EXERCISE 1: INTRODUCTION TO ERDAS IMAGINE

READINGS: Lab manual: Introduction to Geography 315 Laboratory, Policies and Procedures, Laboratory Exercise I.

MATERIALS: Lab manual, pencil, Gainesville, Georgia imagery (provided)

OBJECTIVES: After completing this introductory exercise, students should be able to:

- Display a raster image using panchromatic, normal and false color options.
- Use the zoom tool/buttons to properly display an image and the inquire cursor to identify pixel X, Y locations and digital numbers (DN).
- Display an image automatically scaled with DN's stretched from 0-255, or with natural spectral variation.
- Use the histogram to view spectral variability and frequency/proportion of DN's within each class.
- Perform a linear contrast stretch
- Create spatial and spectral profiles of an image.
- Measure distances and areas within an image.

GETTING STARTED

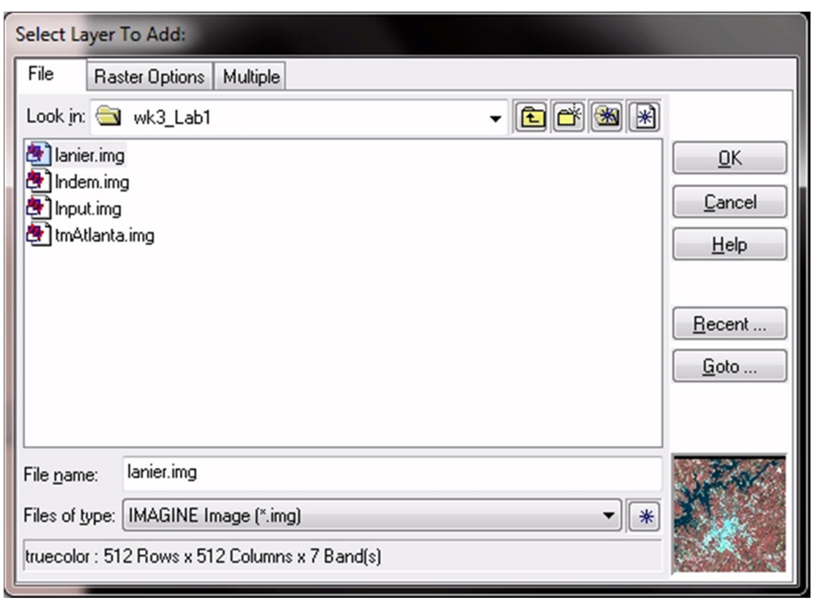
Log on onto the computers in COPH 220 as '*Geog315*'.. Failure to do so will not allow you access to the datasets. To begin your Imagine Session, double-click on the **ERDAS Imagine / Imagine** Icon or select it from the start-up menu. Erdas Imagine 2011 with a blank *2D View# 1*will appear. Before we start a session let's look at how to set some Display Preferences. Under the **File** click on **Sessions** and choose **Session Preferences**. Select **Preferences** from the menu. The *Preference Editor* will appear. Note the default data directory is *$IMAGINE_HOME/examples*. For our exercises, we will be working with our class folder located at c:/geog315 for both the *Data* and *Output* directories; but if you were working on a project, you would change this to your working directory. After you have changed this click on the *User Save* at the bottom of the editor.

Scroll down on the right hand side using your cursor until you come to the Remote Sensor waveband defaults (3-6 Band images). These are the default satellite bands from each of these systems that are assigned to your monitor/printer's *color guns.* Note that all the colors you view in the visible portion of the electromagnetic spectrum are some combination of Blue, Green, and Red light. Displayed on your monitor will also be a combination of these colors. It is possible (as we will see later) to create a *Standard False Color Composite (FCC)* by sending Green light to the Blue color gun/jet on a printer/monitor, Red light to the Green color gun, and Near-Infrared (NIR) light to the Red color gun. It is called 'false color' because electromagnetic information from the different spectral bands (both visible and non-visible) is sent to different visible light color guns. Its purpose is to allow us to 'see' any unique spectral characteristics possessed by the area portrayed in the image, particularly those characteristics found in the non-visible portion of the spectrum. Referring to the above FCC, the naked eye cannot see infrared light and we are 'tricking' it by sending the information contained in this portion of Light to the Red Color gun. This may sound confusing, but remembering that Light and Color are not the same thing helps to clarify it a bit. Using the Preference Editor is one way to alter these defaults to create a False Color Composite. More ways to do this for an individual Layer/Image is by using the *Open Raster Layer* (**File-Open-Raster Layer)**, and using the *Raster Options > Layers to Colors* section to change the band assignments.

