

Metadata Report

Project Name

Waste Dump Landslide, Trappers Loop Road (UT-167), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project (October 2020)

Summary

The Waste Dump landslide is located along the side of Trappers Loop Road (UT-167) in Morgan County, Utah. The Utah Geological Survey (UGS) began monitoring the movement with high-accuracy GPS in 2005, and currently collect GPS movement data on a yearly basis. Using Structure from Motion (SFM), the landslide was surveyed in October 2020. The UGS received field assistance from Weber State University (WSU) for this survey campaign.

Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Jessica Castleton, Brooklyn Smout

- Additional team members

Dr. Michael W. Hernandez (WSU)

Site Information

- Site description

Landslide along Trappers Loop Road (Utah Highway 167) in Morgan County, Utah.

- Site objective

Collect SFM data for the active landslide to assist in landslide monitoring and movement.

- Site location (GPS cords and/or map)

41.211047°, -111.809308°

- Site conditions

Mid-morning, cold temperature, clear skies

- Date/time spent at each site

Flight conducted on 10/29/2020 at approximately 11 AM

Survey Results

- Equipment used

DJI Mavic 2 Pro drone with 20 MP camera and fixed 10.26 mm focal length for image collection. Trimble R8 GNSS unit for Ground Control Point (GCP) survey data collection.

- GPS solutions

8 GCPs were surveyed using the Utah Reference Network (TURN) real-time kinematic network and processed in WGS 84.

- Errors

Overall point cloud error was 16.57 cm using all 8 GCPs. GCP error was 15.34 cm horizontal and 6.26 cm vertical.

- Alignments

- Collection methods

650 images were acquired from 150 ft (45 m) altitude at nadir. Camera positions, overlaps, and orientations were controlled automatically using Pix4D software running on an iPad. Images were processed using Agisoft Metashape Professional (see below for processing details). GCPs were provided by installing orange, black, and white bucket lid targets for visibility in images. GCPs were surveyed and processed in UTM North Zone 12, WGS 84 Datum, g12aus geoid.

Products

- Date of dataset collection

10/29/2020

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 1.64 cm/pix, DEM resolution 6.56 cm/pix, Point density – 232 points/m²

- Horizontal Accuracy

15.34 cm

- Vertical Accuracy

6.26 cm

- Data formats

Raw point cloud is provided in .LAZ format. DEM and orthomosaic are provided as geotiff.

- Data processing methods

Point cloud, DEM, and orthomosaic data were generated by Agisoft Metashape Professional.



