

# Agisoft Metashape

Processing Report

24 August 2023



# Survey Data

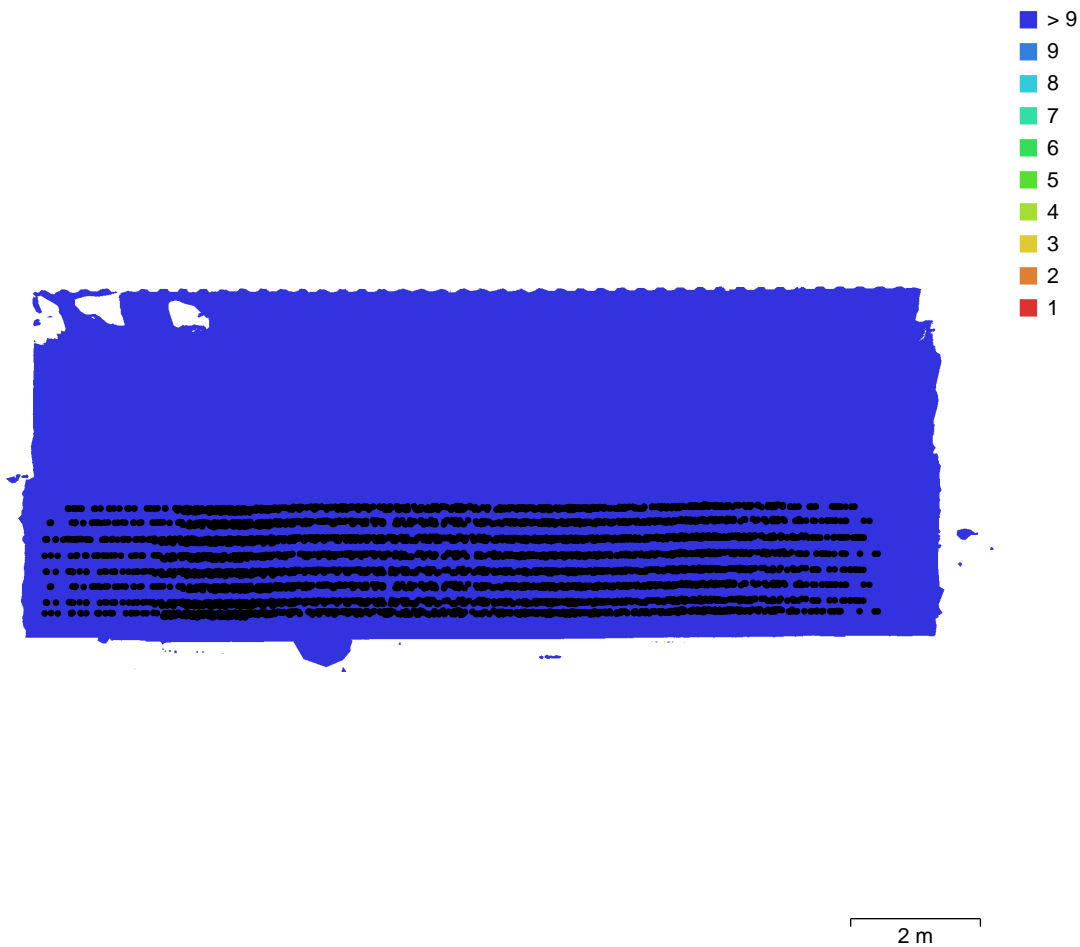


Fig. 1. Camera locations and image overlap.

Number of images:	6,300	Camera stations:	6,300
Flying altitude:	60.6 cm	Tie points:	4,516,777
Ground resolution:	0.181 mm/pix	Projections:	10,986,752
Coverage area:	74.8 m <sup>2</sup>	Reprojection error:	1.26 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

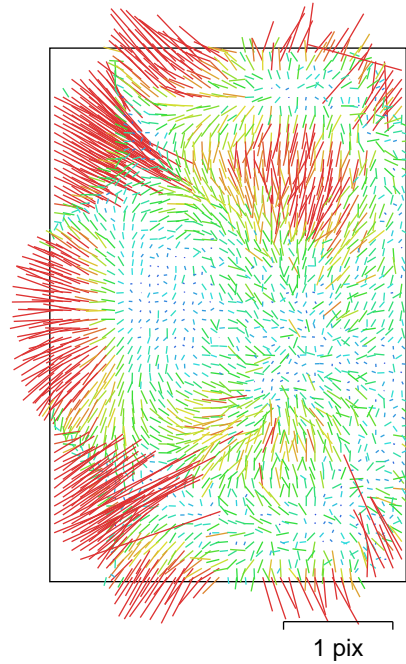


Fig. 2. Image residuals for Camera 0.

