# **Quality Report**



Generated with PIX4Dmapper version 4.7.5



Important: Click on the different icons for:

- Plelp 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	Test_Process_by_code_PSN
Processed	2022-11-16 13:39:35
Camera Model Name(s)	ZenmuseP1_35.0_8192x5460 (RGB)
Average Ground Sampling Distance (GSD)	2.46 cm / 0.97 in
Area Covered	1.155 km² / 115.5345 ha / 0.45 sq. mi. / 285.6397 acres
Time for Initial Processing (without report)	11m:31s

### **Quality Check**



? Images	median of 29277 keypoints per image	<b>②</b>
② Dataset	584 out of 584 images calibrated (100%), all images enabled	<b>②</b>
? Camera Optimization	on 0.18% relative difference between initial and optimized internal camera parameters	<b>②</b>
Matching	median of 10649.6 matches per calibrated image	<b>O</b>
? Georeferencing	yes, 49 GCPs (49 3D), mean RMS error = 0.017 m	<b>②</b>





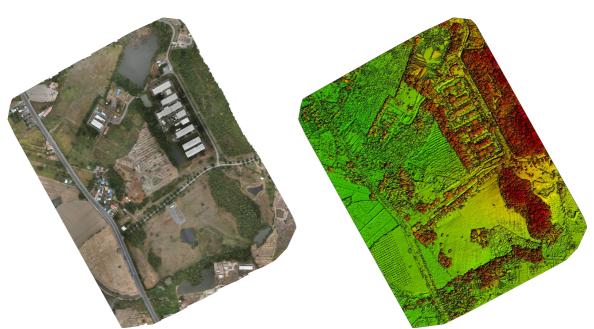


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

## **Calibration Details**



Number of Calibrated Images	584 out of 584
Number of Geolocated Images	584 out of 584

## Initial Image Positions



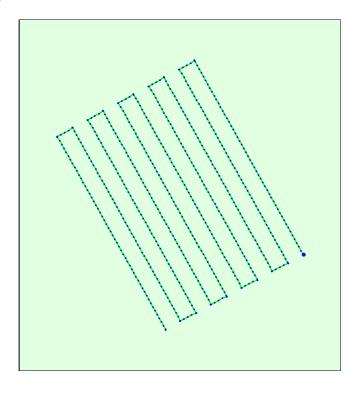
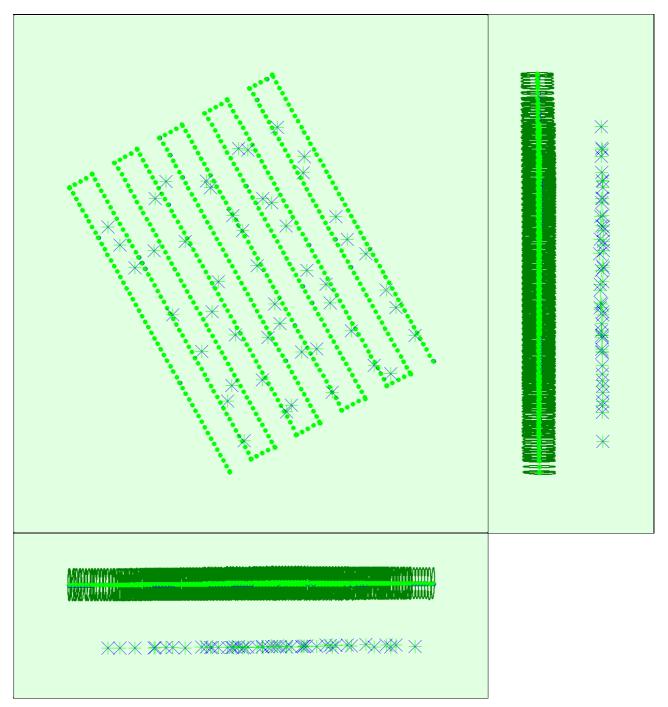


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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	0.005	0.005	0.051	0.002	0.002	0.001
Sigma	0.000	0.000	0.000	0.000	0.000	0.000

Overlap

**(1)** 

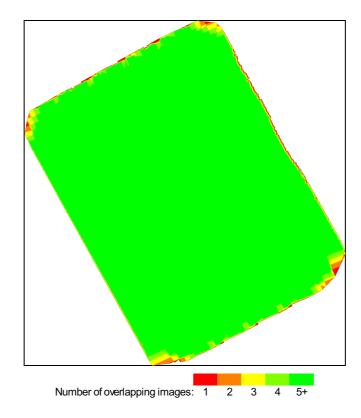


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.

