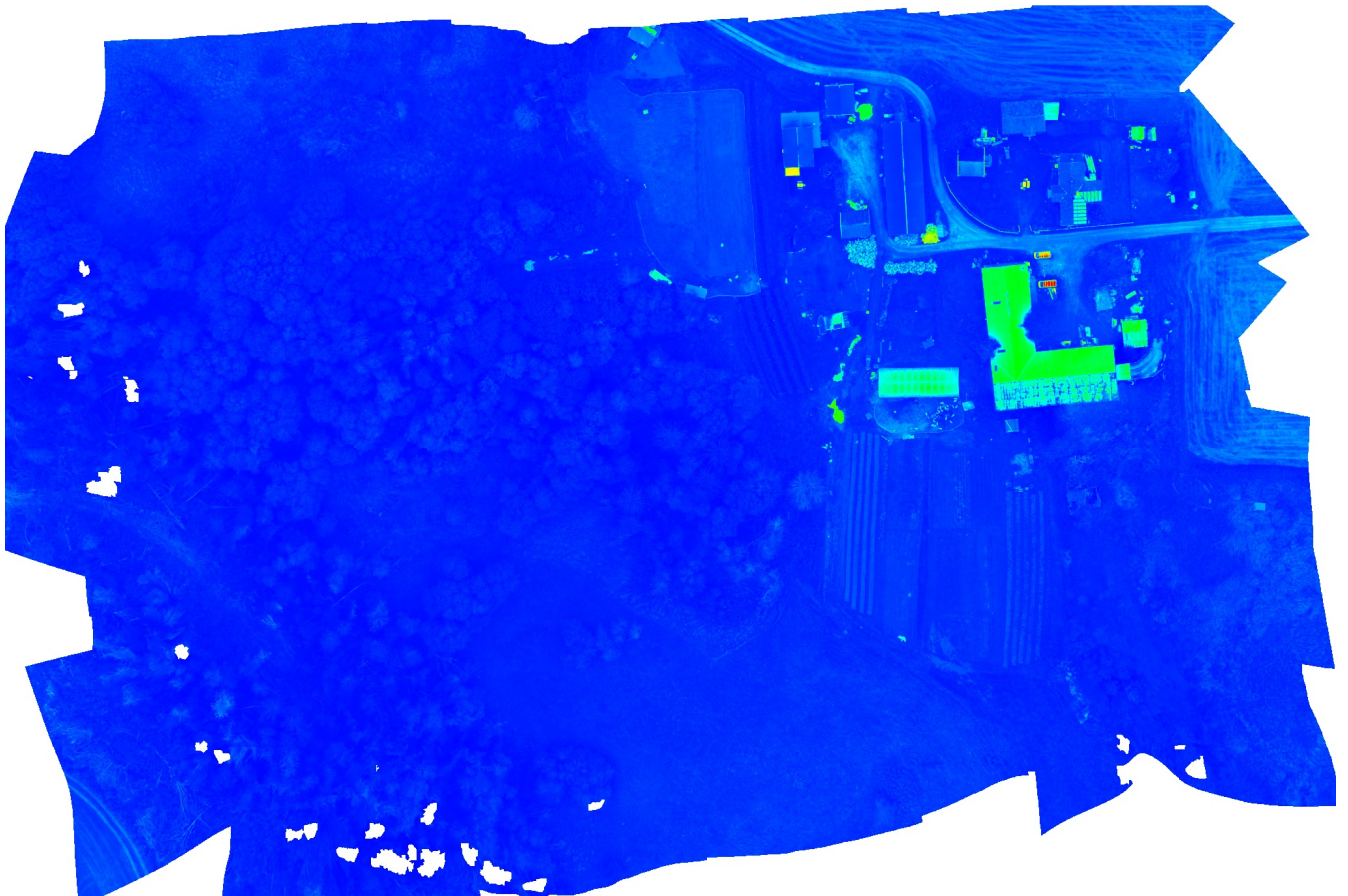


Sander_2022-09-29_2_AltumPT

Processing Report
02 July 2024



Survey Data

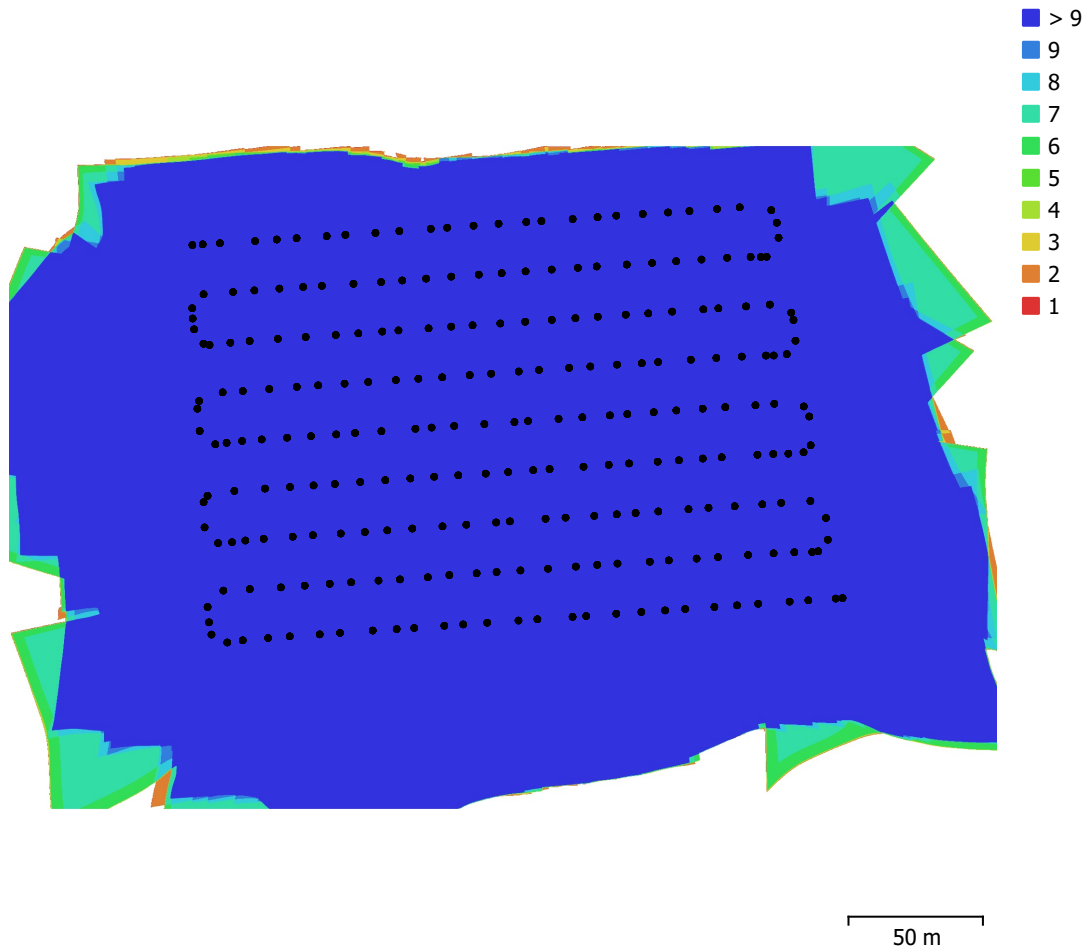


Fig. 1. Camera locations and image overlap.

Number of images:	1,764	Camera stations:	1,757
Flying altitude:	72 m	Tie points:	949,765
Ground resolution:	3.16 cm/pix	Projections:	5,521,235
Coverage area:	0.0821 km ²	Reprojection error:	0.515 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Altum-PT, Blue (8mm)	2064 x 1544	8 mm	3.45 x 3.45 μ m	Yes
