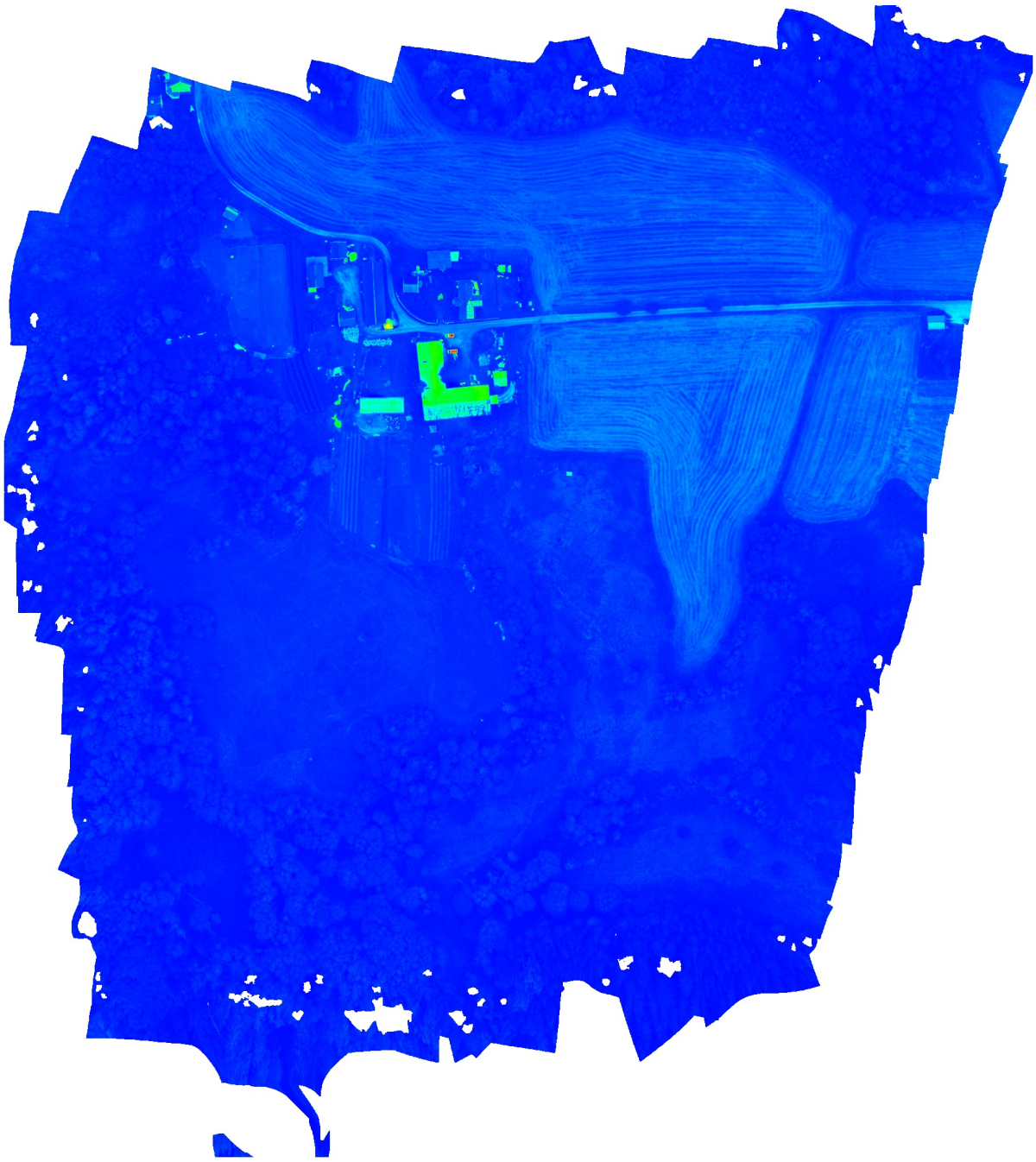
Sander_2022-09-29_1_AltumPT

Processing Report

02 July 2024



Survey Data

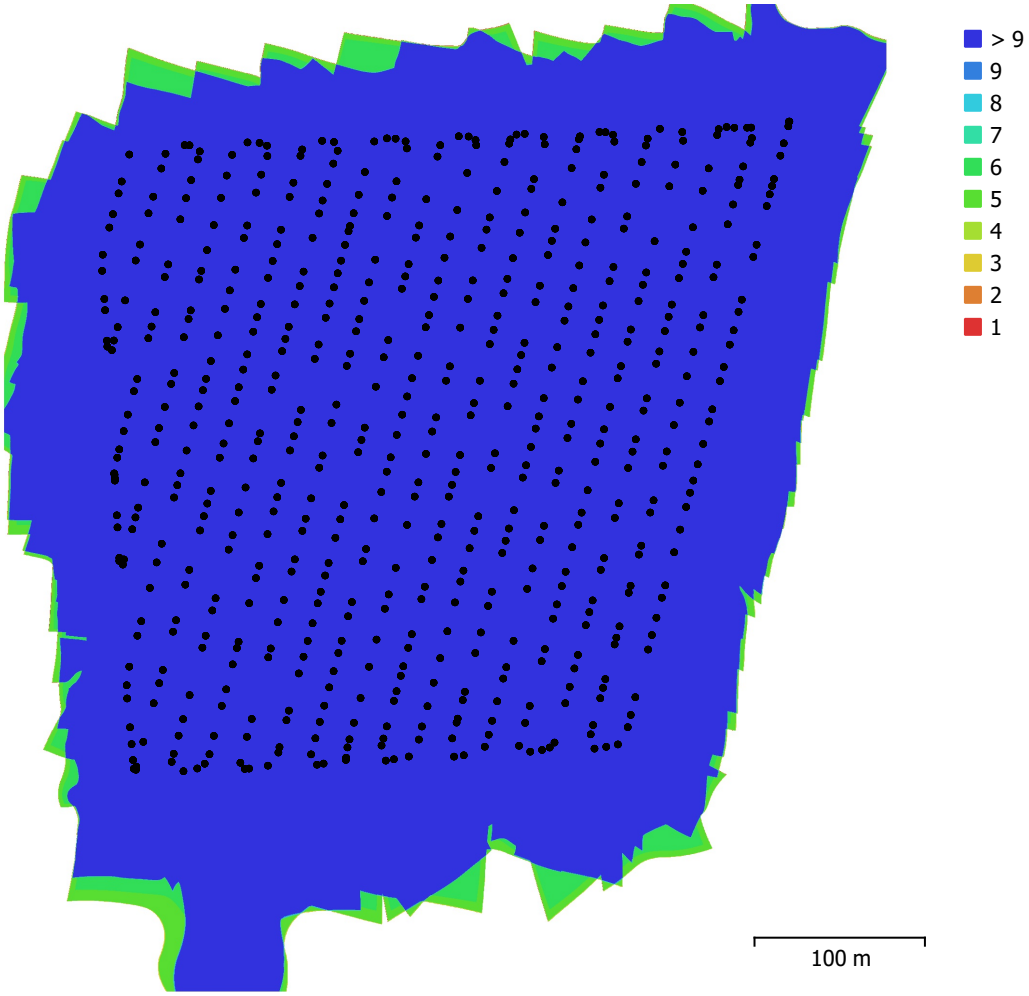


Fig. 1. Camera locations and image overlap.

Number of images:	4,151	Camera stations:	3,552
Flying altitude:	88.5 m	Tie points:	1,893,734
