

Protokol určení bodů technologií GNSS

Lokalita (název): Rokytky	Katastrální území: Hrdlořezy	Okres: Hlavní město Praha
Zhotovitel: Perneroová Monika Na Výsluní 536/14 417 01 Dubí 1	Protokol zpracoval: Perneroová Monika	Dne: 30.10.2019

I. Přístroje GNSS

Přijímače: GPS+GLONASS;L1+L2

výrobce:	Trimble		
typ:	R6-2		
číslo:	5025432888		

Antény : integrovaná

výrobce:	Trimble		
typ:	R6-2		
číslo:	5025432888		

II. Zaměření (datum): 30.10.2019

Metoda: RTK s VRS (sít' Trimble VRS Now)	Použitá stanice nebo síť: Trimble VRS Now	Přístupový bod: TVN_CMV_PLUS
Interval záznamu: 1 sekunda	Elevační maska: 13°	Výška antény vztažena k: ARP (spodek závitů)

na nově určovaných bodech:

Minimální observační doba: 26 s	Maximální hodnota PDOP (GDOP): 2.02	Nejmenší počet zaměření bodu: 1x3
---	---	---

III. Geocentrické souřadnice

Zpracovatelský program (název a verze):	Trimble General Survey, 1.60
Souřadnice nepřipojeny/připojeny do:	připojeno do ETRS89
Kontrola připojení:	kontrola provedena pomocí výsledků nezávislého monitoringu VÚGTK

IV. Transformace do S-JTSK

Použit transformací postup:	transformace s výpočtem místních transformačních parametrů
Zpracovatelský program (název a verze):	Transformační modul zpřesněné globální transformace Trimble 2018 verze 1.0

V. Přílohy s jednotlivými výstupy z aparatur a zpracovatelských programů

počet stran:

1	s hodnotami zaznamenanými aparaturou v průběhu měření (číslo bodu, výška antény, vztažený bod antény, počty družic, hodnota PDOP nebo GDOP, časy observačních dob a další údaje)	1 viz.zap.
2	s nastavením parametrů a s výsledky a charakteristikami přesnosti početního zpracování vektorů	_____
3	se souřadnicemi identických bodů pro transformaci spolu s odchylkami dosaženými po transformaci	_____
4	schéma rozložení identických bodů (ve vhodném měřítku nebo s uvedením vzdáleností mezi nimi v km)	_____
5	s hodnotami odchylek dosažených na kontrolních bodech pro připojení geocentrických souřadnic	_____
6	výpočet výsledných souřadnic nově určovaných bodů a hodnoty dosažené na kontrolních bodech pro připojení	3 viz.zap.

VI. Poznámky a doplňující upřesnění pracovního postupu

----- PROTOKOL GNSS (RTK) MĚŘENÍ A VYTYČOVÁNÍ -----

Zhotovitel: Monika Pernerová
Na Vysluní 536/14
417 01 Dubí u Teplic

Zakazka: ROKYTKA
Meril: Pernerová Monika
Datum: 30.10.2019

Přístroj: Trimble R6-2, fw: 4.19, vyr. c.: 5025432888
Trimble General Survey SW: 1.60
Verze protokolu: 4.95

Souradnicový systém: Použit transformací modul zpřesněné globální transformace Trimble 2018 verze 1.0 schváleny ČUZK pro měření od 1.1.2018

Zona: Krovak_2018
Soubor rovinné dotransformace: KG2018

Vertikální transformace -----

Model kvazigeoidu: CR2005

POUŽÍTE A MĚŘENÉ BODY -----

Cislo bodu	Y	X	Z	Přesnost XY	Přesnost Z	PDOP	Sit*	Pocet sat.	Antena vyska;	od**	Datum	Zacatek mereni	Doba mereni [s]	
4001.1	736083.063	1042794.518	205.240	0.006	0.012	1.58	1 VRS	15	2.45	SZ	30.10	15:53	26	KOLIK
4001.2	736083.062	1042794.517	205.233	0.005	0.011	1.59	1 VRS	15	2.45	SZ	30.10	15:53	26	KOLIK
4001.3	736083.063	1042794.515	205.226	0.005	0.011	1.59	1 VRS	15	2.45	SZ	30.10	15:54	26	KOLIK
4002.1	735968.164	1042759.286	204.463	0.007	0.017	1.82	1 VRS	14	2.45	SZ	30.10	16:03	26	KOLIK
4002.2	735968.163	1042759.287	204.457	0.007	0.016	2.02	1 VRS	13	2.45	SZ	30.10	16:04	26	KOLIK
4002.3	735968.164	1042759.285	204.447	0.007	0.016	2.02	1 VRS	13	2.45	SZ	30.10	16:05	26	KOLIK
4003.1	735870.235	1042734.232	204.711	0.005	0.009	1.38	1 VRS	17	2.45	SZ	30.10	16:14	26	KOLIK
4003.2	735870.236	1042734.231	204.716	0.005	0.009	1.37	1 VRS	17	2.45	SZ	30.10	16:15	26	KOLIK
4003.3	735870.236	1042734.231	204.707	0.004	0.009	1.36	1 VRS	17	2.45	SZ	30.10	16:15	27	KOLIK
4004.1	735758.103	1042717.912	204.396	0.006	0.012	1.39	1 VRS	16	2.45	SZ	30.10	16:22	26	KOLIK
4004.2	735758.102	1042717.911	204.399	0.006	0.011	1.39	1 VRS	16	2.45	SZ	30.10	16:23	26	KOLIK
4004.3	735758.103	1042717.910	204.399	0.006	0.011	1.58	1 VRS	15	2.45	SZ	30.10	16:23	26	KOLIK
4005.1	735617.105	1042697.508	204.056	0.006	0.012	1.51	1 VRS	15	2.45	SZ	30.10	16:31	26	KOLIK
4005.2	735617.106	1042697.509	204.052	0.006	0.011	1.51	1 VRS	15	2.45	SZ	30.10	16:32	26	KOLIK
4005.3	735617.105	1042697.507	204.050	0.006	0.011	1.59	1 VRS	14	2.45	SZ	30.10	16:32	26	KOLIK
4006.1	735660.073	1042728.410	203.534	0.007	0.013	1.67	1 VRS	13	2.45	SZ	30.10	16:47	26	KOLIK
4006.2	735660.075	1042728.414	203.537	0.007	0.012	1.67	1 VRS	13	2.45	SZ	30.10	16:47	26	KOLIK
4006.3	735660.074	1042728.413	203.542	0.006	0.011	1.67	1 VRS	13	2.45	SZ	30.10	16:48	27	KOLIK
4007.1	735863.459	1042784.327	204.766	0.007	0.010	1.58	1 VRS	13	2.45	SZ	30.10	17:01	26	KOLIK
4007.2	735863.459	1042784.329	204.768	0.006	0.009	1.57	1 VRS	13	2.45	SZ	30.10	17:01	26	KOLIK
4007.3	735863.458	1042784.328	204.770	0.006	0.008	1.42	1 VRS	13	2.45	SZ	30.10	17:02	28	KOLIK
4008.1	735976.749	1042801.666	204.043	0.009	0.013	1.75	1 VRS	13	2.45	SZ	30.10	17:46	26	KOLIK
4008.2	735976.751	1042801.666	204.044	0.008	0.012	1.78	1 VRS	12	2.45	SZ	30.10	17:46	26	KOLIK
4008.3	735976.751	1042801.670	204.041	0.008	0.011	1.76	1 VRS	13	2.45	SZ	30.10	17:47	26	KOLIK

* Bod měření na: 1 VRS = Trimble VRS NOW CZ
2 = TOPNET
3 RTK = CZEPOS RTK a RTK3; 3 RTK3-MSM = CZEPOS RTK3-MSM;
3 PRS = CZEPOS RTK-PRS; 3 FKP = CZEPOS RTK-FKP;
3 MAX = CZEPOS VRS3-MAX; 3 iMAX = CZEPOS VRS3-iMAX;
3 MAXG = CZEPOS VRS3-MAX-GG; 3 iMAXG = CZEPOS VRS3-iMAX-GG;
3 CMR = CZEPOS VRS3-iMAX-GG_CM; 3 CMR+ = CZEPOS VRS3-iMAX-GG_CM+;
4 = GEOORBIT
5 = ostatní

** Vyska anteny měřena od: FC = fazového centra; SZ = spodku zavítu; SN = středu narazníku
Hodnoty PDOP označeny * jsou mimo nastavenou toleranci: 7.00
Hodnoty s RMS označeny # jsou mimo nastavenou toleranci: 40.00
Body označeny ! NoFix ! před číslem bodu nebyly při měření fixovány!

