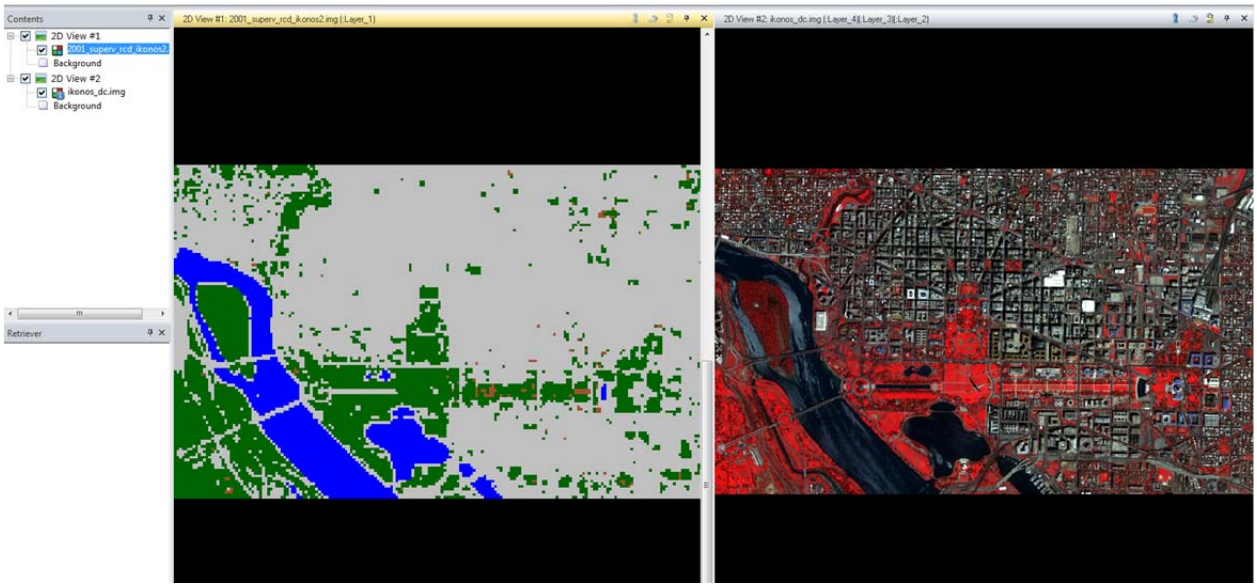
The first step the accuracy assessment is to subset the 2001 classified image to the same size as the Ikonos image. This makes sure none of the sample points created fall outside of the ikonos image extent.

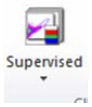
Open your `2001_superv_rcd.img` and the `ikonos_dc.img` side by side. In the ikonos_dc.img view, create an Inquire box covering the area. **Inquire,** 

Inquire Box. Once the square opens in the Ikonos window, extend it by grabbing the corner to covering the entire area that is covered by the Ikonos scene. In the `2001_superv_rcd.img` select **Raster, Subset and Chip** 

, Create Subset Image. The input image should be `2001_superv_rcd.img`, name the output file `2001_superv_rcd_ik_sub.img`, click on **From Inquire Box.** Leave the rest as default and select **OK.** Remove the `2001_superv_rcd.img` and open the new `2001_superv_rcd_ik_sub.img` in its place.

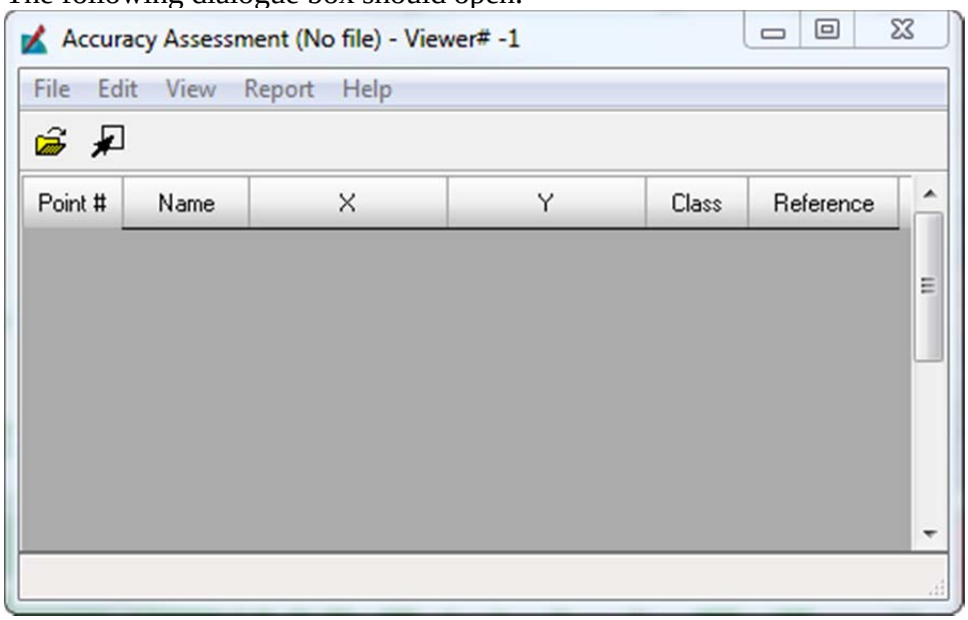
Your screen should look similar to this below:



