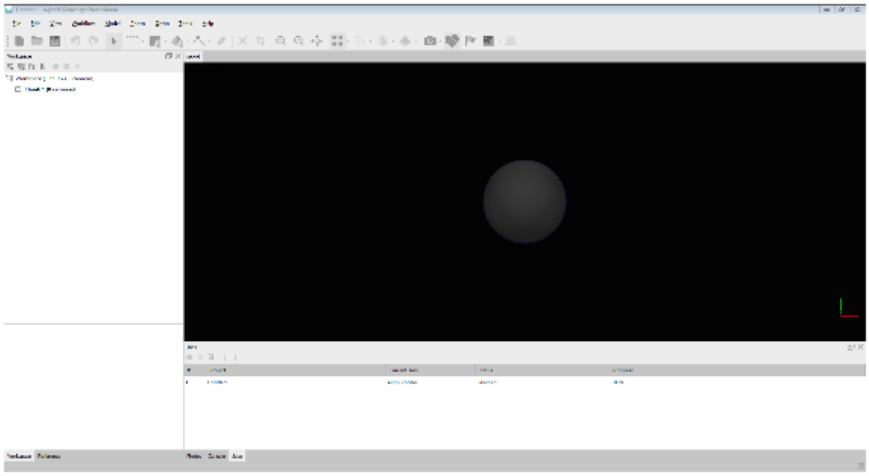
Agisoft Structure-from-Motion Protocols

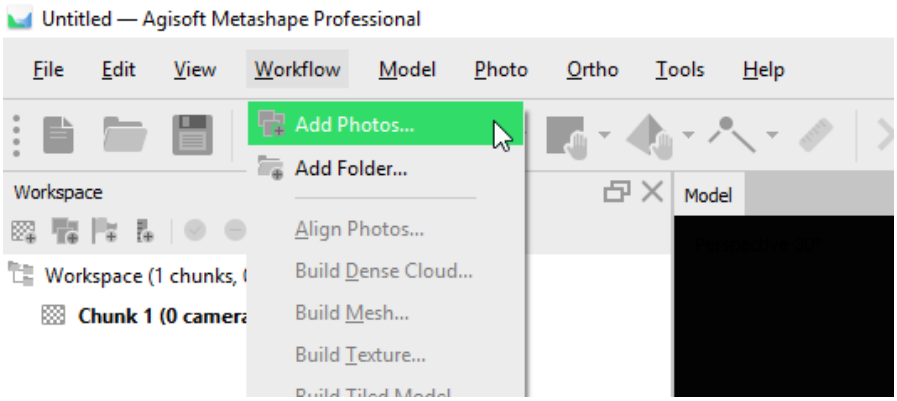
Anna Roser, Valorie Marie, Peter Olsoy, Trevor Caughlin – Boise State

Donna Delparte – Idaho State

Step 1: Start > Agisoft > Agisoft Metashape Professional



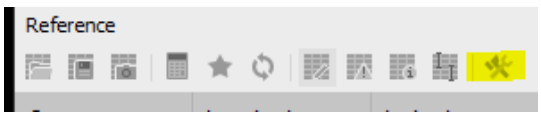
Workflow > Add Photos



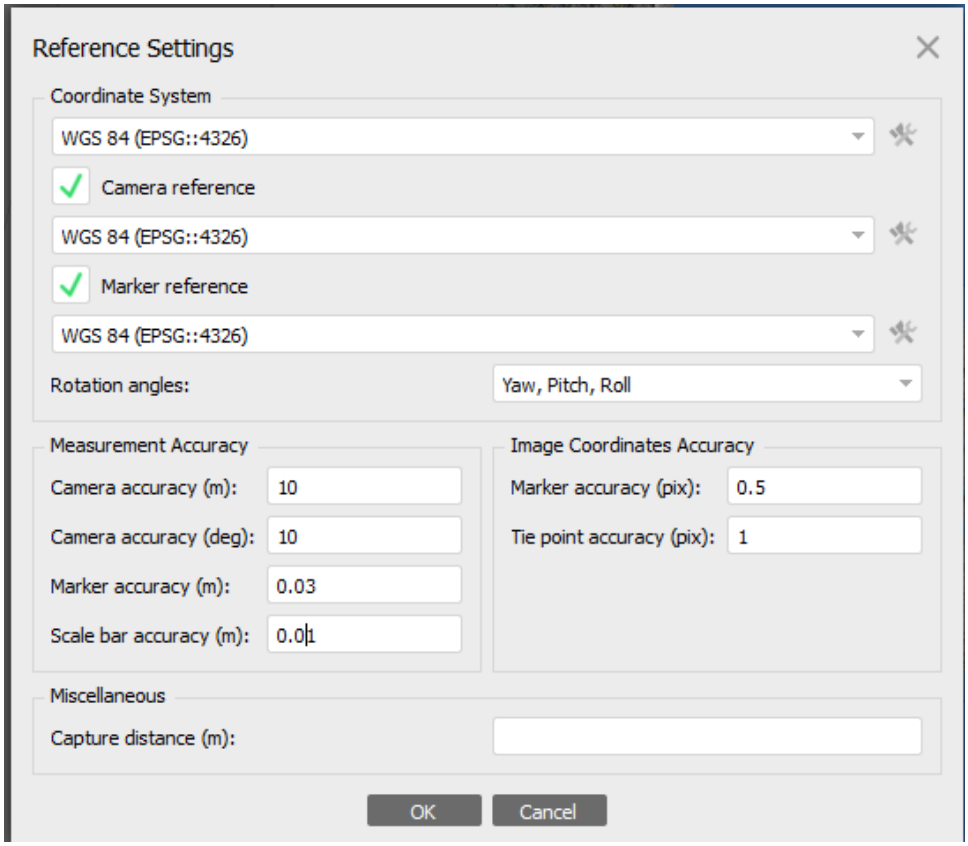
SAVE THE PROJECT. The project name should include the site name and date of collection.

Step 2: Check the Reference Settings and Camera Lens Calibration

Reference > Settings

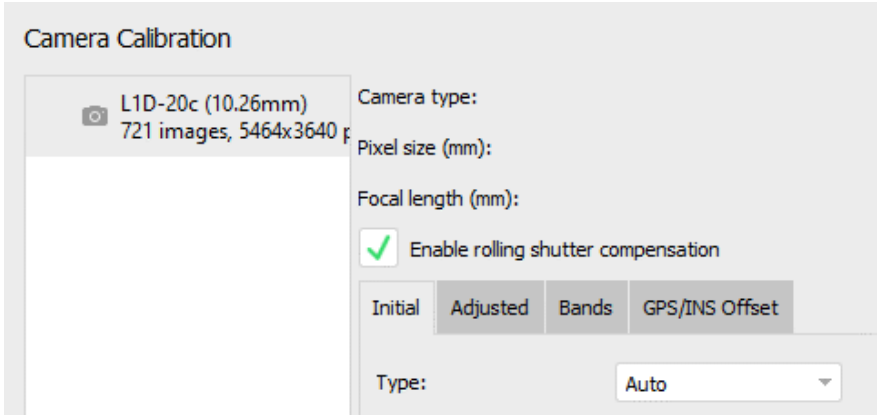


Check that the Camera Reference and Marker Reference Boxes are checked if you have GPS data for both. Also check that the accuracy is correct. (see image below)



Update the setting for the Mavic drone rolling shutter.

