Quality Report

Generated with PIX4Dmapper version 4.8.4

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	231227_AleaPark_2
Processed	2023-12-27 18:25:28
Camera Model Name(s)	FC6310R_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	3.40 cm / 1.34 in
Area Covered	0.614 km^2 / 61.3937 ha / 0.24 sq. mi. / 151.7856 acres

Quality Check

Images	median of 59903 keypoints per image	✓
Dataset	293 out of 293 images calibrated (100%), all images enabled	✓
Camera Optimization	2.23% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 37923.7 matches per calibrated image	✓
Georeferencing	yes, 11 GCPs (11 3D), mean RMS error = 0.007 m	✓

Preview

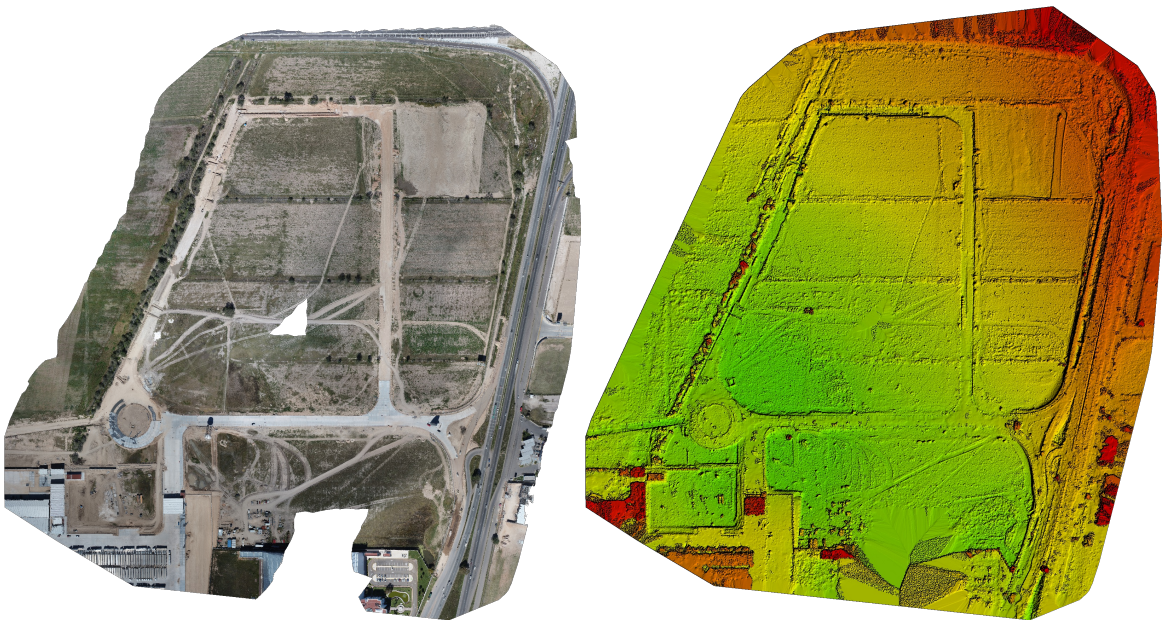


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	293 out of 293
Number of Geolocated Images	293 out of 293