Altum-PT, Green (8mm)	2064 x 1544	8 mm	3.45 x 3.45 μ m	Yes
Altum-PT, Panchro (16.6...	4112 x 3008	16.6 mm	3.45 x 3.45 μ m	Yes
Altum-PT, Red (8mm)	2064 x 1544	8 mm	3.45 x 3.45 μ m	Yes
Altum-PT, Red edge (8m...	2064 x 1544	8 mm	3.45 x 3.45 μ m	Yes

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Altum-PT, NIR (8mm)	2064 x 1544	8 mm	3.45 x 3.45 μm	Yes
Altum-PT, LWIR (4.5mm)	320 x 256	4.5 mm	12 x 12 μm	Yes

Table 1. Cameras.

Camera Calibration

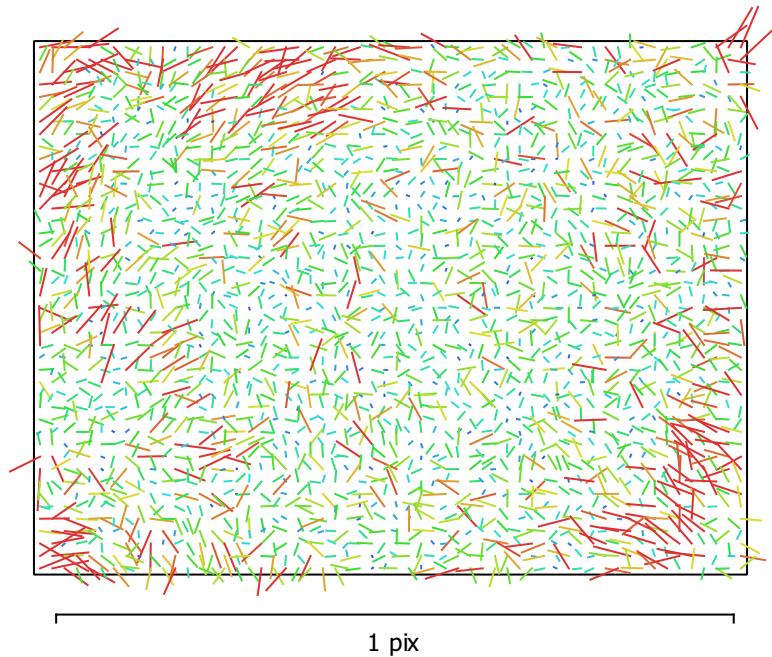


Fig. 2. Image residuals for Altum-PT, Blue (8mm).