Ground resolution:	3.88 cm/pix	Projections:	11,972,540
Coverage area:	0.225 km²	Reprojection error:	0.525 pix

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

Table 1. Cameras.

Camera Calibration

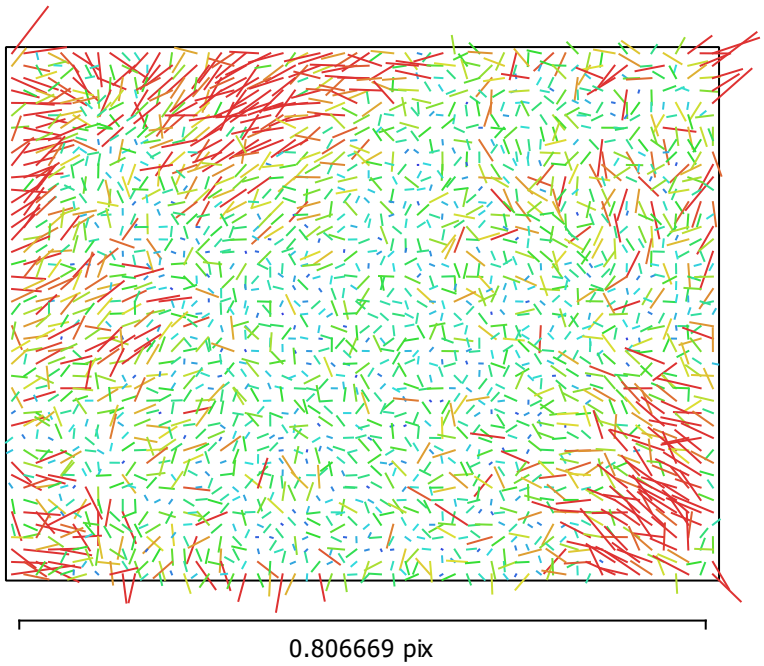


Fig. 2. Image residuals for Altum-PT, Blue (8mm).

