

BASICS OF PROCESSING FIRE IMAGERY



OBJECTIVES

- Demonstrate the workflow for processing photos and deriving data products using photogrammetry
 - Converting TIFF files to JPG for viewing
 - Sorting Photos
 - Be able to set up Photoscan
 - Load Photos
 - Run Processes to create basic products
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PURPOSE

- This Presentation is to provide the user with a very basic step by step
 - The spatial accuracy of map products will be only as good as the aircraft GPS provides
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CONSIDERATIONS

How were the photos collected?

- What were the time intervals?

- What altitude above the highest point?

What format if thermal images were collected? (TIFF preferred)

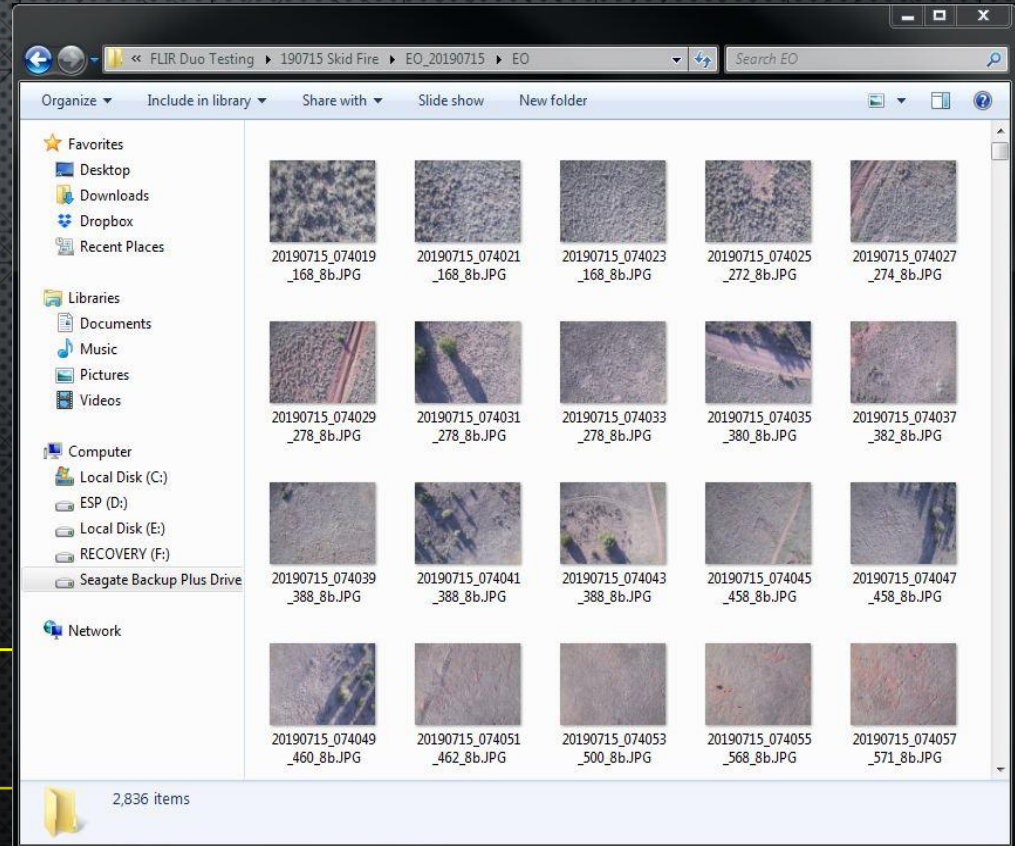
Which camera profile was used to collect? (Flight must use narrowest camera needed)

CONSIDERATIONS USED IN THIS PRESENTATION

- This presentation uses the Skid Fire as an example
 - Flight was 2500' above the highest point in terrain
 - Flown with the Silent Falcon and FLIR Duo camera
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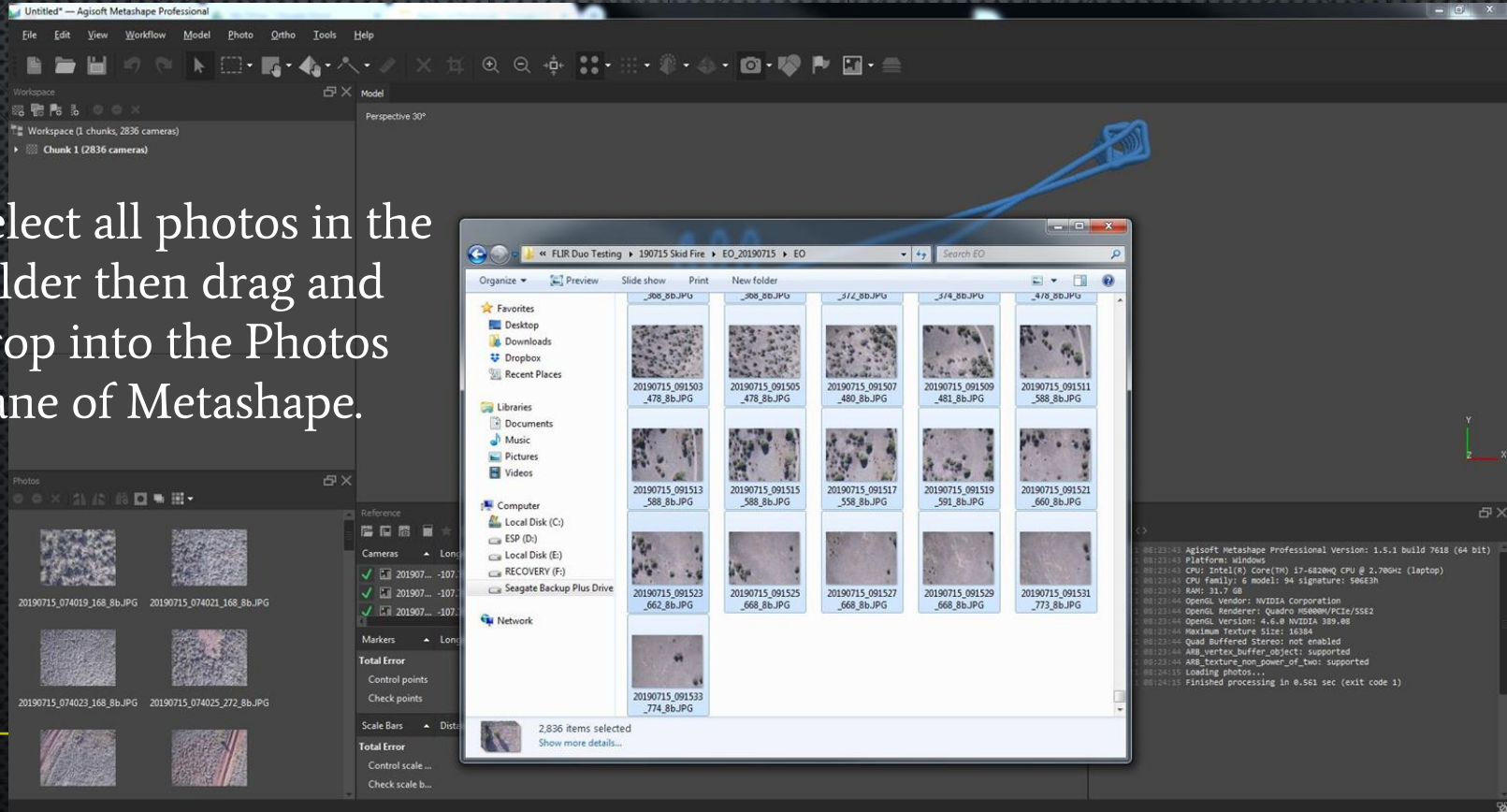
VIEW PHOTOS

Photos are in the folder to view and begin sorting. Note this folder has 2836 images. Images are geotagged and data is in the Exif. Make a copy of this folder to work from.



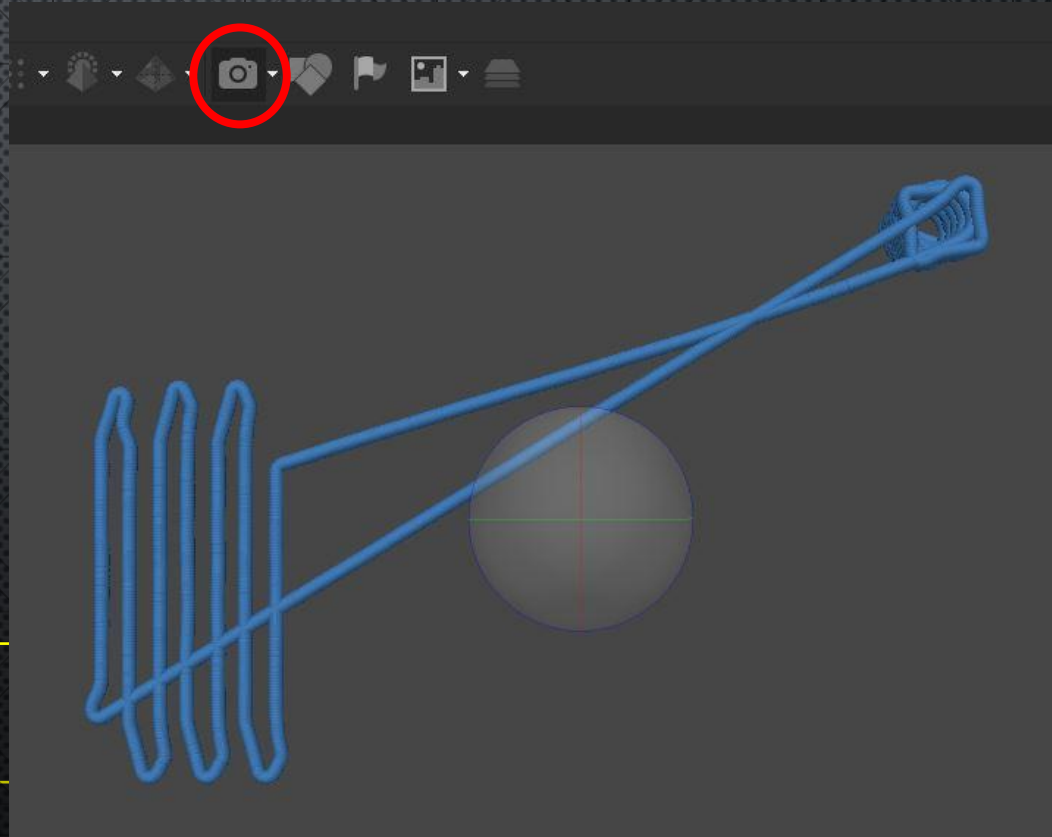
SORTING PHOTOS

Select all photos in the folder then drag and drop into the Photos Pane of Metashape.



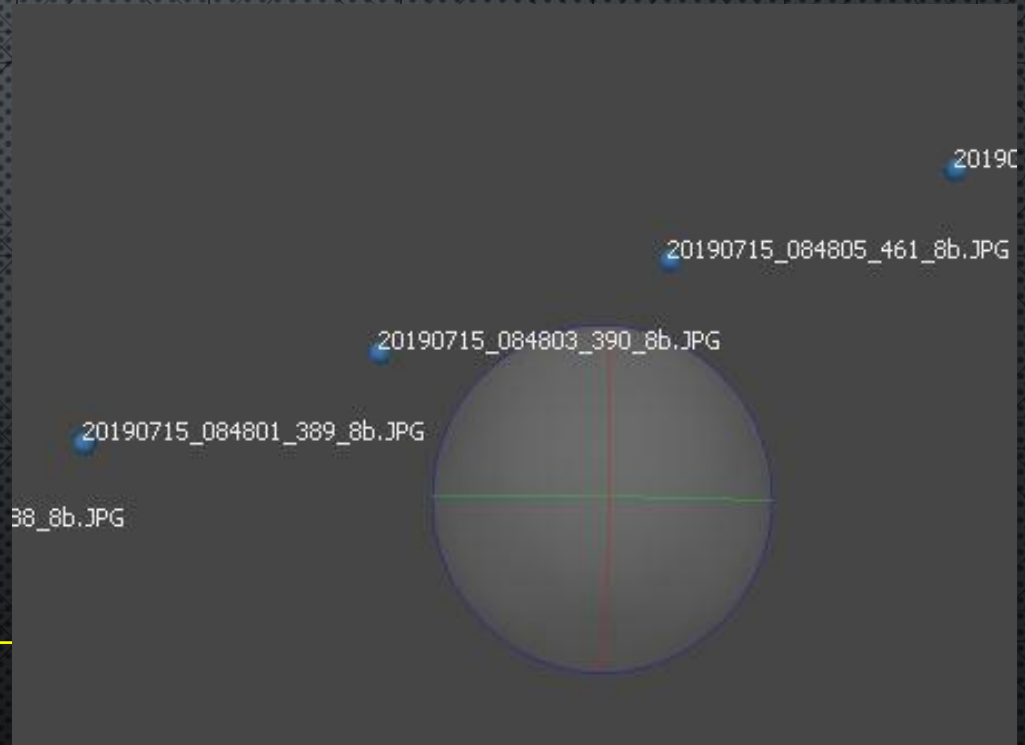
SORTING PHOTOS

In the model pane if the Camera is highlighted each image will appear as a blue dot. Note a large number of photos are not in the fire area, they were taken during the climb, descent, approach and departure from the fire.



SORTING PHOTOS

Determine an appropriate point to cut the lines of photos. In this example it will be just outside the fire area. Photos are named using date and time stamp. Scroll in close to the point of breaking the flight line and you will see the names. Select a photo and take note of it and the direction of UAS travel.