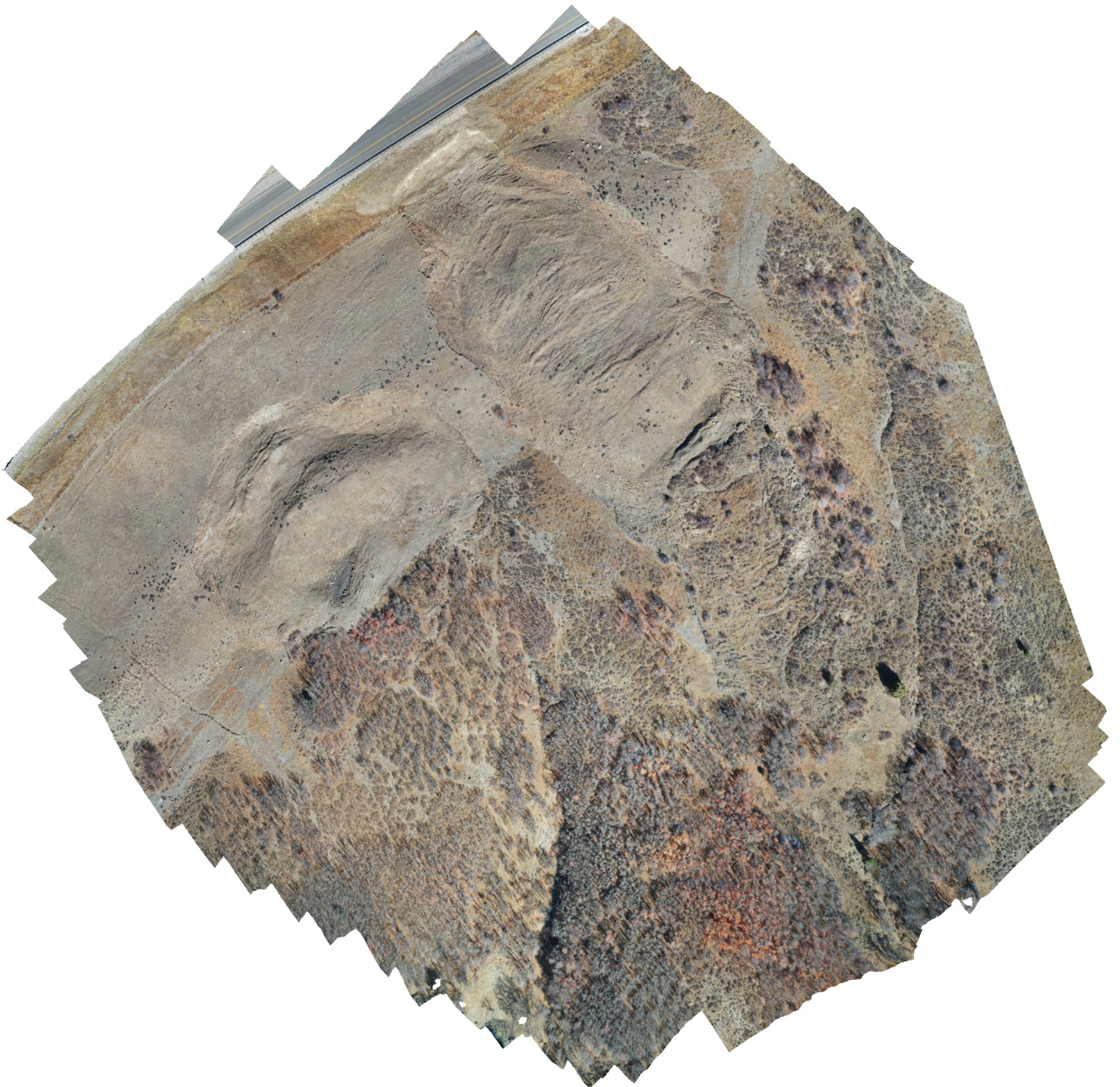
Misc Notes

Please send any questions about this dataset to adamhiscock@utah.gov

Agisoft Metashape

Waste Dump Landslide, October 2020, Trappers Loop Road (UT-167), Morgan
County, Utah