Altum-PT, Blue (8mm)

593 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	**2277.92**	0.022	1.00	0.02	0.22	-0.13	0.04	-0.21	0.20	-0.17	-0.01	0.02
Cx	**4.90264**	0.014		1.00	0.03	-0.00	0.01	-0.00	0.00	-0.00	0.89	0.03
Cy	**-9.27201**	0.011			1.00	-0.05	0.01	0.01	-0.00	0.01	0.03	0.75
B1	**-0.182806**	0.0029				1.00	0.00	0.02	-0.04	0.05	-0.00	0.02
B2	**0.194983**	0.0028					1.00	-0.00	0.00	0.00	-0.04	-0.01
K1	**-0.125258**	5.3e-05						1.00	-0.97	0.92	0.00	0.01
K2	**0.149788**	0.00037							1.00	-0.98	-0.00	-0.00
K3	**-0.0271904**	0.00079								1.00	0.00	0.00
P1	**0.000334515**	1.7e-06									1.00	0.03
P2	**-4.15325e-05**	1.4e-06										1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Calibration

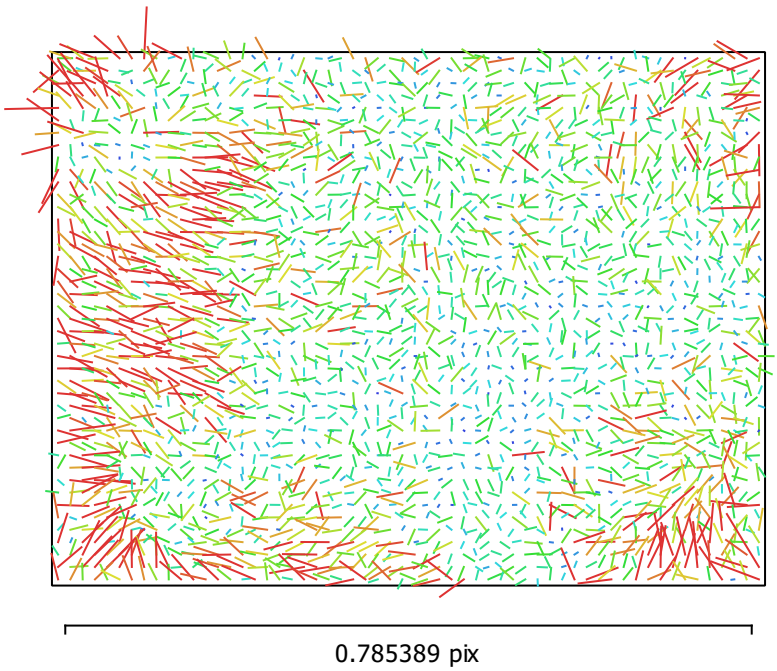


Fig. 3. Image residuals for Altum-PT, Green (8mm).

Altum-PT, Green (8mm)

593 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	**2278.33**	0.022	1.00	0.02	0.27	-0.12	0.04	-0.19	0.18	-0.15	-0.01	0.03
Cx	**0.0955909**	0.012		1.00	-0.01	-0.02	0.03	-0.01	0.01	-0.00	0.88	-0.01
Cy	**5.0611**	0.0096			1.00	-0.06	0.01	-0.00	0.01	-0.01	-0.01	0.71
B1	**-0.1541**	0.0027				1.00	-0.00	0.02	-0.04	0.04	-0.02	0.01
B2	**0.198118**	0.0027					1.00	-0.00	0.00	0.00	-0.03	-0.02
K1	**-0.130926**	4.7e-05						1.00	-0.97	0.92	-0.00	0.02
K2	**0.169967**	0.00033							1.00	-0.98	0.00	-0.00
K3	**-0.0678529**	0.0007								1.00	0.00	0.00
P1	**-0.000153702**	1.5e-06									1.00	-0.01
P2	**9.46286e-06**	1.2e-06										1.00

Table 3. Calibration coefficients and correlation matrix.

Camera Calibration

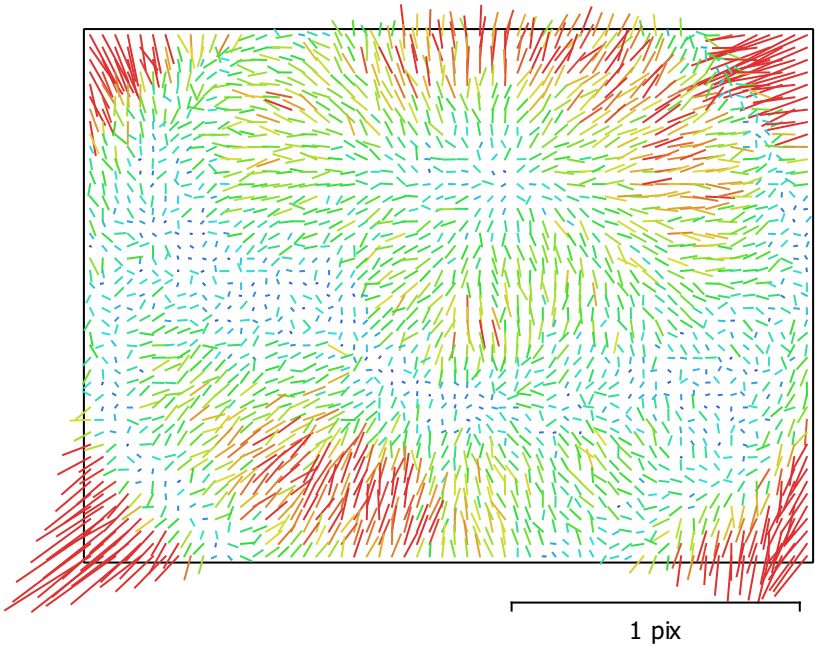


Fig. 4. Image residuals for Altum-PT, Panchro (16.6mm).

