INTRODUCTION TO ENVI

In this exercise, you will become comfortable with using raster data in ENVI 4.4, and will become familiar with image enhancement, classification, and manipulation. The data you will be using for this computer exercise is a mosaic of Quickbird 2007 data and HyMAP 2005 data. The Quickbird data shows a 27 square kilometer area of the San Joaquin River between Highways 91 and 44 and its surrounding areas (mostly Northern Fresno) (see Google Earth image below). The HyMap data is of a site on the San Joaquin River located approximately 10 miles west of the other site, largely surrounded by cropland (see Google Earth image below). The Quickbird data was acquired in May/July 2007 and has a spatial resolution of .6 m (2ft). The Quickbird image contains four bands of spectral imagery including blue (450 to 520-nm), green (520 to 600-nm), red (630 to 690-nm) and near-infrared (760 to 900-nm). The HyMap data was acquired by the HyVista Corporation on June 2005, as part of a study conducted by California Department of Boating and Waterways (CDBW), California Department of Food and Agriculture (CDFA), UC Davis's Center for Spatial Technologies and Remote Sensing (CSTARS), and the California Space Institute Center for Excellence (CalSPACE). The HyMap data has a spatial resolution of 3 m (9.8 ft) and 125 bands of spectral wavelength information ranging from the blue (450 to 520-nm) to the short-wave infrared (2000 to 2490-nm).

The data format is a TIFF file called "chinacamp2001.tif" and can be found on your computer's hard drive in **C:/Workspace/GIIFworkshops/ErdasImagine/**. You will be using this folder throughout this exercise, as it has proper read/write permissions.

In this exercise, you will perform 7 lessons:

1. Explore raster data in ENVI, where you will get comfortable adding, viewing, and working with raster data;
2. Work with ROIs ("Area of Interests"), a tool that will save you a lot of time and work;
3. Enhance images to bring out different aspects of the data;
4. Perform an unsupervised classification;
5. Perform a supervised classification;
6. Manipulate classified output; and
7. Assess accuracy of classification.

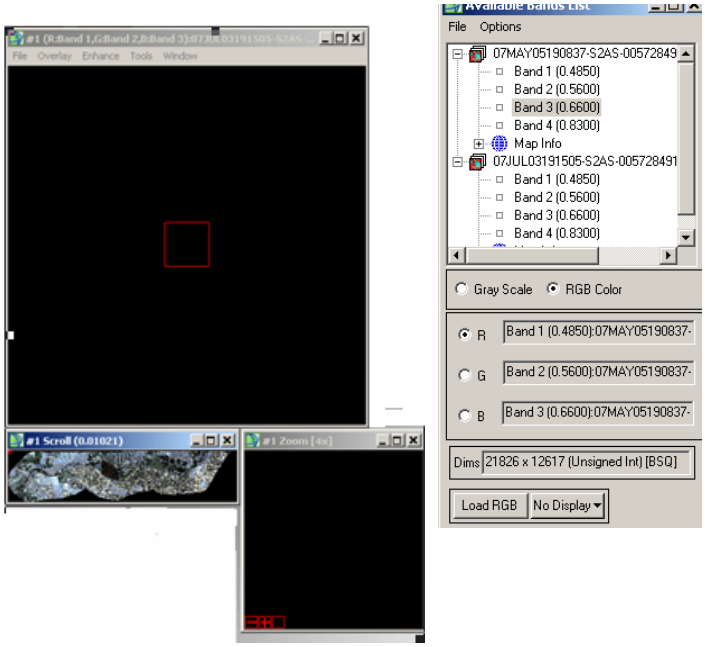
***** START THE EXERCISE BELOW! *****

These are important points that you should read before you go any further!

These are informative tips that may help you in the future!

