

# Metadata Report

## Project Name

Zig Zag Landslide, Snow Basin Road (UT-226), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project

## Summary

The Zig Zag landslide is located along the side of Snow Basin Road (UT-226) 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 2018.

## Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Greg N. McDonald, Nathan Payne

- Additional team members

## Site Information

- Site description

Landslide along Snow Basin Road (Utah Highway 226) 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)

41.215231°, -111.852547°

- Site conditions

Late-morning, cool temperature, some small clouds

- Date/time spent at each site

Flights conducted on 10/30/2018 at approximately 11:15 AM

## Survey Results

- Equipment used

DJI Phantom 4 Pro drone with 20 MP camera and fixed 8.8 mm focal length for image collection. Trimble R8 GNSS unit for Ground Control Point (GCP) survey data collection.



- GPS solutions

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

- Errors

Overall point cloud error was 1.91 cm using all 6 GCPs. GCP error was 1.50 cm horizontal and 1.19 cm vertical.

- Alignments

- Collection methods

395 images were acquired from 100 ft (30 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

10/30/2018

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 1.06 cm/pix, DEM resolution 4.23 cm/pix, Point density – 558 points/m<sup>2</sup>

- Horizontal Accuracy

1.50 cm

- Vertical Accuracy

1.19 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

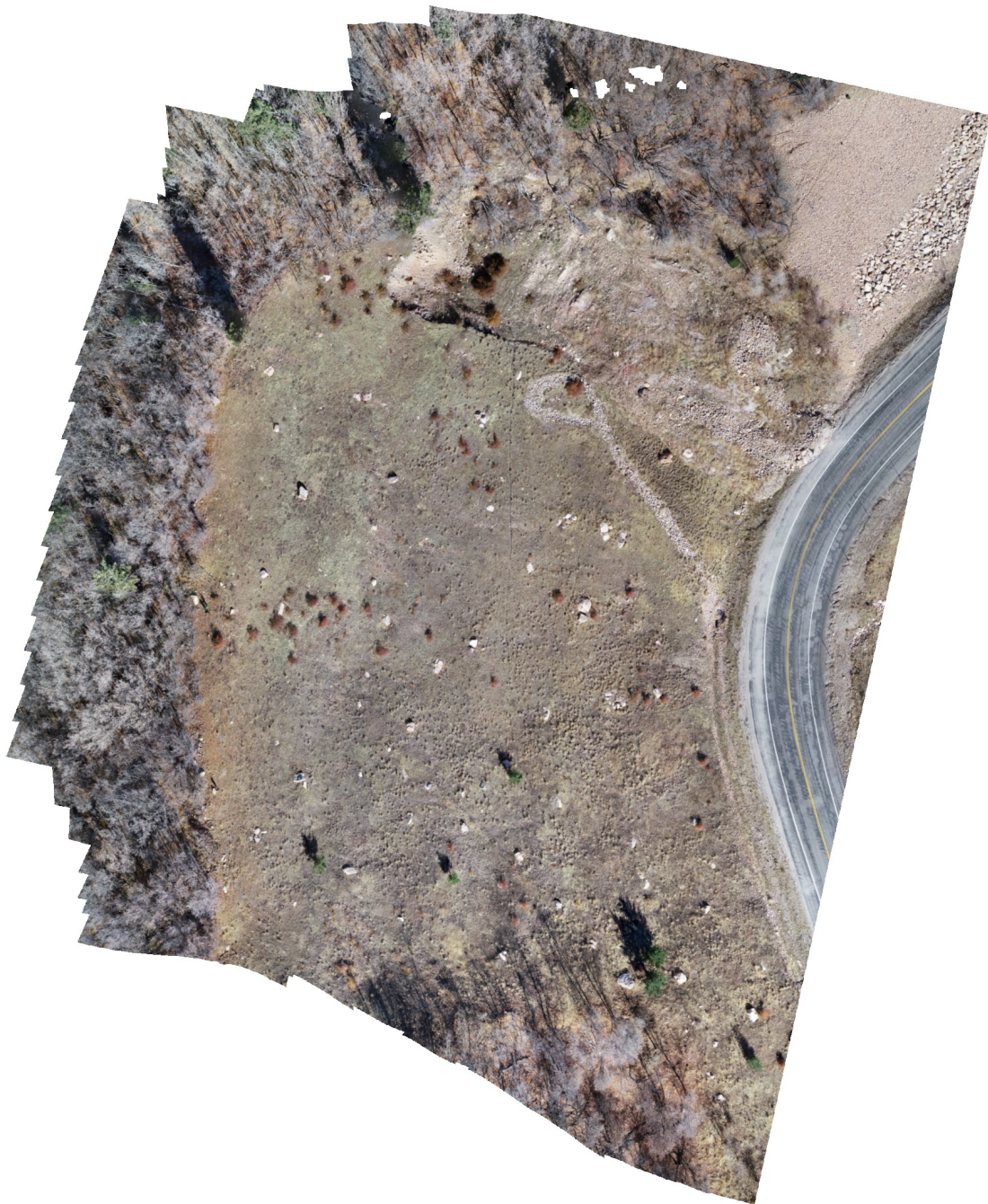
Please send any questions about this dataset to [adamhiscock@utah.gov](mailto:adamhiscock@utah.gov)