Altum-PT, Panchro (16.6mm)

593 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	K4	P1	P2
F	**4807.37**	0.047	1.00	0.01	0.31	-0.13	0.04	-0.24	0.22	-0.20	0.19	-0.00	0.06
Cx	**-17.6896**	0.02		1.00	-0.00	-0.01	0.03	-0.01	0.02	-0.02	0.02	0.87	-0.01
Cy	**-30.6302**	0.017			1.00	-0.06	0.02	-0.02	0.02	-0.03	0.03	0.00	0.72
B1	**-0.195968**	0.0056				1.00	0.00	0.03	-0.03	0.03	-0.02	-0.02	0.03
B2	**-0.077662**	0.0055					1.00	-0.00	-0.00	0.00	-0.00	-0.04	-0.02
K1	**-0.15122**	9.8e-05						1.00	-0.98	0.93	-0.89	-0.01	-0.00
K2	**0.297334**	0.0013							1.00	-0.99	0.96	0.01	0.01
K3	**0.0585981**	0.0069								1.00	-0.99	-0.01	-0.01
K4	**0.923679**	0.012									1.00	0.02	0.01
P1	**0.00062547**	1.4e-06										1.00	-0.00
P2	**0.000211669**	1.2e-06											1.00

Table 4. Calibration coefficients and correlation matrix.

Camera Calibration

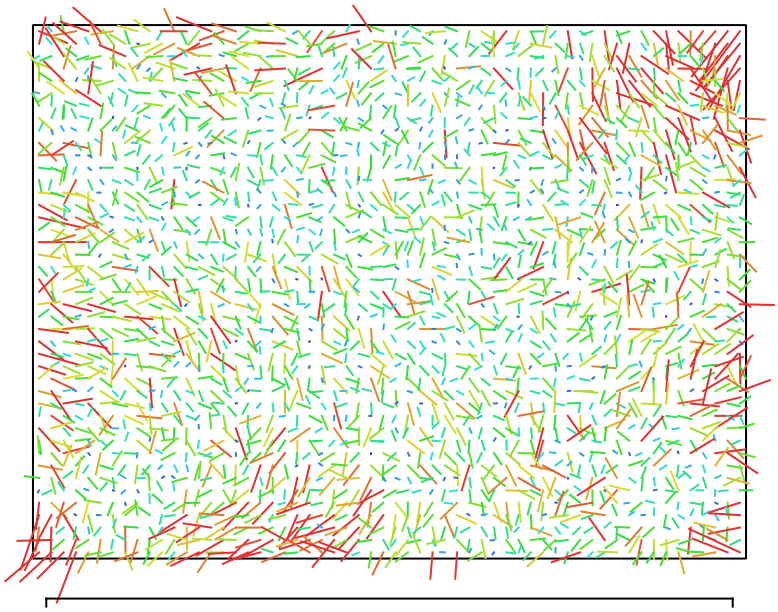


Fig. 5. Image residuals for Altum-PT, Red (8mm).

Altum-PT, Red (8mm)

593 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	**2283.32**	0.022	1.00	0.02	0.24	-0.12	0.04	-0.16	0.20	-0.01	0.02
Cx	**-3.84584**	0.014		1.00	0.01	-0.01	0.01	-0.01	0.01	0.89	0.01
Cy	**0.285516**	0.011			1.00	-0.05	0.00	0.01	0.01	0.01	0.74
B1	**-0.182897**	0.003				1.00	0.00	-0.06	0.03	-0.01	0.01
B2	**-0.014836**	0.0029					1.00	-0.01	0.00	-0.03	-0.01
K1	**-0.136864**	2.2e-05						1.00	-0.96	0.01	0.03
K2	**0.178345**	6.9e-05							1.00	-0.01	-0.00
P1	**-1.27841e-05**	1.7e-06								1.00	0.01
P2	**-0.000245126**	1.4e-06									1.00

Table 5. Calibration coefficients and correlation matrix.