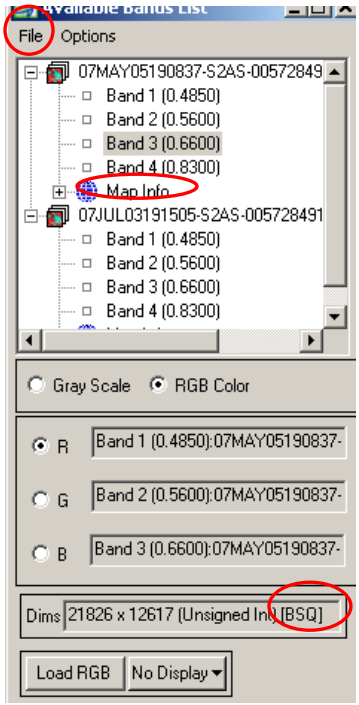
Lesson 1: Explore raster data in ENVI

1. Start ENVI, Select **Start → All Programs → Geospatial Tools→ ENVI 4.4 and IDL 6.4 → ENVI**
   a. *Open an image file,* Go to the ENVI main Toolbar and go to **File→ All Programs→ Open External File→ Quickbird→ Geotiff**
   b. **Scroll** to the necessary files under **2007 Quickbird→Original Files** highlight the file ending in P001 and P002 and click **Open** (you will have to do this twice for both files).
   c. Go to the **Available Bands List**. You should see both images listed in the viewer.
   d. **Click** on the **RGB Color** option. Select

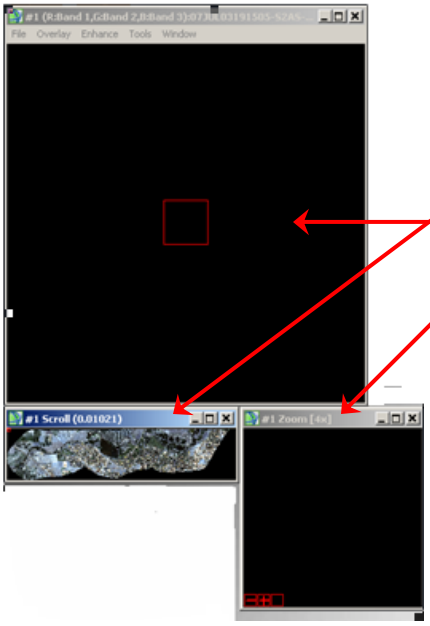


for the first image (file ending in P001), **Band 1** for **R**, **Band 2** for **G**, and **Band 3** for **B**. Click **Load RGB**. You have now loaded a True Color image (Note: to load a Color Infrared projection repeat the same steps, except load **Band 4** for **R**, **Band 3** for **G**, **Band 2** for **B**).

e. Three new windows should open showing the image you see above.



The **Available Bands List** is a special ENVI dialog containing a list of all the available image bands in all open files, as well as any associated map information. Note that the very bottom box tells you that the image data is being stored in BSQ. BSQ is a simple raster data format, where each line of data is followed immediately by the next line of the same spectral band. BSQ format is optimal for spatial (x,y) access to any part of the single spectral band. Other types of formats include BIP and BIL. Also note the **Map Info** icon under each filename. It is a shortcut menu for accessing map information that is in that image's "header file". Click on the icon to find out the Projection and Geographical Coordinates of this photo. You can also load images thru the **Available Bands List** by going to **File→Open Image File**



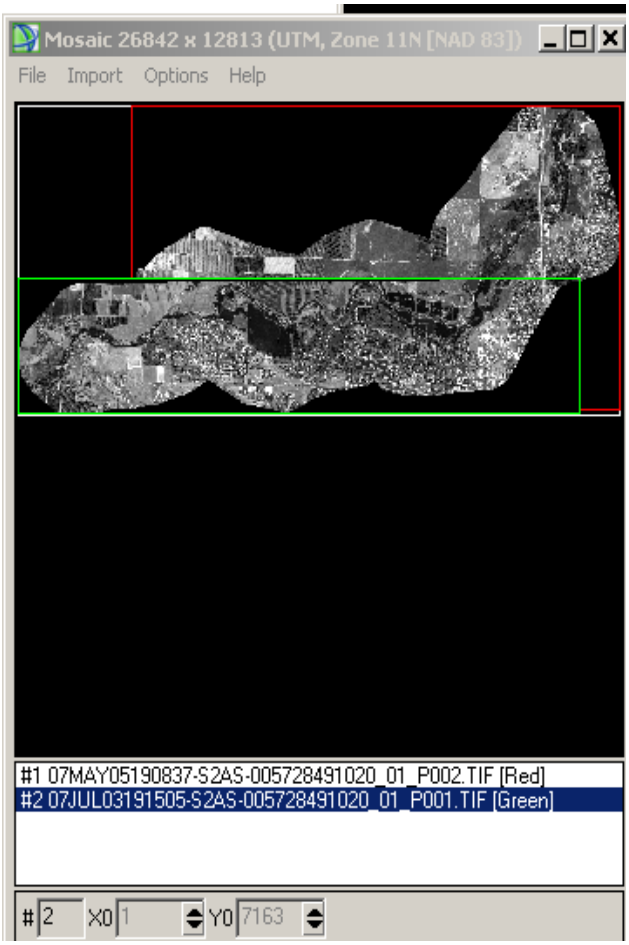
When the image loads, three image windows open. You can choose which combination of windows to appear on the screen by right-clicking in any image window to display the shortcut menu and selecting a style from the Display Window Style submenu. Your three windows are:

Scroll: shows the entire image at a reduced resolution.
Main Image: shows a portion of the image at full resolution.
Zoom: shows a portion of the image, magnified the # of times indicated by the number shown in parentheses in the Title Bar.

