

# Agisoft Metashape

Processing Report

22 August 2023



# Survey Data

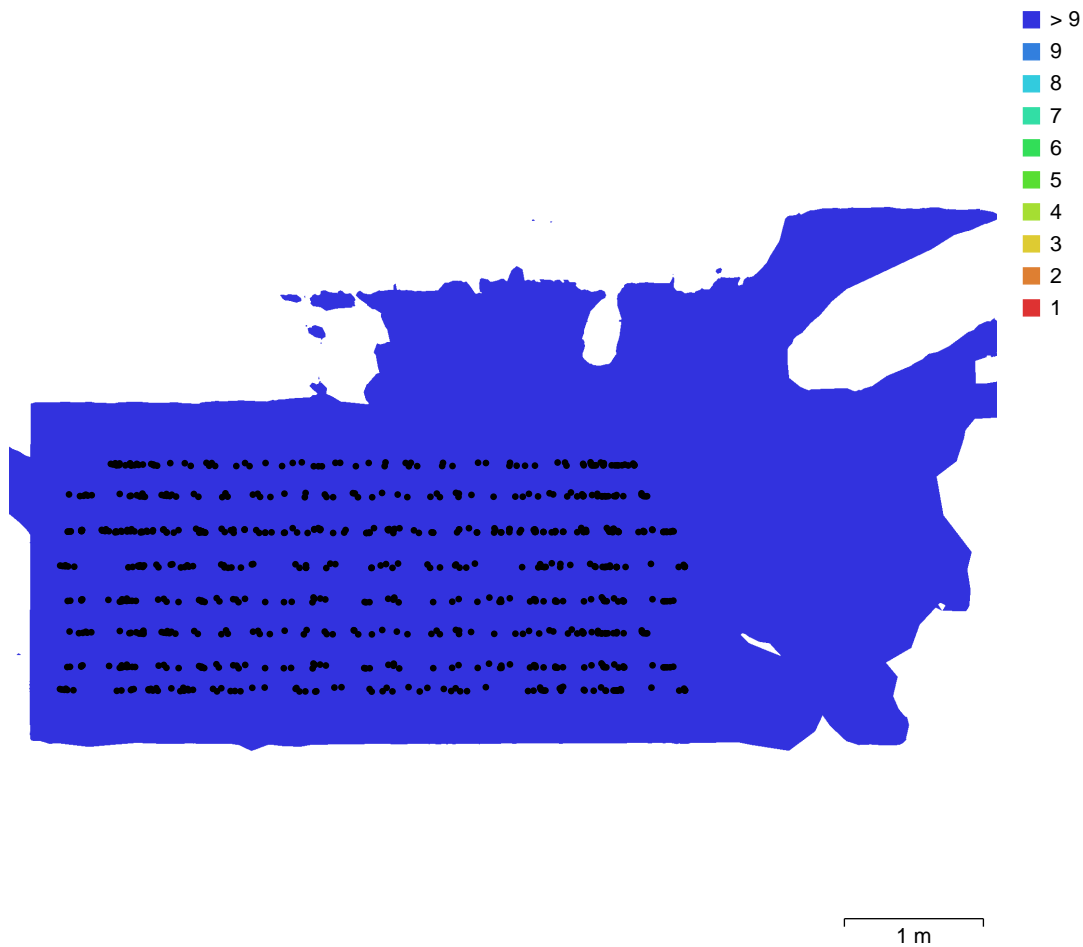


Fig. 1. Camera locations and image overlap.

Number of images:	765	Camera stations:	765
Flying altitude:	56.3 cm	Tie points:	708,029
Ground resolution:	0.288 mm/pix	Projections:	2,069,171
Coverage area:	19.7 m <sup>2</sup>	Reprojection error:	0.794 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Camera 0	5784 x 8660	14 mm	4.17 x 4.17 um	No
Camera 1	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 2	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 3	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 4	5784 x 8660	12 mm	4.17 x 4.17 um	No

<b>Camera Model</b>	<b>Resolution</b>	<b>Focal Length</b>	<b>Pixel Size</b>	<b>Precalibrated</b>
Camera 5	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 6	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 7	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 8	5784 x 8660	12 mm	4.17 x 4.17 um	No

Table 1. Cameras.