Altum-PT, Blue (8mm)

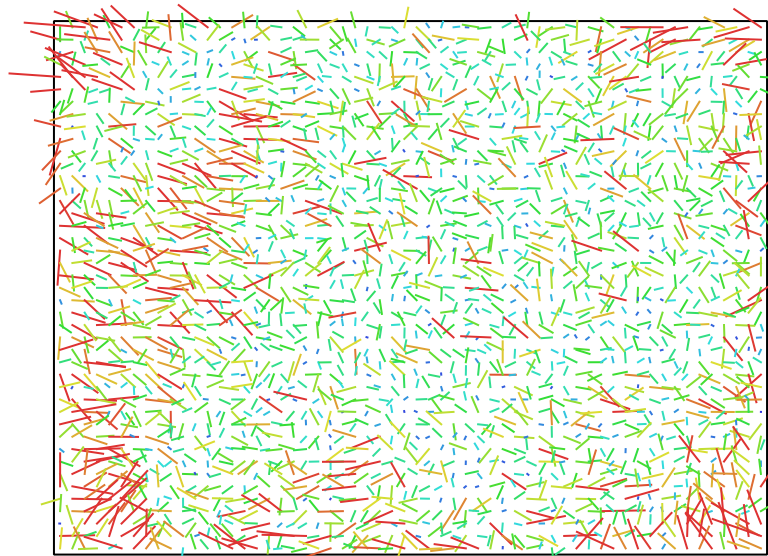
252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	2064 x 1544	8 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	2276.53	0.059	1.00	-0.03	-0.27	-0.02	0.08	-0.08	0.14	-0.10	0.00	-0.10
Cx	4.77226	0.021		1.00	0.04	0.02	0.02	-0.00	-0.00	0.00	0.88	0.04
Cy	-9.05844	0.017			1.00	-0.03	-0.02	-0.00	-0.01	0.01	0.04	0.76
B1	-0.211169	0.0051				1.00	-0.03	0.01	-0.04	0.04	-0.02	0.05
B2	0.134597	0.0049					1.00	-0.00	0.00	0.00	-0.02	-0.02
K1	-0.125015	7.9e-05						1.00	-0.96	0.91	-0.00	-0.03
K2	0.147012	0.00055							1.00	-0.98	0.00	-0.00
K3	-0.0222998	0.0012								1.00	-0.00	-0.00
P1	0.000342095	2.6e-06									1.00	0.04
P2	-2.09731e-05	2.2e-06										1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Calibration



0.949553 pix

Fig. 3. Image residuals for Altum-PT, Green (8mm).

Altum-PT, Green (8mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	2064 x 1544	8 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	2276.95	0.059	1.00	-0.04	-0.28	-0.02	0.09	-0.06	0.13	-0.10	-0.00	-0.10
Cx	0.109958	0.018		1.00	-0.00	0.00	0.03	-0.00	-0.00	0.00	0.85	-0.01
Cy	5.1435	0.015			1.00	-0.04	-0.03	-0.01	-0.01	0.00	-0.01	0.73
B1	-0.188607	0.0049				1.00	-0.04	0.00	-0.03	0.04	-0.04	0.04
B2	0.264305	0.0048					1.00	-0.00	0.00	0.00	-0.02	-0.04
K1	-0.130526	7e-05						1.00	-0.96	0.91	-0.01	-0.03
K2	0.166781	0.00048							1.00	-0.98	0.00	-0.01
K3	-0.0627183	0.001								1.00	-0.00	0.00
P1	-0.000162137	2.2e-06									1.00	0.00
P2	1.97201e-05	1.9e-06										1.00

Table 3. Calibration coefficients and correlation matrix.

Camera Calibration

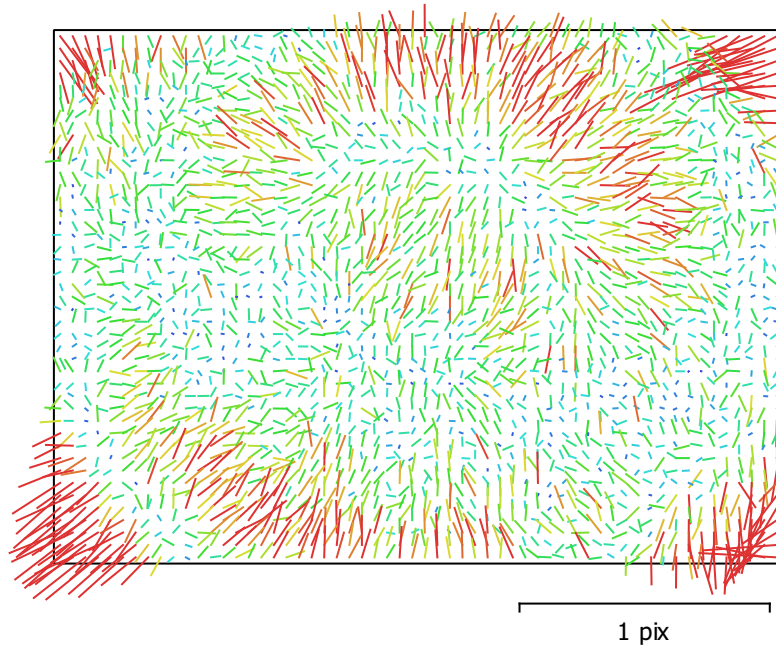


Fig. 4. Image residuals for Altum-PT, Panchro (16.6mm).

