Appendix

This appendix includes:

A - Collection of orthophotos, aerial imageries and digital elevation model

B - Longyearbreen mid-season Agisoft report with orthophoto and DEM

C - Larsbreen mid-season Agisoft report with orthophoto and DEM

D - Upper middle Longyearelva mid-season Agisoft report with orthophoto and DEM

E - Lower Longyearelva mid-season Agisoft report with orthophoto and DEM

F - Longyearbreen late-season Agisoft report with orthophoto and DEM

G - Larsbreen late-season Agisoft report with orthophoto and DEM

H - Upper middle Longyearelva late-season Agisoft report with orthophoto and DEM

I - Lower Longyearelva late-season Agisoft report with orthophoto and DEM

J - The Longyear delta late-season Agisoft report with orthophoto and DEM

K - The Longyear delta mid-season Agisoft report with orthophoto and DEM

References for Appendix A

Esri. (n.d.). World Imagery. https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9

Hanna, J. (2019). Longyear River, lower part. https://sketchfab.com/3d-models/longyear-river-lower-part-a813f4f25ec44f53a9d95f54c79b854

Norwegian Polar Institute. (n.d., 19/05/2020). Norwegian Polar Institute Map Data and Services. https://geodata.npolar.no/

Løvaas, M. A. S. (2021). Management of a High Arctic River [Master Thesis, NTNU]. Trondheim.

Appendix A – Collection of orthophotos, aerial imageries and digital elevation model

Orthophotos

Nr	Name	Year	Institution	Person responsible	Format
1	ortho_1936_all_Svalbard_20m	1936	NPI		Tif
2	S90	1990	NPI		PNG
3	S90 3682	1990	NPI		Tif
4	NP_Ortofoto_Svalbard_WMTS_25833	2009/2011	NPI		WTMS-Server
5	Ortho_Upper	2019	UNIS	Juliano Hanna	Tif
6	Ortho_Low	2019	UNIS	Juliano Hanna	Tif
7	LongyearElva_Ortomosaic_07.08.20	2020	UNIS	Martin Løvaas	Tif
8	World Imagery	2021	Esri		Basemap
9	Ortho_delta_aug_21	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
10	130721_Delta_Ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
11	280721_delta_lower_river_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
12	july_august_upper_middle_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
13	020821_longyearbre_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
14	030821_Larsbre_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
15	endofseason_delta_lower_river_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
16	endofseason_upper_middle_river_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
17	endofseason_longyearbreen_ortho	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
18	endofseason_larsbreen_ORTHO	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif

Aerial imageries

	Name	**Year**	**Institution**	**Person responsible**	**Format**
19	S36_2295	1936	NPI		PNG
20	S36_1358	1936	NPI		PNG
21	S36_3039	1936	NPI		PNG
22	DJI_0624	2020	UNIS	Martin Løvaas	Tif
23	DJI_0630	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
24	DJI_0803	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
25	DJI_0804	2022	UNIS	Marthe Ottem & Lene Pallesen	Tif

Digital elevation models

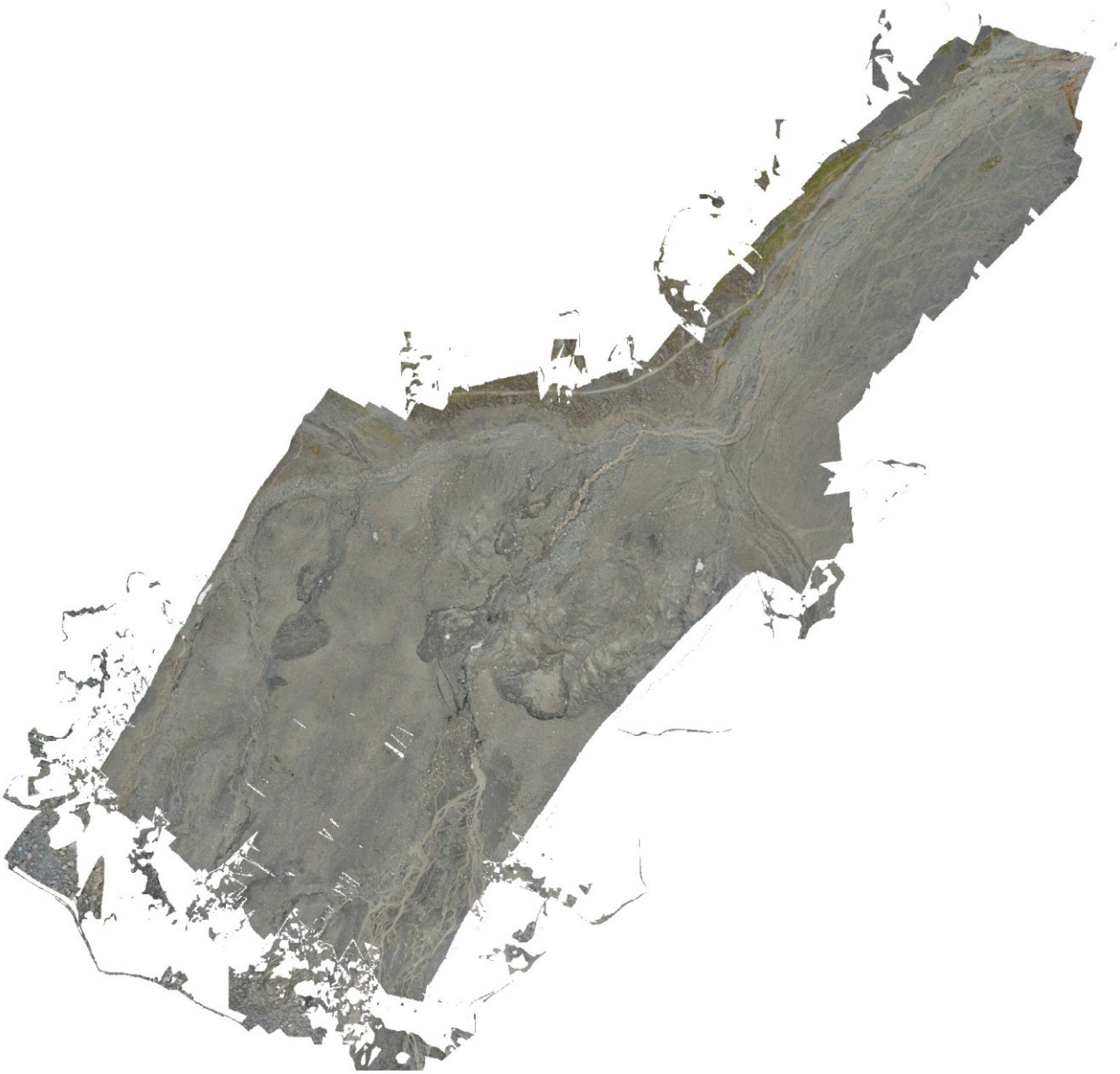
Nr	Name	Year	Institution	Person responsible	Format
27	NP_S0_DTM20	2009/2011	NPI		Tif
28	DEM_Upper	2019	UNIS	Juliano Hanna	Tif
29	DEM_Lower	2019	UNIS	Juliano Hanna	Tif
30	LongyearElva_DEM_07.08.20	2020	UNIS	Martin Løvaas	Tif
31	130721_Delta_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
32	DEM_delta_aug_21	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
33	280721_delta_lower_river_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
34	july_august_upper_middle_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
35	020821_longyearbre_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
36	030821_Larsbre_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
37	endofseason_delta_lower_river_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
38	endofseason_upper_middle_river_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
39	endofseason_longyearbreen_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif
40	endofseason_larsbreen_DEM	2021	UNIS	Marthe Ottem & Lene Pallesen	Tif

Appendix B – Longyearbreen mid-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

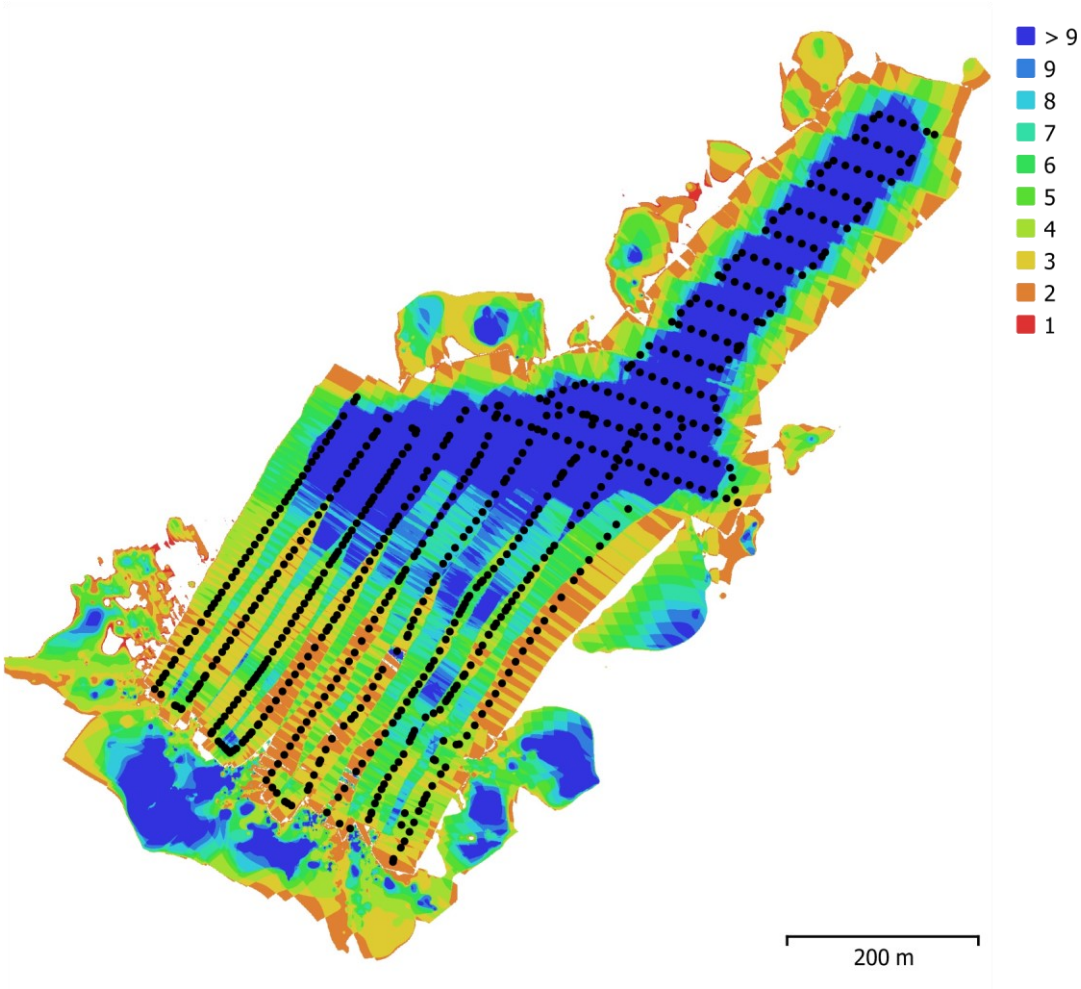


Fig. 1. Camera locations and image overlap.

Number of images:	629	Camera stations:	628
Flying altitude:	63.6 m	Tie points:	1,327,922
Ground resolution:	1.33 cm/pix	Projections:	4,345,304
Coverage area:	0.369 km²	Reprojection error:	0.493 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3078	10.26 mm	2.53 x 2.53 µm	No

Table 1. Cameras.

Camera Calibration

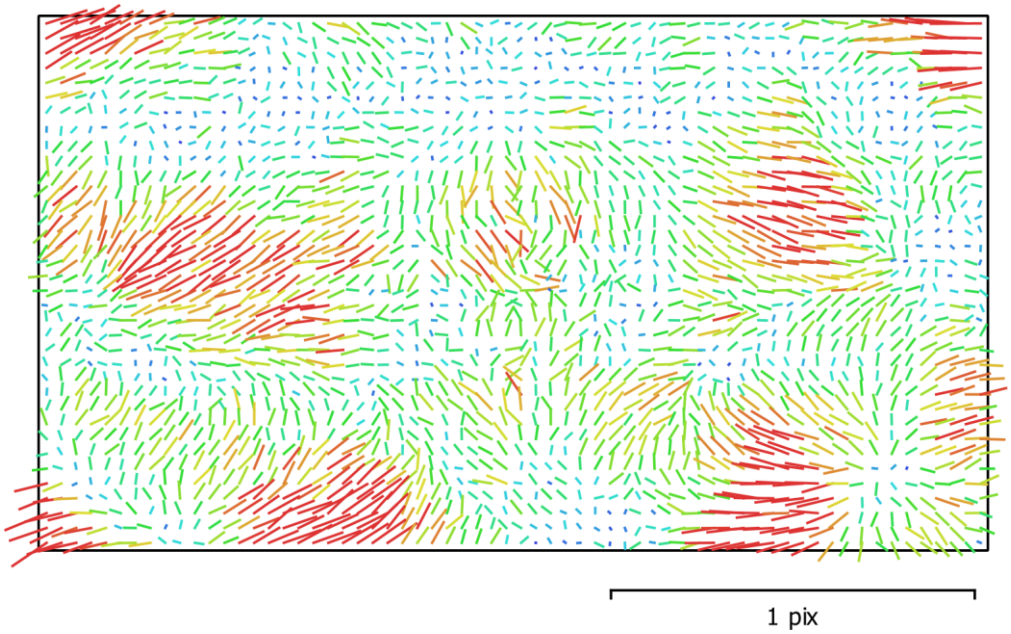


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

629 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3078**	**10.26 mm**	**2.53 x 2.53 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4525.55**	0.82	1.00	0.36	0.41	0.01	0.34	-0.45	-0.04	0.00
Cx	**-12.8956**	0.023		1.00	0.15	-0.02	0.13	-0.17	0.61	0.01
Cy	**2.933**	0.022			1.00	0.01	0.14	-0.19	0.01	0.68
K1	**-0.00205862**	2.6e-05				1.00	-0.66	0.58	0.05	0.06
K2	**0.0422916**	9.5e-05					1.00	-0.98	-0.00	0.00
K3	**-0.0557959**	0.00014						1.00	0.00	-0.00
P1	**-0.000458233**	1.4e-06							1.00	0.04
P2	**-2.08656e-05**	1.5e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

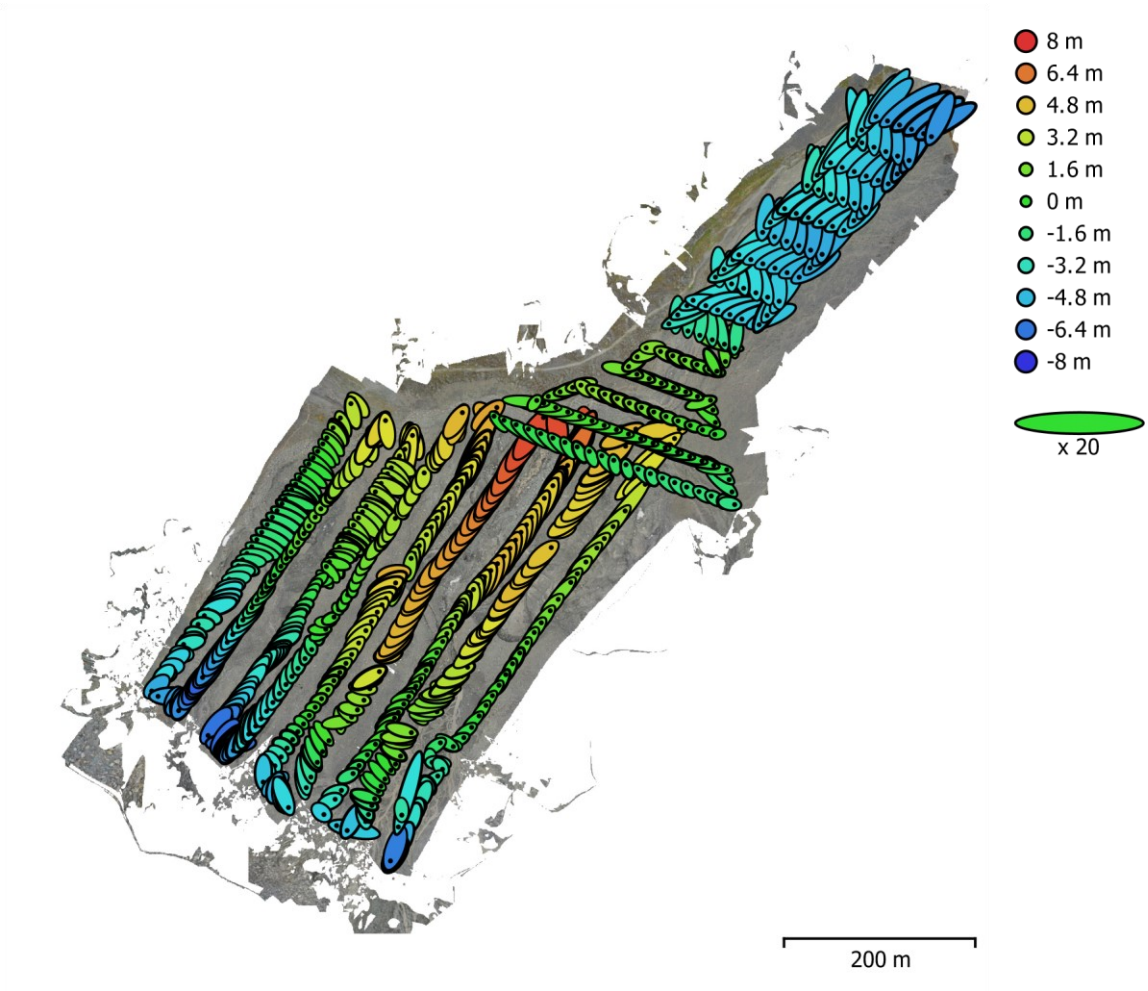


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.910257	0.975309	3.51388	1.33409	3.75861

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

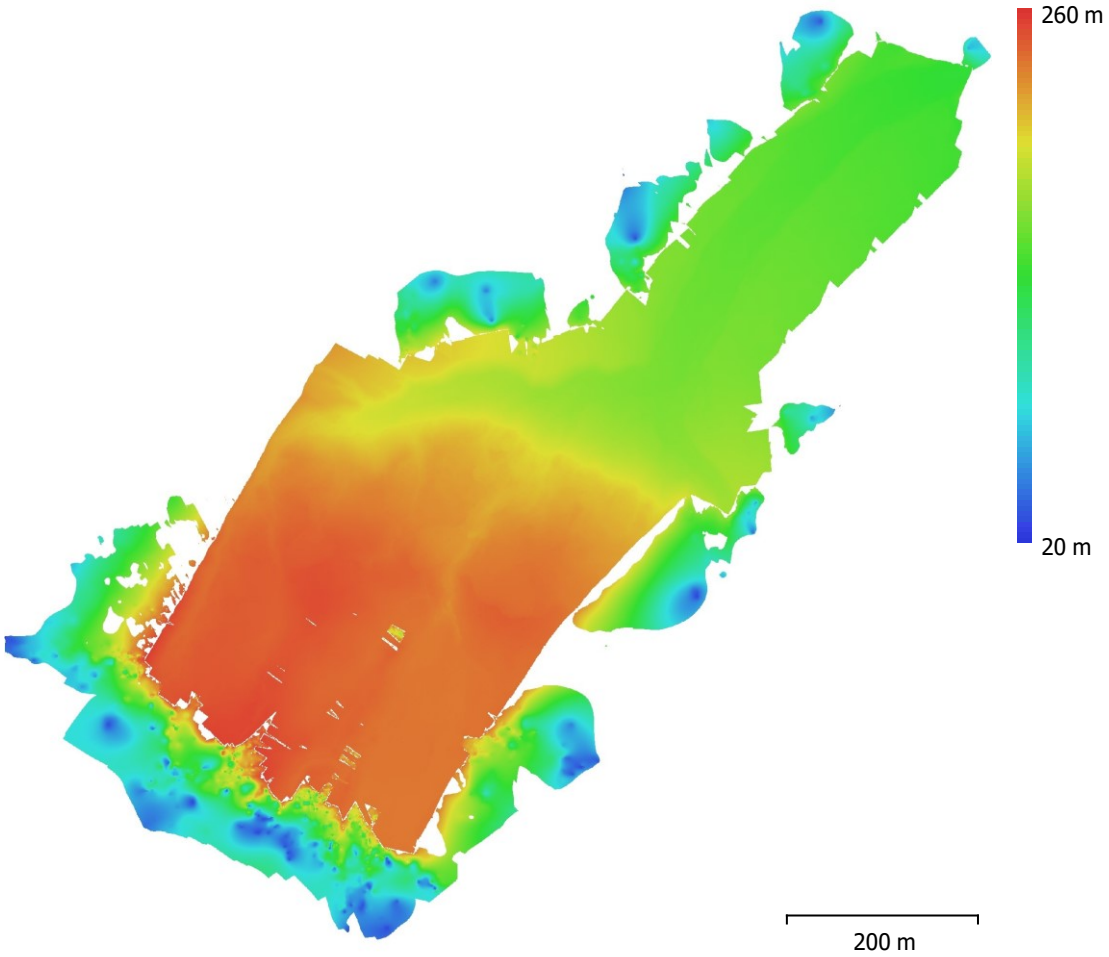


Fig. 4. Reconstructed digital elevation model.