18 November 2020



Survey Data

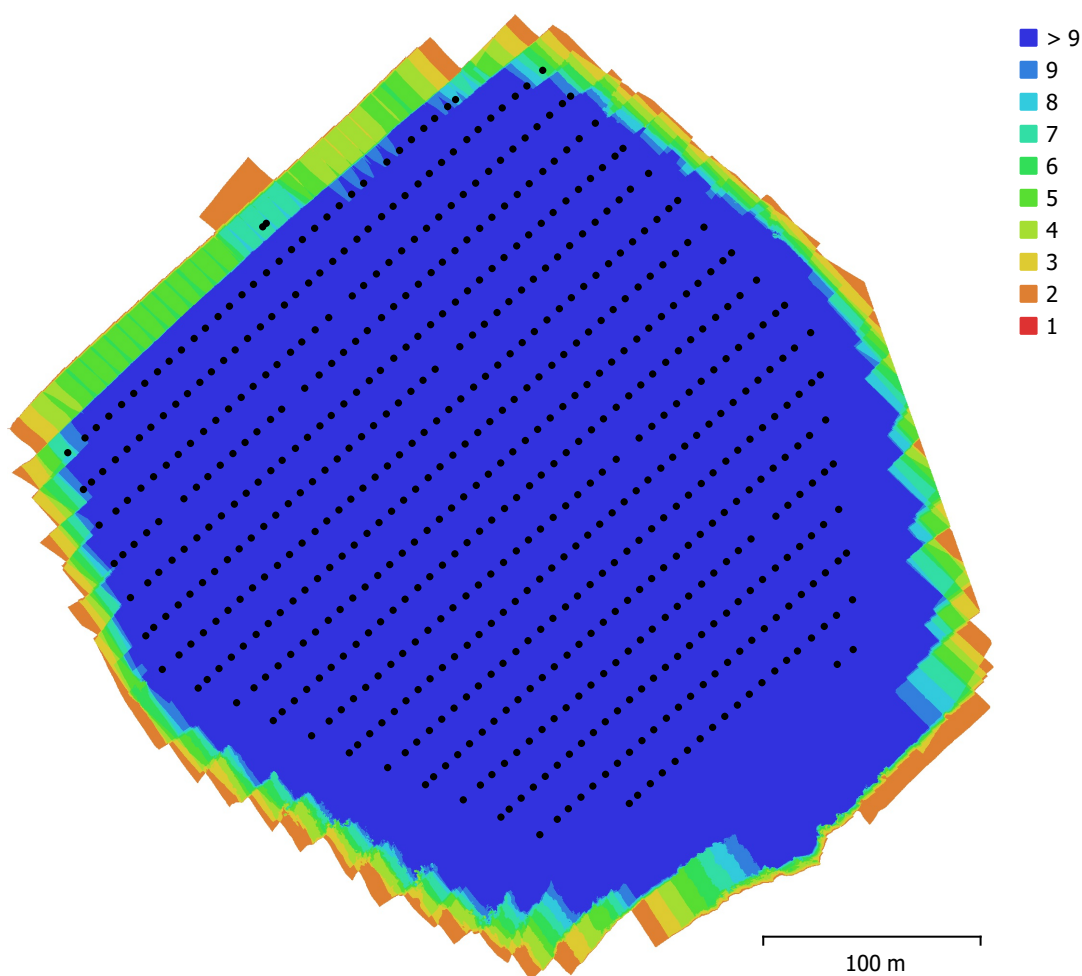


Fig. 1. Camera locations and image overlap.

Number of images:	650	Camera stations:	650
Flying altitude:	76.9 m	Tie points:	201,044
Ground resolution:	1.64 cm/pix	Projections:	1,787,055
Coverage area:	0.128 km ²	Reprojection error:	0.7 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

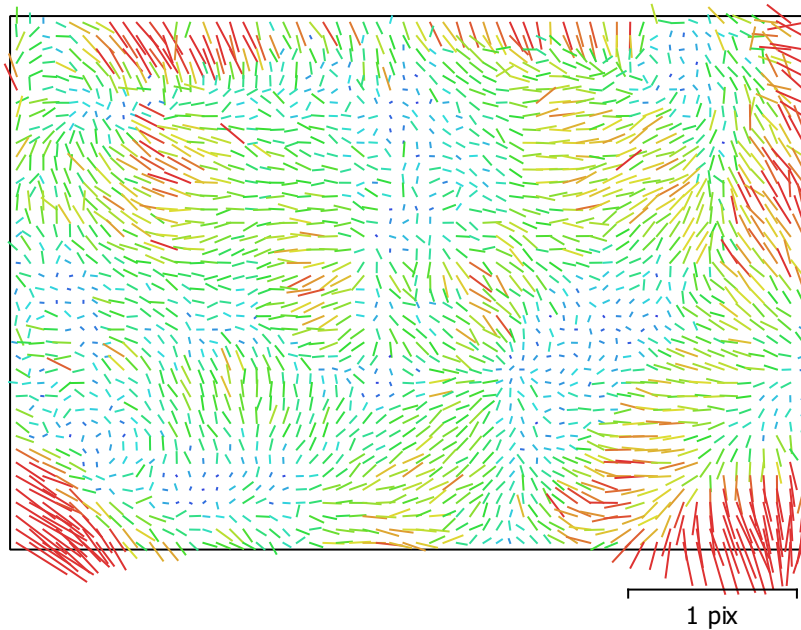


Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

650 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	K1	K2	K3	P1	P2
F	4404.29	2.3	1.00	-0.84	0.87	-0.16	0.16	-0.25	0.07	-0.05
Cx	-2.78372	0.13		1.00	-0.73	0.12	-0.12	0.20	0.34	0.04
Cy	-10.6169	0.11			1.00	-0.13	0.14	-0.21	0.06	0.23
K1	-0.0161192	8.8e-05				1.00	-0.95	0.90	-0.07	0.03
K2	0.0295204	0.00036					1.00	-0.98	0.05	-0.01
K3	-0.0376613	0.00045						1.00	-0.05	0.01
P1	0.000220546	4.6e-06							1.00	-0.03
P2	-2.07653e-05	3.4e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