# **Agisoft Metashape**

## **Processing Report**

**Zig Zag Landslide - October 2018, Snow Basin Road (UT-226), Morgan County,  
Utah**

**12 August 2019**



# Survey Data

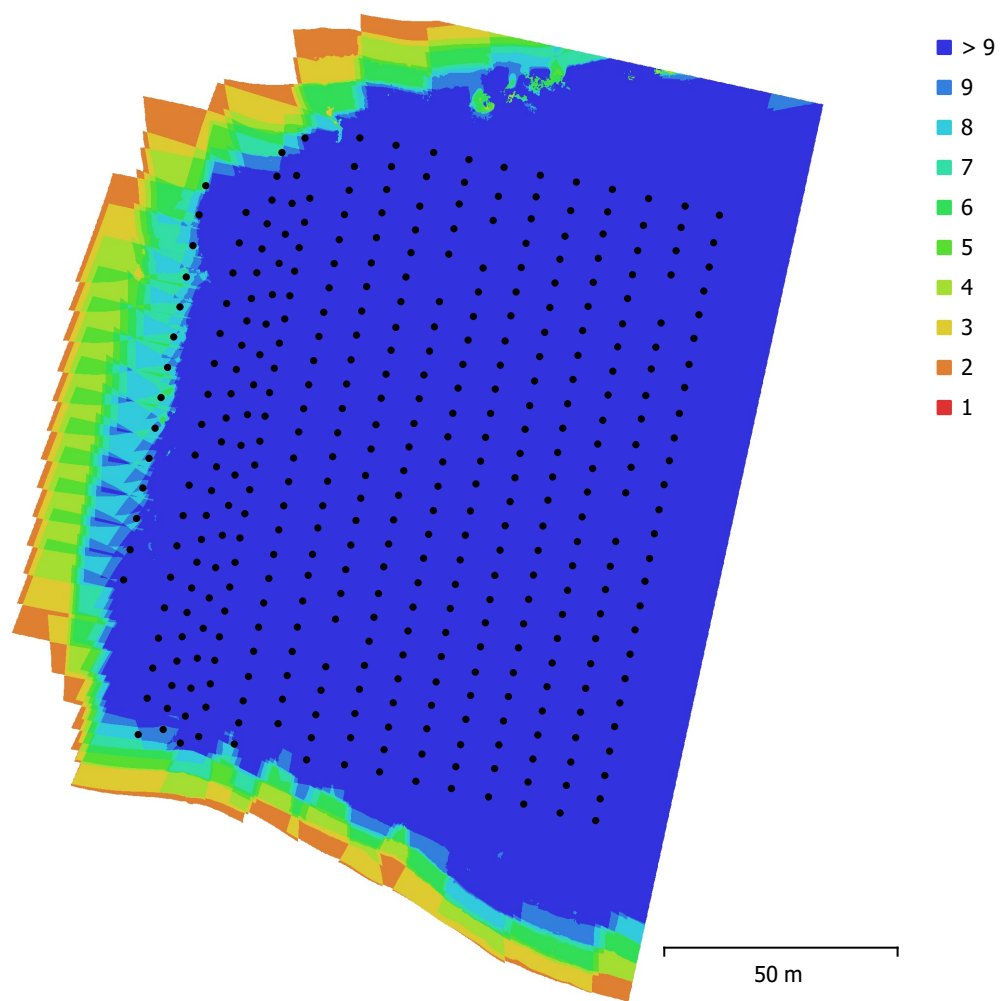


Fig. 1. Camera locations and image overlap.