----- PRUMĚROVÁNÍ BODU -----

Cislo bodu	Y	X	Z	dY	dX	dZ
4001.1	736083.063	1042794.518	205.240	0.000	-0.001	-0.007
4001.2	736083.062	1042794.517	205.233	0.001	0.000	0.000
4001.3	736083.063	1042794.515	205.226	0.000	0.002	0.007
4001	736083.063	1042794.517	205.233	Cas.odstup:	0dnu,0:1:3	
4002.1	735968.164	1042759.286	204.463	0.000	0.000	-0.007
4002.2	735968.163	1042759.287	204.457	0.001	-0.001	-0.001
4002.3	735968.164	1042759.285	204.447	0.000	0.001	0.009
4002	735968.164	1042759.286	204.456	Cas.odstup:	0dnu,0:1:5	

4003.1	735870.235	1042734.232	204.711	0.001	-0.001	0.000
4003.2	735870.236	1042734.231	204.716	0.000	0.000	-0.005
4003.3	735870.236	1042734.231	204.707	0.000	0.000	0.004

 4003 735870.236 1042734.231 204.711 Cas.odstup: 0dnu,0:1:2

4004.1	735758.103	1042717.912	204.396	0.000	-0.001	0.002
4004.2	735758.102	1042717.911	204.399	0.001	0.000	-0.001
4004.3	735758.103	1042717.910	204.399	0.000	0.001	-0.001

 4004 735758.103 1042717.911 204.398 Cas.odstup: 0dnu,0:1:6

4005.1	735617.105	1042697.508	204.056	0.000	0.000	-0.003
4005.2	735617.106	1042697.509	204.052	-0.001	-0.001	0.001
4005.3	735617.105	1042697.507	204.050	0.000	0.001	0.003

 4005 735617.105 1042697.508 204.053 Cas.odstup: 0dnu,0:1:0

4006.1	735660.073	1042728.410	203.534	0.001	0.002	0.004
4006.2	735660.075	1042728.414	203.537	-0.001	-0.002	0.001
4006.3	735660.074	1042728.413	203.542	0.000	-0.001	-0.004

 4006 735660.074 1042728.412 203.538 Cas.odstup: 0dnu,0:1:0

4007.1	735863.459	1042784.327	204.766	0.000	0.001	0.002
4007.2	735863.459	1042784.329	204.768	0.000	-0.001	0.000
4007.3	735863.458	1042784.328	204.770	0.001	0.000	-0.002

 4007 735863.459 1042784.328 204.768 Cas.odstup: 0dnu,0:1:3

4008.1	735976.749	1042801.666	204.043	0.001	0.001	0.000
4008.2	735976.751	1042801.666	204.044	-0.001	0.001	-0.001
4008.3	735976.751	1042801.670	204.041	-0.001	-0.003	0.002

 4008 735976.750 1042801.667 204.043 Cas.odstup: 0dnu,0:0:57

== Výsledné souřadnice GNSS měření ==

Č.bodu-----Y-----X-----Z-----K.Kv

4001	736083.063	1042794.517	205.233
4002	735968.164	1042759.286	204.456
4003	735870.236	1042734.231	204.711
4004	735758.103	1042717.911	204.398
4005	735617.105	1042697.508	204.053
4006	735660.074	1042728.412	203.538
4007	735863.459	1042784.328	204.768
4008	735976.750	1042801.667	204.043

Agisoft Metashape

Processing Report
October 2019



Survey Data

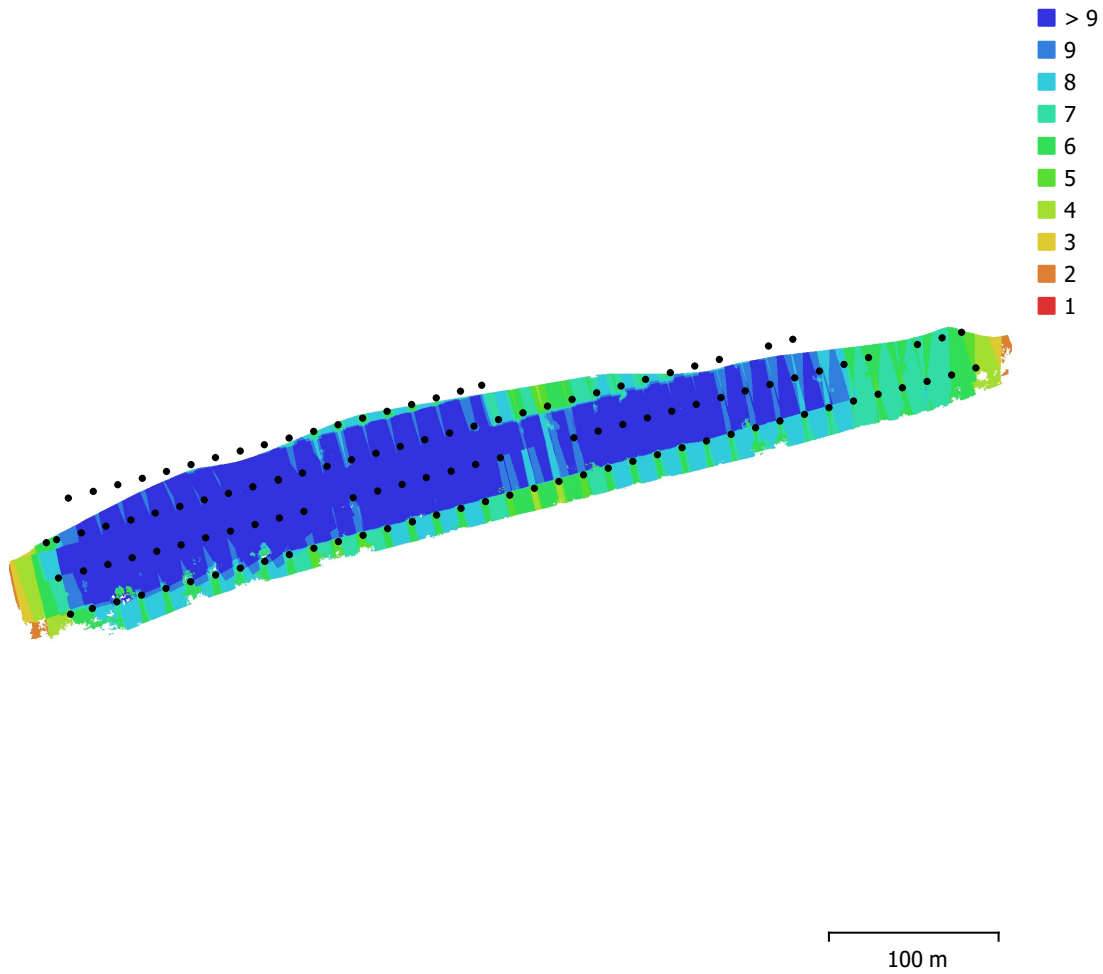


Fig. 1. Camera locations and image overlap.