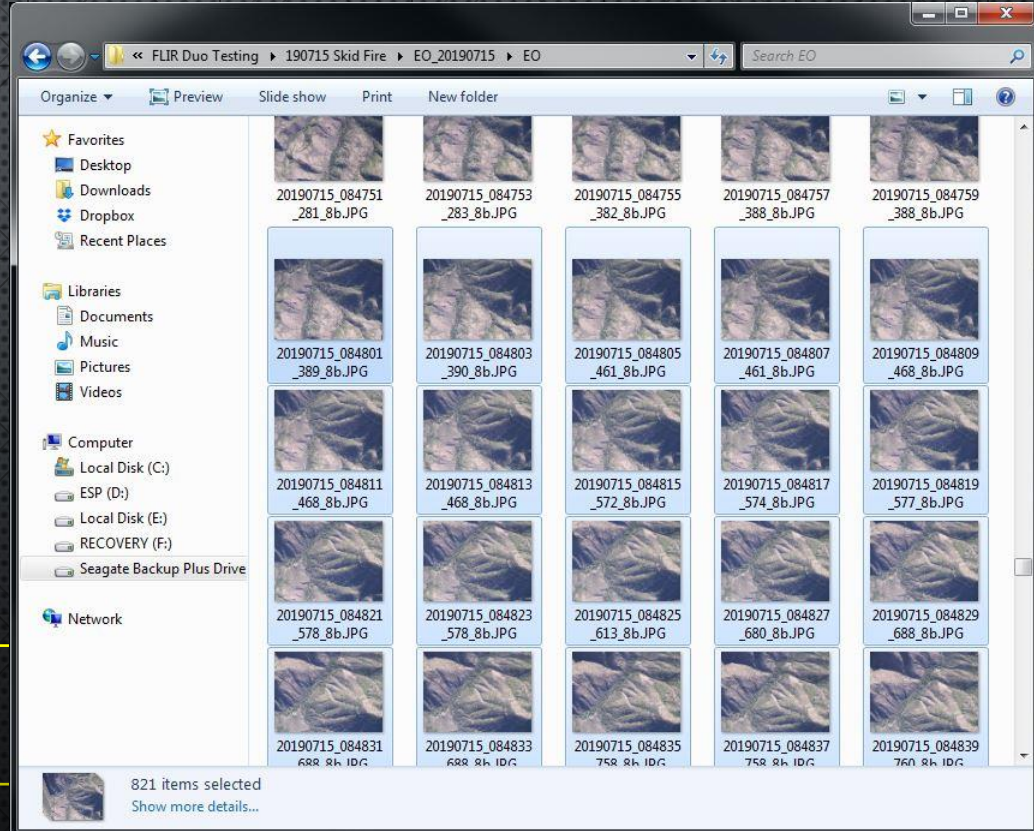


SORTING PHOTOS

Locate that image in the folder. In the previous slide we know that the UAS was enroute to Home. Also can confirm by location of image in folder, its $\frac{2}{3}$ down.

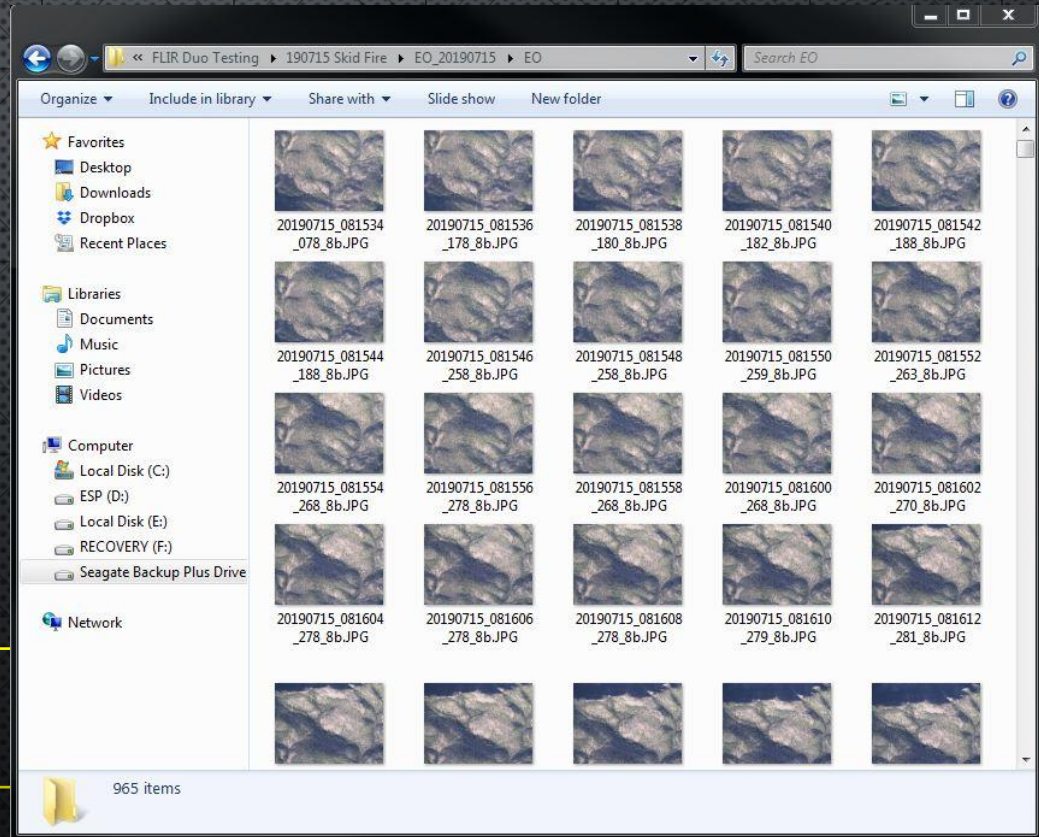
Highlight from that image to the bottom and delete. Note this deleted 821 images.

Repeat for the beginning of the flight.



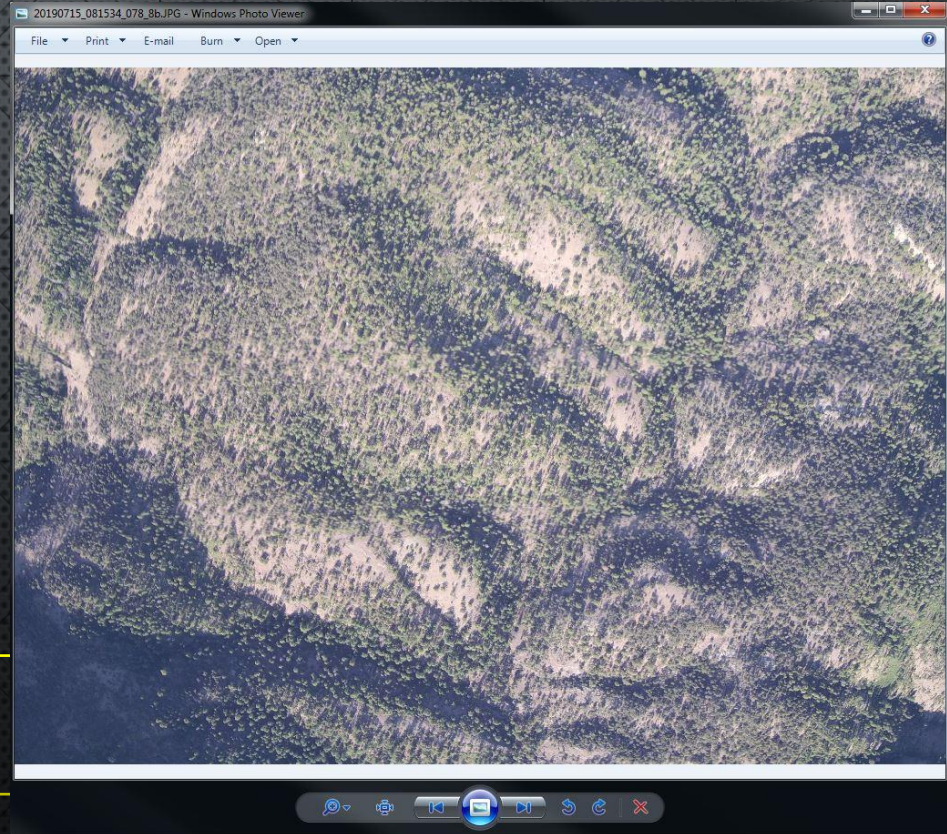
SORTING PHOTOS

We are now left with 965 from the original 2836. This can be further refined using 2 methods. First use the ODS to determine the time interval between images for the flight. In this example the Capture Interval was 11.92 seconds. We can take every fifth photo since this was 2 second triggers.



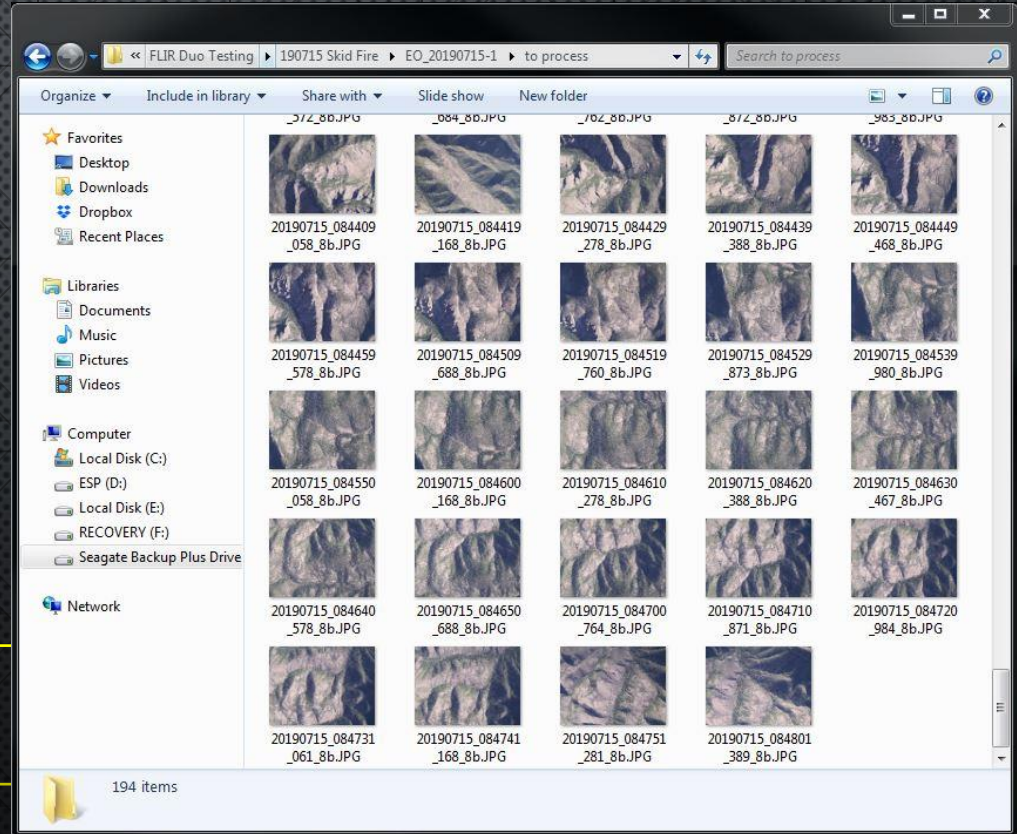
SORTING PHOTOS

Second, open the image in Windows Photo Viewer. Locate a landmark that is easily seen. Press the forward button to the next image and cycle to watch the landmark move. Estimate the Overlap. Close to 66% (landmark in 3 photos) is needed to process, in steep terrain more may be needed.



SORTING PHOTOS

In this example it was determined that every 5th photo would be close to 66% overlap. Now there are only 194 images left to process.

