Spatial Analysis Center
Center for Resources
Yellowstone National Park

How to rectify scanned air photos to reference imagery (& a DEM) using ERDAS Imagine AutoSync

So you have an orthorectified reference image and an air photo you just scanned in. The following methodology will help you process your air photo in order to use it in GIS or do further image processes.

Please direct any comments, questions, or suggestions to: yell_gis@nps.gov

The ERDAS documentation for this module will help you understand the process - I would suggest scanning over the following: C:\ERDAS\ERDAS Desktop 2010\help\hardcopy\ AutoSync.pdf
(path will vary with your version, but this should get you there)

GENERAL PROCESS STEPS:

1. Prep your reference image (if needed)
2. Create an AutoSync project
3. Add your input and reference images
4. Add manual control points
5. Verify and/or adjust your project parameters
6. Solve model
7. Run automatic point matching (APM)
8. Verify and/or delete control points
9. Re-solve model
10. Resample Image (create output image)

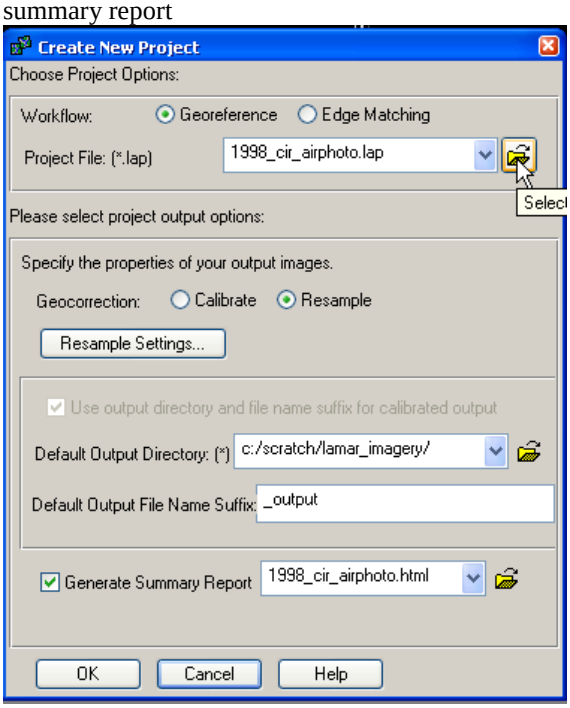
1. Prep your reference image (if needed)

You need a solid reference image for your area. Ideally this image will be larger than the airphoto you are trying to correct and having similar characteristics.
For instance, if you are attempting to rectify a color infrared air photo of the Mammoth area from 1982, you should find a color infrared reference image (or an image with similar bands) that covers the entire Mammoth area. Ideally the spectral signature would be similar - if it's a wet year /month you are trying to rectify, pick a reference image taken in a wet year/month.
You may need to clip out a section of your reference imagery, or mosaic quarter quads together to cover your area of interest. You only get one reference image per project!

2. Create an AutoSync project

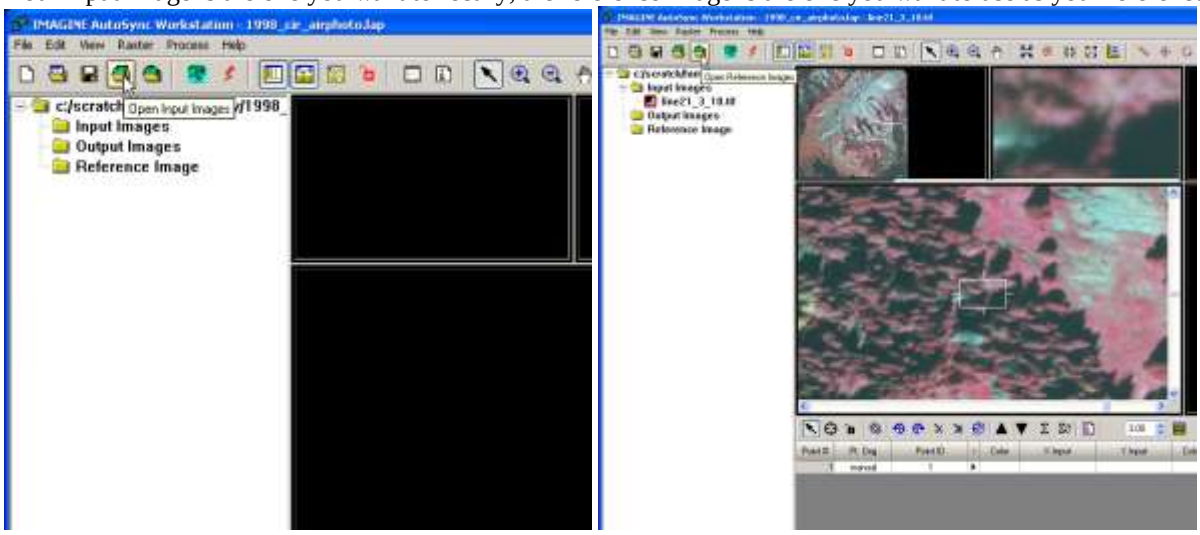
Open Imagine
Open AutoSync → AutoSync Workstation
up pops a new project window, and an input window
select "New Project"

In the "Create a new project" window, set workflow to "Georeference", set your project file location, output Geocorrection as "Resample" set your resample settings as desired, and choose locations for your output and summary report