Altum-PT, Panchro (16.6mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	4112 x 3008	16.6 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	4803.57	0.12	1.00	-0.06	-0.27	-0.02	0.08	-0.07	0.13	-0.01	-0.00	-0.11
Cx	-17.4955	0.031		1.00	0.01	0.02	0.02	0.02	-0.02	0.02	0.86	-0.01
Cy	-30.6035	0.028			1.00	-0.03	-0.02	0.01	-0.04	0.01	-0.00	0.76
B1	-0.0337317	0.01				1.00	-0.04	0.00	-0.03	0.04	-0.03	0.05
B2	-0.106336	0.01					1.00	-0.00	0.00	0.01	-0.02	-0.03
K1	-0.144109	7.2e-05						1.00	-0.97	0.92	0.01	-0.02
K2	0.19876	0.00057							1.00	-0.98	-0.02	-0.01
K3	0.575267	0.0013								1.00	0.02	0.00
P1	0.000647011	2.3e-06									1.00	0.01
P2	0.000244751	1.9e-06										1.00

Table 4. Calibration coefficients and correlation matrix.

Camera Calibration

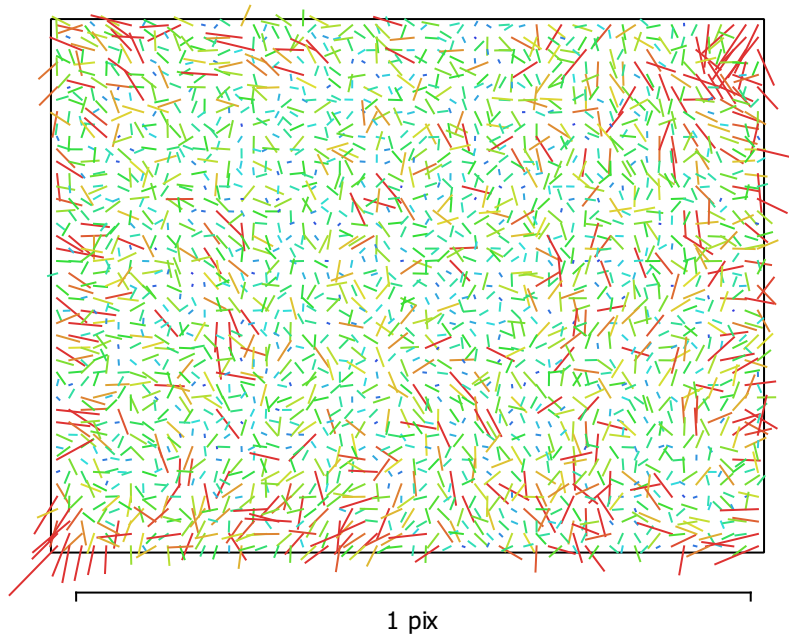


Fig. 5. Image residuals for Altum-PT, Red (8mm).

Altum-PT, Red (8mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	2064 x 1544	8 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	P1	P2
K3	-0.0775957										
F	2281.98	0.059	1.00	-0.04	-0.23	-0.02	0.08	0.03	0.18	-0.01	-0.08
Cx	-3.86279	0.021		1.00	0.02	0.01	0.02	-0.00	-0.01	0.87	0.02
Cy	0.472566	0.018			1.00	-0.03	-0.03	-0.02	-0.03	0.02	0.77
B1	-0.270468	0.0052				1.00	-0.03	-0.08	0.04	-0.03	0.03
B2	-0.0064679	0.005					1.00	-0.01	0.01	-0.02	-0.03
K1	-0.136764	3.4e-05						1.00	-0.91	-0.00	-0.05
K2	0.177559	0.0001							1.00	-0.01	-0.01
P1	-1.61702e-05	2.7e-06								1.00	0.02
P2	-0.000241612	2.3e-06									1.00

Table 5. Calibration coefficients and correlation matrix.

Camera Calibration

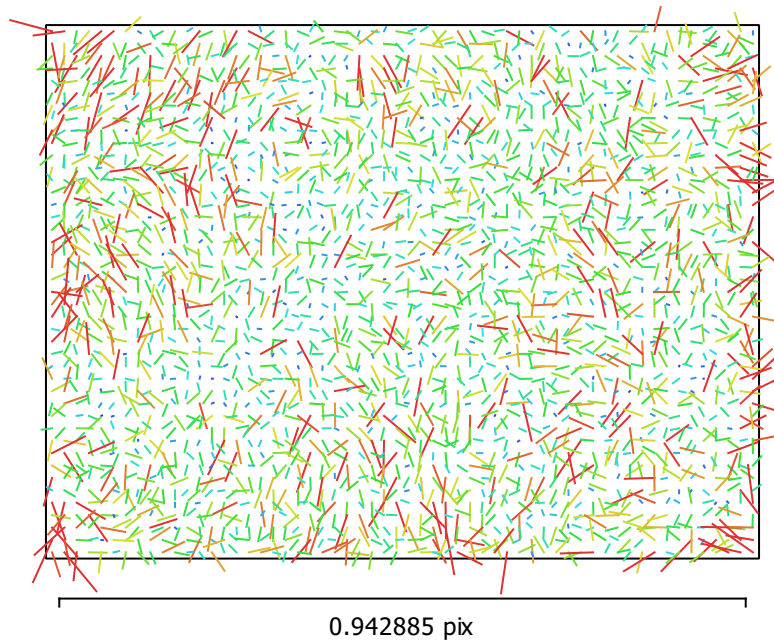


Fig. 6. Image residuals for Altum-PT, Red edge (8mm).