Resolution:	2.67 cm/pix
Point density:	0.141 points/cm²

Processing Parameters

General	
Cameras	629
Aligned cameras	628
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	1,327,922 of 1,634,210
RMS reprojection error	0.165488 (0.49302 pix)
Max reprojection error	0.544328 (24.5797 pix)
Mean key point size	2.7368 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.95497
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	23 minutes 21 seconds
Matching memory usage	1.05 GB
Alignment time	10 minutes 54 seconds
Alignment memory usage	1.10 GB
Date created	2021:09:29 09:37:24
Software version	1.7.4.13028
File size	133.77 MB
Depth Maps	
Count	628
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	57 minutes 25 seconds
Memory usage	6.23 GB
Date created	2021:10:05 08:53:03
Software version	1.7.4.13028
File size	3.97 GB
Dense Point Cloud	
Points	517,036,436
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	57 minutes 25 seconds

Memory usage	6.23 GB
Dense cloud generation parameters	
Processing time	1 hours 5 minutes
Memory usage	9.91 GB
Date created	2021:10:05 09:58:57
Software version	1.7.4.13028
File size	7.25 GB
DEM	
Size	47,369 x 43,640
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	6 minutes 52 seconds
Memory usage	346.87 MB
Date created	2021:10:05 10:09:13
Software version	1.7.4.13028
File size	2.09 GB
Orthomosaic	
Size	77,426 x 72,868
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	22 minutes 13 seconds
Memory usage	9.97 GB
Date created	2021:10:05 10:24:13
Software version	1.7.4.13028
File size	17.58 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix C – Larsbreen mid-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021

Survey Data

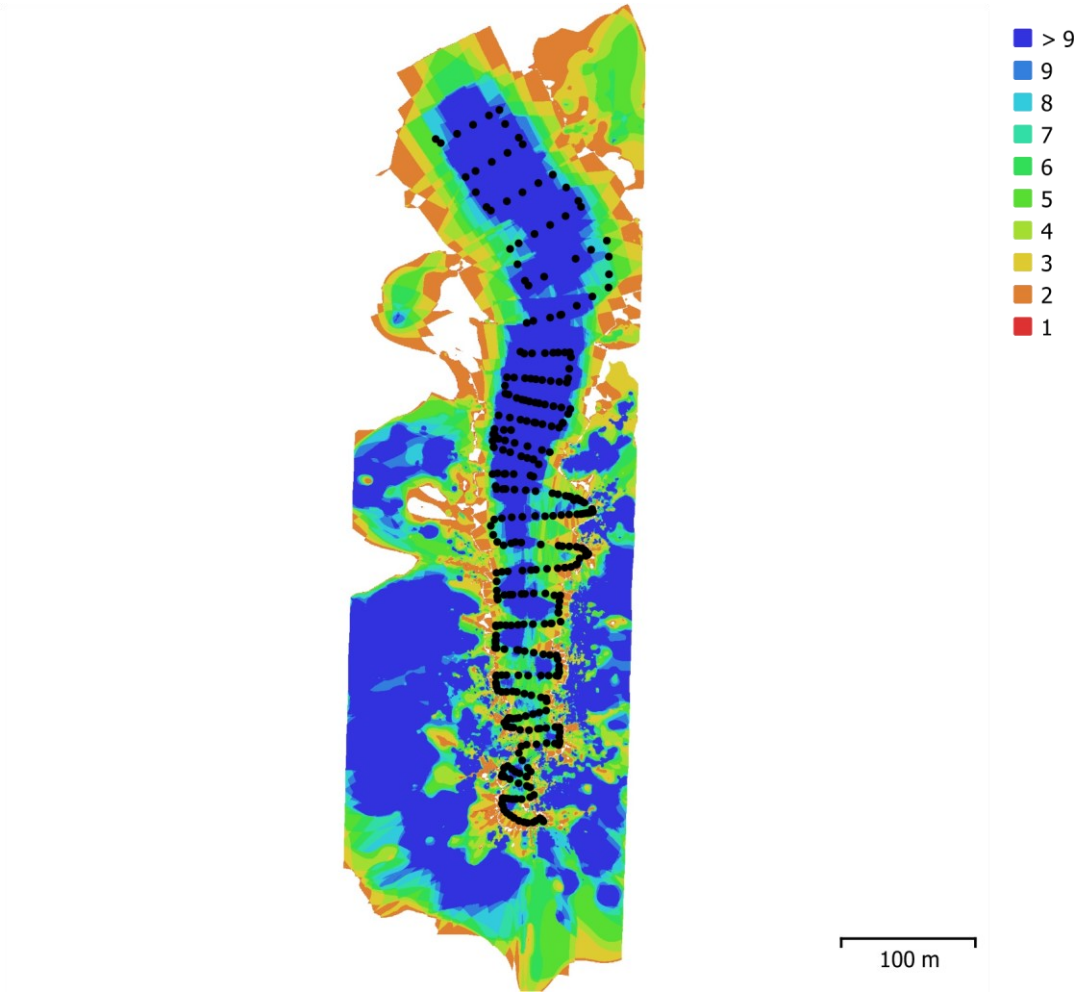


Fig. 1. Camera locations and image overlap.

Number of images:	333	Camera stations:	333
Flying altitude:	34.8 m	Tie points:	814,302
Ground resolution:	7.76 mm/pix	Projections:	2,268,712
Coverage area:	0.125 km²	Reprojection error:	0.7 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3078	10.26 mm	2.53 x 2.53 µm	No

Table 1. Cameras.

Camera Calibration

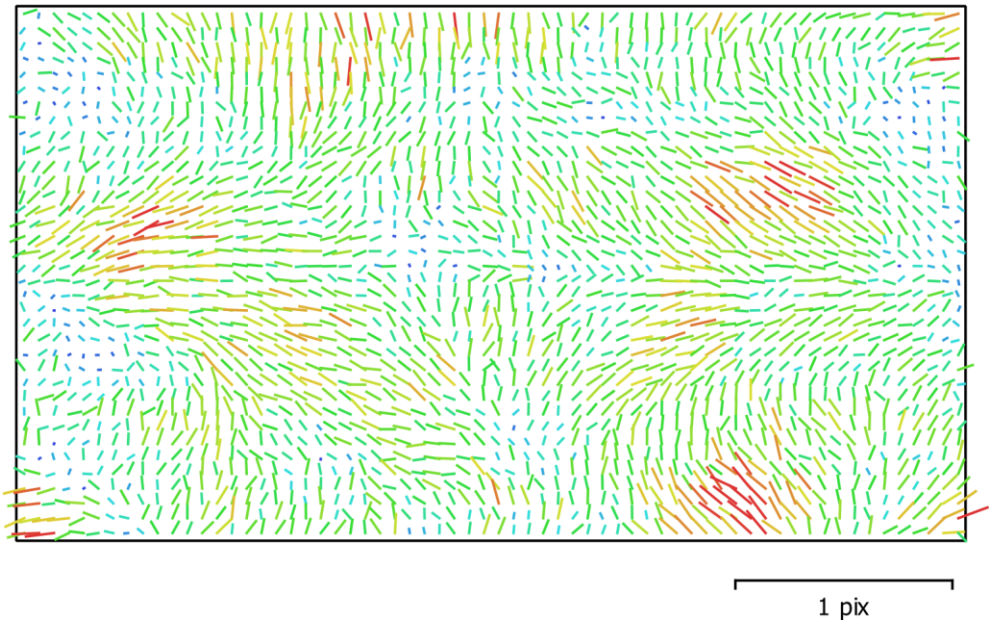


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

333 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3078**	**10.26 mm**	**2.53 x 2.53 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4523.1**	1.1	1.00	0.05	0.24	0.11	0.18	-0.23	-0.01	0.04
Cx	**-12.3113**	0.056		1.00	0.02	-0.06	0.02	-0.02	0.85	0.01
Cy	**8.2582**	0.046			1.00	0.05	0.04	-0.06	-0.00	0.84
K1	**-0.00458812**	6.3e-05				1.00	-0.69	0.62	-0.06	0.06
K2	**0.0377309**	0.00024					1.00	-0.98	0.01	0.01
K3	**-0.049763**	0.00034						1.00	-0.01	-0.01
P1	**-0.000453045**	4.2e-06							1.00	0.01
P2	**9.87065e-06**	3.5e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

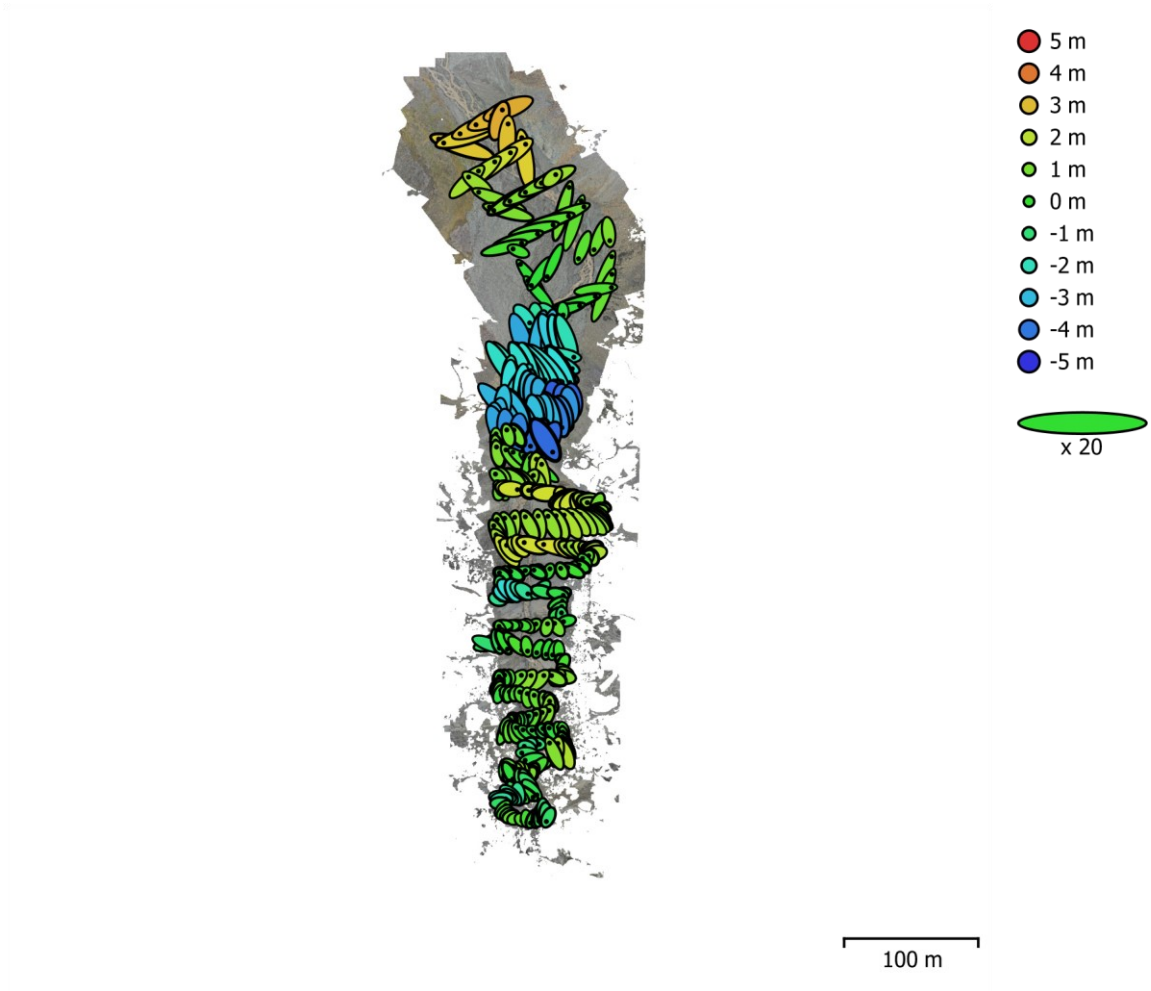


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.503709	0.550805	1.65258	0.746397	1.81332

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

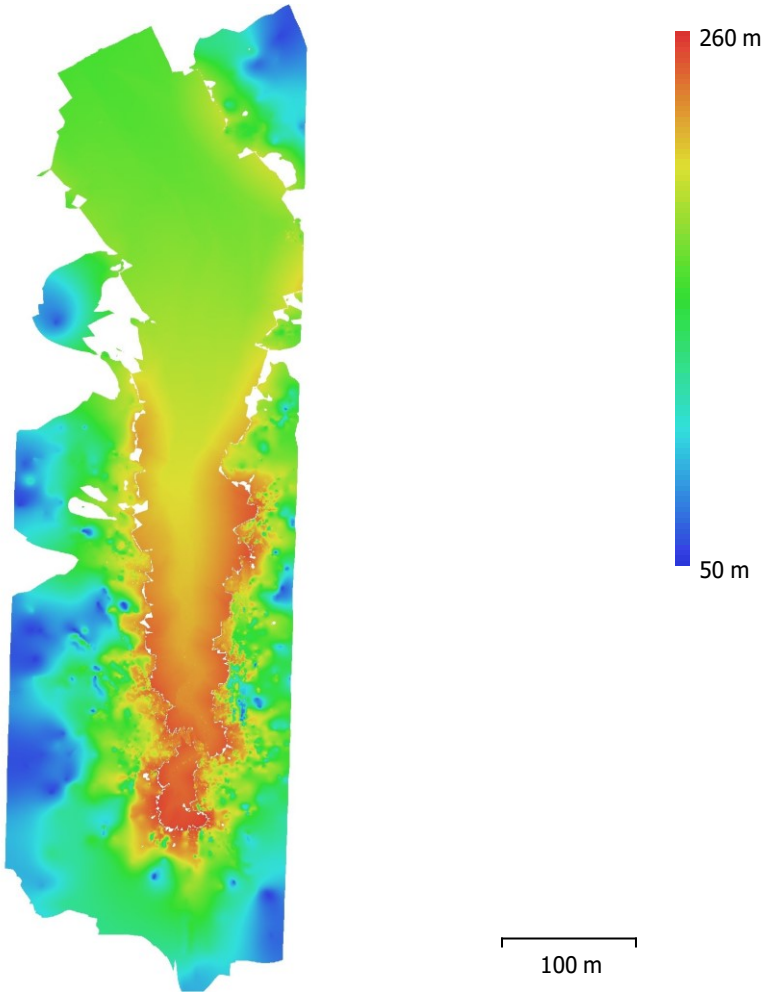


Fig. 4. Reconstructed digital elevation model.

Resolution:	1.55 cm/pix
Point density:	0.416 points/cm²

Processing Parameters

General	
Cameras	333
Aligned cameras	333
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	814,302 of 930,903
RMS reprojection error	0.220897 (0.699793 pix)
Max reprojection error	0.74296 (31.1348 pix)
Mean key point size	3.08763 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.32112
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	8 minutes 40 seconds
Matching memory usage	505.64 MB
Alignment time	4 minutes 2 seconds
Alignment memory usage	309.45 MB
Date created	2021:10:05 08:02:51
Software version	1.7.4.13028
File size	68.52 MB
Depth Maps	
Count	333
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	22 minutes 38 seconds
Memory usage	4.89 GB
Date created	2021:10:05 08:40:06
Software version	1.7.4.13028
File size	2.02 GB
Dense Point Cloud	
Points	310,343,930
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	22 minutes 38 seconds

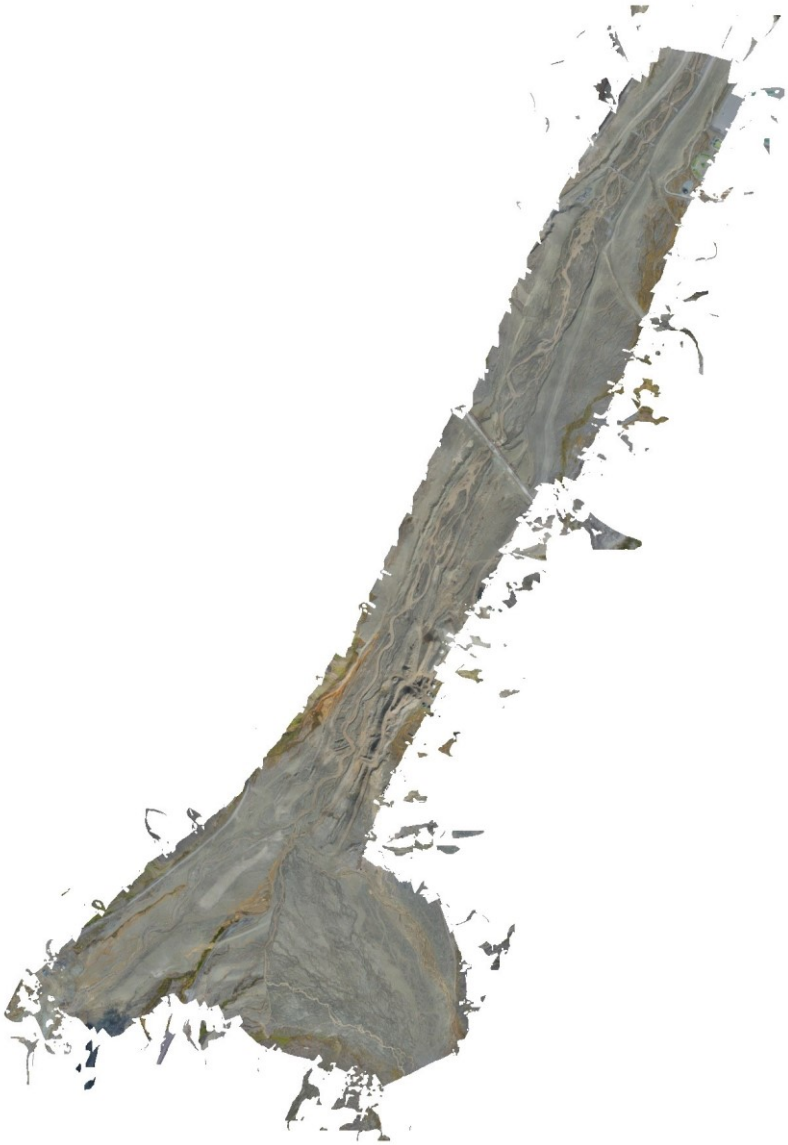
Memory usage	4.89 GB
Dense cloud generation parameters	
Processing time	45 minutes 51 seconds
Memory usage	7.84 GB
Date created	2021:10:05 09:25:57
Software version	1.7.4.13028
File size	4.31 GB
DEM	
Size	14,974 x 48,034
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	6 minutes 6 seconds
Memory usage	369.08 MB
Date created	2021:10:05 09:34:29
Software version	1.7.4.13028
File size	2.25 GB
Orthomosaic	
Size	29,044 x 94,962
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	17 minutes 28 seconds
Memory usage	11.94 GB
Date created	2021:10:05 09:45:25
Software version	1.7.4.13028
File size	9.75 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix D – Upper-middle Longyearelva mid-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

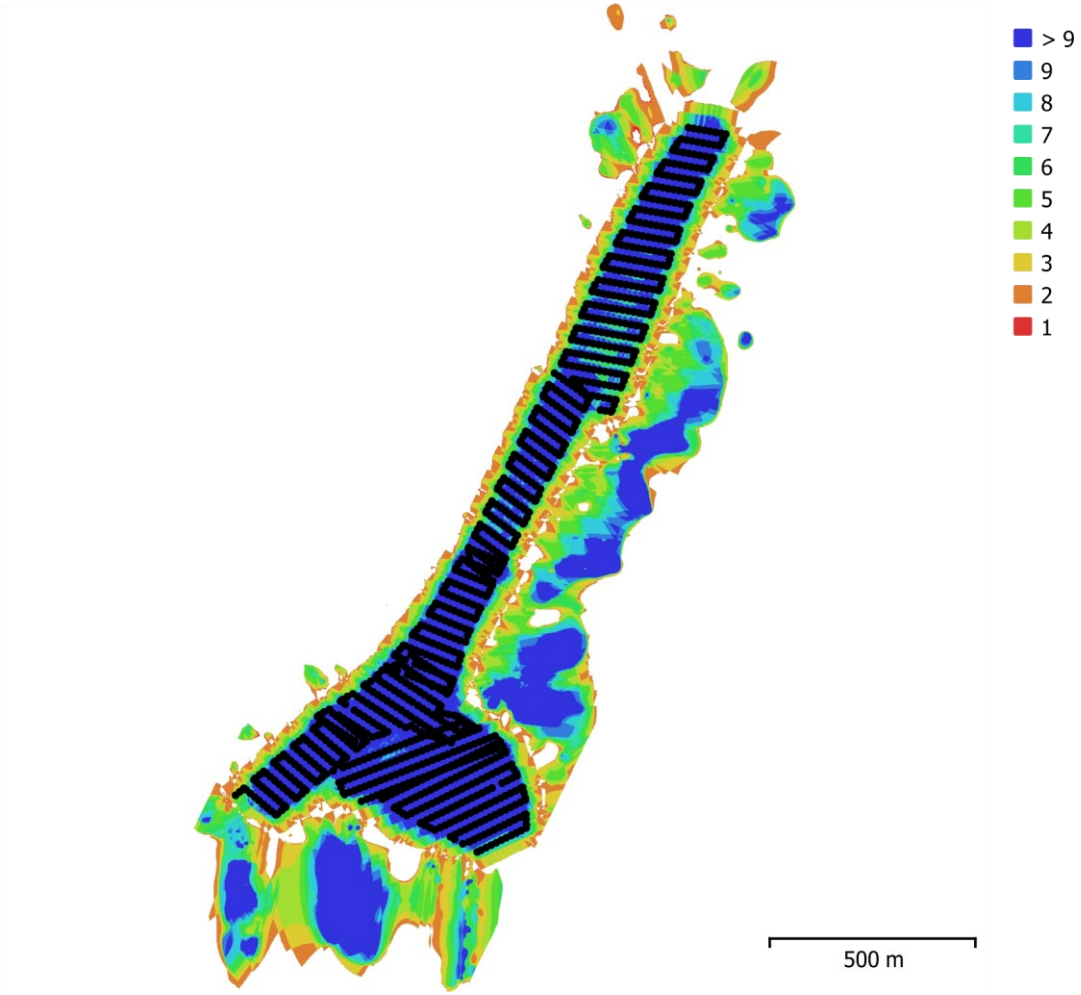


Fig. 1. Camera locations and image overlap.