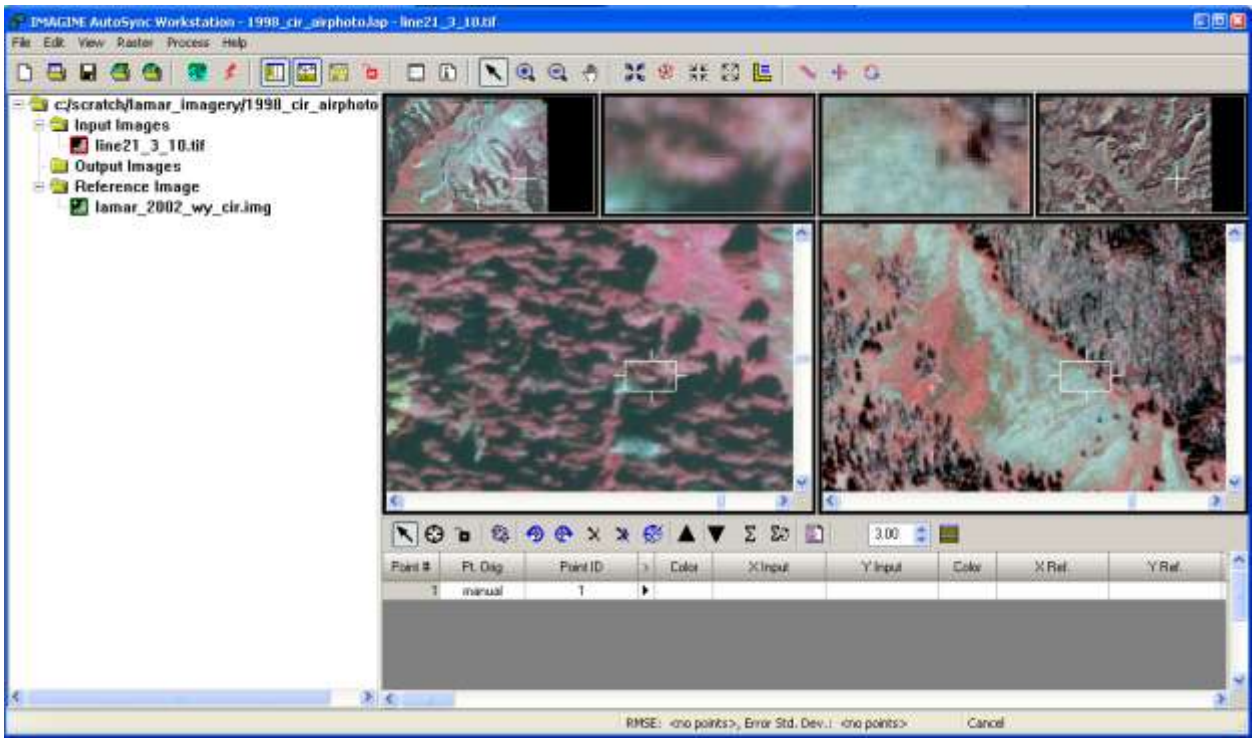


3. Add your input and reference images

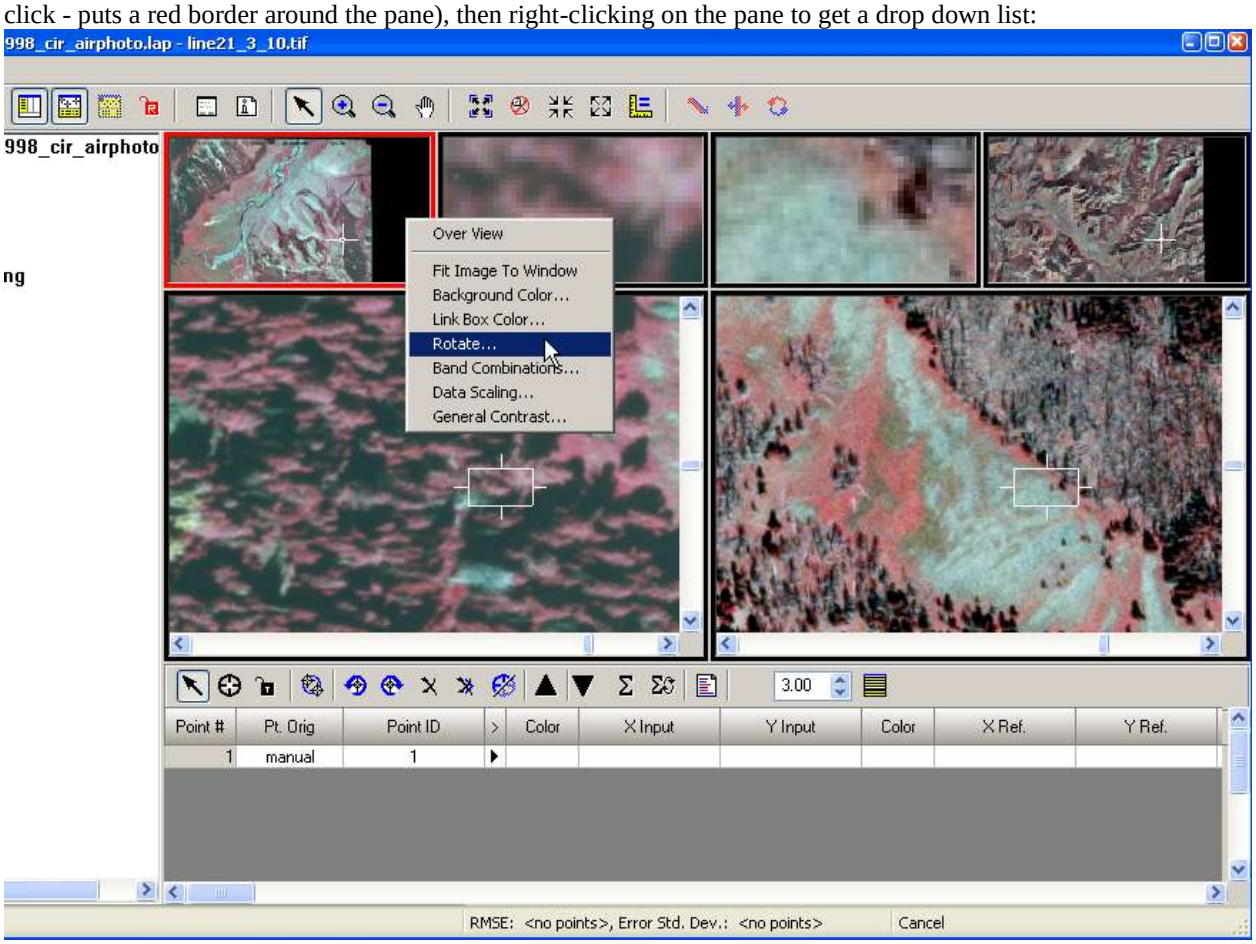
Your input image is the one you want to rectify, the reference image is the one you want to use as your reference.



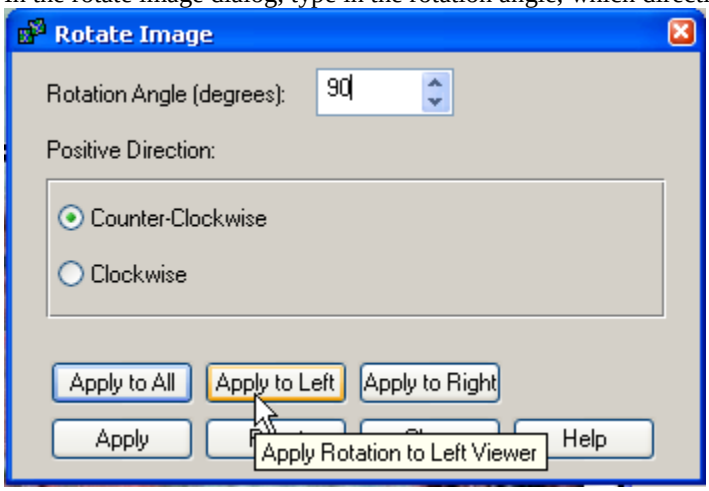
Your window should look something like the one below, with your input image taking up the left 3 panes, and the reference image taking up the right three panes.



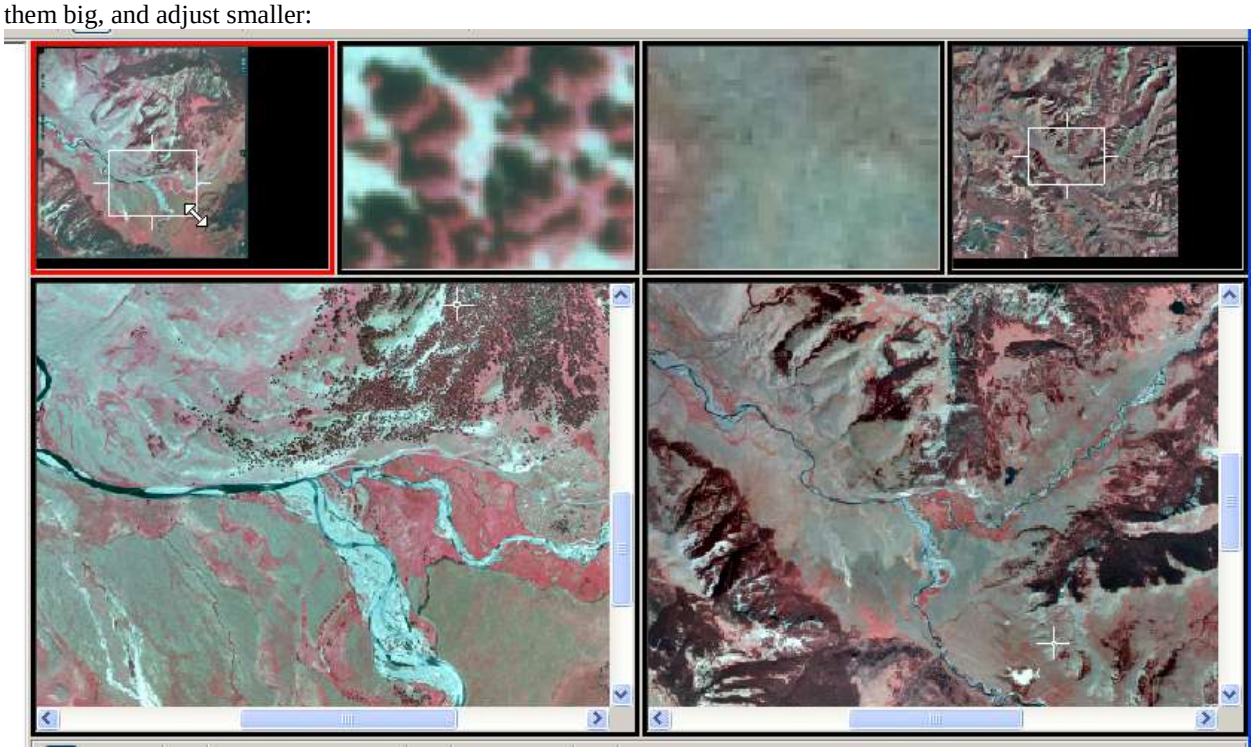
If your input image is rotated (as many air photos are) you can rotate it the correct direction by selecting a pane (left click - puts a red border around the pane), then right-clicking on the pane to get a drop down list:



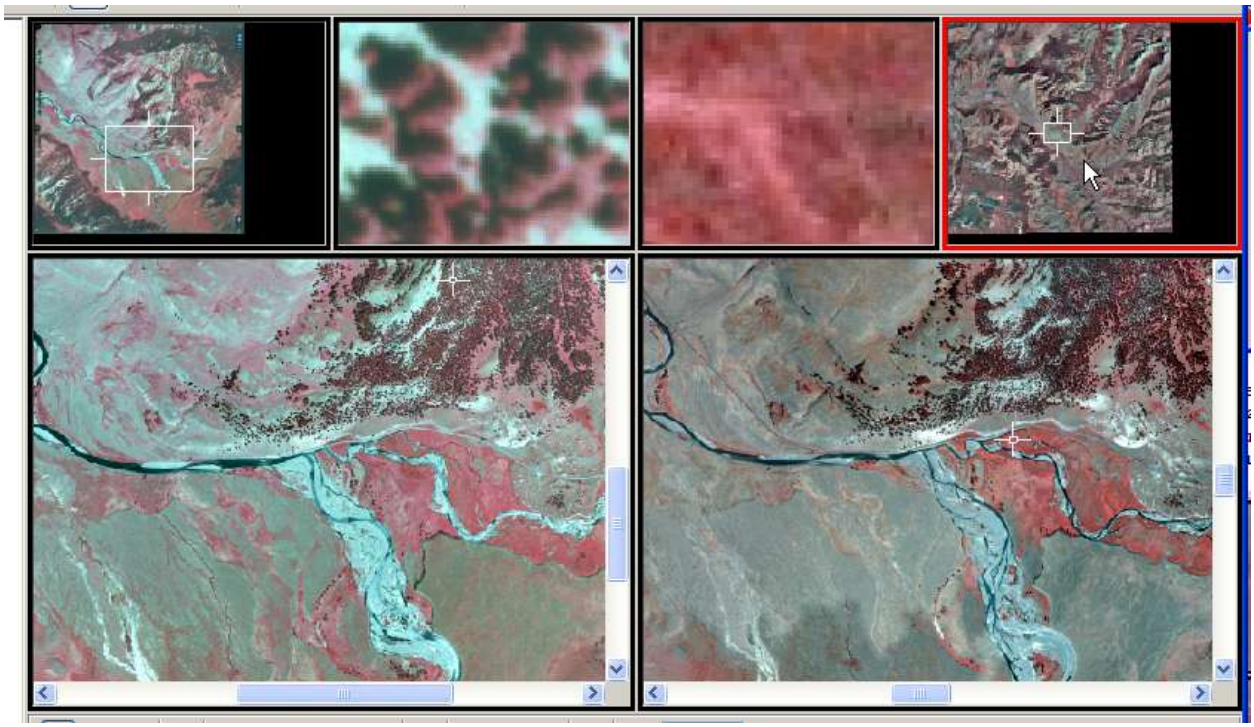
In the rotate image dialog, type in the rotation angle, which direction to rotate, then apply to LEFT only.



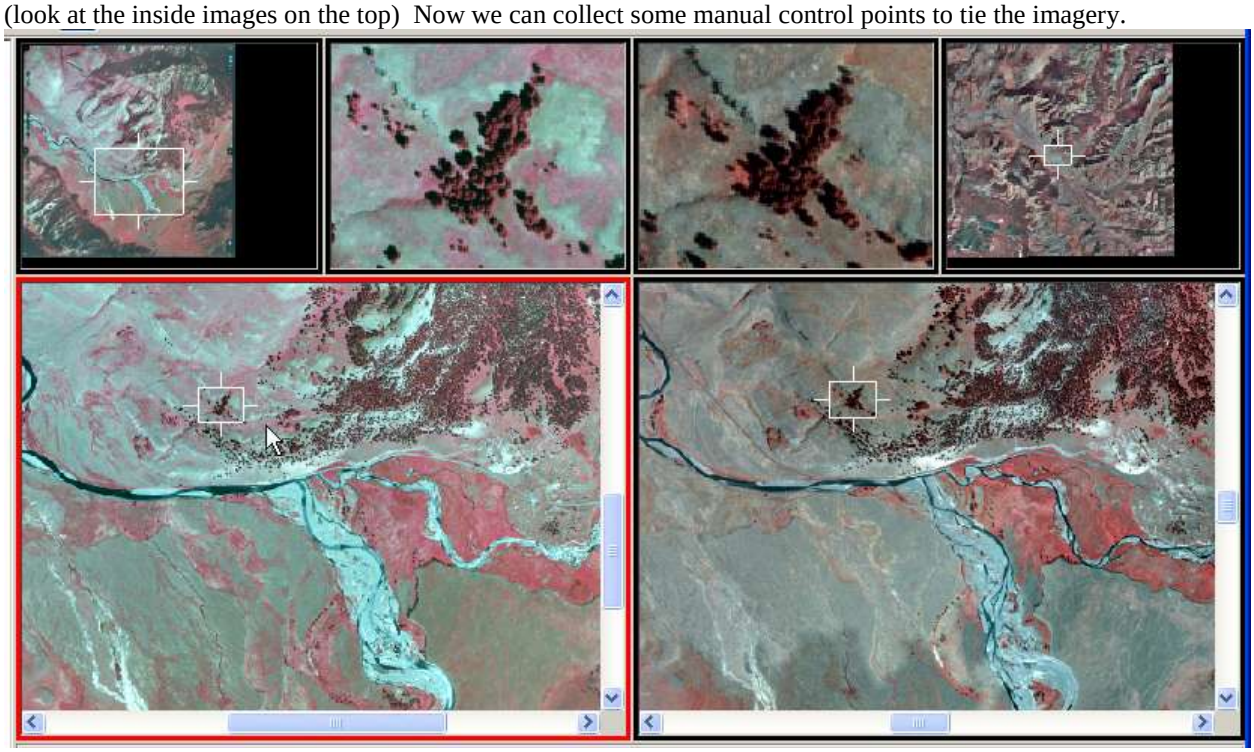
Next you will want to get your head inside both images. Chances are they are not the same scale/coverage area, so you will want to adjust your zoom boxes in both the upper right and upper left panes to show approximately the same amount of area in the bottom pane. Start by looking at your input image. Try to pick out the four corners and match those mentally with the reference image. Now adjust your link boxes so they show about the same area. Start with them big, and adjust smaller:



In the image above, the upper outside panes have roughly the same size boxes, but different coverage. I will make the right box smaller to compensate:

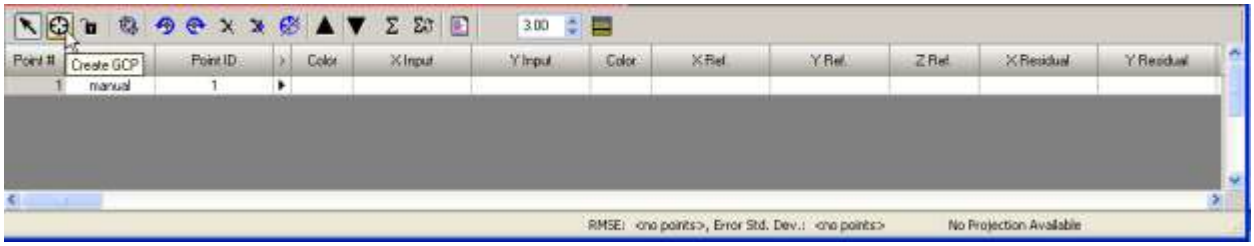


Just about perfect!
Now you can adjust the link boxes in the lower panes to about the same size, and use them to zoom in on the image: (look at the inside images on the top) Now we can collect some manual control points to tie the imagery.

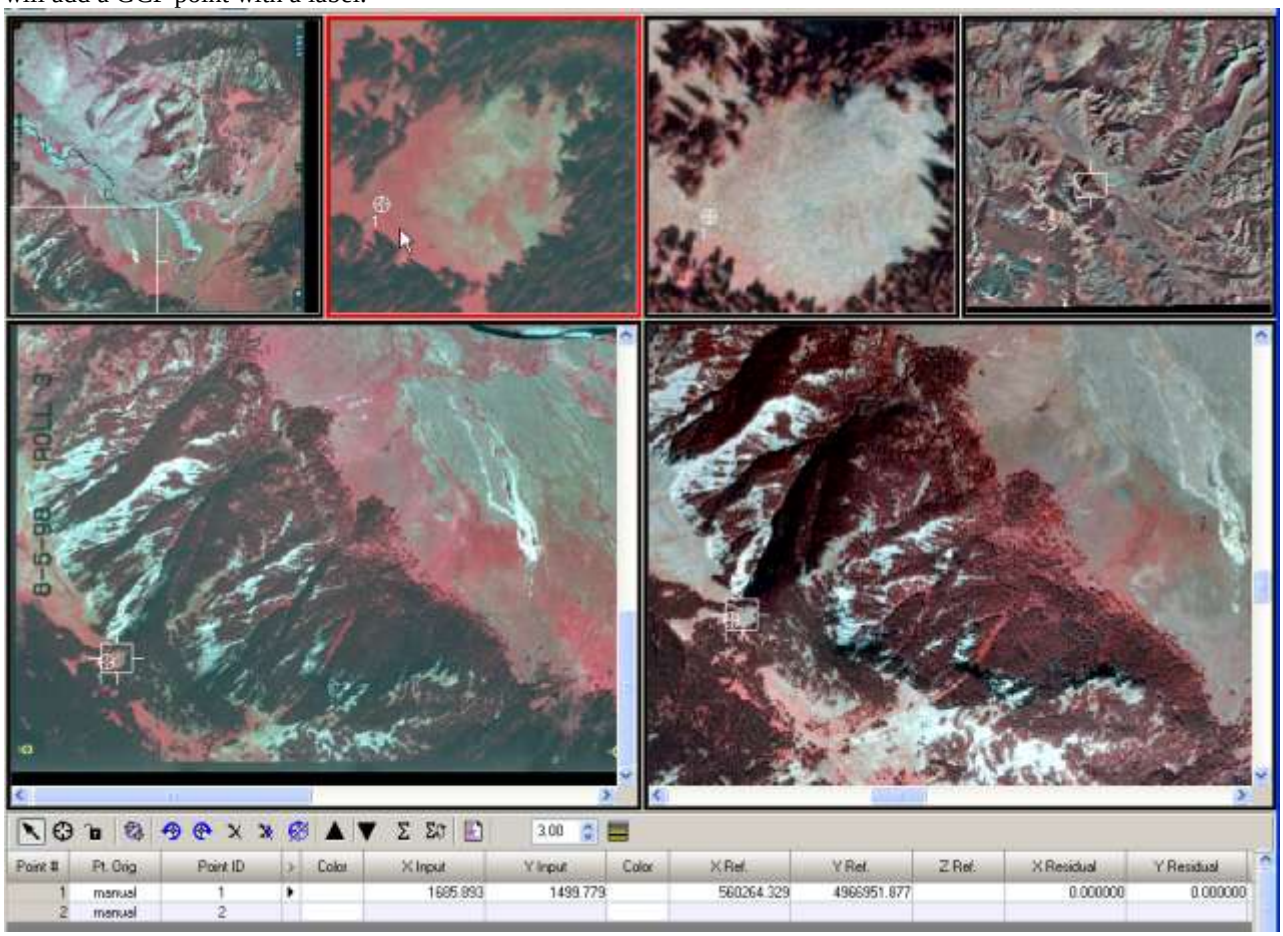


4. Add manual control points

The text box and tools at the bottom of the window is where you do your control point manipulation.



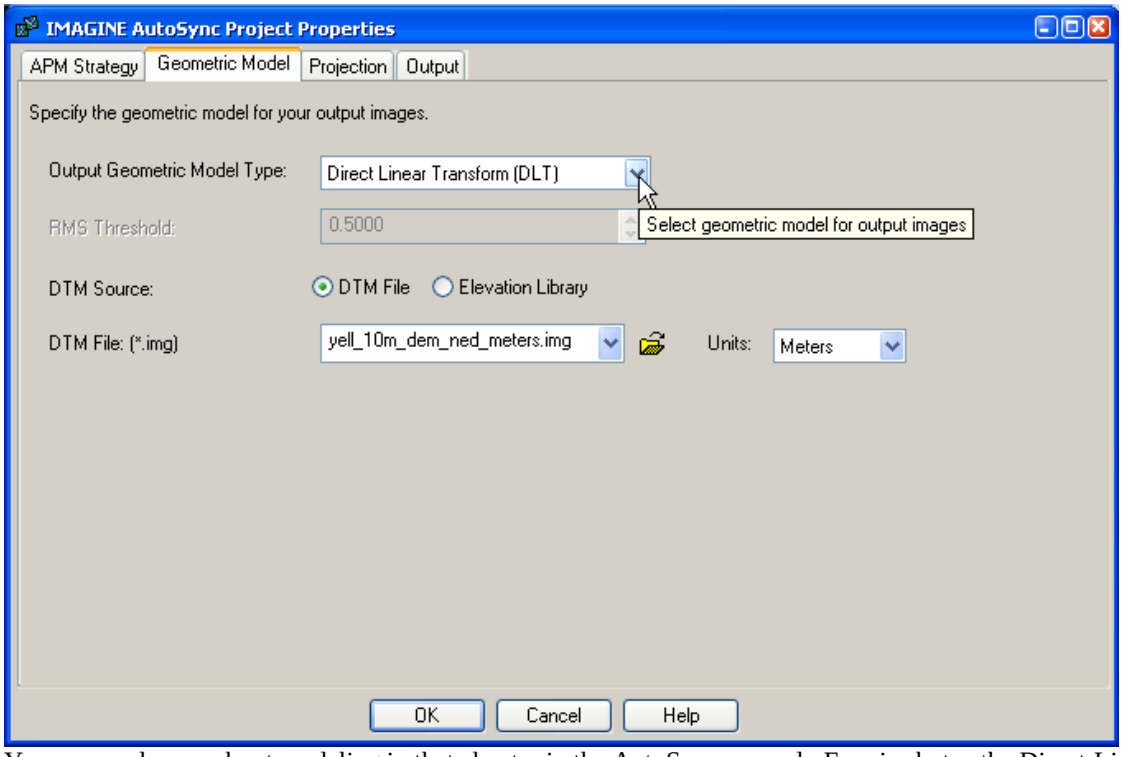
Click on "Create GCP" then click on the location on the reference image, then the same location on the input image. It will add a GCP point with a label.