# Camera Calibration

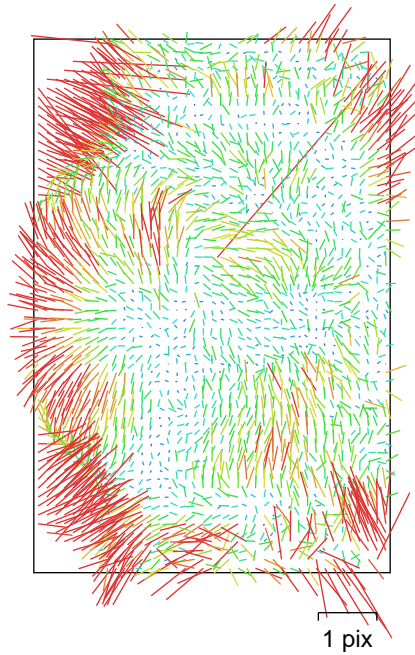


Fig. 2. Image residuals for Camera 0.

## Camera 0

85 images

Type	Resolution	Focal Length	Pixel Size
<b>Fisheye</b>	<b>5784 x 8660</b>	<b>14 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>3343.9</b>	0.036	1.00	0.03	-0.02	-0.82	0.72	-0.64	-0.02	0.01
<b>Cx</b>	<b>-6.52145</b>	0.046		1.00	-0.02	0.07	-0.04	0.03	-0.70	0.01
<b>Cy</b>	<b>28.5782</b>	0.047			1.00	0.02	-0.02	0.01	-0.01	-0.57
<b>K1</b>	<b>-0.0392717</b>	3.1e-05				1.00	-0.97	0.91	-0.17	-0.01
<b>K2</b>	<b>0.00556699</b>	3e-05					1.00	-0.98	0.15	-0.00
<b>K3</b>	<b>-0.00113265</b>	8.9e-06						1.00	-0.13	0.02
<b>P1</b>	<b>-0.000411368</b>	1.9e-06							1.00	0.03
<b>P2</b>	<b>0.000131515</b>	1.1e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration

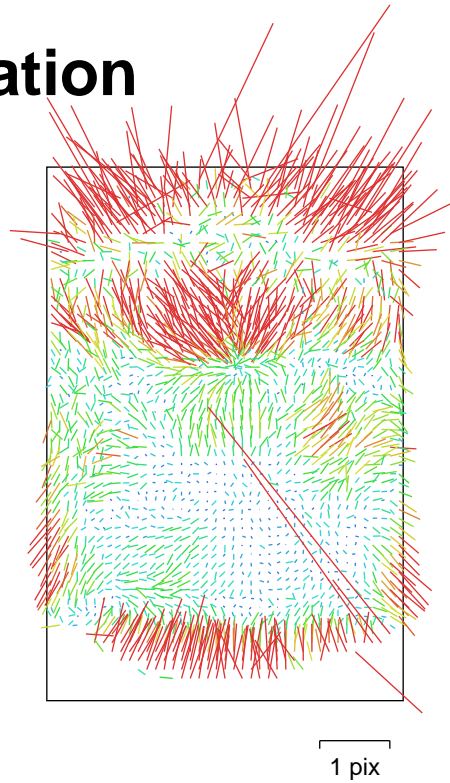


Fig. 3. Image residuals for Camera 1.

## Camera 1

85 images

Type	Resolution	Focal Length	Pixel Size
<b>Fisheye</b>	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2934.58</b>	0.029	1.00	0.02	-0.01	-0.80	0.71	-0.64	-0.00	0.07
<b>Cx</b>	<b>21.3389</b>	0.034		1.00	0.01	-0.00	-0.00	0.00	-0.59	0.00
<b>Cy</b>	<b>28.1135</b>	0.044			1.00	-0.03	0.01	-0.01	-0.00	-0.68
<b>K1</b>	<b>-0.0445447</b>	2.7e-05				1.00	-0.97	0.91	0.01	0.11
<b>K2</b>	<b>0.00684062</b>	2.5e-05					1.00	-0.98	-0.01	-0.12
<b>K3</b>	<b>-0.00129584</b>	7.2e-06						1.00	0.00	0.12
<b>P1</b>	<b>0.000197603</b>	1.1e-06							1.00	0.01
<b>P2</b>	<b>0.000329626</b>	1.6e-06								1.00

Table 3. Calibration coefficients and correlation matrix.