Initial Image Positions

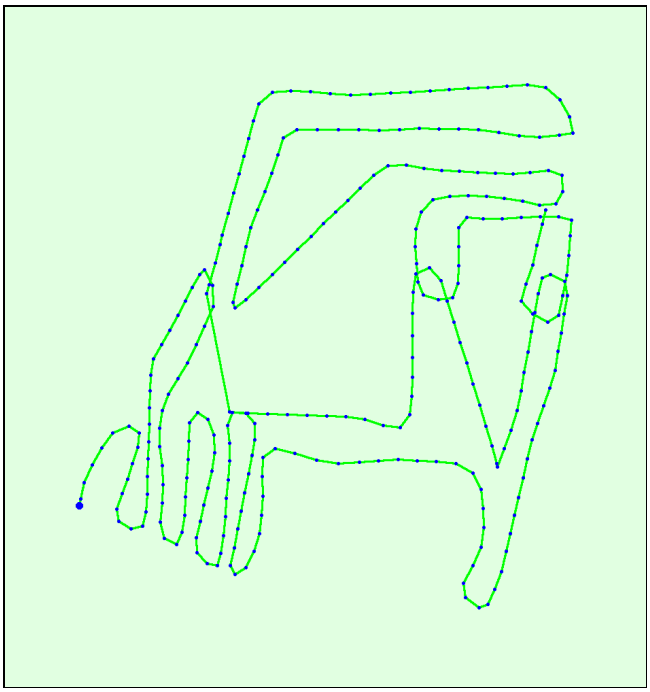
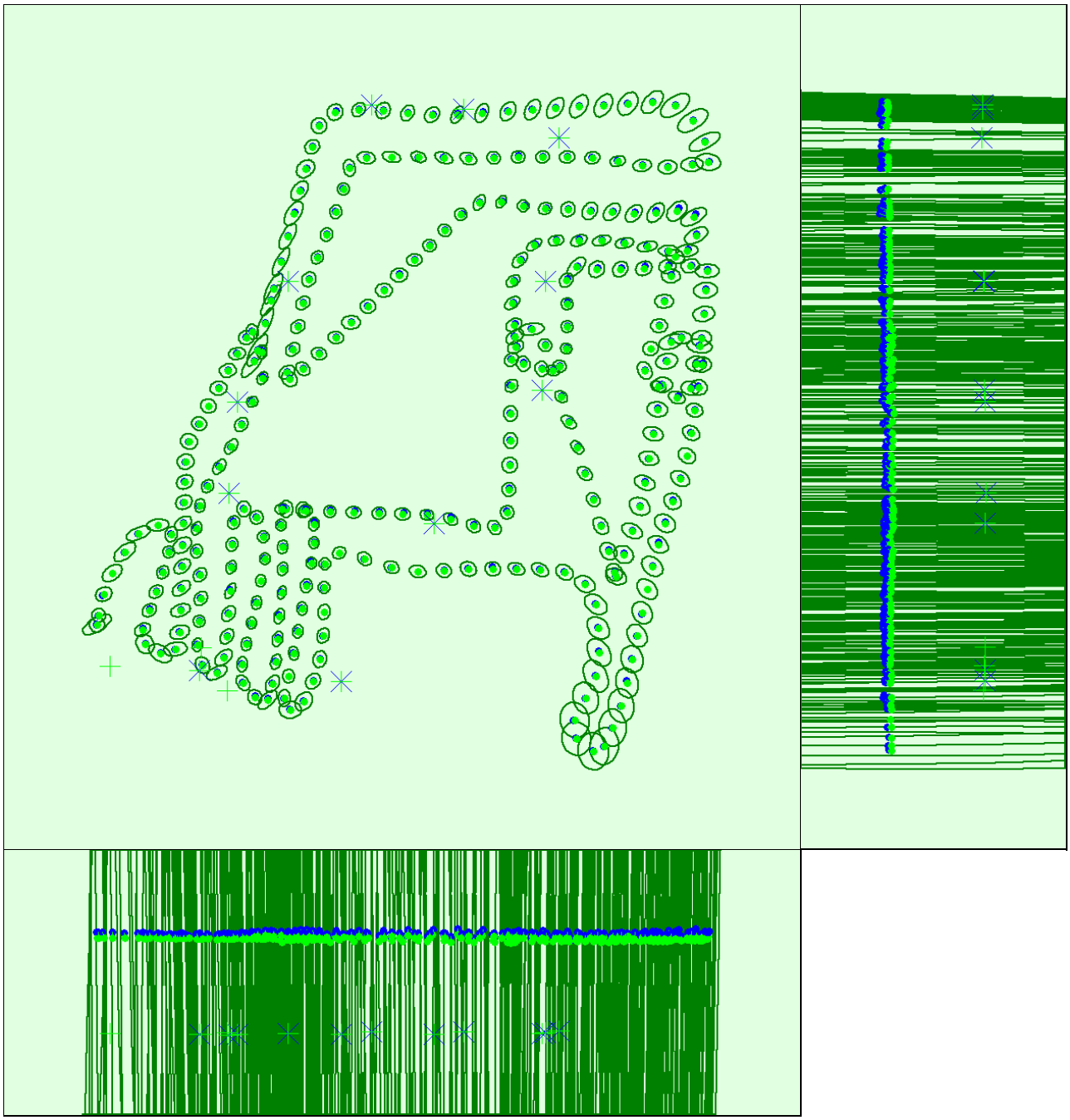