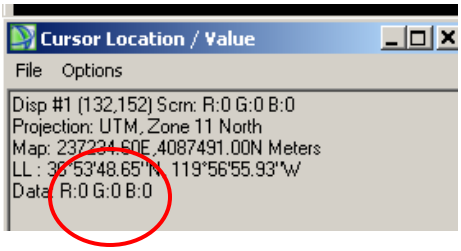
There is a small control box (red by default) in the **Scroll** and **Image** windows. Click on it, hold the left mouse button and move it around the image. Go to the **Zoom** window, click on the **crosshair** in the far right box. Move your mouse to the center crosshair cursor. Hold the left mouse button and toggle around.

f. repeat steps **a-e** for the other image (file ending in P002). Make sure you click on **Display** in the **Available Bands List** and click **New Display** before completing step **d**. You should have two sets of image windows open now (one for each image) along with the **Available Bands List**.

Lesson 2: Mosaicking two images together



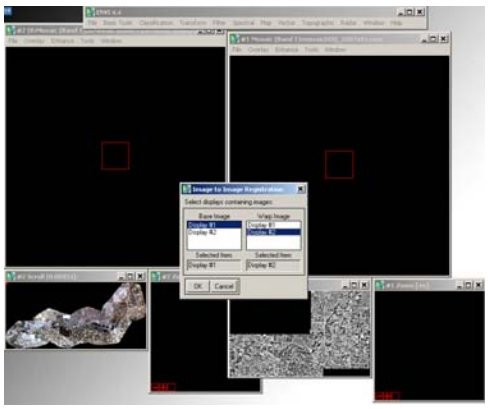
1. Under the ENVI main toolbar, go to **Basic Tools→Mosaicking→Georeferenced**.
   a. Under the Mosaic window go to **Import→ Import Files.** Highlight the two images in the **Select Input Files** box (hold shift and left click). Make sure The Spatial subset is set to "Full Scene" and the Spectral subset is set to "4/4 bands". Click "OK".
   b. The window should now show both your images. Note that you can arrange them by going to the file name, right-clicking and selecting which one goes on top and bottom.
   c. Go to **Import→Import Files and Edit Properties.** Highlight the two images (hold shift and left click). Make sure the Spatial Subset is "Full Scene" and the Spectral Subset is "4/4 Bands". Click "OK".
   d. In **Background to see thru/Data Value to Ignore** enter "0" and click "OK" (you'll do this twice).
   e. Go to **File →Apply**. Check that in **Mosaic Parameters** the x,y is set to .6000 meters. Resampling Is "Nearest Neighbor".
   f. Select **Output Result** to **File**. **Output Filename** to D: Quickbird_Mosaic. Background Value = 0. Click "OK".
   g. After about a minute a new image (the mosaic) will Be added to your **Available Bands List**. Load it In a display window following the steps of Lesson 1. Just to check that the Background Value really came Out as "0", right-click on the display window and go To **Cursor Location/Value**. That should bring up the Dialog box you see to the right. Click anywhere in the black region of the image and see what the **Data** values are.



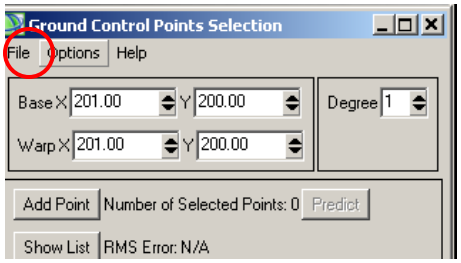
Lesson 3: Georectification

The Quickbird raster image you are working with has not been georectified. It is important to do this in order to continue analyzing the data.

1. Go to the **Available Bands List→File→Open Image**. Go to **mosaicDOQ_2007.img**. Load the image in grayscale in a new display window. This image is an already mosaic'd 1 meter DOQ of the same area as the Quickbird. Since it is already georeferenced, you are going to "warp" it to the unrectified Quickbird.
2. In the ENVI Main toolbar go to **Map→Registration→Select GCPs: to Image to Image**.
3. Enter the DOQ as the **base image** and the Quickbird mosaic as the **warp image**. Click "OK".
4. This will open another dialog box: The **Ground Control Points Selection** box.