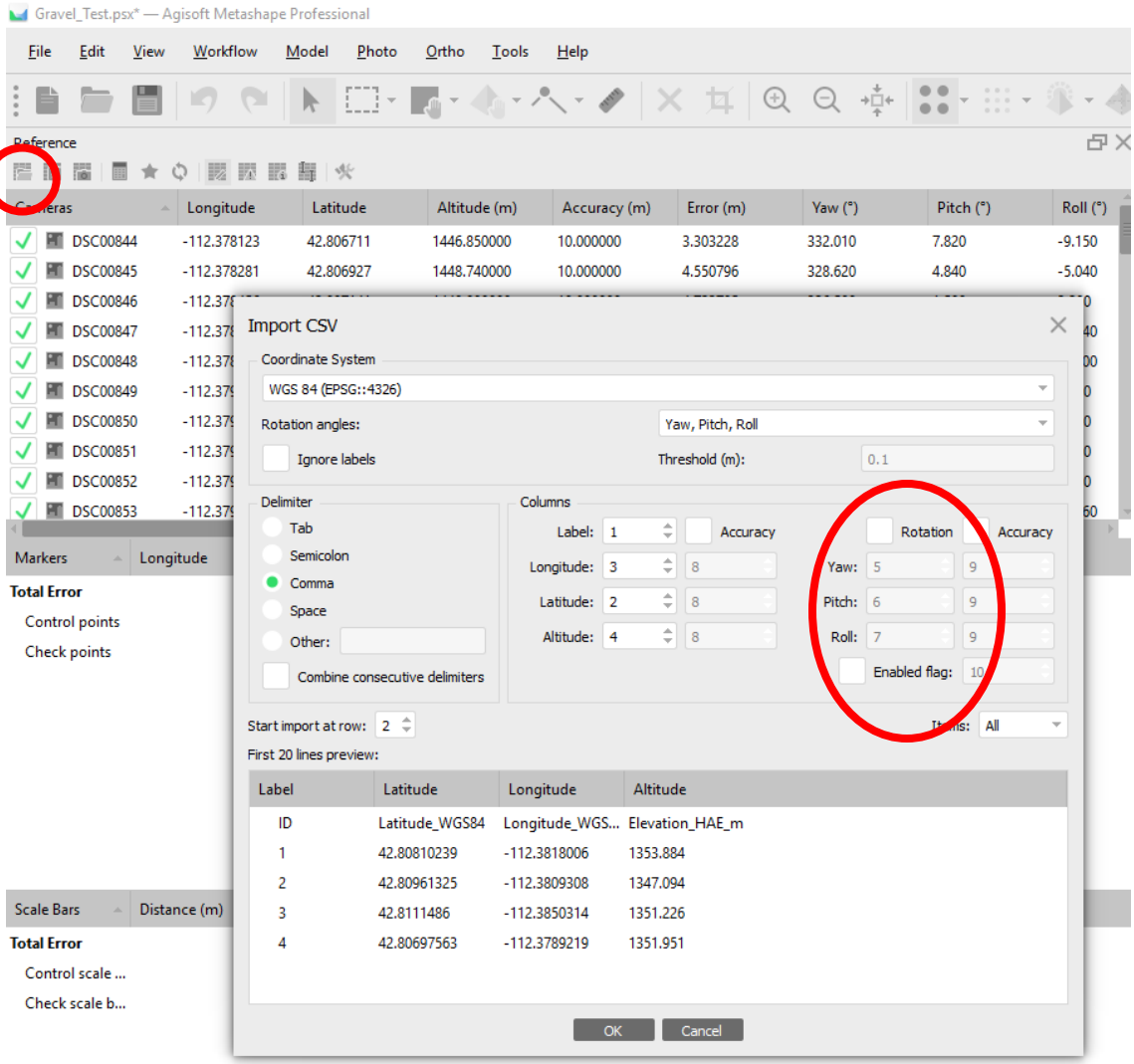
Tools >> Camera calibration >> Check 'Enable rolling shutter compensation' for the entire processing routine

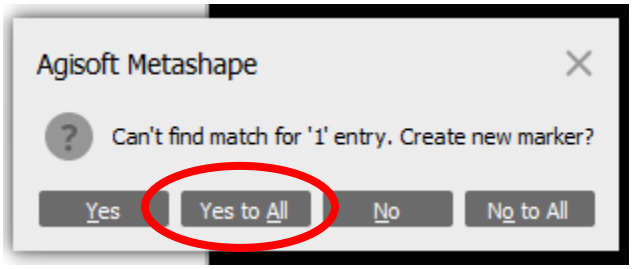


SAVE THE PROJECT

Step 3: Load in Ground Control markers

Use the same folder icon in the reference toolbar. The Rotation section should be unchecked.

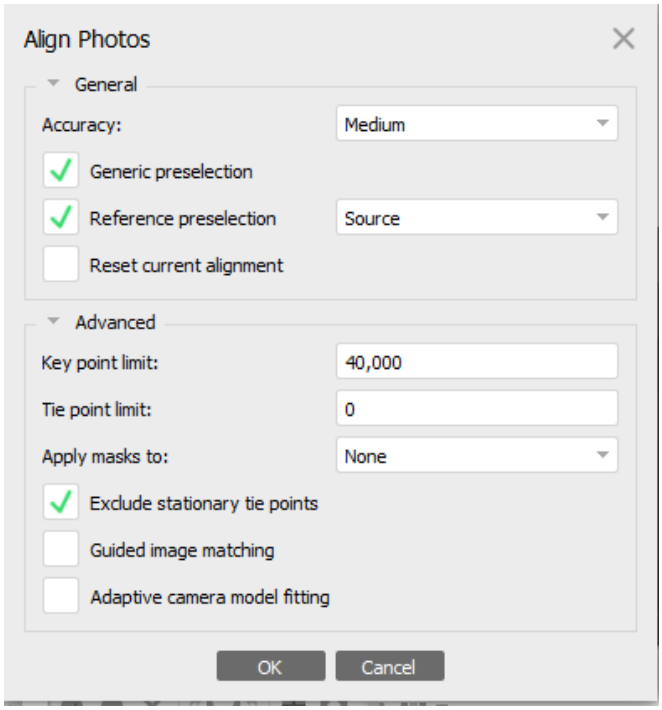




Check the lat/long/elv of photos and markers. Does everything line up and look correct in the model space? If the elevation is incorrect (often occurs when using DJI mavic or phantom) this is the time to make an altitude correction.

Step 4: Workflow > Align Photos

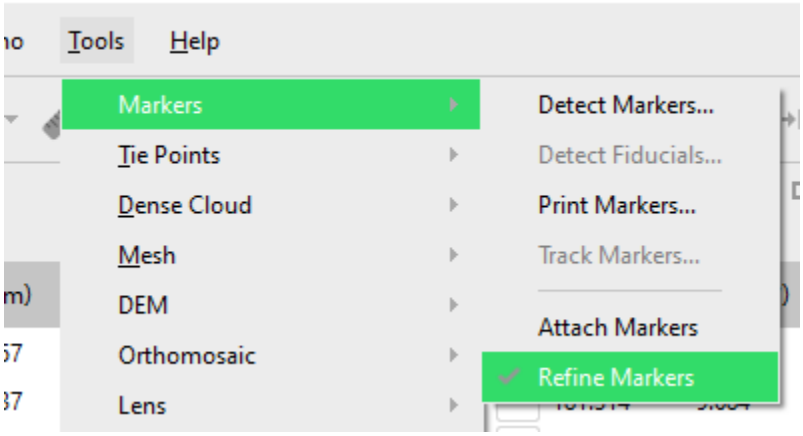
Match your options to those shown below. This will be the first of several alignments. This first alignment is to get the general locations of the photos. Press 'OK' once your alignment tab matches the screenshot below.



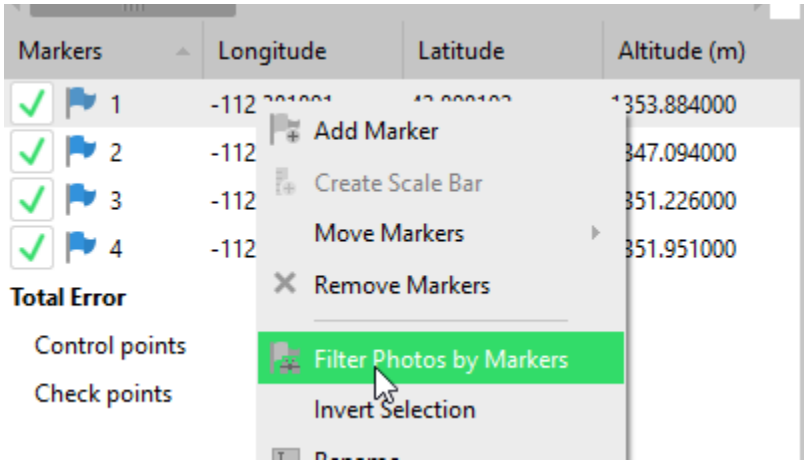
SAVE THE PROJECT

Step 5: Place Markers.

First, turn on 'Refine Markers'. This will allow Agisoft to place the flags on the target centers without you having to place every single one. Go to Tools-> Markers -> Refine Markers. Click to add the check mark – if there's already a check mark, then it's already on.



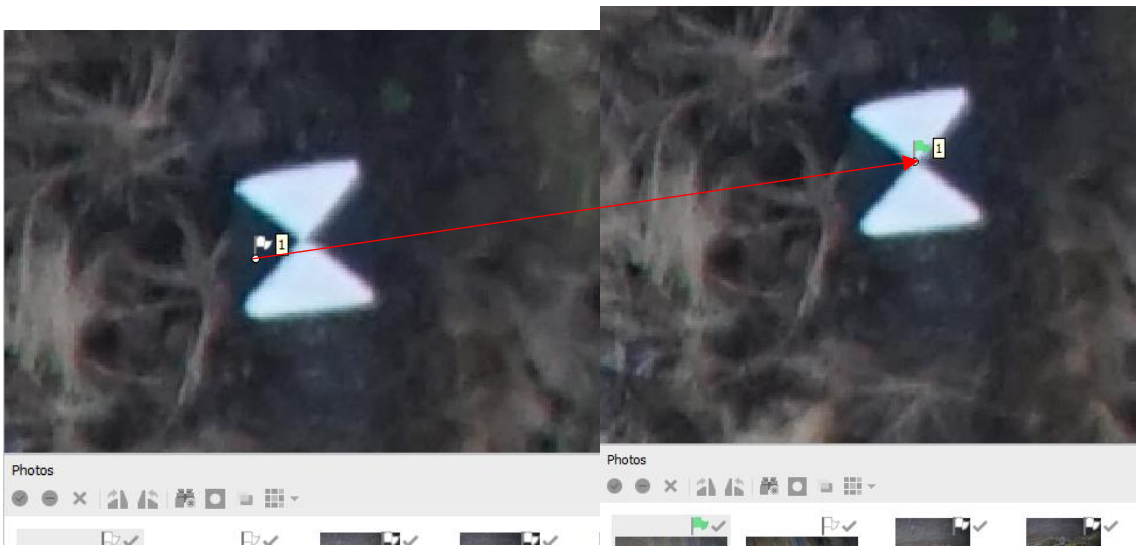
Right click on flag 1 > Filter photos by markers



Place 5-7 markers on the center of the ground control points (GCP). Click and drag flags to move. Move through these flags slowly so that Agisoft can update and place the blue flags on target centers. Once the flags have auto-placed, page through them to make sure they look centered and look for white flags. White flags are ones that you still need to place.

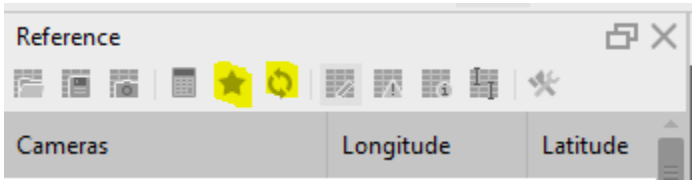
TIP: on your keyboard, use “PgUp” and “PgDown” keys to quickly switch between photos without moving your mouse!

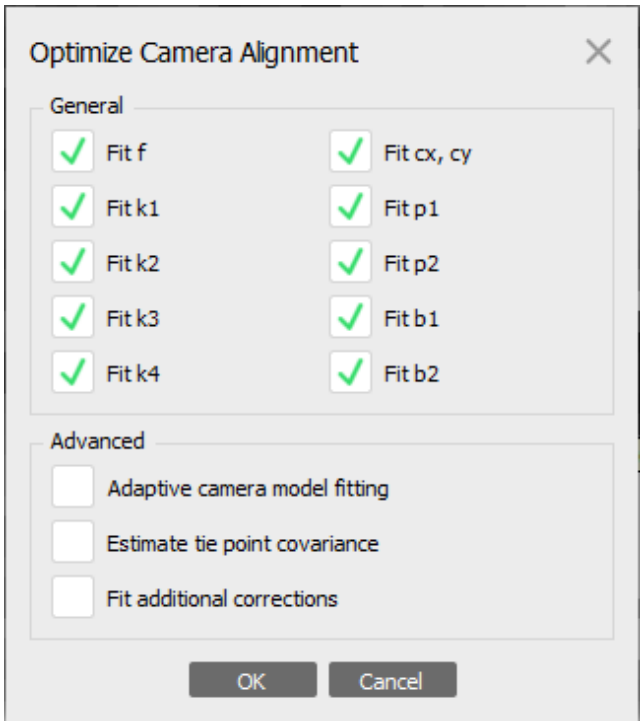
TIP: don’t chase errors with marker placement—just try to be consistent then update. Don’t shimmy the flags around. Ignore error until you’ve accurately placed flags



(Flag should turn green when repositioned, or blue once the auto placement has occurred.)

When you have completed all the markers for three targets, in the Reference pane click Update and then Optimize.





Once you have completed the placement of three markers, return to update and optimize for every subsequent marker!

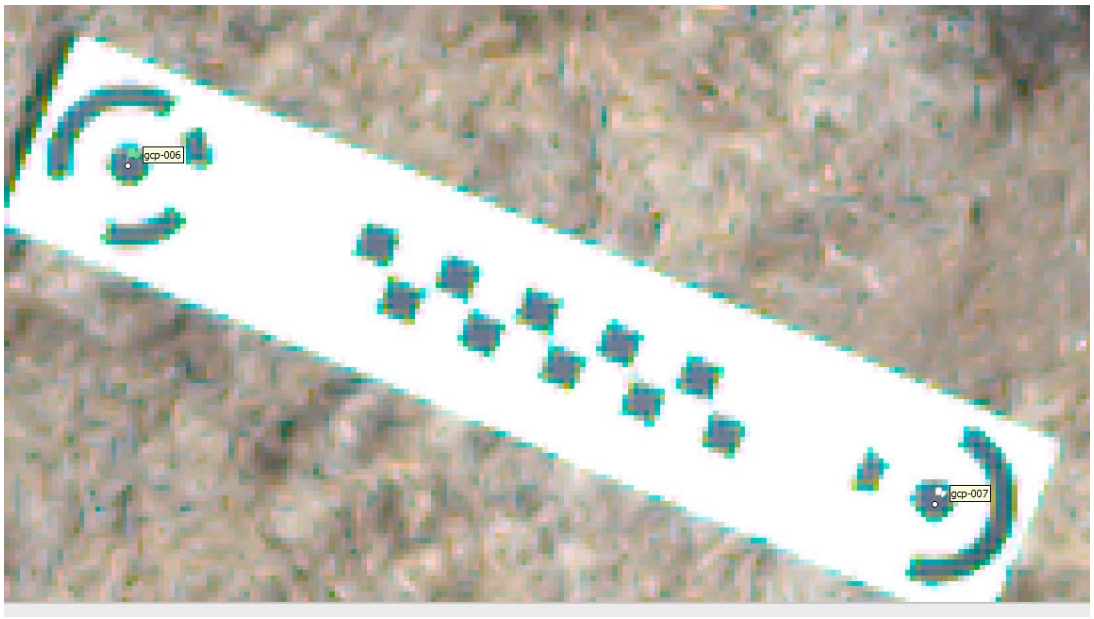
Now, return to the top of step Five and place the markers for another target. Repeat this process until for all of the targets and there are no more white flags – all flags must be green or blue. Remember to save frequently!

Before you move to Step 6, recheck all of your markers with Filter by Marker – sometimes after all of the Update and Optimize, Agisoft will identify new photos that have a flag that needs to be placed. Look for any new white flags for each marker and place them.

Do a final Update and Optimize and Save.

Scale Bars

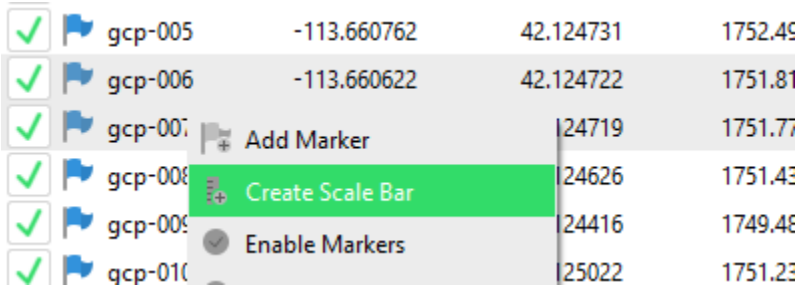
If you have a board that looks like this:



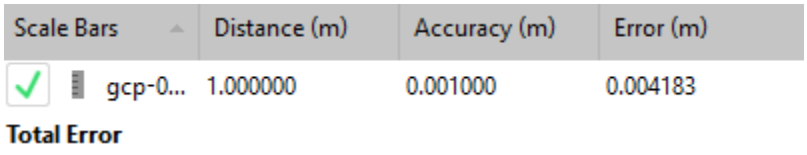
You'll treat it as two normal GCP points and a scale bar. Complete the marker placement for all of the other GCPs in the scene before pinning the GCPs on the scale board.

If only one end of the scale bar has a GPS point, create a marker for the other end but leave it unchecked and clear the lat/long data.

In the Reference pane, highlight the two GCP points that represent the ends of the scale bar, right click and choose "create scale bar".



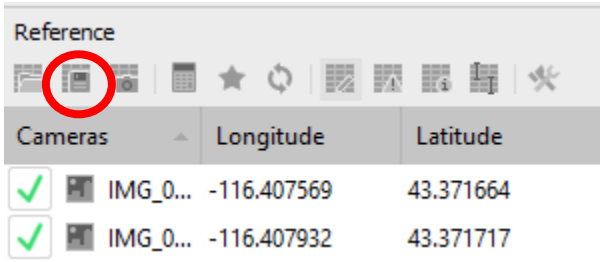
The scale bar will appear below the markers in the Reference pane. In the Distance section, add in 1.0m (this will depend on the scale so check with whomever collected the data).



Place the two markers as you would any other marker.

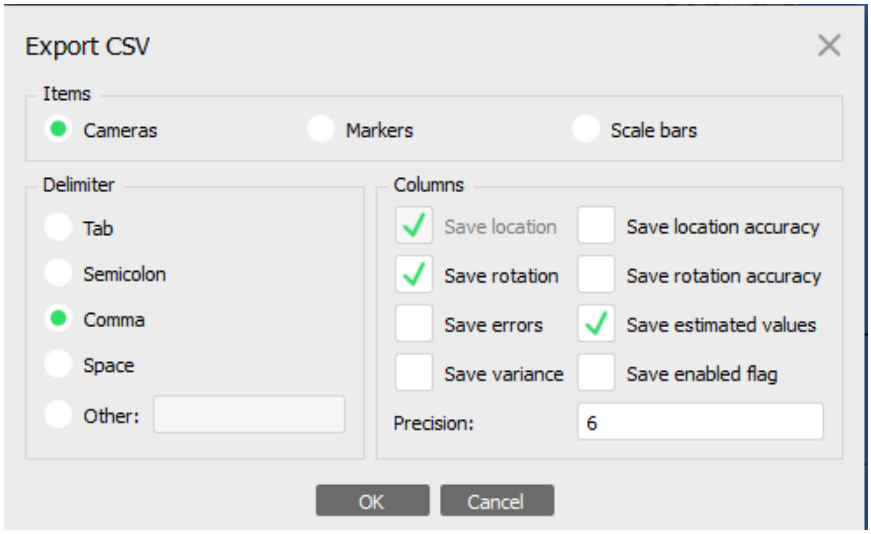
Step 6: Export Camera Locations

Click the Export Reference button.

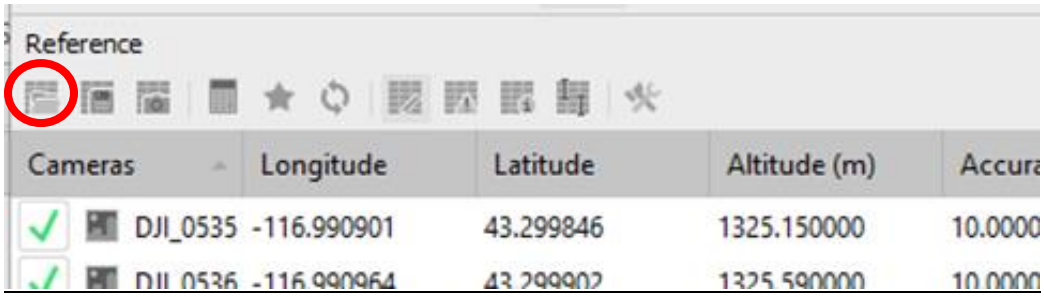


In the 'agisoft' folder for your current project, name the file "camera_locations_update_v1.txt" and Click 'Save".

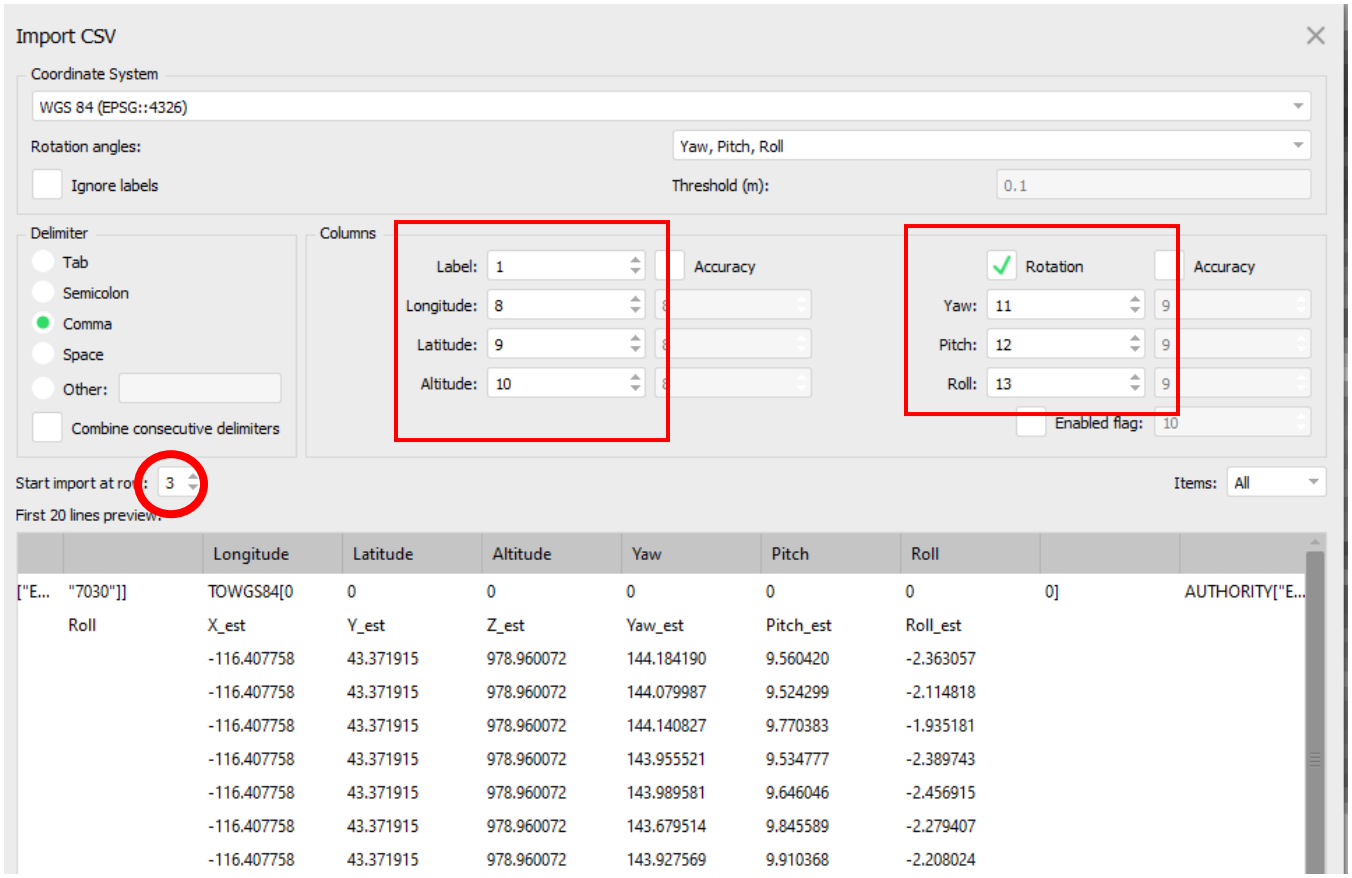
For the cameras, we're going to save the 'Rotation' and 'estimated values'. The precision will be 6 and we'll use a 'Comma' as the Delimiter (see below).



Step 7: Import Estimated Camera Locations



Select the .txt file that you just created. You'll need to adjust the numbers to the correct columns and start the import at Row 3. You'll also bring in the Yaw, Pitch, and Roll that were estimated. (see below).

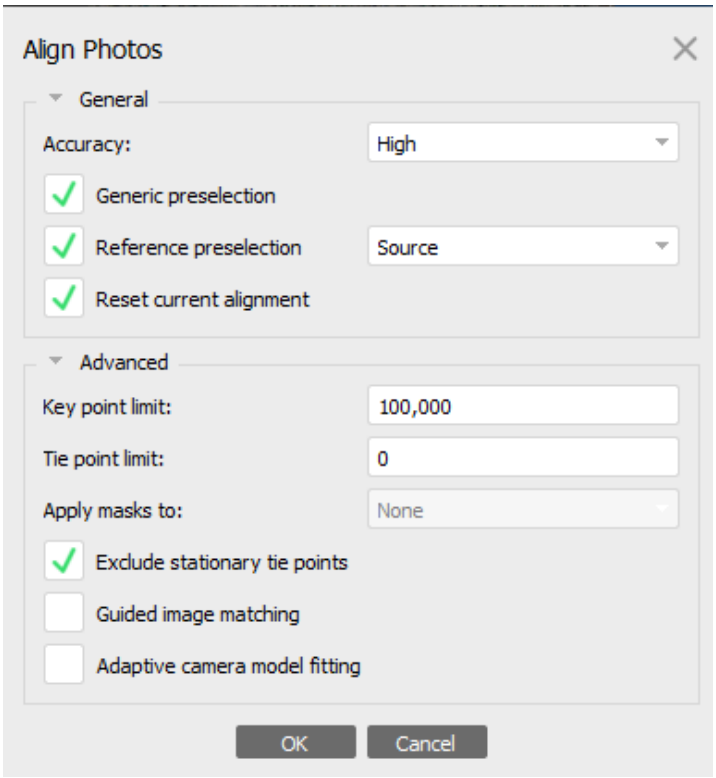


SAVE

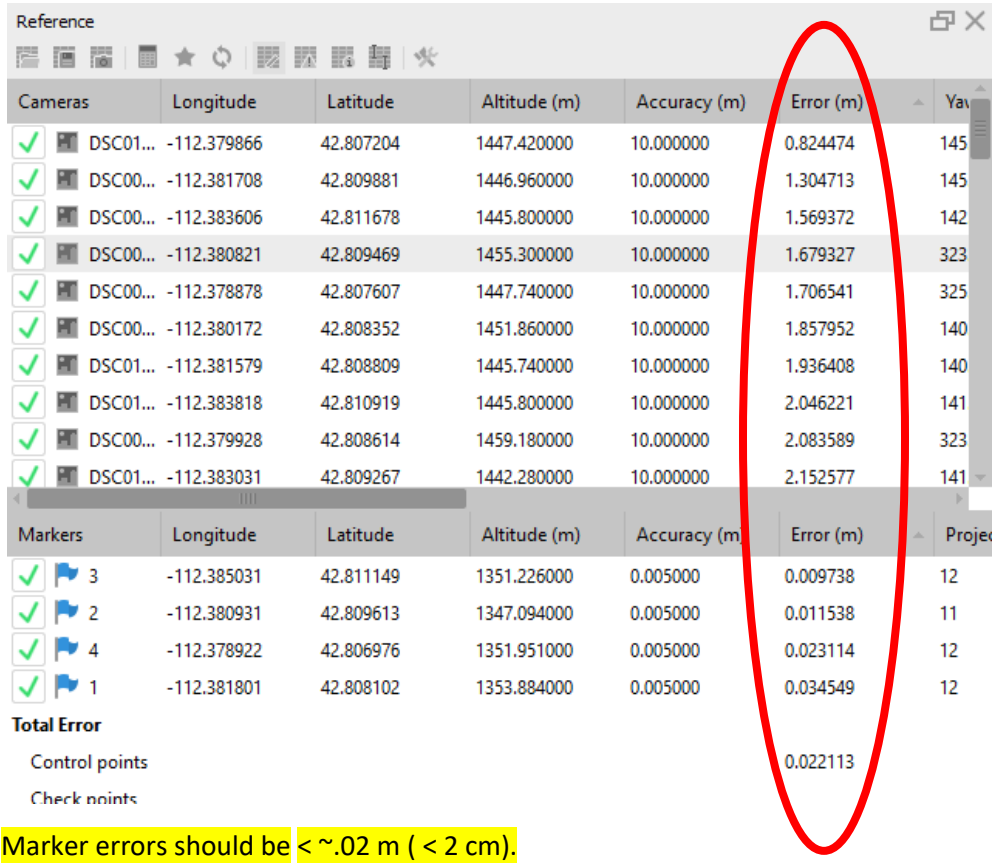
Step 8: Align Photos Again on High Quality

Run Alignment again with parameters that match the screen below*. We're forcing Agisoft to use the estimated locations as the source for this version.

*Depending on the site, the key point limit can go higher than this.



A. Check placement error for the photos and markers:



Marker errors should be < ~.02 m (< 2 cm).

Camera errors should be less than 1m.

Scroll to the bottom of the camera and marker list, in the Reference pane, to view your total error.

***If your cameras or markers are not below the threshold for error, go back to Step 6 and work back to this point through all of the steps.

Step 9: Gradual Selection = Clean the Sparse Cloud

In order to reduce the errors in the adjustment in order to improve the geometry of the overall model. Three steps are used and repeated as necessary to reduce the errors as much as possible:

A. Reconstruction Uncertainty
   removing bad points due to poor geometry

B. Projection Accuracy
   removing bad points due to pixel matching errors

C. Reprojection Error
   removing bad points due to pixel residual errors

Make sure the Model tab is active, then go **Model > Gradual Selection**

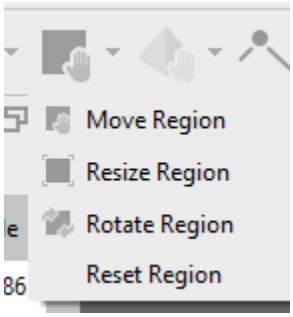
For each step you'll move the slider and watch the model to see where points are selected (in pink). Do not select more than 5,000-10,000 points per step. If points that are the tops of sagebrush or plants or objects of interest are getting selected, then back off the slider until those points are unselected.

Once the points are selected, Press Delete. Click Update and Optimize. Repeat for 9 A, B, and C.

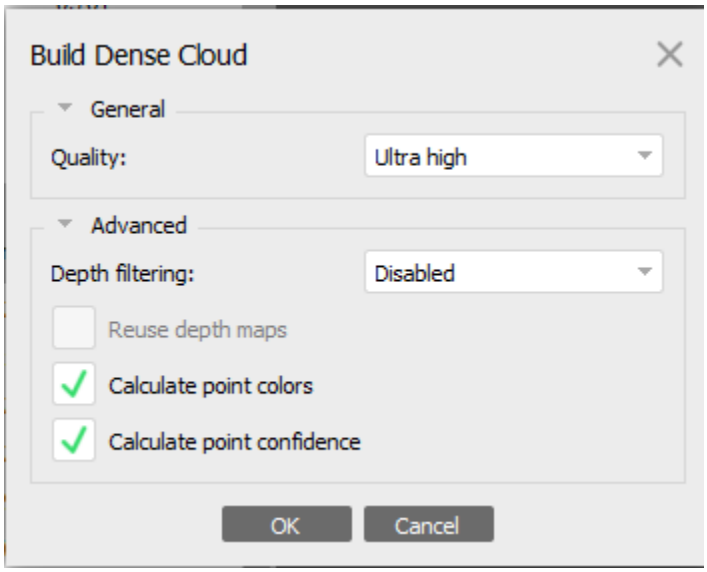
Step 10: Build Dense Cloud

Save your Project.

Resize region bounding box before building dense cloud. Using all three of the tools shown below, reduce the box to the size of the study area. This will save a lot of processing time and result in data products that don't take up excess space.



Workflow -> Build Dense Cloud. Copy the settings below and then Press OK. This will take several hours! Ultra high quality may not be the best option. High quality may be preferable to reduce noise. If dense cloud is too noisy in canopy -> run on High.

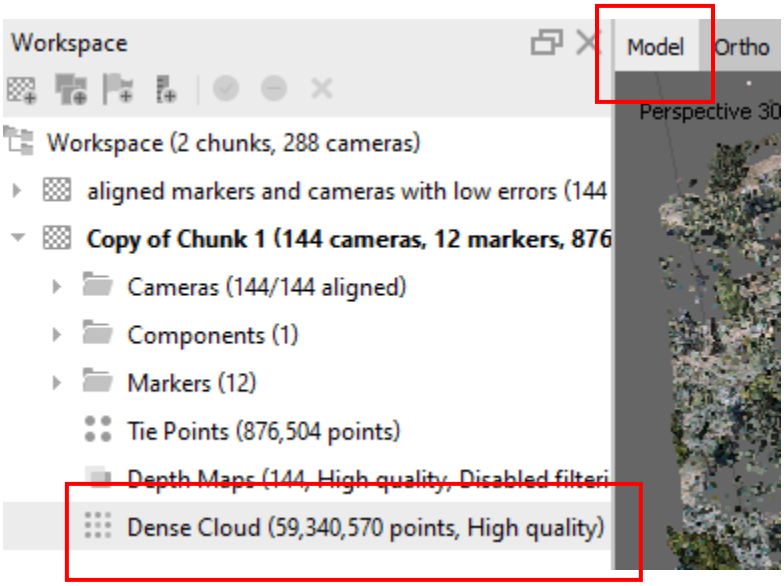


Step 11: Clean Dense Cloud

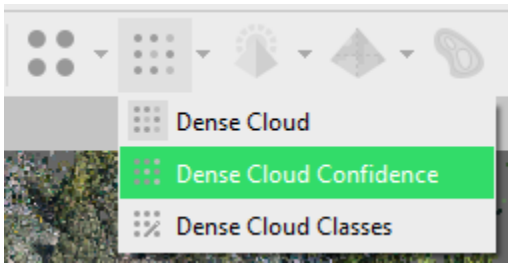
Save Project.

When we clean the dense cloud, we're looking for erroneous points and points that have low location confidence. We want to remove those points at this step so that when we build products that are based on the dense cloud, we're using the best model possible.

Switch to Model View so that you can see the dense cloud and manipulated it.



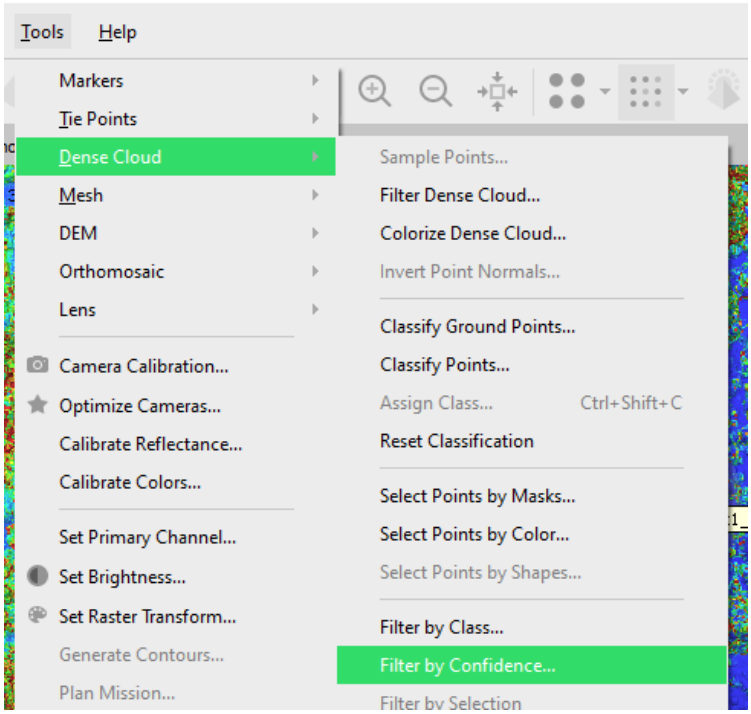
Next, change the display of the dense cloud. On the top icon menu, click the icon with nine dots and select "Dense Cloud Confidence."



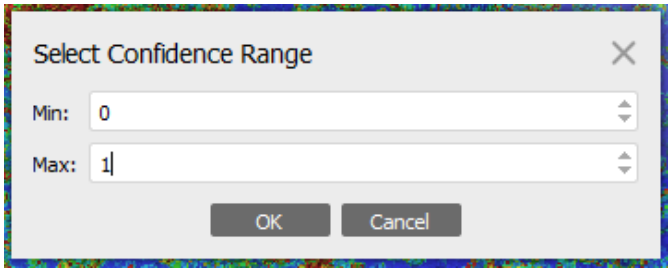
Your point cloud is now displaying a level of confidence for each point, rather than RGB colors. Red points are the least confident and blue and most confident. You'll probably notice that there are more red, low confidence, points around the edges of the site and objects that are more difficult to reconstruct, like trees and some shrubs.

To remove the most erroneous points, we will filter the cloud to show the lowest confidence.

Tools-> Dense Cloud -> Filter by Confidence (see screen shot)



Change the Max to “1” and press OK.



The remaining point cloud is made up of points that have a confidence of 1.

A. Manually delete points

Use the manual selection tool  to draw around points that you’d like to select and delete.

Check out the Tips section at the bottom of this document to see the key short cuts to move the cloud around while you’re cleaning.

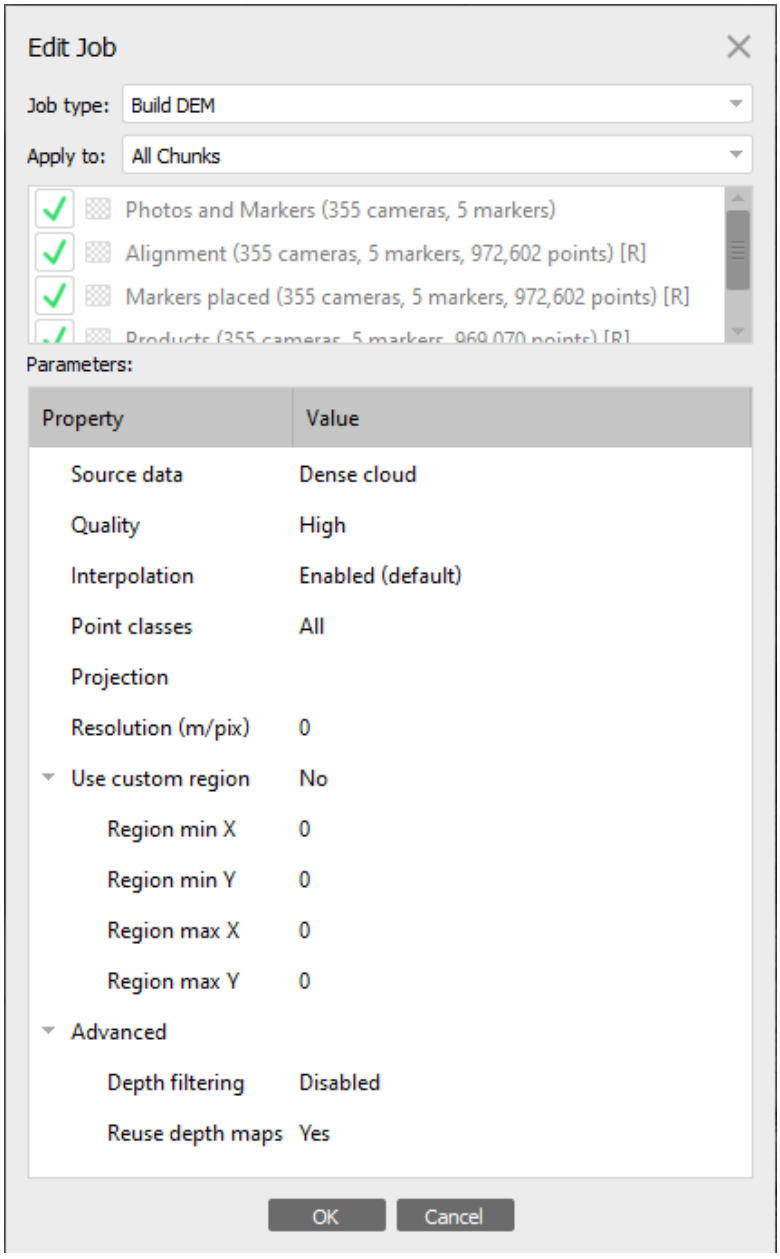
For example, we want to select points that are randomly floating in the air. In some instances, we may delete all the points with a confidence of 1, but that will depend on the site.

Step 12: Batch Process to create products

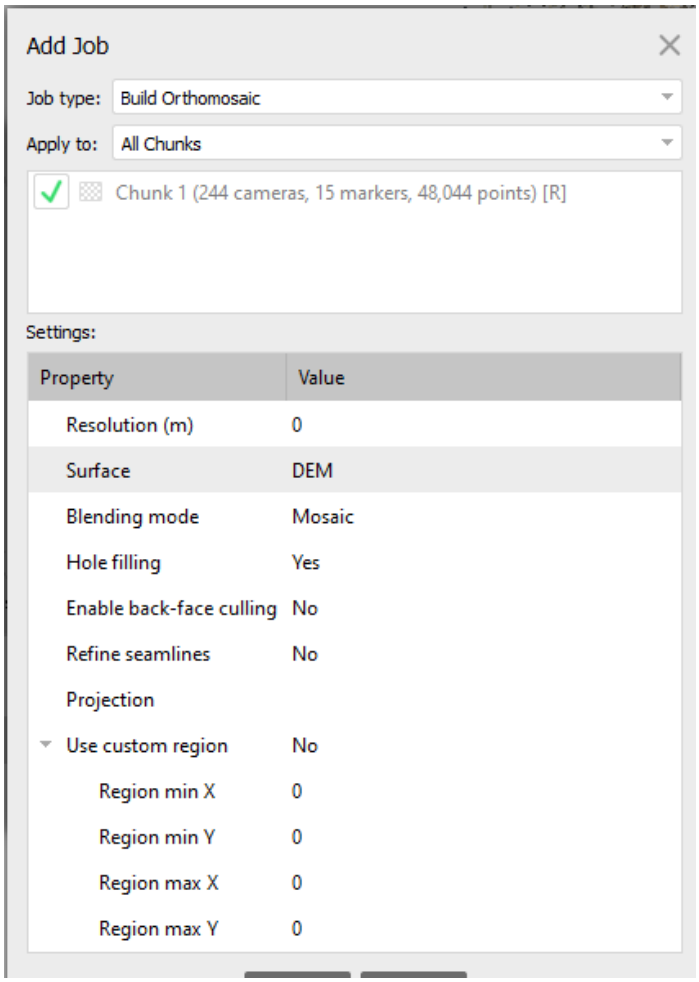
Run a **Batch Process. Workflow > Batch Process**

Click “Add” for each step. Match all of your steps to the screen shots for each.

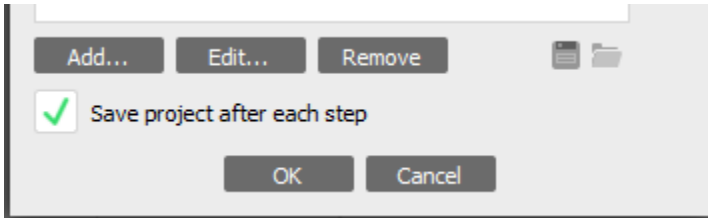
A. Build DEM


Edit Job
Job type: Build DEM
Apply to: All Chunks
Photos and Markers (355 cameras, 5 markers)
Alignment (355 cameras, 5 markers, 972,602 points) [R]
Markers placed (355 cameras, 5 markers, 972,602 points) [R]
Parameters:
Property
Value
Source data
Dense cloud
Quality
High
Interpolation
Enabled (default)
Point classes
All
Projection
Resolution (m/pix)
0
Use custom region
No
Region min X
0
Region min Y
0
Region max X
0
Region max Y
0
Advanced
Depth filtering
Disabled
Reuse depth maps
Yes
OK
Cancel

B. Build Orthomosaic



Save after each step!



The batch process will take several hours to run at least. As a courtesy to others using the shared computer, please note to other users that the computer will be running an intensive program for a while.

Step 13: Generate Report

Once the batch process is complete, a good way to review all of your work is to generate a report.

File > Export > Generate Report

Name the file after the project and save the PDF in the Products folder.

In Agisoft, look at the ortho, look for blurry images -> find and remove those photos. Just regenerate ortho. Can't disable too many photos because it'll result in holes.

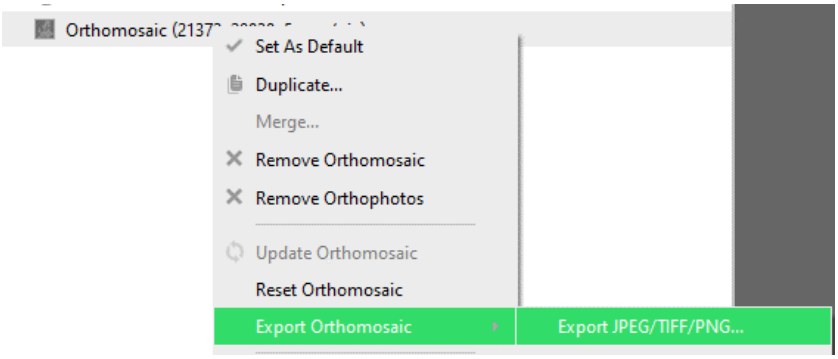
Also, look at DEM for crumbles or holes. If it's very rough or noisy. If it should be flat and there's surface noise -- there may be some parameter changes needed.

Step 14: Export Products

In this step we'll export an orthomosaic, dsm, and point cloud.

A. Export Ortho

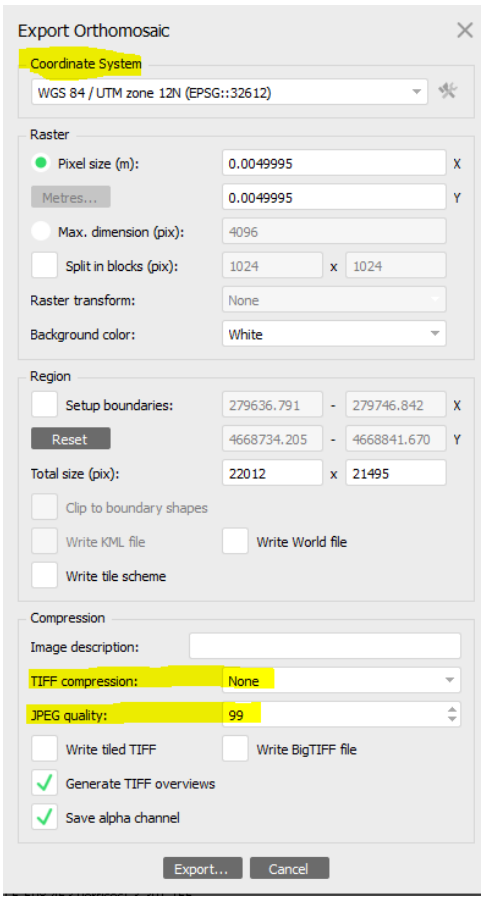
In Workspace, right click on Orthomosaic -> Export Ortho -> Export JPEG/TIFF/PNG



Under 'Coordinate System' choose WGS 84 / UTM zone 12N*. The easiest way to find this system is to click the coordinate drop down menu and click 'More…' . In the Filter type '32612' which is the numeric code for the coordinate system.

