LAB #1 IMAGE REGISTRATION

The following procedures will introduce you to Imagine computing environment that you will use for this exercise. Procedures follow the Introduction, and give you general step-by-step instructions.

Names of application programs are in CAPITAL letters (e.g. IMAGINE).
Terms that are frequently used to refer to programs or features in IMAGINE are in *italics*.
Important notes, remarks, warnings are in ***bold italics***.
Actions and keywords to choose from menus are mostly in **bold** lowercase letters.
File- and directory names, keys to press and commands you have to type are in `courier` font.
Filenames, variables, parameters you can choose are in <*`courier italics`*>,
and/or enclosed in greater/less than signs.

Left-click: Click on the left mouse button.
Right-click: Click on the right mouse button.
Left-hold: Press left mouse button and move the mouse to select an option.
Right-hold: Press right mouse button and move mouse to select an option.
Drag: Press mouse button and move an object to a new screen location.

ERDAS IMAGINE

ERDAS IMAGINE

INTRODUCTION

ERDAS IMAGINE provides an intuitive point-and-click graphical user interface. Most functions in IMAGINE are accessed through icons, pull down and form menus, where text dialog boxes, buttons and scrollbars make it simple to set all parameters before a function is applied to a displayed image. All dialog boxes and functions are fully documented with context-sensitive on-line hypertext help. You can easily explore a topic by following these hypertext links.

Important Notes:

- ***Never*** double-click on icons in IMAGINE. The response may be slow sometimes, but one click is enough. More clicking tends to "confuse" the program ...

- IMAGINE saves processing results to various files. These files may have the same name, and IMAGINE automatically uses different 3-character filename extensions (e.g. .IMG) to distinguish between its different file types. It is therefore important that you ***never assign filename extensions to IMAGINE files on your own.***

OVERVIEW

This brief introduction will first show you how to set up your basic IMAGINE environment. Then you will learn some methods for displaying and querying raster images in the viewer.

The procedures described here and in the other Digital Image Processing and Analysis (DIPA)-labs are ***not*** necessarily the most efficient way to use IMAGINE, but are intended to give you a start, then explore by yourself!

DATA REQUIREMENTS

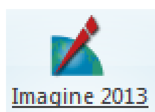
All of the required files can be found in `G:\Share\GEOG_3198_DIPA\Data\Lab_1.`
Make a directory under G:\Share\GEOG_3198_DIPA with your last name `G:\Share\GEOG_3198_DIPA\Engstrom)`and copy the images into your folder.

`1994_raw_dc.img`	Subset of a 6-band Landsat TM scene, from August 23, 1994. It shows the metro D.C. area including portions outside of the beltway.
`1994_raw_dc.rrd`	Pyramid layers (Imagine file type) for the 1994 TM scene
`2001_raw_image.img`	A 6-band Landsat ETM scene, from August 2, 2001. It shows the metro D.C. area, plus portions outside.
`2001_raw_image.rrd`	Pyramid layers (Imagine file type) for the 2001 TM scene

PROCEDURES

PART 1 IMAGE DISPLAY

START IMAGINE
In order to start IMAGINE **Start, Programs, ERDAS 2013, ERDAS IMAGINE 2013** ***(<u>ALL OF THE LABS ARE WRITTEN ASSUMING YOUR ARE USING THE NEW INTERFACE FOR IMAGINE</u>)***.

If you are using Citrix, click on the 

icon.

ERDAS is a big program that can work slowly, so be patient when letting it start. Eventually, the **ERDAS IMAGINE icon panel** and **viewer** window will appear on the screen. The main icon panel is used to launch the different components of IMAGINE (left-click ***once***, do ***not*** double-click on icons in IMAGINE!). You can split the viewer window as you like, and dynamically link different images to zoom and roam across different views of the same area.