DISPLAYING AN IMAGE

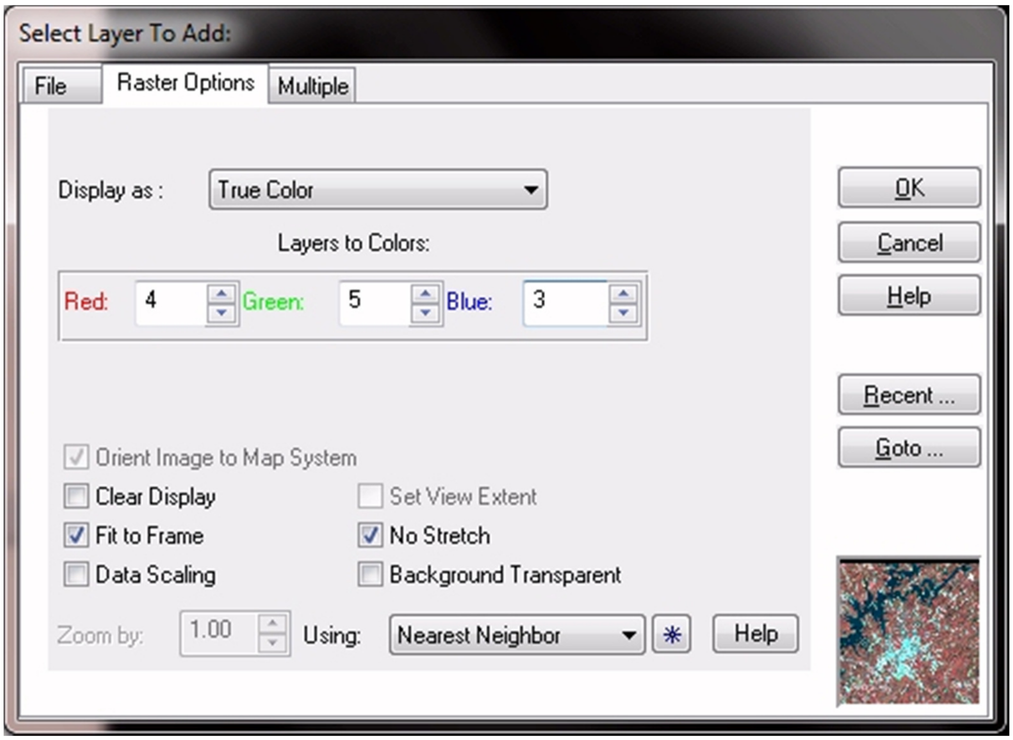
Now lets open and display a raster image. There is more than one way to do this:

- From the *Erdas Application* select **File - Open – Raster Layer**
- "Right Mouse" on the *View* and select the **Open Raster Layer**
- From anywhere on the Erdas Application select "**Control + O"**



- When the *Open Raster Layer / Select Layer to Add* box appears, select the **lanier.img** from the scroll down menu. This is the Lake Lanier region of Gainesville, Georgia. Note that you can also type the name of the file in the top box or click the popup below the scroll down menu to move out of the 'geog315' sub-directory.

- Now select the *Raster Options* tab and the following window appears.



This is a Landsat Thematic Mapper (TM) image that has 7 wavebands of information with 512 rows and columns of raster information. In the **Layers to Colors** section, use the following band/color assignments: **Red 4, Green 5, Blue 3.** This is a False Color Composite which sends Near Infrared (NIR) Light in TM Band 4 to the Red color gun, Mid Infrared (MIR) Light in TM Band 5 to the Green gun, and Red Light TM Band 3 to the Blue gun.

- Under the Display **Options** settings, check the box next to **No Stretch, (**and **Fit to Frame** if you prefer), and then click **OK.** The Lake Lanier image will appear.