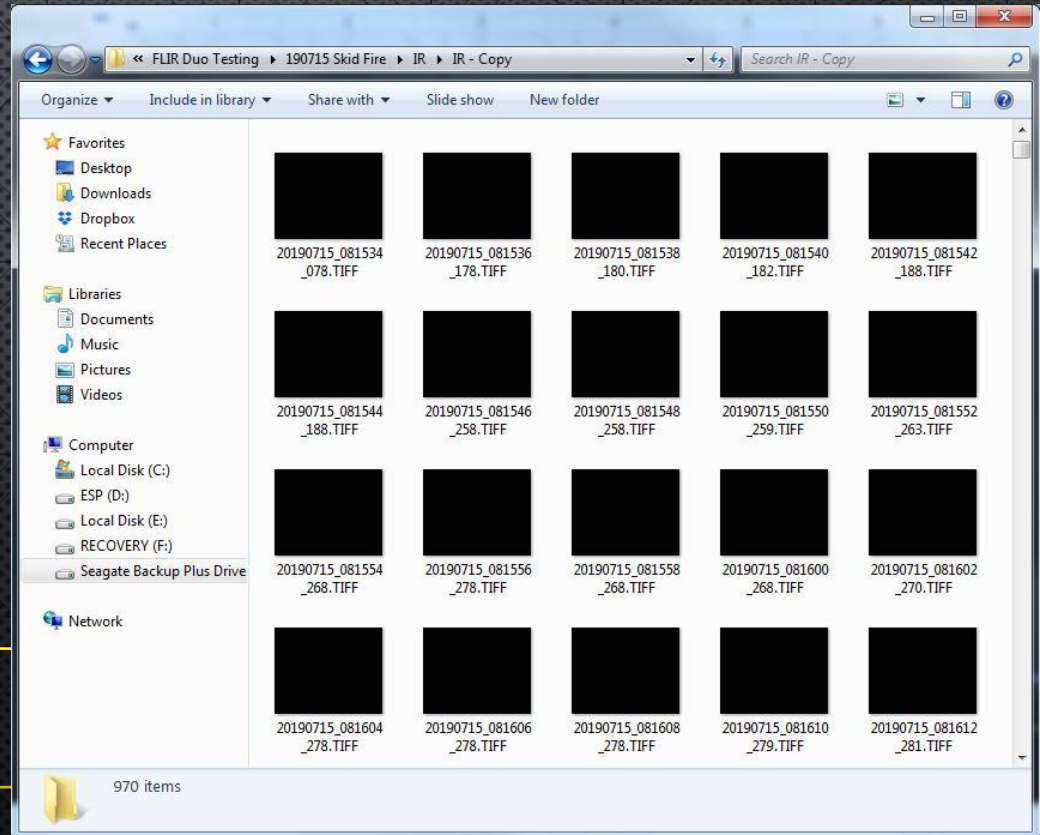


VIEW AND SORTING IR PHOTOS

- TIFF formatted images will appear black, data is present just not visible
 - If visible thermal images are needed convert to JPG using ImageJ
 - Recommend not processing JPG images, use for viewing only
 - Same process is used for sorting
 - IR images use same naming conventions, use the same image numbers to cut the flight lines as used in the EO photos
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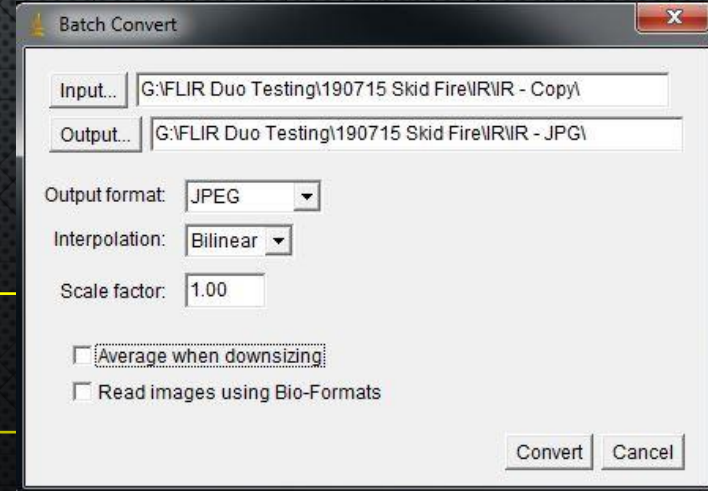
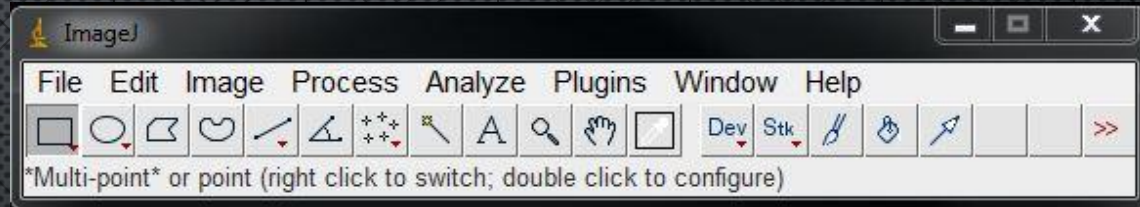
VIEW IR PHOTOS

- This folder contains 970 TIFF images
- To actually view the TIFF format needs converted to JPG
- Converting loses the temp data embedded in the TIFF files
- JPG is a compressed format that is undesirable for deriving data



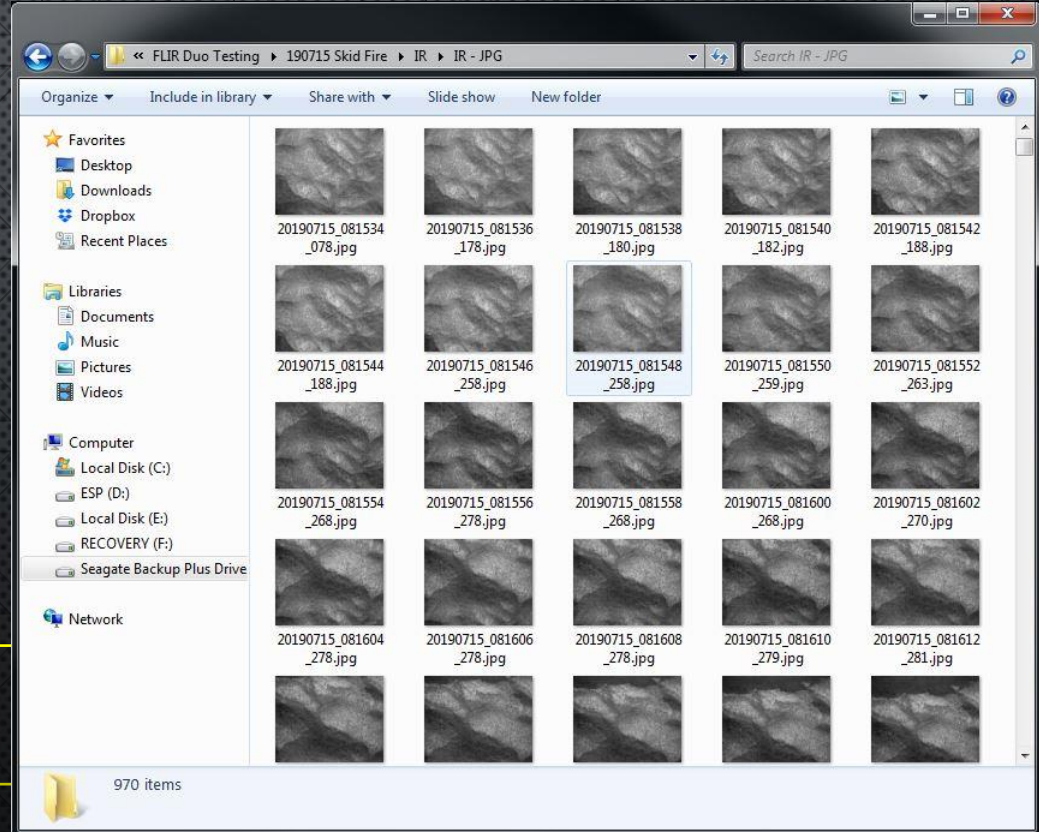
VIEW IR PHOTOS

1. Organize folders
2. Open ImageJ from its folder
3. Process > Batch > Convert
4. Select Input and Output folders as shown
5. Set Output Format to JPG
6. Convert



VIEW IR PHOTOS

Now thermal images can be viewed and sorting determinations can be made. Once determinations are made sort the TIFF files in the same way.



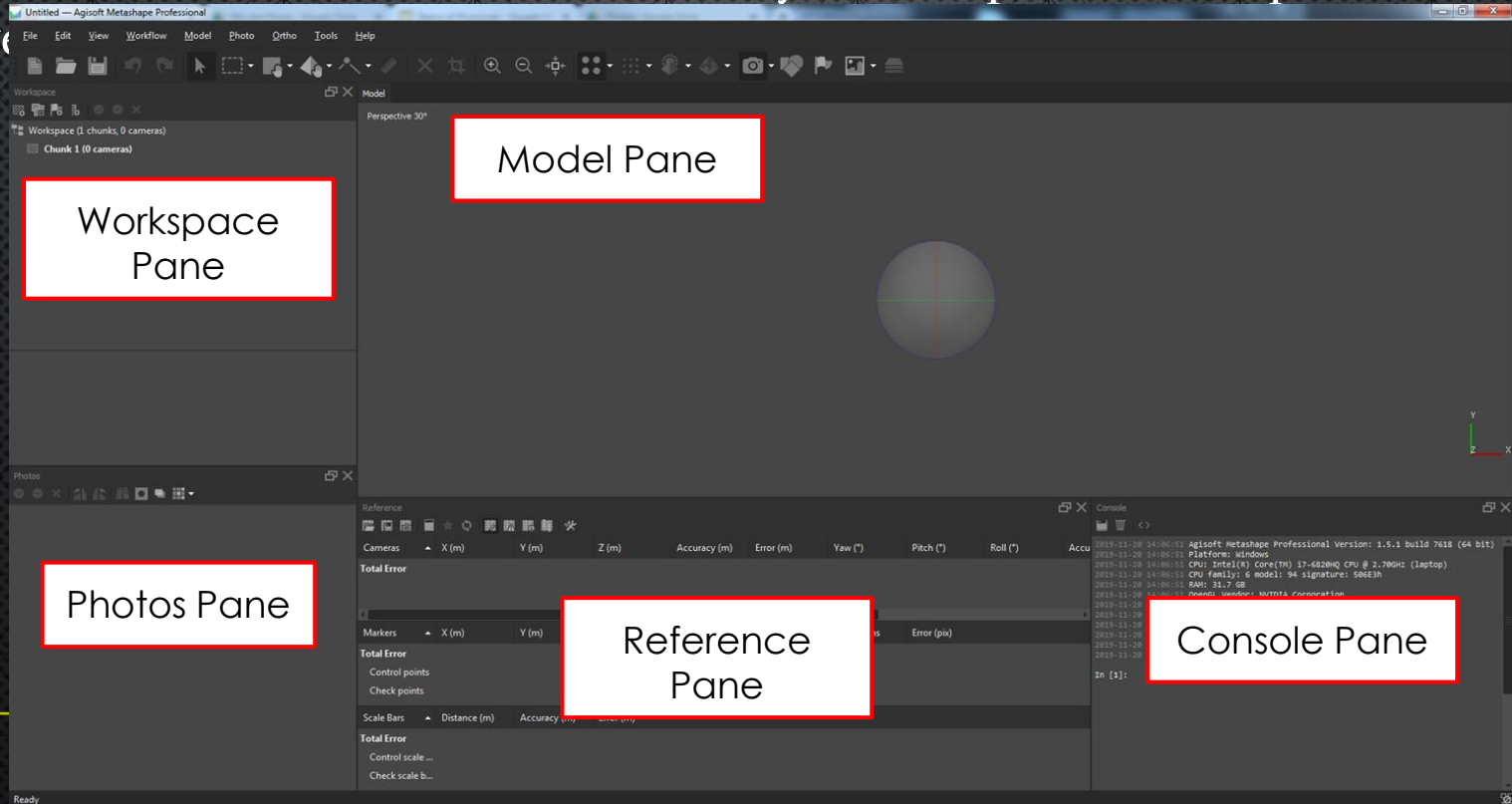
METASHAPE FLOW OVERVIEW

- Load Photos
 - Alignment - Geometry is used with geotags to build a sparse point cloud
 - Refine - Improves the spacial accuracy of the model
 - Gradual Selection - removes points with bad geometry
 - Build Dense Cloud - Builds a dense point cloud based on remaining points in the sparse cloud
 - Build DEM - Needed to generate the Orthophoto
 - Build Orthos
 - Export desired products
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METASHAPE SETUP

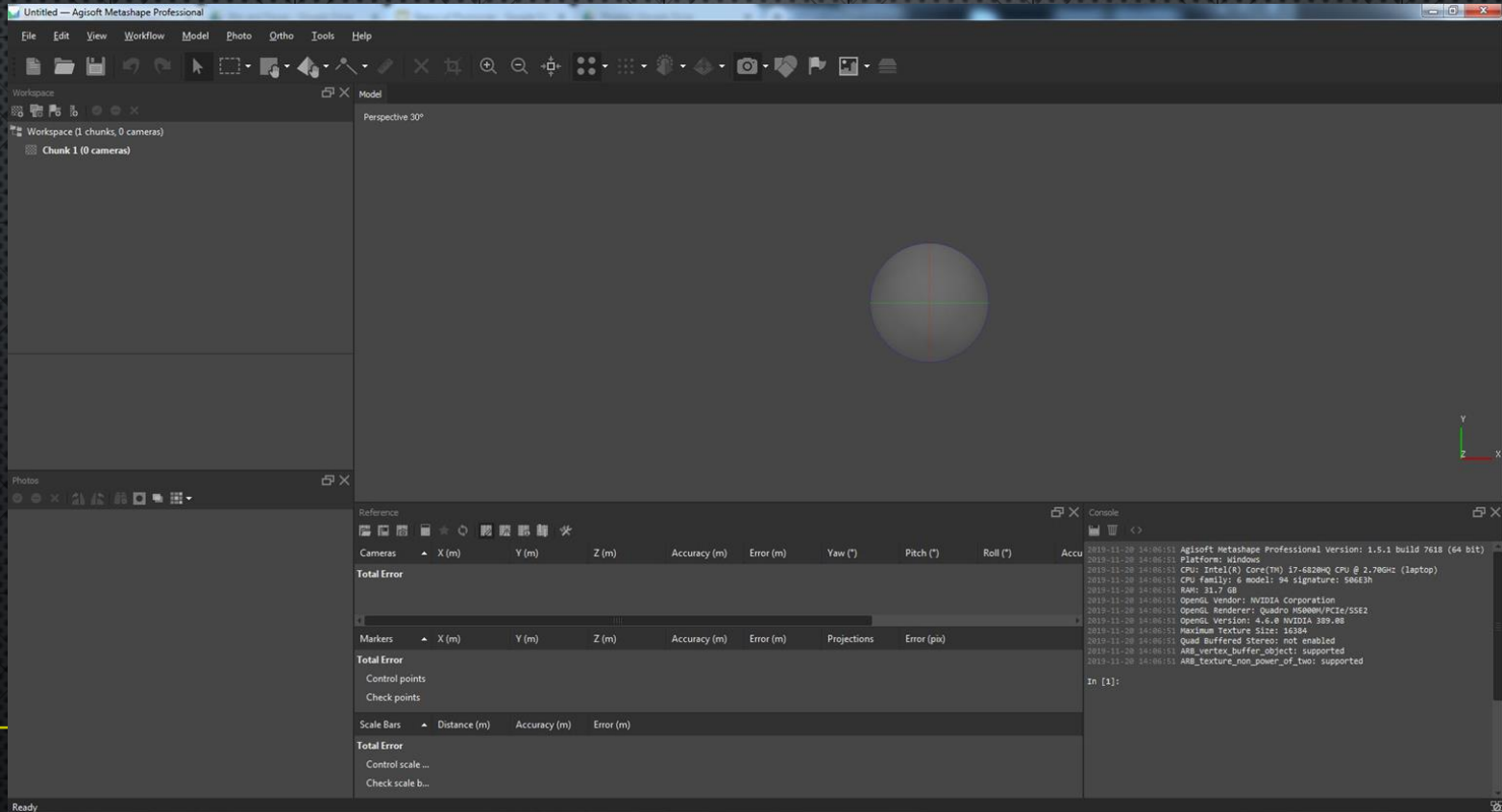
Setup the Workspace and organize the 5 panes as below. This maximizes efficient workflow. Panes can be tricky to manipulate, once placed will be

saved



METASHAPE SETUP

Once setup and arranged the program should appear like this



Select all EO photos for the model then drag and drop from folder into the Photos Pane