## Camera 0

700 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>3344.76</b>	0.037	1.00	0.07	0.02	-0.86	0.77	-0.69	-0.20	0.04
<b>Cx</b>	<b>-6.2943</b>	0.047		1.00	0.02	0.05	-0.04	0.02	-0.77	0.02
<b>Cy</b>	<b>35.4494</b>	0.041			1.00	-0.01	0.01	-0.00	-0.00	-0.56
<b>K1</b>	<b>-0.039395</b>	3e-05				1.00	-0.97	0.92	-0.04	-0.02
<b>K2</b>	<b>0.00610907</b>	2.7e-05					1.00	-0.98	0.07	0.02
<b>K3</b>	<b>-0.00136045</b>	7.6e-06						1.00	-0.06	-0.02
<b>P1</b>	<b>-0.000664174</b>	2.2e-06							1.00	-0.04
<b>P2</b>	<b>0.000100304</b>	9.6e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration

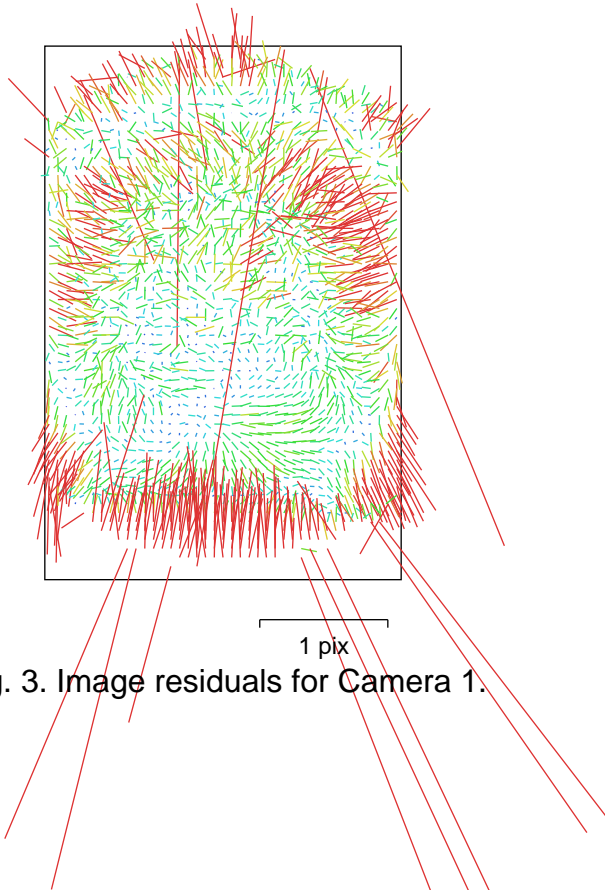


Fig. 3. Image residuals for Camera 1.

## Camera 1

700 images

Type

**Fisheye**

Resolution

**5784 x 8660**

Focal Length

**12 mm**

Pixel Size

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2913.15</b>	0.035	1.00	-0.01	-0.06	-0.85	0.76	-0.68	0.01	0.18
<b>Cx</b>	<b>21.1406</b>	0.028		1.00	0.01	0.01	-0.01	0.01	-0.58	0.00
<b>Cy</b>	<b>28.6063</b>	0.048			1.00	-0.01	-0.00	0.01	-0.00	-0.76
<b>K1</b>	<b>-0.0458152</b>	3e-05				1.00	-0.97	0.92	-0.01	0.10
<b>K2</b>	<b>0.00779436</b>	2.6e-05					1.00	-0.99	0.00	-0.15
<b>K3</b>	<b>-0.00157579</b>	6.6e-06						1.00	-0.00	0.17
<b>P1</b>	<b>0.000189111</b>	1e-06							1.00	0.00
<b>P2</b>	<b>0.000577281</b>	1.8e-06								1.00

Table 3. Calibration coefficients and correlation matrix.