RASTER IMAGE DISPLAY
Now you are ready to explore the IMAGINE user interface. For this portion you will be opening both of the Landsat images, the 1994 and the 2001, geo-linking them together, resizing them and arranging them side-by-side.
In the viewer, display the multispectral Ikonos image:

- **<u>F</u>ile**, **<u>Open</u> <u>R</u>aster...** (or just right-click on the 2D View #1).
- Navigate to the folder that is storing your data in the Look in: section
- Right click on the raster file `1994_raw_dc.img,`
- *Don't click OK yet*,
- Click on **Raster Options** tab,
- display it as **True Color**,
- Accept the following color gun assignments band 4=**Red**, band 3=**Green**, band 2=**Blue** and **Fit to Frame** to fit the entire image in the Viewer.
- Leave default settings for the rest, and left-click **OK.**

Now you display the 2001 image of Washington, D.C.in a second view

- From the icon panel select Add views, Display two views
- 2D View #2 should now be in your Contents screen, using the steps above

Open the file `2001_raw_image.img`
display it as **True Color**,
Accept the following color gun assignments band 4=**Red**, band 3=**Green**, band 2=**Blue** and **Fit to Frame** to fit the entire image in the Viewer.
Leave default settings for the rest and left-click **OK.**

Link the two Viewers geographically, to spatially coordinate the displays in both Viewers:

From the Icon panel, choose **Link Views, Link Views.** 

This will show the extant of one image relative to the other image.

In the icon bar, click on the **image info** icon 

, or Right click on the image layer in the contents bar and scroll down to Metadata. This is the metadata information button. This will provide you with the range in pixel digital number values for all of the different bands. You can scroll through the different bands by selecting the drop down menu, or buttons next to the layer number at the top. The image info will also provide you with the projection information, the pixel size, the x and y location of the upper left, right and lower right, left corners of the image, the projection and many other useful things.

ZOOMING AND PANNING

Explore some methods for zooming and roaming on a displayed image:

In the left Viewer, right-click and find zoom. This will bring a large number of ways to zoom in and out of the image.

Try the magnifying glass tools for zooming :

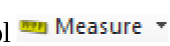
Left-click on the zoom in +glass, then left-click on the area you want to see magnified.

Try the “roam image” tool (

) to move around on the images.

After you explored enough, click on the select tool (the arrow icon) and set both Viewers back to the original display. Right-click in Viewer, Fit To Frame.

Do the images line up?

One way of determining how far off the images are off is to use the measure tool 

Put the inquire cursor on an obvious landmark in on image and then select polyline from the measure list 

Draw a line from where the inquire cursor is in the image that is off to where it is in the other image
This should create a line length in meters that can be used to see how far off the images are.

<u>Written Assignment Part 1</u>:

1. What areas are covered in both images? What other metropolitan area is in the image with the larger extant?
2. Does there appear to be any atmospheric issues with one of the images? If so what is it?
3. Compare the two images, does there seem to be any obvious errors as to the location of the where things are located spatially? Approximately how far off do the images appear to be?

PART 2: IMAGE SUBSETTING

BACKGROUND

Many times you are interested in only part of scene and processing large images can take a long time. Therefore, the study area and the most suitable bands are usually selected using subsetting techniques before any image-processing project begins. In this study the 1994_raw_dc.img is a much smaller spatial extent than the 2001_raw_image.img. Therefore, the 2001 image will be subset to match the approximately the same spatial area. The most straightforward way to do this is using the inquire box and will be described below:

DATA REQUIREMENTS

`1994_raw_dc.img`
`2001_raw_image.img`

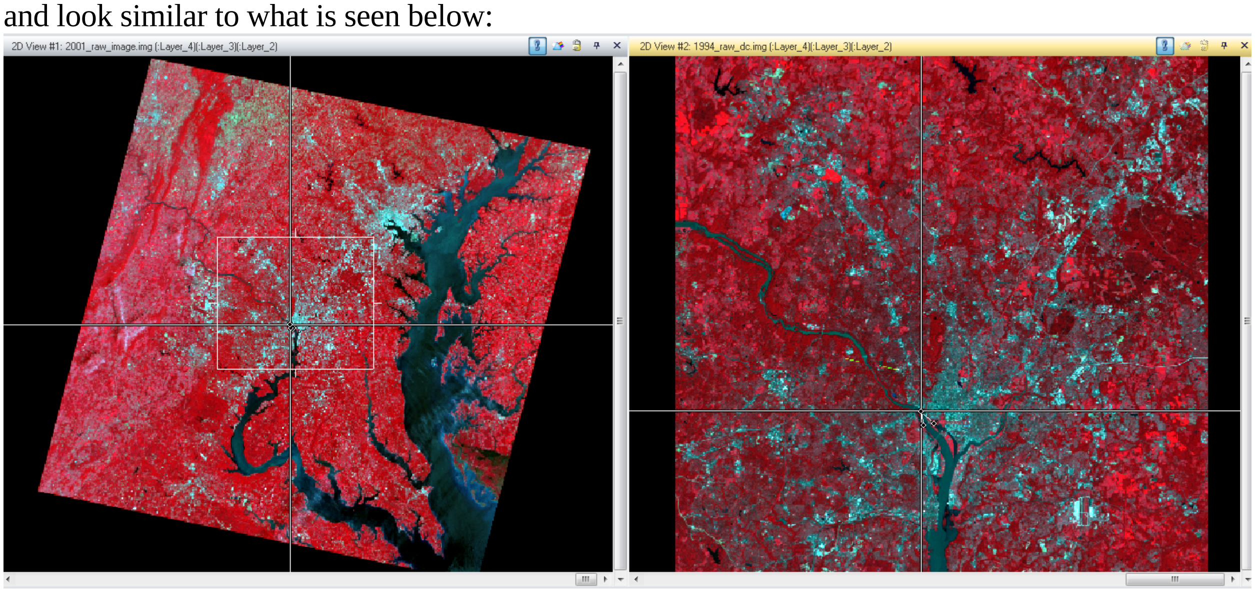
PROCEDURES

IMAGE SUBSETTING

The two images should be opened side by side and geo-linked as described above.

In the view that has the smaller image, `1994_raw_dc.img` right click and select fit to frame.

If it is set up correctly the extant of the 1994 image should be displayed in the 2001 image and look similar to what is seen below:

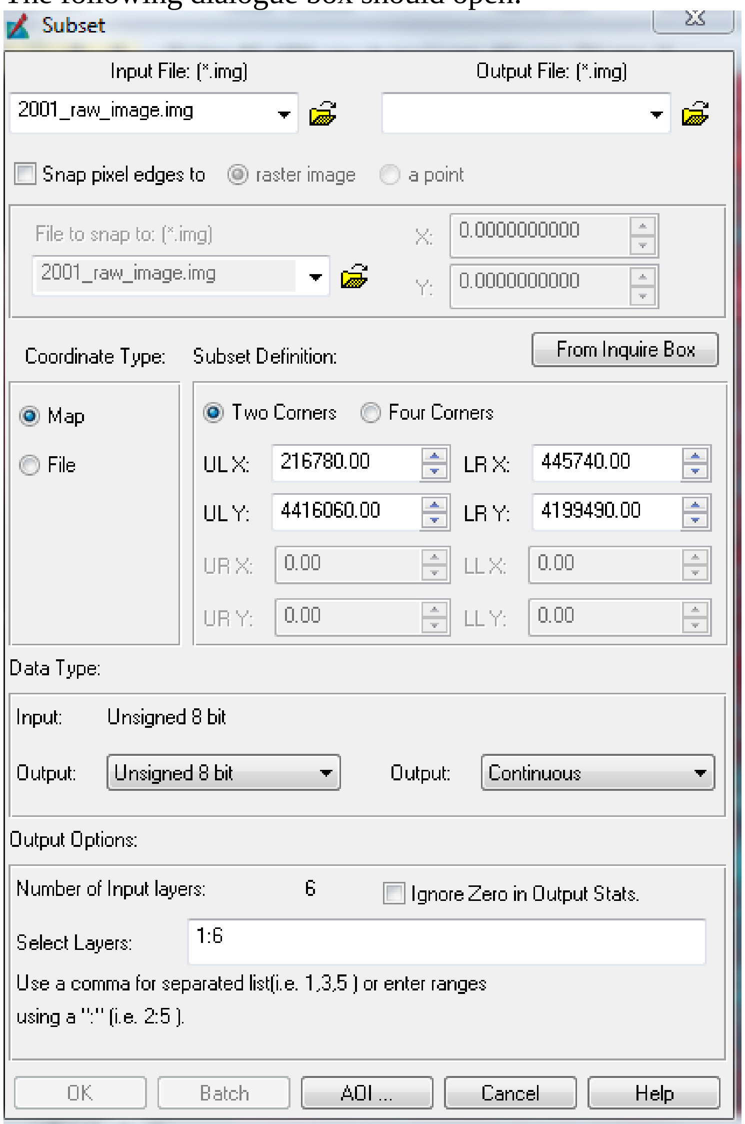


Make sure you have the 2D View with the 2001 image selected.