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**

1

Number of 2D Keypoint Observations for Bundle Block Adjustment	6576032
Number of 3D Points for Bundle Block Adjustment	1779311
Mean Reprojection Error [pixels]	0.087

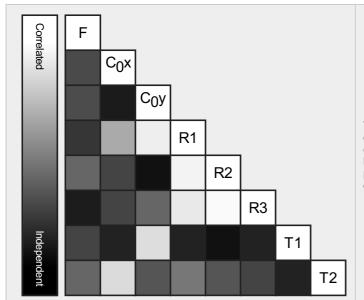
#### Internal Camera Parameters

#### **☑** ZenmuseP1\_35.0\_8192x5460 (RGB). Sensor Dimensions: 35.000 [mm] x 23.328 [mm]

**(1)** 

#### EXIF ID: ZenmuseP1\_35.0\_8192x5460

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	8194.340 [pixel] 35.010 [mm]	4096.001 [pixel] 17.500 [mm]	2729.996 [pixel] 11.664 [mm]	-0.048	0.021	-0.097	0.002	-0.001
Optimized Values	8209.487 [pixel] 35.075 [mm]	4076.551 [pixel] 17.417 [mm]	2747.346 [pixel] 11.738 [mm]	-0.049	0.018	-0.095	0.001	-0.001
Uncertainties (Sigma)	2.073 [pixel] 0.009 [mm]	0.121 [pixel] 0.001 [mm]	0.111 [pixel] 0.000 [mm]	0.000	0.001	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 reprojection 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	29277	10650
Min	12629	1325
Max	43463	24252
Mean	28734	11260

### 3D Points from 2D Keypoint Matches

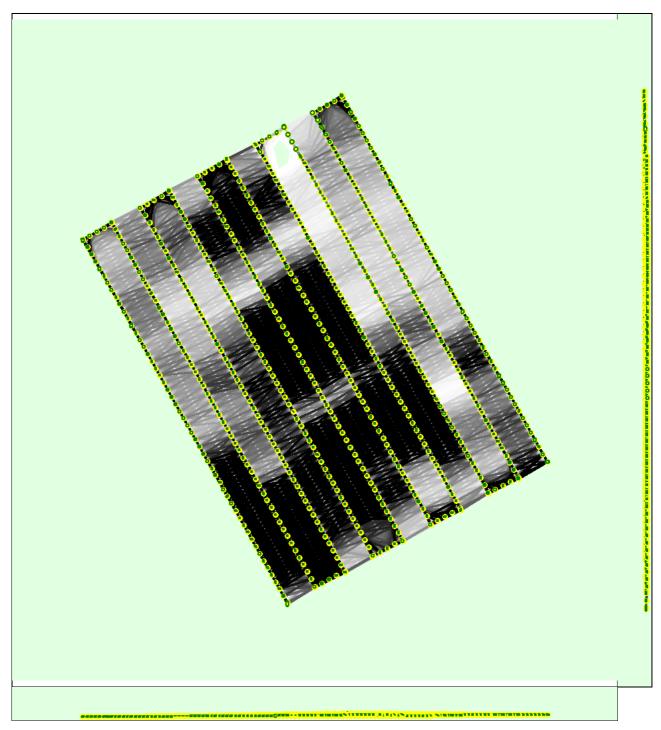


	Number of 3D Points Observed
In 2 Images	914875
In 3 Images	336593
In 4 Images	159949
In 5 Images	96034
In 6 Images	69346
In 7 Images	44378
In 8 Images	25081
In 9 Images	20531
In 10 Images	18341
In 11 Images	17242
In 12 Images	18191
In 13 Images	19732
In 14 Images	9708
In 15 Images	5198
In 16 Images	4567
In 17 Images	4319
In 18 Images	4304
In 19 Images	4800
In 20 Images	3871
In 21 Images	1233
In 22 Images	280
In 23 Images	251

In 24 Images	191
In 25 Images	149
In 26 Images	83
In 27 Images	46
In 28 Images	18

### ② 2D Keypoint Matches





Uncertainty ellipses 100x magnified

Number of matches

25 222 444 666 888 1111 1333 1555 1777 2000

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.