# Camera Calibration

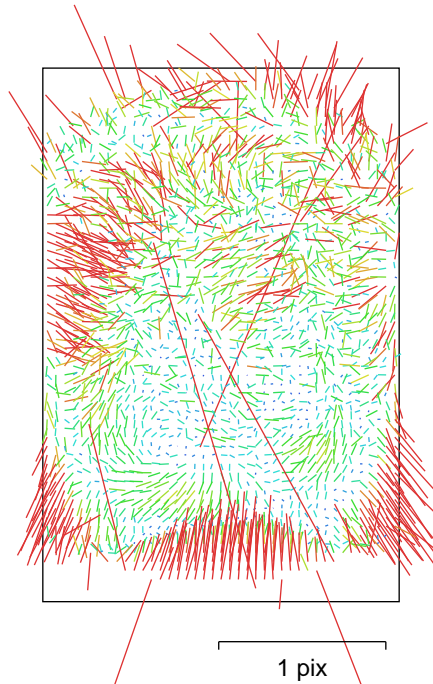


Fig. 4. Image residuals for Camera 2.

## Camera 2

700 images

Type

**Fisheye**

Resolution

**5784 x 8660**

Focal Length

**12 mm**

Pixel Size

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2893.7</b>	0.038	1.00	0.00	-0.05	-0.88	0.80	-0.74	0.00	0.18
<b>Cx</b>	<b>-13.8039</b>	0.029		1.00	-0.01	0.00	-0.00	0.00	-0.64	0.01
<b>Cy</b>	<b>55.0767</b>	0.05			1.00	-0.00	-0.01	0.01	0.01	-0.78
<b>K1</b>	<b>-0.0437036</b>	3.1e-05				1.00	-0.98	0.93	-0.01	0.03
<b>K2</b>	<b>0.00590445</b>	2.5e-05					1.00	-0.99	0.01	-0.07
<b>K3</b>	<b>-0.00100511</b>	6.2e-06						1.00	-0.01	0.08
<b>P1</b>	<b>-8.33562e-05</b>	1e-06							1.00	-0.01
<b>P2</b>	<b>0.000288385</b>	1.8e-06								1.00

Table 4. Calibration coefficients and correlation matrix.

# Camera Calibration



Fig. 5. Image residuals for Camera 3.

## Camera 3

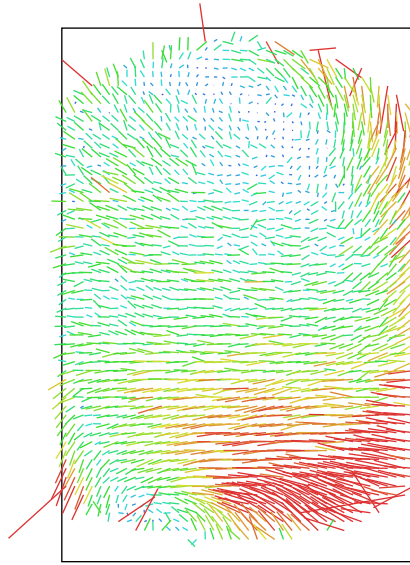
700 images

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>2932.23</b>	0.07	1.00	-0.01	-0.01	-0.90	0.82	-0.76	0.05	0.09
<b>Cx</b>	<b>-16.1394</b>	0.039		1.00	-0.01	0.00	-0.01	0.01	-0.60	0.02
<b>Cy</b>	<b>23.0765</b>	0.067			1.00	-0.00	0.00	-0.00	0.01	-0.68
<b>K1</b>	<b>-0.0424017</b>	5.6e-05				1.00	-0.98	0.94	-0.04	0.02
<b>K2</b>	<b>0.00492402</b>	4.4e-05					1.00	-0.99	0.03	-0.05
<b>K3</b>	<b>-0.000786802</b>	1.1e-05						1.00	-0.03	0.06
<b>P1</b>	<b>-0.000307032</b>	1.9e-06							1.00	-0.01
<b>P2</b>	<b>0.000447665</b>	2.2e-06								1.00

Table 5. Calibration coefficients and correlation matrix.

# Camera Calibration



1 pix

Fig. 6. Image residuals for Camera 4.