Number of images:	1,155	Camera stations:	1,155
Flying altitude:	83.2 m	Tie points:	1,250,733
Ground resolution:	1.79 cm/pix	Projections:	7,402,183
Coverage area:	1.08 km²	Reprojection error:	0.908 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3078	10.26 mm	2.53 x 2.53 µm	No

Table 1. Cameras.

Camera Calibration

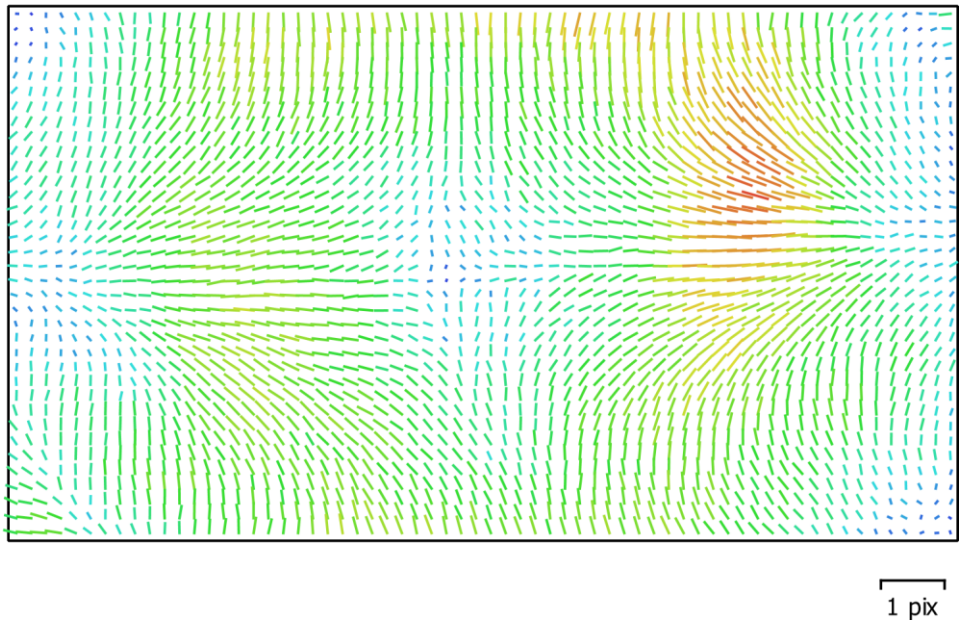


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

1155 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3078**	**10.26 mm**	**2.53 x 2.53 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4384.07**	0.91	1.00	0.41	0.32	-0.02	0.37	-0.46	-0.11	-0.03
Cx	**-15.8765**	0.027		1.00	0.15	-0.01	0.15	-0.19	0.45	0.00
Cy	**11.7725**	0.021			1.00	-0.02	0.13	-0.16	-0.02	0.37
K1	**-0.00916705**	2.6e-05				1.00	-0.64	0.58	0.06	0.05
K2	**0.0408692**	9.3e-05					1.00	-0.98	-0.04	-0.01
K3	**-0.0473657**	0.00013						1.00	0.04	0.01
P1	**-0.000667358**	1.3e-06							1.00	0.02
P2	**-0.000128228**	8.1e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

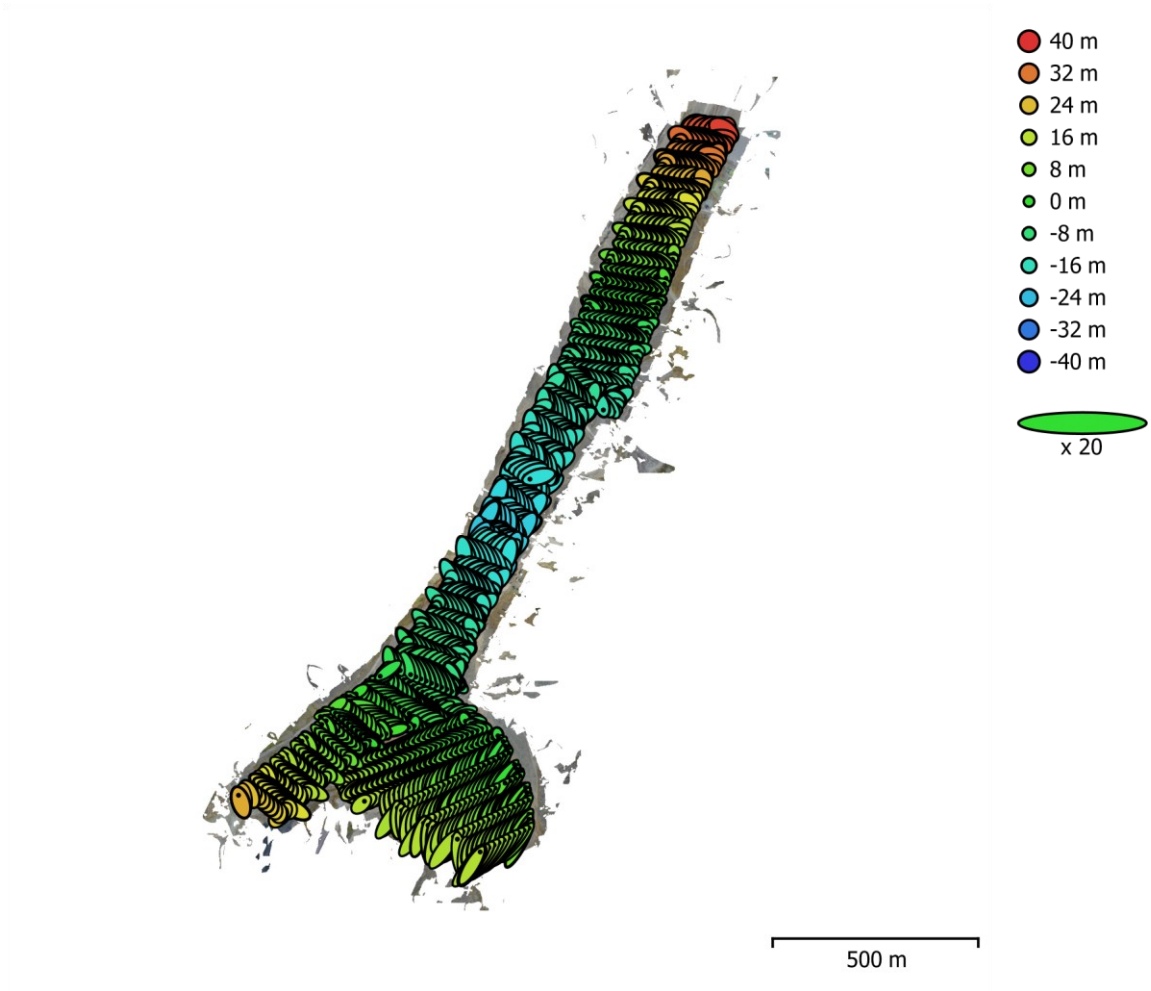


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
1.44357	1.50219	13.4678	2.08338	13.628

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

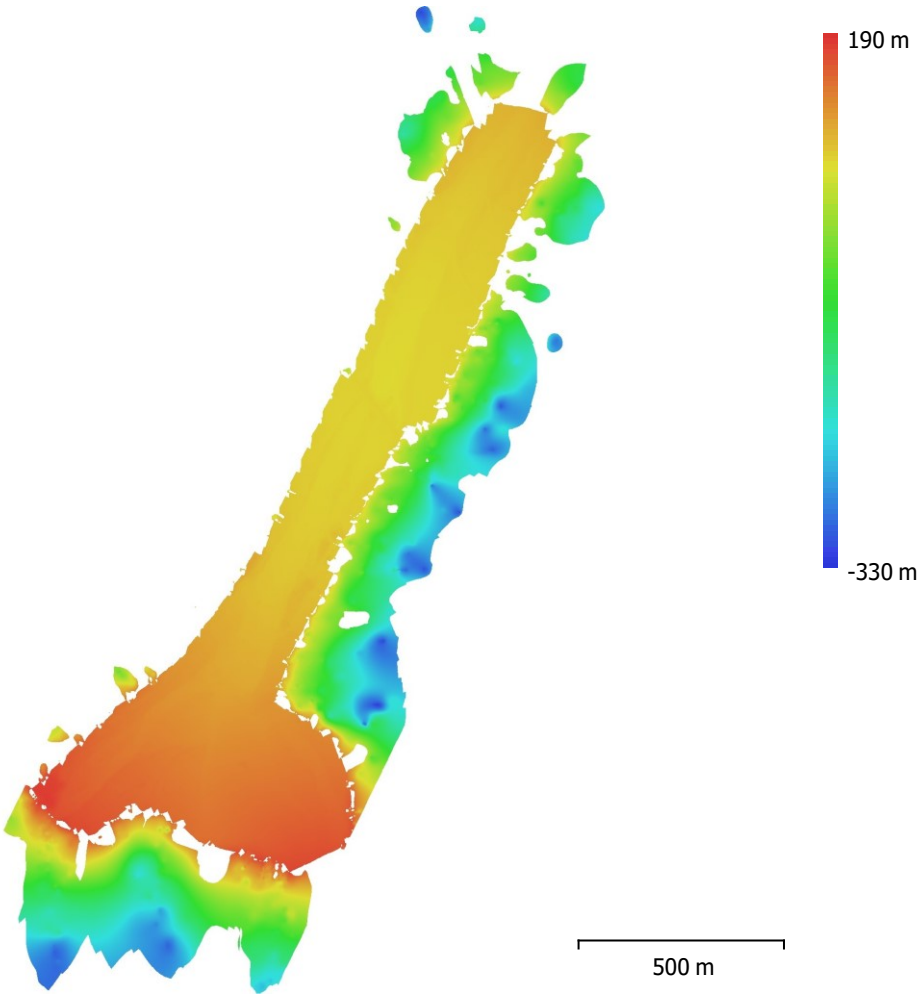


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.58 cm/pix
Point density:	779 points/m²

Processing Parameters

General	
Cameras	1155
Aligned cameras	1155
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	1,250,733 of 1,777,780
RMS reprojection error	0.362566 (0.90798 pix)
Max reprojection error	1.20048 (53.1381 pix)
Mean key point size	2.47128 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	6.82413
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	15 minutes 11 seconds
Matching memory usage	1.86 GB
Alignment time	24 minutes 44 seconds
Alignment memory usage	1.23 GB
Date created	2021:09:29 11:58:19
Software version	1.7.4.13028
File size	218.98 MB
Depth Maps	
Count	1155
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 26 minutes
Memory usage	8.23 GB
Date created	2021:09:29 13:50:01
Software version	1.7.4.13028
File size	6.75 GB
Dense Point Cloud	
Points	528,425,409
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 26 minutes

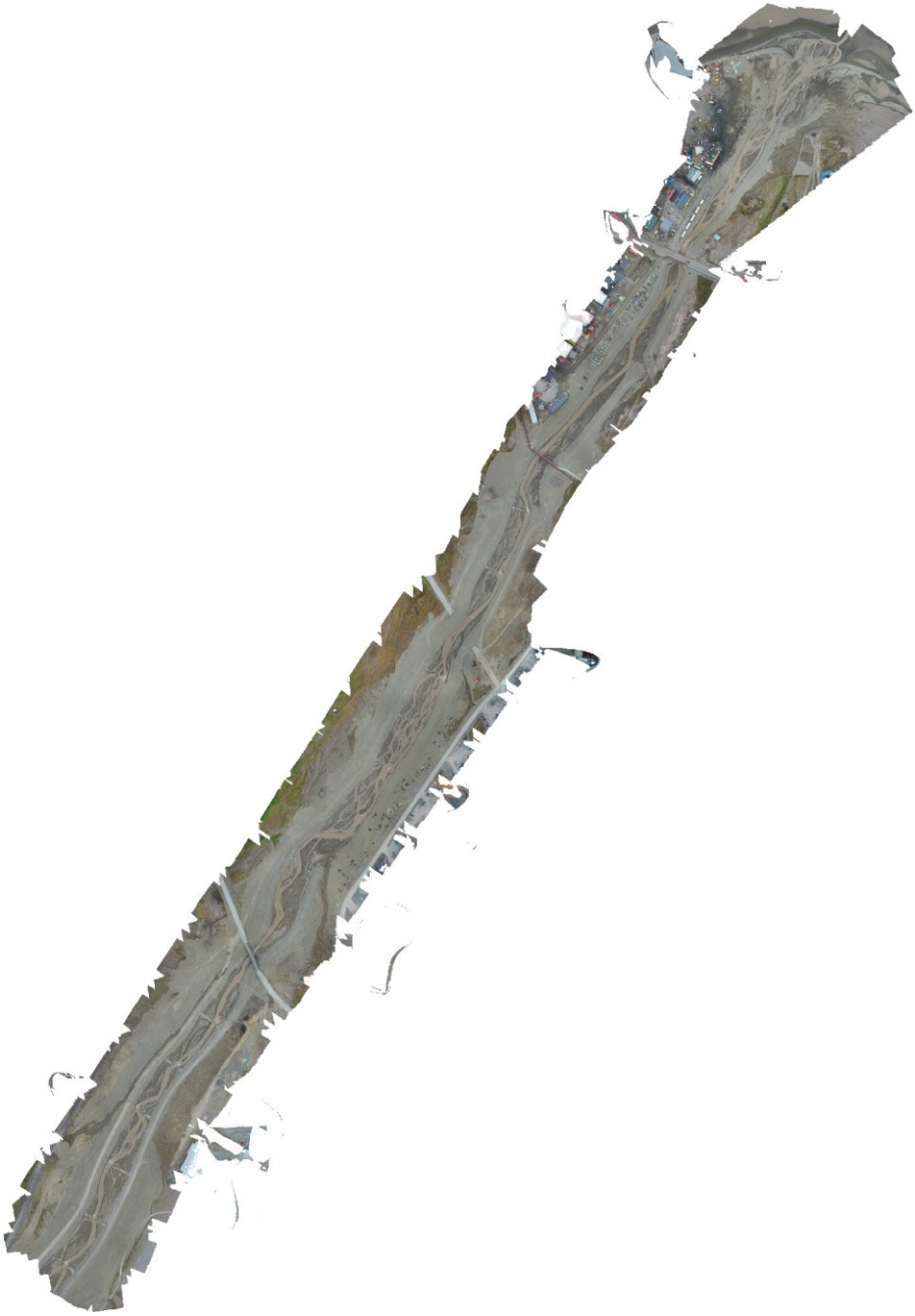
Memory usage	8.23 GB
Dense cloud generation parameters	
Processing time	1 hours 27 minutes
Memory usage	10.17 GB
Date created	2021:09:29 15:18:01
Software version	1.7.4.13028
File size	7.49 GB
DEM	
Size	51,420 x 75,411
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	9 minutes 24 seconds
Memory usage	321.42 MB
Date created	2021:10:01 08:04:03
Software version	1.7.4.13028
File size	3.65 GB
Orthomosaic	
Size	81,649 x 134,130
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	38 minutes 5 seconds
Memory usage	7.01 GB
Date created	2021:10:01 08:36:48
Software version	1.7.4.13028
File size	31.58 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix E – Lower Longyearelva mid-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

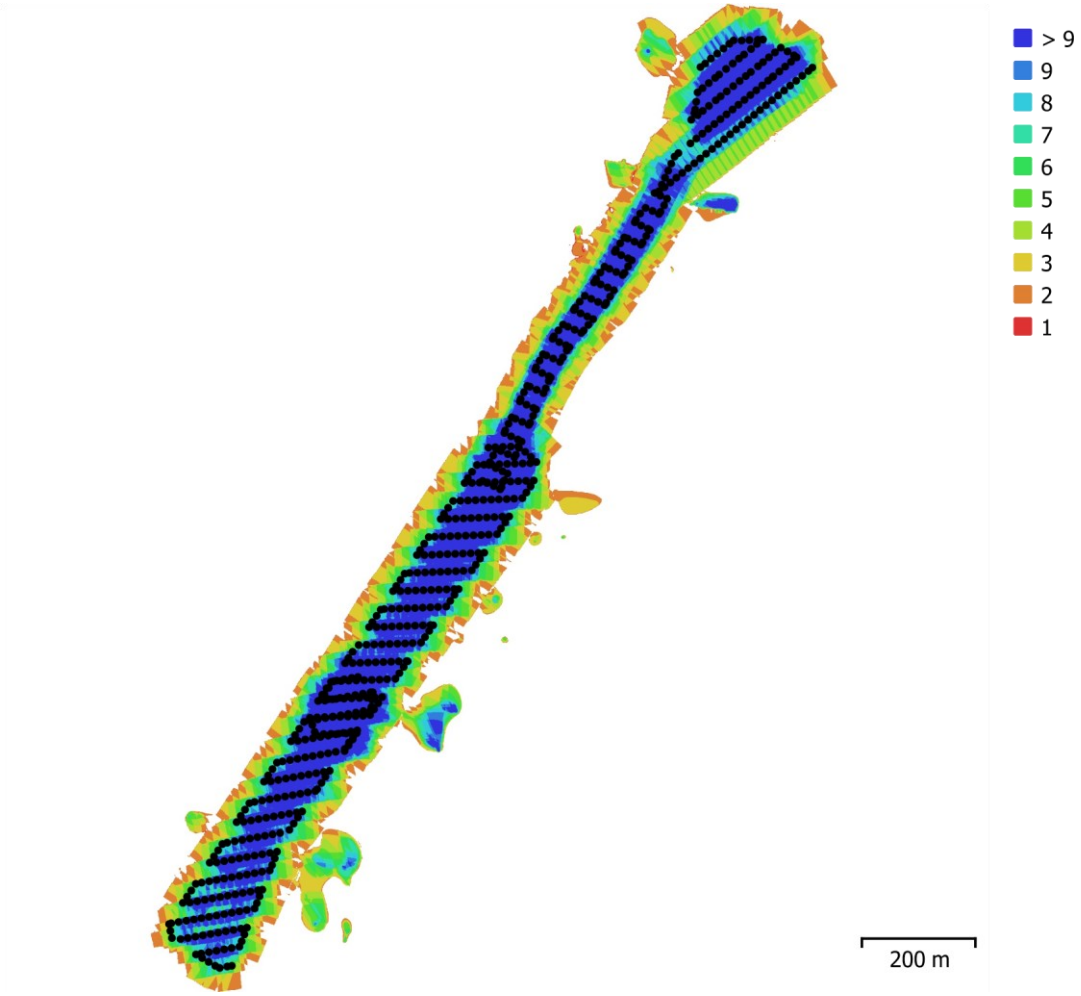


Fig. 1. Camera locations and image overlap.

Number of images:	586	Camera stations:	586
Flying altitude:	78.1 m	Tie points:	882,376
Ground resolution:	1.71 cm/pix	Projections:	4,673,644
Coverage area:	0.364 km²	Reprojection error:	1.4 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c (10.26mm)	5472 x 3078	10.26 mm	2.53 x 2.53 µm	No

Table 1. Cameras.