# Camera Calibration

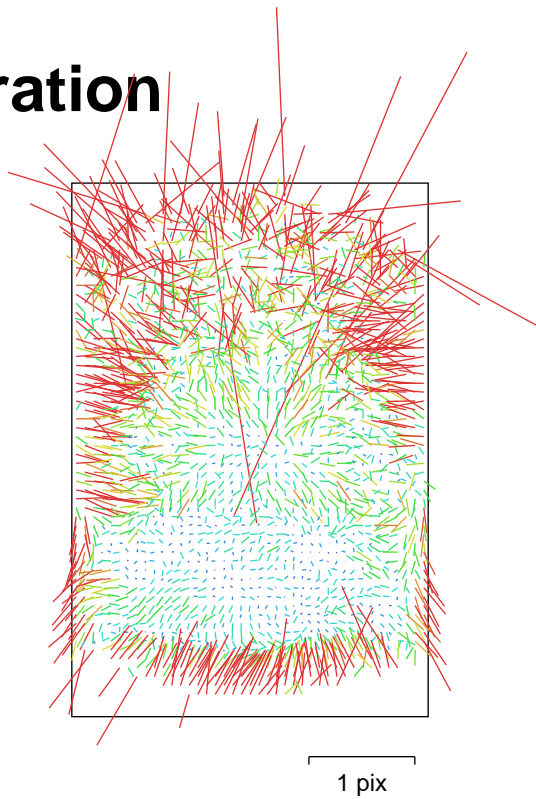


Fig. 4. Image residuals for Camera 2.

## Camera 2

85 images

Type

Resolution

Focal Length

Pixel Size

**Fisheye**

**5784 x 8660**

**12 mm**

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2892.22</b>	0.027	1.00	0.02	0.01	-0.83	0.74	-0.67	-0.01	0.10
<b>Cx</b>	<b>-13.8649</b>	0.031		1.00	-0.01	0.01	-0.01	0.01	-0.66	0.02
<b>Cy</b>	<b>54.463</b>	0.042			1.00	-0.01	0.00	-0.00	0.02	-0.71
<b>K1</b>	<b>-0.0428314</b>	2.3e-05				1.00	-0.97	0.92	-0.01	0.00
<b>K2</b>	<b>0.00532517</b>	2e-05					1.00	-0.98	0.01	-0.05
<b>K3</b>	<b>-0.000852633</b>	5.2e-06						1.00	-0.01	0.04
<b>P1</b>	<b>-0.000155924</b>	1e-06							1.00	-0.01
<b>P2</b>	<b>9.74451e-05</b>	1.5e-06								1.00

Table 4. Calibration coefficients and correlation matrix.

# Camera Calibration

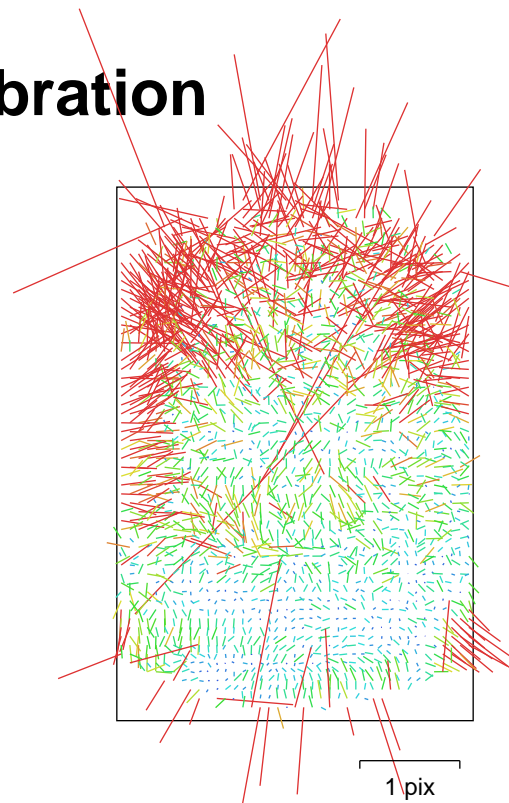


Fig. 5. Image residuals for Camera 3.