## Camera 4

700 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>2864.56</b>	0.052	1.00	0.00	-0.00	-0.90	0.81	-0.74	-0.00	0.09
<b>Cx</b>	<b>3.03334</b>	0.032		1.00	-0.00	0.00	-0.00	-0.00	-0.61	0.01
<b>Cy</b>	<b>15.0923</b>	0.056			1.00	-0.02	0.02	-0.01	0.00	-0.74
<b>K1</b>	<b>-0.0419786</b>	4.2e-05				1.00	-0.98	0.93	0.00	0.01
<b>K2</b>	<b>0.0037674</b>	3.3e-05					1.00	-0.99	-0.00	-0.04
<b>K3</b>	<b>-0.000468341</b>	8.1e-06						1.00	0.00	0.04
<b>P1</b>	<b>-6.69815e-06</b>	1.5e-06							1.00	-0.01
<b>P2</b>	<b>8.87554e-05</b>	1.9e-06								1.00

Table 6. Calibration coefficients and correlation matrix.



# Camera Calibration

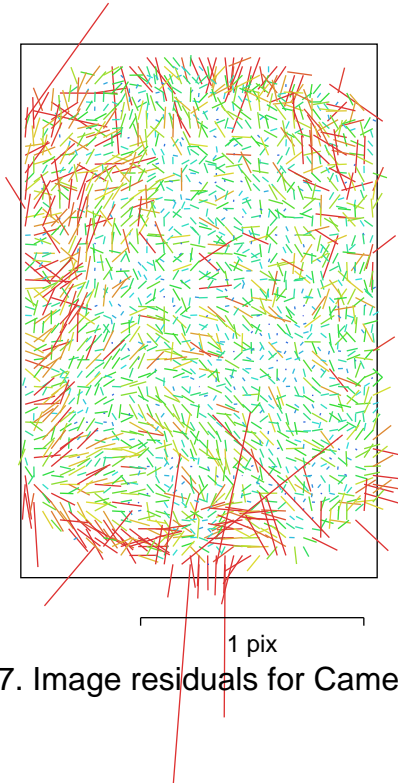


Fig. 7. Image residuals for Camera 5.

## Camera 5

700 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>2884.38</b>	0.039	1.00	0.02	0.02	-0.90	0.82	-0.75	-0.01	0.07
<b>Cx</b>	<b>45.6302</b>	0.026		1.00	0.01	-0.01	0.01	-0.01	-0.65	0.00
<b>Cy</b>	<b>-11.244</b>	0.051			1.00	-0.04	0.03	-0.02	0.00	-0.81
<b>K1</b>	<b>-0.0418312</b>	3.1e-05				1.00	-0.98	0.94	0.01	-0.00
<b>K2</b>	<b>0.00435014</b>	2.4e-05					1.00	-0.99	-0.01	-0.02
<b>K3</b>	<b>-0.000627258</b>	5.7e-06						1.00	0.01	0.01
<b>P1</b>	<b>0.000187651</b>	1.2e-06							1.00	-0.01
<b>P2</b>	<b>-0.000124219</b>	1.6e-06								1.00

Table 7. Calibration coefficients and correlation matrix.

# Camera Calibration

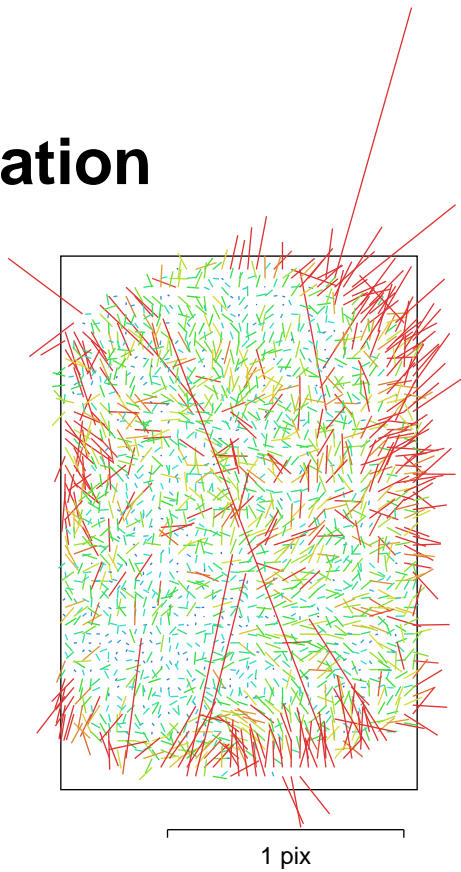


Fig. 8. Image residuals for Camera 6.

