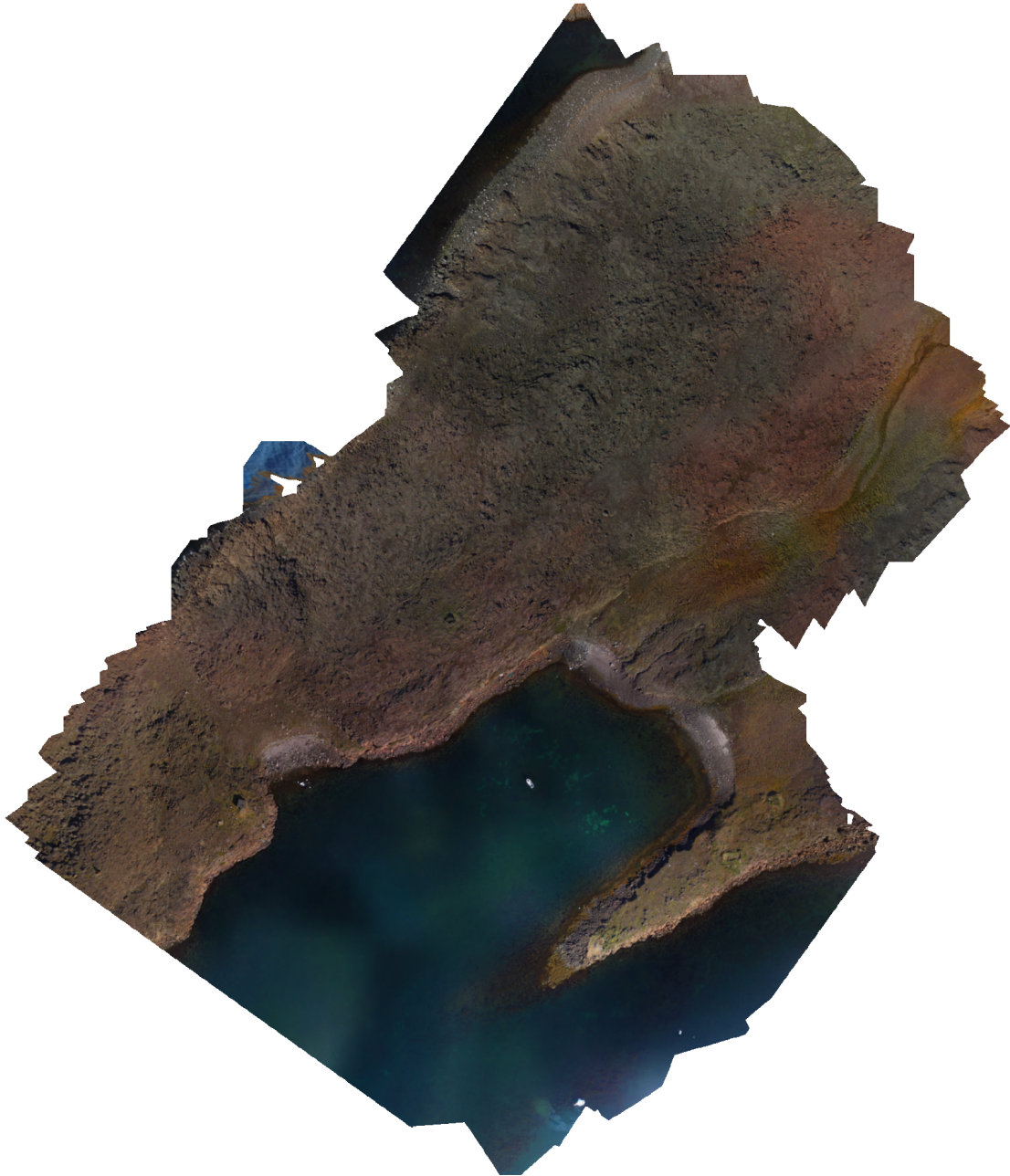


Bear Trap Phantom Survey

Bear Trap Aerial Survey

24 August 2020



Survey Data

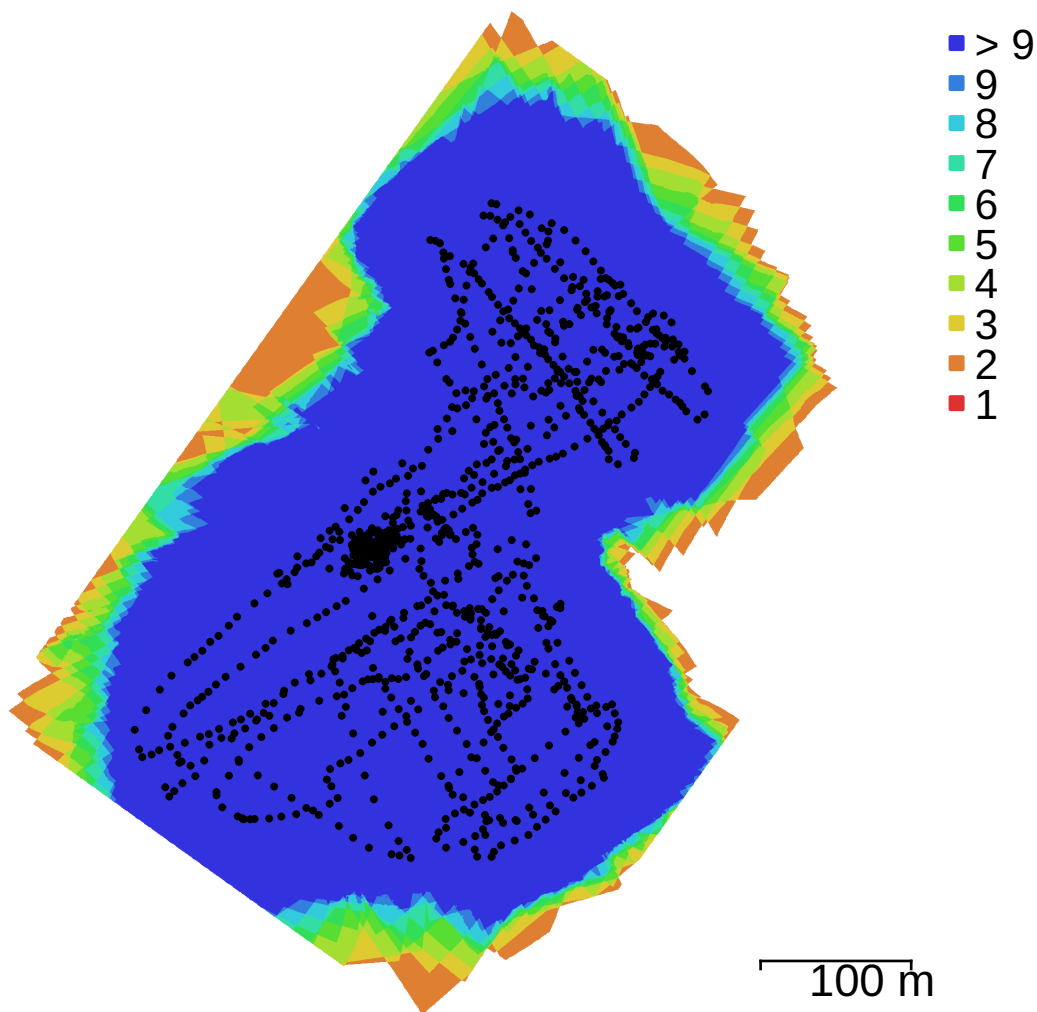


Fig. 1. Camera locations and image overlap.

Number of images:	1,113	Camera stations:	1,113
Flying altitude:	56.8 m	Tie points:	2,270,992
Ground resolution:	1.92 cm/pix	Projections:	8,615,294
Coverage area:	0.197 km ²	Reprojection error:	0.688 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC300C (3.61mm)	4000 x 3000	3.61 mm	1.56 x 1.56 μm	No

Table 1. Cameras.