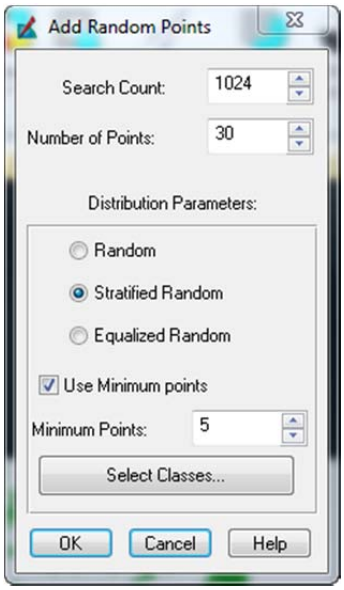
Now you will perform the accuracy assessment. Go to **Raster, Supervised**, 

and select **Accuracy Assessment.**

The following dialogue box should open.

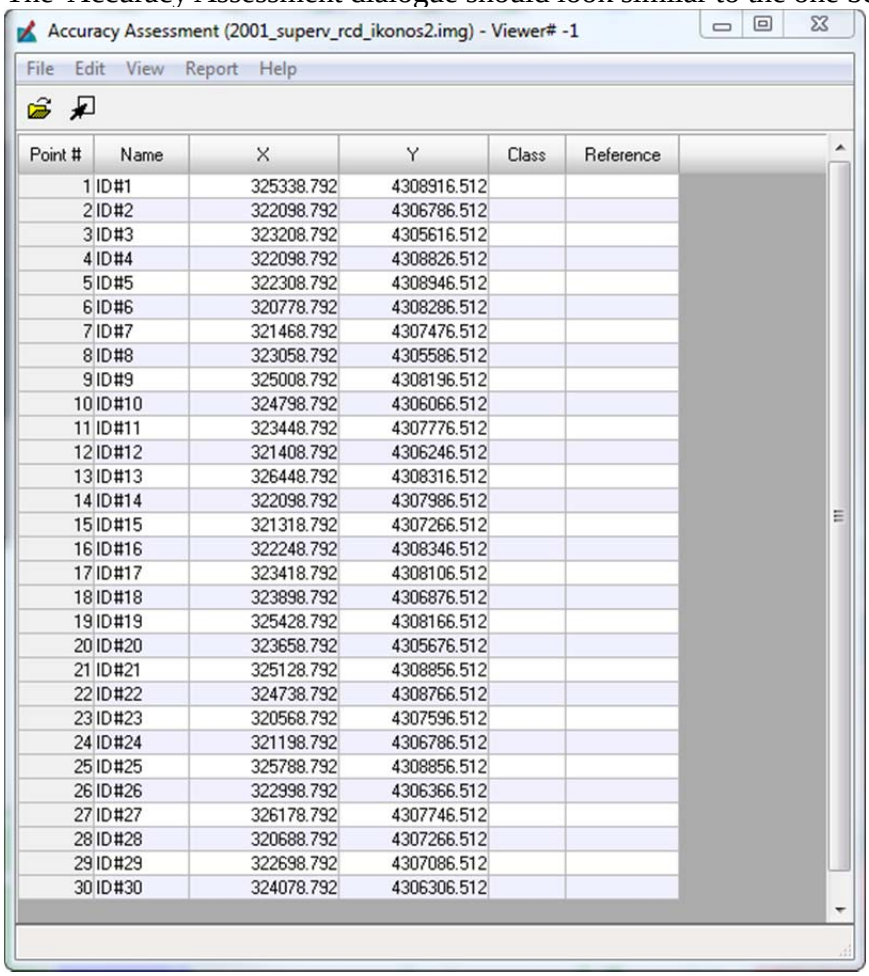


File, Open your `2001_superv_rcd_ik_sub.img.` The file name should now be at the top. The click **Edit, Create/Add Random Points.** A dialogue box should open up. Change the Number of points to **30, Select Stratified Random,** check the **Use Minimum points,** put **5** as the number**.** then **click Select Classes. Under Row, highlight all four classes by left clicking and dragging down.** Then click **OK**