A note about manual control point creation: Make sure you have a wide distribution of points, and a bare minimum of 10 points total (20 is better). For the Lamar project, we were looking at a particular area, so we chose 9 points (if you divided the image into quarters, the corners would be where we tried to put control points) then we added 11 in our area of interest.

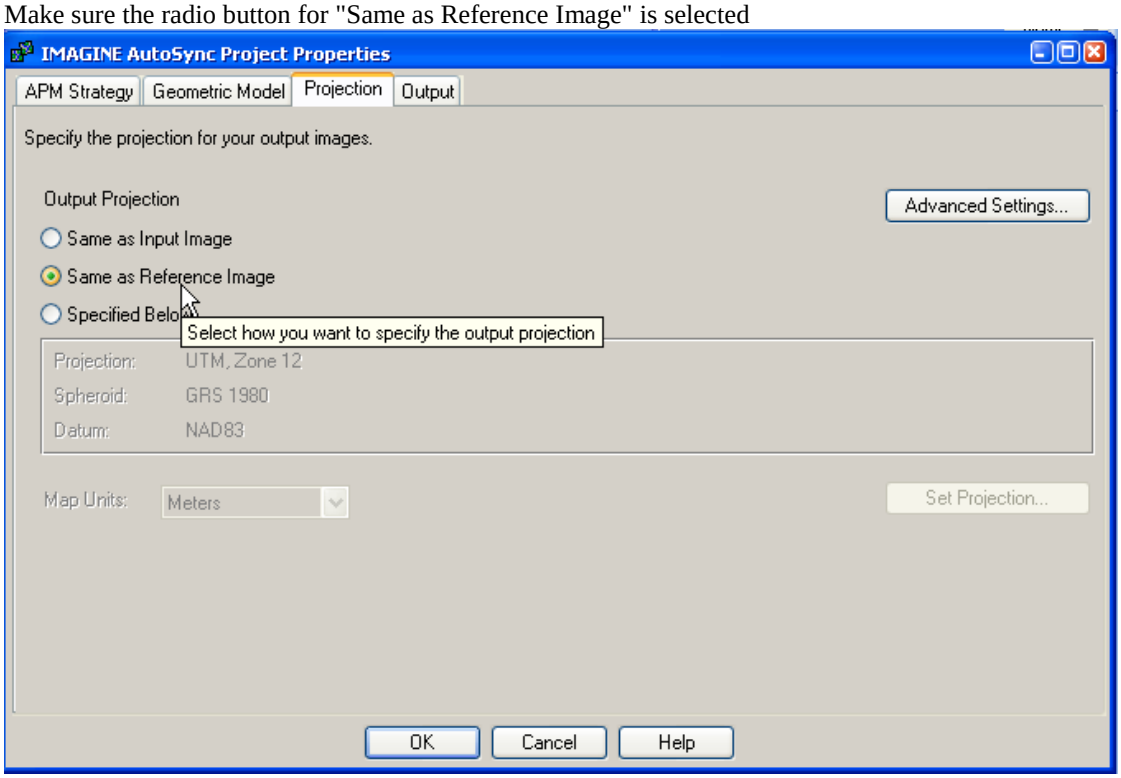
5. Verify and/or adjust your project parameter

Before solving your model or running automatic point matching (APM), you will need to set up your parameters.
Go to Process → Project Properties…
Here you will define what strategy you want to use for APM, the geometric correction model, projection, and output settings. Leave the APM tab for now (we will deal with it last)
Select the Geometric Model Tab



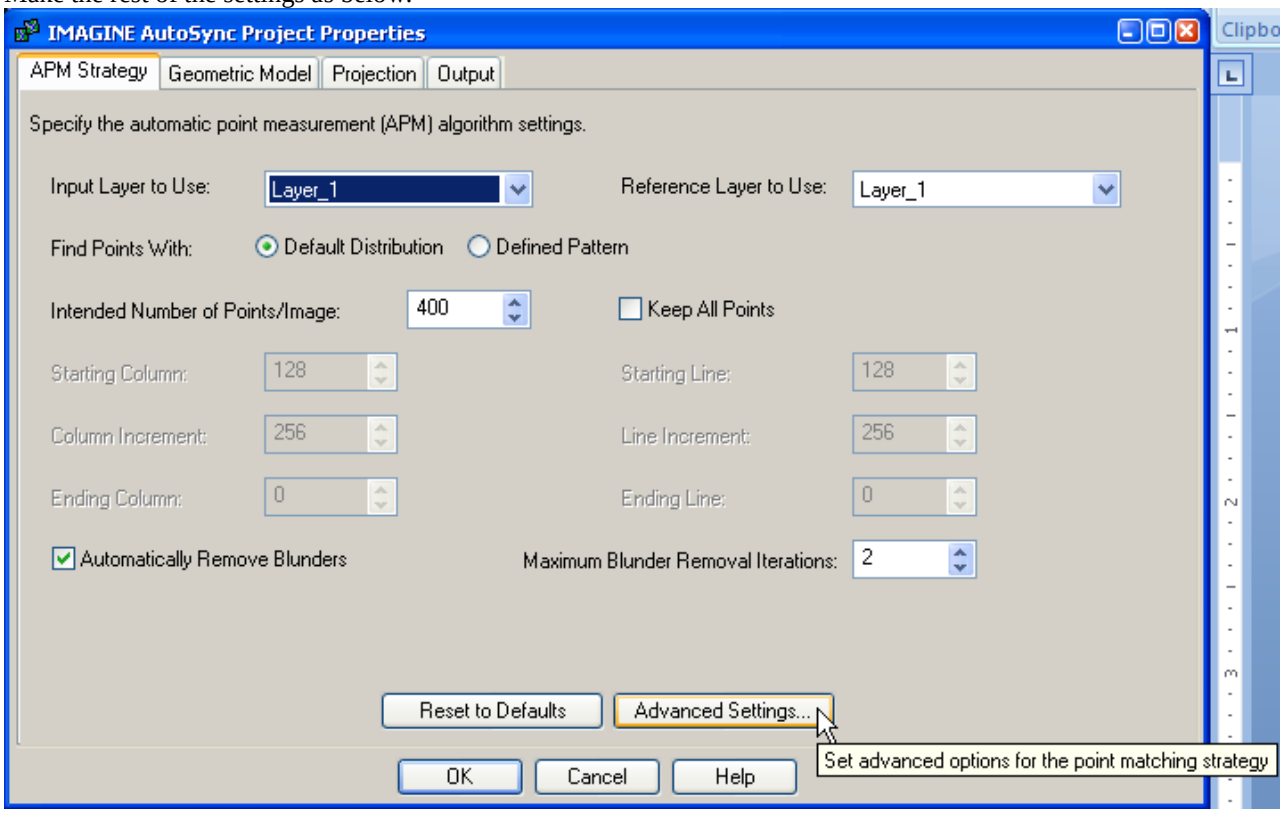
You can read more about modeling in that chapter in the AutoSync manual. For air photos the Direct Linear Transform is the best model to use. Once you have selected DLT, the option comes up to use a DTM. Use the DEM at G:\yell_data\elevation\yell_10m_dem_ned_meters.img
Click OK on the warning dialog, then make sure the units are set to meters.