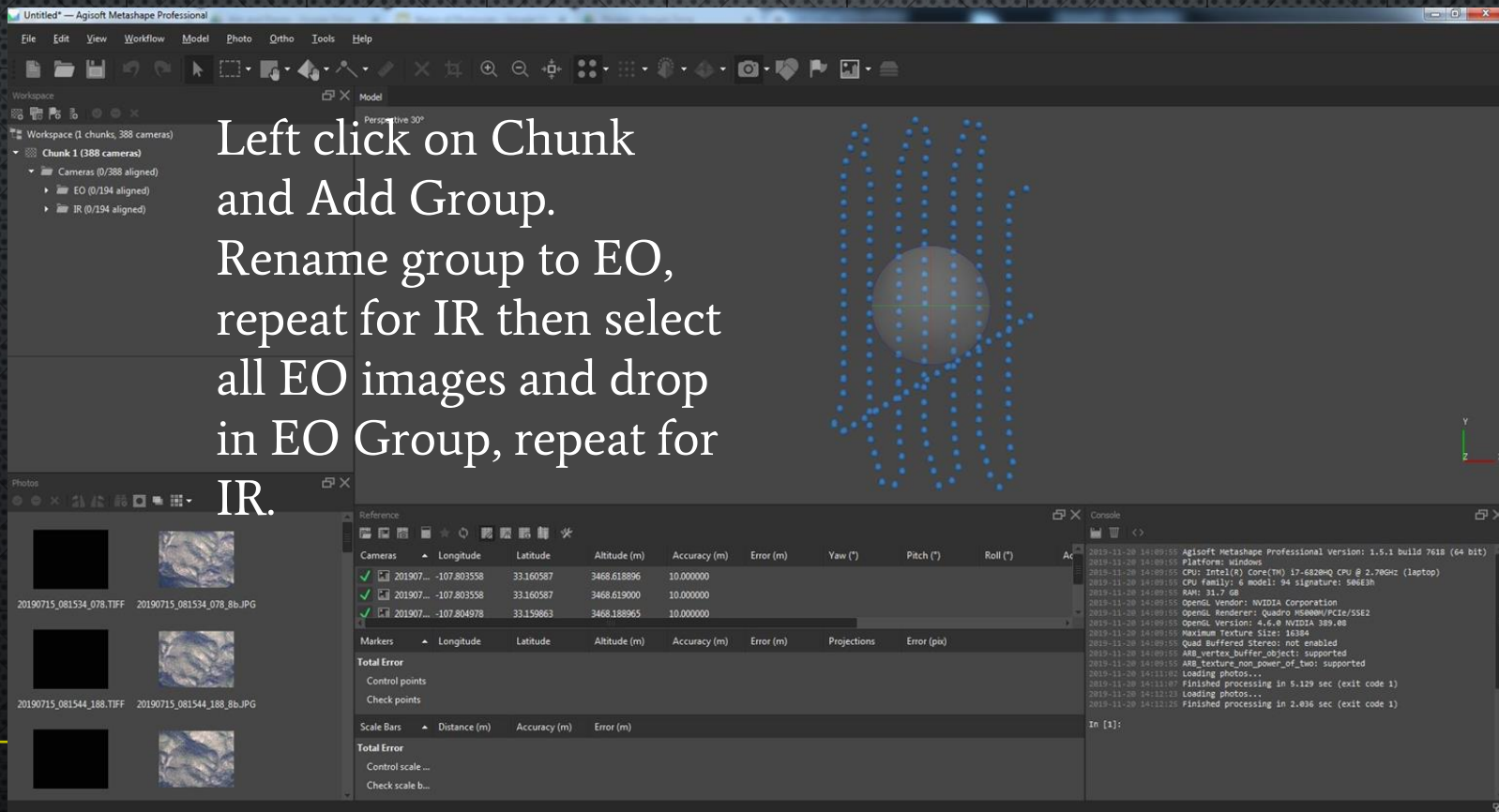


SELECT all IR photos for the model then drag and drop from folder into the Photos Pane. Note how the EO and IR photos separate into 2 columns.



STARTING THE PROCESS

Left click on Chunk and Add Group.
Rename group to EO,
repeat for IR then select
all EO images and drop
in EO Group, repeat for
IR.



Cameras	Longitude	Latitude	Altitude (m)	Accuracy (m)	Error (m)	Yaw (°)	Pitch (°)	Roll (°)
201907... -107.803558	33.160587	3468.618896	10.000000					
201907... -107.803558	33.160587	3468.619000	10.000000					
201907... -107.804978	33.159863	3468.188965	10.000000					

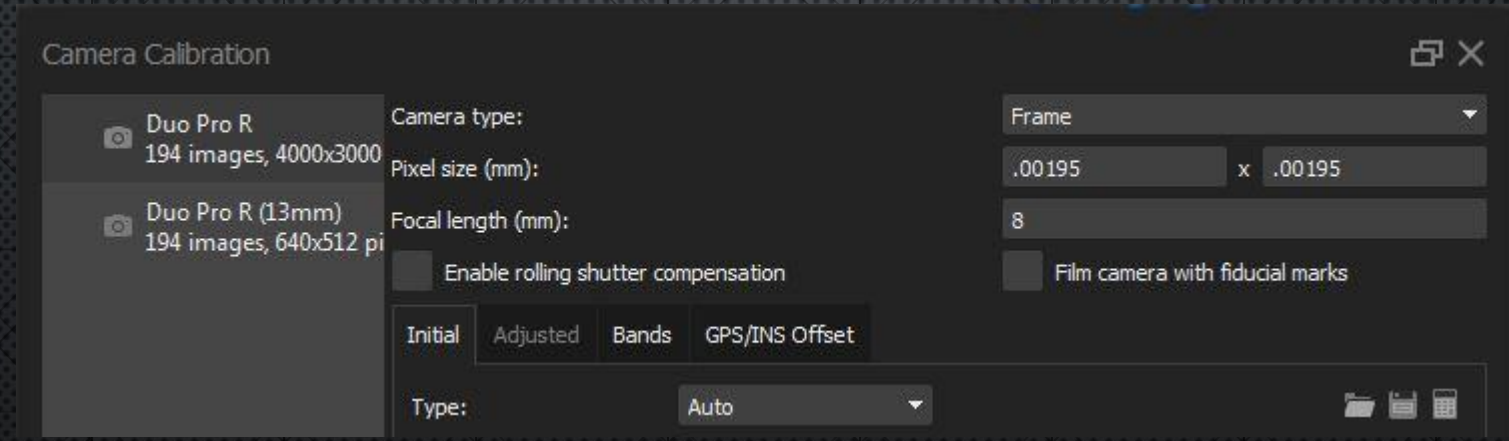
Markers	Longitude	Latitude	Altitude (m)	Accuracy (m)	Error (m)	Projections	Error (pix)
Total Error							
Control points							
Check points							

Scale Bars	Distance (m)	Accuracy (m)	Error (m)
Total Error			
Control scale...			
Check scale...			

```
2019-11-20 14:09:55 Agisoft Metashape Professional version: 1.5.1 build 7618 (64 bit)
2019-11-20 14:09:55 Platform: windows
2019-11-20 14:09:55 CPU: Intel(R) Core(TM) i7-6820HQ CPU @ 2.70GHz (laptop)
2019-11-20 14:09:55 CPU family: 6 model: 94 signature: 506E3H
2019-11-20 14:09:55 RAM: 31.7 GB
2019-11-20 14:09:55 OpenGL Vendor: NVIDIA Corporation
2019-11-20 14:09:55 OpenGL Renderer: Quadro M5600M/PCIe/SS2
2019-11-20 14:09:55 OpenGL Version: 4.6.0 NVIDIA 389.08
2019-11-20 14:09:55 Maximum Texture Size: 16384
2019-11-20 14:09:55 Quad Buffered Stereo: not enabled
2019-11-20 14:09:55 ARB_vertex_buffer_object: supported
2019-11-20 14:09:55 ARB_texture_non_power_of_two: supported
2019-11-20 14:11:02 Loading photos...
2019-11-20 14:11:07 Finished processing in 5.129 sec (exit code 1)
2019-11-20 14:12:13 Loading photos...
2019-11-20 14:12:20 Finished processing in 2.036 sec (exit code 1)
```

CAMERA CALIBRATION

Click Tools and select Camera Calibration. Make sure the boxes under Frame match what is shown in the picture below. Note Duo Pro R is highlighted.

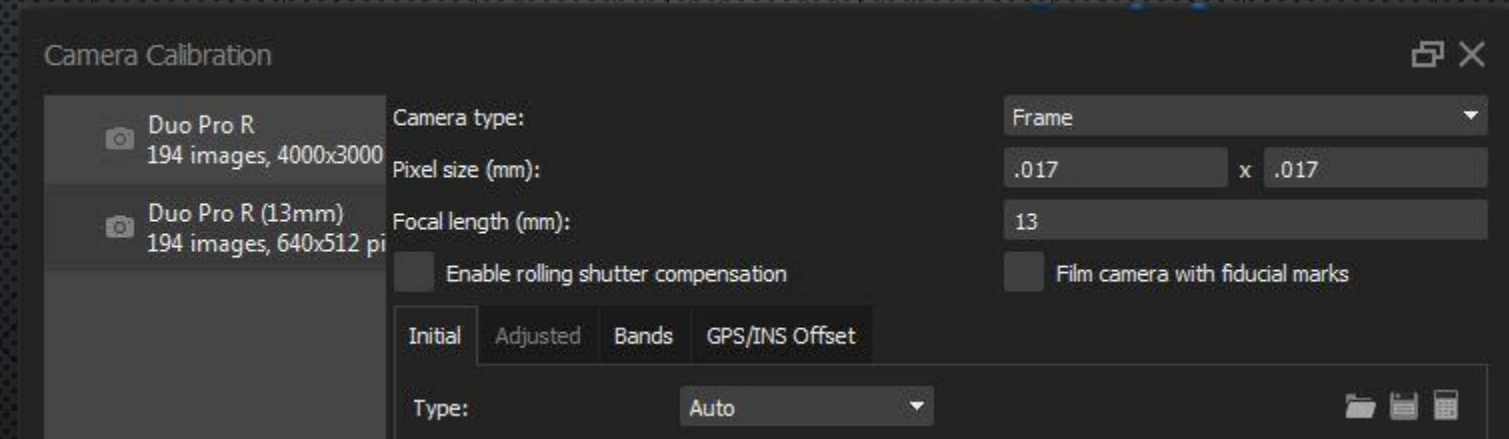


The screenshot shows the 'Camera Calibration' window with the following settings:

- Camera list:** Two cameras are listed. 'Duo Pro R' is highlighted with a camera icon and shows '194 images, 4000x3000'. 'Duo Pro R (13mm)' is listed below it with '194 images, 640x512 pi'.
- Camera type:** Set to 'Frame' in a dropdown menu.
- Pixel size (mm):** Set to '.00195 x .00195'.
- Focal length (mm):** Set to '8'.
- Enable rolling shutter compensation:** An unchecked checkbox.
- Film camera with fiducial marks:** An unchecked checkbox.
- Calibration tabs:** 'Initial', 'Adjusted', 'Bands', and 'GPS/INS Offset'. 'Initial' is the active tab.
- Type:** Set to 'Auto' in a dropdown menu.
- Icons:** In the bottom right corner, there are icons for a folder, a document, and a calendar.

CAMERA CALIBRATION

Make sure the boxes under Frame match what is shown in the picture below. Note that the other set of images is highlighted (13mm).



The screenshot shows the 'Camera Calibration' window with a dark theme. On the left, a list of camera models is shown, with 'Duo Pro R (13mm)' selected and highlighted in a lighter grey. The main area contains various settings: 'Camera type' is set to 'Frame'; 'Pixel size (mm)' is .017 x .017; 'Focal length (mm)' is 13; there are checkboxes for 'Enable rolling shutter compensation' and 'Film camera with fiducial marks'; a row of tabs includes 'Initial', 'Adjusted', 'Bands', and 'GPS/INS Offset'; and 'Type' is set to 'Auto'. Icons for file operations are visible in the bottom right corner.

