

# 20190814\_Atanikerluk

Processing Report

16 Mai 2022



# Survey Data

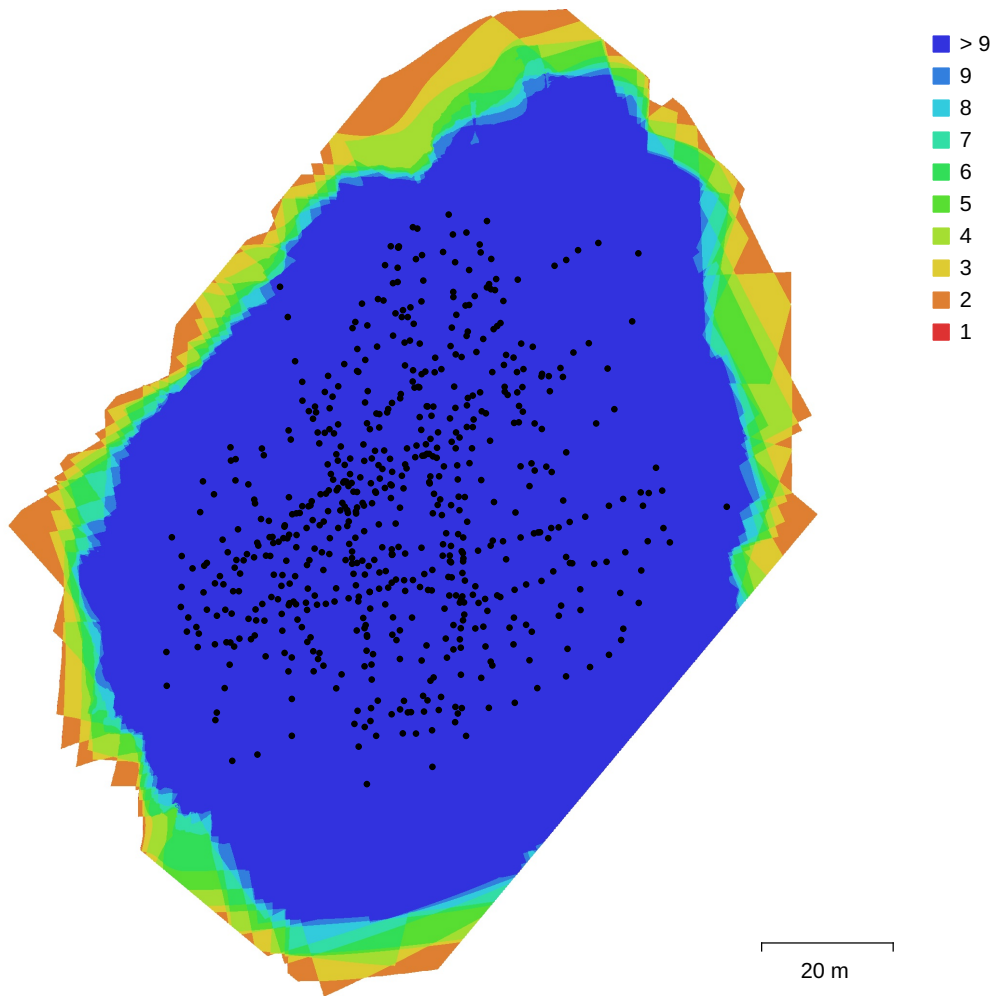


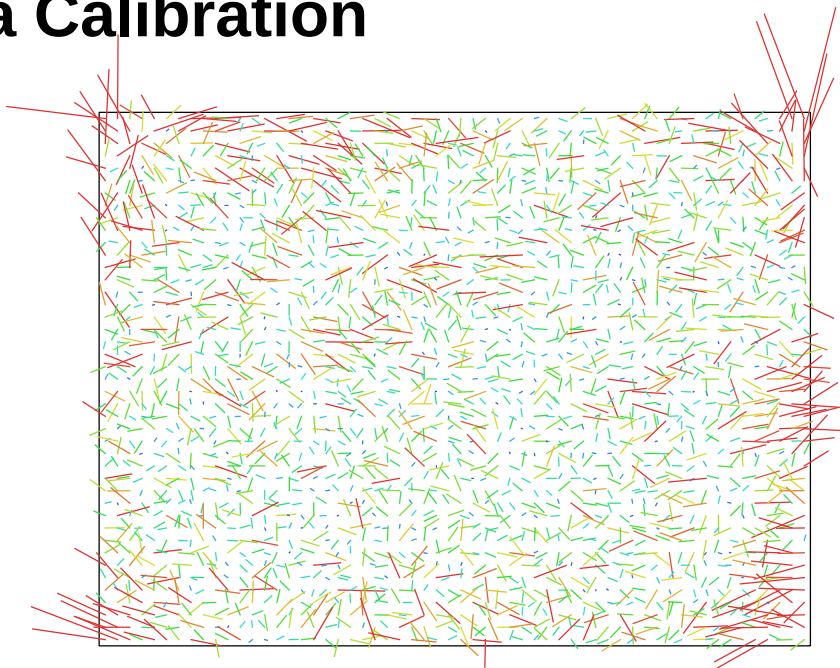
Fig. 1. Camera locations and image overlap.

Number of images:	612	Camera stations:	612
Flying altitude:	22.5 m	Tie points:	919,809
Ground resolution:	7.69 mm/pix	Projections:	2,169,818
Coverage area:	0.0113 km <sup>2</sup>	Reprojection error:	0.317 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
f_32m	4000 x 3000	3.61 mm	1.56 x 1.56 $\mu\text{m}$	No
f_37m	4000 x 3000	3.61 mm	1.56 x 1.56 $\mu\text{m}$	No
f_53m	4000 x 3000	3.61 mm	1.56 x 1.56 $\mu\text{m}$	No
f_45m	4000 x 3000	3.61 mm	1.56 x 1.56 $\mu\text{m}$	No

Table 1. Cameras.

# Camera Calibration



0.890901 pix

Fig. 2. Image residuals for  $f_{32m}$ .

$f_{32m}$

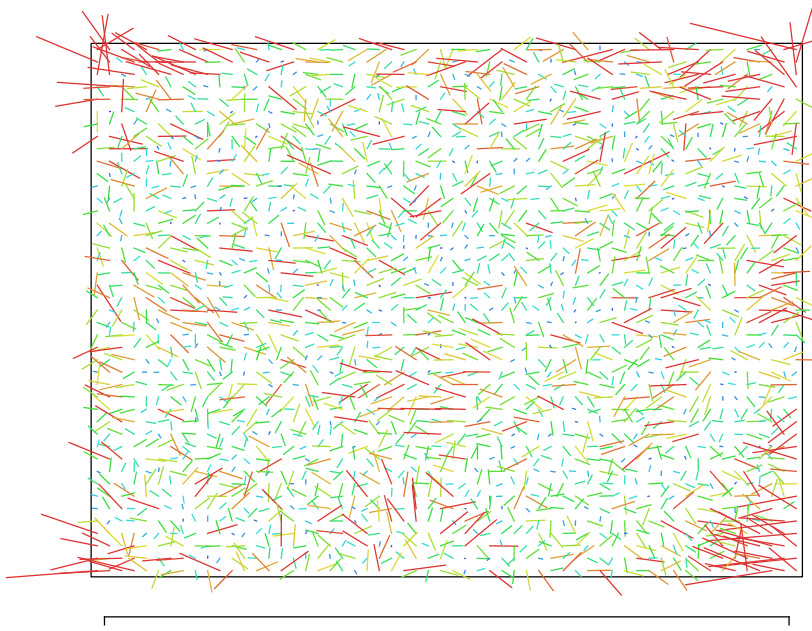