Altum-PT, Red edge (8mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	2064 x 1544	8 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	2281.33	0.059	1.00	-0.05	-0.28	-0.02	0.09	-0.07	0.14	-0.10	-0.00	-0.09
Cx	-7.06391	0.018		1.00	0.01	0.02	0.03	0.00	-0.01	0.01	0.85	-0.00
Cy	2.8741	0.015			1.00	-0.03	-0.03	-0.01	-0.01	0.00	0.00	0.72
B1	-0.283352	0.0049				1.00	-0.03	0.01	-0.04	0.04	-0.03	0.05
B2	0.00506907	0.0048					1.00	-0.00	-0.00	0.00	-0.02	-0.03
K1	-0.137995	7e-05						1.00	-0.96	0.91	-0.00	-0.03
K2	0.172404	0.00049							1.00	-0.98	-0.00	-0.01
K3	-0.0584516	0.001								1.00	-0.00	0.00
P1	0.000137536	2.2e-06									1.00	0.01
P2	-1.5442e-05	1.9e-06										1.00

Table 6. Calibration coefficients and correlation matrix.

Camera Calibration

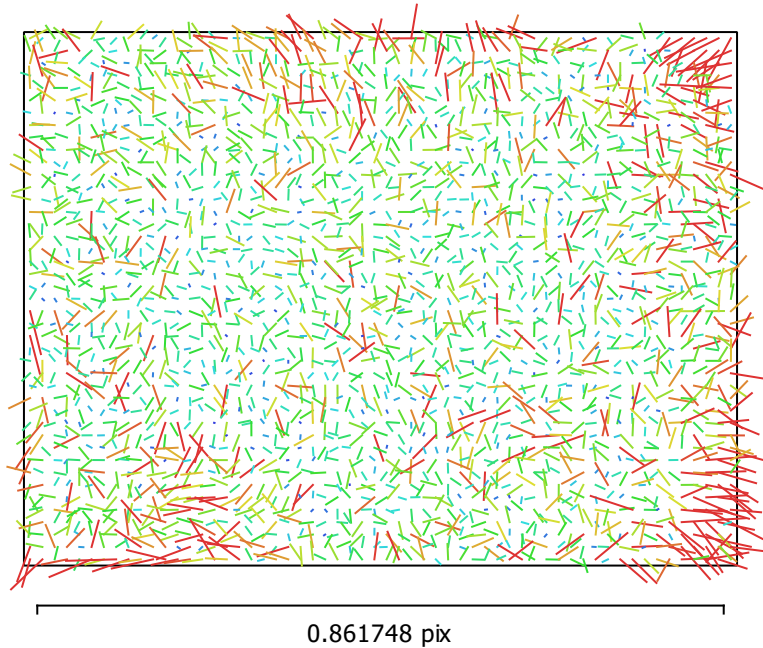


Fig. 7. Image residuals for Altum-PT, NIR (8mm).

Altum-PT, NIR (8mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	2064 x 1544	8 mm	3.45 x 3.45 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	2284.09	0.059	1.00	-0.03	-0.27	-0.02	0.09	-0.07	0.13	-0.10	-0.00	-0.09
Cx	2.6269	0.018		1.00	-0.01	0.02	0.02	0.00	-0.00	0.00	0.85	-0.02
Cy	1.76208	0.015			1.00	-0.04	-0.03	-0.01	-0.01	-0.00	-0.01	0.72
B1	-0.266322	0.0049				1.00	-0.04	0.01	-0.04	0.04	-0.02	0.04
B2	-0.0983782	0.0048					1.00	-0.00	0.00	0.00	-0.02	-0.02
K1	-0.138224	7e-05						1.00	-0.96	0.92	-0.01	-0.03
K2	0.160936	0.00049							1.00	-0.98	0.00	-0.00
K3	-0.0410148	0.001								1.00	-0.00	-0.00
P1	-6.3528e-05	2.2e-06									1.00	-0.01
P2	-0.000138746	1.8e-06										1.00

Table 7. Calibration coefficients and correlation matrix.

Camera Calibration

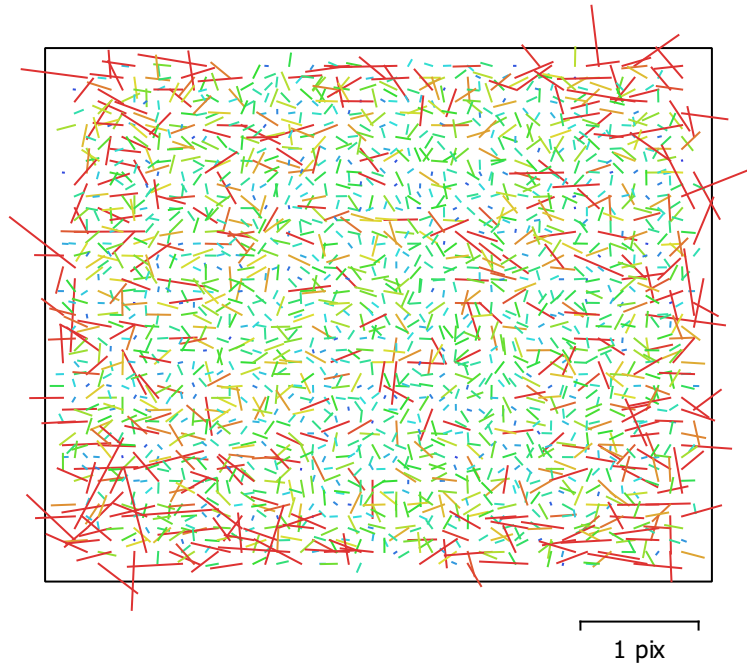


Fig. 8. Image residuals for Altum-PT, LWIR (4.5mm).