Click the "Projection" tab
Make sure the radio button for "Same as Reference Image" is selected

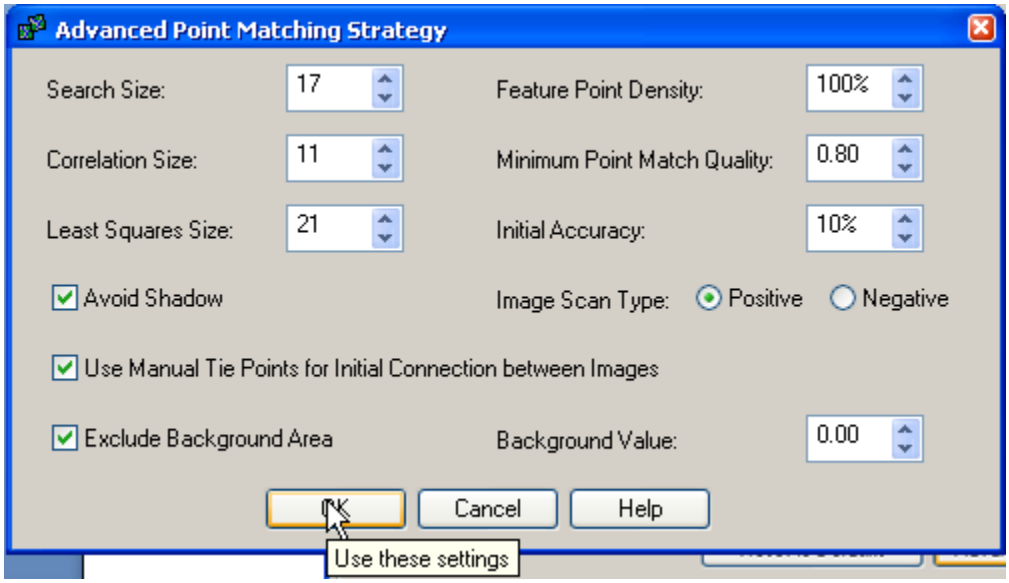


On the "Output" tab, you can make changes to your output and resampling settings - these were defined when you created your project, so only change the settings if you need to.

Last, click back on the first tab, the "APM Strategy" tab.
This tab has a lot of settings, all affecting the generation of automated tie points. You should read the section in the pdf manual "APM Engine" if you have questions.
First, make sure you are matching the correct layer to the correct layer - if you have a 3 band image and a 4 band image, pick the images that are spectrally closest to one another.
Select "Default Distribution" radio button - intended number of points is up to you.
Make the rest of the settings as below:



Click on "Advanced Settings…"
You can read up on what each of these settings mean, but for now accept the defaults, check on the boxes and radio buttons as below:



Click OK, then click OK again on the "IMAGINE AutoSync Project Properties" dialog box

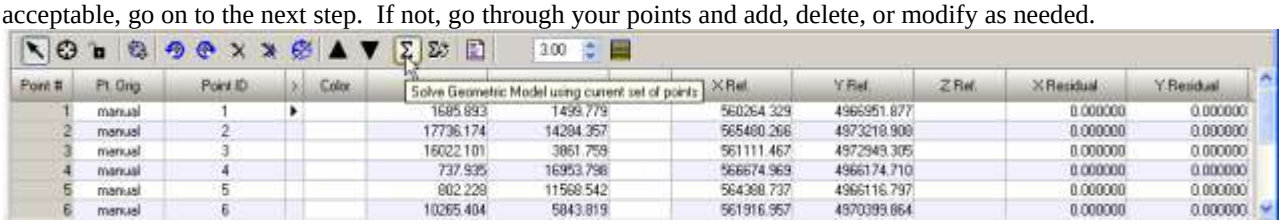
Ideal Situations for Good APM Performance (ERDAS Documentation)

For the best APM results, try to ensure that the following conditions are met as much as possible. Not meeting one or more of these conditions does not necessarily mean that the APM results will be of poor quality.

- Use images with an overlap larger than 40%.
- Use images with the same or similar resolution or pixel size.
- Use images that were captured in the same season, at the same time of day (similar illumination conditions), and with similar weather situations with good visibility.
- Use images that were captured by the same or similar sensor.
- Select the same band or a similar band in the images for point matching to ensure similarity of radiometric characteristics.
- Use images that are properly orthorectified (if appropriate). This reduces the impact of vertical displacement and other distortions. Pay special attention to quality of orthorectification. A poorly orthorectified image produces bad results and is misleading in raising your expectation.
- Use images with relatively flat terrain. There is minimal vertical displacement and the radiometric characteristics are better preserved because they have not gone through extensive modification in a prior rectification process.
- Ensure good initial map information is available for the images. Images with less than 10% misalignment in the overlap region tend to yield better results. When there is no initial image map information, you need to perform an initial manual registration. You can do this by digitizing 3-4 high quality points that are evenly distributed and preferably placed close to the image corners.
- When using images with mountainous terrain, use an accurate DEM in order to remove the image displacement caused by the steep terrain change.
- Before using APM, confirm that the **Initial Pyramid Layer Number** is set to **1** in **Image Files (General)** category of the Preference Editor. This retains the largest pyramid layer when computing pyramid layers to ensure point matching accuracy.

6. Solve model

Click on the solve button - this will generate the residuals and errors based on your manual tie points. If your RMSE is acceptable, go on to the next step. If not, go through your points and add, delete, or modify as needed.



7. Run automatic point matching (APM)

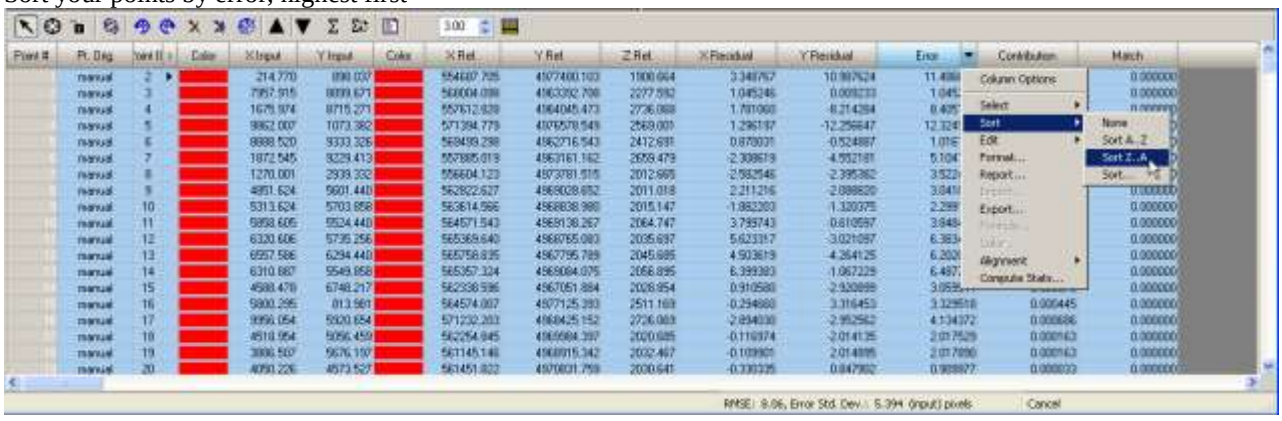
At this point, you are going to do a lot of finger-crossing. Did you use the right bands? Did you use the correct APM strategy?