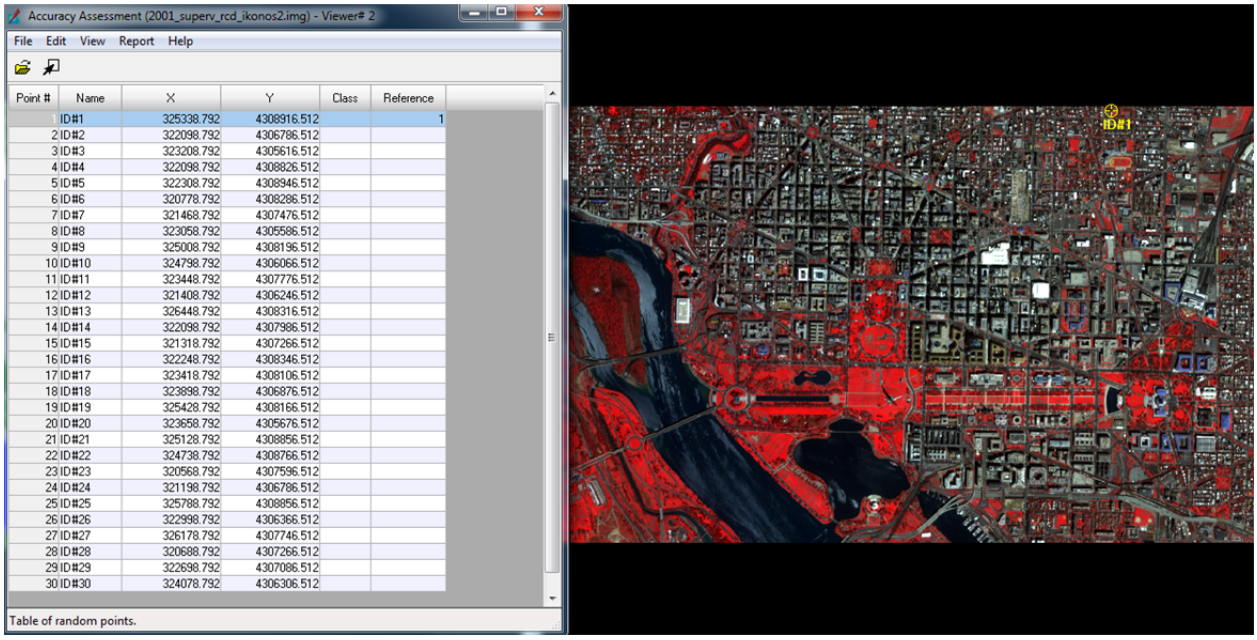
This should select 30 random points with a minimum of 5 points for each class covering the entire image. This will create 30, stratified random sample points with a minimum of 5 points per class, based on your classification.

The Accuracy Assessment dialogue should look similar to the one below:



Point #	Name	X	Y	Class	Reference
1	ID#1	325338.792	4308916.512		
2	ID#2	322098.792	4306786.512		
3	ID#3	323208.792	4305616.512		
4	ID#4	322098.792	4308826.512		
5	ID#5	322308.792	4308946.512		
6	ID#6	320778.792	4308286.512		
7	ID#7	321468.792	4307476.512		
8	ID#8	323058.792	4305586.512		
9	ID#9	325008.792	4308196.512		
10	ID#10	324798.792	4306066.512		
11	ID#11	323448.792	4307776.512		
12	ID#12	321408.792	4306246.512		
13	ID#13	326448.792	4308316.512		
14	ID#14	322098.792	4307986.512		
15	ID#15	321318.792	4307266.512		
16	ID#16	322248.792	4308346.512		
17	ID#17	323418.792	4308106.512		
18	ID#18	323898.792	4306876.512		
19	ID#19	325428.792	4308166.512		
20	ID#20	323658.792	4305676.512		
21	ID#21	325128.792	4308856.512		
22	ID#22	324738.792	4308766.512		
23	ID#23	320568.792	4307596.512		
24	ID#24	321198.792	4306786.512		
25	ID#25	325788.792	4308856.512		
26	ID#26	322998.792	4306366.512		
27	ID#27	326178.792	4307746.512		
28	ID#28	320688.792	4307266.512		
29	ID#29	322698.792	4307086.512		
30	ID#30	324078.792	4306306.512		

Now click on **View, Select Viewer** and click in the Viewer with the Ikonos image open in it. Highlight the row by left clicking under the Point #, then click **View, Current Selection.** The point that you have highlighted should now show up on the Ikonos image. It should look something similar to below: (see point #1 in the upper right portion of the image)



Now enter the number for the land cover class that you see in the Ikonos image in the Reference Column. Use Urban=1, Vegetation=2, Water=3, and Soil = 4. Continue to do this for the remaining 30 points.

Once you have visually inspected all 30 points and have filled in the entire reference Column, click on **Report, Accuracy Report**. This will generate an Error Matrix, Accuracy Totals, and Kappa statistic based on your Reference data you just put in and your classification.

BE SURE TO SAVE THE VALUES FROM THE REPORT AND TURN IT IN WITH YOUR LAB!

FYI: I have found that it keeps some of the information that should have been removed during the recoding. It is fine, the statistics should only be for the 4 classes that you created in your classification.

Written Assignment Part 2:

1. What were your Overall Accuracy, Kappa, and Accuracy per land cover class? What were your largest and smallest errors? Is this what you expected?
2. What are some of the limitations of using this methodology?

PART 2: CHANGE DETECTION

Images to be used for change detection must first be geometrically corrected and registered to each other. You will use a graphical model to subtract the 1994 Classification from the 2001 Classification. The first model will simply use a change no change value. A value of 0 is no change

and a value of 1 is change. Next you will generalize this change image using a majority filter. Finally, you will delete all groups of pixels smaller than a specified area.

On the main icon panel select **Toolbox**, then **MODEL MAKER...** 

Open the model to calculate a difference image by:

File, Open... `change.gmd` (***make sure you open the change.gmd in your lab folder and not the one in the Imagine Models folder!!!)***

A graphical representation of the model will appear on the screen. Click on the Raster Icons in the model and make the directory and pathnames for the two input and one output files the correct for your directory. Then run the model:

Double-click on each of the input files (one at a time). These are the shapes with the squiggles on the side.
In the left one, navigate to your `1994_unsuperv_rcd.img`. **OK**.
In the right one, the input file should be your `2001_superv_rcd.img`.. **OK**.
Double-click on the first function (circle) that calculates the the difference.
In the function editor, make sure that the variable names ($.....) correspond to the available input images.
Move to the bottom of the model, double click on the "Results.." object, and enter a name for the output directory and file (`tm_change.img`).
At this point it is a good idea to save the model.
Click on the red lightning flash to run the model.

This model will output a 0 for areas that do not change and a value of 1 for areas that changed.

Display the result. You should see possible change areas in a color and black in non-change areas. If you want to change the colors, use the Attribute Table as described above.
Now generalize this image, by running a focal majority filter on it:

Click on **Raster, Thematic...** 

, Neighborhood...
In the Neighborhood Function form menu, specify the difference image as input,
and choose a name and the proper location for the output file.
As Function use a `5x5 Majority` filter, and check on **Ignore Zero** in the output statistics. **OK**.

Now you are going to look at what the classes change from to. On the main icon panel select **Toolbox**, then **MODEL MAKER...** 

Open the model `Type_of_change.gmd`.
Double-click on each of the input files (one at a time).

In the left one, navigate to your `1994_unsuperv_rcd.img`. **OK**.
In the right one, the input file should be your `2001_superv_rcd.img`.. **OK**.
Double-click on the first function (circle) that calculates the the difference.
In the function editor, make sure that the variable names ($.....) correspond to the available input images.
Move to the bottom of the model, double click on the "Results.." object, and enter a name for the output directory and file (`tm_type_change.img`).
At this point it is a good idea to save the model.
Click on the red lightning flash to run the model.

The output of the model will be a large number of values. Look at the function circle to determine what the from to classes are (i.e., Class 1 in 1994 to Class 2 in 2001 would be change from urban to vegetation, Class 2 in 1994 to Class 1 in 2001 would be vegetation to urban).
Open the `tm_type_change.img` and Add class names and change the colors as described above. Examine the output map relative to your two classified inputs.

Written Assignment Part 3:

1. Display the final difference image simultaneously with the two single date classifications. Briefly analyze and comment on the change detection image you created. What features seemed to be detected on the difference image?
2. How many pixels changed? What is the area of this?
3. Where does most of the change occur?
4. What was the largest from to change class? What is the smallest? Is this consistent with what you thought it should be?
5. Do the from to classes make sense for the most part? Are there substantial errors?
6. Do the errors you detected in your classification accuracy seem to be affecting your results? If so why?

Create a sub-directory `lab4-report` and copy the images that you generated during this lab to it. Be sure to list the filenames in your write-up.