Camera Calibration

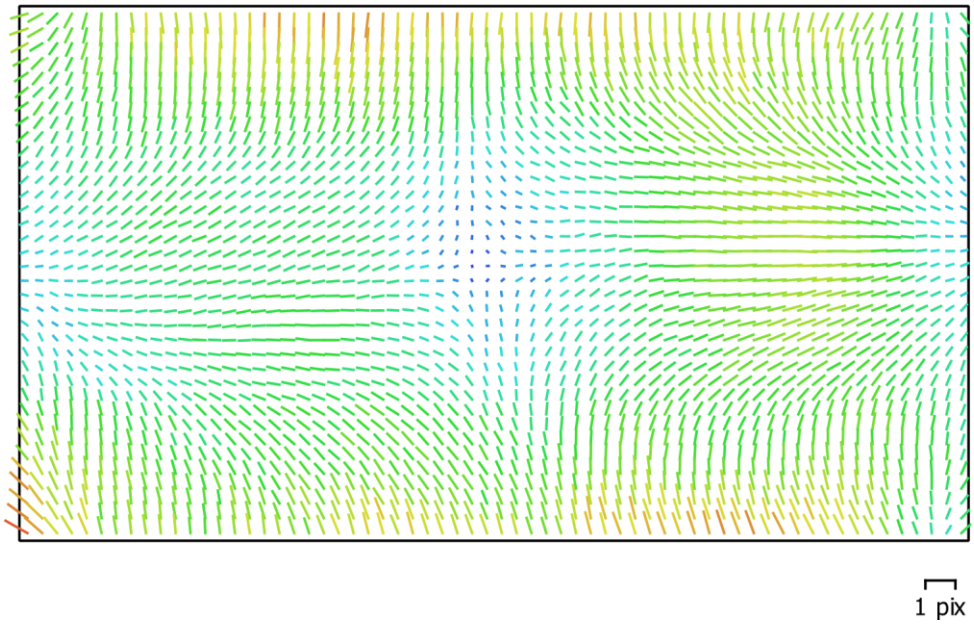


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

586 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3078**	**10.26 mm**	**2.53 x 2.53 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4291.6**	0.87	1.00	0.08	0.16	0.16	0.11	-0.10	-0.07	0.01
Cx	**-13.4692**	0.064		1.00	0.00	-0.00	0.02	-0.02	0.43	-0.00
Cy	**17.7026**	0.054			1.00	0.02	0.03	-0.03	0.06	0.31
K1	**-0.00548896**	5.3e-05				1.00	-0.65	0.61	0.01	0.09
K2	**0.018234**	0.00016					1.00	-0.98	0.01	0.00
K3	**-0.013817**	0.00021						1.00	-0.00	0.00
P1	**-0.00118446**	2.6e-06							1.00	0.05
P2	**-0.000256777**	1.7e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

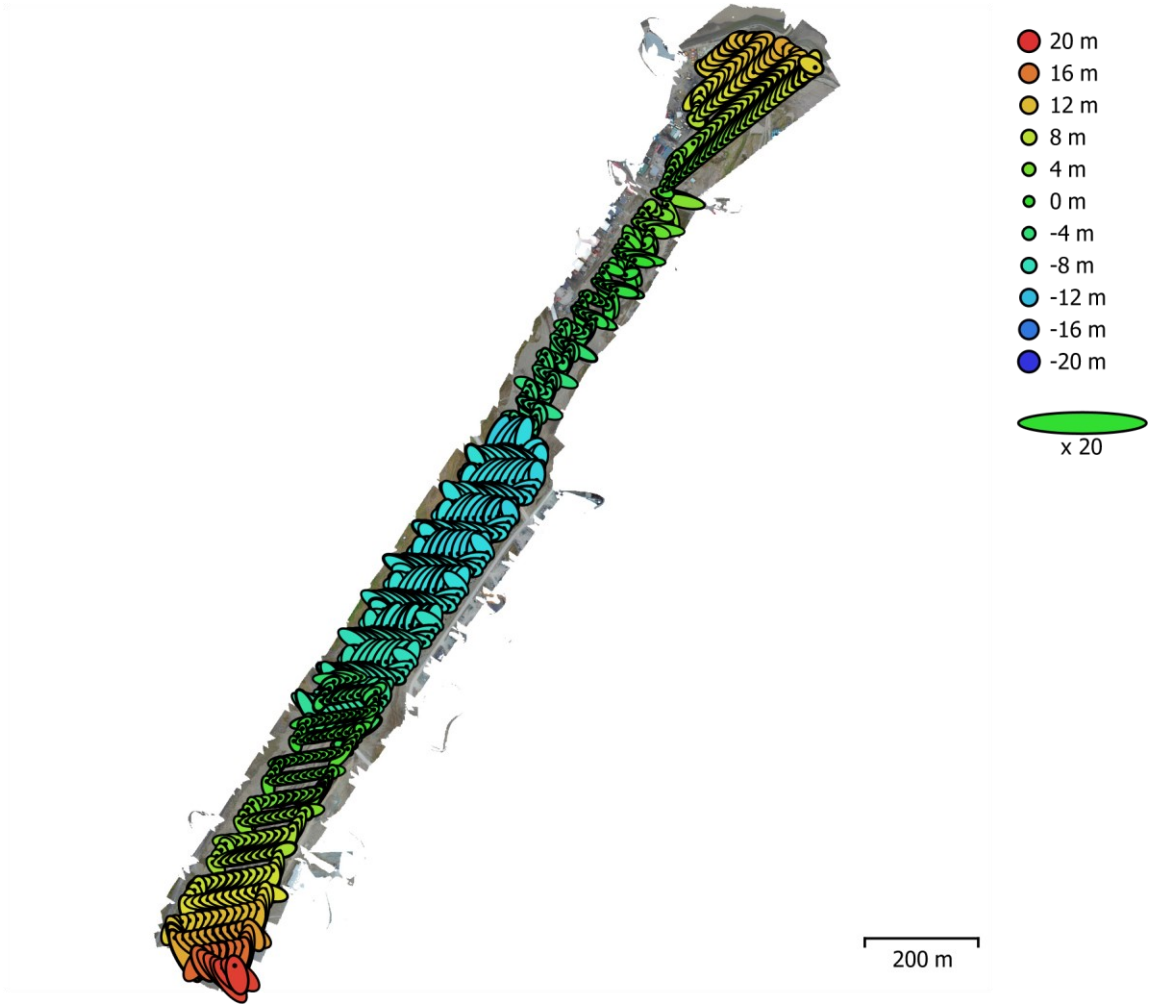


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
1.2936	1.11211	7.944	1.70593	8.12511

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

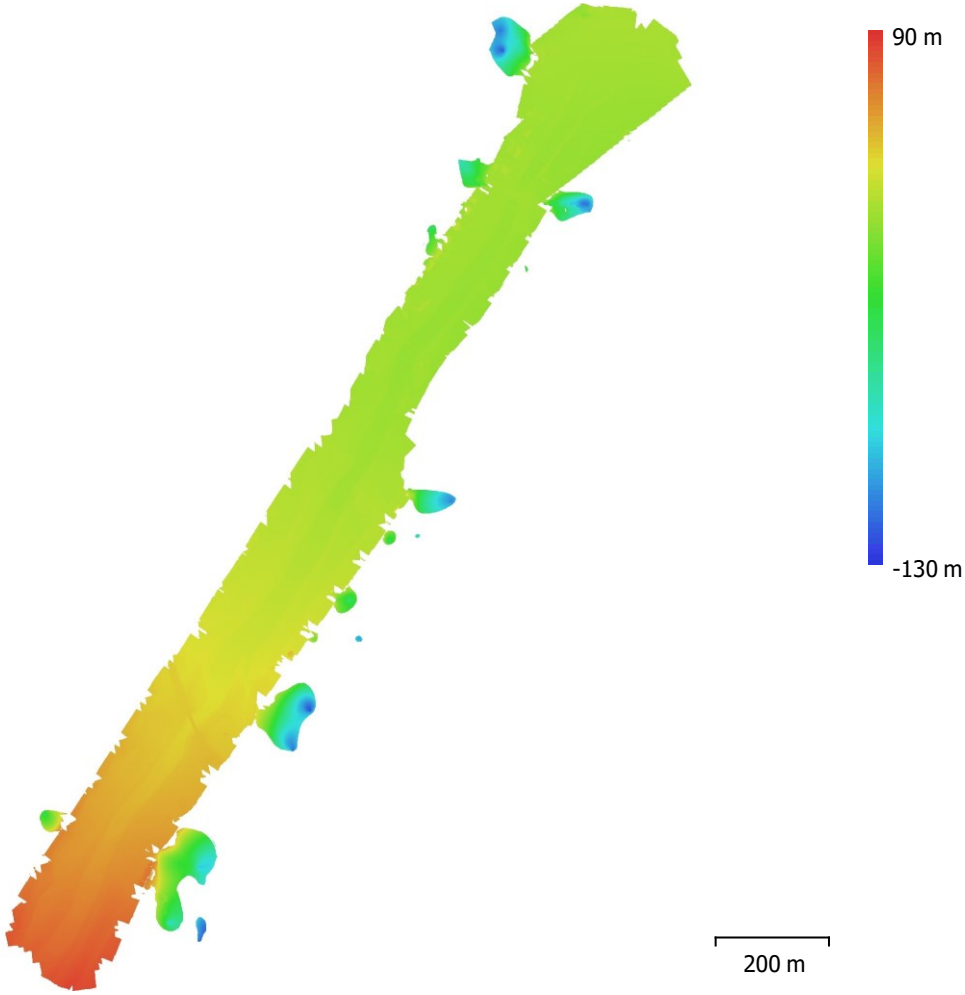


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.41 cm/pix
Point density:	858 points/m²

Processing Parameters

General	
Cameras	586
Aligned cameras	586
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	882,376 of 1,047,614
RMS reprojection error	0.541005 (1.40361 pix)
Max reprojection error	1.67104 (49.8718 pix)
Mean key point size	2.76873 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	5.89399
Alignment parameters	
Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	10,000
Exclude stationary tie points	No
Guided image matching	No
Adaptive camera model fitting	No
Matching time	3 minutes 35 seconds
Matching memory usage	2.59 GB
Alignment time	14 minutes 24 seconds
Alignment memory usage	507.91 MB
Date created	2021:07:28 12:58:10
Software version	1.7.2.12040
File size	117.49 MB
Depth Maps	
Count	586
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	26 minutes 46 seconds
File size	3.50 GB
Dense Point Cloud	
Points	332,814,540
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	26 minutes 46 seconds
Dense cloud generation parameters	
Processing time	1 hours 30 minutes
Date created	2021:07:28 15:12:02
Software version	1.7.2.12040
File size	4.74 GB
DEM	

Size	58,515 x 81,835
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	10 minutes 28 seconds
Memory usage	390.27 MB
Date created	2021:07:29 13:37:10
Software version	1.7.2.12040
File size	1.32 GB
Orthomosaic	
Size	70,958 x 101,990
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	28 minutes 46 seconds
Memory usage	4.22 GB
Date created	2021:08:03 12:05:10
Software version	1.7.2.12040
File size	12.51 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix F – Longyearbreen late-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021

Survey Data

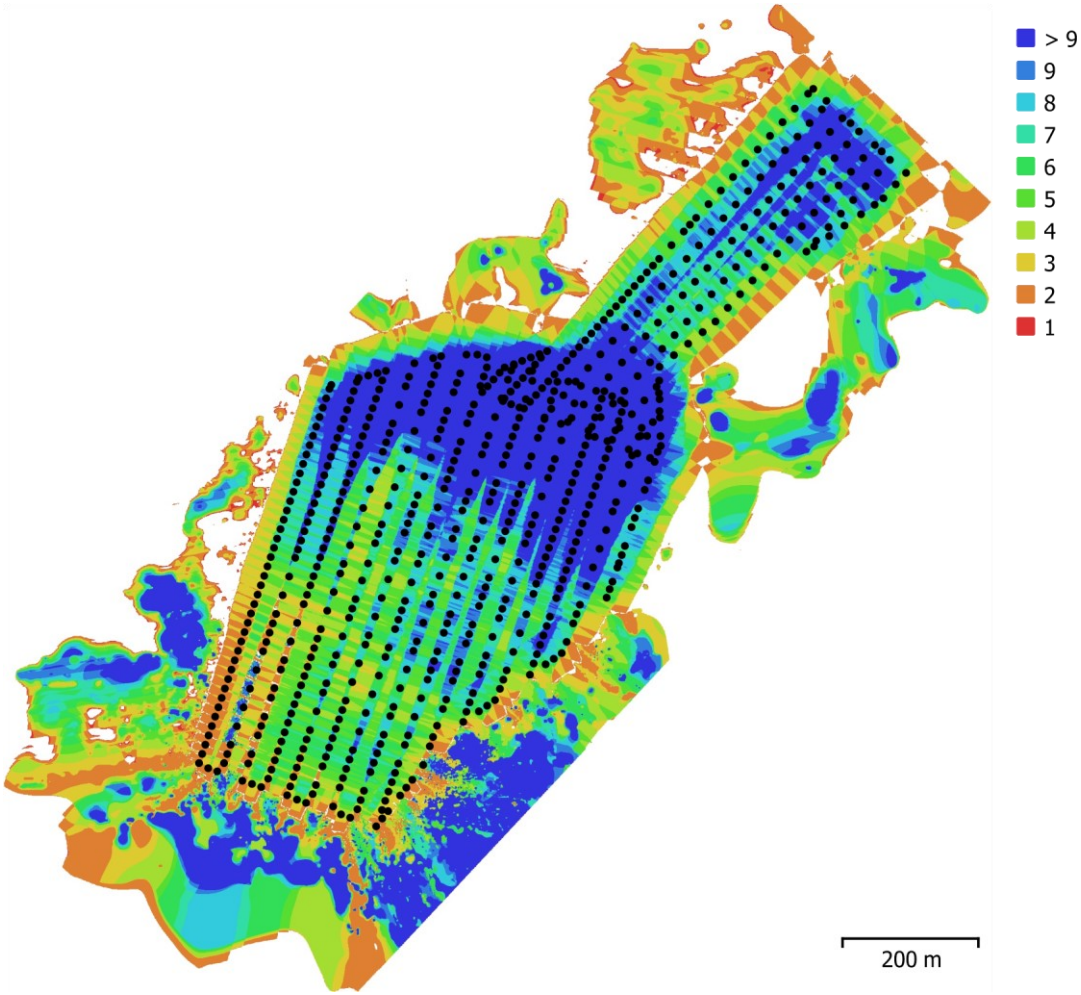


Fig. 1. Camera locations and image overlap.

Number of images:	675	Camera stations:	675
Flying altitude:	79.5 m	Tie points:	1,367,858
Ground resolution:	1.73 cm/pix	Projections:	5,136,245
Coverage area:	0.869 km²	Reprojection error:	0.411 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

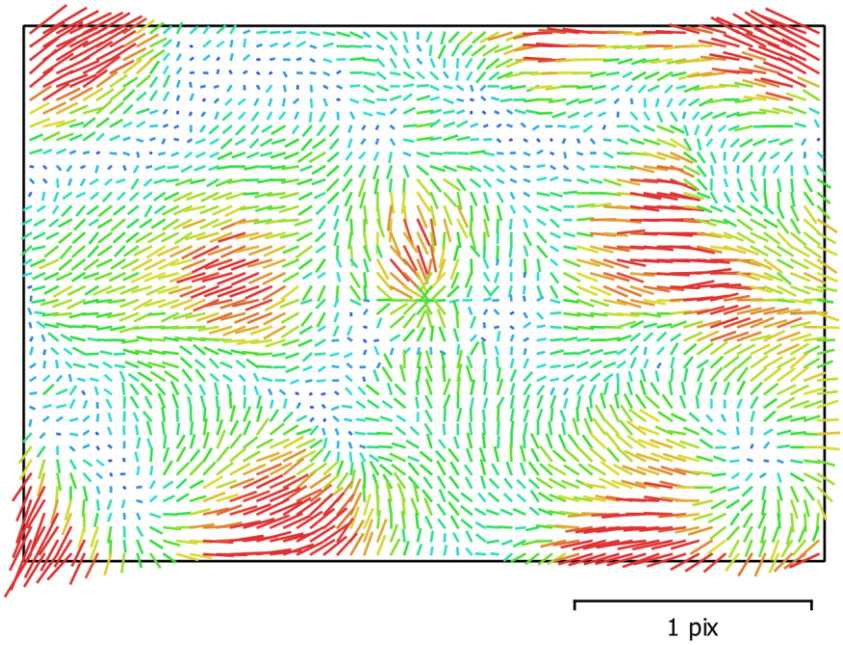


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

675 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4404.68**	0.49	1.00	0.76	0.57	-0.05	0.42	-0.57	-0.04	-0.02
Cx	**-11.2512**	0.013		1.00	0.43	-0.05	0.33	-0.44	0.40	-0.01
Cy	**1.41513**	0.0095			1.00	-0.03	0.24	-0.32	-0.03	0.51
K1	**-0.00567269**	1.2e-05				1.00	-0.73	0.63	0.07	0.04
K2	**0.0410294**	4.4e-05					1.00	-0.97	-0.02	-0.01
K3	**-0.0499692**	5.9e-05						1.00	0.02	0.01
P1	**-0.000441054**	6e-07							1.00	0.01
P2	**-0.000157434**	5.1e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

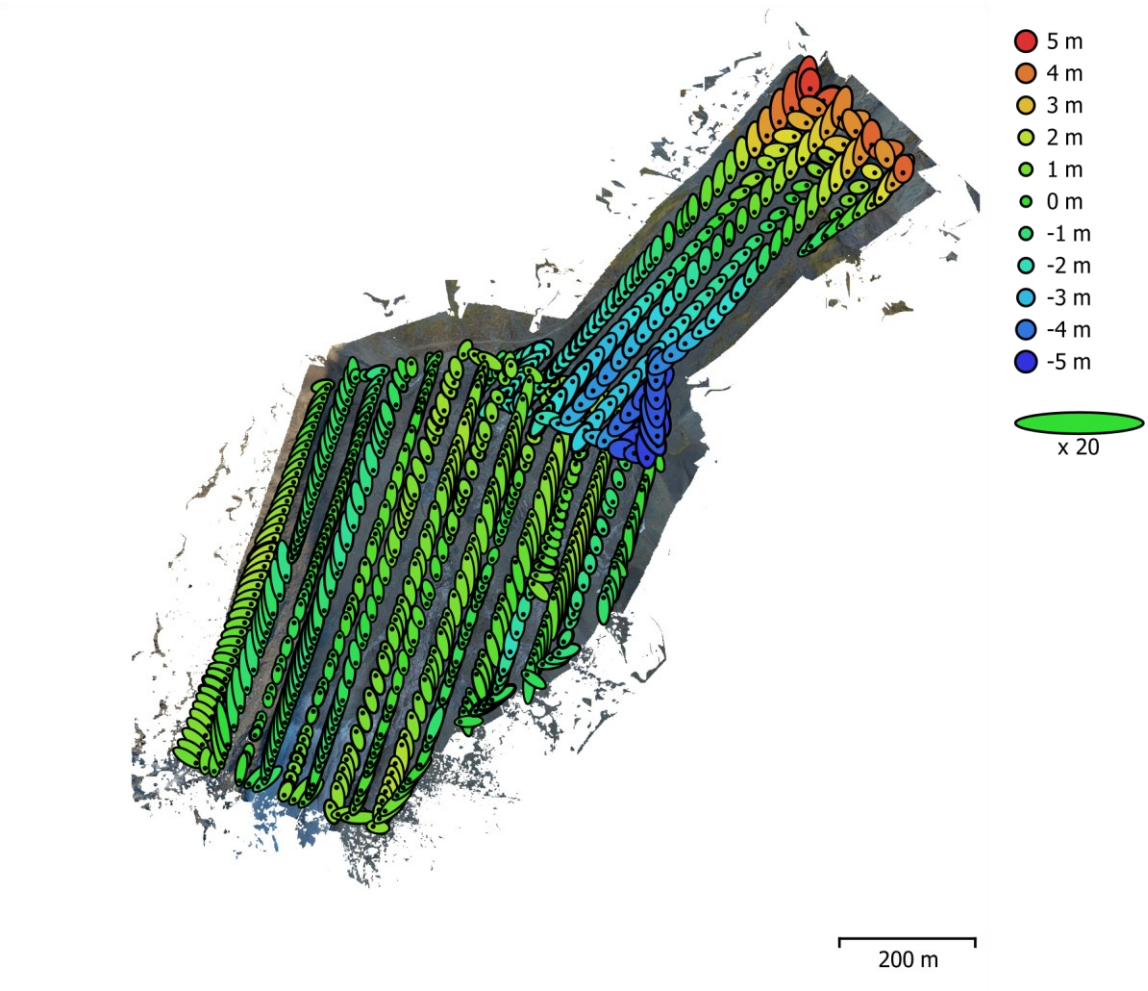


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.562391	1.40889	1.53441	1.51699	2.1577

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

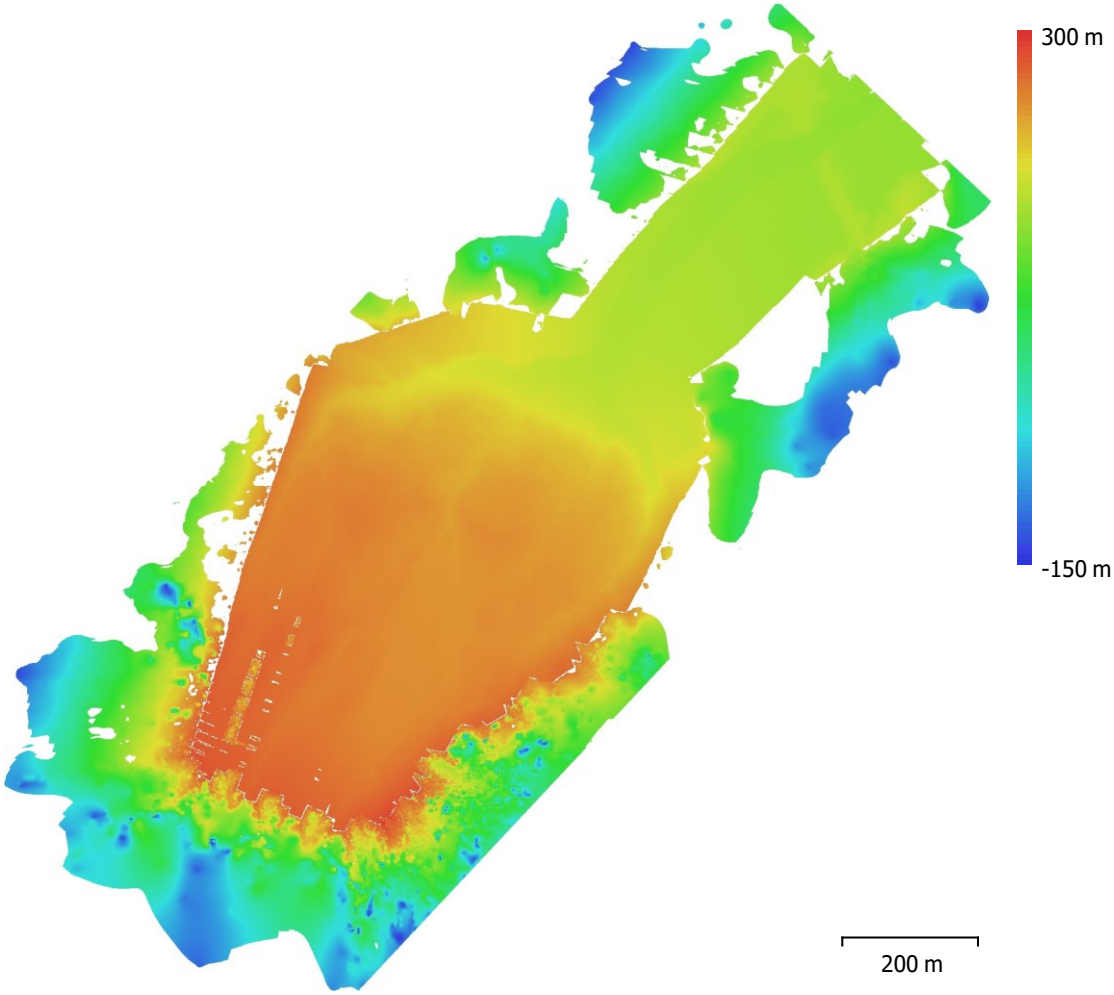


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.46 cm/pix
Point density:	833 points/m²

Processing Parameters

General	
Cameras	675
Aligned cameras	675
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	1,367,858 of 1,623,208
RMS reprojection error	0.134402 (0.410646 pix)
Max reprojection error	0.416779 (27.0887 pix)
Mean key point size	2.8085 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.25485
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	12 minutes 18 seconds
Matching memory usage	5.11 GB
Alignment time	16 minutes 29 seconds
Alignment memory usage	798.46 MB
Date created	2021:09:24 10:01:29
Software version	1.7.4.13028
File size	141.43 MB
Depth Maps	
Count	675
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 3 minutes
Memory usage	8.53 GB
Date created	2021:09:27 13:33:23
Software version	1.7.4.13028
File size	4.86 GB
Dense Point Cloud	
Points	545,173,912
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 3 minutes