Camera Calibration

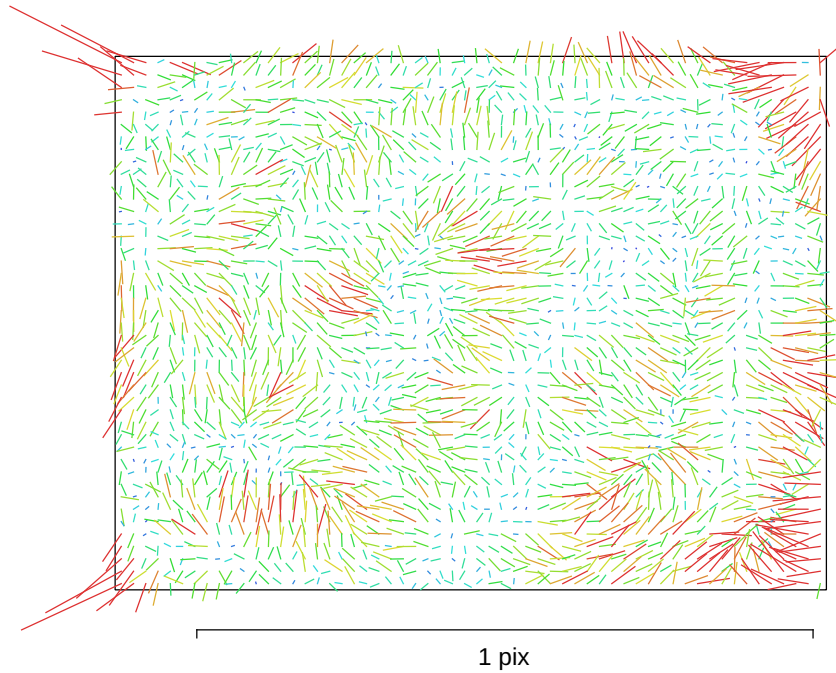


Fig. 2. Image residuals for FC300C (3.61mm).

FC300C (3.61mm)

1113 images

Type	Resolution	Focal Length	Pixel Size
Frame	4000 x 3000	3.61 mm	1.56 x 1.56 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2	P3	P4
F	2708.24	0.046	1.00	-0.05	-0.92	0.68	-0.18	-0.29	0.20	-0.14	0.12	0.53	0.64	-0.35	-0.41
Cx	19.4923	0.011		1.00	0.04	-0.04	0.70	0.02	-0.01	0.00	-0.00	0.29	-0.07	0.02	0.05
Cy	19.0339	0.03			1.00	-0.84	0.19	0.19	-0.11	0.06	-0.05	-0.53	-0.64	0.32	0.46
B1	-3.81599	0.0062				1.00	-0.18	-0.19	0.07	-0.03	0.02	0.51	0.73	-0.28	-0.52
B2	-0.658964	0.0034					1.00	0.05	-0.03	0.01	-0.01	-0.13	-0.20	0.08	0.16
K1	-0.146176	2.2e-05						1.00	-0.96	0.90	-0.85	-0.15	-0.22	0.10	0.12
K2	0.162801	9.4e-05							1.00	-0.98	0.95	0.09	0.11	-0.09	-0.02
K3	-0.0889901	0.00016								1.00	-0.99	-0.06	-0.06	0.07	-0.02
K4	0.0352943	9.3e-05									1.00	0.06	0.05	-0.07	0.03
P1	5.00074e-05	7.6e-07										1.00	0.71	-0.58	-0.15
P2	0.000227951	2.7e-06											1.00	-0.71	-0.23
P3	-0.393095	0.022												1.00	-0.47
P4	1.58398	0.018													1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