On the main icon panel, select **Inquire**, **Inquire Box**
A box should display on the 2001 image.
Adjust this box so that it covers an area slightly larger than the extant of the smaller 1994 Image.

Click on the **Raster** tab Raster then **Subset and Chip** 

then **Create Subset Image**.
The following dialogue box should open:



For the output file, name it `2001_raw_sub.img` . Make sure to save it to your own folder in the **<u>`G:\Share\GEOG_3198_DIPA` directory. You will have to navigate to this location by clicking on the folder icon</u>** 

For the Subset Definition, select **From the Inquire Box**
Leave the rest as defaults, and select **OK**
The Process List should come up and once the green bar reaches 100% it is done.

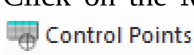
Written Assignment Part 2:
1. In general, what is the area covered by these two subset images?

BACKGROUND
Now that you have subset the image to the approximate size it is time to geometrically align the images. This is the most important part of preparing imagery for doing change detection because if the images do not line up you will detect change that did not actually occur, and is a result of mis-registration. Overall, this is a painful, time consuming process, however it must be done when the images are visible off as is the case with the data in this lab.

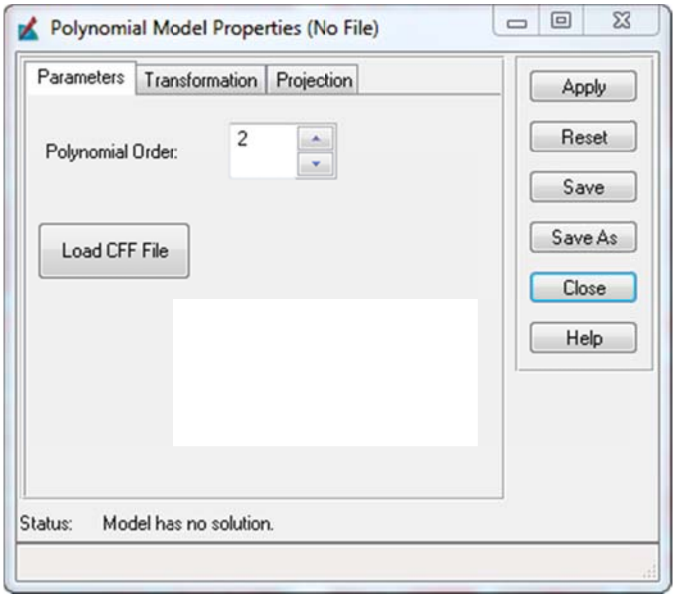
In this lab you will be registering the 1994 data to the 2001 one data because we are assuming that the 2001 data are better spatially located and using this as the base image. Typically when you do image to image registration the base image should be geo-located using ground based digital global positioning system (GPS) points. In many cases today imagery, in particular Landsat data are relatively well registered as this has been done globally and now there are automated routines that get it close to exact location. Remember with Landsat, since it is 30m spatial resolution it does not have to be too fine. However, with the newer, high resolution imagery, something off by 15 meters (half a TM pixel), it is off by large number of pixels.

PROCEDURES
IMAGE TO IMAGE REGISTRATION
To do this process you will be using the Warptool in Erdas Imagine. This tool can crash, so be sure to save your work and the points you collect.