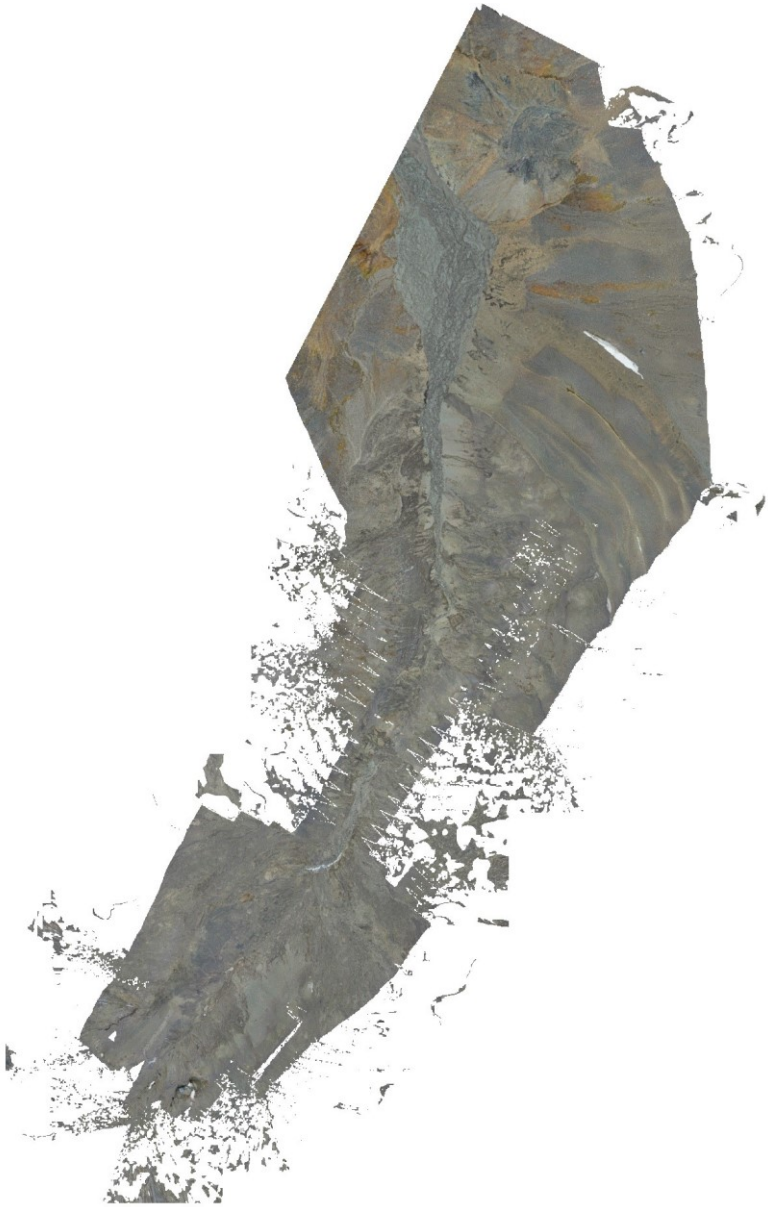
Memory usage	8.53 GB
Dense cloud generation parameters	
Processing time	1 hours 46 minutes
Memory usage	10.91 GB
Date created	2021:09:27 15:19:33
Software version	1.7.4.13028
File size	7.66 GB
DEM	
Size	47,176 x 48,448
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	14 minutes 8 seconds
Memory usage	337.10 MB
Date created	2021:09:28 07:39:36
Software version	1.7.4.13028
File size	3.13 GB
Orthomosaic	
Size	83,952 x 83,965
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	27 minutes 14 seconds
Memory usage	11.16 GB
Date created	2021:09:28 08:03:34
Software version	1.7.4.13028
File size	19.66 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix G – Larsbreen late-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

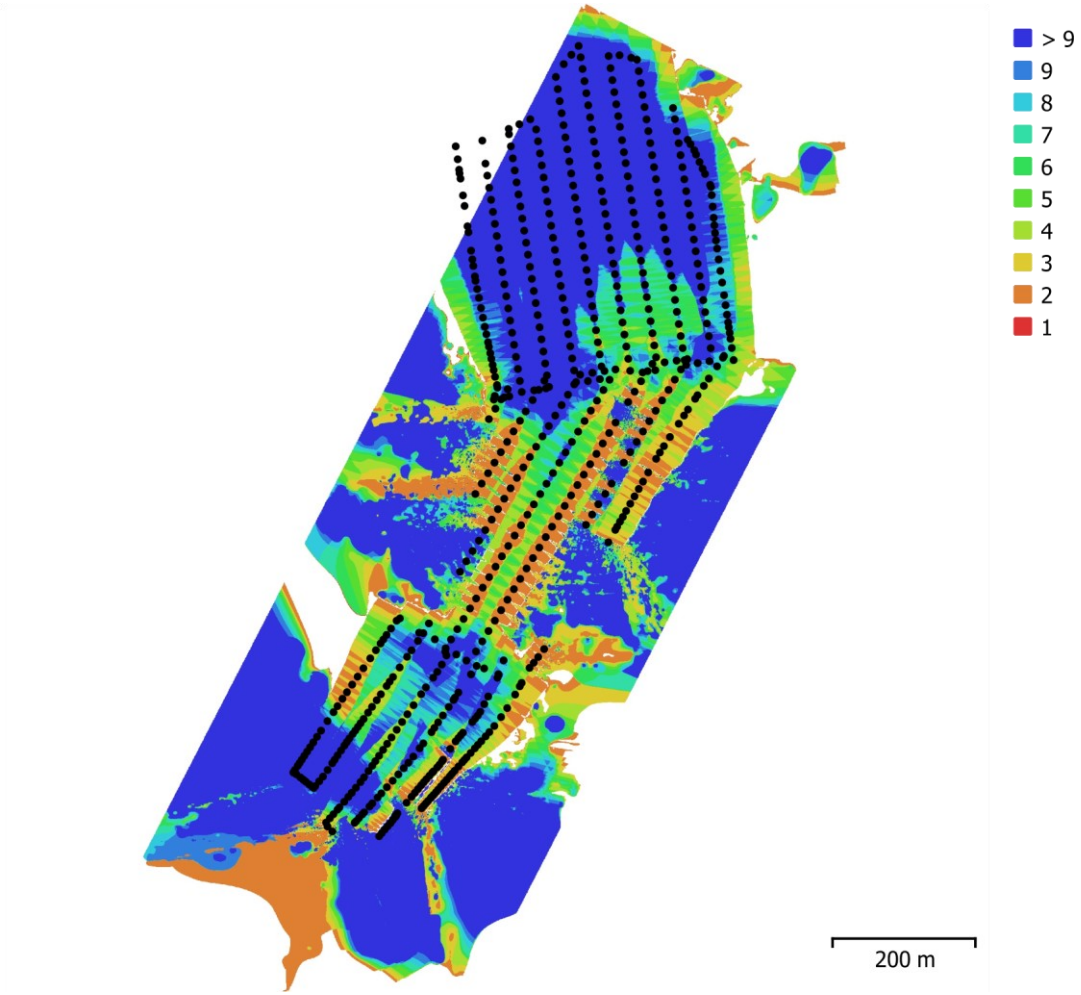


Fig. 1. Camera locations and image overlap.

Number of images:	688	Camera stations:	605
Flying altitude:	68.4 m	Tie points:	1,377,256
Ground resolution:	1.55 cm/pix	Projections:	4,114,197
Coverage area:	0.591 km²	Reprojection error:	0.358 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

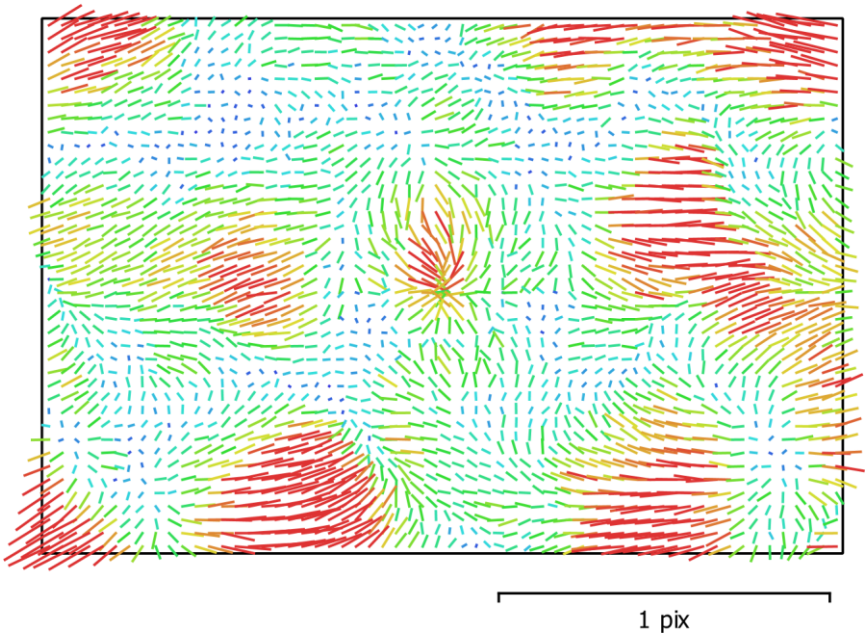


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

688 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4384.58**	0.46	1.00	0.39	0.29	-0.03	0.36	-0.50	-0.03	0.00
Cx	**-14.4965**	0.011		1.00	0.16	0.02	0.15	-0.21	0.73	0.03
Cy	**1.98257**	0.0093			1.00	0.01	0.10	-0.14	0.05	0.78
K1	**-0.0042765**	1.3e-05				1.00	-0.74	0.65	0.04	0.03
K2	**0.0399057**	4.8e-05					1.00	-0.97	0.01	0.00
K3	**-0.0484539**	6.2e-05						1.00	-0.00	-0.00
P1	**-0.000458496**	7.9e-07							1.00	0.04
P2	**-0.000154643**	7.5e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

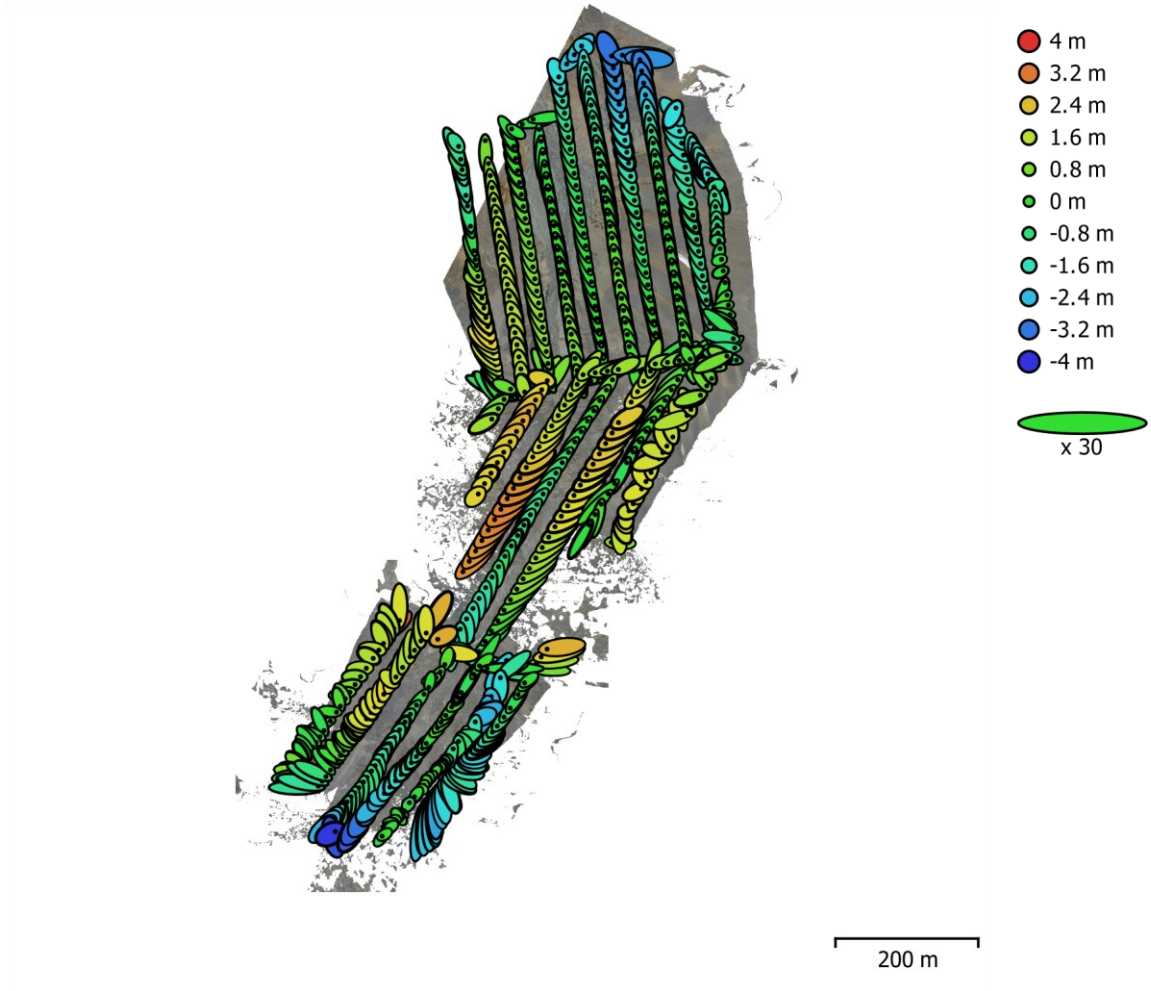


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.656276	0.956281	1.37719	1.15982	1.80051

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

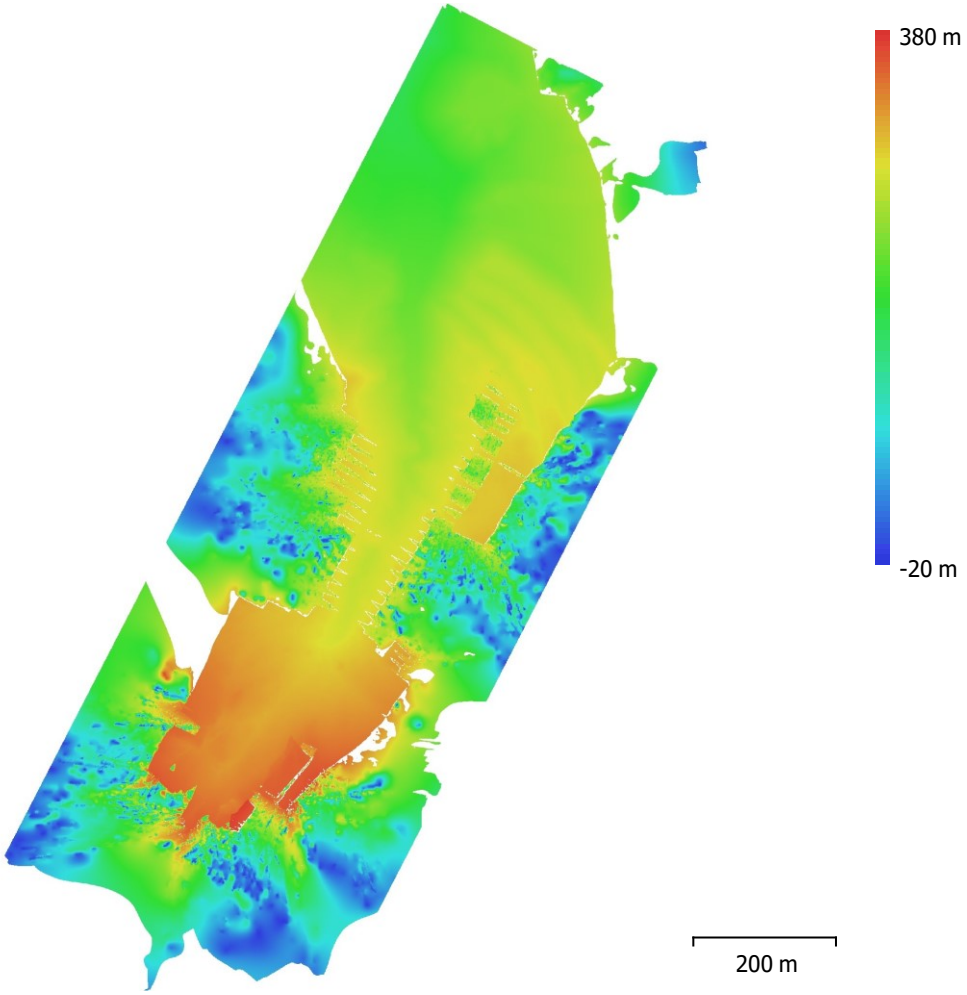


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.1 cm/pix
Point density:	0.104 points/cm²

Processing Parameters

General	
Cameras	688
Aligned cameras	605
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	1,377,256 of 1,753,961
RMS reprojection error	0.113798 (0.357792 pix)
Max reprojection error	0.368644 (26.7373 pix)
Mean key point size	3.0229 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.41942
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	12 minutes 30 seconds
Matching memory usage	5.00 GB
Alignment time	19 minutes 47 seconds
Alignment memory usage	729.12 MB
Date created	2021:09:24 09:04:19
Software version	1.7.4.13028
File size	128.14 MB
Depth Maps	
Count	598
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	39 minutes 58 seconds
Memory usage	7.49 GB
Date created	2021:09:28 13:40:52
Software version	1.7.4.13028
File size	4.39 GB
Dense Point Cloud	
Points	480,315,279
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	39 minutes 58 seconds

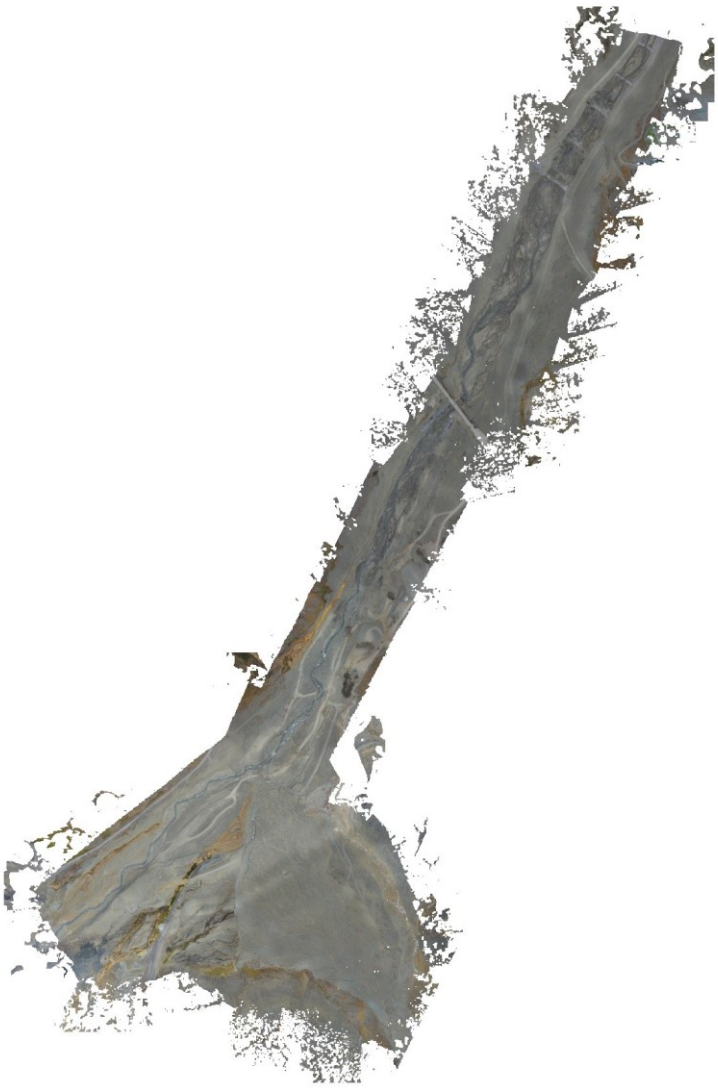
Memory usage	7.49 GB
Dense cloud generation parameters	
Processing time	58 minutes 23 seconds
Memory usage	13.03 GB
Date created	2021:09:28 14:39:16
Software version	1.7.4.13028
File size	6.71 GB
DEM	
Size	35,398 x 48,197
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	7 minutes 6 seconds
Memory usage	337.14 MB
Date created	2021:09:29 08:03:43
Software version	1.7.4.13028
File size	2.75 GB
Orthomosaic	
Size	63,466 x 89,190
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	31 minutes 9 seconds
Memory usage	11.86 GB
Date created	2021:09:29 08:36:17
Software version	1.7.4.13028
File size	16.01 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix H – Upper middle Longyearelva late-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

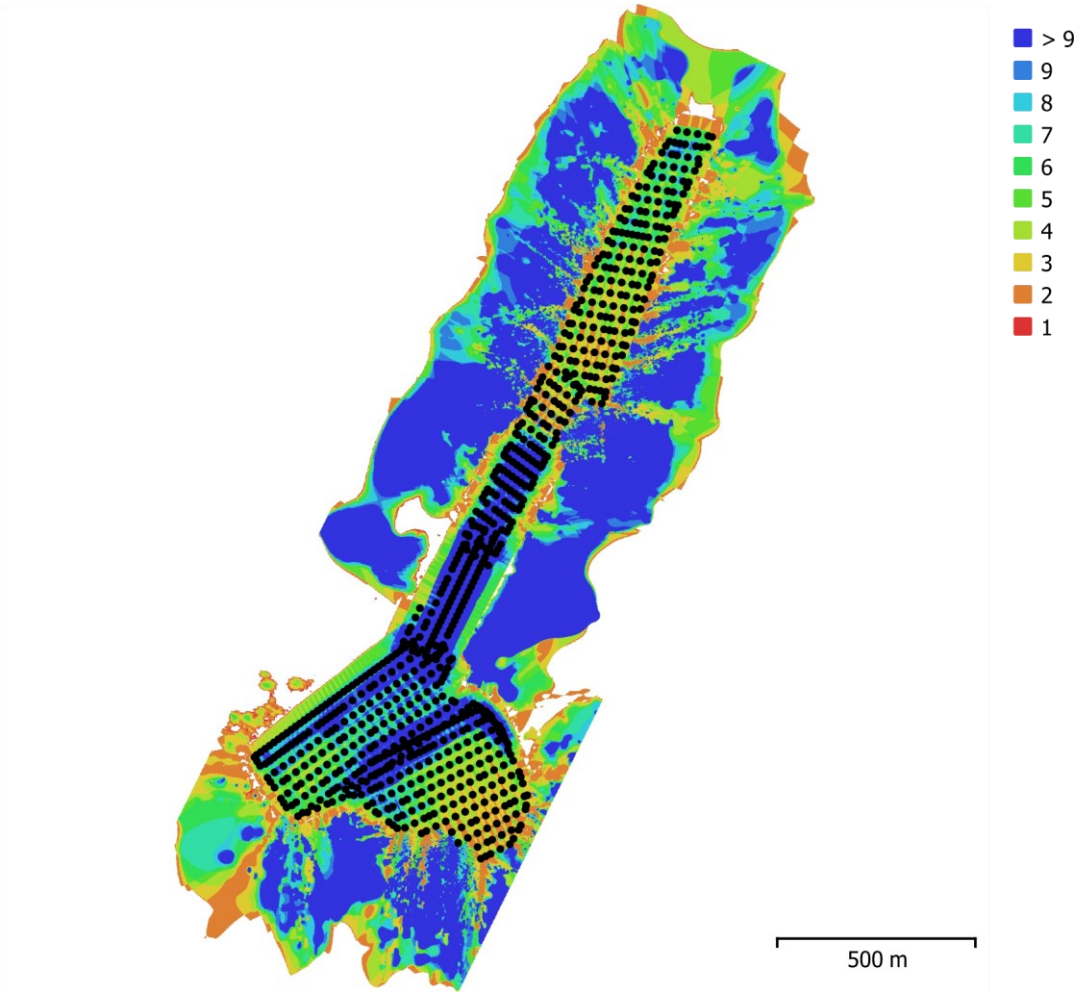


Fig. 1. Camera locations and image overlap.