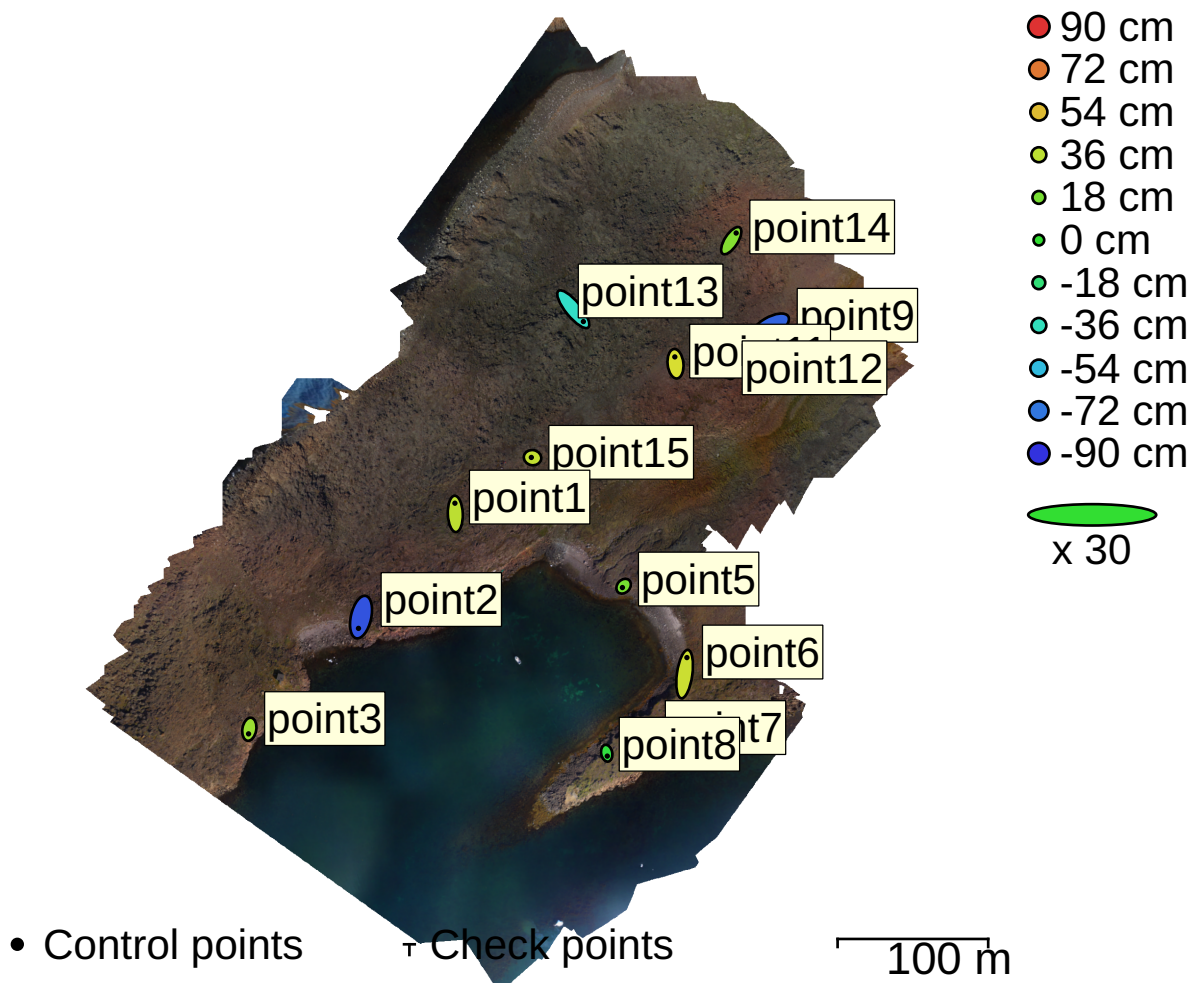


Fig. 3. GCP locations and error estimates.

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)
13	23.7931	36.5554	42.082	43.6166	60.6078

Table 3. Control points RMSE.

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

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
point2	-11.2609	-49.916	-81.361	96.1146	0.563 (45)
point3	-3.39847	-20.4217	27.1149	34.1147	1.218 (39)
point5	-5.34678	-5.85184	17.9202	19.595	1.852 (46)
point6	10.1222	73.2283	40.0517	84.0772	3.741 (40)
point7	-37.6518	12.3158	-32.8417	51.4579	2.252 (50)
point8	2.53569	-12.8475	-3.69532	13.6068	3.383 (44)
point9	-44.8578	-26.7995	-77.3358	93.3341	1.683 (42)
point11	-3.10971	30.3485	43.4442	53.0858	1.501 (76)
point12	33.9051	-27.2176	9.19135	44.4391	1.167 (49)
point13	44.6244	-54.6456	-38.9418	80.585	1.478 (53)
point14	21.7274	33.7536	21.2963	45.4414	1.895 (24)
point15	-5.28914	0.963474	37.6749	38.0566	1.742 (50)
point1	-1.76483	47.3653	36.1558	59.614	1.143 (68)
Total	23.7931	36.5554	42.082	60.6078	1.936