Camera Calibration

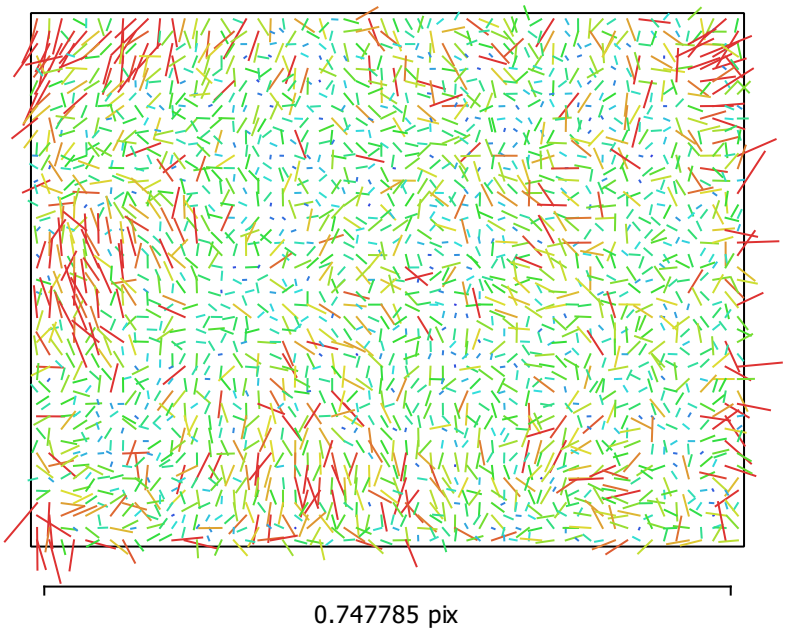


Fig. 6. Image residuals for Altum-PT, Red edge (8mm).

Altum-PT, Red edge (8mm)

593 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	**2282.63**	0.022	1.00	0.01	0.27	-0.12	0.04	-0.20	0.19	-0.15	-0.01	0.02
Cx	**-7.15688**	0.012		1.00	0.00	-0.00	0.02	-0.00	0.00	0.00	0.87	-0.00
Cy	**2.72055**	0.0098			1.00	-0.06	0.01	-0.00	0.01	-0.00	-0.00	0.70
B1	**-0.185929**	0.0028				1.00	0.00	0.02	-0.04	0.04	-0.00	0.02
B2	**0.0324608**	0.0027					1.00	-0.00	-0.00	0.00	-0.03	-0.01
K1	**-0.138167**	4.7e-05						1.00	-0.97	0.92	0.00	0.02
K2	**0.174147**	0.00034							1.00	-0.98	-0.00	-0.01
K3	**-0.0607904**	0.00071								1.00	-0.00	0.01
P1	**0.000119909**	1.5e-06									1.00	0.00
P2	**-1.35147e-05**	1.2e-06										1.00

Table 6. Calibration coefficients and correlation matrix.

Camera Calibration

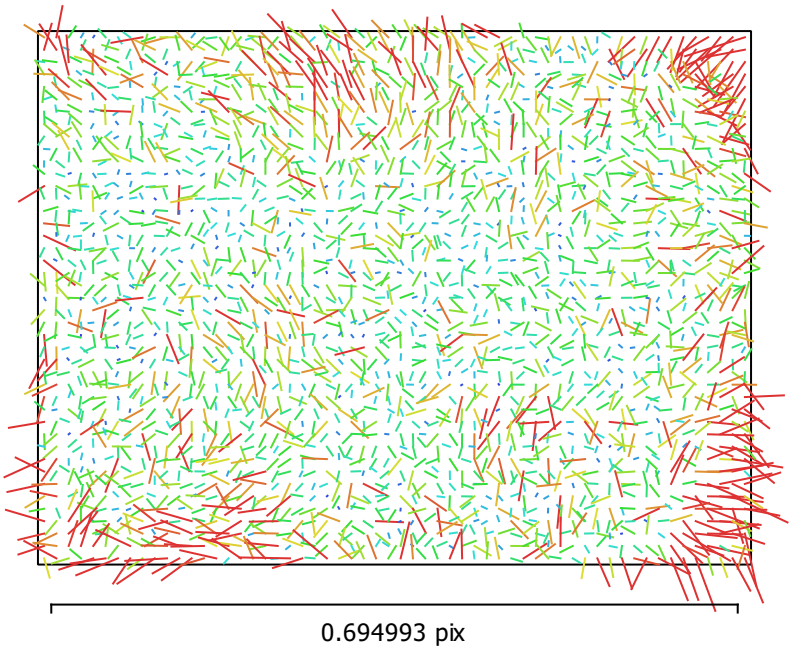


Fig. 7. Image residuals for Altum-PT, NIR (8mm).