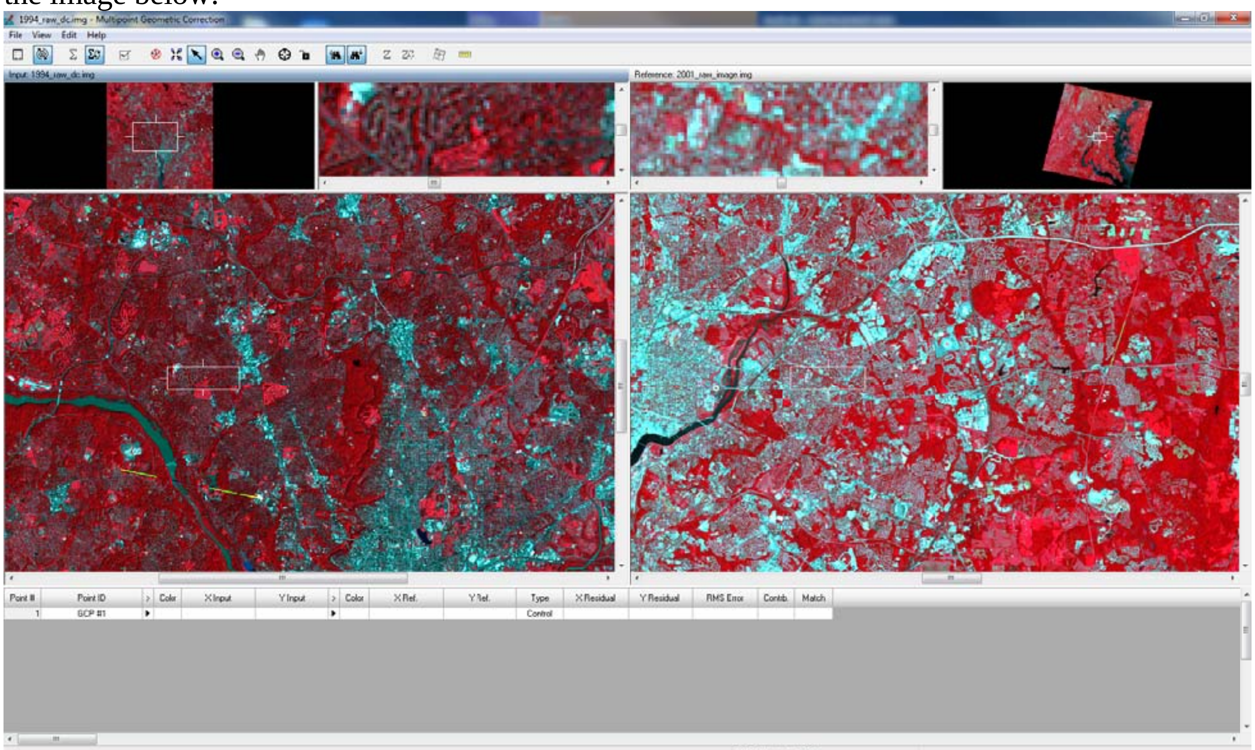
Make sure you have the `1994_raw_dc.img` open in a viewer.

Click on the **Multispectral Tab**, then Transform & Orthocorrect select **Control Points**


.
Set Geometric Model will come up, scroll down and select **Polynomial**
The GCP Tool Reference Setup should come up, select **Image Layer (New Viewer)**
Select the `2001_raw_image_sub.img` as the reference layer. You are using this as your base image.
Keep the current UTM (Zone 18) coordinate system.
On the Polynomial Model Properties, select 2 and then apply.
This does not always come to the front of the screen. You may need to find this be clicking on the Imagine Icon at the bottom of your screen.