Camera Calibration

Duo Pro R
194 images, 4000x3000

Duo Pro R (13mm)
194 images, 640x512 pi

Camera type: Frame

Pixel size (mm): .017 x .017

Focal length (mm): 13

☐ Enable rolling shutter compensation

☐ Film camera with fiducial marks

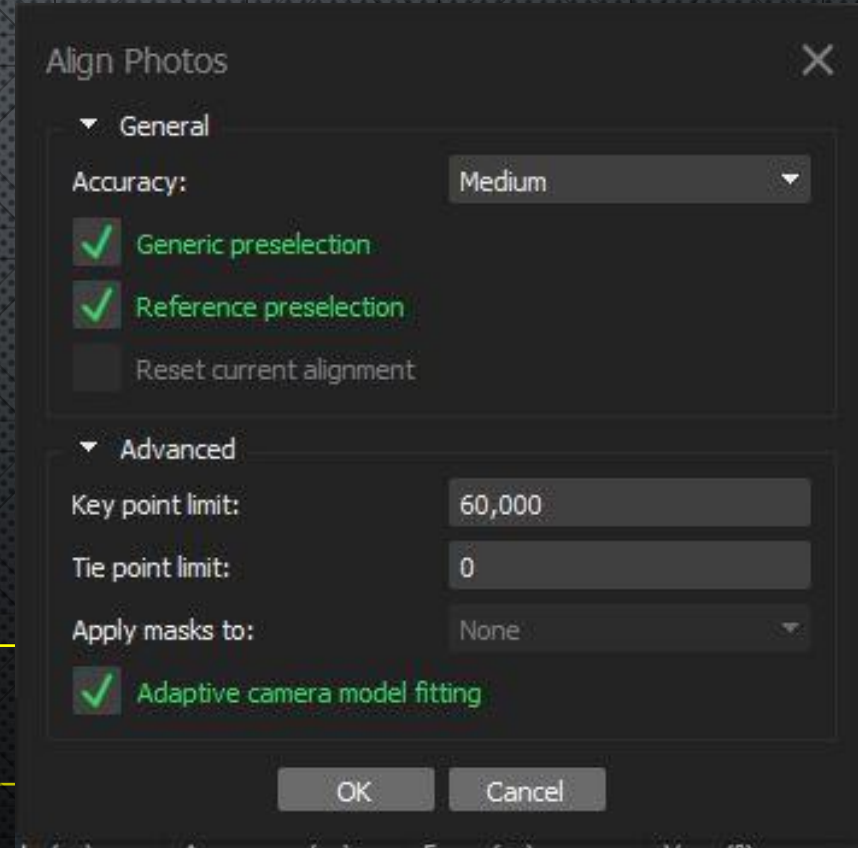
Initial Adjusted Bands GPS/INS Offset

Type: Auto

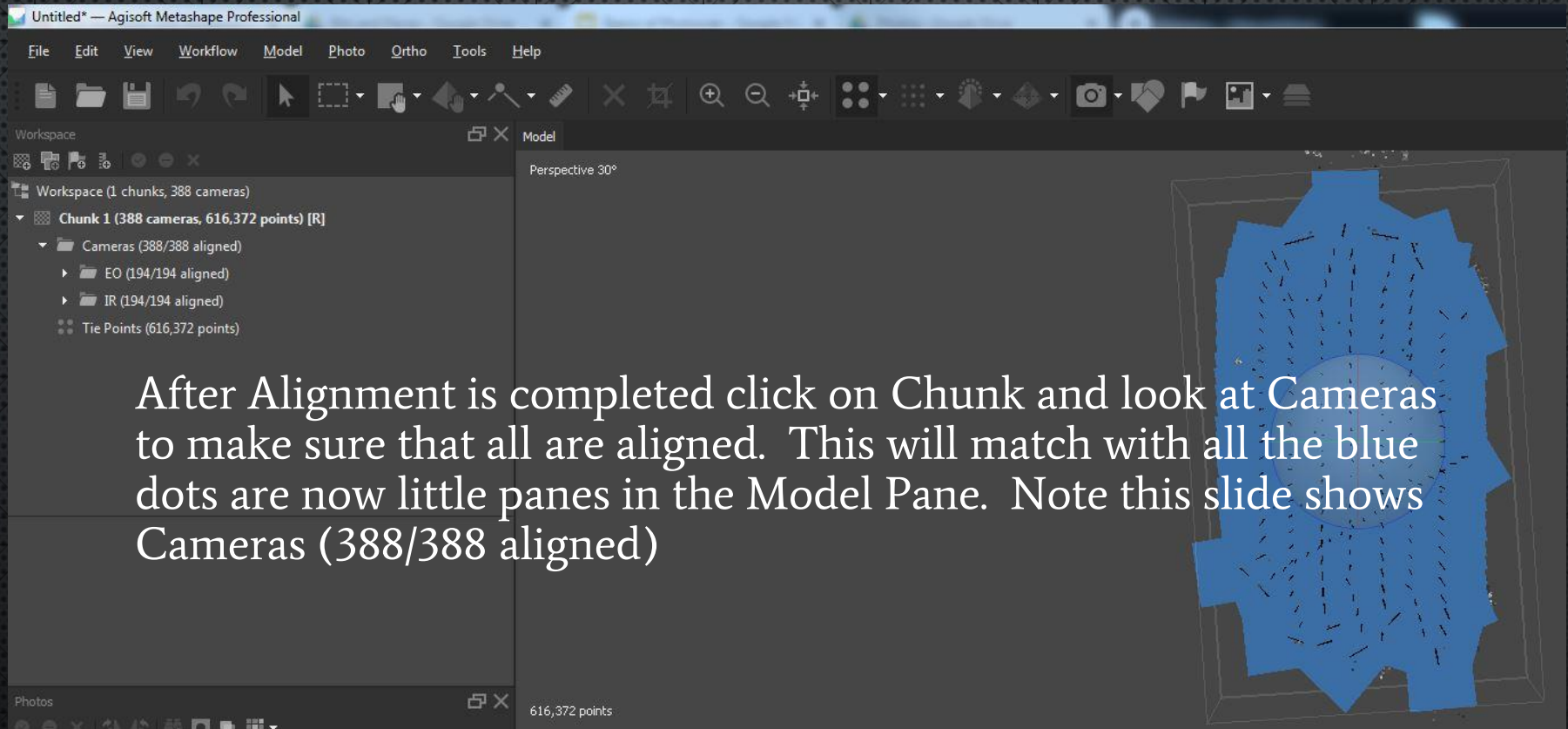
ALIGNMENT

Click Workflow Tab and select Align Photos. Match settings below and click OK.

This will take a bit to run. This example with a Photogrammetry laptop took 14 minutes and 38 seconds.

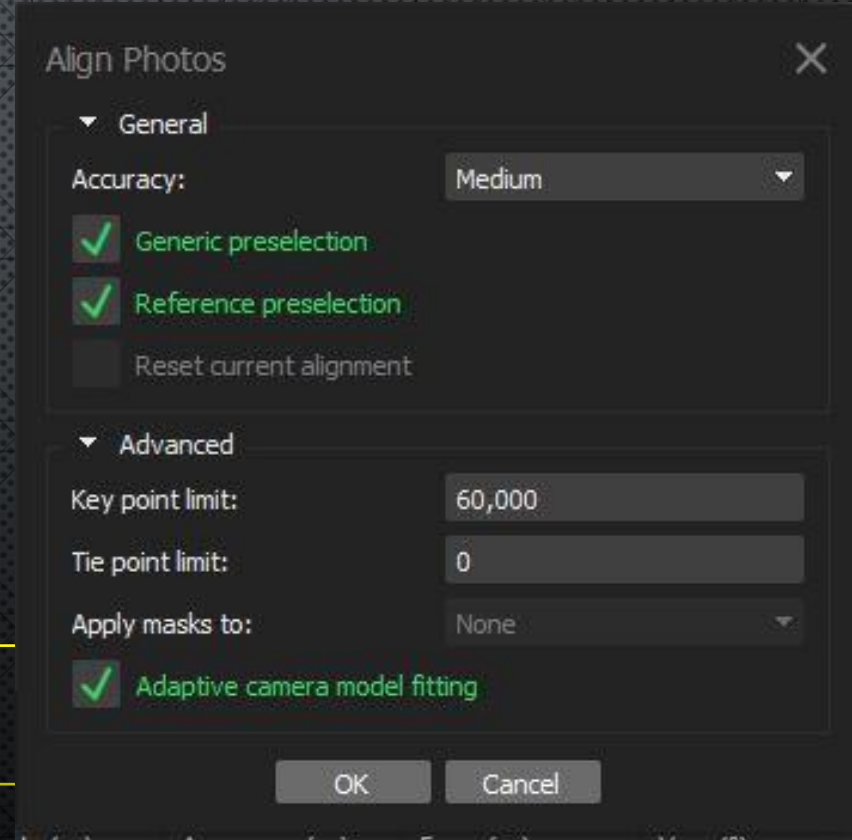


AFTER ALIGNMENT



AFTER ALIGNMENT

IF a few images do not align run
again with all 3 top boxes
unchecked



SAVE AND DUPLICATE

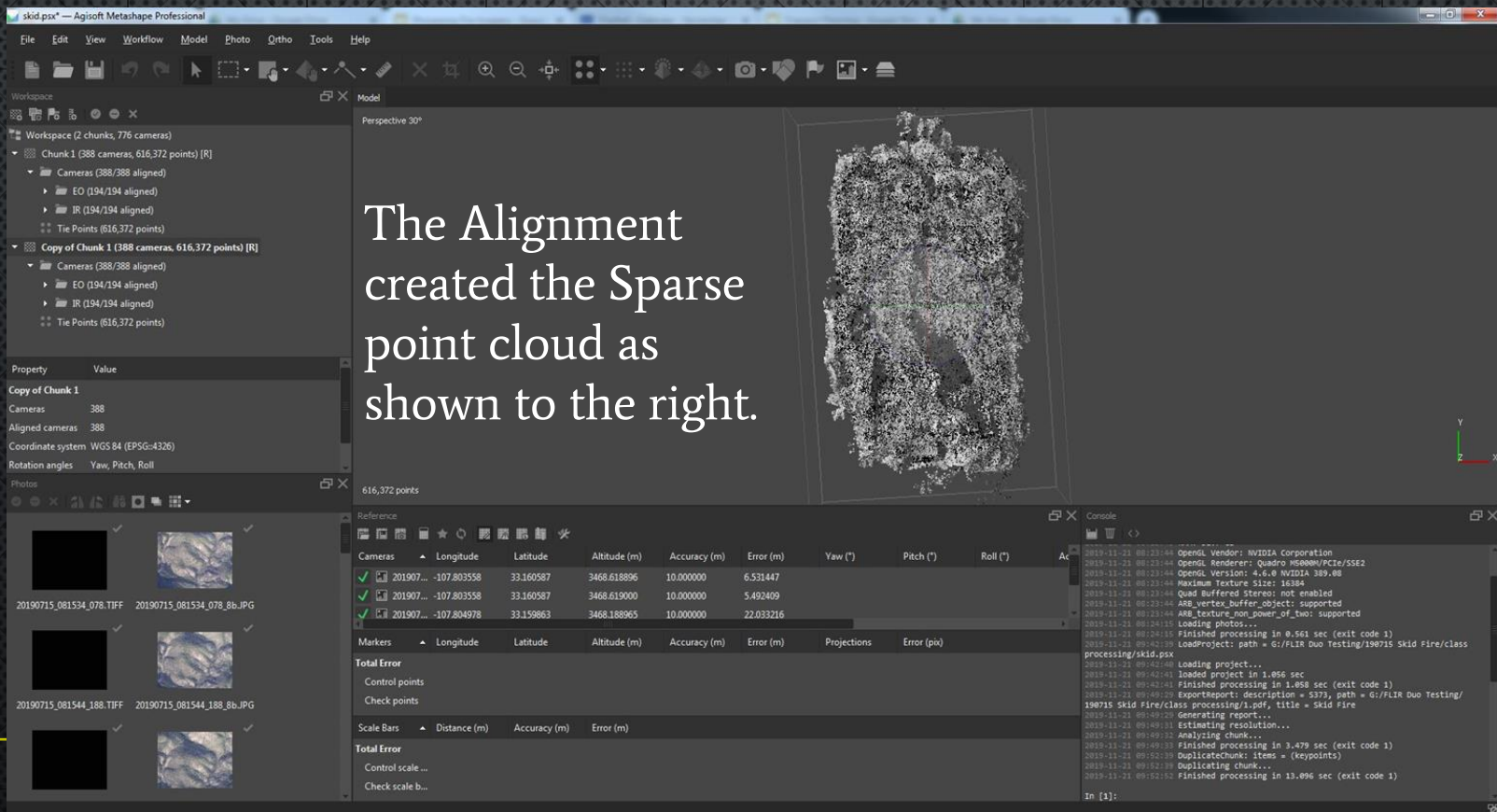
Save. Then right click on Chunk and Duplicate. Set the Copy to Active.