Number of images:	122	Camera stations:	122
Flying altitude:	62.8 m	Tie points:	55,728
Ground resolution:	1.53 cm/pix	Projections:	282,074
Coverage area:	0.0376 km ²	Reprojection error:	0.481 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310 (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 μ m	No

Table 1. Cameras.

Camera Calibration

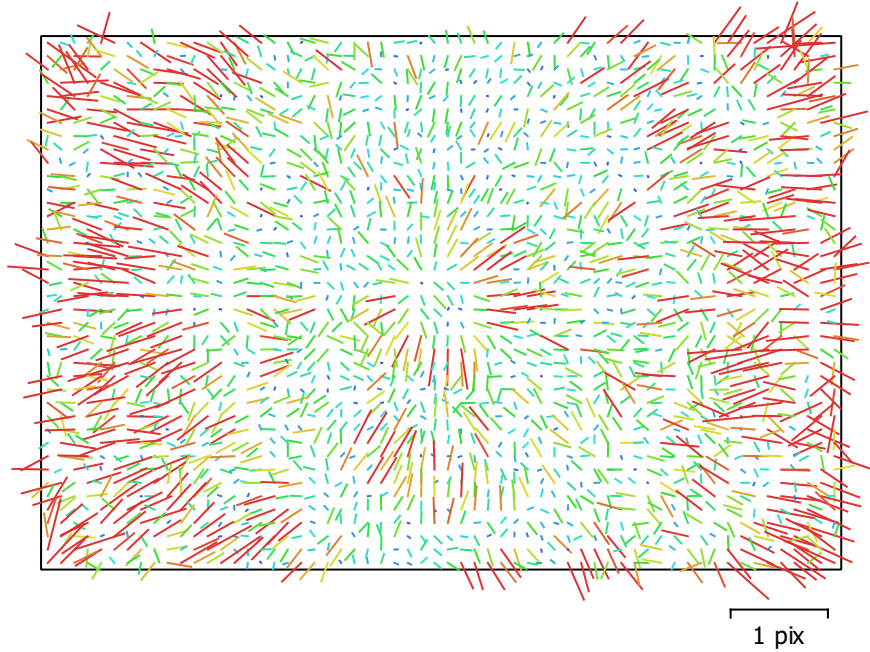


Fig. 2. Image residuals for FC6310 (8.8mm).

FC6310 (8.8mm)

122 images

Type
Frame

Resolution
5472 x 3648

Focal Length
8.8 mm

Pixel Size
2.41 x 2.41 μm

	Value	Error	F	B1	B2	K1	K2	K3	K4	P1	P2
F	3775.21	11	1.00	-0.11	0.14	0.84	-0.96	0.98	-0.98	-0.60	0.06
B1	-1.15207	0.041		1.00	-0.00	-0.09	0.11	-0.11	0.11	0.02	0.23
B2	1.04308	0.045			1.00	0.13	-0.14	0.14	-0.14	-0.16	-0.02
K1	0.018166	0.00013				1.00	-0.96	0.93	-0.91	-0.51	0.05
K2	-0.105974	0.0013					1.00	-1.00	0.99	0.57	-0.06
K3	0.205609	0.0037						1.00	-1.00	-0.58	0.06
K4	-0.132668	0.0032							1.00	0.59	-0.06
P1	-0.00072363	4e-06								1.00	-0.07
P2	6.8671e-05	3.7e-06									1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

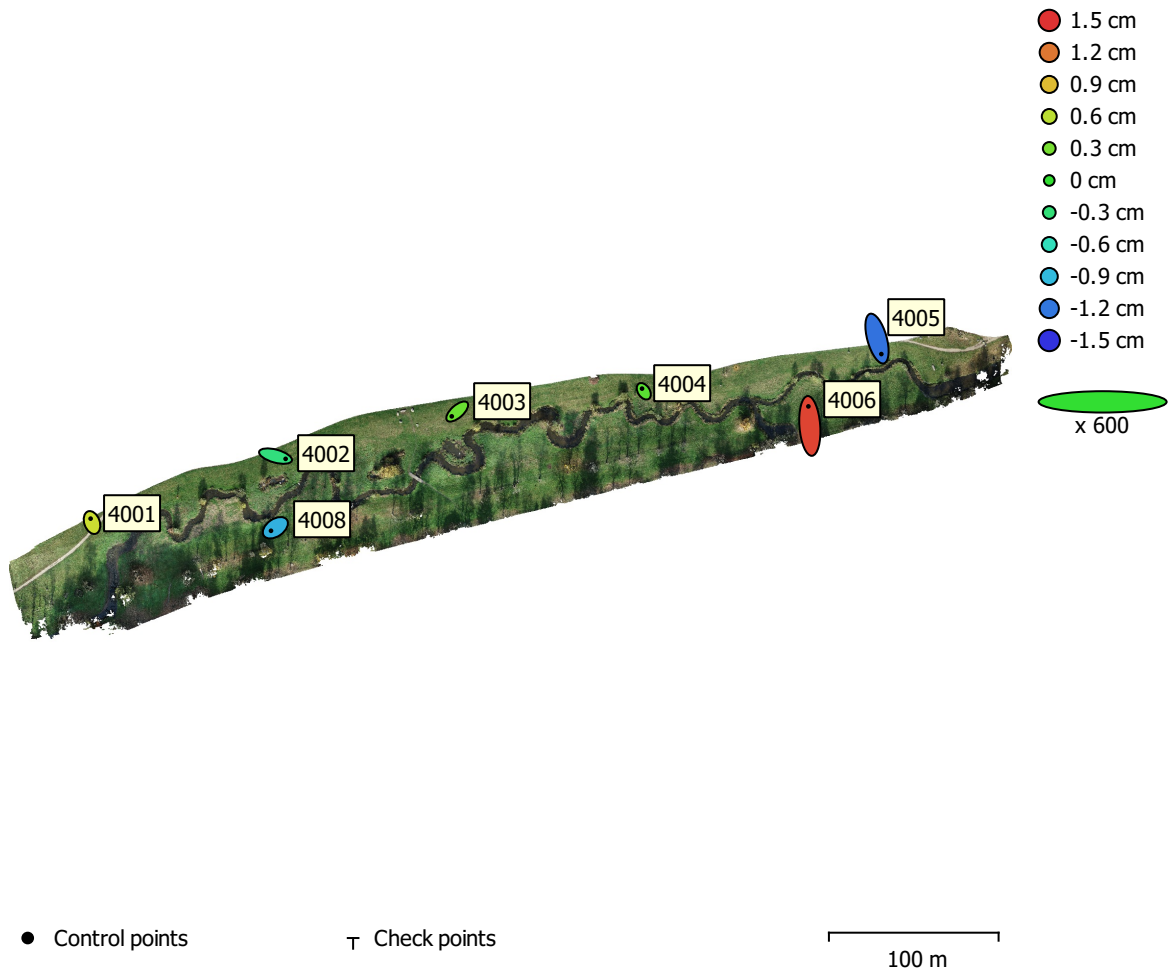


Fig. 3. GCP locations and error estimates.