Altum-PT, LWIR (4.5mm)

252 images, precalibrated

Type	Resolution	Focal Length	Pixel Size
Frame	320 x 256	4.5 mm	12 x 12 μm

	Value	Error	F	B1	P1	P2
Cx	2.42583					
Cy	-11.2858					
K1	-0.400371					
K2	0.0198036					
K3	0.4258					
F	369.382	0.082	1.00	-0.39	-0.05	-0.04
B1	0.351168	0.042		1.00	-0.04	0.09
P1	-0.000588879	9.2e-05			1.00	0.01
P2	0.00123975	7.7e-05				1.00

Table 8. Calibration coefficients and correlation matrix.

Camera Locations

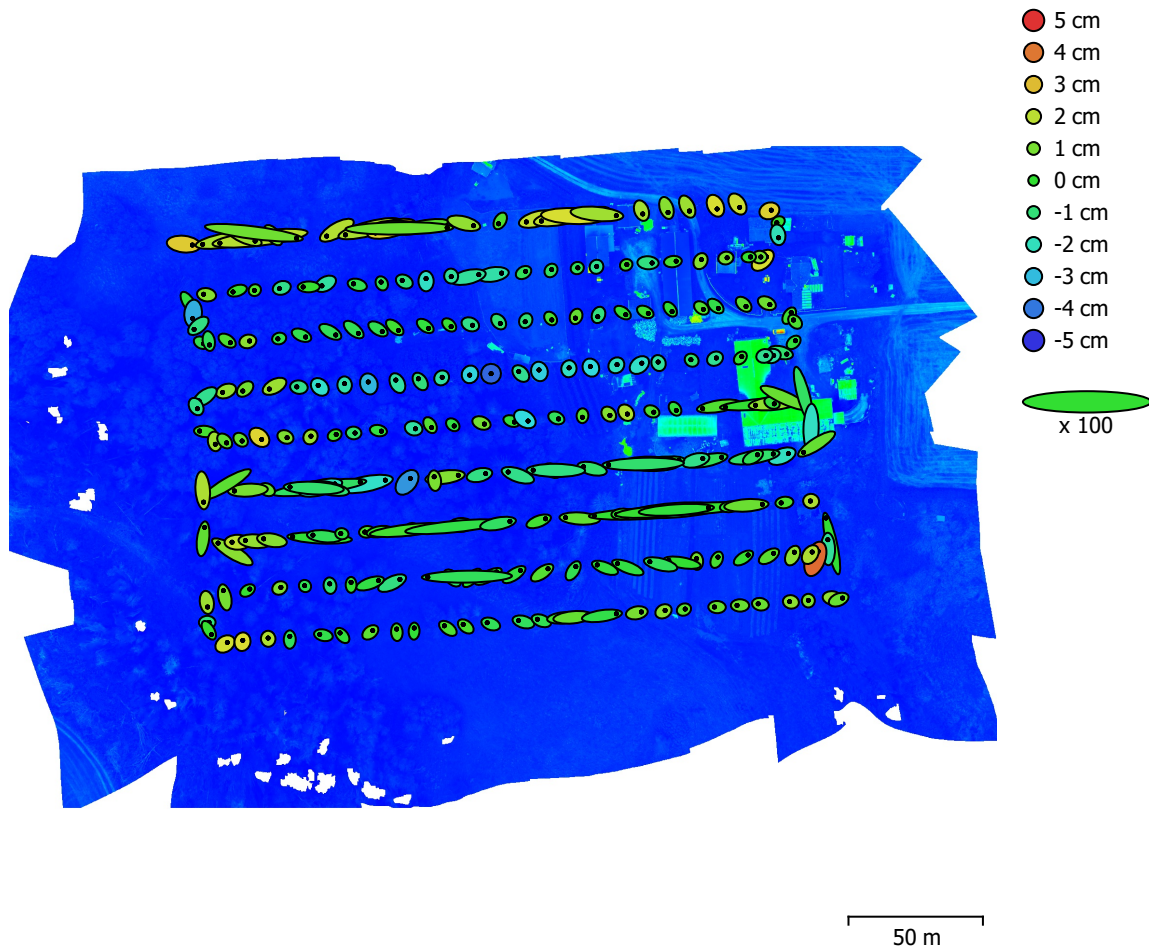


Fig. 9. Camera locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.

Estimated camera locations are marked with a black dot.

X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total error (cm)
8.9856	2.80375	1.27366	9.41286	9.49864

Table 9. Average camera location error.

X - Easting, Y - Northing, Z - Altitude.