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions



Uncertainty ellipses 1000x 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]
Mean	0.010	0.009	0.560	0.004	0.004	0.001
Sigma	0.003	0.003	0.012	0.001	0.001	0.000

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

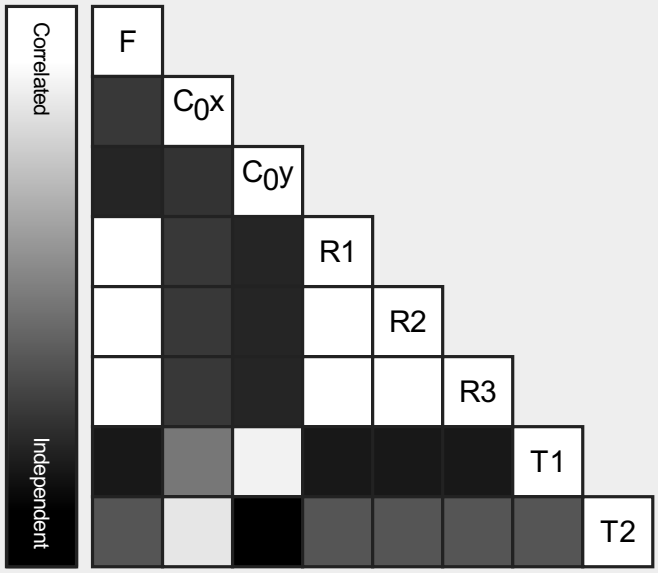
Number of 2D Keypoint Observations for Bundle Block Adjustment	10916622
Number of 3D Points for Bundle Block Adjustment	2586395
Mean Reprojection Error [pixels]	0.173

Internal Camera Parameters

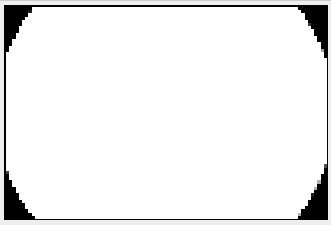
FC6310R_8.8_5472x3648 (RGB). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]

EXIF ID: FC6310R_8.8_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	3658.300 [pixel] 8.580 [mm]	2722.500 [pixel] 6.385 [mm]	1835.100 [pixel] 4.304 [mm]	-0.269	0.112	-0.033	0.000	-0.001
Optimized Values	3576.624 [pixel] 8.388 [mm]	2717.921 [pixel] 6.374 [mm]	1813.716 [pixel] 4.254 [mm]	-0.265	0.111	-0.030	-0.000	-0.000
Uncertainties (Sigma)	18.178 [pixel] 0.043 [mm]	0.107 [pixel] 0.000 [mm]	0.106 [pixel] 0.000 [mm]	0.003	0.002	0.001	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