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)
7	0.98733	1.94016	0.849626	2.17693	2.33686

Table 3. Control points RMSE.
X - Easting, Y - Northing, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
4001	-0.273125	0.764554	0.666432	1.05037	0.551 (10)
4002	1.98356	-0.542055	-0.327847	2.08227	0.205 (12)
4008	-0.858427	-0.593387	-0.950131	1.4113	0.252 (14)
4003	-1.07626	-0.946017	0.243733	1.45351	0.380 (12)
4004	-0.345003	0.521414	0.168203	0.647451	0.340 (7)
4005	0.849579	-3.03997	-1.22138	3.38452	0.331 (6)
4006	-0.280325	3.83546	1.42099	4.09982	0.543 (6)
Total	0.98733	1.94016	0.849626	2.33686	0.375

Table 4. Control points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

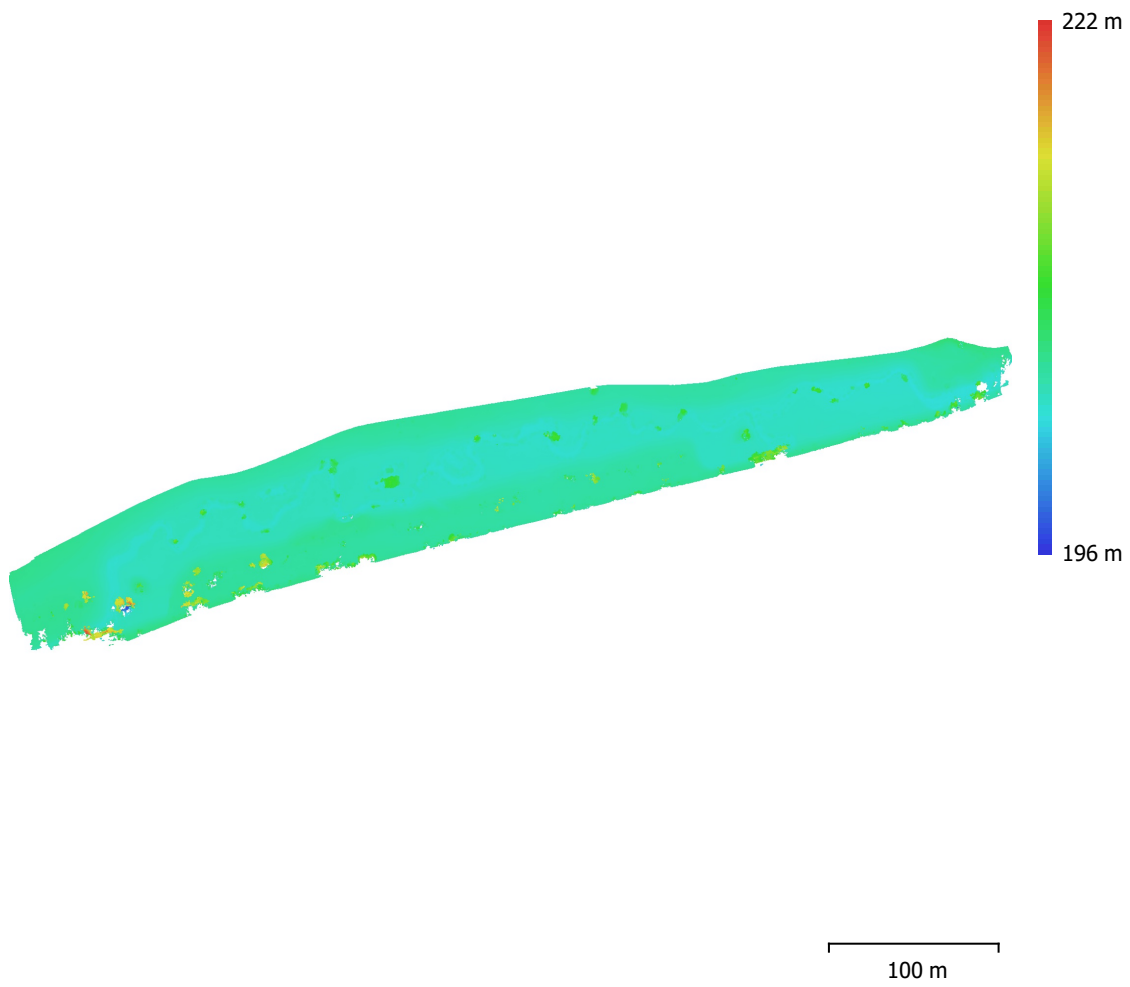


Fig. 4. Reconstructed digital elevation model.

Resolution: unknown

Point density: unknown

Processing Parameters

General

Cameras	122
Aligned cameras	122
Markers	8
Coordinate system	S-JTSK / Krovak East North (EPSG::5514)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	55,728 of 89,622
RMS reprojection error	0.189683 (0.481417 pix)
Max reprojection error	0.605392 (20.8518 pix)
Mean key point size	2.44563 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.08284

Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	4,000
Filter points by mask	Yes
Mask tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	1 minutes 59 seconds
Matching memory usage	158.02 MB
Alignment time	34 seconds
Alignment memory usage	23.10 MB

Optimization parameters

Parameters	f, b1, b2, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	1 seconds
Software version	1.6.2.10247

Depth Maps

Count	122
-------	-----

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	5 minutes 12 seconds
Software version	1.6.2.10247

Dense Point Cloud

Points	11,281,357
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	5 minutes 12 seconds

Dense cloud generation parameters

Processing time	1 minutes 42 seconds
Software version	1.6.2.10247

System

General

Software name	Agisoft Metashape Professional
Software version	1.6.1 build 10009
OS	Windows 64 bit
RAM	7.91 GB
CPU	Intel(R) Core(TM) i5-7200U CPU @ 2.50GHz
GPU(s)	None