Altum-PT, NIR (8mm)

593 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	**2285.46**	0.022	1.00	0.02	0.27	-0.12	0.04	-0.20	0.18	-0.15	-0.01	0.02
Cx	**2.58932**	0.012		1.00	-0.02	0.00	0.02	-0.00	0.00	0.00	0.87	-0.02
Cy	**1.64908**	0.0098			1.00	-0.07	0.01	-0.00	0.01	-0.01	-0.02	0.70
B1	**-0.218248**	0.0028				1.00	-0.00	0.02	-0.04	0.04	0.00	0.01
B2	**-0.108717**	0.0027					1.00	-0.00	0.00	0.00	-0.03	-0.00
K1	**-0.13827**	4.7e-05						1.00	-0.97	0.92	0.00	0.02
K2	**0.161557**	0.00033							1.00	-0.98	-0.00	-0.00
K3	**-0.0410563**	0.0007								1.00	0.00	0.00
P1	**-6.85292e-05**	1.4e-06									1.00	-0.01
P2	**-0.000147251**	1.2e-06										1.00

Table 7. Calibration coefficients and correlation matrix.

Camera Locations

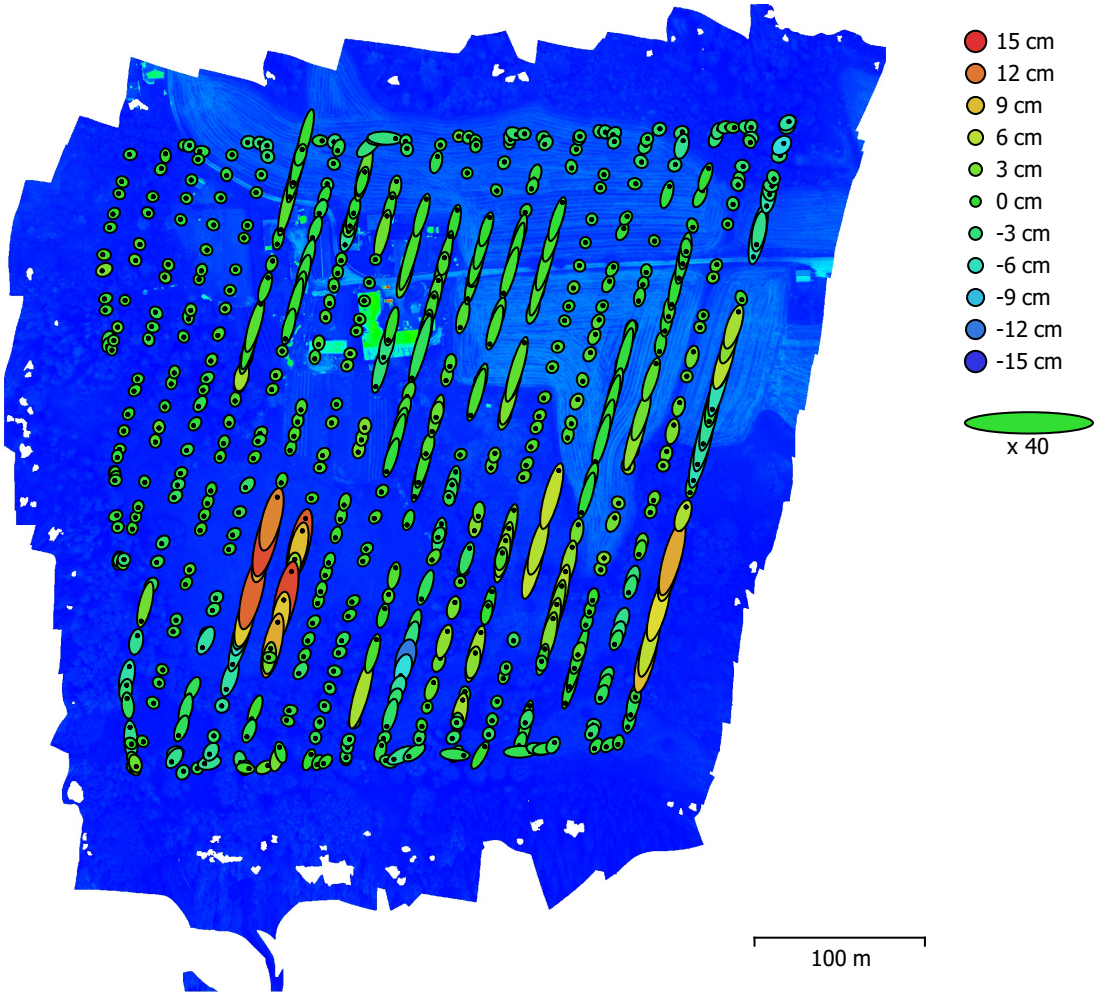


Fig. 8. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total error (cm)
8.23056	27.9741	2.66514	29.1597	29.2813

Table 8. Average camera location error.
X - Easting, Y - Northing, Z - Altitude.