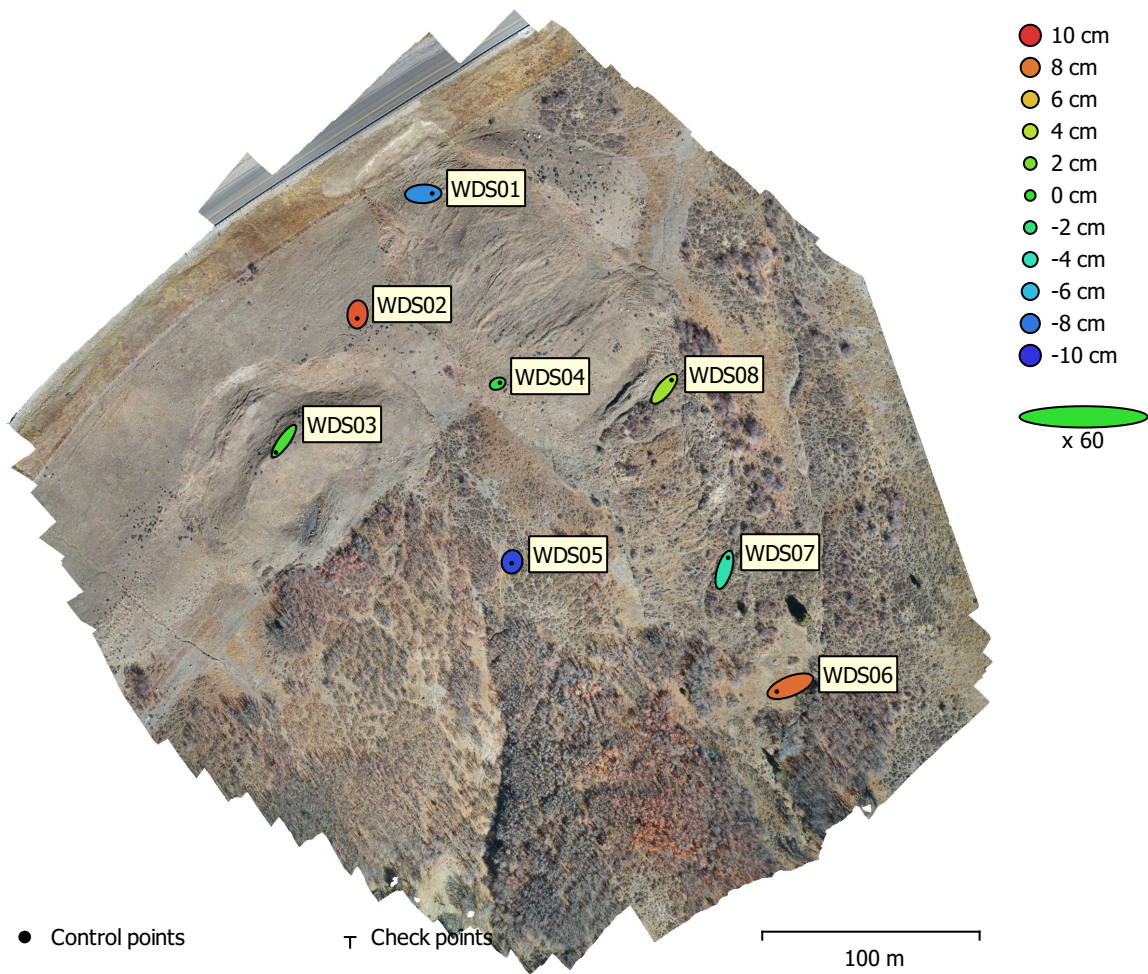


Fig. 3. GCP locations and error estimates.

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	10.8354	10.8572	6.2651	15.339	16.5691

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)
WDS01	13.7449	0.564895	-7.36084	15.6021	1.379 (24)
WDS02	-0.463847	-6.19461	8.9431	10.8889	1.186 (22)
WDS03	-12.31	-17.3811	0.650715	21.3088	1.101 (26)
WDS04	3.48426	1.413	-0.832631	3.85097	0.612 (29)
WDS05	-0.508482	-2.19703	-9.35017	9.61827	1.037 (49)
WDS06	-20.7274	-8.27842	8.29552	23.8112	102.793 (34)
WDS07	5.585	18.5384	-3.52157	19.6791	30.799 (66)
WDS08	11.1963	13.5352	3.17667	17.8508	0.889 (48)
Total	10.8354	10.8572	6.2651	16.5691	37.634