Agisoft Metashape

Processing Report
January 2020



Survey Data

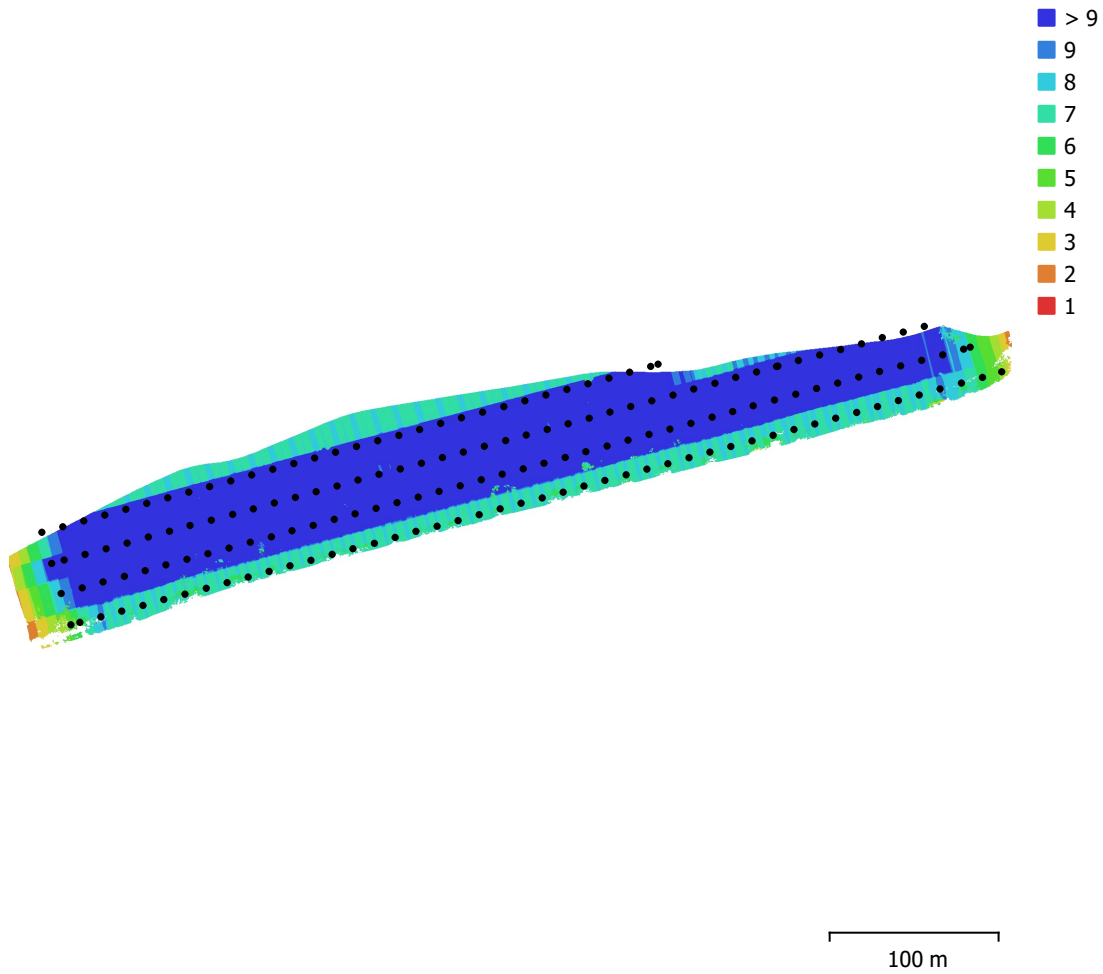


Fig. 1. Camera locations and image overlap.

Number of images:	166	Camera stations:	166
Flying altitude:	61.8 m	Tie points:	80,958
Ground resolution:	1.31 cm/pix	Projections:	505,168
Coverage area:	0.0382 km ²	Reprojection error:	0.605 pix

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

Table 1. Cameras.

Camera Calibration

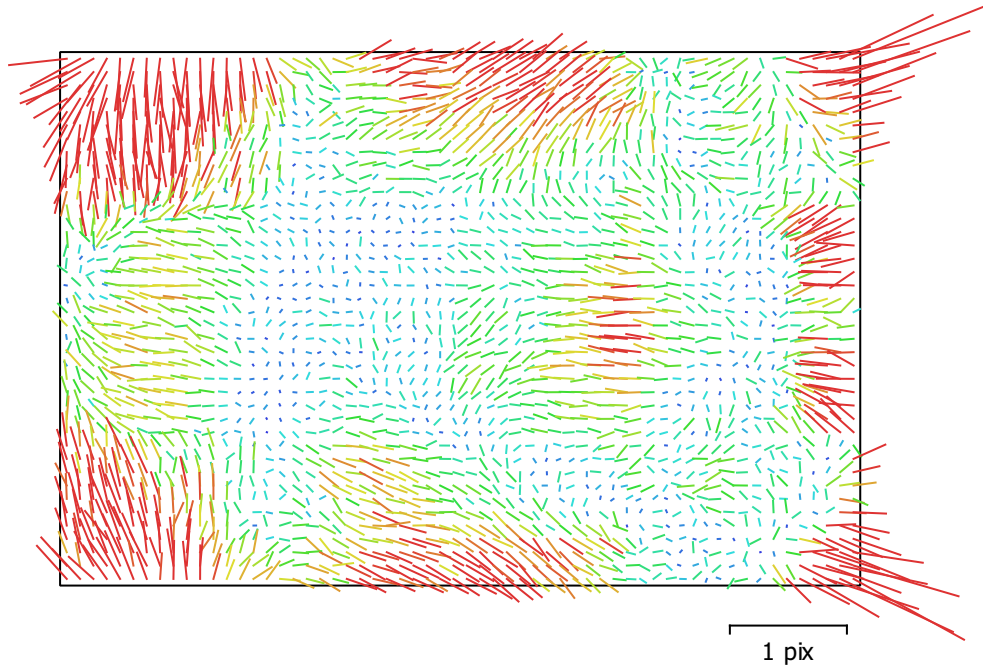


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

166 images

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

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	4402.36	14	1.00	-0.01	0.09	-0.42	-0.79	0.72	0.57	-0.08	-0.40	0.35	-0.18
Cx	375.628	1.2		1.00	-0.04	-0.16	-0.15	-0.04	0.06	-0.14	0.16	0.67	-0.00
Cy	-90.7317	1.3			1.00	0.08	-0.15	0.07	0.03	0.03	-0.08	0.01	0.68
B1	-14.1847	0.17				1.00	0.35	-0.30	-0.26	0.07	0.13	-0.22	0.44
B2	-55.0448	0.26					1.00	-0.58	-0.46	0.09	0.29	-0.47	0.07
K1	0.00989587	8.7e-05						1.00	-0.13	0.57	-0.83	0.25	-0.12
K2	0.0197688	0.00047							1.00	-0.85	0.49	0.24	-0.11
K3	-0.00288413	0.00095								1.00	-0.87	-0.11	0.04
K4	-0.0139253	0.00086									1.00	-0.04	0.04
P1	0.00084182	5.9e-06										1.00	-0.05
P2	-0.000634979	5.9e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

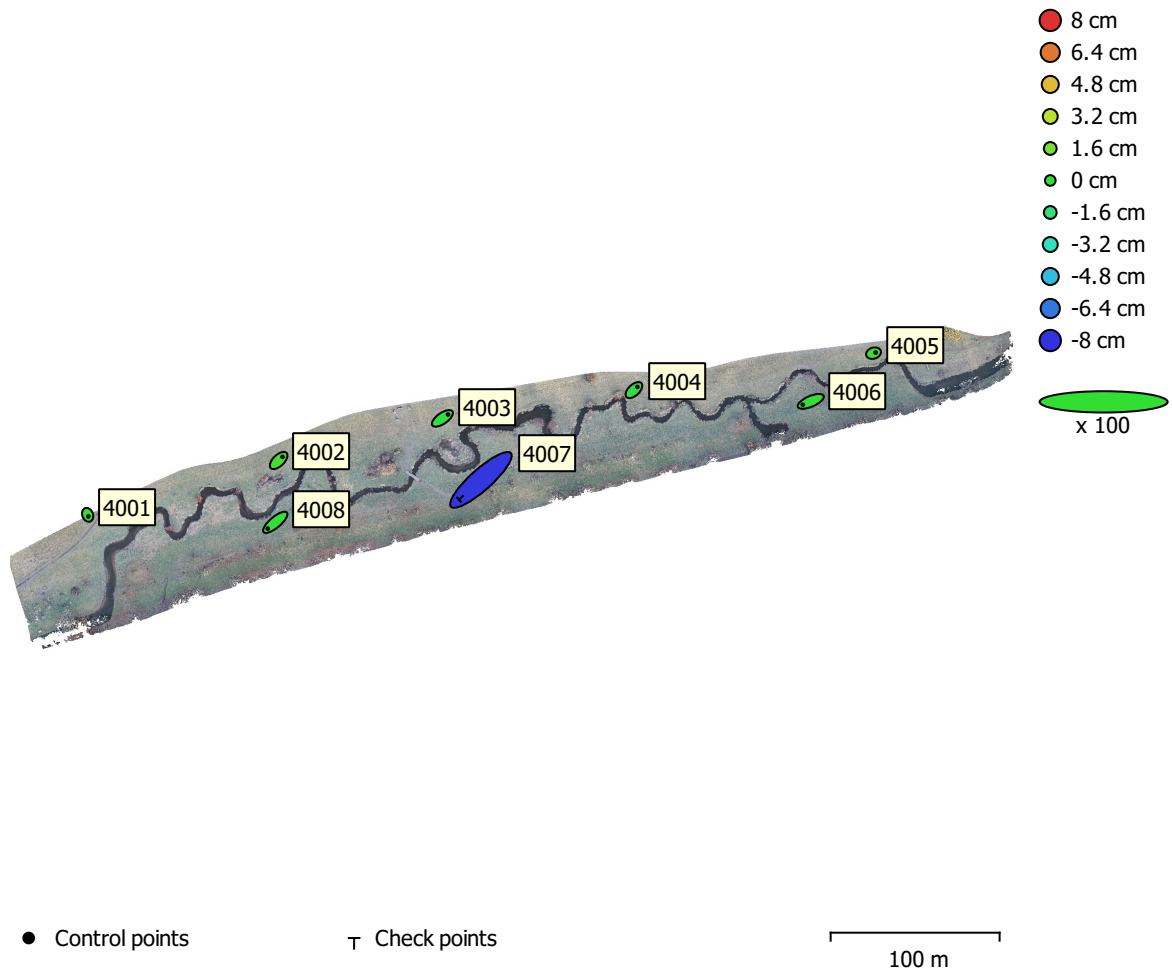


Fig. 3. GCP locations and error estimates.