Ground Control Points

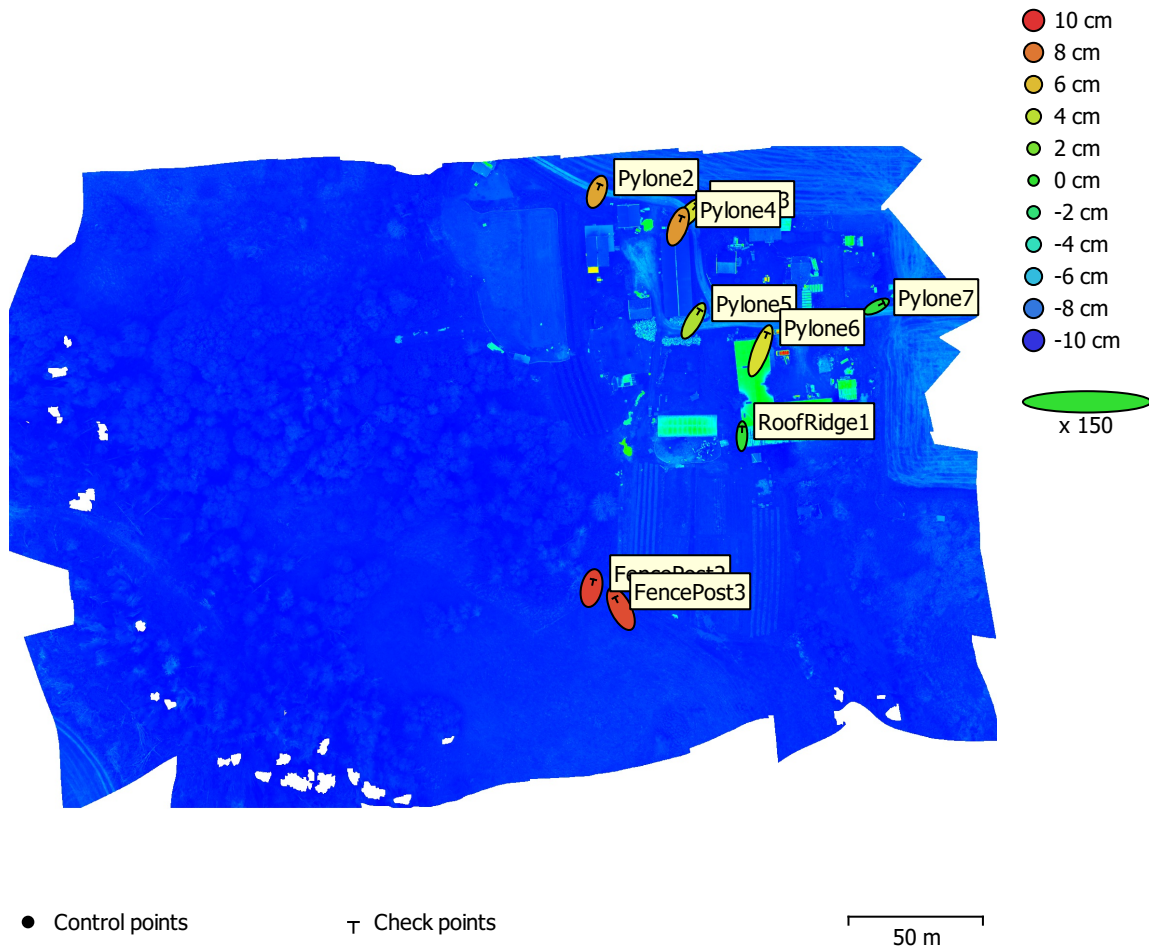


Fig. 10. GCP locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.

Estimated GCP locations are marked with a dot or crossing.

Count	X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total (cm)
9	2.63718	5.18576	6.04942	5.8178	8.39299

Table 10. Check points RMSE.

X - Easting, Y - Northing, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
Pylone2	1.42784	3.70502	6.65351	7.74824	0.281 (10)
Pylone3	3.49652	3.9001	4.65472	7.00734	0.298 (6)
Pylone4	1.90977	5.07976	7.0673	8.91056	0.706 (8)
Pylone5	3.25817	5.53422	3.62946	7.37674	1.379 (9)
Pylone6	3.3717	8.9396	4.85347	10.7164	0.376 (9)
Pylone7	3.65929	1.87254	-0.450159	4.13515	0.543 (2)
FencePost2	0.93309	4.261	9.54626	10.4956	4.432 (8)
FencePost3	-2.90094	5.70494	9.2417	11.2415	0.834 (7)
RoofRidge1	0.142998	4.74696	-0.0702419	4.74963	0.854 (6)
Total	2.63718	5.18576	6.04942	8.39299	1.713