5. Entering GCP's can take a long time, and for the purpose of this lab we are going to use GCP points that have already been created for this image. To do this we are going to go to the **File→Restore GCPs from ASCII** and open the file GCPS.pts file.



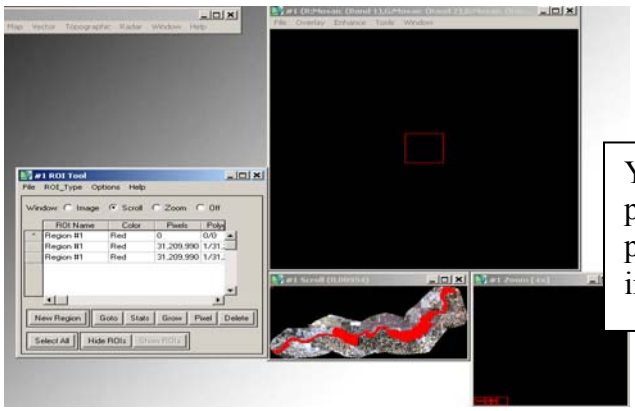
6. After the points are loaded you should see red point locations on both images. To investigate what these points are registering too go to **Tools→Geographic Link** in one of the **Image** display windows. Turn both Display boxes on. Click "OK". You will now be able to see the same scene in both images.
7. Scroll around one of the images to any of the points on the image. Use your **Zoom +** and **–** signs to see what the points are on. GCP's need to be highly accurate in both images in order to ensure a low RMS (i.e. high accuracy) for rectification. Try to add a point that is slightly off from one image to another. To do this, turn of the **Geographic Link** (follow the steps before to turn off) and place your **crosshair** cursor in the DOQ at a random point very different from the Quickbird. Click **Add Point** in the GCP window. How much did your RMS change from the 9.866497 that it was before?
8. **Delete** the last point you made by clicking on **Delete Last Point** in the **GCP window**.
9. Check that your RMS is still 9.866497.
10. Go to **Options→Warp File (as Image to Map)** in the GCP window. Put the Quickbird_Mosaic as your input file. Check that the Spatial Subset is "Full Scene" and the Spectral Subset is "4/4 Bands". Click "OK".
11. Go to X Pixel Size and Y Pixel Size. Delete whatever the value is and enter .60 meters. **HIT ENTER AFTER EVERY RE-ENTRY** (this is very important, the image will warp incorrectly if you don't.)
12. Keep the Warp Parameters Polynomial, Degree 1, Nearest Neighbor, Background 0.
13. Output Result to File. Choose filename: **D:Rectified_Mosaic_Quick**. Click 'Ok".

14. Wait awhile…it should take a five-ten minutes. You should be able to move on to the next part of the lab by opening ENVI again from the **START** menu. But be careful, DON'T delete or close the other window.

Lesson 3: Working with ROIs ("Regions of Interest")

The ROI is the cornerstone of remote sensing work in ENVI. ROIs are typically used to extract statistics for classification, masking and other operations. ROIs take a long time to make, so in this lab we are going to emphasize how to load and use them. Please see further ENVI workshops on how to create your own ROIs for your own specific projects.

1. Load the mosaic_envi file from the class folder. This is the original hyperspectral HyMAP data. Right click on the filename in the **Available Bands List**. Select to load it as a True Color. Also Load it as a CIR in another display window. Scroll around it. From the display group menu bar. Select **Tools→Profiles→Z Profile (Spectrum)**.
2. In a previous workshop, we masked out the data using an ROI polygon (**Subset Data via ROIs**). It takes awhile to do this, so we will provided you with the result. Open (in a new display) **masked_roisj.img**.
3. In the ENVI main toolbar, click on the **Basic Tools→Region of Interest→ROI Tool…**
4. In the ROI tool bar, Select **Off** in the **Window:** options
5. In the ROI Tool window, go to **File→Restore ROIs…** go to D:/hyperspectral_class_scheme.roi .



In the ENVI main toolbar, go to **Basic Tools→Reconcile ROIs Via Map**→Highlight **Region#1 [Red] 31209990points**. Click "OK". Select the **masked_roisj.img** as your input file. Click "OK".

You can make an ROI be a point, polygon (as you can see to the right) or a polyline, whatever pixels fall within, or intersect, the shape are part of the ROI.