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)
7	6.03864	4.32116	0.251022	7.42548	7.42972

Table 3. 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	26.1263	23.3198	7.89112	35.02	35.898

Table 4. Check points RMSE.
 X - Easting, Y - Northing, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
4001	0.762186	-1.93985	-0.0757189	2.08559	2.905 (11)
4002	4.53583	4.34141	0.460076	6.2955	10.588 (7)
4003	6.58836	4.60954	-0.208904	8.04351	13.648 (7)
4004	4.06088	3.74986	-0.30285	5.5357	6.161 (11)
4005	2.39941	0.77133	0.271005	2.53487	2.911 (11)
4006	-9.44448	-4.0787	-0.0240239	10.2876	9.490 (13)
4008	-8.9022	-7.4536	-0.119584	11.6112	12.524 (11)
Total	6.03864	4.32116	0.251022	7.42972	8.872

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

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
4007	-26.1263	-23.3198	-7.89112	35.898	0.485 (11)
Total	26.1263	23.3198	7.89112	35.898	0.485

Table 6. Check points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

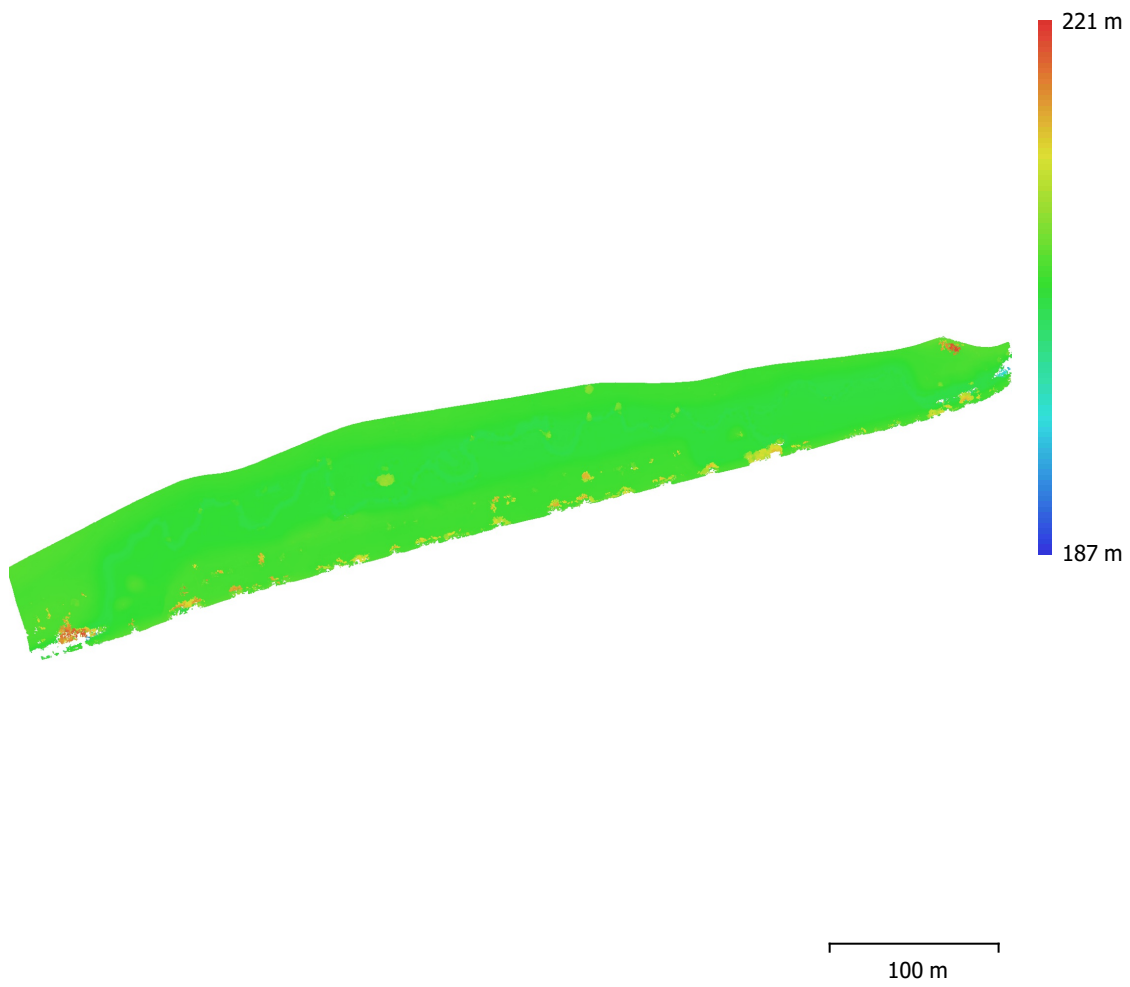


Fig. 4. Reconstructed digital elevation model.

Resolution: unknown

Point density: unknown

Processing Parameters

General

Cameras	166
Aligned cameras	166
Markers	8
Coordinate system	S-JTSK / Krovak East North (EPSG::5514)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	80,958 of 103,072
RMS reprojection error	0.20516 (0.604647 pix)
Max reprojection error	1.32401 (48.6378 pix)
Mean key point size	2.73427 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	5.5134

Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	4,000
Filter points by mask	Yes
Mask tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	3 minutes 9 seconds
Matching memory usage	206.02 MB
Alignment time	1 minutes 15 seconds
Alignment memory usage	32.13 MB

Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	3 seconds
Software version	1.6.2.10247

Depth Maps

Count	166
-------	-----

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	8 minutes 52 seconds
Software version	1.6.2.10247

Dense Point Cloud

Points	15,584,191
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	8 minutes 52 seconds

Dense cloud generation parameters

Processing time	2 minutes 41 seconds
Software version	1.6.2.10247

System

General

Software name	Agisoft Metashape Professional
Software version	1.6.1 build 10009
OS	Windows 64 bit
RAM	7.91 GB
CPU	Intel(R) Core(TM) i5-7200U CPU @ 2.50GHz
GPU(s)	None