## Camera 3

85 images

Type

Resolution

Focal Length

Pixel Size

**Fisheye**

**5784 x 8660**

**12 mm**

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2930</b>	0.042	1.00	-0.00	0.01	-0.87	0.79	-0.73	0.02	0.04
<b>Cx</b>	<b>-15.9706</b>	0.032		1.00	0.01	0.01	-0.02	0.02	-0.71	0.00
<b>Cy</b>	<b>20.218</b>	0.045			1.00	-0.01	0.02	-0.02	0.00	-0.71
<b>K1</b>	<b>-0.0422502</b>	3.1e-05				1.00	-0.97	0.93	-0.03	0.02
<b>K2</b>	<b>0.00503676</b>	2.4e-05					1.00	-0.99	0.03	-0.08
<b>K3</b>	<b>-0.00079921</b>	5.7e-06						1.00	-0.03	0.09
<b>P1</b>	<b>-0.000339783</b>	1.2e-06							1.00	0.01
<b>P2</b>	<b>0.000376137</b>	1.7e-06								1.00

Table 5. Calibration coefficients and correlation matrix.

# Camera Calibration

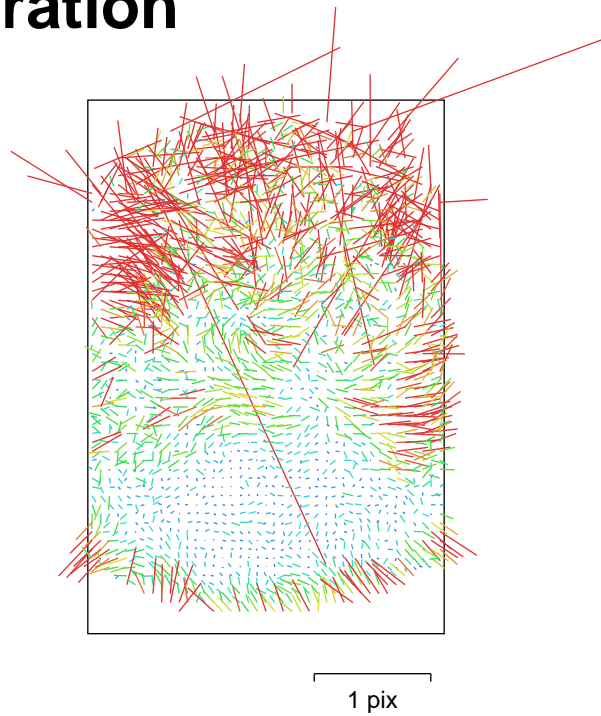


Fig. 6. Image residuals for Camera 4.

## Camera 4

85 images

Type

Resolution

Focal Length

Pixel Size

**Fisheye**

**5784 x 8660**

**12 mm**

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2870.97</b>	0.023	1.00	-0.01	0.04	-0.80	0.70	-0.64	0.01	0.07
<b>Cx</b>	<b>3.01002</b>	0.026		1.00	0.01	0.01	-0.01	0.01	-0.74	0.01
<b>Cy</b>	<b>18.8695</b>	0.043			1.00	-0.08	0.07	-0.05	0.01	-0.81
<b>K1</b>	<b>-0.0423012</b>	1.7e-05				1.00	-0.97	0.92	-0.00	0.01
<b>K2</b>	<b>0.00458011</b>	1.4e-05					1.00	-0.99	0.00	-0.07
<b>K3</b>	<b>-0.000654164</b>	3.4e-06						1.00	0.00	0.06
<b>P1</b>	<b>0.000102192</b>	9e-07							1.00	-0.01
<b>P2</b>	<b>0.000108293</b>	1.5e-06								1.00

Table 6. Calibration coefficients and correlation matrix.