Table 11. Check points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

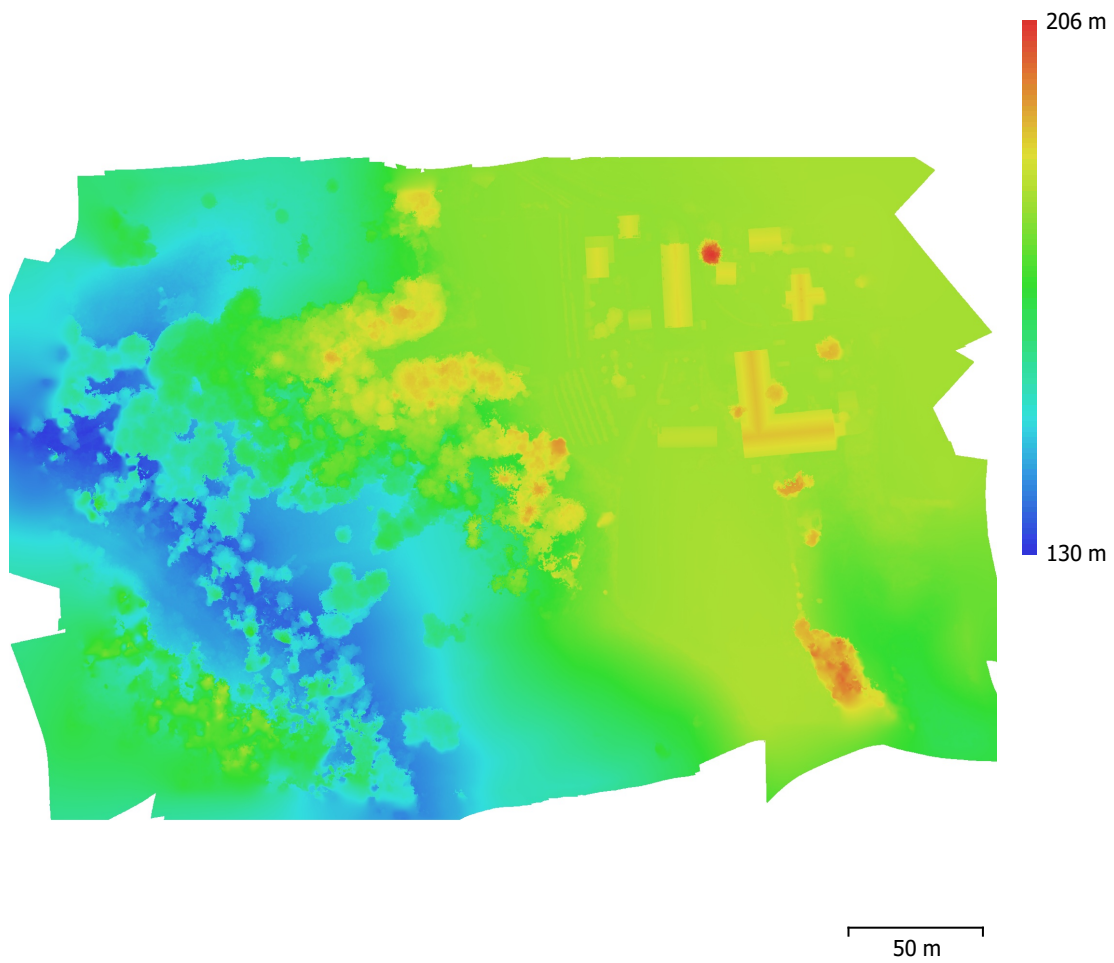


Fig. 11. Reconstructed digital elevation model.

Resolution: 5 cm/pix
Point density: 400 points/m²

Processing Parameters

General	
Cameras	1764
Aligned cameras	1757
Markers	9
Coordinate system	ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972)
Rotation angles	Yaw, Pitch, Roll
Tie Points	
Points	949,765 of 1,062,031
RMS reprojection error	0.242067 (0.514932 pix)
Max reprojection error	0.900417 (39.2373 pix)
Mean key point size	1.93613 pix
Point colors	1 bands, uint16
Key points	No
Average tie point multiplicity	6.63748
Alignment parameters	
Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Key point limit per Mpx	1,000
Tie point limit	4,000
Filter points by mask	No
Mask tie points	No
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	6 minutes 12 seconds
Matching memory usage	2.36 GB
Alignment time	3 minutes 29 seconds
Alignment memory usage	5.39 GB
Optimization parameters	
Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	Yes
Optimization time	14 seconds
Date created	2024:07:02 15:06:47
Software version	2.1.0.17532
File size	346.45 MB
Depth Maps	
Count	251
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	16
Processing time	6 minutes 8 seconds
Memory usage	5.11 GB
Date created	2024:07:02 15:27:06
Software version	2.1.0.17532
File size	1.01 GB
DEM	
Size	7,349 x 4,924

Coordinate system ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972)

Depth maps generation parameters

Quality High
Filtering mode Mild
Max neighbors 16
Processing time 6 minutes 8 seconds
Memory usage 5.11 GB

Reconstruction parameters

Source data Depth maps
Interpolation Enabled
Processing time 3 minutes 14 seconds
Memory usage 8.36 GB
Date created 2024:07:02 15:30:21
Software version 2.1.0.17532
File size 141.72 MB

Orthomosaic

Size 14,680 x 9,840
Coordinate system ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972)
Colors 7 bands, uint16

Reconstruction parameters

Blending mode Mosaic
Surface DEM
Enable hole filling Yes
Enable ghosting filter No
Processing time 7 minutes 45 seconds
Memory usage 3.57 GB
Date created 2024:07:02 15:40:27
Software version 2.1.0.17532
File size 30.23 GB

Raster Transform

Expression B1/16384; B2/16384; B4/16384; B5/16384; B6/16384; B7/100-273.15; B3...

System

Software name Agisoft Metashape Professional
Software version 2.1.0 build 17532
OS Windows 64 bit
RAM 127.15 GB
CPU AMD Ryzen 9 7950X 16-Core Processor
GPU(s) NVIDIA GeForce RTX 4080 SUPER