Table 4. Control points.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

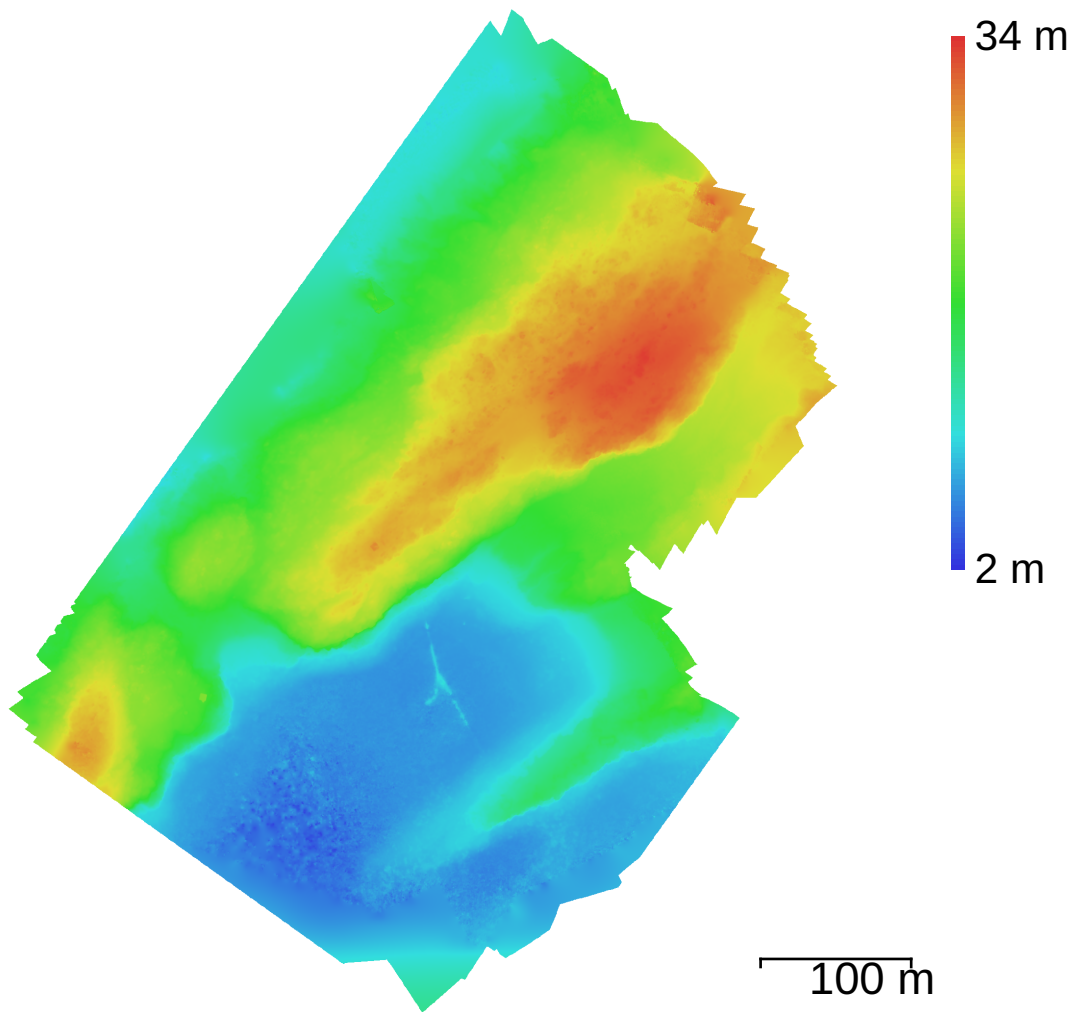


Fig. 4. Reconstructed digital elevation model.

Resolution: 7.66 cm/pix
Point density: 170 points/m²

Processing Parameters

General

Cameras	1113
Aligned cameras	1113
Markers	13
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	2,270,992 of 5,701,868
RMS reprojection error	0.201299 (0.687643 pix)
Max reprojection error	0.499981 (14.2503 pix)
Mean key point size	3.28483 pix
Point colors	3 bands, uint8
Key points	Yes
Average tie point multiplicity	5.43322

Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Yes
Key point limit	60,000
Tie point limit	0
Adaptive camera model fitting	No
Matching time	1 hours 19 minutes
Alignment time	1 hours 20 minutes

Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1-p4
Adaptive camera model fitting	No
Optimization time	27 seconds

Dense Point Cloud

Points	33,186,283
Point colors	3 bands, uint8

Reconstruction parameters

Quality	Medium
Depth filtering	Aggressive
Depth maps generation time	1 hours 51 minutes
Dense cloud generation time	5 hours 18 minutes

DEM

Size	8,705 x 9,228
Coordinate system	WGS 84 (EPSG::4326)

Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	39 seconds

Orthomosaic

Size	28,712 x 34,756
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

Reconstruction parameters

Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	12 minutes 50 seconds

Software

Version	1.4.4 build 6848
Platform	Linux 64