# Camera Calibration

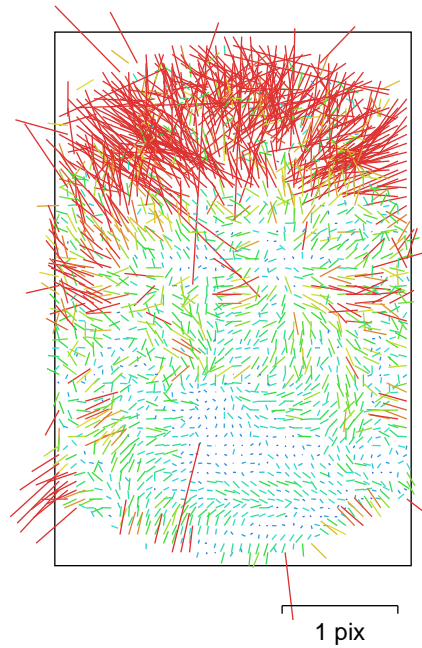


Fig. 7. Image residuals for Camera 5.

## Camera 5

85 images

Type	Resolution	Focal Length	Pixel Size
<b>Fisheye</b>	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2924.81</b>	0.023	1.00	0.04	0.09	-0.82	0.73	-0.66	0.00	0.01
<b>Cx</b>	<b>46.5936</b>	0.026		1.00	0.03	-0.01	0.01	-0.01	-0.76	-0.00
<b>Cy</b>	<b>-12.5769</b>	0.043			1.00	-0.09	0.08	-0.06	-0.01	-0.81
<b>K1</b>	<b>-0.0418213</b>	1.7e-05				1.00	-0.97	0.92	-0.00	-0.01
<b>K2</b>	<b>0.00442219</b>	1.3e-05					1.00	-0.99	-0.01	-0.06
<b>K3</b>	<b>-0.000661283</b>	3e-06						1.00	0.01	0.06
<b>P1</b>	<b>0.000235002</b>	8.8e-07							1.00	0.01
<b>P2</b>	<b>-0.000168602</b>	1.6e-06								1.00

Table 7. Calibration coefficients and correlation matrix.

# Camera Calibration

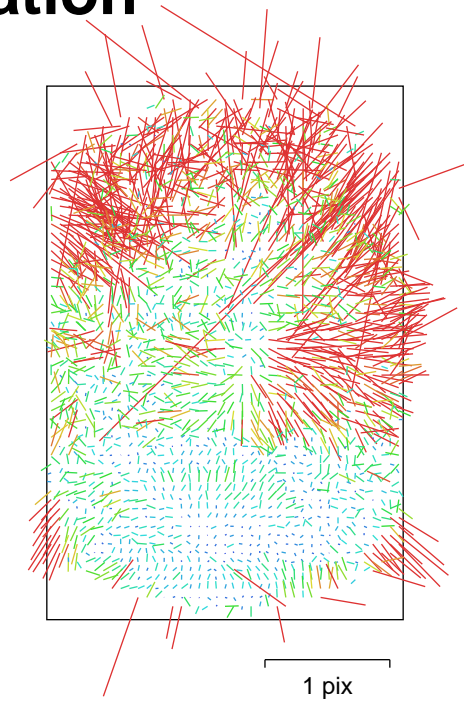


Fig. 8. Image residuals for Camera 6.

## Camera 6

85 images

Type

Resolution

Focal Length

Pixel Size

**Fisheye**

**5784 x 8660**

**12 mm**

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2915.58</b>	0.025	1.00	-0.02	0.08	-0.84	0.75	-0.68	0.01	0.00
<b>Cx</b>	<b>12.1779</b>	0.027		1.00	0.01	-0.01	0.01	-0.00	-0.77	-0.01
<b>Cy</b>	<b>0.945927</b>	0.043			1.00	-0.07	0.07	-0.06	-0.00	-0.80
<b>K1</b>	<b>-0.0426243</b>	1.8e-05				1.00	-0.97	0.92	0.03	-0.01
<b>K2</b>	<b>0.0046878</b>	1.4e-05					1.00	-0.99	-0.02	-0.06
<b>K3</b>	<b>-0.000741905</b>	3.2e-06						1.00	0.01	0.06
<b>P1</b>	<b>-0.000121425</b>	9.1e-07							1.00	-0.01
<b>P2</b>	<b>-8.35563e-05</b>	1.6e-06								1.00

Table 8. Calibration coefficients and correlation matrix.