First, “Right Mouse” the *lanier.*img in the **View** and select **Metadata** to show the *Image Metadata* [or **Home > Metadata Icon.** This gives us all of the information Imagine has on this image. Note the number of layers is 7 for TM, the min and max DN (Digital Number) values, the Measurement Units, and the Projection (if any).

Now lets take a look at our image using the *Inquire Cursor* utility. Once again, there are two ways to access this:

- **Home Tab > Inquire** (+ sign)
- **“Control + I”** from anywhere in the *Erdas Application*

A set of ‘crosshairs’ will appear along with the *Inquire Cursor Dialog Box.* To move the crosshairs to a new pixel location you can do one of the following:

- Click on the crosshairs with your cursor and drag them across the image.
- In the Cell Array along the top of the *Inquire Cursor Box,* enter new coordinates.
- Click on the black arrows at the bottom of the *Inquire Cursor Box.*

Five columns of information are present in the *Inquire Cursor Box:*

Layer: tells us there are 7 layers/bands possible in the Landsat TM image.

Band: lets us know what colors we have assigned to each of these wavebands of information.

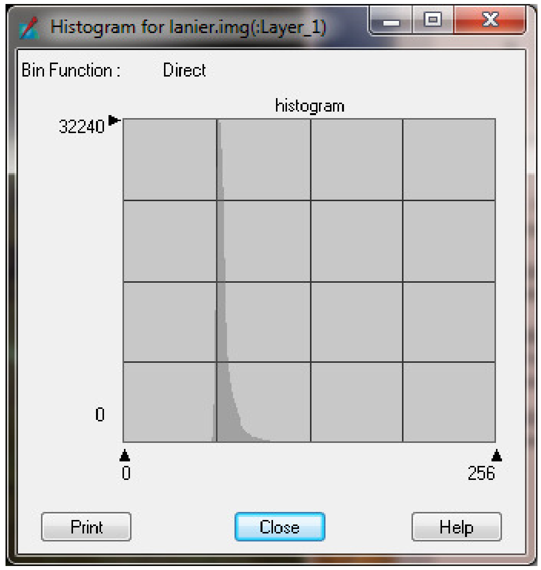
File Pixel: gives us the DN value of the pixel from the file, remember TM records in 8 bit (2^8) data or 0-255 values.

LUT Value: in this case the ‘Look-Up Table Value’ is the same as the Pixel value since we checked the ‘No Stretch’ box to leave the contrast the same as the recorded DN values.

Histogram: records the number of pixels (using a histogram) that are similar within the band.

Histogram

- Go back to the *Image Metadata* window (**Home > Metadata**). We mentioned that the Min / Max pixel values are given under 'Statistics Info', as well as the Mean (average), Median (middle) and Mode (most occurring) values. Now, lets look at a Histogram by selecting *Histogram* from the *Image Info's ' View'* window or clicking on the *Histogram Icon* (far right).



- Move the cursor across the window and note the changing numbers along the sides. The 'Mean' is displayed along the top of the histogram (68.8433).
- The bottom of the window shows the pixel value (In the example above 0-255 are DN values. In a later question, those numbers will represent elevation values in an elevation image.), the number along the Y-axis in the center is the number of occurrences (frequency) of that pixel.
- The Top number along the Y-axis is the Mode (most often-occurring pixel value).
- Note how this 'Un-stretched' image's pixel values range from about 60 to 100. You will compare this later to the stretched Lanier image to compare how the same information is 'stretched' over a broader range of DN values.

Stretching an Image

Now let's open a 'Stretched' (no check mark in the 'No Stretch' box) version of the same image to compare it with the recorded non-stretched image. Open a raster image with the same 4-5-3 FCC Band Combination. This time, make sure the *Clear Display* is unchecked and Click 'OK'. The new stretched image is displayed over the existing 'non-stretched' coverage. There are several ways to display them for comparison:

- "Right Mouse" on the *2D* View and select **Swipe.**
- The *Viewer Swipe* window will appear. You can manually move the 'pointer' on the swipe by clicking on it and dragging it or you can put a Check mark in the *Auto Mode*

box and adjust the speed. Try doing both. Change the Direction from Vertical to Horizontal.