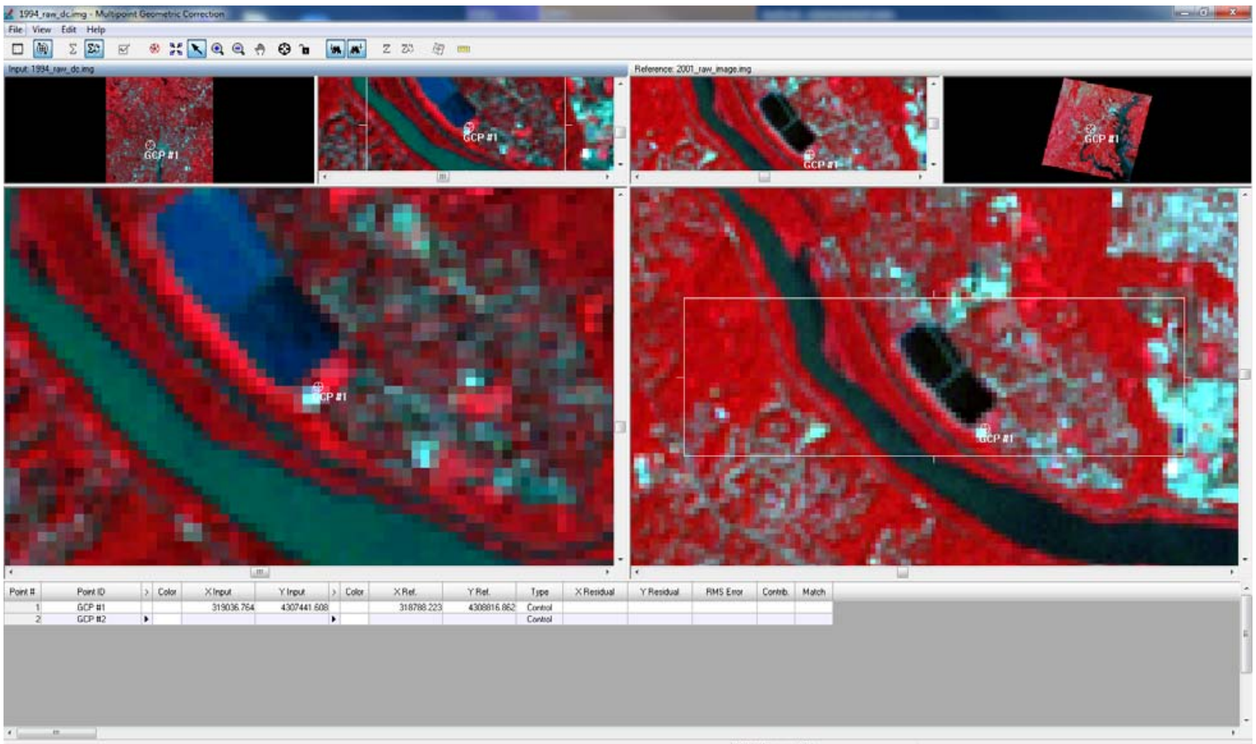
After selecting the Polynomial Model Properties, your screen should now look similar to the image below:

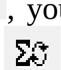


Now you will be select, ground control points (GCPs). These are areas in the image that you can obviously see in both images. For this lab make sure to collect at least 13 and cover the full extent of the imagery (every corner and every side).

To do this find the approximate same location by panning and moving both of the scenes. This can be difficult at first. Use the water bodies as guides as to where you are in a scene.

Then select the GCP button . Put one in both locations on the images where the same feature is located.



Do this for at least 6 locations throughout the scene, making sure to save your points as you are doing this.
To do this, click **File, Save Input As…**select a name and the proper location.
Then**, File, Save Reference As…** select a name and the proper location.
The second and, next times you do this, simply click **File, Save Input to Image Node**
And **File, Save Reference** for the GCPs of the image you want to transform and the reference file respectively.
After, collecting 6 locations, click on the **Solve Geometric Model With Control Points** button , you may need to click on the **Set Automatic Transformation Calculation** button first 