# Camera Calibration

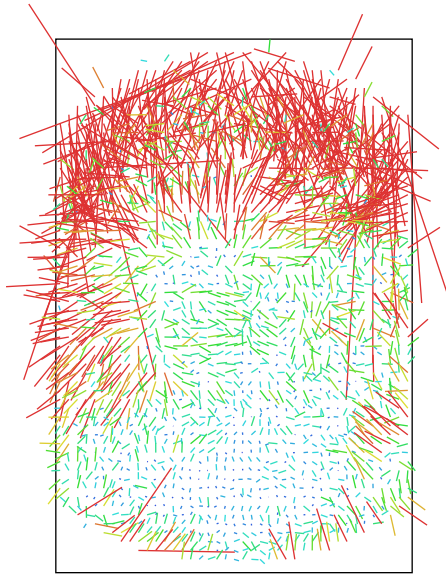


Fig. 9. Image residuals for Camera 7.

## Camera 7

85 images

Type

Resolution

Focal Length

Pixel Size

**Fisheye**

**5784 x 8660**

**12 mm**

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2910.75</b>	0.029	1.00	-0.01	0.10	-0.83	0.74	-0.68	0.01	-0.02
<b>Cx</b>	<b>4.66012</b>	0.028		1.00	0.01	0.01	-0.00	0.00	-0.75	-0.01
<b>Cy</b>	<b>9.38932</b>	0.046			1.00	-0.03	0.04	-0.03	0.00	-0.75
<b>K1</b>	<b>-0.0420961</b>	2.1e-05				1.00	-0.96	0.91	-0.00	-0.09
<b>K2</b>	<b>0.00464321</b>	1.6e-05					1.00	-0.99	-0.00	-0.02
<b>K3</b>	<b>-0.000731976</b>	3.8e-06						1.00	0.00	0.04
<b>P1</b>	<b>-4.69858e-05</b>	1e-06							1.00	0.00
<b>P2</b>	<b>6.29769e-05</b>	1.9e-06								1.00

Table 9. Calibration coefficients and correlation matrix.

# Camera Calibration

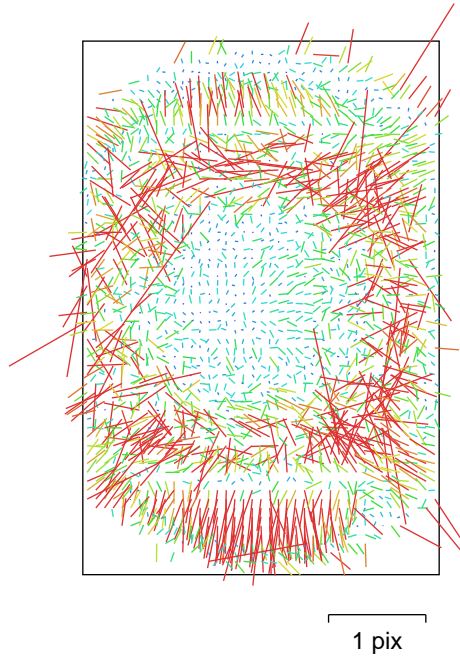


Fig. 10. Image residuals for Camera 8.