## Camera 6

700 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>2914.71</b>	0.04	1.00	0.02	0.03	-0.90	0.82	-0.75	-0.01	0.06
<b>Cx</b>	<b>15.7686</b>	0.027		1.00	-0.02	-0.01	0.01	-0.01	-0.63	0.02
<b>Cy</b>	<b>2.65467</b>	0.052			1.00	-0.04	0.03	-0.02	0.02	-0.81
<b>K1</b>	<b>-0.0425324</b>	3.2e-05				1.00	-0.98	0.94	0.02	-0.00
<b>K2</b>	<b>0.00449126</b>	2.5e-05					1.00	-0.99	-0.01	-0.01
<b>K3</b>	<b>-0.000694349</b>	5.9e-06						1.00	0.01	0.01
<b>P1</b>	<b>-0.0001704</b>	1.2e-06							1.00	-0.02
<b>P2</b>	<b>-1.91619e-05</b>	1.6e-06								1.00

Table 8. Calibration coefficients and correlation matrix.

# Camera Calibration

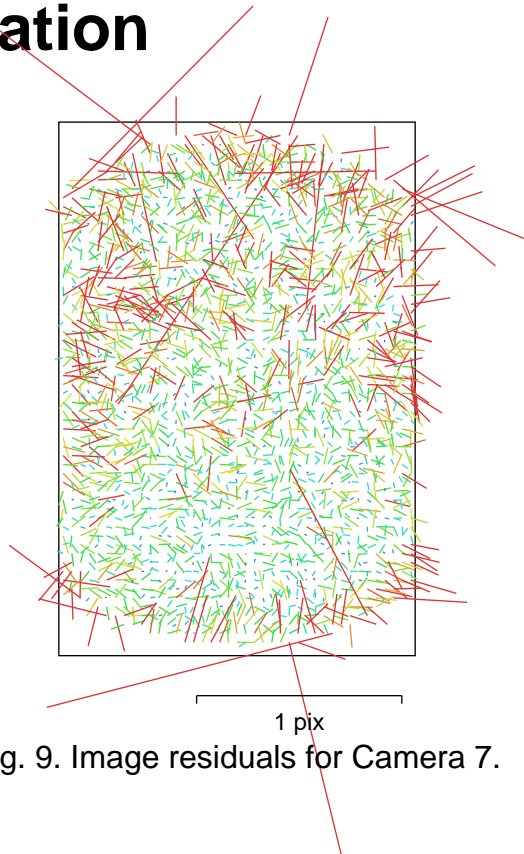


Fig. 9. Image residuals for Camera 7.

## Camera 7

700 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>2904.64</b>	0.057	1.00	0.01	0.03	-0.91	0.83	-0.76	-0.01	0.06
<b>Cx</b>	<b>11.1931</b>	0.034		1.00	-0.02	-0.00	0.00	-0.00	-0.60	0.02
<b>Cy</b>	<b>6.29574</b>	0.062			1.00	-0.01	0.00	0.00	0.01	-0.73
<b>K1</b>	<b>-0.0423254</b>	4.6e-05				1.00	-0.98	0.94	0.01	-0.03
<b>K2</b>	<b>0.00424822</b>	3.7e-05					1.00	-0.99	-0.01	0.02
<b>K3</b>	<b>-0.000636931</b>	8.8e-06						1.00	0.01	-0.03
<b>P1</b>	<b>-8.3517e-05</b>	1.7e-06							1.00	-0.02
<b>P2</b>	<b>0.000157837</b>	2e-06								1.00

Table 9. Calibration coefficients and correlation matrix.