Crud, what went wrong?
You have horrible RMSE and none of your points match up - what do you do?
Delete the auto-generated points
Check and adjust your settings
Try a different band
Worst case: Start a new project with a different reference image

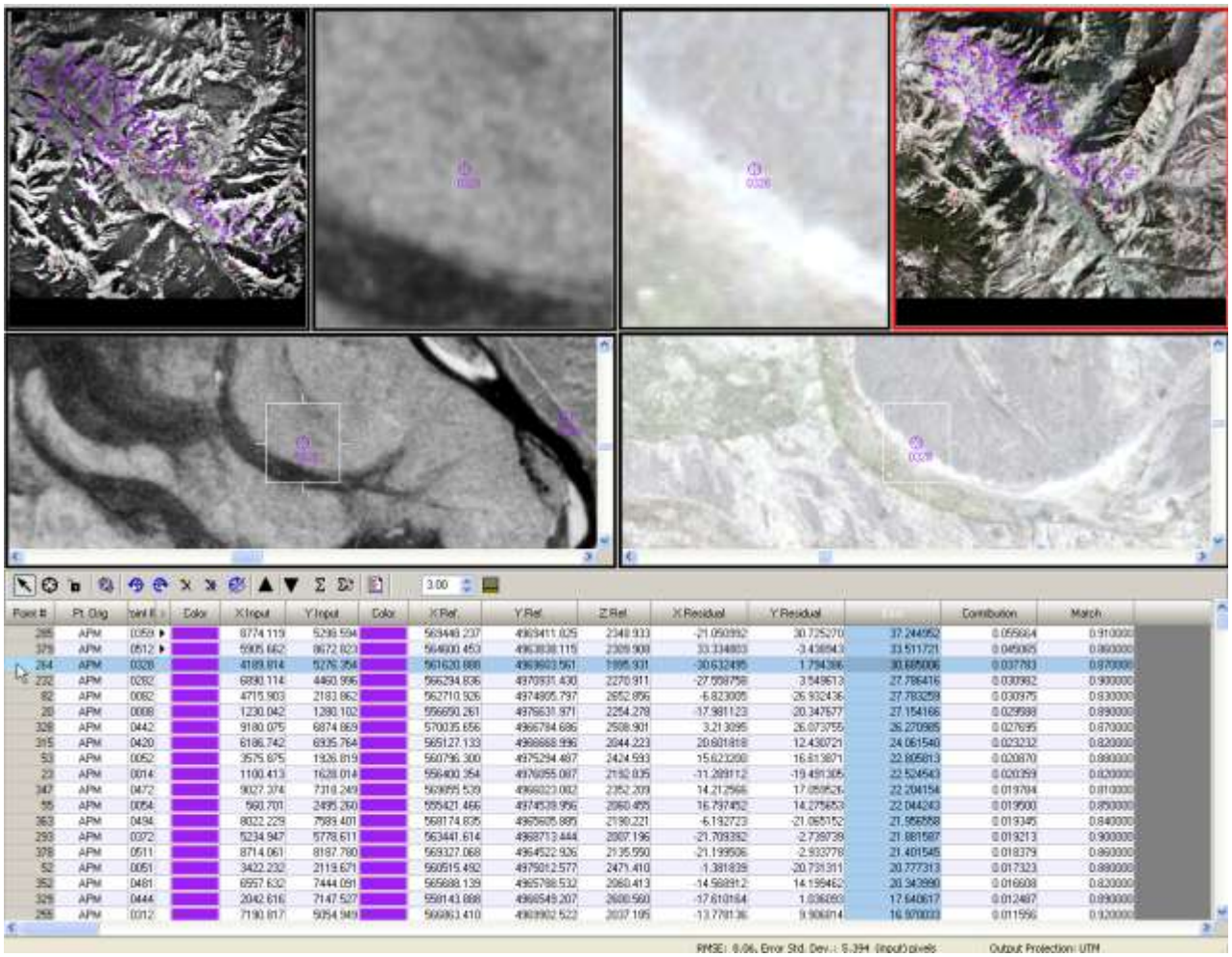
8. Verify and/or delete control points

There are a couple of ways you can go about checking the control points - deleting those over a certain error threshold or stepping through your points manually. I like a combination of both.

Sort your points by error, highest first



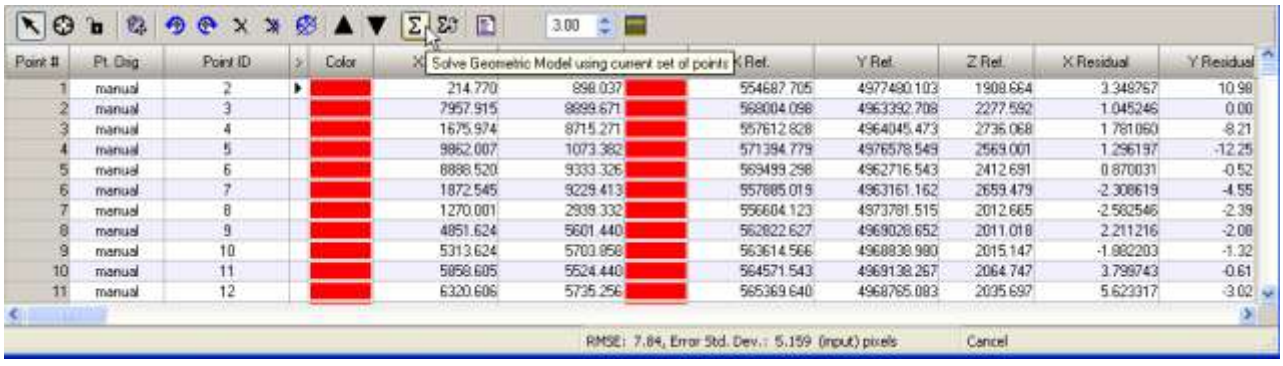
Now you can see what kind of error you are talking about - is it just a few outliers, or a bunch of bad matches? Usually this happens because of ground condition changes like fire, phenology, stream changes, landslides, etc.



In this example, there are some definite errors. I would step through the points until I started getting into "good" points, then delete those points with a greater error. Then re-solve the model.
Rinse
Repeat

Alternately, you could step through each point and visually check it. This depends on your time constraints.