    - You can also experiment with the Swipe and Flicker commands under the *2D Viewer.*

- Notice how the water, urban areas, and vegetation are more easily distinguished in the 'Stretched' image.

Arranging Layers

You can switch the position of the layers by using a " **Click and Drag"** on the layer you wish to move or **"Right Mouse"** the layer and select *Raise to* Top or *Lower to Bottom* from the menu that appears. Try the **Swipe** command again.

Measurement

Now choose the **Measure** option under the **Home Tab** and the *Measurement Tool* will appear. This allows us to measure:

- Positions: (Plus Icon).
- Lines (Line Icon): click at each vertex, double click when you are finished.
- Polygons (Polygon Icon): click at start, each vertex and double click when finished.
- Rectangles (Box Icon): click to start, drag, and double click to end.
- Ellipsoids (Oval Icon): click to start, drag, double click to end.

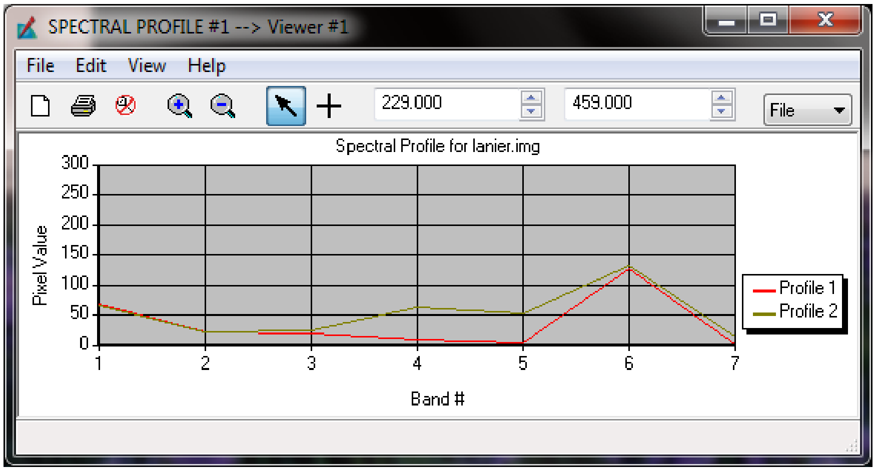
Try using a few of these and note the distance, area, perimeter and number of pixels involved.

SPECTRAL / SPATIAL PROFILES

Now lets once again open the **lanier.img** using the FCC 4-5-3 combination as a 'stretched' image (no check mark) and choose the 'Clear Display' option.   We will now create Spectral and Spatial Profiles of this image.

Spectral Profiles

- From the **Multispectral Tab** go to the **Utilities** pull-down many and select **Spectral Profile.**
- When the '*Spectral Profile Window'* appears, click on the '*Plus*' sign and then select a water pixel from the image.

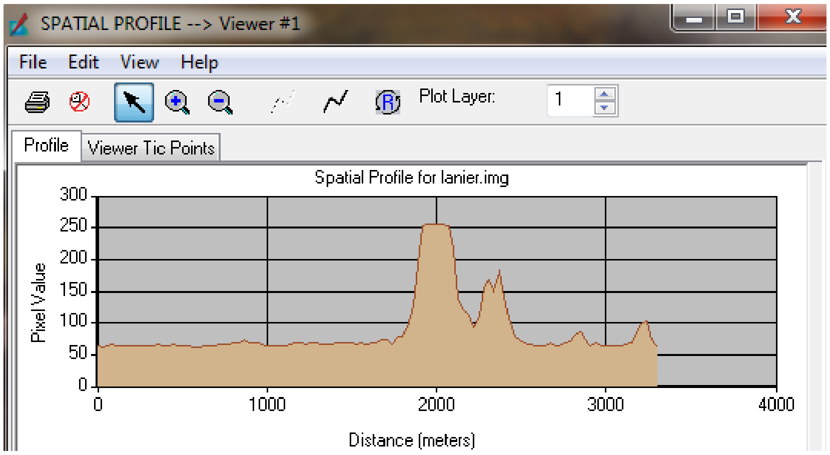


- This is a 'Spectral Profile', or what is often called a 'Spectral Curve' in Remote Sensing, for Water in each of the 7 TM bands: Blue-1, Green-2, Red-3, NIR-4, MIR-5, TIR-6, FIR-7. The Y-axis is the corresponding DN value from 0-255 while X-axis contains the bands. Notice water receives the highest response in the Thermal Band (6). Band 1 is 'artificially' high due to 'Scattering'.

- Scroll down to the SW of the City, and select some of the vegetated areas (red). Compare this to the water Profile. Note vegetation begins to climb considerably between the last visible band (3) and the first Infrared band (4). You can see that there is a lot more information about vegetation that we can't see in the visible that is available in the IR.

Spatial Profiles

- Close the Spectral Profile box and reselect the **Multispectral Tab** > **Utilities** and this time choose **Spectral Profile** from the **Utilities** pull-down menu.
- Go to the NE corner of the image. Click on the *Polyline* Icon in the 'Spatial Profile' window.
- In the Viewer, draw a line from the Water across the Cloud, to the Highway, and 'Double Click'.



- The Spatial profile gives you a ‘cross-section’ of the DN values (Spectral Responses) at each location along that line.
- In the *Plot Layer* box, change the Band numbers from 1 to 7 to see how the DN values vary for each feature by waveband.
- Note how the IR bands separate more information out of the landcover than the visible bands1-3. Also, note how the water is artificially high in the Blue, while the Thermal (6) tells us very little.

Spectral Enhancement / NDVI

Close the Profile windows. Now lets make an NDVI (Normalized Difference Vegetation Index) of this Lanier Image. This gives us a standardized ratio value for vegetation using the following equation (which accentuates the difference between vegetation in the Red and NIR bands): *NDVI = NIR - Red / NIR + Red.* This produces a ‘bounded ratio’, so values will range from -1.0 to 1.0.

- Go to the **Raster Tab** and from the **Unsupervised** pull-down menu select **NDVI** (or **Indices**).
- Under *Input File,* select the folder and go to the **c:\...Lab1** directory and select ‘lanier.img’. For an *Output File*, give the name *lnNDVI* under your name in the ***c:\geog315…*** the directory.
- From the *Select Function* window, choose NDVI and then hit OK or enter.
- As soon as the *Modeler* is done running, click ‘Dismiss’ and Close it.
- Now Open the *lnNDVI* image using a ‘Gray-Scale’ and the ‘Stretch’ option.
- Select the *Inquire Cursor* and move it around over dark (water) and light (vegetation) and note the pixel values ranging from -1.0 to 1.0.
- **Answer Lab Questions 1-6 on Exercise 1 found at the end of this lab and turn it in.**
- ***Don’t Forget to Log Off of your Computers when you are finished!***

Name:____________________

EXERCISE 1: LAB QUESTIONS

1) Reopen the **lanier.img** with a 'Linear Contrast Stretch' using the same False Color Composite combination as before. Using the Cursor Inquiry Box and select the following pixels.

   A) A Water Pixel: what is the recorded Near-Infrared Value (Band 4) for that pixel __________?

   B) What is the 'Stretched' NIR value ____________?

   C) Find the Cloud (NE corner). Which of the three displayed bands gives the highest recorded DN value ___________?

   D) What is the stretched value for this band ___________?

2) Open the **lndem.img** image using a 'Gray Scale' and "No Stretch' option. Select the *ImageInfo* icon. This is a USGS DEM (Digital Elevation Model) of the Lanier area,

   A) In what projection is this DEM _______________?

   B) What is the average elevation for all pixels ____________?

   C) What is the distance at which each elevation was sampled (resolution) ____________?

3) In what projection is the **tmatlanta.img** image ___________________________________?

4) Open the **lnput.img**, public utilities image in *Pseudo Color*.

   A) How many acres is the city of Gainesville ____________________? (Hint: Measure the Area).

   B) How far is it from the NW edge of town to the SE _________________?

5) Open the **lndem.img** using the gray scale. Bring up the Histogram of these DN values.

   A) How many pixels lie at 1200 meters ______________?

   B) What is the range of elevations in the Lanier image ________________?

6) Using the **lnNDVI.img**:

   A) What is a pixel value for water _______________, for vegetation __________?

   B) What is the Maximum Pixel Value ____________?