Ground Control Points

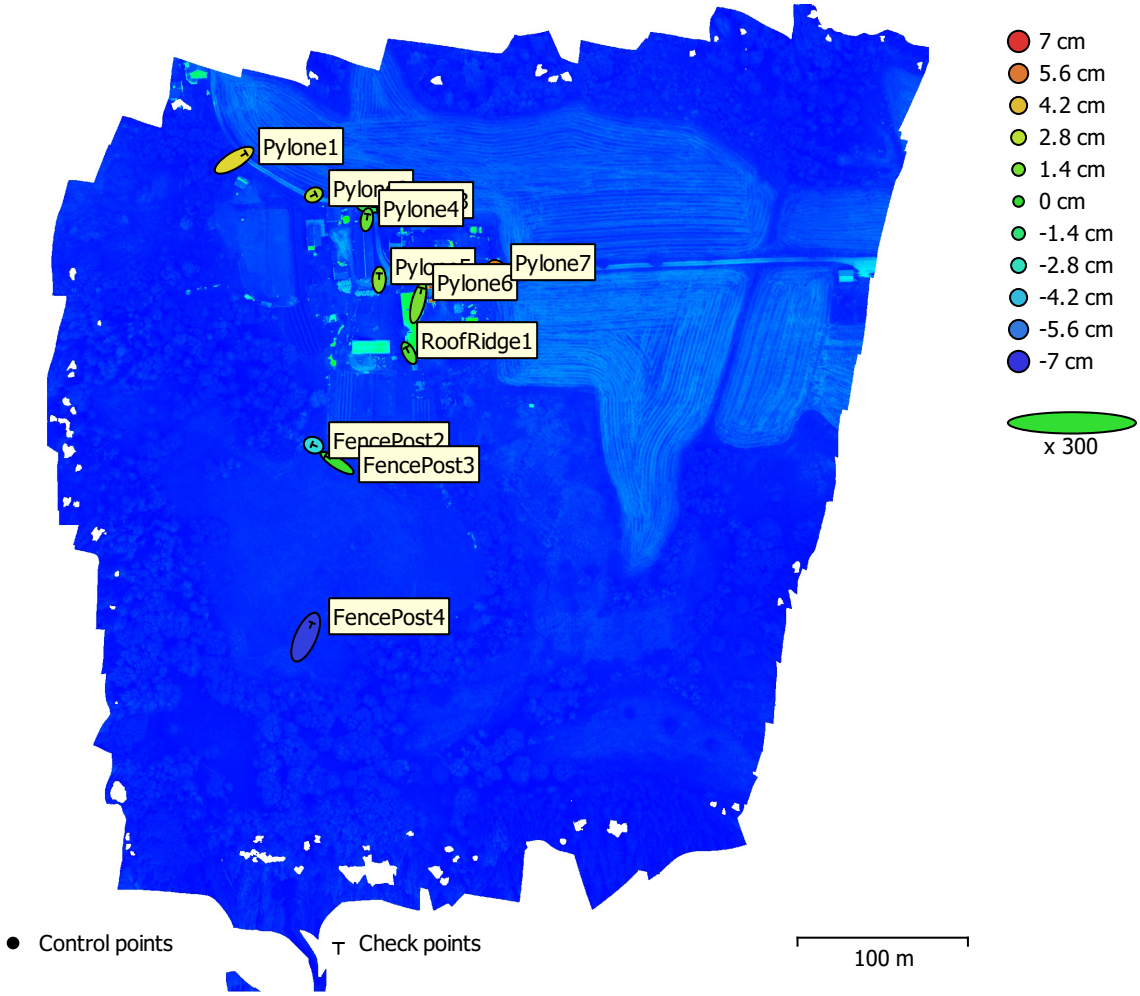


Fig. 9. GCP locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated GCP locations are marked with a dot or crossing.

Count	X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total (cm)
11	2.37928	2.9661	3.20687	3.80246	4.97421

Table 9. Check points RMSE.
X - Easting, Y - Northing, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
Pylone1	4.68985	2.85862	3.63326	6.58536	0.421 (6)
Pylone2	0.784733	0.387184	2.36044	2.51742	0.367 (6)
Pylone3	2.75904	-0.171699	-0.898501	2.90673	0.378 (6)
Pylone4	0.349897	2.14627	1.02453	2.40387	0.778 (6)
Pylone5	0.0760208	2.50216	1.8085	3.08825	0.326 (7)
Pylone6	1.46067	5.63119	1.47135	6.00072	0.350 (7)
Pylone7	-0.708347	1.0014	5.33032	5.46963	0.629 (6)
FencePost2	-0.749894	0.300865	-3.53559	3.62674	0.722 (5)
FencePost3	-4.57123	2.85835	0.131222	5.39291	0.410 (7)
FencePost4	2.55233	5.6388	-6.77029	9.17318	2.146 (5)
RoofRidge1	-1.14522	2.18796	0.540982	2.52811	0.717 (6)
Total	**2.37928**	**2.9661**	**3.20687**	**4.97421**	**0.775**

Table 10. Check points.