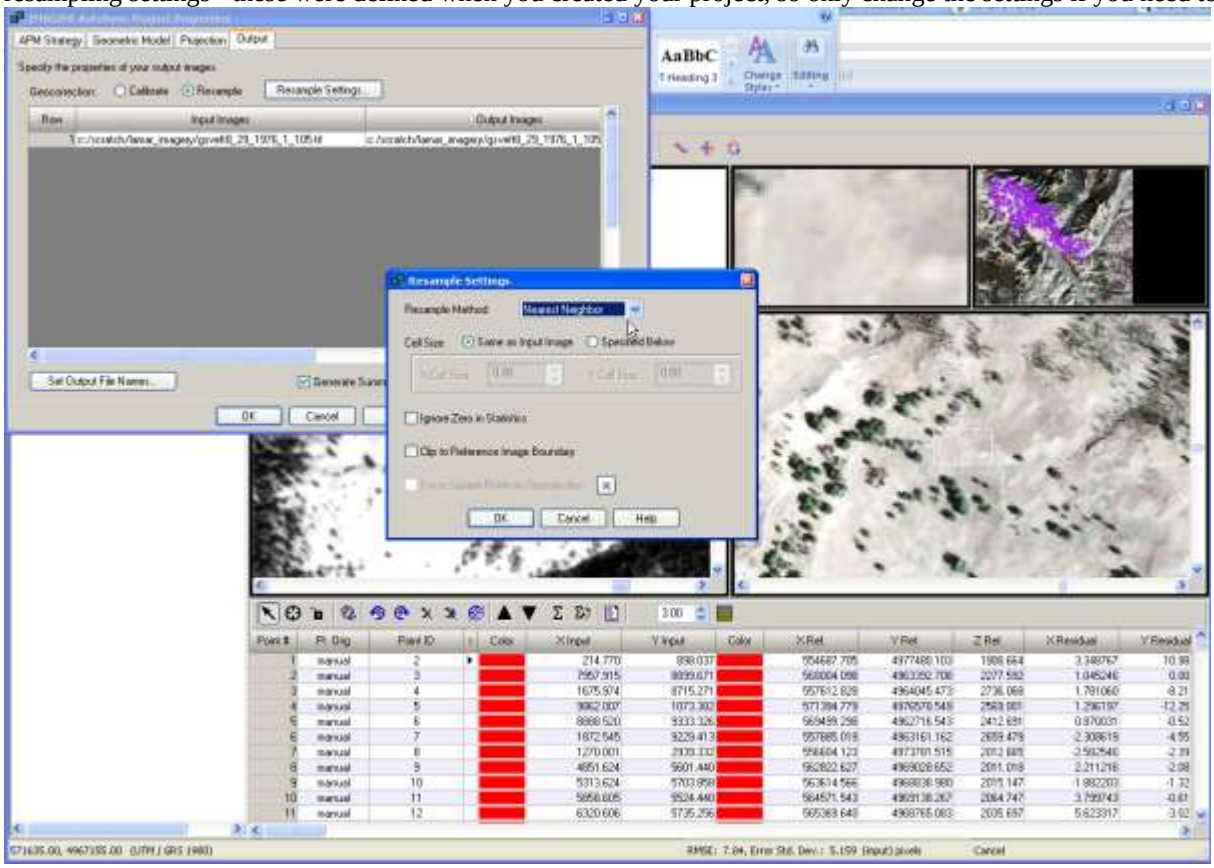
9. Re-solve model



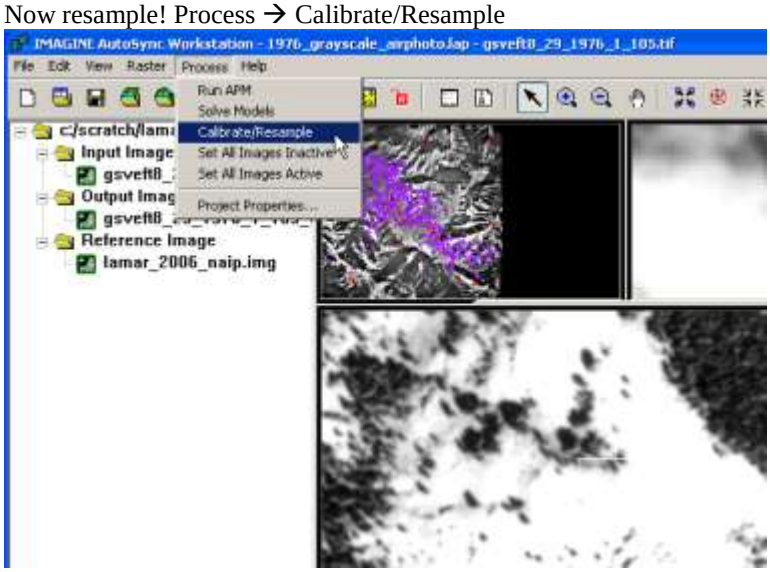
Point #	Pt. Orig	Point ID	Color	X	Y	X Ref.	Y Ref.	Z Ref.	X Residual	Y Residual
1	manual	2		214.770	898.037	554687.705	4977490.103	1908.664	3.348757	10.98
2	manual	3		7957.915	8899.671	568004.098	4963392.708	2277.592	1.045246	0.00
3	manual	4		1675.974	8715.271	557612.828	4964045.473	2736.068	1.781060	-8.21
4	manual	5		9862.007	1073.382	571394.779	4976578.549	2569.001	1.296197	-12.25
5	manual	6		8888.520	9333.326	569499.298	4962716.543	2412.691	0.870031	-0.52
6	manual	7		1872.545	9229.413	557685.019	4963161.162	2659.479	-2.308619	-4.55
7	manual	8		1270.001	2939.332	556604.123	4973781.515	2012.665	-2.562546	-2.39
8	manual	9		4851.624	5601.440	562822.627	4969028.652	2011.018	2.211216	-2.08
9	manual	10		5313.624	5703.958	563614.566	4968839.980	2015.147	-1.882203	-1.32
10	manual	11		5858.605	5524.440	564571.543	4969138.267	2064.747	3.799743	-0.61
11	manual	12		6320.606	5735.256	565369.640	4968765.083	2035.697	5.623317	-3.02

10. Resample Image (create output image)

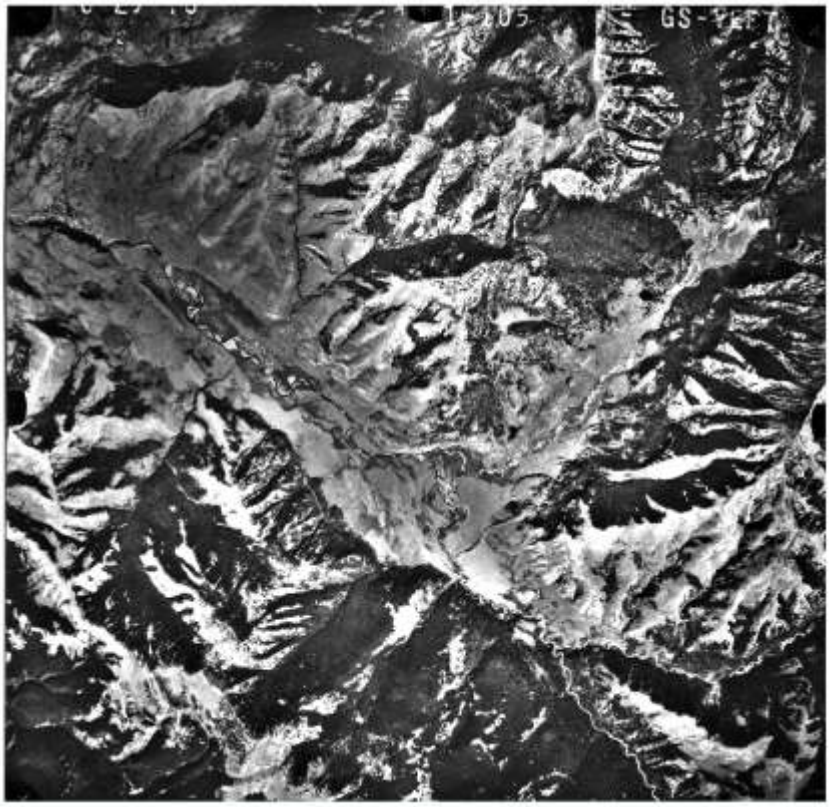
It's a good idea to verify your project parameters again - On the "Output" tab, you can make changes to your output and resampling settings - these were defined when you created your project, so only change the settings if you need to.



Now resample! Process → Calibrate/Resample



And this



becomes this: