Quality Report

Generated with Pix4Dmapper version 4.4.12

Important: Click on the different icons for:

Help to analyze the results in the Quality Report

Additional information about the sections

Click here for additional tips to analyze the Quality Report

Summary

Project	tw_taichung_houli_hangou-channel_20190822
Processed	2019-12-24 07:41:53
Camera Model Name(s)	L1D-20c_10.3_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	3.12 cm / 1.23 in
Area Covered	0.128 km^2 / 12.8321 ha / 0.05 sq. mi. / 31.7253 acres
Time for Initial Processing (without report)	27m:29s

Quality Check

Images	median of 66233 keypoints per image	✓
Dataset	102 out of 102 images calibrated (100%), all images enabled	✓
Camera Optimization	3.88% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 25547.9 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

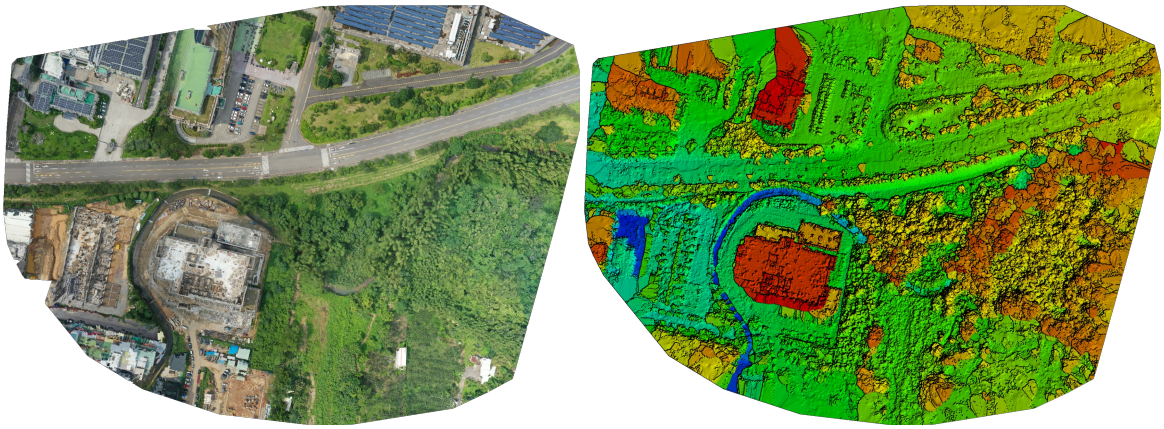


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	102 out of 102
Number of Geolocated Images	102 out of 102

Initial Image Positions

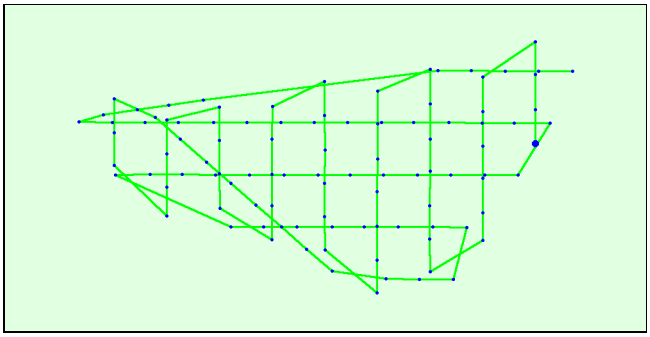
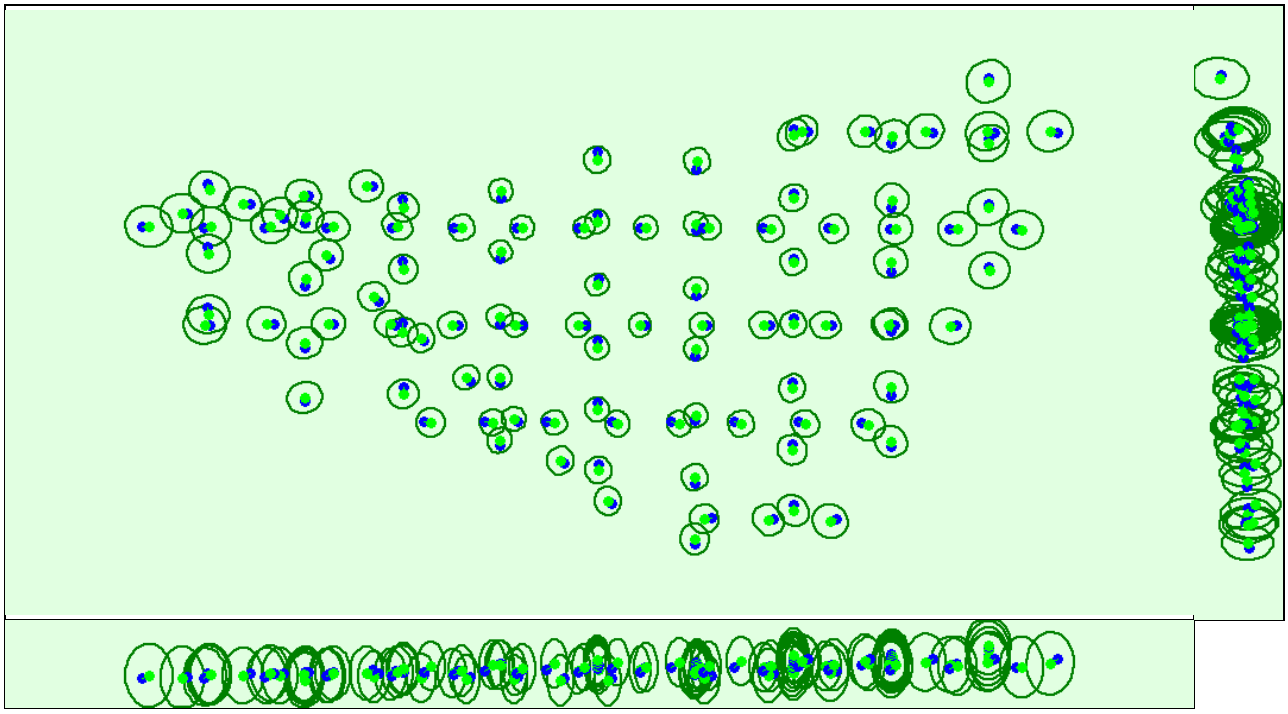


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions



Uncertainty ellipses 50x magnified

Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Dark green ellipses indicate the absolute position uncertainty of the bundle block adjustment result.

Absolute camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]	Camera Displacement X [m]	Camera Displacement Y [m]	Camera Displacement Z [m]
Mean	0.100	0.095	0.162	0.051	0.050	0.046	0.003	0.003	0.008
Sigma	0.020	0.015	0.013	0.001	0.001	0.003	0.001	0.001	0.003

Overlap

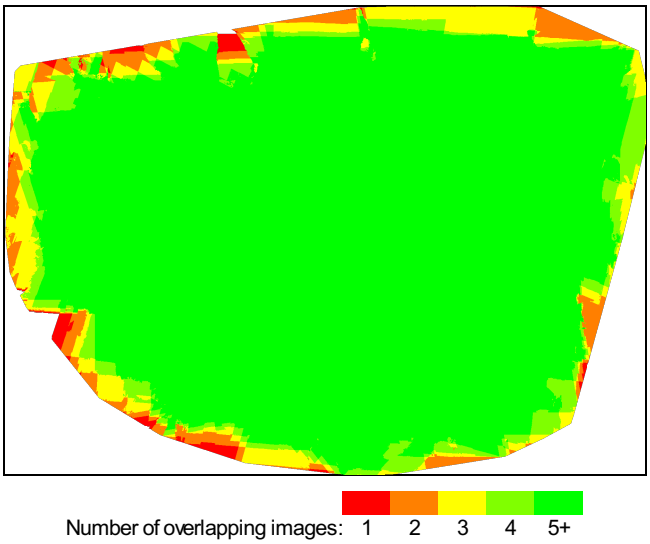


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint matches is also sufficient for these areas (see Figure 5 for keypoint matches).

Bundle Block Adjustment Details

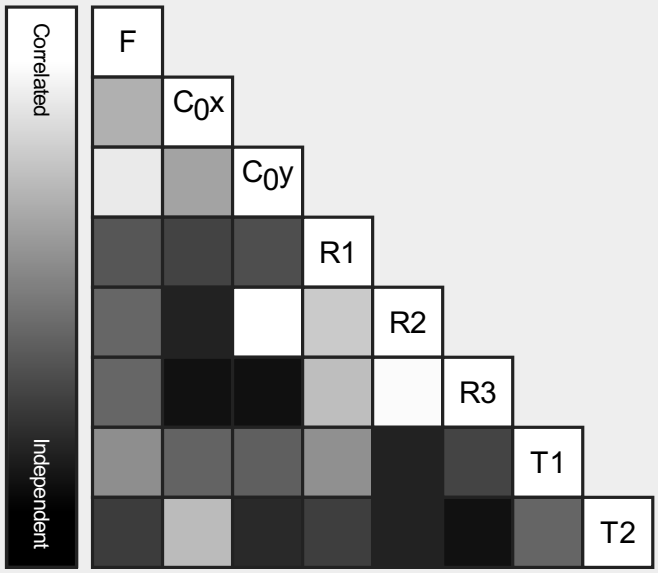
Number of 2D Keypoint Observations for Bundle Block Adjustment	2550662
Number of 3D Points for Bundle Block Adjustment	779102
Mean Reprojection Error [pixels]	0.221

Internal Camera Parameters

L1D-20c_10.3_5472x3648 (RGB). Sensor Dimensions: 12.825 [mm] x 8.550 [mm]

EXIF ID: L1D-20c_10.3_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	4470.830 [pixel] 10.479 [mm]	2770.870 [pixel] 6.494 [mm]	1698.700 [pixel] 3.981 [mm]	0.009	0.040	-0.050	-0.003	0.002
Optimized Values	4297.080 [pixel] 10.071 [mm]	2705.114 [pixel] 6.340 [mm]	1842.558 [pixel] 4.318 [mm]	-0.000	0.001	0.001	0.000	-0.002
Uncertainties (Sigma)	1.008 [pixel] 0.002 [mm]	0.130 [pixel] 0.000 [mm]	0.702 [pixel] 0.002 [mm]	0.000	0.000	0.000	0.000	0.000



The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

	The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	66233	25548
Min	46080	10102
Max	79376	35237
Mean	64966	25006

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	457177
In 3 Images	138187
In 4 Images	65566
In 5 Images	37169
In 6 Images	22880
In 7 Images	14637
In 8 Images	9732
In 9 Images	6960
In 10 Images	5342
In 11 Images	4033
In 12 Images	3116
In 13 Images	2459
In 14 Images	1851
In 15 Images	1486
In 16 Images	1322
In 17 Images	1160
In 18 Images	952
In 19 Images	802
In 20 Images	673
In 21 Images	634
In 22 Images	494
In 23 Images	434
In 24 Images	346
In 25 Images	293
In 26 Images	256
In 27 Images	226
In 28 Images	161
In 29 Images	145
In 30 Images	132
In 31 Images	106
In 32 Images	86
In 33 Images	61
In 34 Images	57
In 35 Images	46
In 36 Images	40
In 37 Images	30
In 38 Images	24
In 39 Images	19
In 40 Images	5

In 41 Images	2
In 43 Images	1

2D Keypoint Matches

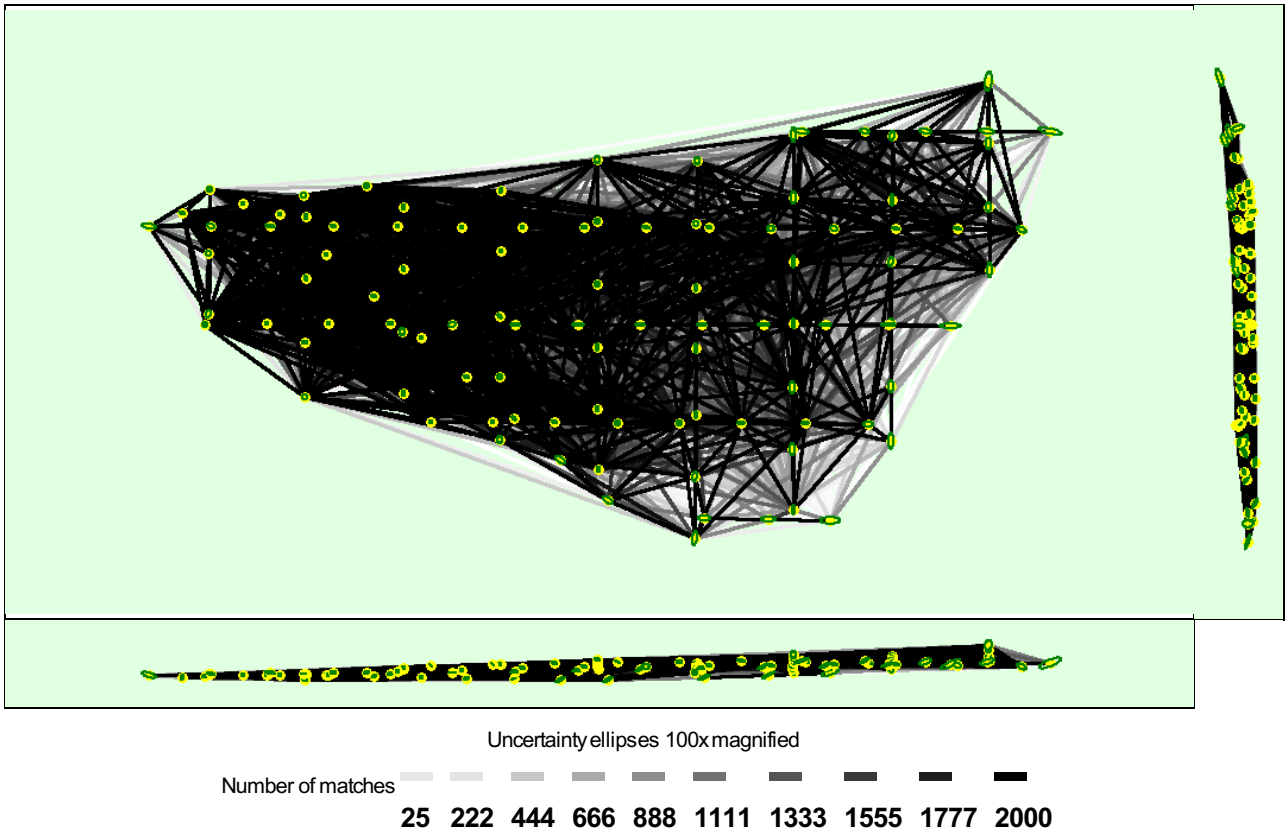


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty of the bundle block adjustment result.

Relative camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]	Camera Displacement X [m]	Camera Displacement Y [m]	Camera Displacement Z [m]
Mean	0.010	0.009	0.007	0.006	0.007	0.003	0.003	0.003	0.008
Sigma	0.006	0.005	0.002	0.003	0.003	0.001	0.001	0.001	0.003

Geolocation Details

Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-15.00	0.00	0.00	0.00
-15.00	-12.00	0.00	0.00	0.00
-12.00	-9.00	0.00	0.00	0.00
-9.00	-6.00	0.00	0.00	0.00
-6.00	-3.00	0.00	0.00	0.00
-3.00	0.00	58.82	50.98	41.18
0.00	3.00	41.18	49.02	58.82
3.00	6.00	0.00	0.00	0.00
6.00	9.00	0.00	0.00	0.00

9.00	12.00	0.00	0.00	0.00
12.00	15.00	0.00	0.00	0.00
15.00	-	0.00	0.00	0.00
Mean [m]		-0.000000	-0.000000	0.000000
Sigma [m]		1.427215	1.398526	0.864276
RMS Error [m]		1.427215	1.398526	0.864276

Min Error and Max Error represent geolocation error intervals between -1.5 and 1.5 times the maximum accuracy of all the images. Columns X, Y, Z show the percentage of images with geolocation errors within the predefined error intervals. The geolocation error is the difference between the initial and computed image positions. Note that the image geolocation errors do not correspond to the accuracy of the observed 3D points.

Relative Geolocation Variance

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	100.00	100.00	100.00
[-2.00, 2.00]	100.00	100.00	100.00
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [m]	5.000000	5.000000	10.000000
Sigma of Geolocation Accuracy [m]	0.000000	0.000000	0.000000

Images X, Y, Z represent the percentage of images with a relative geolocation error in X, Y, Z.

Geolocation Orientational Variance	RMS [degree]
Omega	1.477
Phi	1.123
Kappa	2.858

Geolocation RMS error of the orientation angles given by the difference between the initial and computed image orientation angles.

Rolling Shutter Statistics

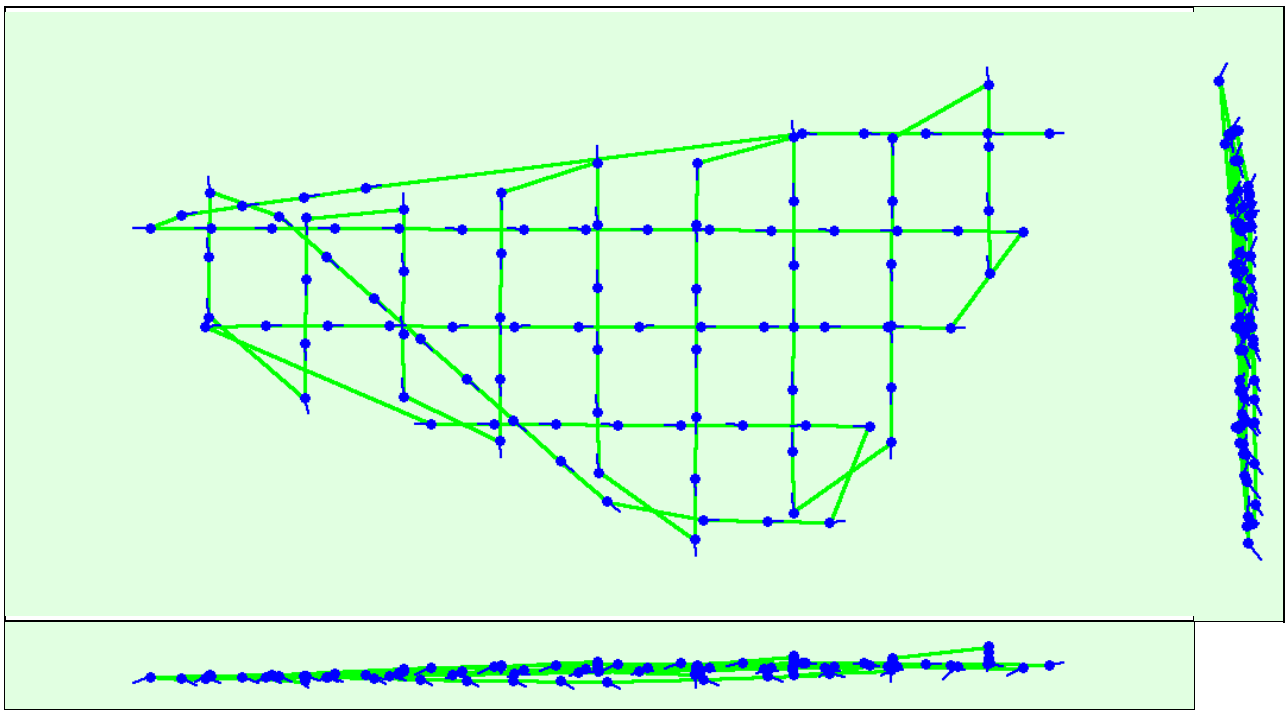


Figure 6: Camera movement estimated by the rolling shutter camera model. The green line follows the computed image positions. The blue dots represent the camera position at the start of the exposure. The blue lines represent the camera motion during the rolling shutter readout, re-scaled by a project dependant scaling factor for better visibility.

Median Camera Speed	8.1949 [m/s]
Median Camera Displacement During Sensor Readout)	0.5559 [m]
Median Rolling Shutter Readout Time	70.2981 [ms]

Initial Processing Details

System Information

Hardware	CPU: Intel(R) Xeon(R) CPU E3-1505Mv5 @ 2.80GHz RAM: 32GB GPU: Intel(R) HD Graphics P530 (Driver: 23.20.16.4973)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84
Output Coordinate System	TWD97 / TM2 zone 121

Processing Options

Detected Template	DJI Mavic 2 Pro*
Keypoints Image Scale	Full, Image Scale: 1
Advanced: Matching Image Pairs	Aerial Grid or Corridor
Advanced: Matching Strategy	Use Geometrically Verified Matching: yes
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Automatic
Advanced: Calibration	Calibration Method: Standard Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Auto, yes

Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: yes
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	03h:08m:59s
Time for Point Cloud Classification	14m:00s
Time for 3D Textured Mesh Generation	27m:44s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	12323477
Average Density (per m^3)	87.04

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (3.12 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Raster DSM	Generated: yes Method: Inverse Distance Weighting Merge Tiles: yes
Orthomosaic	Generated: yes Merge Tiles: yes GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Raster DTM	Generated: yes Merge Tiles: yes
DTM Resolution	10 x GSD (3.12 [cm/pixel])
Time for DSM Generation	23m:16s
Time for Orthomosaic Generation	55m:39s
Time for DTM Generation	01m:22s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s