	X[m]	Y[m]	Z[m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.026	0.029	0.013	0.008	0.007	0.002
Sigma	0.006	0.006	0.004	0.002	0.002	0.001

# **Geolocation Details**

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GCP Name	Accuracy XY/Z [m]	Error X[m]	Error Y[m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
LCP-01 (3D)	0.020/ 0.050	-0.001	0.001	0.005	0.179	8/8
LCP-02 (3D)	0.020/ 0.050	-0.005	-0.013	0.033	0.251	8/8
LCP-03 (3D)	0.020/ 0.050	-0.013	0.010	-0.000	0.188	8/8
LCP-04 (3D)	0.020/ 0.050	0.025	-0.006	0.011	0.181	8/8
LCP-05 (3D)	0.020/ 0.050	-0.007	0.009	-0.019	0.208	8/8
LCP-06 (3D)	0.020/ 0.050	-0.017	0.011	-0.006	0.179	8/8
LCP-07 (3D)	0.020/ 0.050	0.017	0.023	0.045	0.275	8/8
LCP-08 (3D)	0.020/ 0.050	-0.000	0.011	0.040	0.232	8/8
LCP-09 (3D)	0.020/ 0.050	-0.012	-0.009	0.017	0.180	8/8
LCP-10 (3D)	0.020/ 0.050	0.009	-0.032	0.016	0.157	8/8
LCP-11 (3D)	0.020/ 0.050	0.016	-0.002	0.002	0.286	8/8
LCP-12 (3D)	0.020/ 0.050	0.014	0.001	0.025	0.216	8/8
LCP-13 (3D)	0.020/ 0.050	-0.031	-0.006	0.039	0.181	8/8
LCP-14 (3D)	0.020/ 0.050	0.013	0.001	0.004	0.214	8/8
LCP-15 (3D)	0.020/ 0.050	0.003	-0.002	0.004	0.140	8/8
LCP-16 (3D)	0.020/ 0.050	0.001	0.011	0.004	0.257	8/8
LCP-17 (3D)	0.020/ 0.050	-0.004	-0.004	0.007	0.269	8/8
LCP-18 (3D)	0.020/ 0.050	0.069	-0.016	0.028	0.226	8/8
LCP-19 (3D)	0.020/ 0.050	0.005	-0.012	-0.005	0.178	8/8
LCP-20 (3D)	0.020/ 0.050	-0.012	-0.006	0.013	0.256	8/8
LCP-21 (3D)	0.020/ 0.050	0.001	0.006	0.028	0.227	8/8
LCP-22 (3D)	0.020/ 0.050	-0.016	0.003	0.051	0.143	8/8
LCP-23 (3D)	0.020/ 0.050	-0.014	-0.002	-0.029	0.299	8/8
LCP-24 (3D)	0.020/ 0.050	-0.008	0.005	0.050	0.198	8/8
LCP-25 (3D)	0.020/ 0.050	-0.012	-0.005	0.011	0.193	8/8
LCP-26 (3D)	0.020/ 0.050	-0.005	-0.005	0.003	0.239	8/8
LCP-27 (3D)	0.020/ 0.050	0.007	0.009	0.034	0.218	8/8
LCP-28 (3D)	0.020/ 0.050	-0.010	0.008	0.013	0.197	8/8
LCP-29 (3D)	0.020/ 0.050	-0.016	0.014	0.029	0.240	8/8
LCP-30 (3D)	0.020/ 0.050	-0.002	0.000	-0.006	0.236	8/8
LCP-32 (3D)	0.020/ 0.050	-0.008	0.033	0.026	0.153	8/8
GCP-01 (3D)	0.020/ 0.050	-0.000	0.005	-0.062	0.303	8/8
GCP-02 (3D)	0.020/ 0.050	-0.000	0.002	-0.045	0.421	8/8
GCP-03 (3D)	0.020/ 0.050	0.015	0.008	-0.038	0.208	8/8
GCP-04 (3D)	0.020/ 0.050	-0.002	-0.003	-0.026	0.249	8/8
GCP-05 (3D)	0.020/ 0.050	-0.014	-0.014	-0.014	0.276	8/8
GCP-06 (3D)	0.020/ 0.050	-0.002	0.006	-0.053	0.247	8/8
GCP-07 (3D)	0.020/ 0.050	0.009	-0.007	-0.015	0.310	8/8
GCP-08 (3D)	0.020/ 0.050	0.005	-0.000	-0.002	0.307	8/8
GCP-09 (3D)	0.020/ 0.050	-0.014	0.002	-0.037	0.399	8/8
GCP-10 (3D)	0.020/ 0.050	-0.001	-0.006	0.006	0.236	8/8
GCP-11 (3D)	0.020/ 0.050	0.012	0.001	-0.039	0.350	8/8
GCP-12 (3D)	0.020/ 0.050	-0.005	0.004	0.010	0.140	8/8
GCP-13 (3D)	0.020/ 0.050	0.015	-0.015	-0.033	0.361	8/8
GCP-14 (3D)	0.020/ 0.050	0.013	-0.007	-0.033	0.477	8/8
GCP-15 (3D)	0.020/ 0.050	-0.014	0.010	-0.021	0.215	8/8