143 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>4000 x 3000</b>	<b>3.61 mm</b>	<b>1.56 x 1.56 <math>\mu\text{m}</math></b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>2712.66</b>	0.081	1.00	-0.12	-0.68	0.23	-0.08	-0.28	0.22	-0.18	0.17	0.05	0.28
<b>Cx</b>	<b>19.2123</b>	0.038		1.00	0.06	0.09	0.67	0.00	-0.01	0.01	-0.01	0.34	-0.02
<b>Cy</b>	<b>16.7944</b>	0.062			1.00	-0.70	0.12	0.07	-0.04	0.02	-0.02	-0.03	-0.22
<b>B1</b>	<b>-1.51112</b>	0.018				1.00	-0.00	-0.05	0.00	0.00	-0.00	0.00	0.50
<b>B2</b>	<b>-0.610214</b>	0.015					1.00	0.01	-0.01	0.01	-0.02	-0.22	-0.04
<b>K1</b>	<b>-0.147082</b>	7.8e-05						1.00	-0.97	0.92	-0.87	-0.03	-0.08
<b>K2</b>	<b>0.165769</b>	0.00033							1.00	-0.99	0.96	0.01	0.01
<b>K3</b>	<b>-0.0932838</b>	0.00057								1.00	-0.99	-0.01	-0.00
<b>K4</b>	<b>0.0380085</b>	0.00033									1.00	0.01	0.00
<b>P1</b>	<b>-5.86488e-05</b>	2.7e-06										1.00	0.03
<b>P2</b>	<b>0.000242825</b>	3.8e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration



0.915264 pix  
Fig. 3. Image residuals for f\_37m.

**f\_37m**  
125 images

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>4000 x 3000</b>	<b>3.61 mm</b>	<b>1.56 x 1.56 <math>\mu\text{m}</math></b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>2711.26</b>	0.069	1.00	-0.03	-0.71	0.27	0.03	-0.28	0.23	-0.19	0.17	0.00	0.25
<b>Cx</b>	<b>19.8458</b>	0.031		1.00	-0.02	0.04	0.59	-0.00	0.00	-0.00	-0.00	0.51	-0.03
<b>Cy</b>	<b>17.0852</b>	0.051			1.00	-0.67	-0.01	0.06	-0.03	0.01	-0.01	-0.04	-0.16
<b>B1</b>	<b>-0.581182</b>	0.014				1.00	0.01	-0.05	-0.01	0.02	-0.01	0.01	0.53
<b>B2</b>	<b>-0.720992</b>	0.011					1.00	-0.00	0.00	-0.00	-0.00	-0.14	0.00
<b>K1</b>	<b>-0.146635</b>	7.3e-05						1.00	-0.97	0.92	-0.87	-0.01	-0.08
<b>K2</b>	<b>0.164348</b>	0.00031							1.00	-0.99	0.96	0.01	0.00
<b>K3</b>	<b>-0.0906182</b>	0.00053								1.00	-0.99	-0.01	0.01
<b>K4</b>	<b>0.0361702</b>	0.00031									1.00	0.00	-0.01
<b>P1</b>	<b>4.29215e-05</b>	2.4e-06										1.00	-0.05
<b>P2</b>	<b>0.000267969</b>	3.5e-06											1.00

Table 3. Calibration coefficients and correlation matrix.