Number of images:	801	Camera stations:	788
Flying altitude:	69.4 m	Tie points:	3,050,199
Ground resolution:	1.56 cm/pix	Projections:	8,965,757
Coverage area:	1.68 km²	Reprojection error:	0.404 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

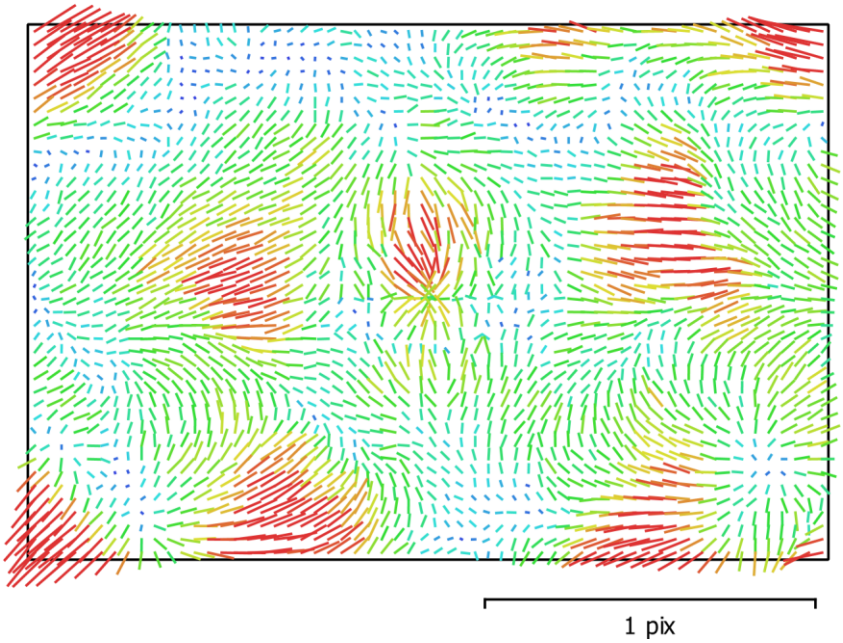


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

801 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4309.42**	0.65	1.00	0.60	0.44	-0.07	0.61	-0.75	-0.11	-0.06
Cx	**-14.2086**	0.015		1.00	0.29	-0.03	0.37	-0.45	0.31	-0.01
Cy	**5.80549**	0.011			1.00	-0.03	0.27	-0.33	-0.01	0.45
K1	**-0.00599457**	1.2e-05				1.00	-0.52	0.42	0.11	0.08
K2	**0.0379555**	3.8e-05					1.00	-0.97	-0.06	-0.03
K3	**-0.0444886**	5.4e-05						1.00	0.08	0.04
P1	**-0.000418238**	5e-07							1.00	0.04
P2	**-0.000105932**	4.4e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

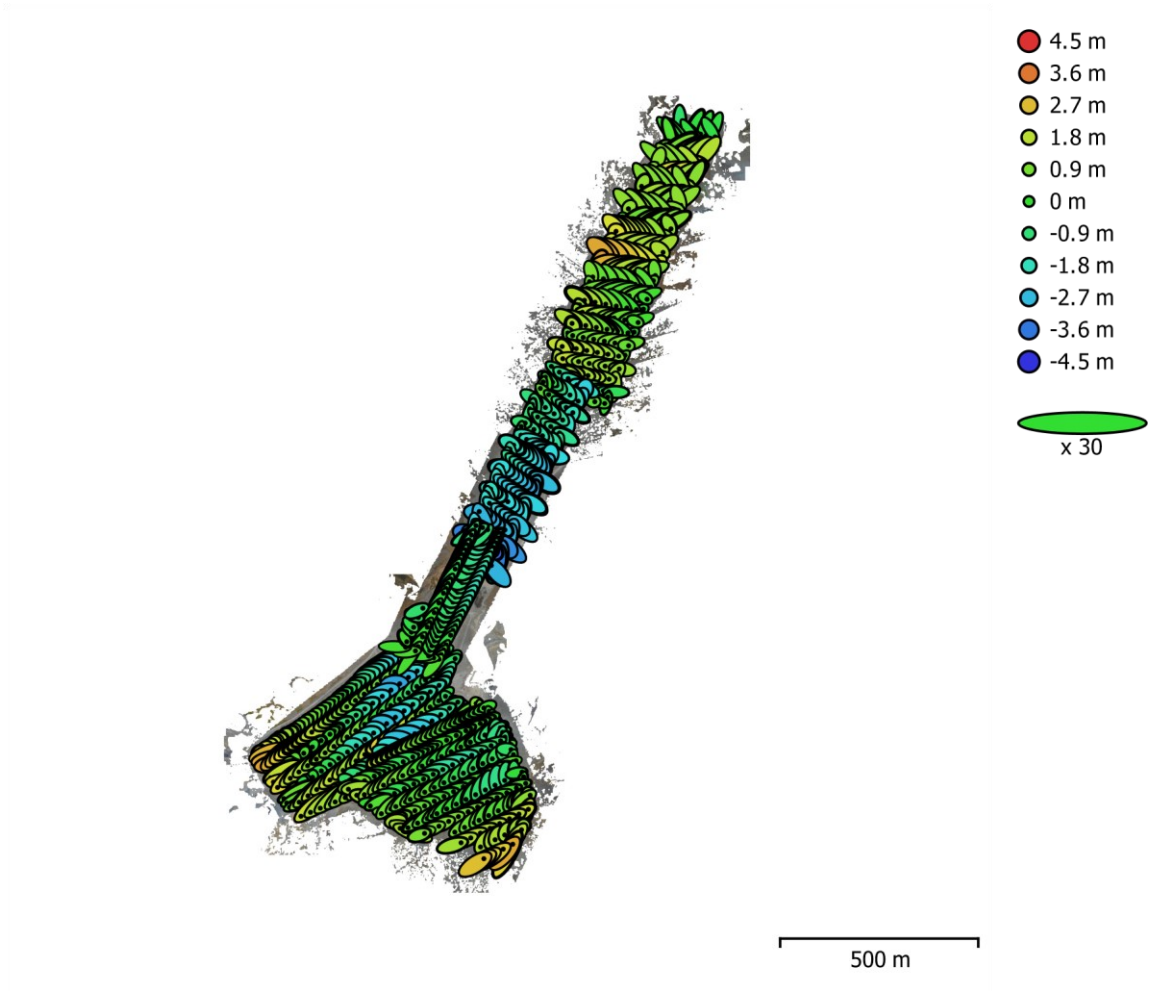


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
1.18864	1.00451	1.43666	1.55625	2.11799

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

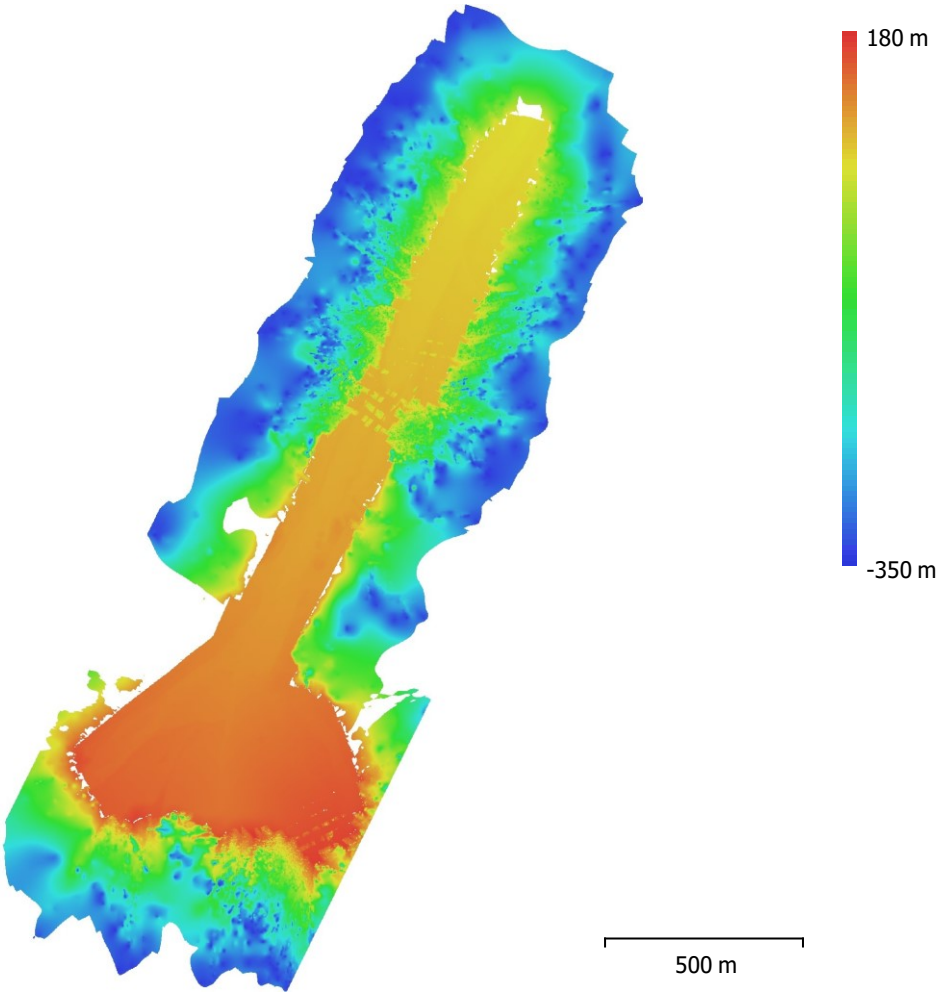


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.13 cm/pix
Point density:	0.102 points/cm²

Processing Parameters

General	
Cameras	801
Aligned cameras	788
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	3,050,199 of 3,625,290
RMS reprojection error	0.115426 (0.404371 pix)
Max reprojection error	0.372664 (26.9199 pix)
Mean key point size	3.18037 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.36558
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	30,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	9 minutes 12 seconds
Matching memory usage	865.26 MB
Alignment time	12 minutes 55 seconds
Alignment memory usage	1.04 GB
Date created	2021:10:06 08:52:15
Software version	1.7.4.13028
File size	266.47 MB
Depth Maps	
Count	787
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	41 minutes 1 seconds
Memory usage	5.94 GB
Date created	2021:10:06 09:52:14
Software version	1.7.4.13028
File size	5.50 GB
Dense Point Cloud	
Points	637,454,796
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	41 minutes 1 seconds

Memory usage	5.94 GB
Dense cloud generation parameters	
Processing time	1 hours 14 minutes
Memory usage	12.42 GB
Date created	2021:10:06 11:06:38
Software version	1.7.4.13028
File size	9.05 GB
DEM	
Size	61,628 x 88,420
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	15 minutes 43 seconds
Memory usage	419.12 MB
Date created	2021:10:06 11:23:05
Software version	1.7.4.13028
File size	7.77 GB
Orthomosaic	
Size	103,402 x 159,469
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	34 minutes 31 seconds
Memory usage	11.75 GB
Date created	2021:10:06 11:45:09
Software version	1.7.4.13028
File size	20.35 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix I – Lower Longyearelva late-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021

Survey Data

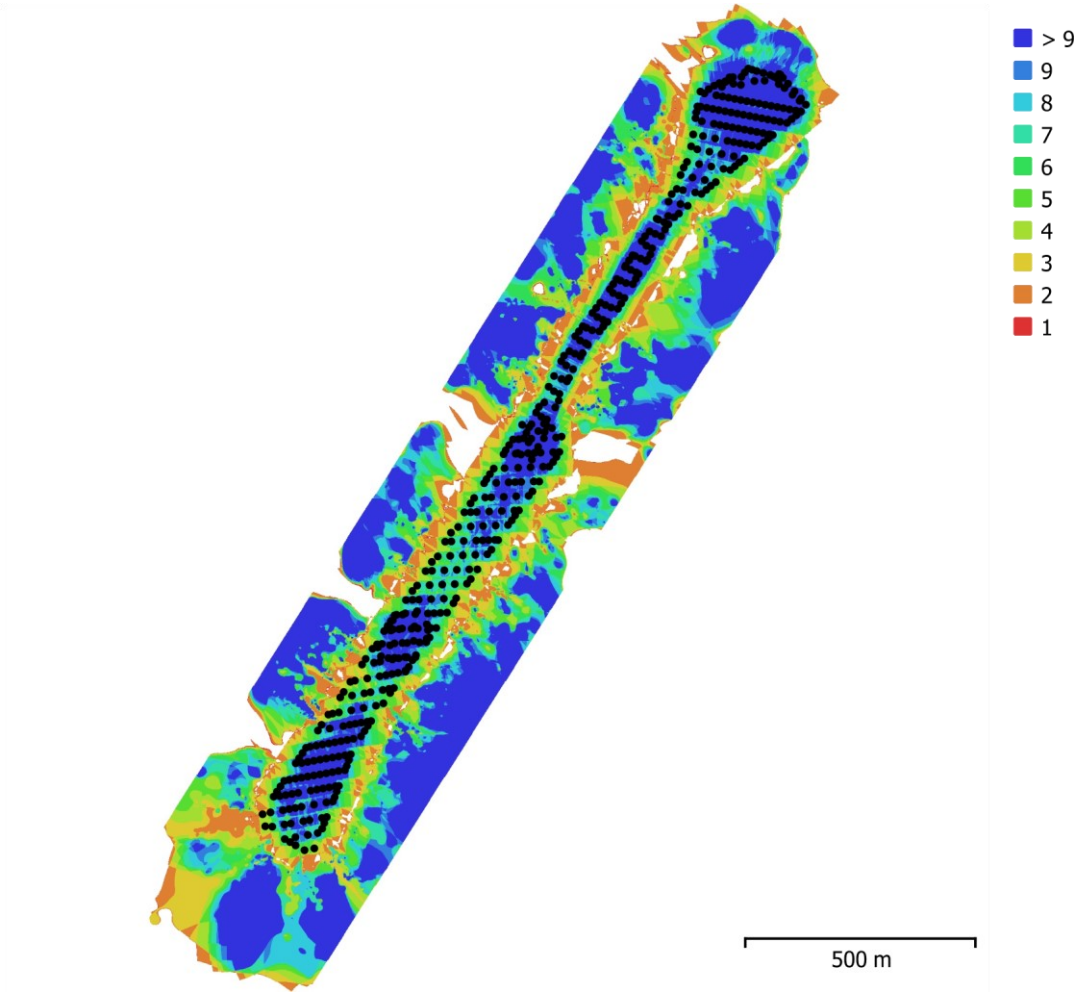


Fig. 1. Camera locations and image overlap.

Number of images:	476	Camera stations:	476
Flying altitude:	81 m	Tie points:	976,475
Ground resolution:	1.65 cm/pix	Projections:	3,399,392
Coverage area:	0.967 km²	Reprojection error:	1.08 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

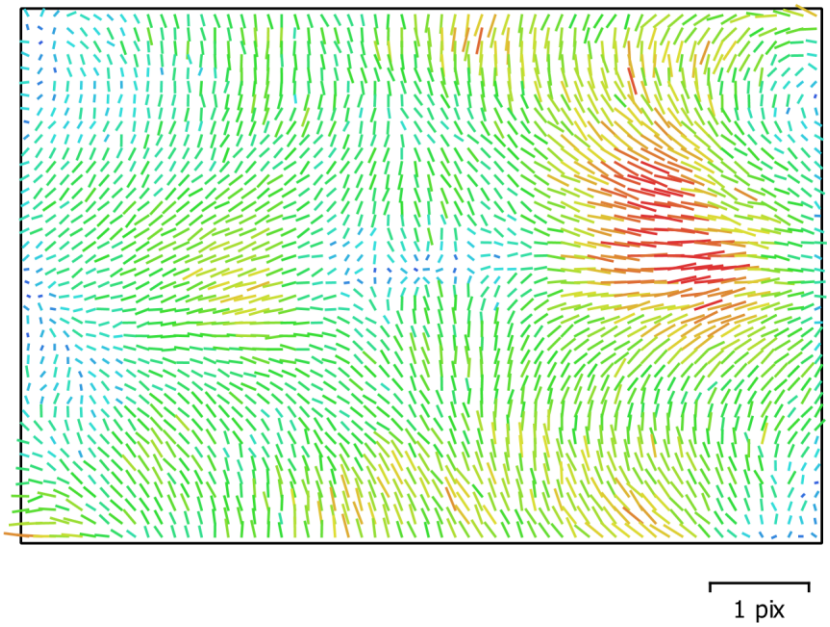


Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

476 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4620.38**	2.6	1.00	0.46	0.61	-0.10	0.60	-0.72	-0.17	-0.05
Cx	**-10.7086**	0.06		1.00	0.29	-0.05	0.28	-0.34	0.31	-0.00
Cy	**9.45902**	0.057			1.00	-0.06	0.36	-0.44	-0.06	0.30
K1	**-0.00558197**	4.2e-05				1.00	-0.64	0.55	0.07	0.08
K2	**0.047959**	0.00018					1.00	-0.98	-0.10	-0.03
K3	**-0.0620008**	0.00029						1.00	0.12	0.04
P1	**-0.00069751**	2.1e-06							1.00	0.10
P2	**-0.00024374**	1.6e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

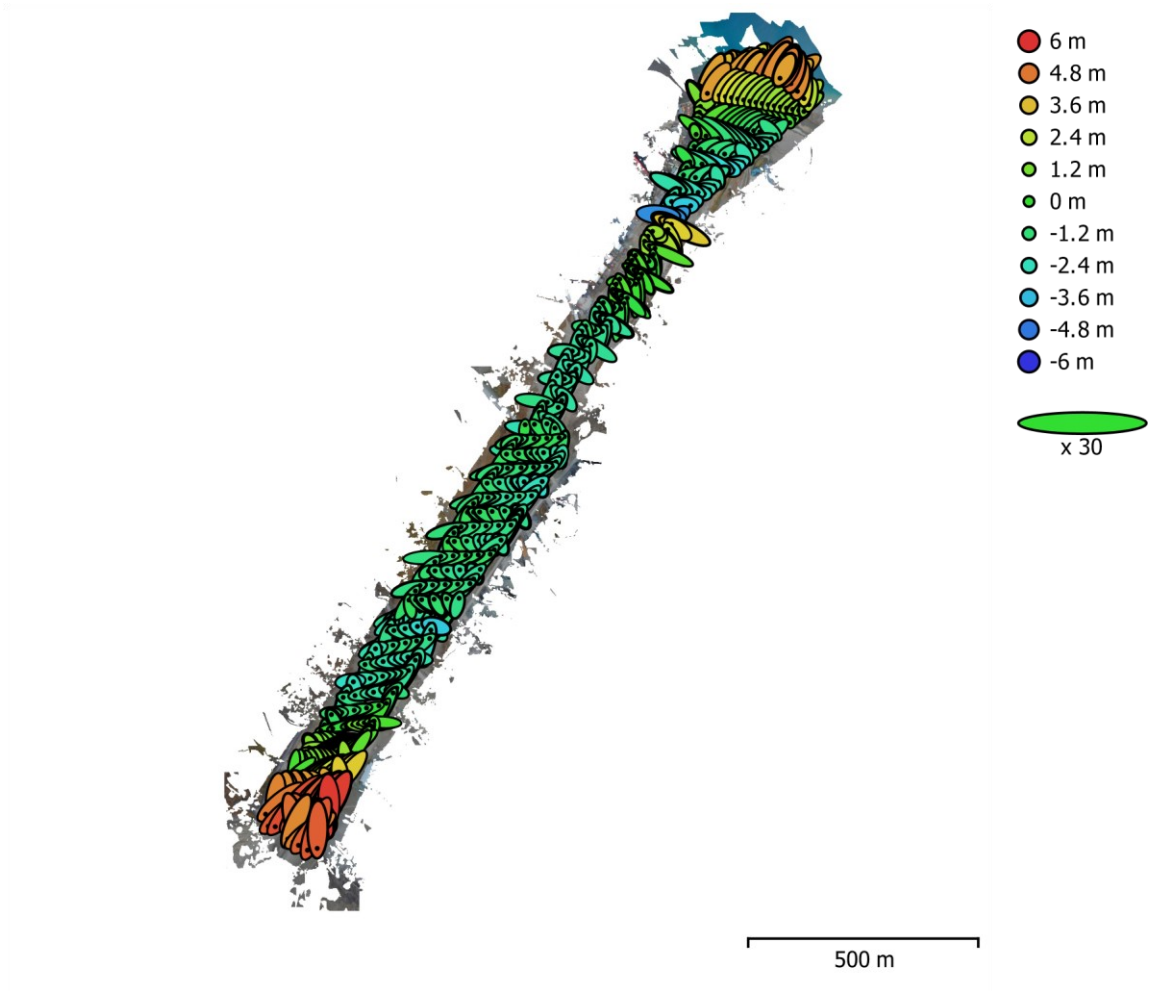


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
1.30492	1.23828	2.22957	1.79893	2.8648