# Camera Calibration

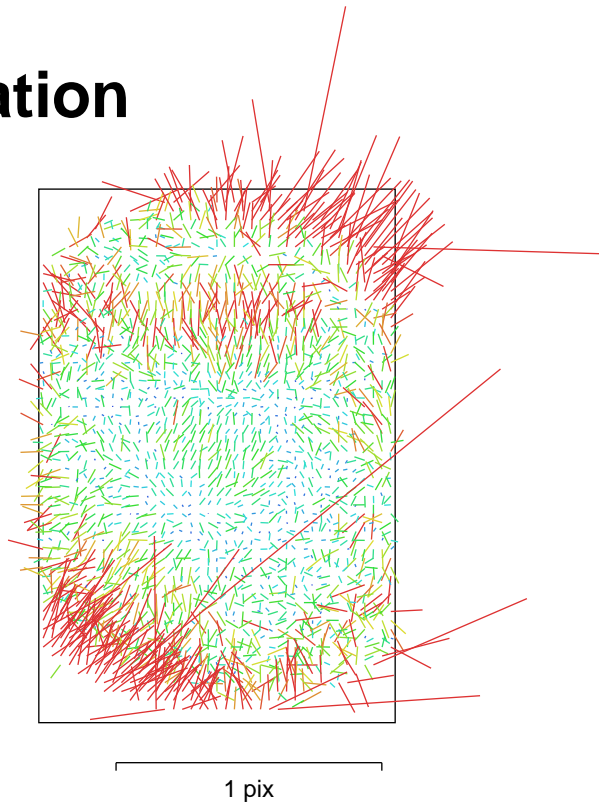


Fig. 10. Image residuals for Camera 8.

## Camera 8

700 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>2901.62</b>	0.078	1.00	0.01	0.03	-0.79	0.61	-0.51	-0.01	-0.10
<b>Cx</b>	<b>12.6729</b>	0.015		1.00	-0.02	-0.01	0.00	-0.00	-0.60	0.01
<b>Cy</b>	<b>5.42381</b>	0.019			1.00	-0.01	0.01	-0.01	0.01	-0.61
<b>K1</b>	<b>-0.0421553</b>	5.1e-05				1.00	-0.95	0.87	0.01	0.08
<b>K2</b>	<b>0.00384702</b>	4.4e-05					1.00	-0.98	-0.01	-0.08
<b>K3</b>	<b>-0.000623201</b>	1.2e-05						1.00	0.01	0.09
<b>P1</b>	<b>-0.000393892</b>	7.2e-07							1.00	-0.01
<b>P2</b>	<b>8.81179e-05</b>	5.9e-07								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	0.249726	-0.00033354
006. 15-16	0.249887	-0.000143374
009. 23-24	0.252136	0.00201606
002a. 4-5	0.249546	-0.000454029
002b. 5-6	0.249743	-0.00015677
005a. 12-13	0.249587	-0.00039301
005b. 13-14	0.249718	-0.000172033
008a. 20-21	0.249707	-0.000323455
008b. 21-22	0.249885	5.08871e-06
<b>Total</b>		<b>0.000723859</b>

Table 11. Control scale bars.