The screenshot displays the Agisoft Metashape Professional interface. The main workspace shows a 3D point cloud model of a rock formation. The left sidebar contains the project hierarchy, including 'Workspace (2 chunks, 776 cameras)', 'Chunk 1 (388 cameras, 616,372 points) [R]', and 'Copy of Chunk 1 (388 cameras, 616,372 points) [R]'. The bottom-left panel shows a grid of photo thumbnails. The bottom-middle panel displays a reference table with columns for Cameras, Markers, Scale Bars, and Total Error. The bottom-right panel shows the console window with logs.

Cameras	Longitude	Latitude	Altitude (m)	Accuracy (m)	Error (m)	Yaw (°)	Pitch (°)	Roll (°)
20190715_081534_078.TIFF	-107.803558	33.160587	3468.618896	10.000000	6.531447			
20190715_081534_078_8b.JPG	-107.803558	33.160587	3468.619000	10.000000	5.492409			
20190715_081544_188.TIFF	-107.804978	33.159863	3468.188965	10.000000	22.032216			
20190715_081544_188_8b.JPG								

```
2019-11-21 09:12:44 Opengl Vendor: NVIDIA Corporation
2019-11-21 09:12:44 Opengl Renderer: Quadro M5000M/PCIe/SSE2
2019-11-21 09:12:44 Opengl Version: 4.6.0 NVIDIA 389.68
2019-11-21 09:12:44 Maximum Texture Size: 16384
2019-11-21 09:12:44 Quad Buffered Stereo: not enabled
2019-11-21 09:12:44 ARB_vertex_buffer_objects: supported
2019-11-21 09:12:44 ARB_texture_non_power_of_two: supported
2019-11-21 09:12:45 Loading photos...
2019-11-21 09:12:45 Finished processing in 0.561 sec (exit code 1)
2019-11-21 09:12:45 LoadProject: path = G:/FLIR Duo Testing/190715 Skid Fire/class
processing/skid.psx
2019-11-21 09:12:46 Loading project...
2019-11-21 09:12:46 loaded project in 1.056 sec
2019-11-21 09:12:46 ExportReport: description = 5373, path = G:/FLIR Duo Testing/
190715 Skid Fire/class processing/s.psx, title = skid Fire
2019-11-21 09:12:46 Generating report...
2019-11-21 09:12:46 Estimating resolution...
2019-11-21 09:12:46 Analyzing chunk...
2019-11-21 09:12:46 Finished processing in 3.479 sec (exit code 1)
2019-11-21 09:12:46 DuplicateChunk: items = (keypoints)
2019-11-21 09:12:46 Duplicating chunk...
2019-11-21 09:12:46 Finished processing in 13.096 sec (exit code 1)
In [1]:
```

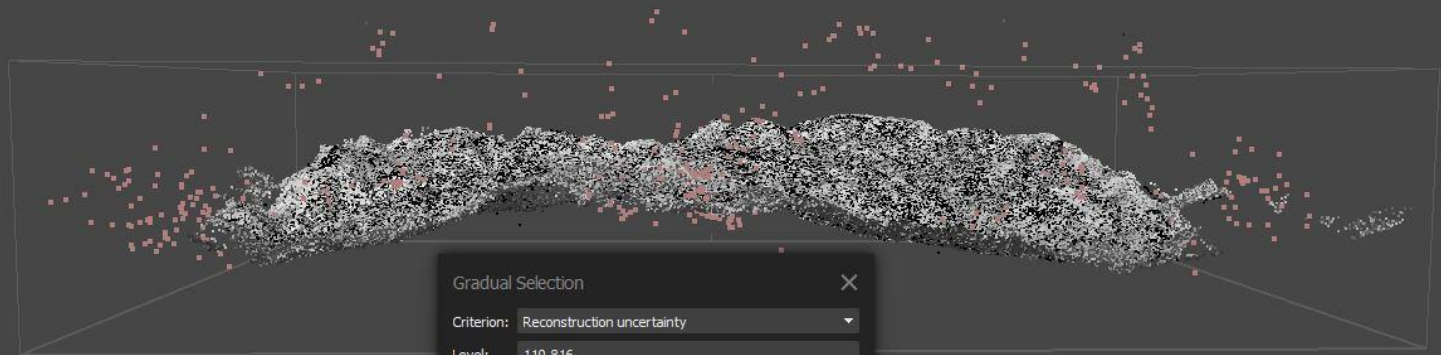
POINT CLOUD



GRADUAL SELECTION

Click the Model tab and select Gradual Selection. In the dialog box drop down select Reconstruction Uncertainty. Slide the rule to the right and observe the points being highlighted. Move slider until the points that need removed are highlighted.

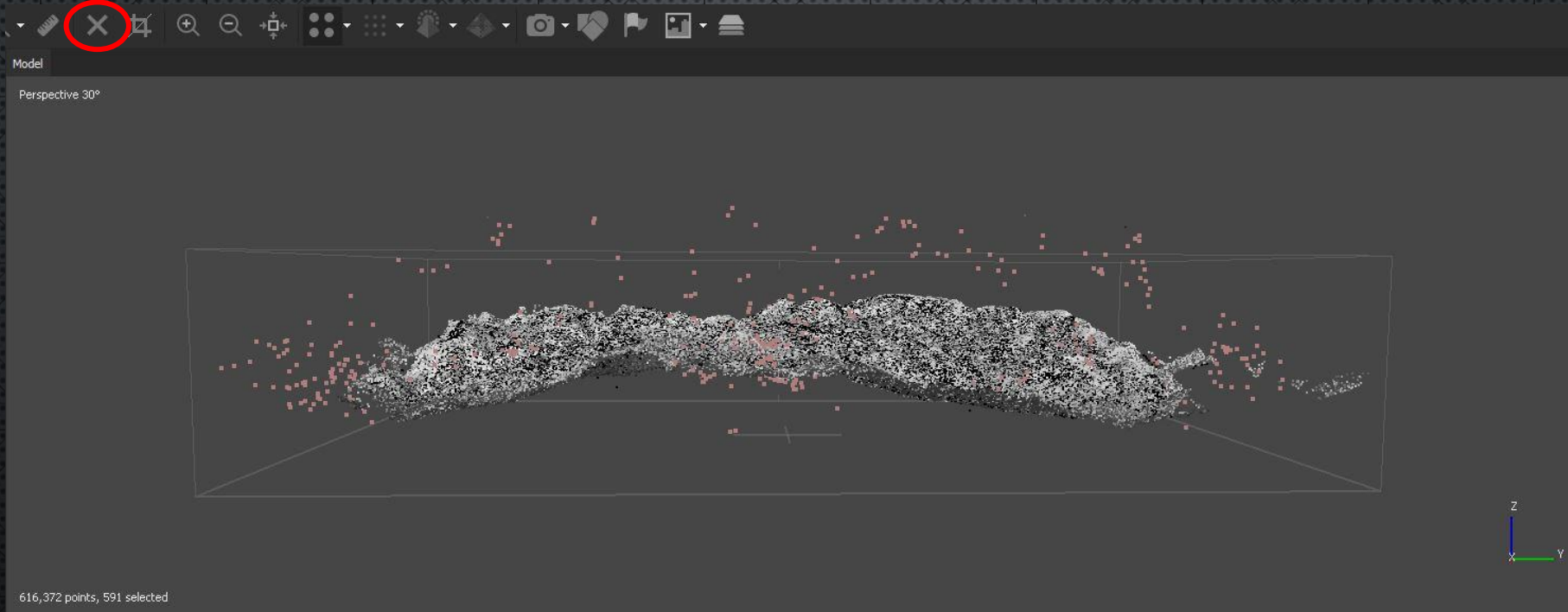
Perspective 30°



616,372 points, 591 selected

GRADUAL SELECTION

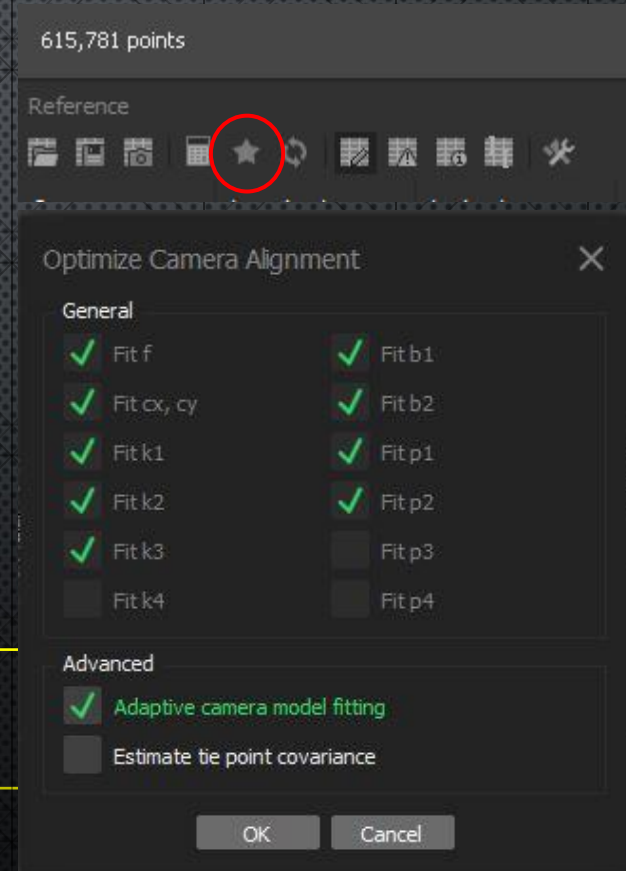
Click OK on Gradual Selection. Then click the X in the menu bar above model. The highlighted points will disappear.



OPTIMIZE

Click the Optimize
Star, circled to the
left.

Match the
checkboxes as
shown and Click
OK.



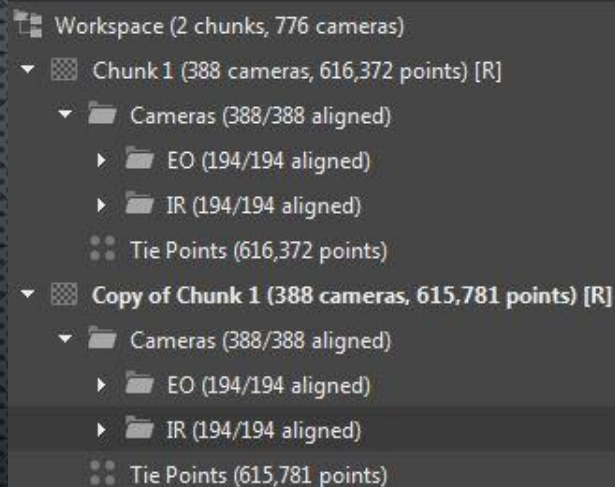
DENSE POINT CLOUD

In Workspace Pane
highlight the IR
Group.

Right click and
Disable Cameras.

Disabled will
appear as below.

▶  IR (194/194 aligned)



ERROR REDUCTION

Select View Error as shown in RED circle and scroll to bottom. View Total Error row.. IF the box is checked the location values for that image are true, if not MS ignores those values. Sort by clicking the Error(m) column. Uncheck boxes for up to $\frac{2}{3}$ of the photos. Optimize again. Uncheck more up to $\frac{3}{4}$ of the checkboxes. Optimize a last time.

Reference								
Cameras			Long. err (m)	Lat. err (m)	Alt. err (m)	Accuracy (m)	Error (m)	Yaw err (°) Pitch err (°)
✓		20190715_083121_458.TIFF	-2.248558	-41.709773	-5.527065	10.000000	42.134423	
✓		20190715_082930_378.TIFF	0.792569	51.686991	5.357104	10.000000	51.969912	
✓		20190715_082930_378_8b.JPG	0.257289	53.970320	5.922984	10.000000	54.294967	
Total Error			5.306845	15.285422	6.454817		17.420430	


Note the reduction in Error

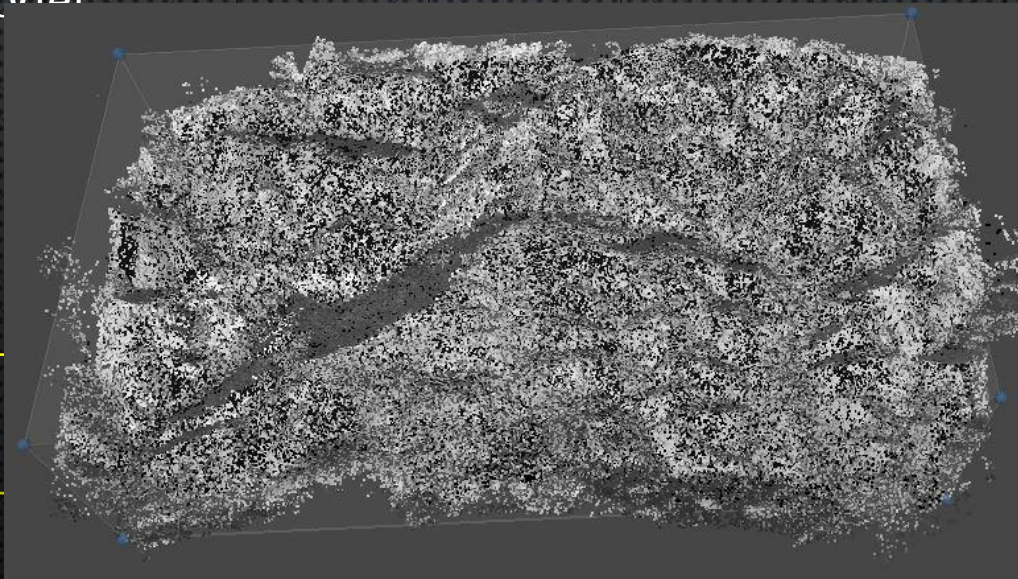
Total Error	3.058961	4.820879	7.268425	9.242733
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SAVE WORK



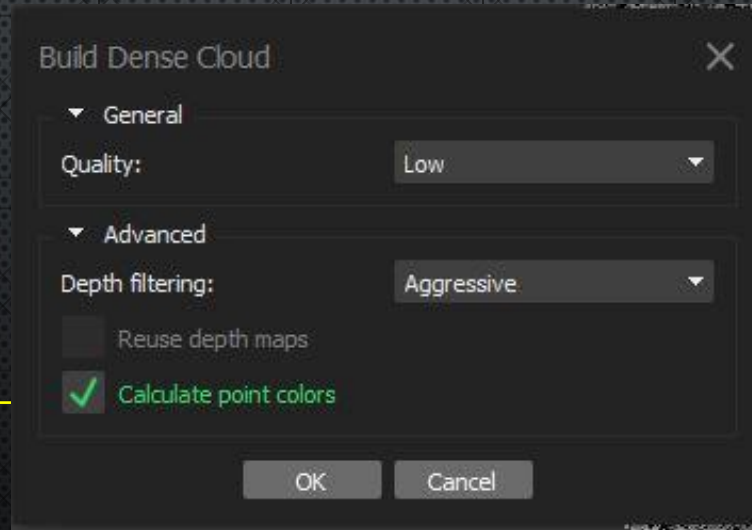
SETTING BOUNDING BOX

Click the Resize Region dropdown  and select Resize Region. Click and hold blue dot to drag and place box on the area that is to be modeled. In general bring the horizontal boundaries just inside of the ragged edge, make sure the vertical boundaries are well above and below the model.