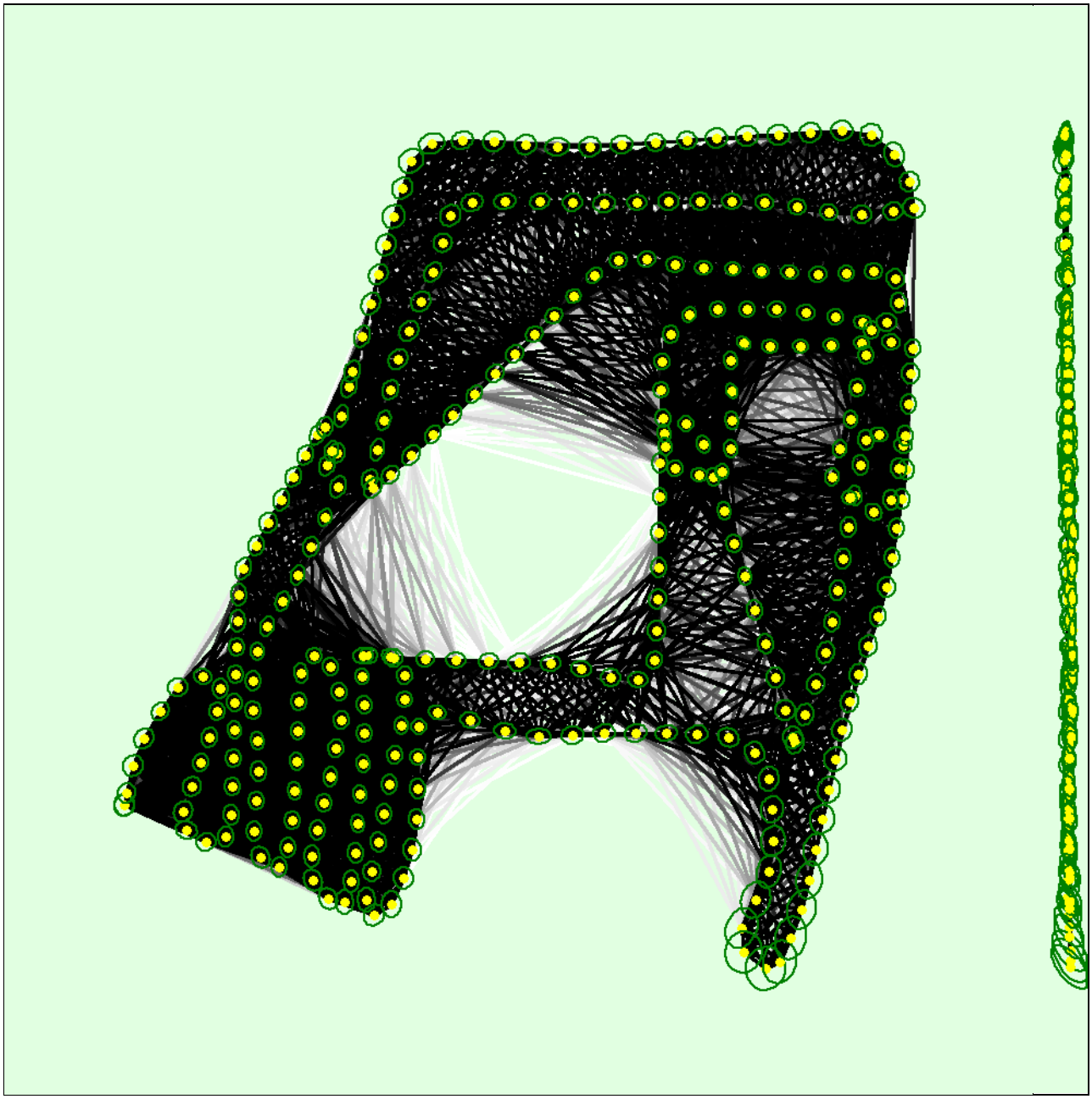
	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	59903	37924
Min	25226	12999
Max	79083	59684
Mean	56746	37258

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	1065543
In 3 Images	474928
In 4 Images	285581
In 5 Images	187802
In 6 Images	132767
In 7 Images	101778
In 8 Images	79267
In 9 Images	60657
In 10 Images	46654
In 11 Images	36673
In 12 Images	28476
In 13 Images	22337
In 14 Images	16732
In 15 Images	12078
In 16 Images	9004
In 17 Images	6713
In 18 Images	4554
In 19 Images	3425
In 20 Images	2421
In 21 Images	1963
In 22 Images	1538
In 23 Images	1209

In 24 Images	907
In 25 Images	778
In 26 Images	630
In 27 Images	500
In 28 Images	338
In 29 Images	296
In 30 Images	225
In 31 Images	193
In 32 Images	138
In 33 Images	94
In 34 Images	62
In 35 Images	62
In 36 Images	34
In 37 Images	18
In 38 Images	8
In 39 Images	5
In 40 Images	3
In 41 Images	3
In 42 Images	1

2D Keypoint Matches



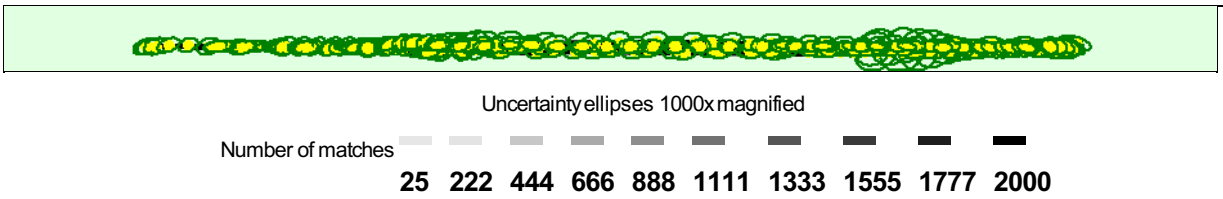


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty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