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

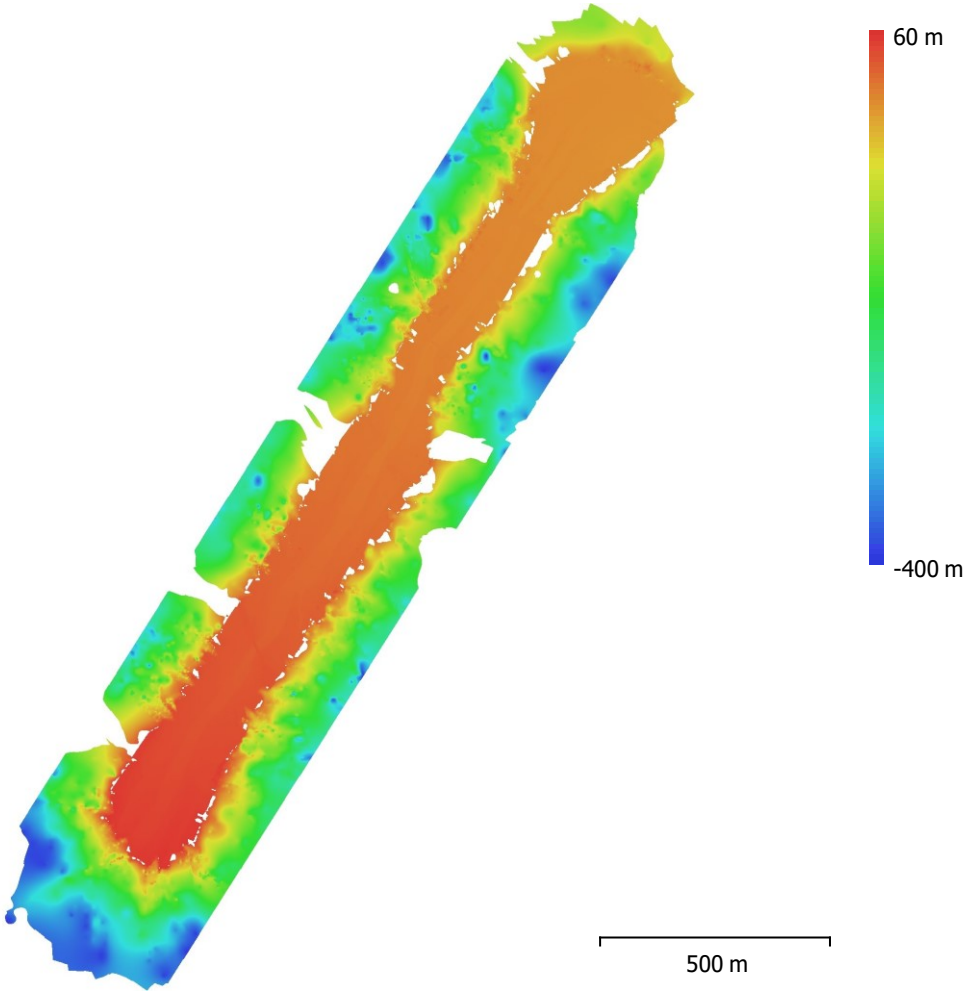


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.3 cm/pix
Point density:	919 points/m²

Processing Parameters

General	
Cameras	476
Aligned cameras	476
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	976,475 of 1,194,228
RMS reprojection error	0.28051 (1.08306 pix)
Max reprojection error	0.918521 (39.8581 pix)
Mean key point size	3.58147 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.89232
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	10,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	7 minutes 27 seconds
Matching memory usage	3.62 GB
Alignment time	19 minutes 10 seconds
Alignment memory usage	485.21 MB
Date created	2021:09:24 08:53:49
Software version	1.7.4.13028
File size	96.76 MB
Depth Maps	
Count	476
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 37 minutes
Memory usage	5.69 GB
Date created	2021:09:24 11:03:13
Software version	1.7.4.13028
File size	3.23 GB
Dense Point Cloud	
Points	368,525,494
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Max neighbors	40
Processing time	1 hours 37 minutes

Memory usage	5.69 GB
Dense cloud generation parameters	
Processing time	1 hours 22 minutes
Memory usage	8.86 GB
Date created	2021:09:24 12:25:44
Software version	1.7.4.13028
File size	5.26 GB
DEM	
Size	61,201 x 85,405
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	13 minutes 4 seconds
Memory usage	453.32 MB
Date created	2021:09:28 12:03:32
Software version	1.7.4.13028
File size	4.22 GB
Orthomosaic	
Size	90,894 x 130,110
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	23 minutes 58 seconds
Memory usage	10.30 GB
Date created	2021:09:28 12:30:06
Software version	1.7.4.13028
File size	11.08 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

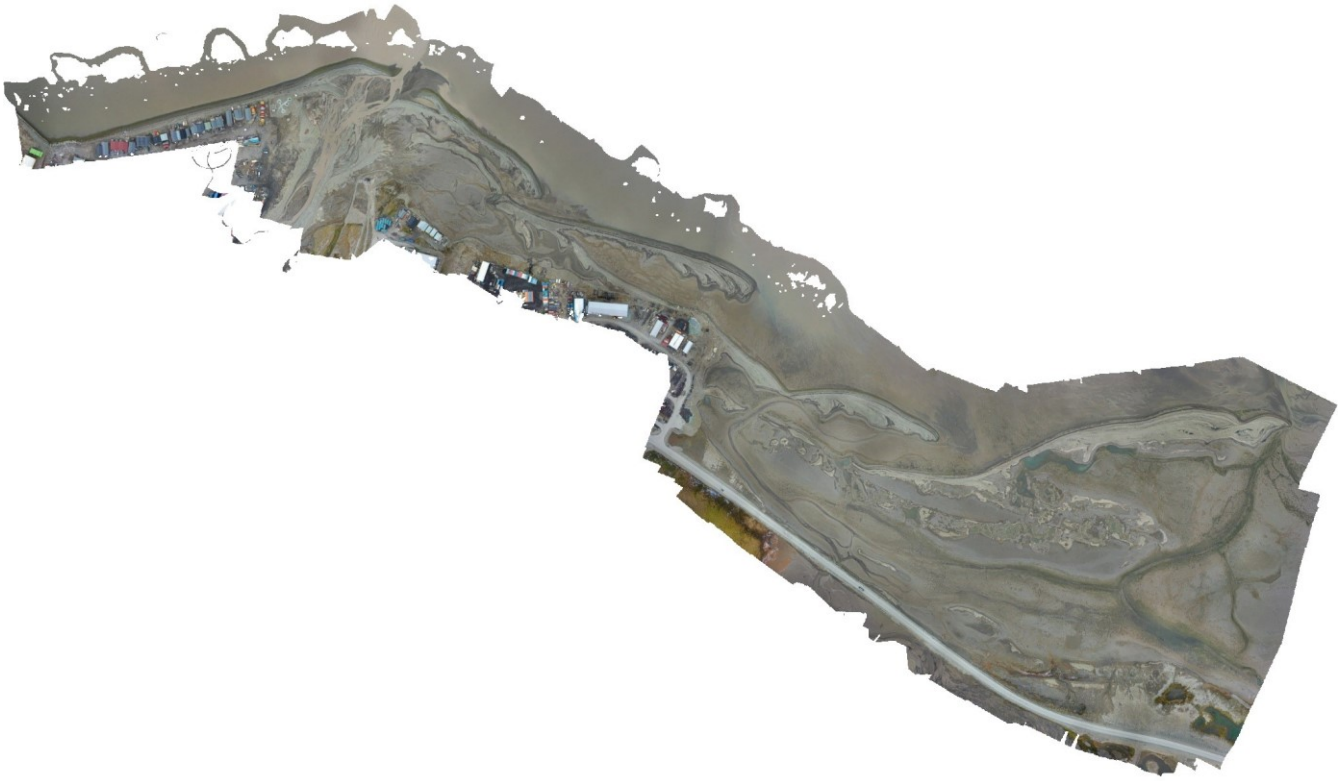
Norwegian Polar Institute. (n.d., 19/05/2020). *Norwegian Polar Institute Map Data and Services*. https://geodata.npolar.no/

Appendix J - The Longyear delta late-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

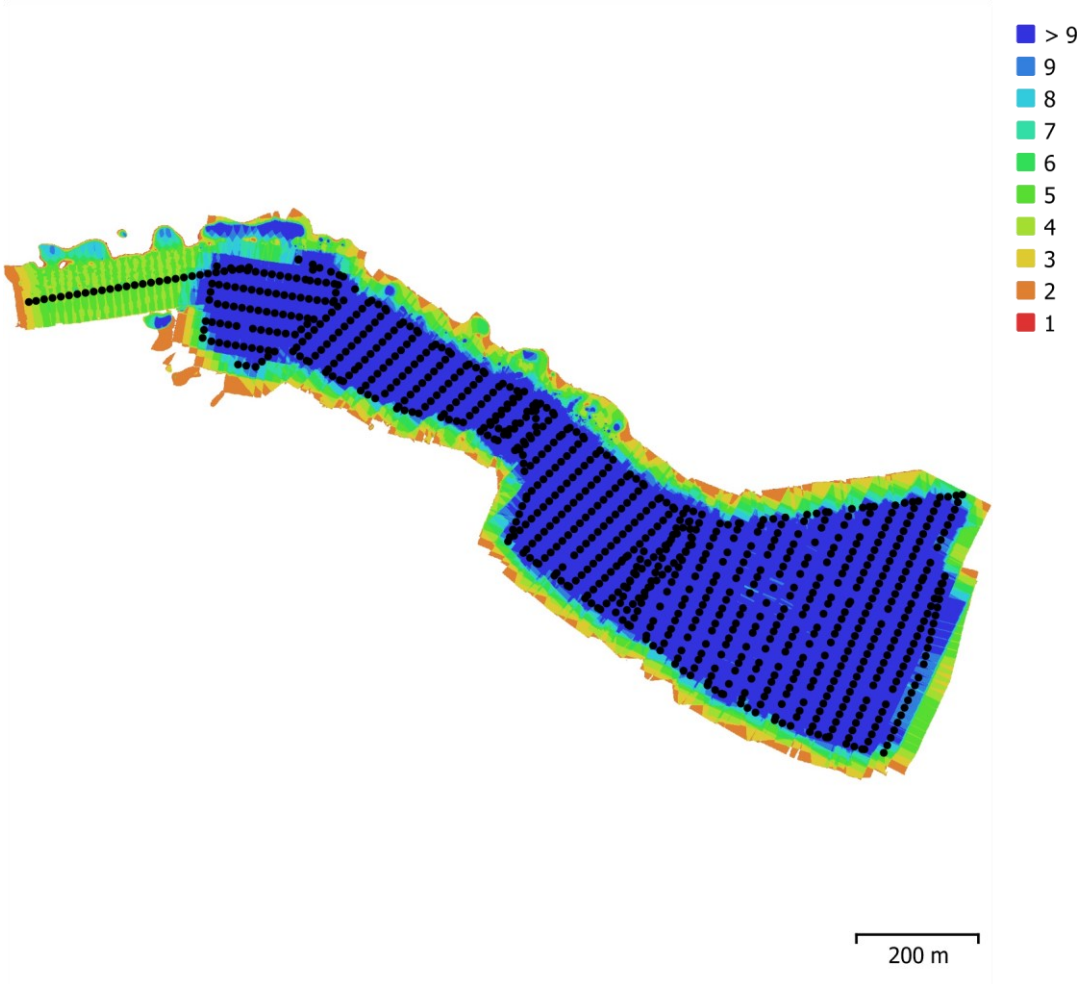


Fig. 1. Camera locations and image overlap.

Number of images:	865	Camera stations:	865
Flying altitude:	97.4 m	Tie points:	1,022,338
Ground resolution:	1.81 cm/pix	Projections:	5,514,730
Coverage area:	0.489 km²	Reprojection error:	0.893 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

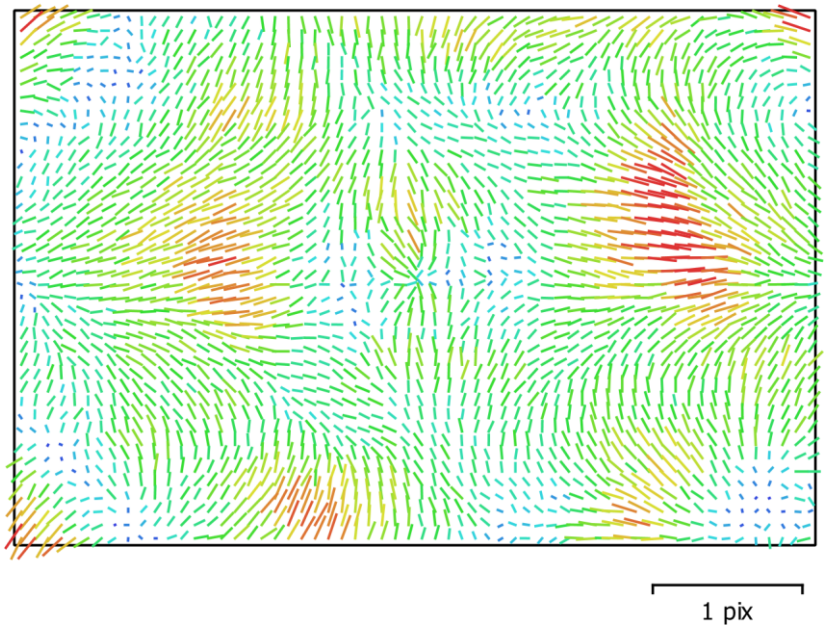


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

865 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**5097.4**	2.3	1.00	0.06	0.48	-0.10	0.78	-0.87	-0.24	-0.06
Cx	**-2.31396**	0.046		1.00	-0.03	0.02	0.06	-0.06	0.29	-0.00
Cy	**11.7463**	0.046			1.00	-0.04	0.37	-0.42	-0.12	0.20
K1	**-0.00734887**	3.8e-05				1.00	-0.35	0.28	0.11	0.19
K2	**0.0736581**	0.00017					1.00	-0.98	-0.19	-0.04
K3	**-0.119162**	0.00037						1.00	0.21	0.05
P1	**-0.00058868**	1.1e-06							1.00	0.02
P2	**-0.000196001**	7.5e-07								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

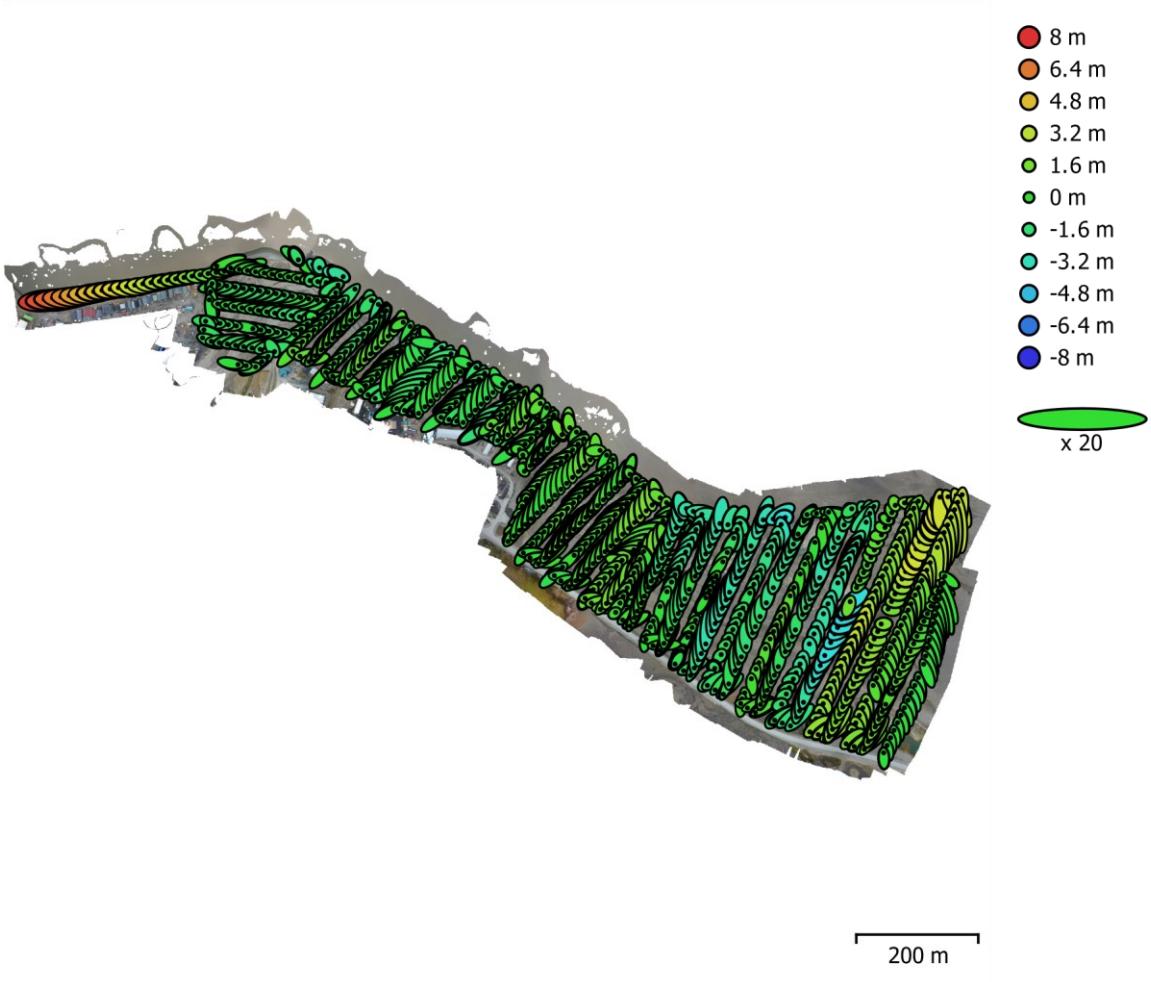


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.87817	1.16403	1.56535	1.45813	2.13927

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

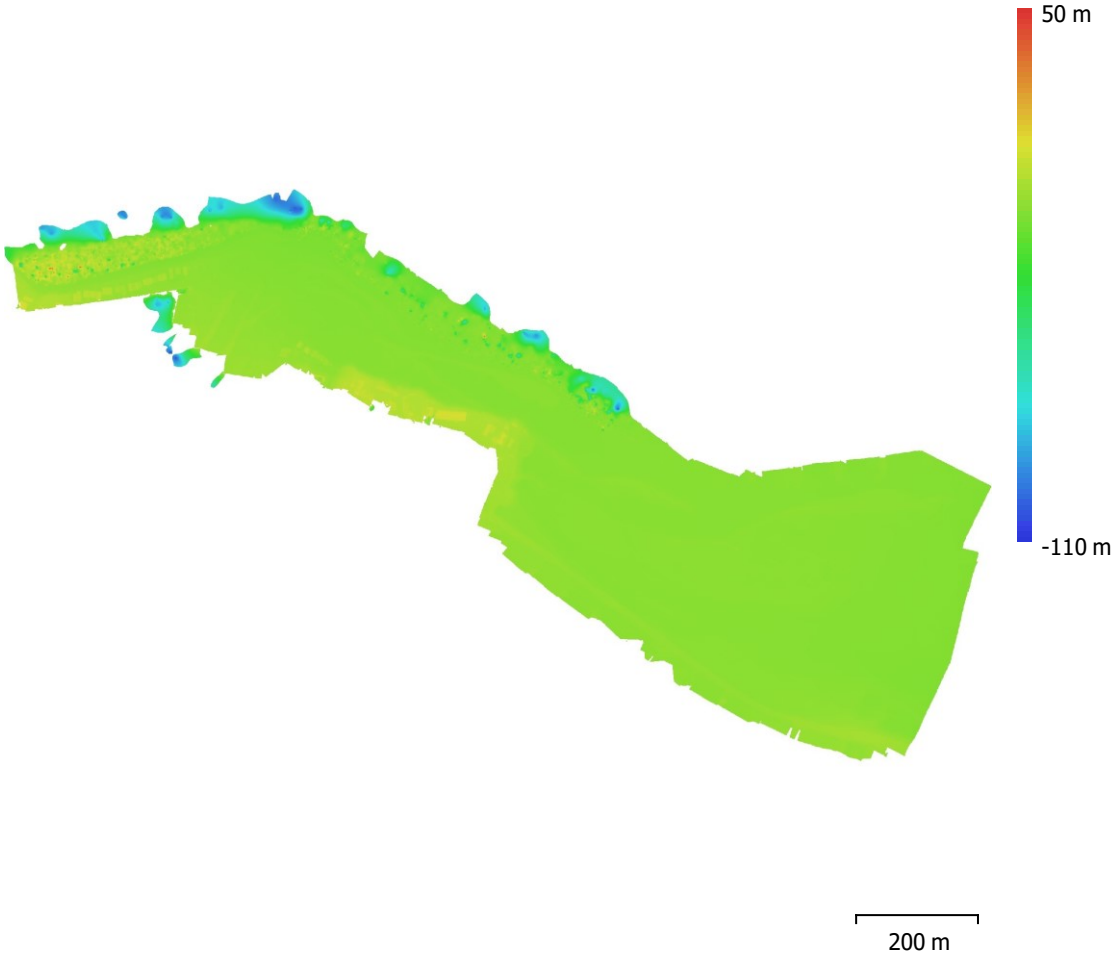


Fig. 4. Reconstructed digital elevation model.