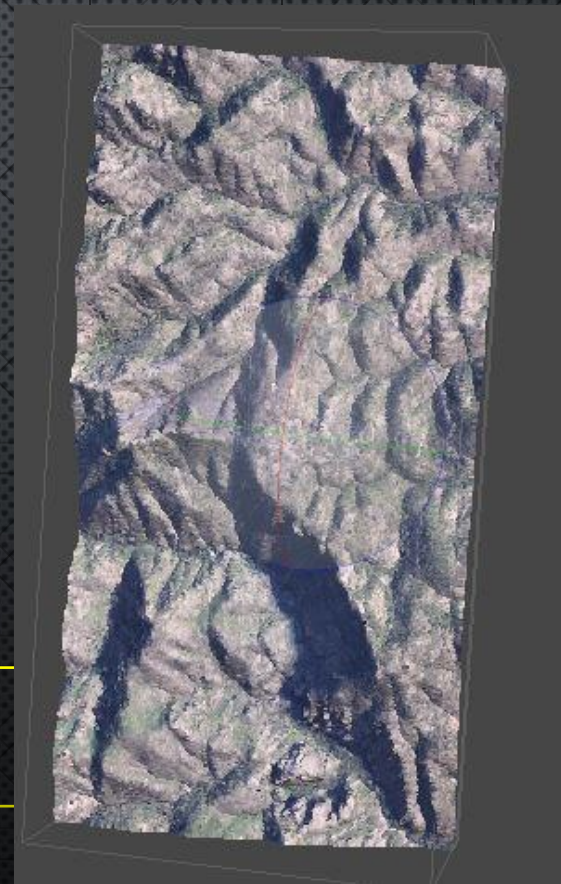
BUILDING DENSE CLOUD

Click Workflow and select Build Dense Cloud. Use settings below. This will take some time to process. This example with a photogrammetry laptop took 6 minutes 22 seconds.



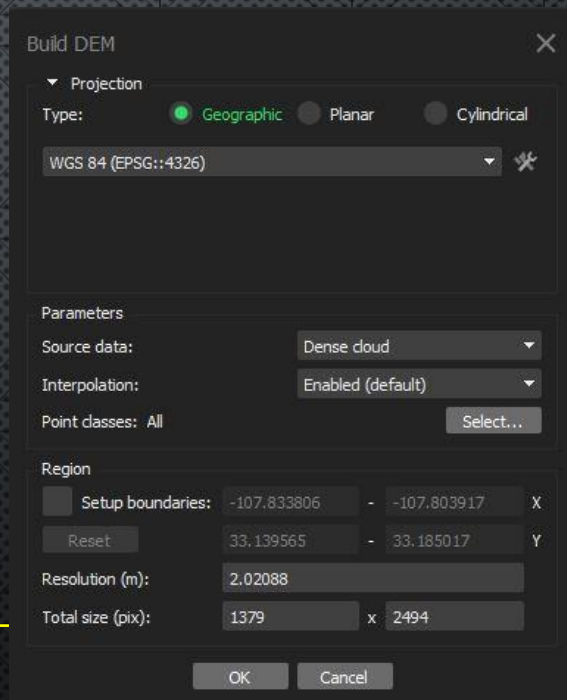
DENSE CLOUD

Click the Dense Cloud button  to view the Dense Cloud. Note there is a lot more detail now in the model.



BUILDING THE DEM

Click Workflow and select Build DEM. Use settings shown. Click OK.



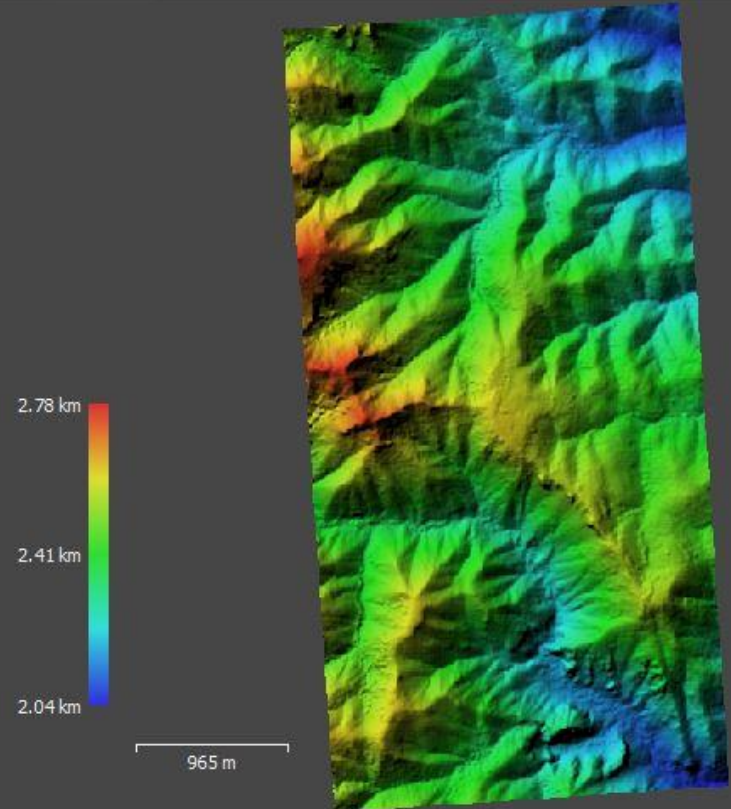
The 'Build DEM' dialog box is shown with the following settings:

- Projection:**
 - Type: ☒ Geographic ☐ Planar ☐ Cylindrical
 - WGS 84 (EPSG::4326)
- Parameters:**
 - Source data: Dense cloud
 - Interpolation: Enabled (default)
 - Point classes: All
- Region:**
 - Setup boundaries: -107.833806 - -107.803917 X
 - Reset 33.139565 - 33.185017 Y
 - Resolution (m): 2.02088
 - Total size (pix): 1379 x 2494

Buttons: OK, Cancel

DEM

Double click on DEM in
Workspace Pane to view.
DEM will open a tab
contained in the Model pane.
When finished click the X of
the Tab labeled Ortho.

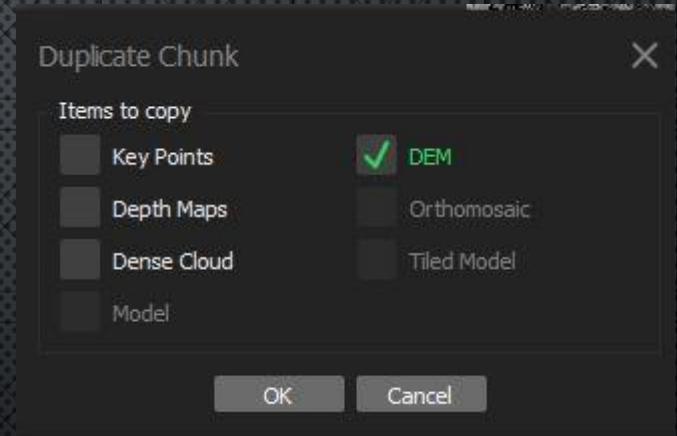


SAVE AND COPY

Save.

Duplicate the Copy of Chunk 1 only bringing over the DEM and rename EO Chunk.

Duplicate again with only the DEM and rename IR Chunk.



BUILDING THE ORTHOMOSAIC

Set EO Chunk as Active.
Click Workflow and
select Build Orthomosaic.
Use settings shown. Click
OK.

Build Orthomosaic

Projection

Type: ☒ Geographic ☐ Planar ☐ Cylindrical

WGS 84 (EPSG::4326)

Parameters

Surface: DEM

Blending mode: Mosaic (default)

☐ Refine seamlines

☒ Enable hole filling

☐ Enable back-face culling

☒ Pixel size (°): 2.70708e-06 X

Metres... 2.27644e-06 Y

☐ Max. dimension (pix): 4096

Region

☐ Setup boundaries: - X

Estimate - Y

Total size (pix): x

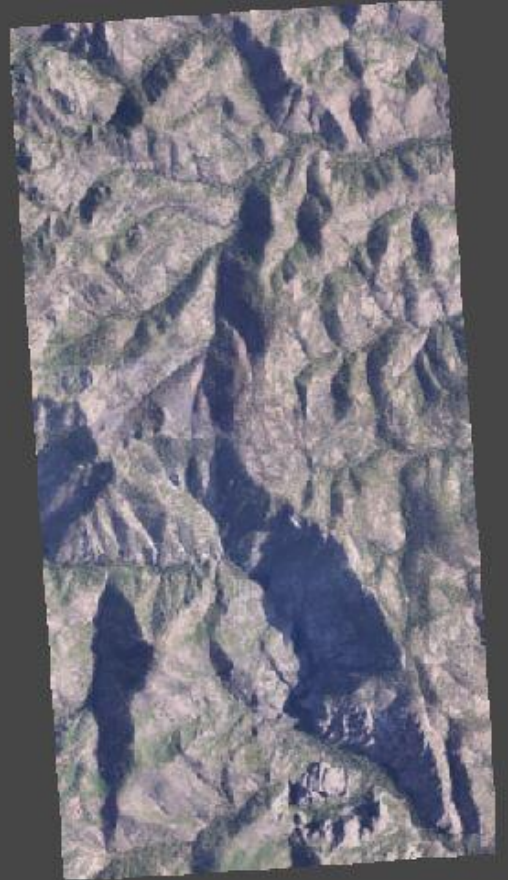
OK

Cancel


ORTHOMOSAIC

Double click on Orthomosaic in Workspace Pane to view. You can zoom in/out and drag around.

Ortho may be exported at this point if the shape is appropriate.



REFINING THE ORTHOMOSAIC

Click the Polygon arrow  and select Draw Polygon. Click and draw around the fire with a buffer outside of the line. Left click the pointer on the polyline. Select Set Boundary Type and Outer Boundary.



REFINING THE ORTHOMOSAIC

Right click the pointer on the polyline. Select Set Boundary Type and Outer Boundary. Note the line will appear as pictured. Export Shape to import on the IR ortho

Ortho is ready for Export.



IR ORTHOMOSAIC

Set IR Chunk Active and repeat building an Ortho. The ortho will be black to the eye until opened in Arc. The temperature data is embedded in each pixel.



IR ORTHOMOSAIC

IF needed Import the shape from the EO ortho. This allows exportation of the desired shape.

Right click > Set Boundary Type > Outer Boundary



SAVE AND EXPORT

Save and prepare for exports.

Export:
EO Ortho
IR Ortho
Report

METASHAPE REPORT

This generates a report for the entire process of Photoscan. It will be important to have as Metadata as well as tell you a lot about your model.

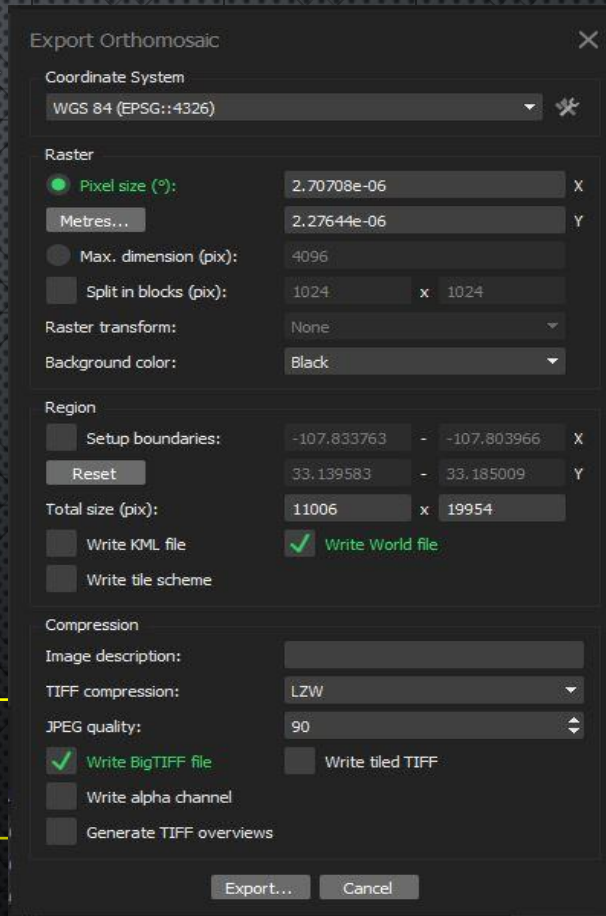
To export. Click File > Export > Generate Report...