GCP-16 (3D)	0.020/ 0.050	0.012	-0.013	-0.038	0.259	8/8
GCP-17 (3D)	0.020/ 0.050	-0.002	-0.007	-0.008	0.168	8/8
GCP-18 (3D)	0.020/ 0.050	-0.016	-0.003	-0.047	0.367	8/8
Mean [m]		0.000015	0.000046	-0.000165		
Sigma [m]		0.015141	0.010614	0.028090		
RMS Error [m]		0.015141	0.010614	0.028090		

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 [%]
-	-0.08	0.00	0.00	0.00
-0.08	-0.06	0.00	0.00	0.00
-0.06	-0.05	0.00	0.00	0.00
-0.05	-0.03	0.00	0.00	0.68
-0.03	-0.01	0.17	0.00	7.36
-0.01	0.00	48.29	54.11	40.92
0.00	0.01	51.37	45.89	43.32
0.01	0.03	0.17	0.00	6.85
0.03	0.05	0.00	0.00	0.86
0.05	0.06	0.00	0.00	0.00
0.06	0.08	0.00	0.00	0.00
0.08	-	0.00	0.00	0.00
Mean [m]		0.048460	0.017476	-0.530223
Sigma [m]		0.002690	0.002338	0.010706
RMS Error [m]		0.048535	0.017632	0.530331

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	Υ	Z
Translation [m]	0.048460	0.017476	-0.530223

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]	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]	0.020000	0.020000	0.050000
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.

# **Initial Processing Details**



Hardware	CPU: Intel(R) Core(TM) i9-10900F CPU @ 2.80GHz RAM: 64GB GPU: NMDIA GeForce RTX 2070 SUPER (Driver: 30.0.15.1277)
Operating System	Windows 10 Pro, 64-bit

### **Coordinate Systems**



Image Coordinate System	WGS 84 (2D)	
Ground Control Point (GCP) Coordinate System	WGS 84 / UTMzone 47N (2D)	
Output Coordinate System	WGS 84 / UTM zone 47N (2D)	

### **Processing Options**



Detected Template	⊜ 3D Maps
Keypoints Image Scale	Full, Image Scale: 0.5
Advanced: Matching Image Pairs	Aerial Grid or Corridor
Advanced: Matching Strategy	Use Geometrically Verified Matching: no
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Automatic
Advanced: Calibration	Calibration Method: Standard Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Auto, no