Relative camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.008	0.009	0.005	0.004	0.004	0.002
Sigma	0.002	0.002	0.002	0.001	0.001	0.000

Manual Tie Points

MTP Name	Projection Error [pixel]	Verified/Marked
LP01	0.396	19 / 19
LP02	0.507	18 / 18
LP04	0.402	8 / 8

Projection errors for manual tie points.The last column counts the number of images where the manual tie point has been automatically verified vs. manually marked.

Geolocation Details

Ground Control Points

GCP Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
GC2 (3D)	0.020/ 0.020	-0.015	0.022	0.004	0.382	13 / 13
GC4 (3D)	0.020/ 0.020	0.008	0.001	0.006	0.405	11 / 11
GC6 (3D)	0.020/ 0.020	0.004	0.014	-0.001	0.393	14 / 14
GC7 (3D)	0.020/ 0.020	0.007	-0.008	0.002	0.448	19 / 19
GC8 (3D)	0.020/ 0.020	-0.001	-0.005	0.006	0.716	11 / 11
GC9 (3D)	0.020/ 0.020	0.001	0.002	-0.006	0.338	9 / 9
GC10 (3D)	0.020/ 0.020	-0.005	-0.010	0.005	0.314	9 / 9
GC11 (3D)	0.020/ 0.020	-0.007	0.006	0.001	0.373	15 / 15
GC12 (3D)	0.020/ 0.020	0.006	-0.001	-0.009	0.300	13 / 13
GC13 (3D)	0.020/ 0.020	-0.003	-0.004	0.002	0.385	21 / 21
GC14 (3D)	0.020/ 0.020	-0.005	-0.012	0.004	0.337	18 / 18
Mean [m]		-0.000767	0.000256	0.001179		
Sigma [m]		0.006624	0.009779	0.004723		
RMS Error [m]		0.006668	0.009783	0.004868		

Localisation accuracy per GCP and mean errors in the three coordinate directions. The last column counts the number of calibrated images where the GCP has been automatically verified vs. manually marked.

Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]

-	-4.90	0.00	0.00	0.34
-4.90	-3.92	0.00	0.00	0.34
-3.92	-2.94	0.00	0.00	0.68
-2.94	-1.96	0.34	0.00	2.39
-1.96	-0.98	1.71	5.46	16.72
-0.98	0.00	54.27	50.85	31.74
0.00	0.98	39.93	38.23	29.35
0.98	1.96	3.07	4.44	13.65
1.96	2.94	0.68	1.02	3.07
2.94	3.92	0.00	0.00	0.68
3.92	4.90	0.00	0.00	0.34
4.90	-	0.00	0.00	0.68
Mean [m]		-0.217738	1.075129	5.375374
Sigma [m]		0.563759	0.632095	1.285725
RMS Error [m]		0.604346	1.247175	5.527000

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.

Geolocation Bias	X	Y	Z
Translation [m]	-0.200174	1.079002	5.380097

Bias between image initial and computed geolocation given in output coordinate system.

Relative Geolocation Variance

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	97.95	94.88	97.61
[-2.00, 2.00]	100.00	99.66	99.66
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [m]	1.417596	1.417596	2.892789
Sigma of Geolocation Accuracy [m]	0.054353	0.054353	0.131756

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

Geolocation Orientational Variance	RMS [degree]
Omega	0.229
Phi	0.262
Kappa	3.337

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

Initial Processing Details

System Information

Hardware	CPU: Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz RAM: 64GB GPU: NVIDIA GeForce RTX 3080 (Driver: 31.0.15.3742)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84
Ground Control Point (GCP) Coordinate System	WGS 84 / UTM zone 13N (2D)
Output Coordinate System	WGS 84 / UTM zone 13N (2D)

Processing Options

Detected Template	No Template Available
Keypoints Image Scale	Custom, 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