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

Digital Elevation Model

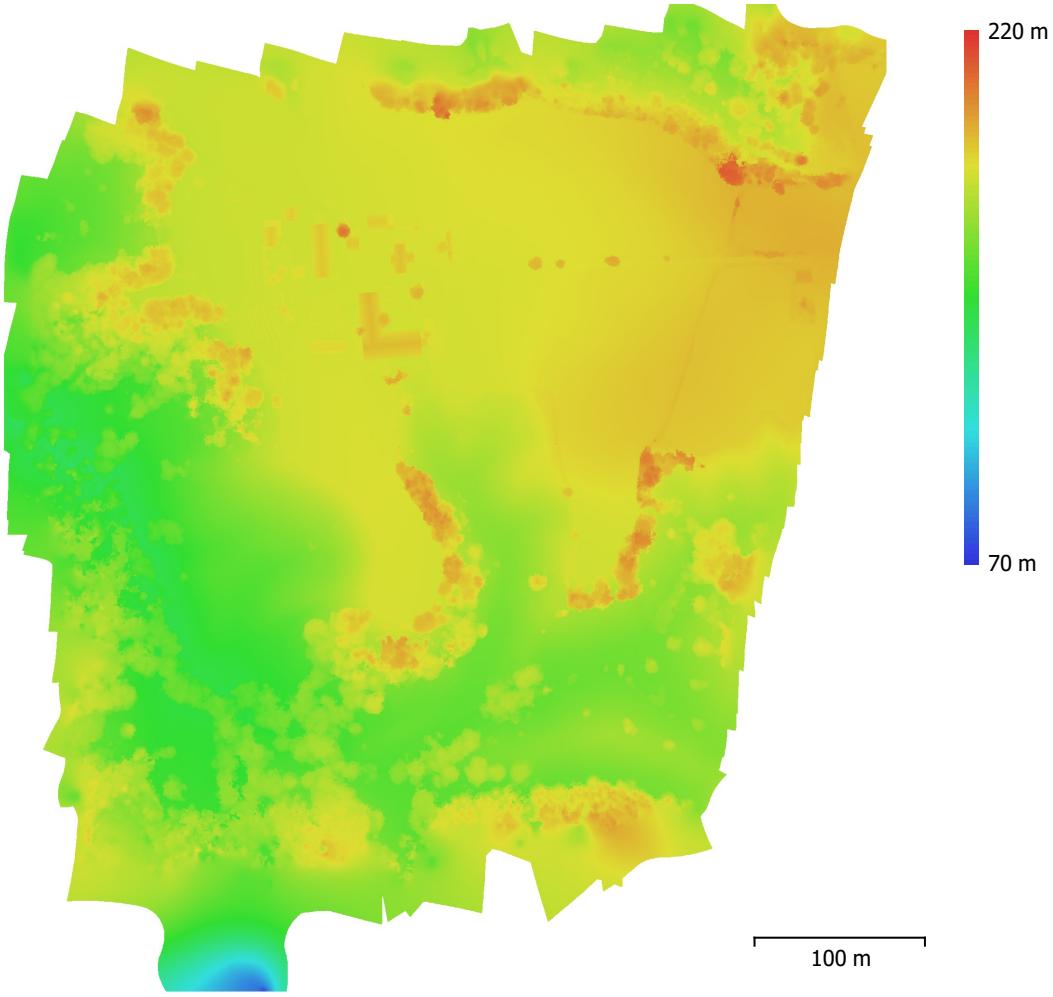


Fig. 10. Reconstructed digital elevation model.

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

Processing Parameters

General	
Cameras	4151
Aligned cameras	3552
Markers	11
Coordinate system	ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972)
Rotation angles	Yaw, Pitch, Roll
Tie Points	
Points	1,893,734 of 2,208,948
RMS reprojection error	0.238612 (0.524622 pix)
Max reprojection error	0.940427 (50.7745 pix)
Mean key point size	2.05679 pix
Point colors	1 bands, uint16
Key points	No
Average tie point multiplicity	7.54879
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	17 minutes 7 seconds
Matching memory usage	5.71 GB
Alignment time	8 minutes 37 seconds
Alignment memory usage	9.63 GB
Optimization parameters	
Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	Yes
Optimization time	27 seconds
Date created	2024:07:02 11:48:20
Software version	2.1.0.17532
File size	810.87 MB
Depth Maps	
Count	592
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	16
Processing time	16 minutes 40 seconds
Memory usage	6.07 GB
Date created	2024:07:02 12:36:23
Software version	2.1.0.17532
File size	2.38 GB
DEM	
Size	10,346 x 11,587

Coordinate system	ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972)
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	16
Processing time	16 minutes 40 seconds
Memory usage	6.07 GB
Reconstruction parameters	
Source data	Depth maps
Interpolation	Enabled
Processing time	9 minutes 8 seconds
Memory usage	11.72 GB
Date created	2024:07:02 12:45:32
Software version	2.1.0.17532
File size	388.92 MB
Orthomosaic	
Size	20,680 x 23,160
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	19 minutes 3 seconds
Memory usage	3.48 GB
Date created	2024:07:02 13:24:07
Software version	2.1.0.17532
File size	93.62 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