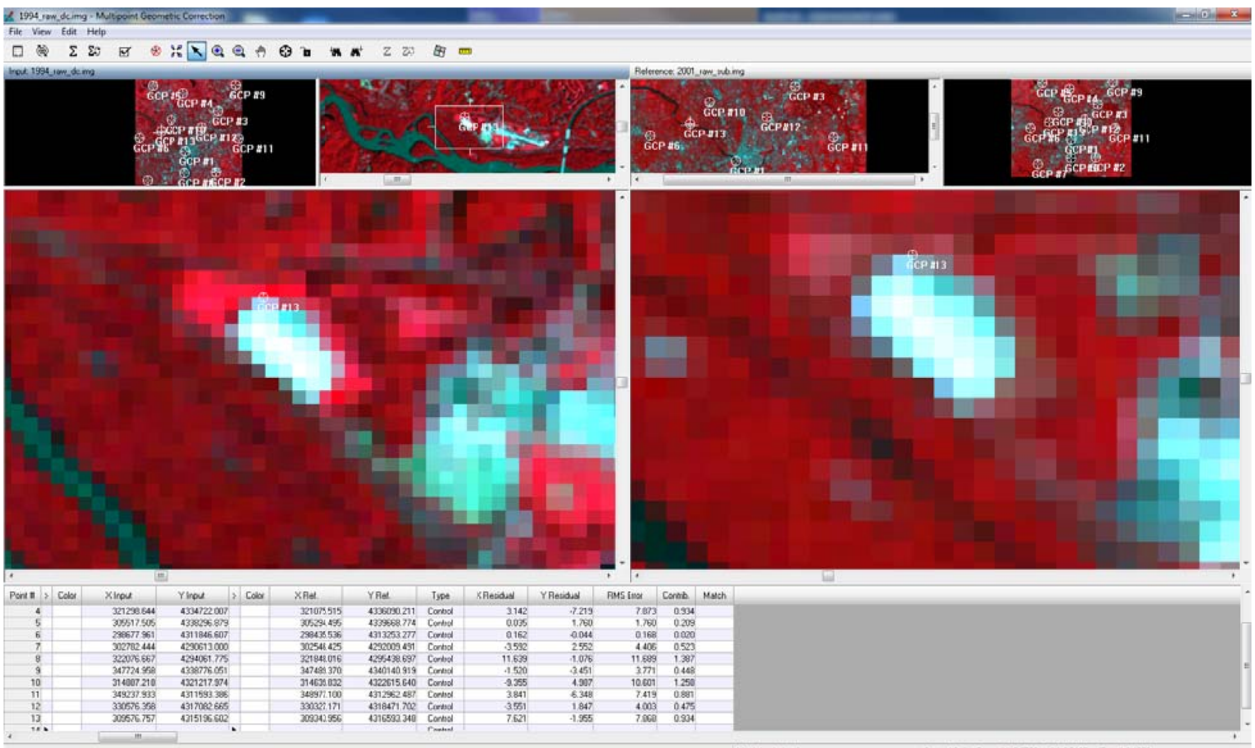
This will now give you information about the control points you have selected. The RMS Error and Contribution will show up in the GCP box at the bottom. This will give you a measure of the impact that each of your control points has on your transformation.

Point #	>	Color	X Input	Y Input	>	Color	X Ref.	Y Ref.	Type	X Residual	Y Residual	RMS Error	Contrib.	Match
4			321298.644	4334722.007			321075.515	4336090.211	Control	3.142	-7.219	7.873	0.934	
5			305517.505	4338296.879			305294.495	4339668.774	Control	0.035	1.760	1.760	0.209	
6			298677.961	4311846.607			298435.536	4313253.277	Control	0.162	-0.044	0.168	0.020	
7			302782.444	4290613.000			302546.425	4292009.491	Control	-3.592	2.552	4.406	0.523	
8			322076.667	4294061.775			321848.016	4295438.697	Control	11.639	-1.076	11.689	1.387	
9			347724.958	4338776.051			347489.370	4340140.919	Control	-1.520	-3.451	3.771	0.448	
10			314887.218	4321217.974			314639.832	4322615.640	Control	-9.355	4.987	10.601	1.258	
11			349237.933	4311593.386			348977.100	4312962.487	Control	3.841	-6.348	7.419	0.881	
12			330576.358	4317082.665			330327.171	4318471.702	Control	-3.551	1.847	4.003	0.475	
13			309576.757	4315196.602			309343.956	4316593.348	Control	7.621	-1.955	7.868	0.934	

The RMS Error, should be below half a pixel, (i.e., around 15 m for Landsat) and the contribution should be less than 2 for each point. The higher the error and/or contribution the more of an impact that control point has on the transformation. The goal is to reduce the error or the contribution, unless you know for sure your points are in the correct location.

If you want to delete problem GCPs, left click under Point # on the row with the GCPs, you want to delete select them and then right click and select Delete Selection.