*the coordinate system depends on where the flight was and what data you need to match.

On the ortho export widow, you should only have to change three inputs (highlighted below).



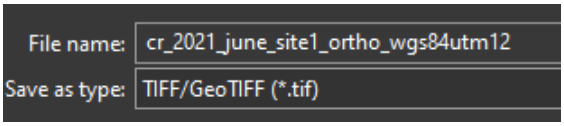
Click Export.

Choose the file location to save the product. If you don't already have one, make a folder called 'products' for your site.

Name your site very specifically so it's easy to identify later. Use this template:

"cr_2021_june_site[your site number]_ortho_wgs84utm12"

Here's my example for site 1:



Click save.

B. Export DSM

In Workspace, right click on DEM -> Export DEM -> Export JPEG/TIFF/PNG

Under 'Coordinate System' choose WGS 84 / UTM zone 12N. The easiest way to find this system is to click the coordinate drop down menu and click 'More…' . In the Filter type '32612' which is the numeric code for the coordinate system.

On the export widow, you should only have to change one input, the coordinate system.

Click Export.

Save the DSM in the same location as the ortho.

Name your site very specifically so it's easy to identify later. Make sure you update the name to note that it's a dsm, not an ortho. Use this template:

"cr_2021_june_site[your site number]_dsm_wgs84utm12"

Click save.

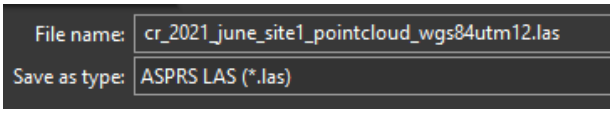
C. Export Point Cloud

In Workspace, right click on dense cloud -> Export Dense Cloud

Save the point cloud in the same location as the ortho and DSM.

Name your site very specifically so it's easy to identify later. Make sure you update the name to note that it's a point cloud. Also make sure you save as type "ASPRS LAS". Use this template:

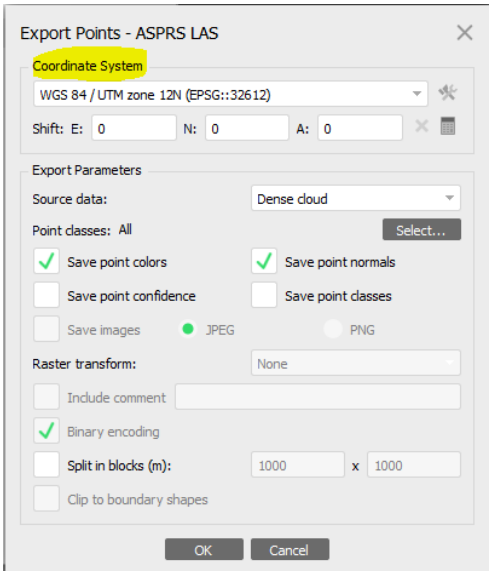
"cr_2021_june_site[your site number]_pointcloud_wgs84utm12.las"



Click save.

Under 'Coordinate System' choose WGS 84 / UTM zone 12N. The easiest way to find this system is to click the coordinate drop down menu and click 'More…' . In the Filter type '32612' which is the numeric code for the coordinate system.

On the export widow, you should only have to change one input, the coordinate system.



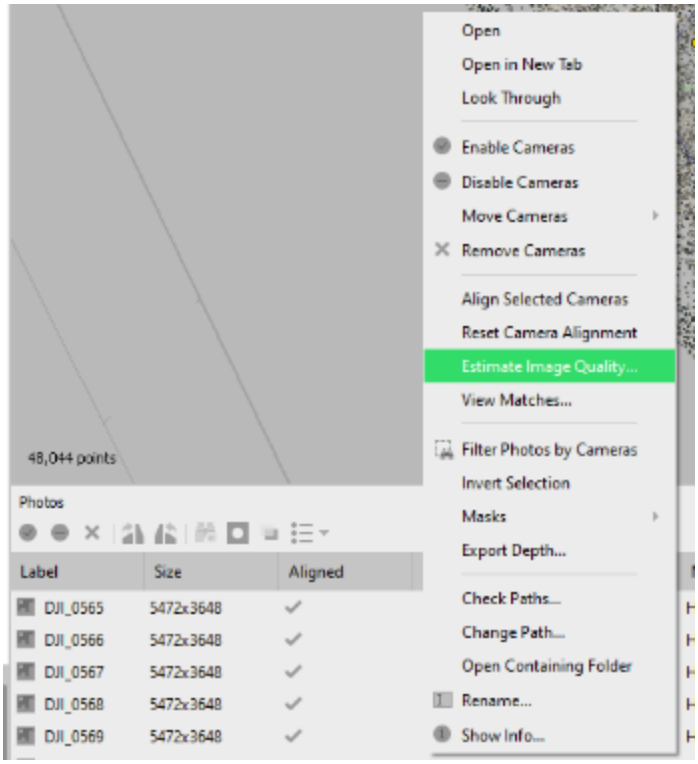
Click Export.

Troubleshooting and Tips

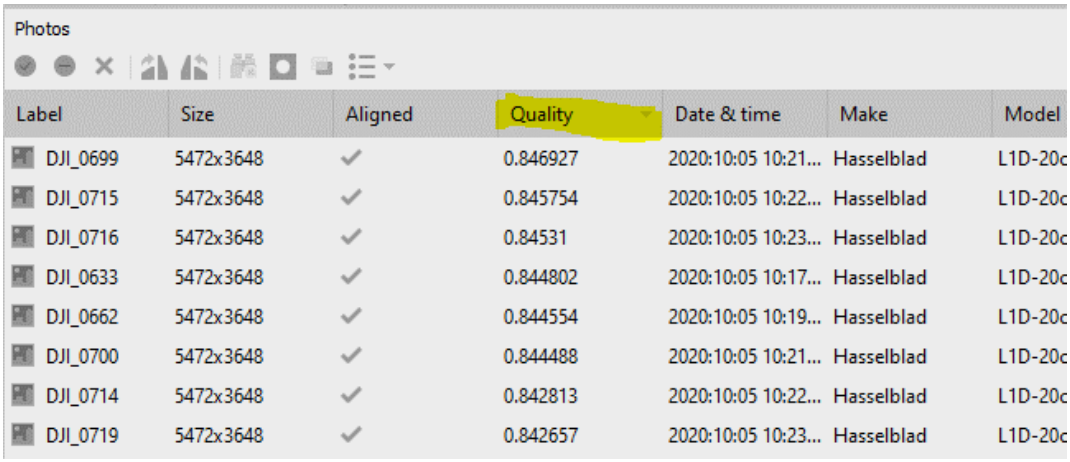
Run Image Quality Check

This can help you to identify cameras that are low quality and you can consider removing these from the project.

In the “Photos” tab, select all of the images, right click and select “Estimate Image Quality…”. Pick “All Cameras” and click Ok.



Once the Quality Estimate is done, review the outputs in the new Photos column. Click the column name Quality to switch the sorting. If there are any photos with a Quality rating of less then .65, highlight and delete those photos. Then run Update and Optimize – and SAVE!



Tip: Model View Shortcut Keys

Undo (only for Delete, Assign Class / Classify Ground Points,Masking and Close Holes operations)	Ctrl + Z
Redo (only for Delete, Assign Class / Classify Ground Points,Masking and Close Holes operations)	Ctrl + Y
Switch between navigation and any other previously selected mode	Space
Reset view	0
Switch to stereoview mode	9
Switch between orthographic and perspective view modes	5
Change the angle for perspective view	Ctrl + mouse wheel
Assign dense cloud class (only if some points are selected)	Ctrl + Shift + C
Predefined Views	
Top	7
Bottom	Ctrl + 7
Right	3
Left	Ctrl + 3
Front	1
Back	Ctrl + 1
Rotate View	
Rotate Up	8
Rotate Down	2
Rotate Left	4
Rotate Right	6