Fill the dialog boxes as appropriate and save

EXPORTING ORTHOMOSAIC

Click File > Export > Export Orthomosaic > Export
JPG/TIFF/PNG

Match ALL of the settings to the right then click
Export and save as TIFF file in next popup.



The 'Export Orthomosaic' dialog box contains the following settings:

- Coordinate System:** WGS 84 (EPSG::4326)
- Raster:**
 - ☒ Pixel size (°): 2.70708e-06 X, 2.27644e-06 Y
 - ☐ Metres...
 - ☐ Max. dimension (pix): 4096
 - ☐ Split in blocks (pix): 1024 x 1024
- Raster transform:** None
- Background color:** Black
- Region:**
 - ☐ Setup boundaries: -107.833763 - -107.803966 X, 33.139583 - 33.185009 Y
 -
 - Total size (pix): 11006 x 19954
 - ☐ Write KML file
 - ☒ Write World file
 - ☐ Write tile scheme
- Compression:**
 - Image description:
 - TIFF compression: LZW
 - JPEG quality: 90
 - ☒ Write BigTIFF file
 - ☐ Write alpha channel
 - ☐ Generate TIFF overviews
 - ☐ Write tiled TIFF

Buttons at the bottom: Export..., Cancel

EXPORTING DEM

Only export if needed, a BAER team may request

Click File > Export > Export DEM,
Export TIFF/BIL/XYZ

Match ALL of the settings to the right. Click
Export and save as TIFF file in next popup.

Export DEM

Coordinate System
WGS 84 (EPSG::4326)

Raster
☒ Pixel size (°): 2.16559e-05 X
Metres... 1.82143e-05 Y
☐ Max. dimension (pix): 4096
☐ Split in blocks (pix): 1024 x 1024
Raster transform: None
No-data value: -32767

Region
☐ Setup boundaries: -107.833806 -107.803921 X
Reset 33.139565 -33.185009 Y
Total size (pix): 1379 x 2494
☒ Write KML file Write World file
☐ Write tile scheme

Compression
Image description:
☐ Write BigTIFF file ☐ Write tiled TIFF
☐ Generate TIFF overviews

Export... Cancel

FINISHED

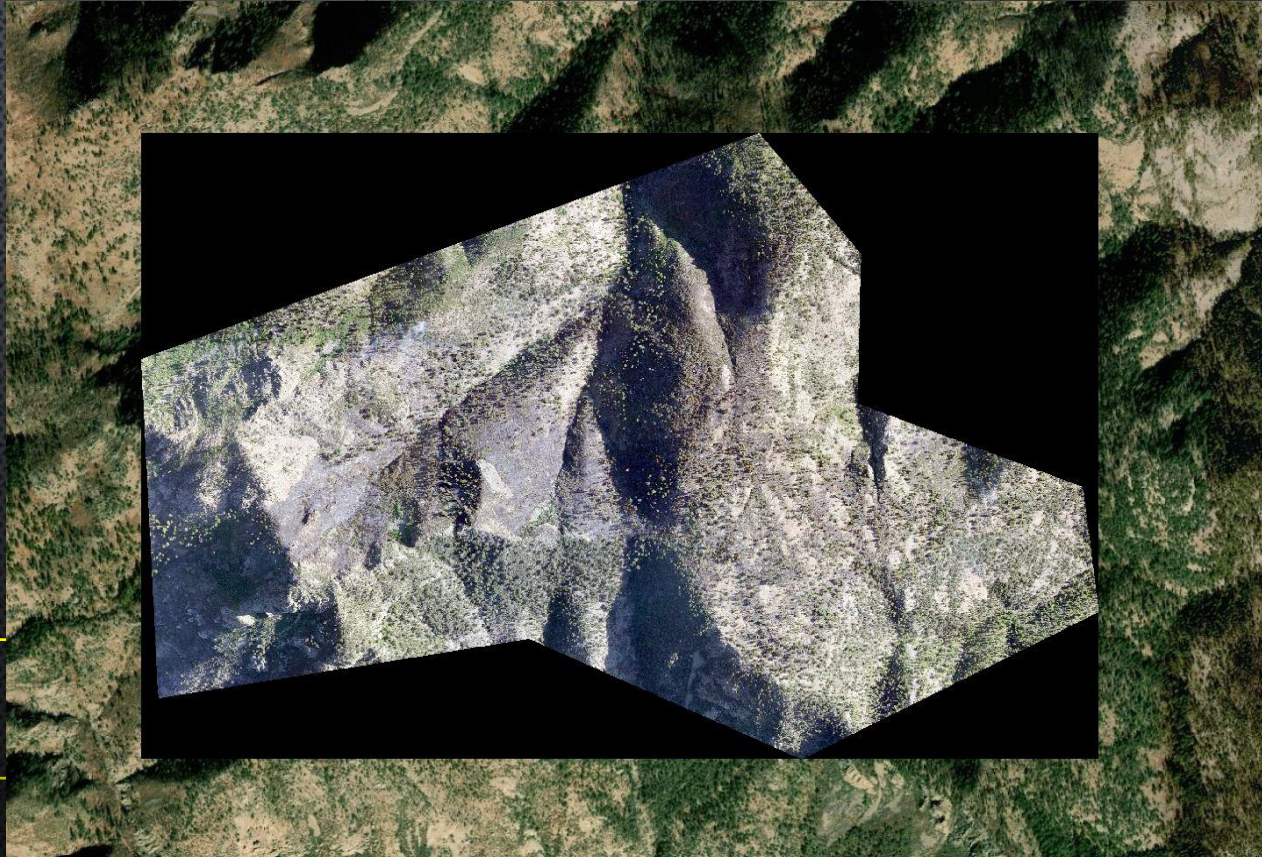
This concludes processing of fire imagery

You should be able to do basic processing and produce simple products

The exports can now be brought into Arc and developed into usable data

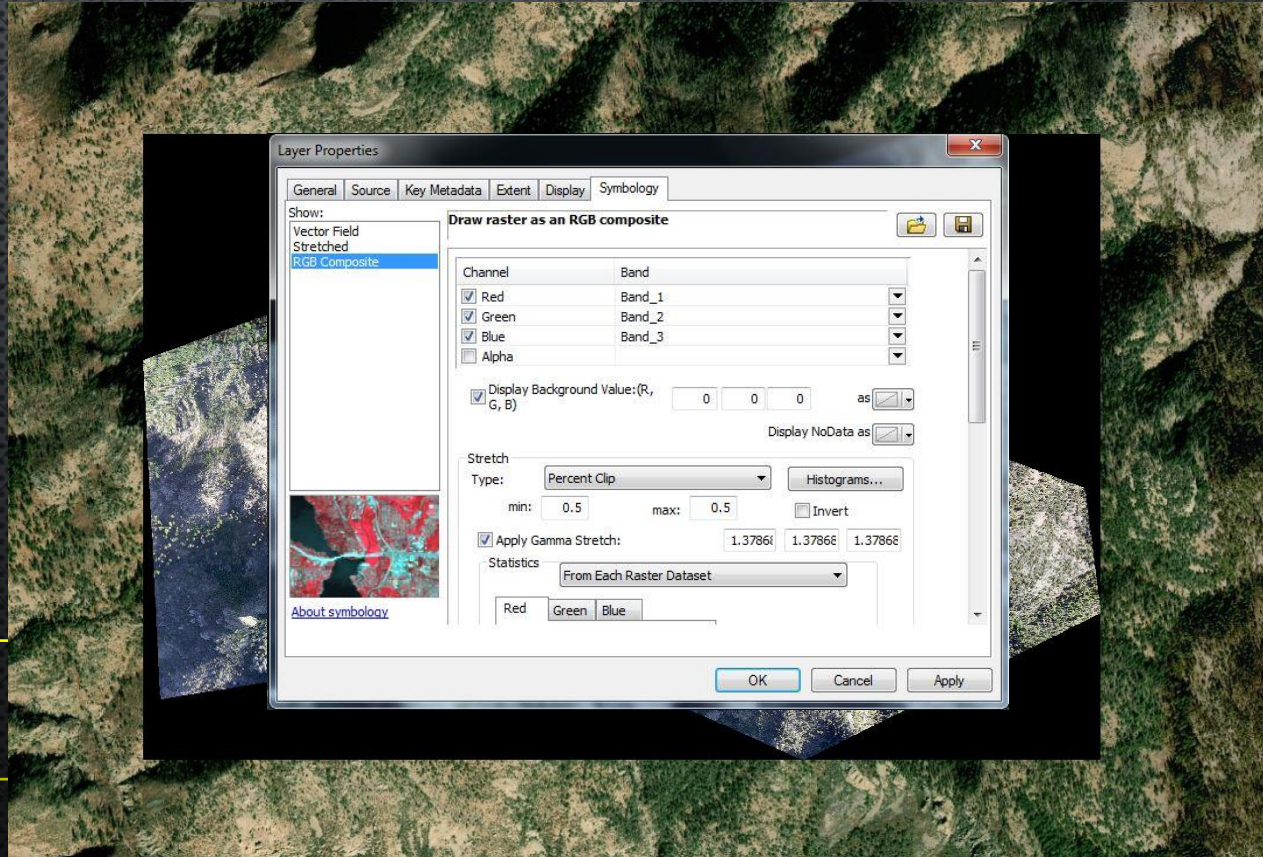
ARC TIPS

Note that
Metashape will
always export a
square or rectangle.



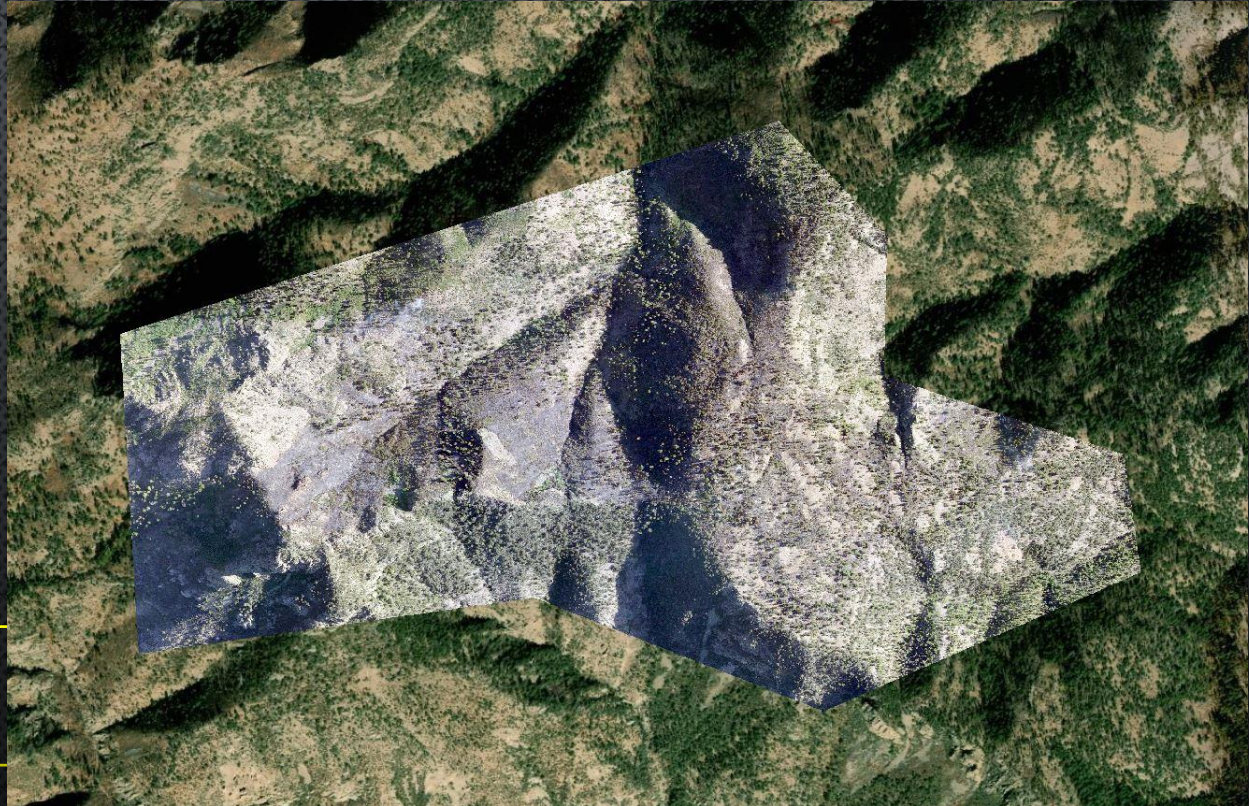
ARC TIPS

Left click layer and properties. Under symbology tab check the box for Display Background Value. Click Apply and OK.



ARC TIPS

Now the new
imagery is over
laid on the
Basemap.



REVIEW

- Students have seen the workflow for processing photos
 - Students understand how to sort photos
 - Students can convert thermal images for viewing
 - Students can setup Metashape and process images
 - Students can export products from Metashape
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Questions