Agisoft Metashape

Processing Report
March 2020



Survey Data

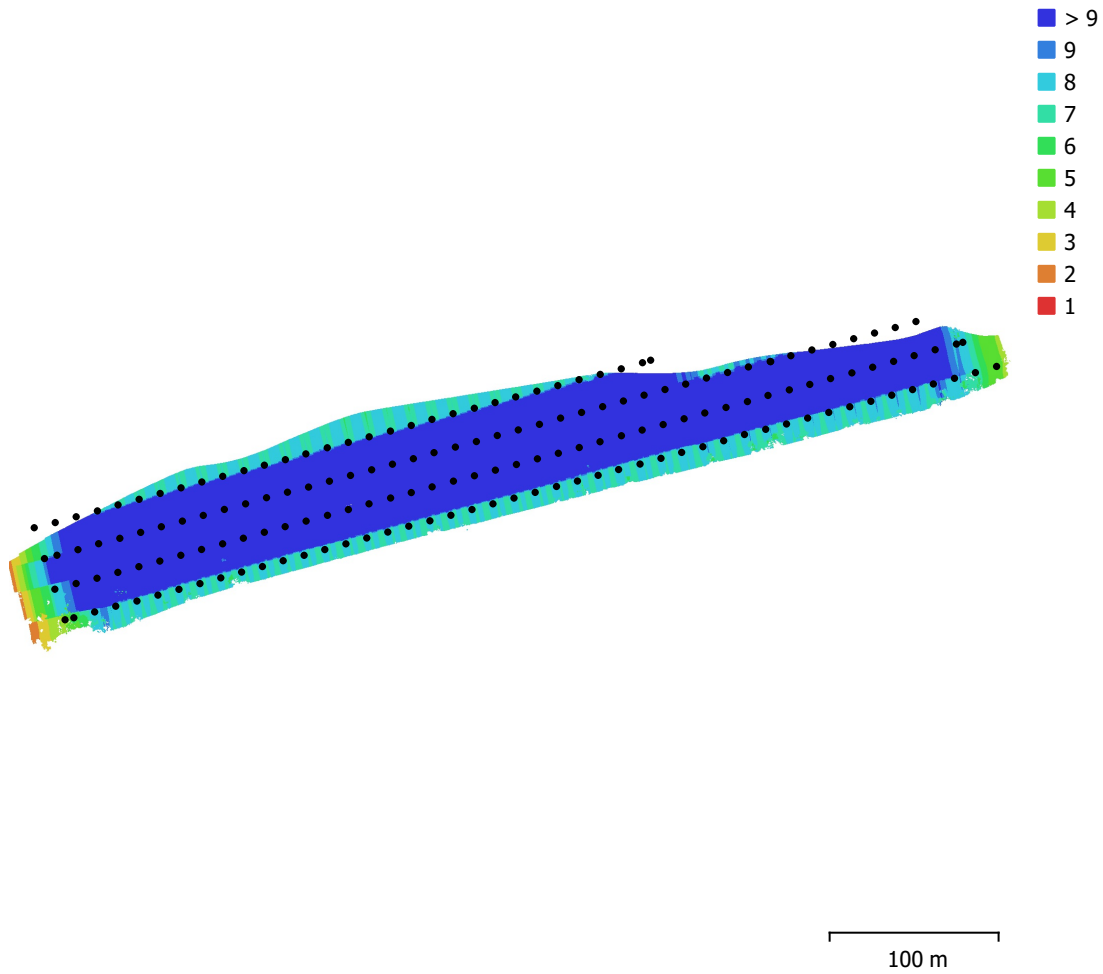


Fig. 1. Camera locations and image overlap.

Number of images:	166	Camera stations:	166
Flying altitude:	61.5 m	Tie points:	79,534
Ground resolution:	1.35 cm/pix	Projections:	417,133
Coverage area:	0.038 km ²	Reprojection error:	0.56 pix

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

Table 1. Cameras.

Camera Calibration

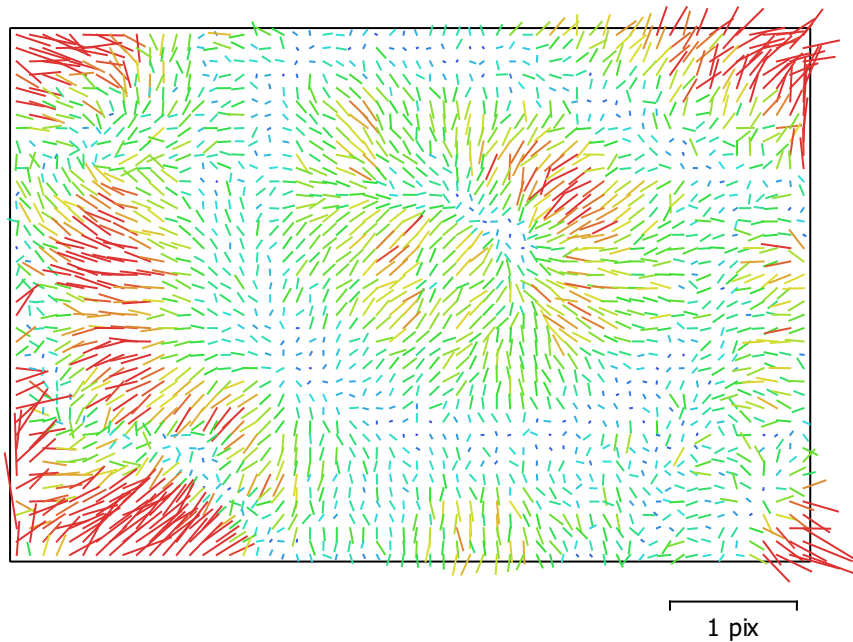


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

166 images

Type
Frame

Resolution
5472 x 3648

Focal Length
10.26 mm

Pixel Size
2.41 x 2.41 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	4228.54	12	1.00	-0.07	0.05	0.01	0.20	0.42	0.54	-0.23	-0.25	-0.49	0.08
Cx	22.3404	1.2		1.00	0.00	0.01	-0.04	-0.05	-0.01	-0.02	0.06	0.72	-0.09
Cy	234.849	1.4			1.00	-0.01	0.03	0.04	0.01	-0.03	0.05	0.01	0.79
B1	-0.330879	0.13				1.00	0.01	0.00	0.01	-0.01	-0.00	0.04	0.08
B2	9.7669	0.14					1.00	0.09	0.10	-0.04	-0.05	-0.14	-0.02
K1	0.0051469	7e-05						1.00	-0.51	0.71	-0.87	-0.22	0.05
K2	0.0237082	0.0005							1.00	-0.93	0.64	-0.25	0.04
K3	-0.0146027	0.0011								1.00	-0.87	0.09	-0.04
K4	-0.0106979	0.00093									1.00	0.16	0.04
P1	-0.000791892	5.4e-06										1.00	-0.06
P2	0.000195116	5.1e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