## Camera 8

85 images

Type	Resolution	Focal Length	Pixel Size
<b>Fisheye</b>	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2858.65</b>	0.22	1.00	-0.04	-0.04	-0.89	0.75	-0.66	0.07	0.01
<b>Cx</b>	<b>11.0985</b>	0.022		1.00	0.04	0.04	-0.03	0.02	-0.89	-0.03
<b>Cy</b>	<b>4.77038</b>	0.03			1.00	0.05	-0.03	0.00	-0.03	-0.86
<b>K1</b>	<b>-0.0271961</b>	0.00011				1.00	-0.96	0.91	-0.06	-0.03
<b>K2</b>	<b>-0.000824397</b>	6.6e-05					1.00	-0.99	0.05	0.00
<b>K3</b>	<b>-0.000178167</b>	1.3e-05						1.00	-0.03	0.03
<b>P1</b>	<b>-0.000401096</b>	1.7e-06							1.00	0.03
<b>P2</b>	<b>0.000117928</b>	1.8e-06								1.00

Table 10. Calibration coefficients and correlation matrix.

# Scale Bars

<b>Label</b>	<b>Distance (m)</b>	<b>Error (m)</b>
003. 7-8	0.250042	-1.79501e-05
006. 15-16	0.250099	6.92757e-05
009. 23-24	0.250324	0.000203523
002a. 4-5	0.250079	7.86416e-05
002b. 5-6	0.250236	0.000336025
005a. 12-13	0.250037	5.74181e-05
005b. 13-14	0.250171	0.000281138
008a. 20-21	0.250302	0.00027201
008b. 21-22	0.248746	-0.00113352
<b>Total</b>		<b>0.000422536</b>

Table 11. Control scale bars.

