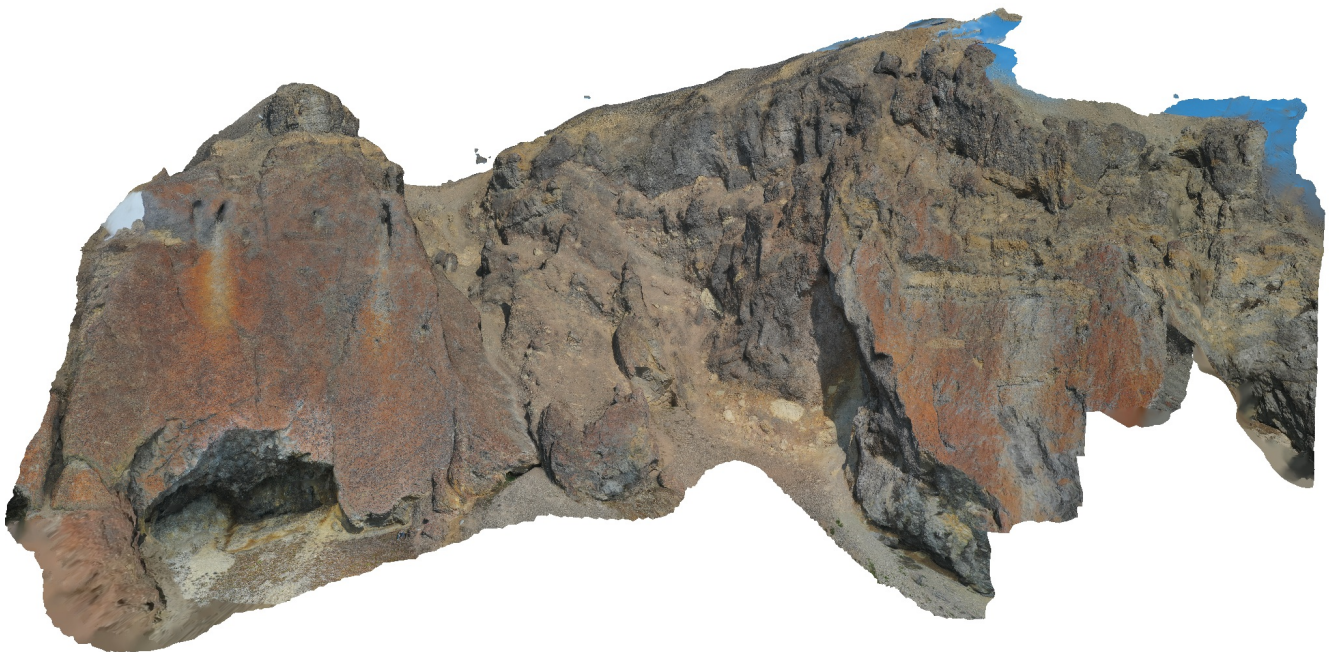


# Fortet South

Processing Report  
25 April 2020



# Survey Data

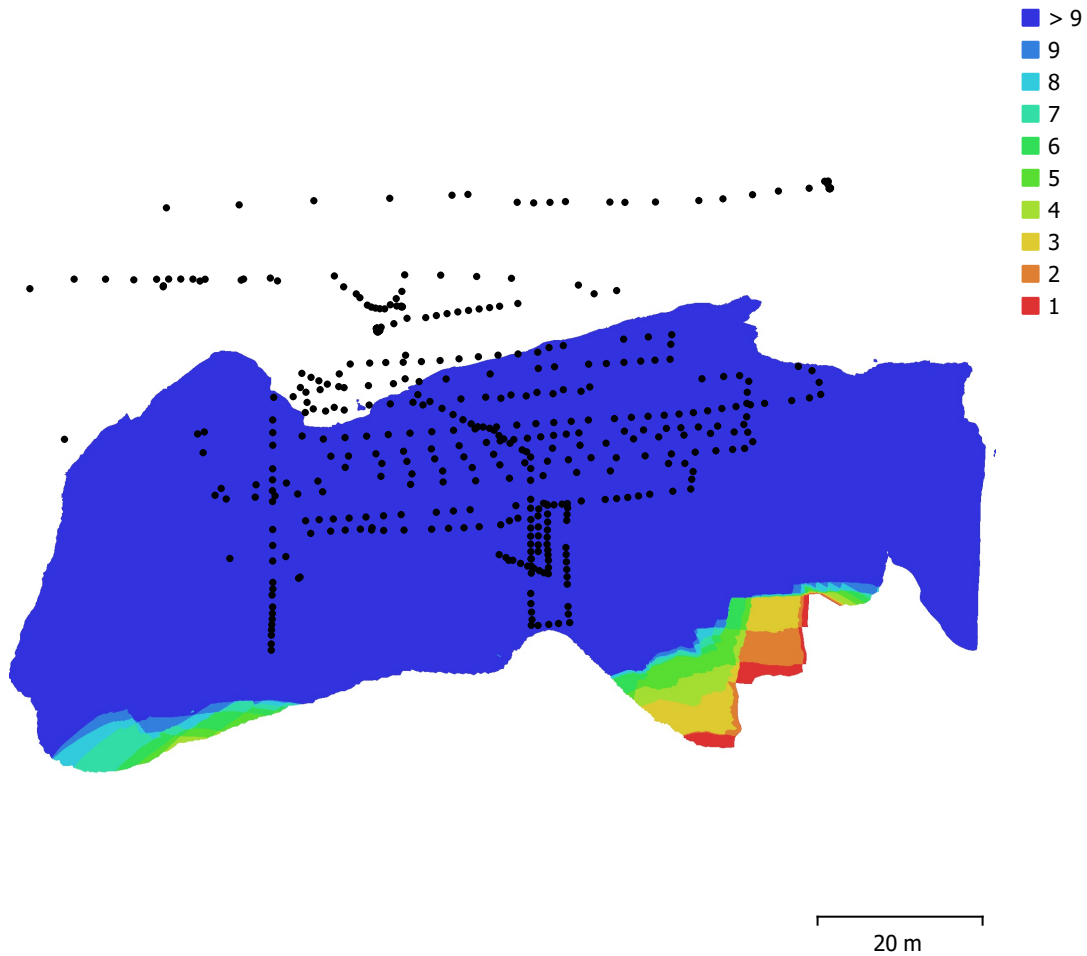


Fig. 1. Camera locations and image overlap.

Number of images:	423	Camera stations:	423
Flying altitude:	38.6 m	Tie points:	95,894
Ground resolution:	1.36 cm/pix	Projections:	731,608
Coverage area:	4.36e+03 m <sup>2</sup>	Reprojection error:	0.98 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 $\mu$ m	No
unknown	2688 x 1512	unknown	unknown	No

Table 1. Cameras.

# Camera Calibration

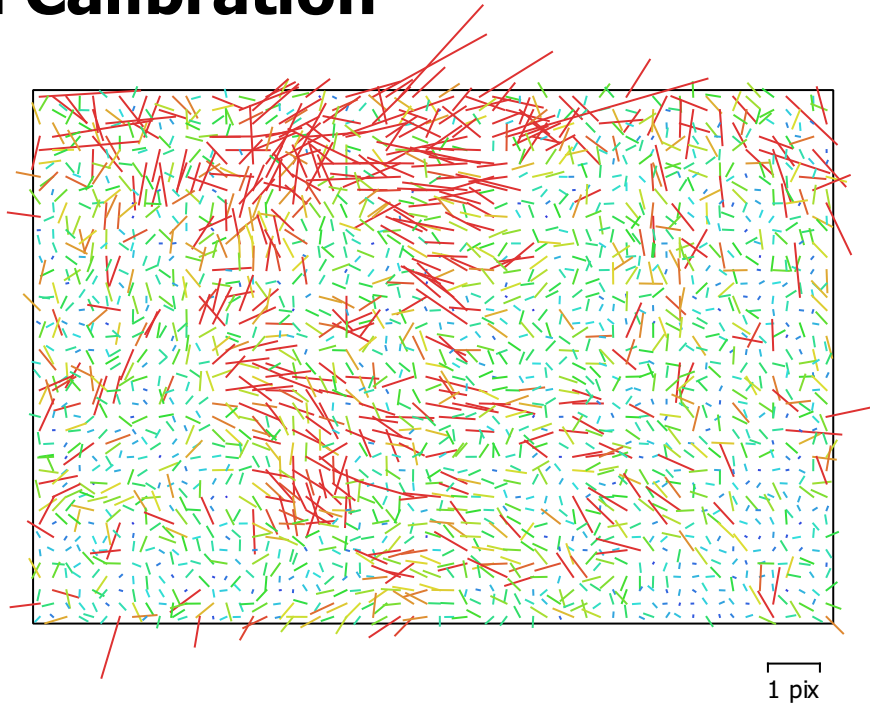


Fig. 2. Image residuals for L1D-20c (10.26mm).

## L1D-20c (10.26mm)

8 images

Type  
**Frame**

Resolution  
**5472 x 3648**

Focal Length  
**10.26 mm**

Pixel Size  
**2.41 x 2.41  $\mu\text{m}$**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>4355.95</b>	1.4	1.00	-0.02	-0.48	-0.03	0.11	-0.08	-0.16	-0.13
<b>Cx</b>	<b>24.5642</b>	1.5		1.00	-0.14	0.04	0.01	-0.01	0.93	-0.04
<b>Cy</b>	<b>-45.5414</b>	1.3			1.00	-0.10	0.02	-0.03	-0.09	0.82
<b>K1</b>	<b>0.00724998</b>	0.00064				1.00	-0.95	0.89	0.02	-0.14
<b>K2</b>	<b>0.00612895</b>	0.0027					1.00	-0.98	0.02	0.07
<b>K3</b>	<b>-0.0070948</b>	0.0034						1.00	-0.02	-0.07
<b>P1</b>	<b>0.00264389</b>	0.00011							1.00	-0.06
<b>P2</b>	<b>-0.00466797</b>	7.4e-05								1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration

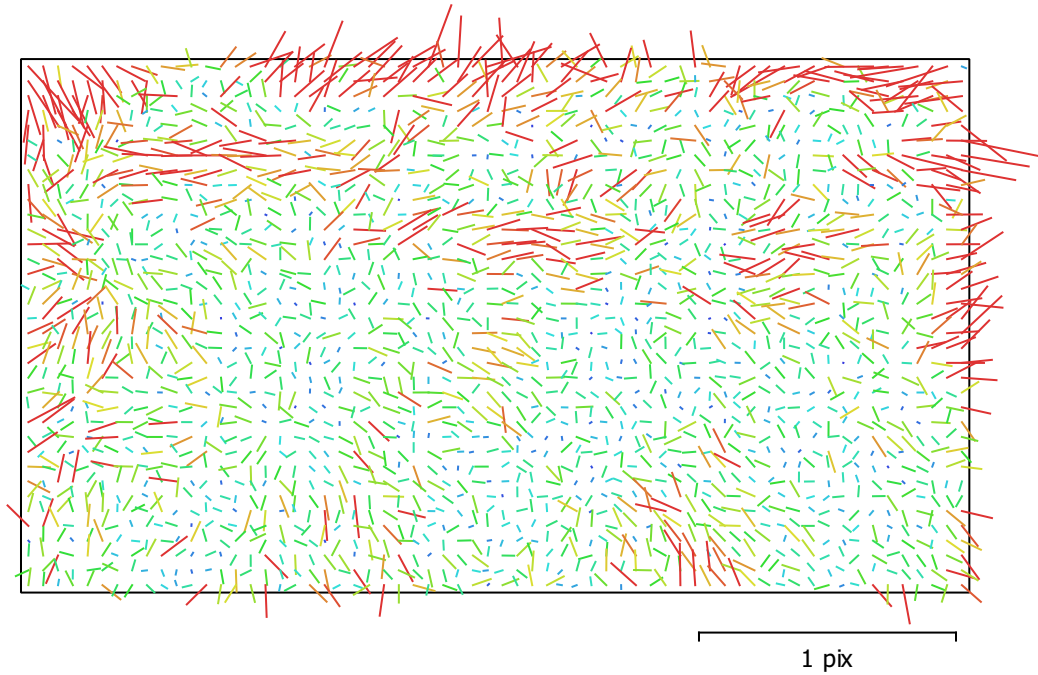


Fig. 3. Image residuals for unknown.

**unknown**  
415 images

Type **Frame**                      Resolution **2688 x 1512**                      Focal Length **unknown**                      Pixel Size **unknown**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2205.4</b>	0.087	1.00	-0.04	-0.35	-0.01	0.16	-0.15	0.01	-0.31
<b>Cx</b>	<b>-4.71073</b>	0.14		1.00	0.02	0.03	-0.02	0.02	0.97	0.04
<b>Cy</b>	<b>-19.0996</b>	0.13			1.00	-0.03	-0.01	0.01	-0.00	0.82
<b>K1</b>	<b>0.00819717</b>	0.00012				1.00	-0.95	0.89	0.03	-0.07
<b>K2</b>	<b>0.0228921</b>	0.00054					1.00	-0.98	-0.02	0.01
<b>K3</b>	<b>-0.0201455</b>	0.00078						1.00	0.02	-0.00
<b>P1</b>	<b>-0.00143871</b>	2.2e-05							1.00	0.02
<b>P2</b>	<b>-0.00282865</b>	1.5e-05								1.00

Table 3. Calibration coefficients and correlation matrix.

# Camera Locations

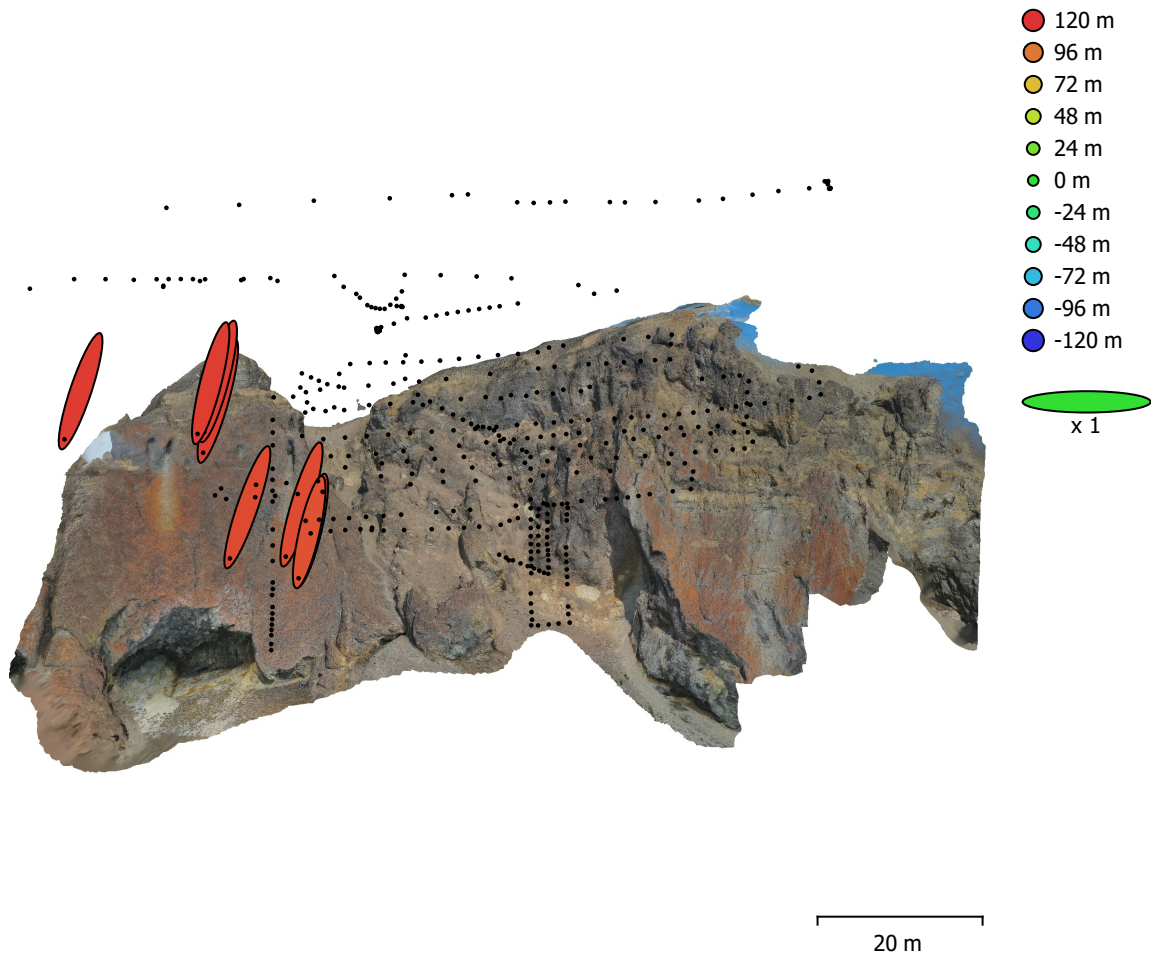


Fig. 4. Camera locations and error estimates.

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 (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
3.45097	12.0519	113.51	12.5362	114.2

Table 4. Average camera location error.  
 X - Easting, Y - Northing, Z - Altitude.

# Ground Control Points

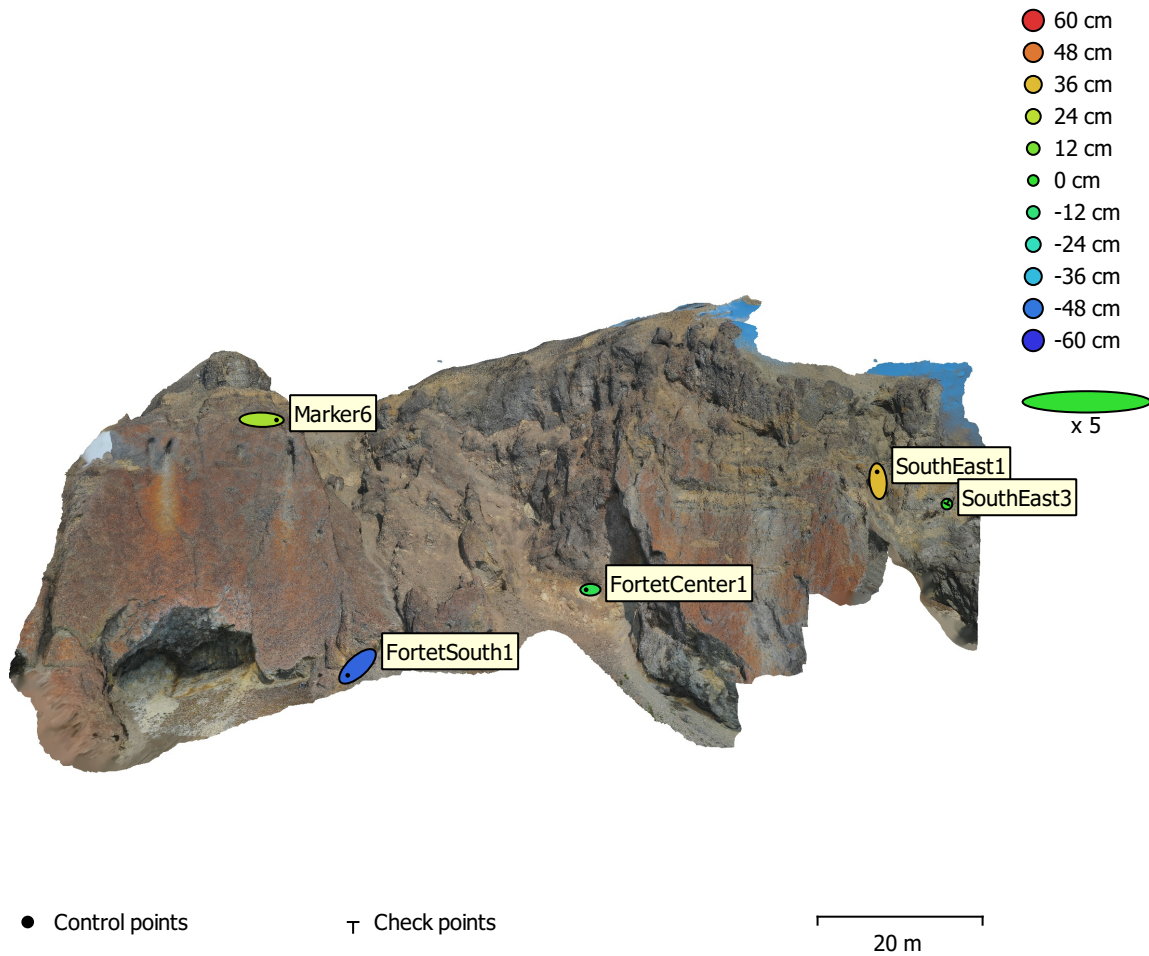


Fig. 5. GCP locations and error estimates.

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)
4	44.5112	31.336	33.1121	54.4352	63.715

Table 5. Control points RMSE.  
X - Easting, Y - Northing, Z - Altitude.

Count	X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total (cm)
1	0.00187099	0.00363489	0.000784417	0.00408816	0.00416274

Table 6. Check points RMSE.  
X - Easting, Y - Northing, 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>
Marker6	72.3721	-1.42718	20.4563	75.2211	6.318 (64)
FortetSouth1	-47.3602	-43.4583	-51.2631	82.2163	7.297 (17)
FortetCenter1	-20.6139	-0.247313	-5.40952	21.3133	0.209 (163)
SouthEast1	-4.39968	45.1338	36.1942	58.021	2.762 (61)
<b>Total</b>	<b>44.5112</b>	<b>31.336</b>	<b>33.1121</b>	<b>63.715</b>	<b>3.591</b>

Table 7. Control points.  
X - Easting, Y - Northing, 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>
SouthEast3	-0.00187099	-0.00363489	0.000784417	0.00416274	0.003 (40)
<b>Total</b>	<b>0.00187099</b>	<b>0.00363489</b>	<b>0.000784417</b>	<b>0.00416274</b>	<b>0.003</b>

Table 8. Check points.  
X - Easting, Y - Northing, Z - Altitude.

# Digital Elevation Model

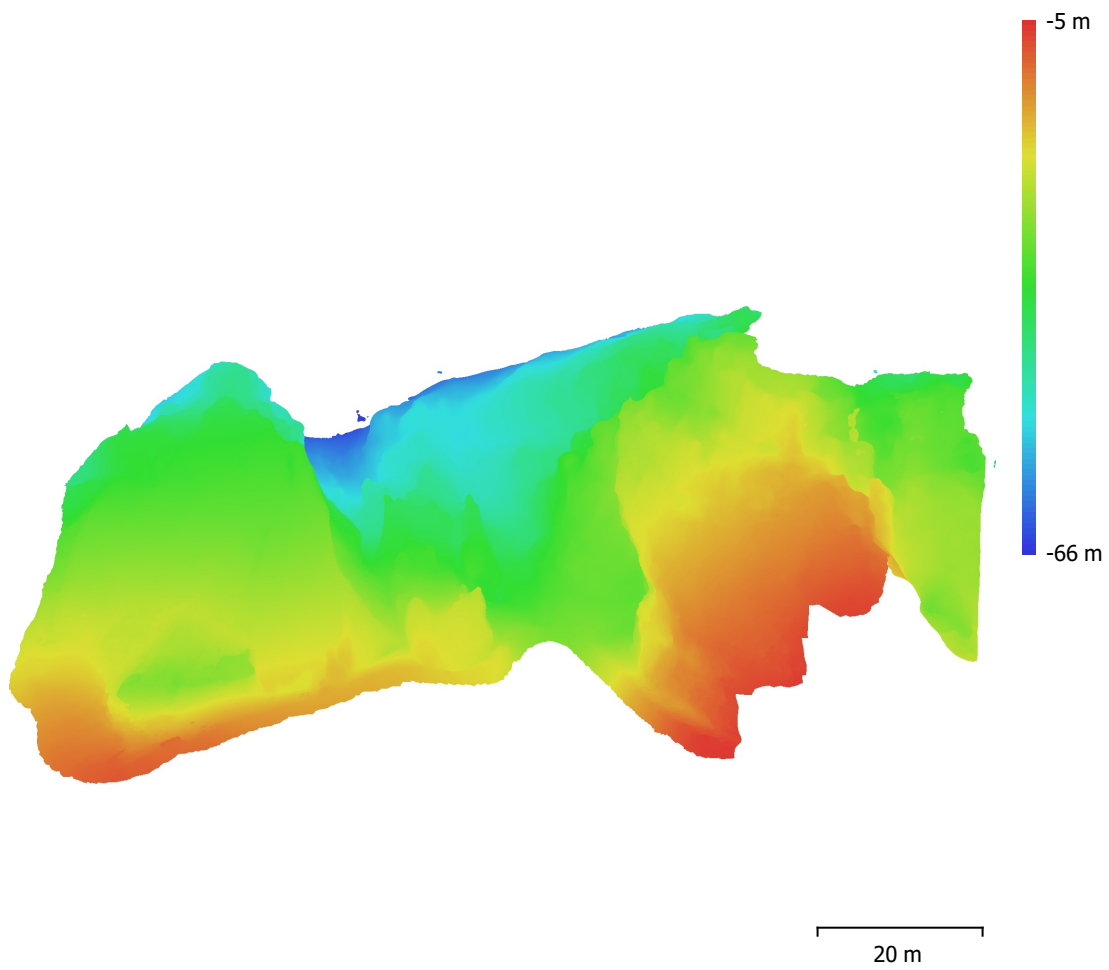


Fig. 6. Reconstructed digital elevation model.

Resolution: 5.43 cm/pix  
Point density: 340 points/m<sup>2</sup>



# Processing Parameters

## General

Cameras	423
Aligned cameras	423
Markers	5
Coordinate system	WGS 84 / UTM zone 33N (EPSG::32633)
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	95,894 of 151,072
RMS reprojection error	0.24462 (0.979583 pix)
Max reprojection error	1.34079 (39.3719 pix)
Mean key point size	3.74505 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	14.145

## Alignment parameters

Accuracy	Medium
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	4,000
Guided image matching	No
Adaptive camera model fitting	No
Matching time	30 minutes 56 seconds
Matching memory usage	311.40 MB
Alignment time	16 minutes 20 seconds
Alignment memory usage	379.69 MB

## Optimization parameters

Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	1 minutes 5 seconds
Software version	1.6.1.10009

## Depth Maps

Count	421
<b>Depth maps generation parameters</b>	
Quality	Medium
Filtering mode	Mild
Processing time	4 hours 29 minutes
Software version	1.6.1.10009

## Dense Point Cloud

Points	3,952,238
Point colors	3 bands, uint8

## Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Processing time	4 hours 29 minutes

## Dense cloud generation parameters

Processing time	25 minutes 41 seconds
Software version	1.6.1.10009

## Model

Faces	263,482
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## General

Vertices 133,191  
Vertex colors 3 bands, uint8  
Texture 4,096 x 4,096 x 10, 4 bands, uint8

### Depth maps generation parameters

Quality Medium  
Filtering mode Mild  
Processing time 4 hours 29 minutes

### Reconstruction parameters

Surface type Arbitrary  
Source data Dense cloud  
Interpolation Enabled  
Strict volumetric masks No  
Processing time 3 minutes 45 seconds

### Texturing parameters

Mapping mode Generic  
Blending mode Mosaic  
Texture size 4,096  
Enable hole filling Yes  
Enable ghosting filter Yes  
UV mapping time 5 minutes 48 seconds  
Blending time 11 minutes 28 seconds  
Software version 1.6.1.10009

## Tiled Model

Texture 3 bands, uint8

### Depth maps generation parameters

Quality Medium  
Filtering mode Mild  
Processing time 4 hours 29 minutes

### Reconstruction parameters

Source data Dense cloud  
Tile size 256  
Face count Medium  
Enable ghosting filter No  
Processing time 15 minutes 6 seconds  
Software version 1.6.1.10009

## Orthomosaic

Size 8,659 x 4,610  
Coordinate system WGS 84 (EPSG::4978)  
Colors 3 bands, uint8

### Reconstruction parameters

Blending mode Mosaic  
Surface Mesh  
Enable hole filling Yes  
Processing time 2 minutes 13 seconds  
Software version 1.6.1.10009

## System

Software name Agisoft Metashape Professional  
Software version 1.6.1 build 10009  
OS Windows 64 bit  
RAM 127.78 GB  
CPU Intel(R) Core(TM) i9-9900K CPU @ 3.60GHz  
GPU(s) GeForce RTX 2080