# Camera Calibration

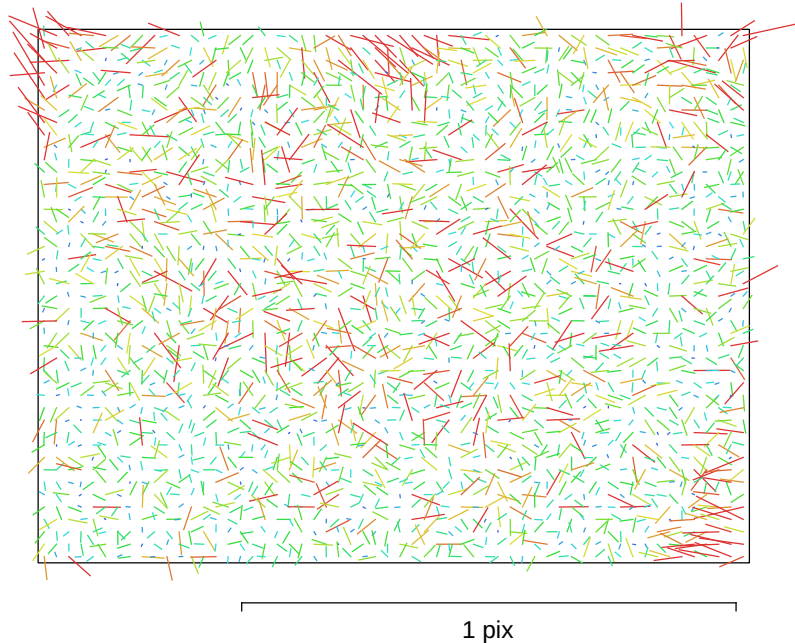


Fig. 4. Image residuals for f\_53m.

**f\_53m**

124 images

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>4000 x 3000</b>	<b>3.61 mm</b>	<b>1.56 x 1.56 μm</b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>2711.84</b>	0.099	1.00	-0.00	-0.66	0.13	0.06	-0.28	0.25	-0.21	0.20	-0.00	0.00
<b>Cx</b>	<b>20.2943</b>	0.035		1.00	-0.04	-0.01	0.54	-0.01	0.00	0.00	-0.01	0.53	0.03
<b>Cy</b>	<b>17.3562</b>	0.048			1.00	-0.52	-0.10	0.04	-0.04	0.02	-0.02	-0.04	0.10
<b>B1</b>	<b>-1.69596</b>	0.011				1.00	0.05	-0.04	-0.01	0.02	-0.02	0.05	0.39
<b>B2</b>	<b>-0.652368</b>	0.0093					1.00	-0.01	0.00	0.00	-0.00	-0.08	0.07
<b>K1</b>	<b>-0.146397</b>	0.0001						1.00	-0.97	0.93	-0.88	-0.02	-0.10
<b>K2</b>	<b>0.163855</b>	0.00043							1.00	-0.99	0.96	0.02	0.01
<b>K3</b>	<b>-0.0886021</b>	0.0007								1.00	-0.99	-0.01	-0.00
<b>K4</b>	<b>0.0348003</b>	0.00039									1.00	0.01	-0.00
<b>P1</b>	<b>0.000116843</b>	3e-06										1.00	-0.01
<b>P2</b>	<b>0.000258309</b>	3.7e-06											1.00

Table 4. Calibration coefficients and correlation matrix.

# Camera Calibration

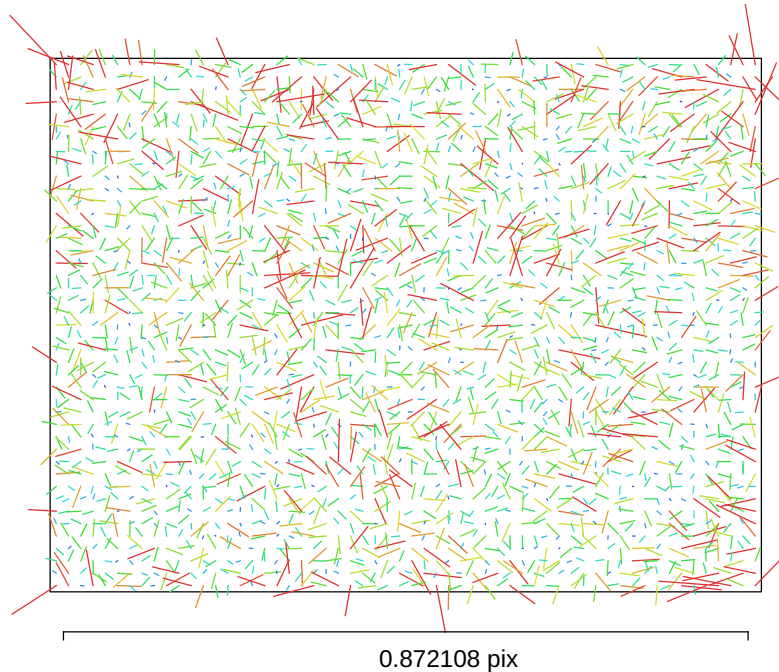


Fig. 5. Image residuals for f\_45m.

**f\_45m**  
220 images

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>4000 x 3000</b>	<b>3.61 mm</b>	<b>1.56 x 1.56 μm</b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>2712.96</b>	0.079	1.00	-0.01	-0.76	0.18	0.02	-0.26	0.23	-0.19	0.18	0.01	0.00
<b>Cx</b>	<b>18.149</b>	0.025		1.00	-0.01	0.06	0.50	-0.00	-0.00	0.01	-0.02	0.53	0.02
<b>Cy</b>	<b>16.0509</b>	0.037			1.00	-0.47	0.02	0.06	-0.05	0.04	-0.04	-0.02	0.10
<b>B1</b>	<b>-4.10811</b>	0.0073				1.00	-0.00	-0.05	-0.02	0.02	-0.02	0.05	0.46
<b>B2</b>	<b>-0.754052</b>	0.006					1.00	-0.00	-0.00	0.01	-0.01	-0.15	-0.01
<b>K1</b>	<b>-0.145951</b>	7.3e-05						1.00	-0.97	0.92	-0.87	-0.01	-0.12
<b>K2</b>	<b>0.162638</b>	0.0003							1.00	-0.99	0.96	0.00	0.00
<b>K3</b>	<b>-0.0880431</b>	0.0005								1.00	-0.99	0.00	0.01
<b>K4</b>	<b>0.0348235</b>	0.00028									1.00	-0.01	-0.02
<b>P1</b>	<b>-4.90317e-05</b>	2.1e-06										1.00	0.04
<b>P2</b>	<b>0.000264218</b>	2.9e-06											1.00

Table 5. Calibration coefficients and correlation matrix.

# Ground Control Points

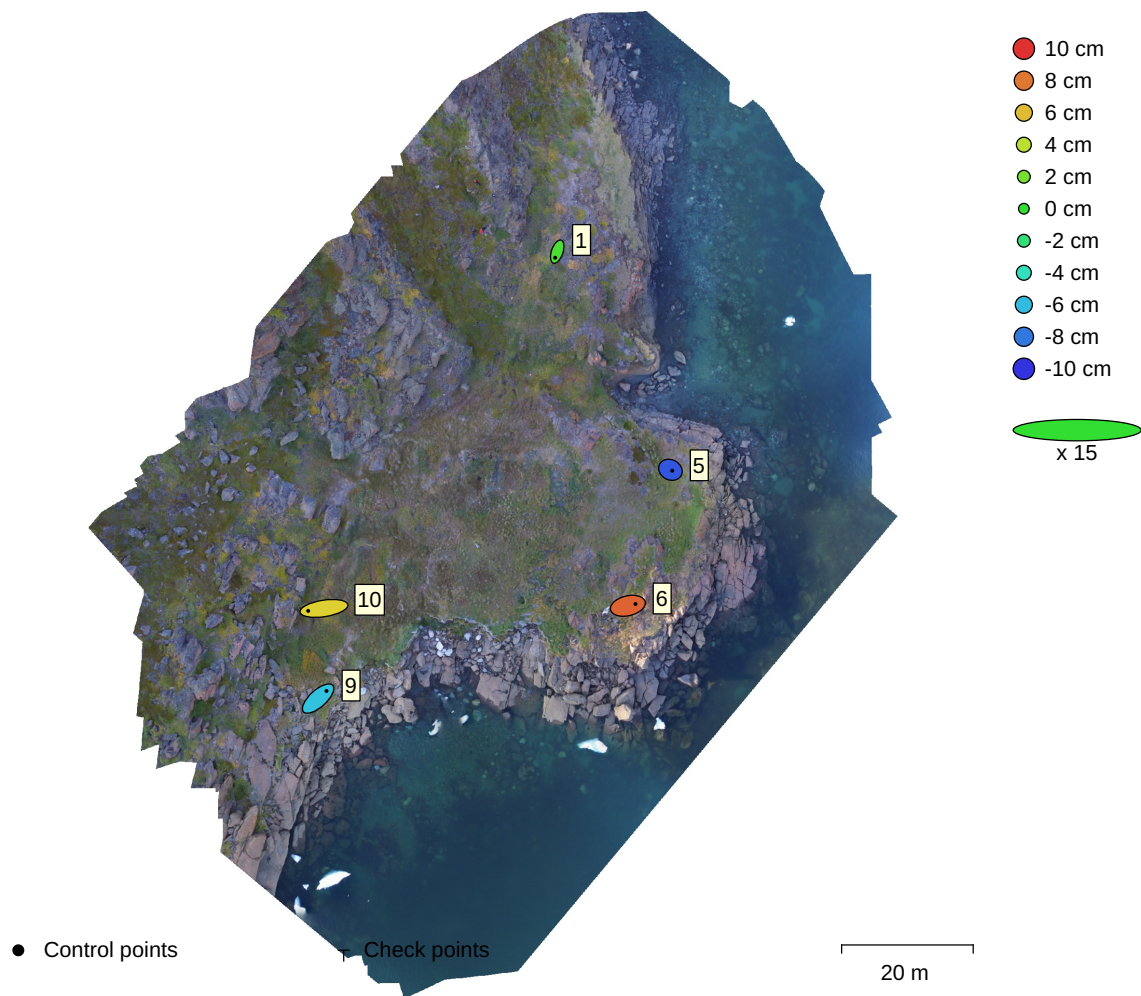


Fig. 6. GCP locations and error estimates.

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)
5	17.7707	9.25499	6.60277	20.0363	21.0962

Table 6. Control points RMSE.

X - Longitude, Y - Latitude, Z - Altitude.

<b>Label</b>	<b>X error (cm)</b>	<b>Y error (cm)</b>	<b>Z error (cm)</b>	<b>Total (cm)</b>	<b>Image (pix)</b>
1	-4.20648	-12.2513	0.736706	12.9743	0.291 (24)
5	3.71796	-1.85768	-8.96167	9.87855	0.256 (35)
6	15.4512	3.67239	8.59237	18.057	0.261 (47)
9	16.9807	15.3863	-5.80653	23.639	0.382 (32)
10	-31.9436	-4.95005	5.43912	32.7792	0.392 (33)
<b>Total</b>	<b>17.7707</b>	<b>9.25499</b>	<b>6.60277</b>	<b>21.0962</b>	<b>0.318</b>

Table 7. Control points.  
X - Longitude, Y - Latitude, Z - Altitude.



# Digital Elevation Model

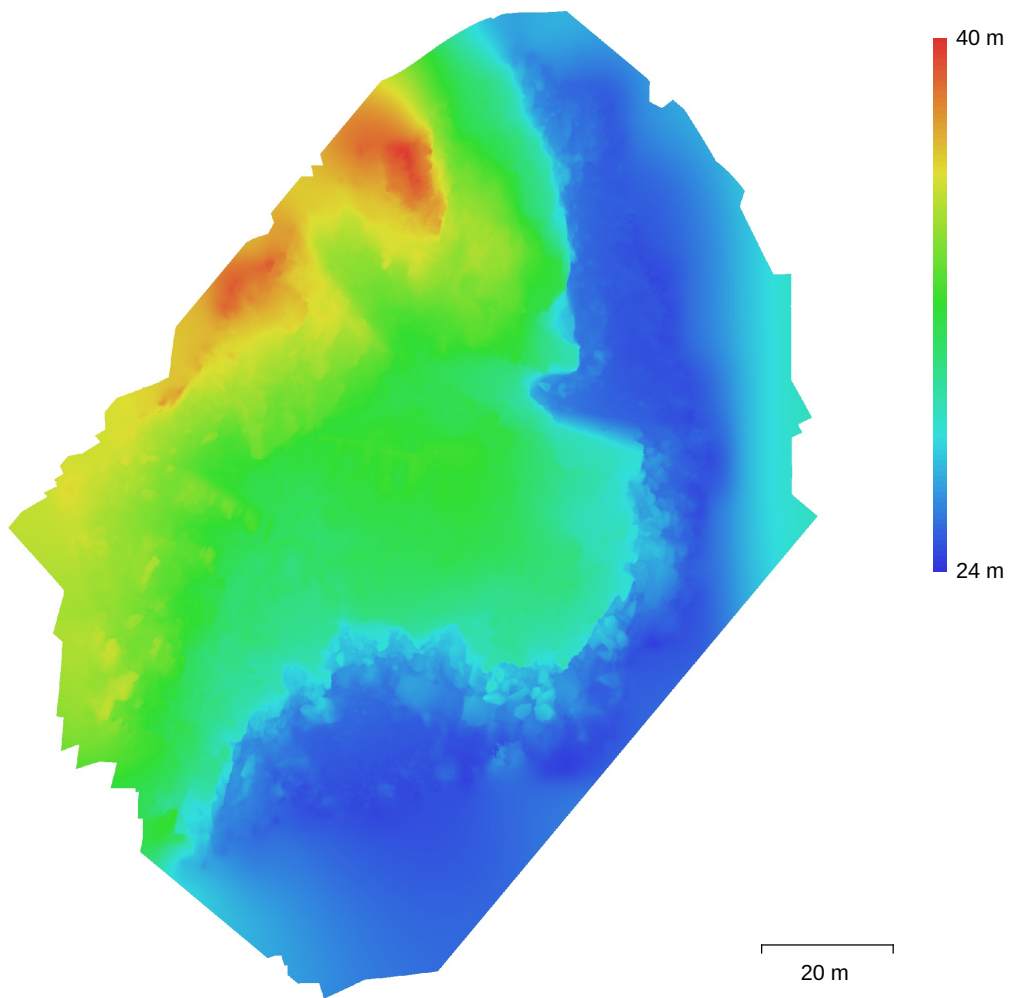


Fig. 7. Reconstructed digital elevation model.

Resolution: 1.54 cm/pix  
Point density: 0.423 points/cm<sup>2</sup>

# Processing Parameters

## General

Cameras	612
Aligned cameras	612
Markers	5
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	919,809 of 3,265,819
RMS reprojection error	0.117808 (0.31695 pix)
Max reprojection error	0.36938 (2.29733 pix)
Mean key point size	2.56835 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	5.72807

## Alignment parameters

Accuracy	High
Generic preselection	No
Reference preselection	No
Key point limit	0
Tie point limit	60,000
Exclude stationary tie points	No
Guided image matching	No
Adaptive camera model fitting	No
Matching time	11 hours 56 minutes
Matching memory usage	4.83 GB
Alignment time	48 minutes 38 seconds
Alignment memory usage	3.12 GB

## Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	12 seconds
Software version	1.7.1.11797
File size	315.92 MB

## Depth Maps

Count	611
<b>Depth maps generation parameters</b>	
Quality	High
Filtering mode	Mild
Processing time	1 hours 20 minutes
Memory usage	4.91 GB
Software version	1.7.1.11797
File size	2.85 GB

## Dense Point Cloud

Points	32,138,796
Point colors	3 bands, uint8

## Depth maps generation parameters

Quality	High
Filtering mode	Mild
Processing time	1 hours 20 minutes
Memory usage	4.91 GB

## Dense cloud generation parameters

Processing time	2 hours 29 minutes
Memory usage	17.96 GB
Software version	1.7.1.11797
File size	481.42 MB
<b>DEM</b>	
Size	10,471 x 10,854
Coordinate system	WGS 84 (EPSG::4326)
<b>Reconstruction parameters</b>	
Source data	Dense cloud
Interpolation	Enabled
Processing time	28 seconds
Memory usage	282.45 MB
Software version	1.7.1.11797
File size	204.69 MB
<b>Orthomosaic</b>	
Size	15,990 x 19,506
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
<b>Reconstruction parameters</b>	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	7 minutes 46 seconds
Memory usage	4.55 GB
Software version	1.7.1.11797
File size	9.04 GB
<b>System</b>	
Software name	Agisoft Metashape Professional
Software version	1.7.1 build 11797
OS	Linux 64 bit
RAM	125.62 GB
CPU	Intel(R) Core(TM) i7-9800X CPU @ 3.80GHz
GPU(s)	Quadro P1000