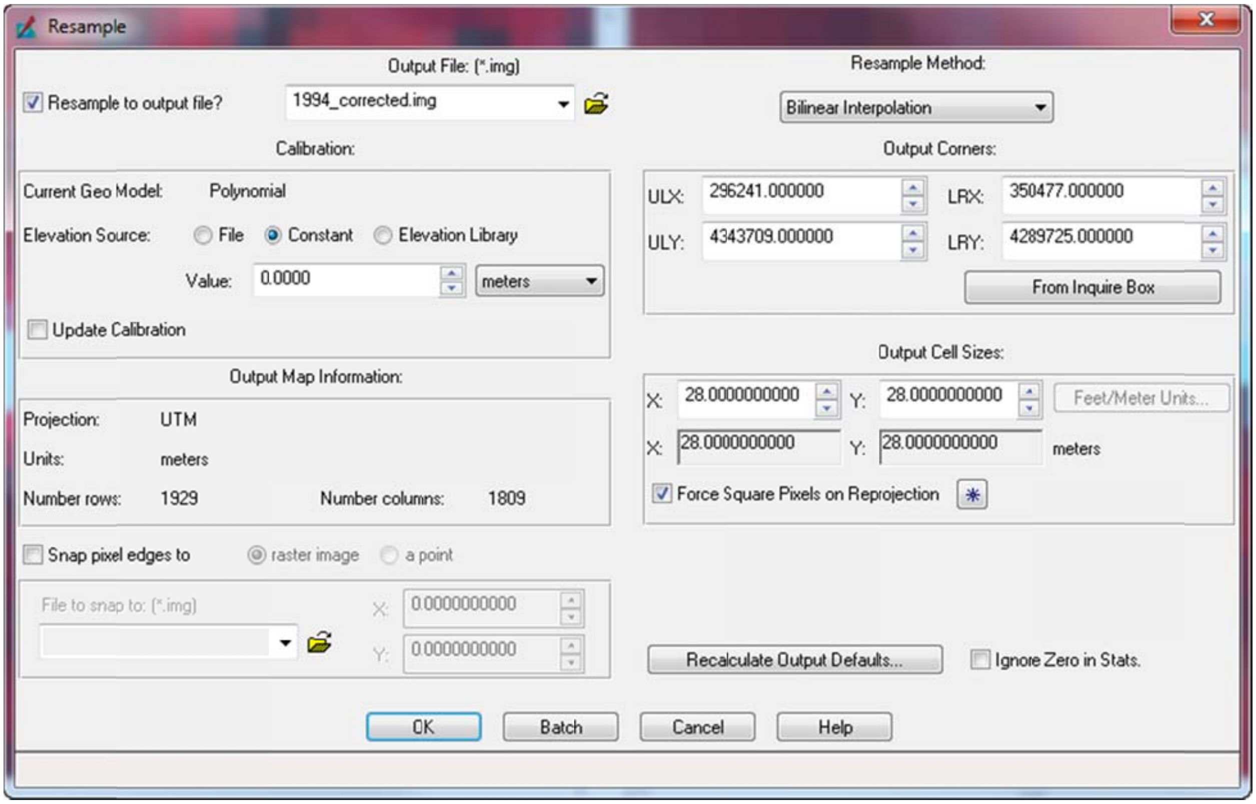
Continue collecting and deleting GCPS until you have approximately 13 covering the entire scene as you see below.



Once you have collected all 13 GCPs, and the errors have been reduced. You can than transform the image.

Select the **Display Resampling Dialogue Box** 

Change the Output file to `1994_corrected.img` making sure to navigate to where you want to save it.
Select the Resample method to **Bilinear Interpolation**
Use a constant elevation source as we do not have a DEM for DC.
Force Square Pixels on Reprojection.
The cell size can either be 28 or 30 meters.



Once this is done processing display the `1994_corrected.img` and the `2001_raw_image_sub.img` next to each other. Do they line up now? If they do not, you need to check your work.

<u>Written Assignment Part 3</u>:

1. What type of features did you generally used to collect the image to image GCPs? Could these types of areas always be used, even with higher or lower spatial resolution imagery?
2. What is RMS Error and what was your highest and lowest value? Did these GCPs correspond with the ones with the highest/lowest contribution to the orthorectification?
3. What was the most difficult part about choosing the locations to locate the GCPs?
4. Why do you think you were asked to capture approximately 13 GCPs and not to solve the geometric model until you had at least 6 points?
5. How well did the two images spatially register? Did it improve over the raw imagery? If so, by how much?
6. If you had to do it over again, what would you do differently?