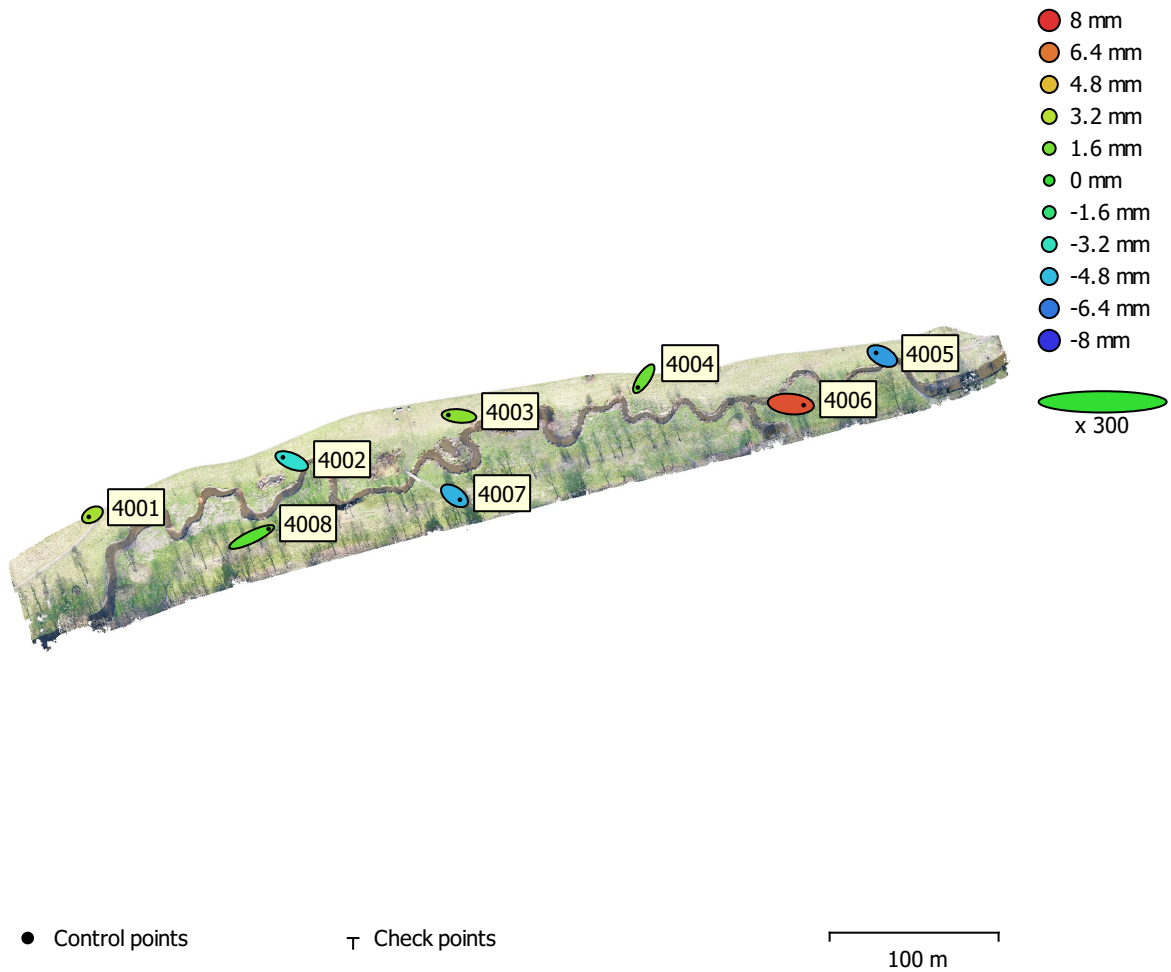


Fig. 3. GCP locations and error estimates.

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)
8	3.83377	1.90844	0.414109	4.28252	4.30249

Table 3. Control points RMSE.

X - Easting, Y - Northing, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
4001	-1.42772	-0.83474	0.270784	1.67586	0.877 (11)
4002	-3.48117	1.46136	-0.367534	3.79331	1.118 (7)
4003	-4.18871	0.376198	0.204312	4.21053	0.881 (8)
4004	-2.3337	-3.46443	0.129929	4.17915	0.780 (11)
4005	-2.42941	1.24102	-0.557761	2.78447	0.540 (12)
4006	5.06055	-0.437932	0.730725	5.13175	1.064 (11)
4007	2.1416	-1.52165	-0.501514	2.67459	0.869 (11)
4008	6.65856	3.1802	0.0910421	7.37959	1.097 (11)
Total	3.83377	1.90844	0.414109	4.30249	0.908

Table 4. Control points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

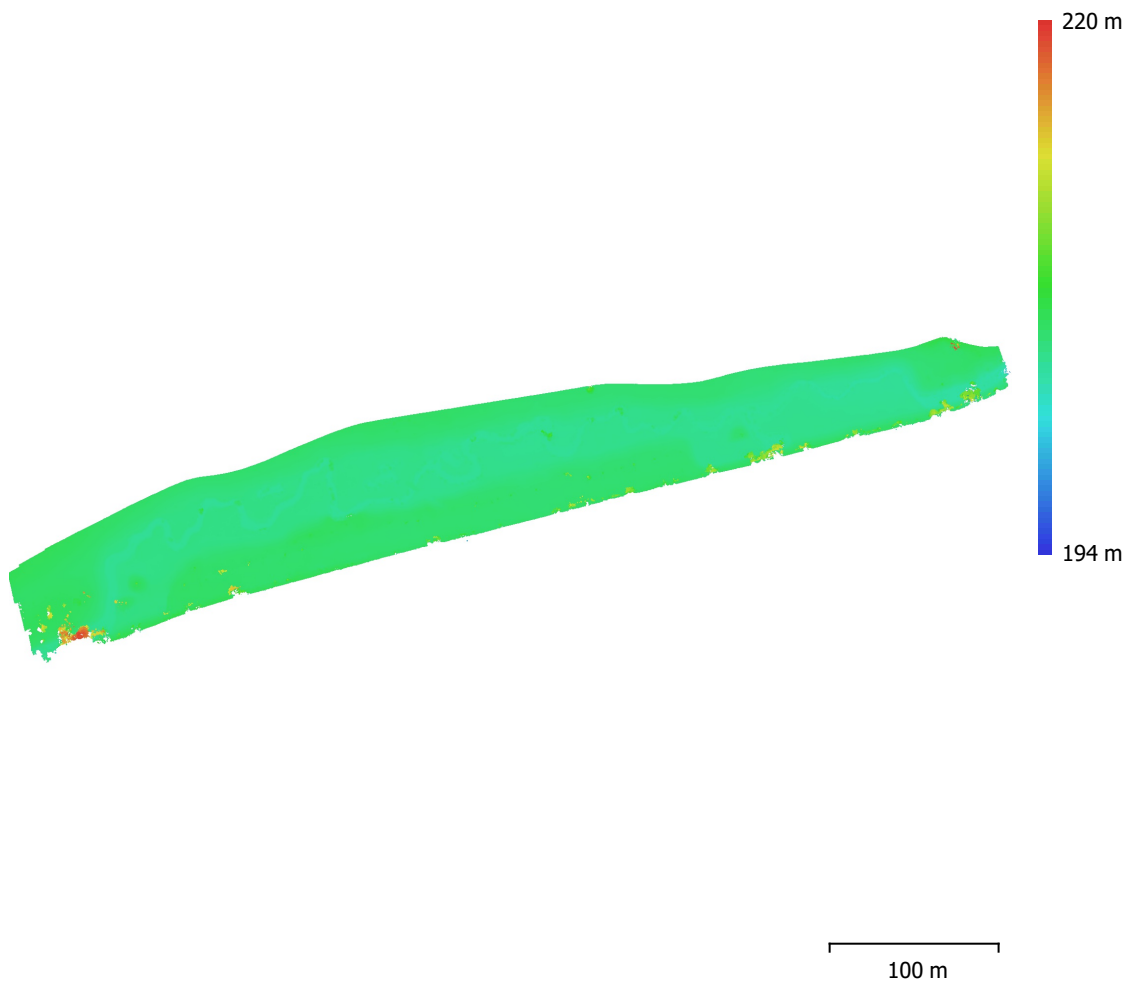


Fig. 4. Reconstructed digital elevation model.

Resolution: unknown

Point density: unknown

Processing Parameters

General

Cameras	166
Aligned cameras	166
Markers	8
Coordinate system	S-JTSK / Krovak East North (EPSG::5514)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	79,534 of 113,861
RMS reprojection error	0.176743 (0.560355 pix)
Max reprojection error	0.816283 (33.5494 pix)
Mean key point size	2.73778 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.62427

Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	4,000
Filter points by mask	Yes
Mask tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	3 minutes 7 seconds
Matching memory usage	192.00 MB
Alignment time	1 minutes 15 seconds
Alignment memory usage	41.79 MB

Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	9 seconds
Software version	1.6.2.10247

Depth Maps

Count	166
-------	-----

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	7 minutes 47 seconds
Software version	1.6.2.10247

Dense Point Cloud

Points	13,958,309
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Moderate
Processing time	7 minutes 47 seconds

Dense cloud generation parameters

Processing time	2 minutes 33 seconds
Software version	1.6.2.10247

System

General

Software name	Agisoft Metashape Professional
Software version	1.6.1 build 10009
OS	Windows 64 bit
RAM	7.91 GB
CPU	Intel(R) Core(TM) i5-7200U CPU @ 2.50GHz
GPU(s)	None