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

Digital Elevation Model

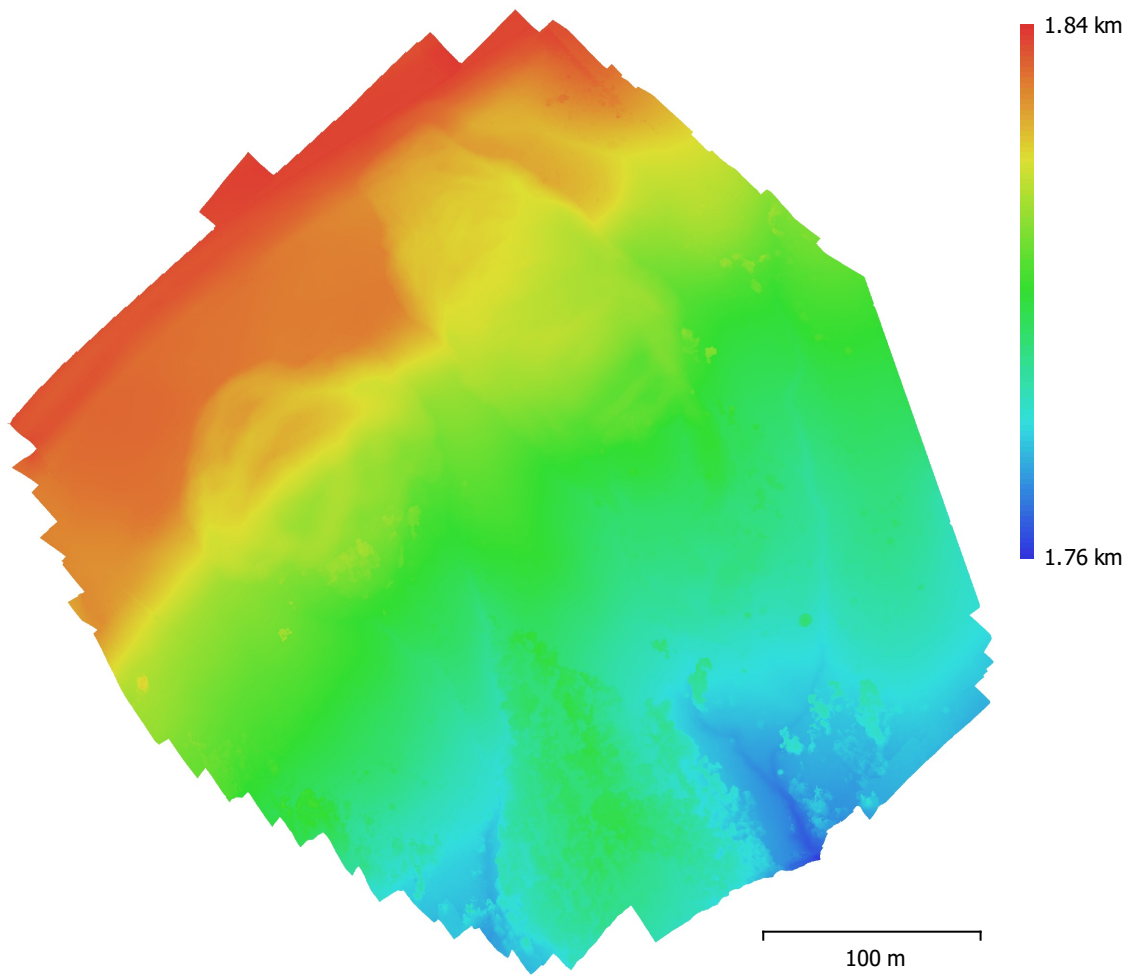


Fig. 4. Reconstructed digital elevation model.

Resolution: 6.56 cm/pix
Point density: 232 points/m²

Processing Parameters

General

Cameras	650
Aligned cameras	650
Markers	8
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	201,044 of 264,970
RMS reprojection error	0.242441 (0.699678 pix)
Max reprojection error	17.266 (45.41 pix)
Mean key point size	2.84543 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	10.6946

Alignment parameters

Accuracy	High
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	20 minutes 51 seconds
Matching memory usage	2.60 GB
Alignment time	7 minutes 47 seconds
Alignment memory usage	438.47 MB

Optimization parameters

Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	30 seconds
Software version	1.6.2.10247

Depth Maps

Count	650
Depth maps generation parameters	
Quality	Medium
Filtering mode	Aggressive
Processing time	4 hours 40 minutes
Software version	1.6.2.10247

Dense Point Cloud

Points	39,119,215
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Processing time	4 hours 40 minutes

Dense cloud generation parameters

Processing time	1 hours 13 minutes
Software version	1.6.2.10247

Model

Faces	7,823,842
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Vertices	3,917,718
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8
Depth maps generation parameters	
Quality	Medium
Filtering mode	Aggressive
Processing time	4 hours 40 minutes
Reconstruction parameters	
Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Strict volumetric masks	No
Processing time	42 minutes 4 seconds
Texturing parameters	
Mapping mode	Generic
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	Yes
UV mapping time	7 minutes 39 seconds
Blending time	14 minutes 9 seconds
Software version	1.6.2.10247
DEM	
Size	8,501 x 9,682
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	1 minutes 14 seconds
Software version	1.6.2.10247
Orthomosaic	
Size	27,692 x 27,072
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	33 minutes 41 seconds
Software version	1.6.2.10247
System	
Software name	Agisoft Metashape Professional
Software version	1.6.2 build 10247
OS	Windows 64 bit
RAM	15.92 GB
CPU	Intel(R) Xeon(R) CPU E3-1240 v5 @ 3.50GHz
GPU(s)	Quadro M2000