Resolution:	3.63 cm/pix
Point density:	760 points/m²

Processing Parameters

General	
Cameras	865
Aligned cameras	865
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	1,022,338 of 1,404,783
RMS reprojection error	0.220779 (0.892741 pix)
Max reprojection error	0.711158 (42.3206 pix)
Mean key point size	3.90251 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	6.21659
Alignment parameters	
Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	10,000
Exclude stationary tie points	No
Guided image matching	No
Adaptive camera model fitting	No
Matching time	5 minutes 40 seconds
Matching memory usage	3.77 GB
Alignment time	23 minutes 2 seconds
Alignment memory usage	730.06 MB
Date created	2021:09:05 09:36:56
Software version	1.7.2.12040
File size	160.79 MB
Depth Maps	
Count	865
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	52 minutes 22 seconds
File size	5.59 GB
Dense Point Cloud	
Points	349,611,635
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	52 minutes 22 seconds
Dense cloud generation parameters	
Processing time	1 hours 54 minutes
Date created	2021:09:05 12:59:36
Software version	1.7.2.12040
File size	4.94 GB
DEM	

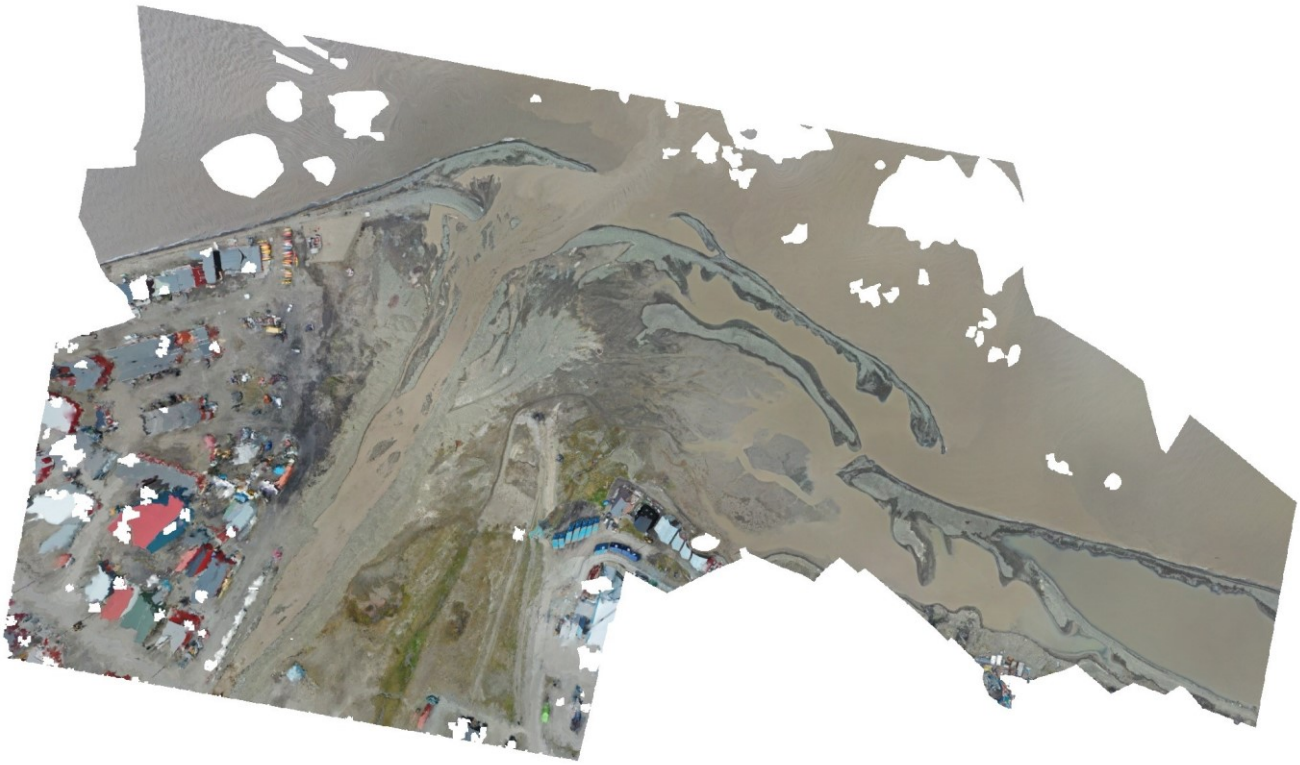
Size	56,937 x 39,761
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	4 minutes 17 seconds
Memory usage	549.73 MB
Date created	2021:09:06 08:26:02
Software version	1.7.2.12040
File size	1.58 GB
Orthomosaic	
Size	89,329 x 51,796
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	17 minutes 5 seconds
Memory usage	6.96 GB
Date created	2021:09:06 08:38:20
Software version	1.7.2.12040
File size	15.10 GB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000

Appendix K – The Longyear delta mid-season Agisoft report

Agisoft Metashape

Processing Report

29 October 2021



Survey Data

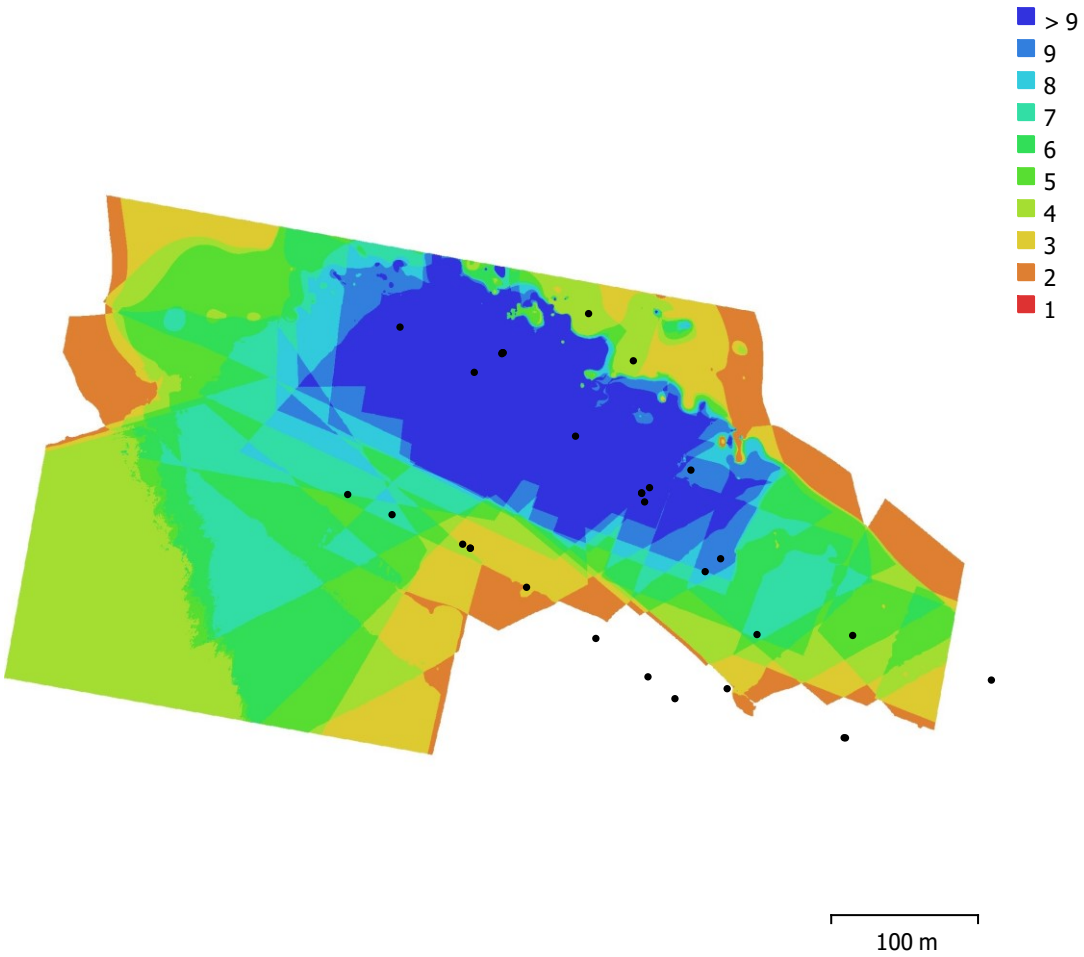


Fig. 1. Camera locations and image overlap.

Number of images:	32	Camera stations:	31
Flying altitude:	175 m	Tie points:	49,303
Ground resolution:	3.59 cm/pix	Projections:	135,963
Coverage area:	0.16 km²	Reprojection error:	0.744 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c (10.26mm)	5472 x 3078	10.26 mm	2.53 x 2.53 µm	No

Table 1. Cameras.

Camera Calibration

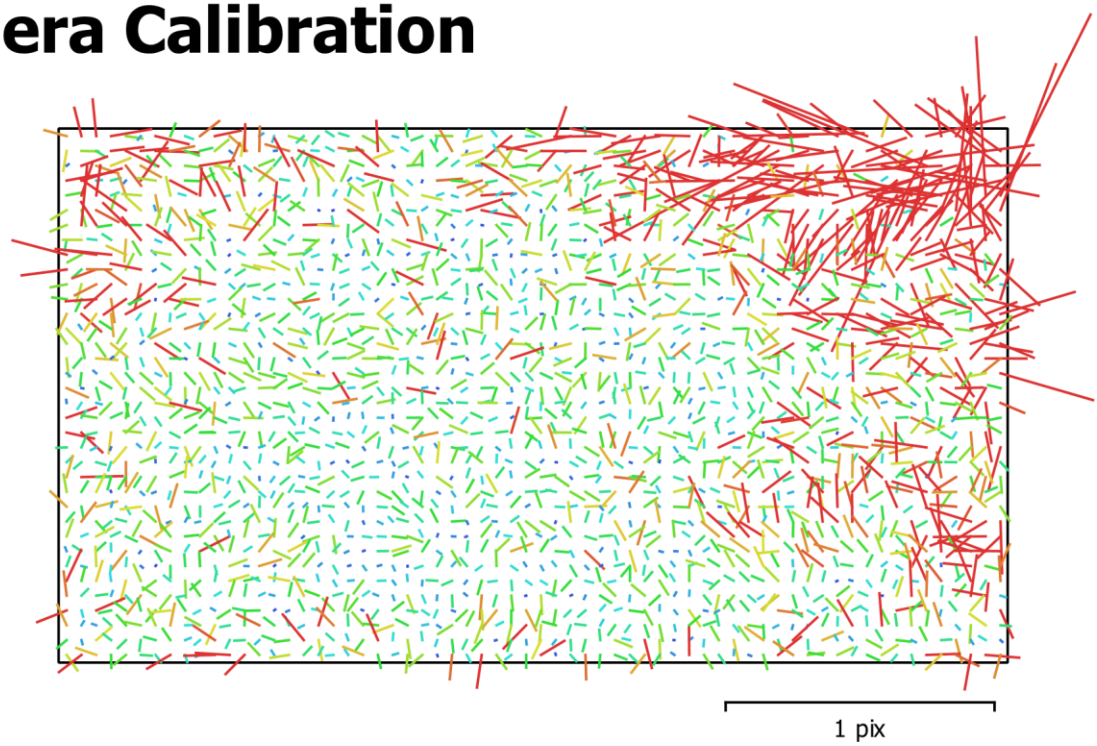


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

32 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3078**	**10.26 mm**	**2.53 x 2.53 µm**

	Value	**Error**	**F**	**Cx**	**Cy**	**K1**	**K2**	**K3**	**P1**	**P2**
F	**4359.4**	0.2	1.00	0.04	-0.48	0.04	0.06	-0.07	0.01	0.03
Cx	**-15.3373**	0.26		1.00	-0.02	-0.05	-0.00	0.01	0.97	0.06
Cy	**-17.3349**	0.27			1.00	-0.10	0.07	-0.06	0.02	0.69
K1	**0.000579909**	9.8e-05				1.00	-0.95	0.90	-0.06	-0.07
K2	**0.0216362**	0.00046					1.00	-0.98	-0.00	0.04
K3	**-0.02743**	0.00065						1.00	0.01	-0.04
P1	**-0.000524155**	1.8e-05							1.00	0.09
P2	**-0.000253957**	1.3e-05								1.00

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

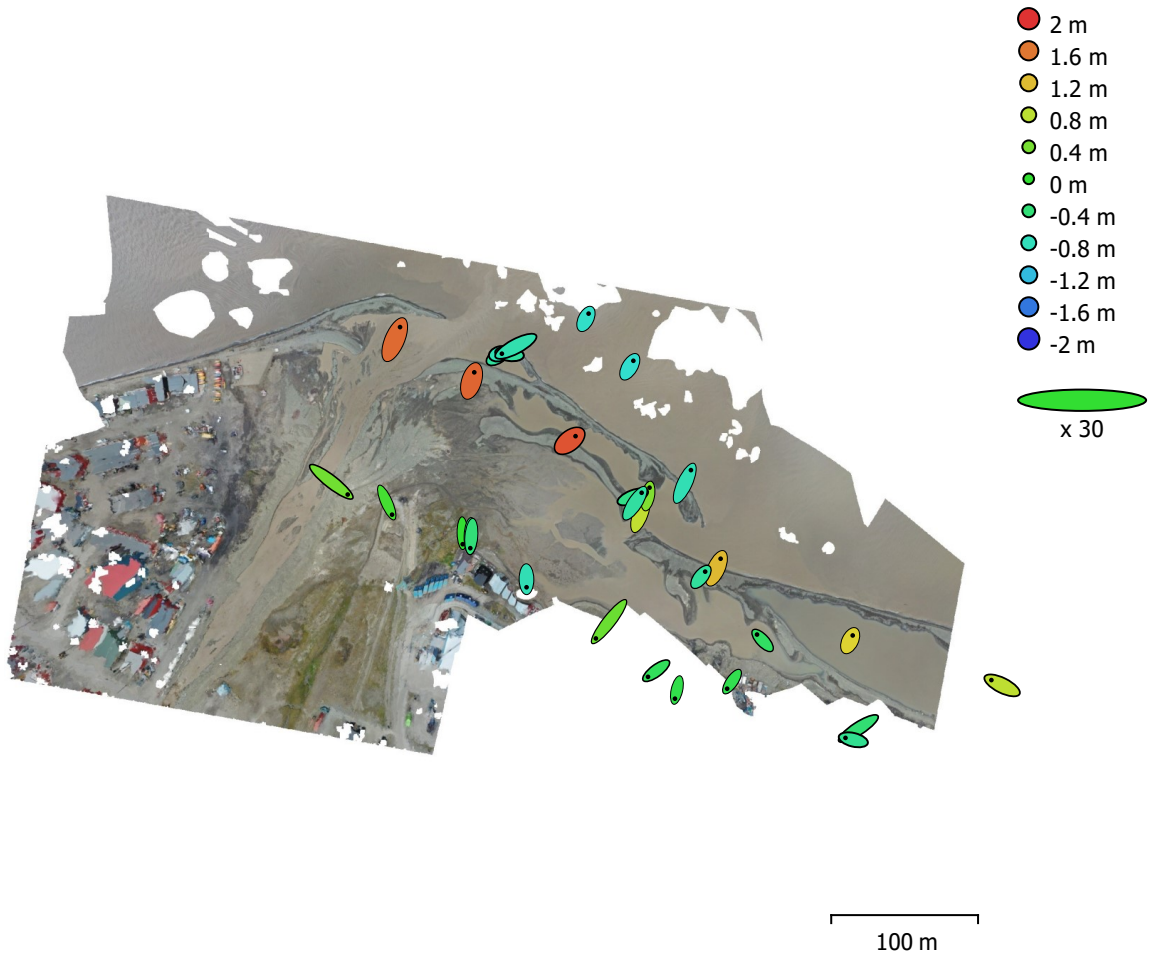


Fig. 3. Camera locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated camera locations are marked with a black dot.

X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total error (cm)
32.4139	40.0256	80.4411	51.5045	95.5169

Table 3. Average camera location error.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

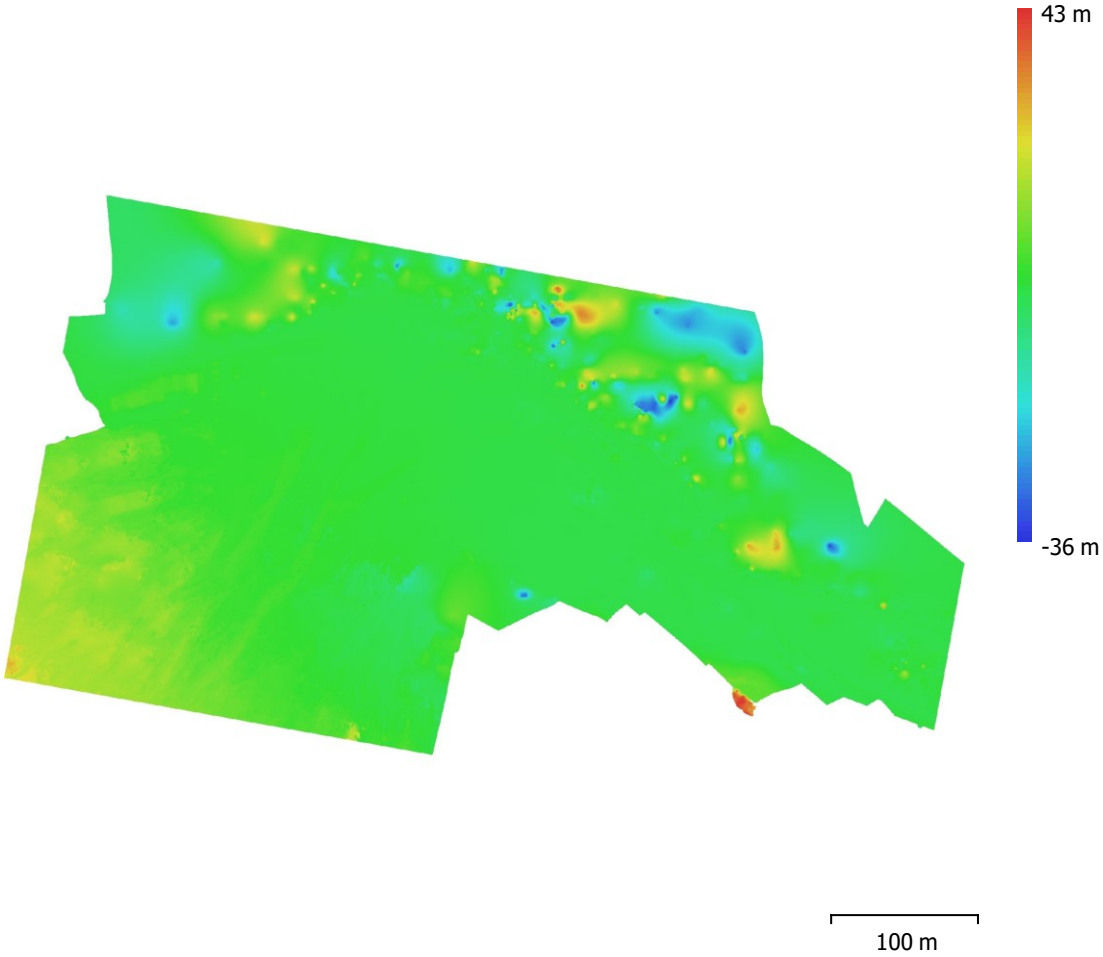


Fig. 4. Reconstructed digital elevation model.

Resolution:	7.17 cm/pix
Point density:	194 points/m²

Processing Parameters

General	
Cameras	32
Aligned cameras	31
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	49,303 of 63,485
RMS reprojection error	0.118208 (0.743518 pix)
Max reprojection error	0.358148 (24.4484 pix)
Mean key point size	4.66351 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	2.69831
Alignment parameters	
Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	10,000
Exclude stationary tie points	No
Guided image matching	No
Adaptive camera model fitting	No
Matching time	30 seconds
Matching memory usage	372.51 MB
Alignment time	10 seconds
Alignment memory usage	35.85 MB
Date created	2021:07:26 10:30:35
Software version	1.7.2.12040
File size	3.93 MB
Depth Maps	
Count	31
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	45 seconds
File size	91.75 MB
Dense Point Cloud	
Points	14,656,015
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	High
Filtering mode	Mild
Processing time	45 seconds
Dense cloud generation parameters	
Processing time	52 seconds
Date created	2021:07:26 10:34:34
Software version	1.7.2.12040
File size	198.26 MB
DEM	

Size	9,462 x 6,161
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	16 seconds
Memory usage	247.23 MB
Date created	2021:07:26 10:37:06
Software version	1.7.2.12040
File size	166.11 MB
Orthomosaic	
Size	18,218 x 10,624
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	1 minutes 9 seconds
Memory usage	4.07 GB
Date created	2021:07:26 10:38:23
Software version	1.7.2.12040
File size	590.73 MB
System	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	127.86 GB
CPU	AMD Ryzen Threadripper PRO 3945WX 12-Cores
GPU(s)	Quadro RTX 4000