# Digital Elevation Model

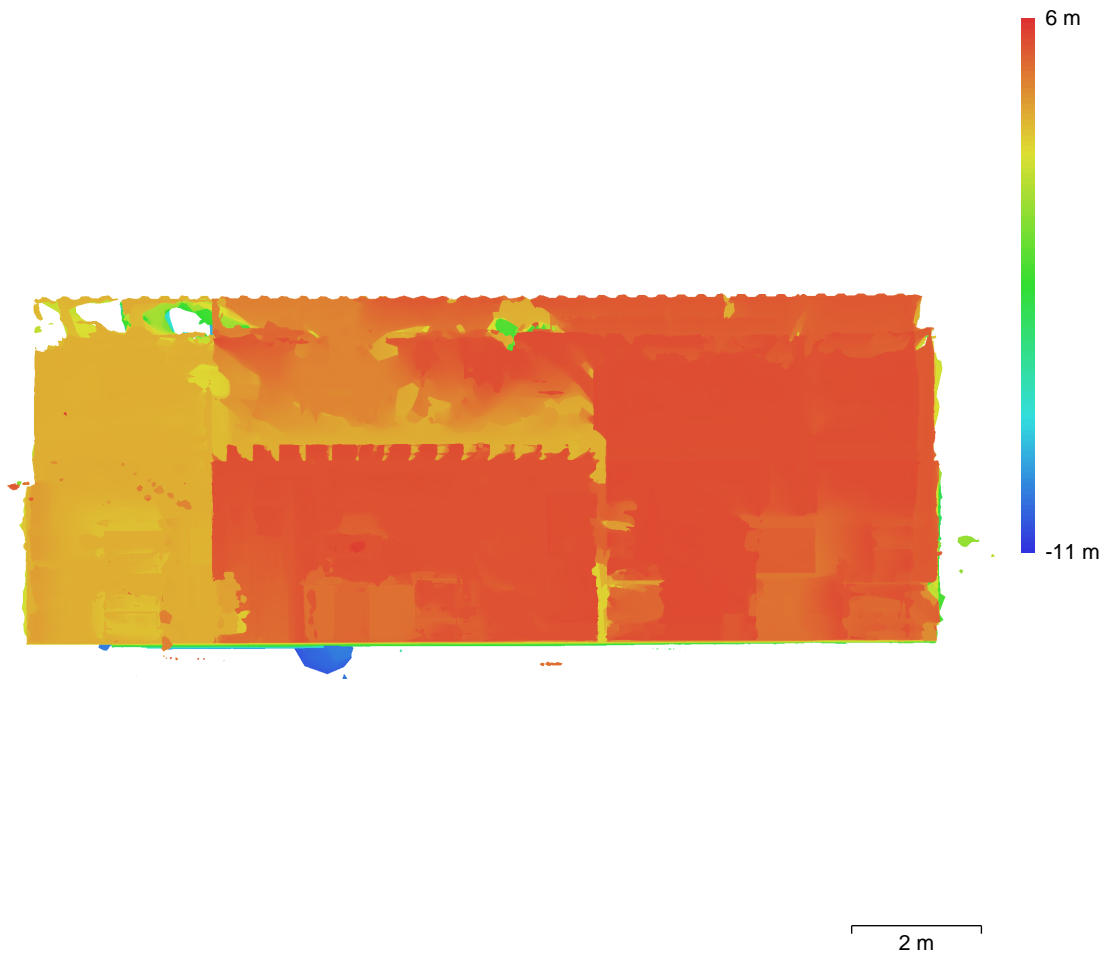


Fig. 11. Reconstructed digital elevation model.

Resolution: unknown

Point density: unknown

# Processing Parameters

## General

Cameras	6300
Aligned cameras	6300
Markers	15
Scale bars	9
Coordinate system	Local Coordinates (m)
Rotation angles	Yaw, Pitch, Roll

## Tie Points

Points	4,516,777 of 13,747,010
RMS reprojection error	0.446702 (1.25883 pix)
Max reprojection error	5.49962 (20.0629 pix)
Mean key point size	2.68829 pix
Point colors	3 bands, uint8
Key points	29.85 GB
Average tie point multiplicity	4.18485

## 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	2 hours 37 minutes
Matching memory usage	5.47 GB
Alignment time	2 hours 8 minutes
Alignment memory usage	16.42 GB

## Optimization parameters

Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	45 seconds
Date created	2023:08:22 22:41:43
Software version	2.0.2.16404
File size	1.21 GB

## Depth Maps

Count	6142
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## Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	2 hours 4 minutes
Memory usage	5.58 GB
Date created	2023:08:23 05:03:06
Software version	2.0.2.16404
File size	19.79 GB

## Point Cloud

Points	723,451,502
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## Point attributes

Color	3 bands, uint8
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Normal

**Point classes**

Created (never classified) 723,451,502

**Depth maps generation parameters**

Quality Medium  
Filtering mode Mild  
Max neighbors 16  
Processing time 2 hours 4 minutes  
Memory usage 5.58 GB

**Point cloud generation parameters**

Processing time 1 days 1 hours  
Memory usage 127.95 GB  
Date created 2023:08:24 07:09:21  
Software version 2.0.2.16404  
File size 9.52 GB

**Model**

Faces 1,767,723  
Vertices 894,151  
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 2 hours 4 minutes  
Memory usage 5.58 GB

**Reconstruction parameters**

Surface type Arbitrary  
Source data Depth maps  
Interpolation Enabled  
Strict volumetric masks No  
Processing time 55 minutes 53 seconds  
Memory usage 11.51 GB

**Texturing parameters**

Mapping mode Generic  
Blending mode Mosaic  
Texture size 16,384  
Enable hole filling Yes  
Enable ghosting filter Yes  
UV mapping time 7 minutes 1 seconds  
UV mapping memory usage 624.72 MB  
Blending time 42 minutes 13 seconds  
Blending memory usage 11.08 GB  
Blending GPU memory usage 7.56 GB  
Date created 2023:08:24 08:09:40  
Software version 2.0.2.16404  
File size 318.79 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