# Digital Elevation Model

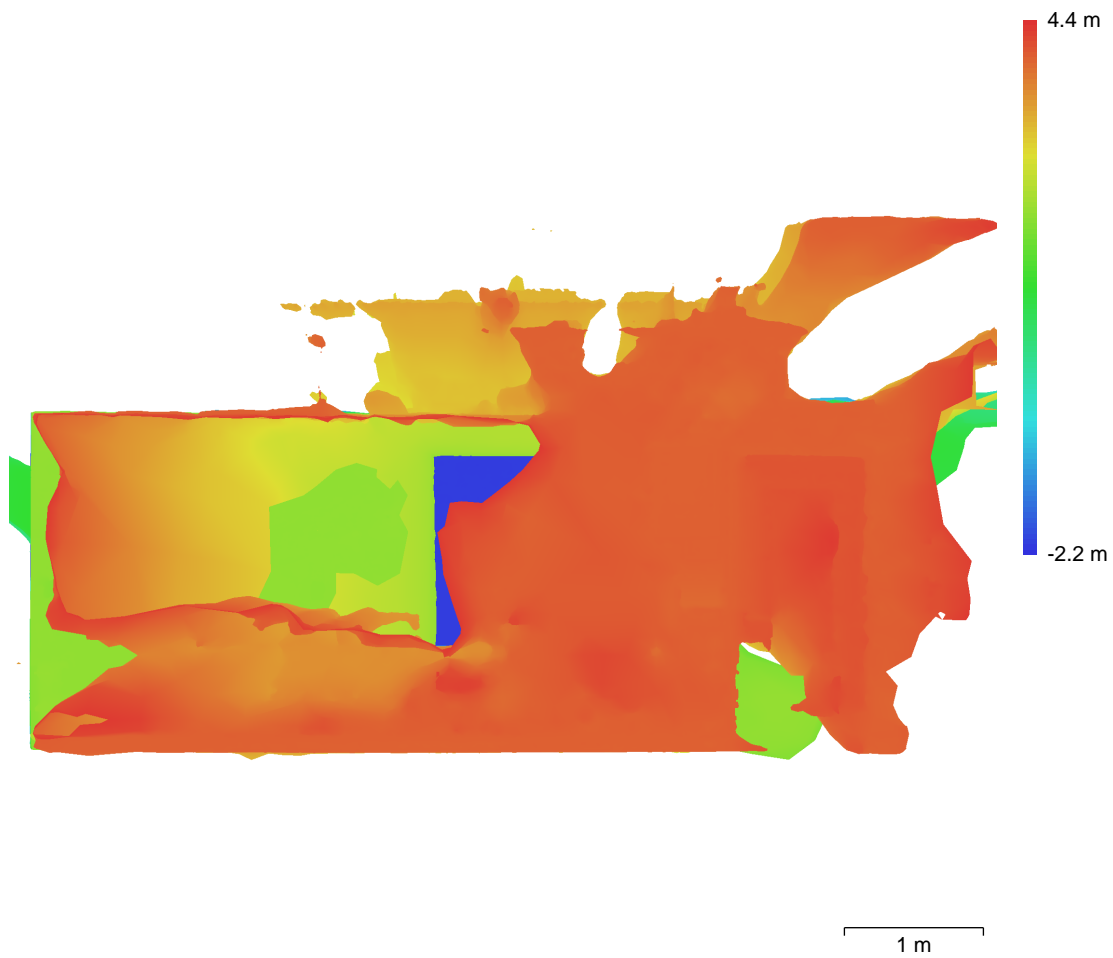


Fig. 11. Reconstructed digital elevation model.

Resolution: 3.7 mm/pix  
Point density: 7.31 points/cm<sup>2</sup>

# Processing Parameters

## General

Cameras	765
Aligned cameras	765
Markers	15
Scale bars	9
Coordinate system	Local Coordinates (m)
Rotation angles	Yaw, Pitch, Roll

## Tie Points

Points	708,029 of 1,166,253
RMS reprojection error	0.314998 (0.794132 pix)
Max reprojection error	1.12754 (14.7736 pix)
Mean key point size	2.44095 pix
Point colors	3 bands, uint8
Key points	3.63 GB
Average tie point multiplicity	3.2914

## Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Estimated
Key point limit	60,000
Key point limit per Mpx	1,000
Tie point limit	0
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	9 minutes 27 seconds
Matching memory usage	3.02 GB
Alignment time	2 minutes 2 seconds
Alignment memory usage	6.30 GB

## Optimization parameters

Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	3 seconds
Date created	2023:08:22 20:21:43
Software version	2.0.2.16404
File size	92.87 MB

## Depth Maps

Count	755
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## Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	21 minutes 35 seconds
Memory usage	5.00 GB
Date created	2023:08:22 22:40:52
Software version	2.0.2.16404
File size	1.82 GB

## Point Cloud

Points	99,027,158
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## Point attributes

Color	3 bands, uint8
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Normal

**Point classes**

Created (never classified) 99,027,158

**Depth maps generation parameters**

Quality Medium  
Filtering mode Mild  
Max neighbors 16  
Processing time 21 minutes 35 seconds  
Memory usage 5.00 GB

**Point cloud generation parameters**

Processing time 1 hours 25 minutes  
Memory usage 31.61 GB  
Date created 2023:08:23 00:07:00  
Software version 2.0.2.16404  
File size 1.30 GB

**Model**

Faces 1,970,959  
Vertices 986,142  
Vertex colors 3 bands, uint8  
Texture 16,384 x 16,384, 4 bands, uint8

**Depth maps generation parameters**

Quality Medium  
Filtering mode Mild  
Max neighbors 16  
Processing time 21 minutes 35 seconds  
Memory usage 5.00 GB

**Reconstruction parameters**

Surface type Arbitrary  
Source data Depth maps  
Interpolation Enabled  
Strict volumetric masks No  
Processing time 5 minutes 48 seconds  
Memory usage 6.91 GB

**Texturing parameters**

Mapping mode Generic  
Blending mode Mosaic  
Texture size 16,384  
Enable hole filling Yes  
Enable ghosting filter Yes  
UV mapping time 3 minutes 20 seconds  
UV mapping memory usage 2.29 GB  
Blending time 7 minutes 35 seconds  
Blending memory usage 10.94 GB  
Blending GPU memory usage 7.56 GB  
Date created 2023:08:23 00:13:03  
Software version 2.0.2.16404  
File size 268.34 MB

**System**

Software name Agisoft Metashape Professional  
Software version 2.0.2 build 16404  
OS Windows 64 bit  
RAM 255.87 GB  
CPU AMD Ryzen Threadripper 3970X 32-Core Processor  
GPU(s) NVIDIA GeForce RTX 3090  
NVIDIA GeForce RTX 3090  
NVIDIA GeForce RTX 3090