Number of images:	395	Camera stations:	381
Flying altitude:	40.6 m	Tie points:	332,337
Ground resolution:	1.06 cm/pix	Projections:	1,597,556
Coverage area:	0.0253 km <sup>2</sup>	Reprojection error:	0.589 pix

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

Table 1. Cameras.

# Camera Calibration

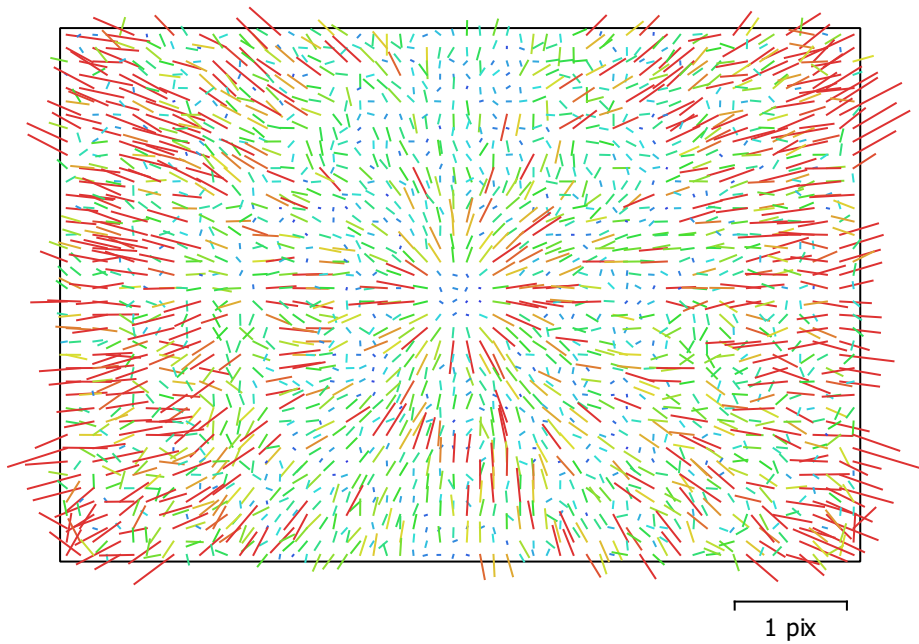


Fig. 2. Image residuals for FC6310 (8.8mm).

## FC6310 (8.8mm)

395 images

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>5472 x 3648</b>	<b>8.8 mm</b>	<b>2.41 x 2.41 <math>\mu\text{m}</math></b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>3647.2</b>	0.21	1.00	-0.13	-1.00	0.60	0.19	0.03	-0.06	0.11	-0.14	-0.09	-0.17
<b>Cx</b>	<b>-9.41642</b>	0.014		1.00	0.13	-0.11	-0.30	-0.00	0.01	-0.02	0.02	0.73	0.01
<b>Cy</b>	<b>10.3056</b>	0.12			1.00	-0.61	-0.19	-0.06	0.09	-0.13	0.16	0.09	0.20
<b>B1</b>	<b>-0.159623</b>	0.03				1.00	0.15	0.02	-0.06	0.09	-0.11	-0.06	-0.02
<b>B2</b>	<b>0.521361</b>	0.024					1.00	0.01	-0.02	0.03	-0.03	0.07	-0.04
<b>K1</b>	<b>0.00794813</b>	3e-005						1.00	-0.96	0.92	-0.87	-0.01	-0.13
<b>K2</b>	<b>-0.0559142</b>	0.00014							1.00	-0.99	0.96	0.01	0.01
<b>K3</b>	<b>0.103098</b>	0.00027								1.00	-0.99	-0.01	-0.02
<b>K4</b>	<b>-0.0619274</b>	0.00018									1.00	0.02	0.03
<b>P1</b>	<b>-0.000886532</b>	1.1e-006										1.00	-0.00
<b>P2</b>	<b>-0.00120672</b>	1.5e-006											1.00

Table 2. Calibration coefficients and correlation matrix.



# Ground Control Points

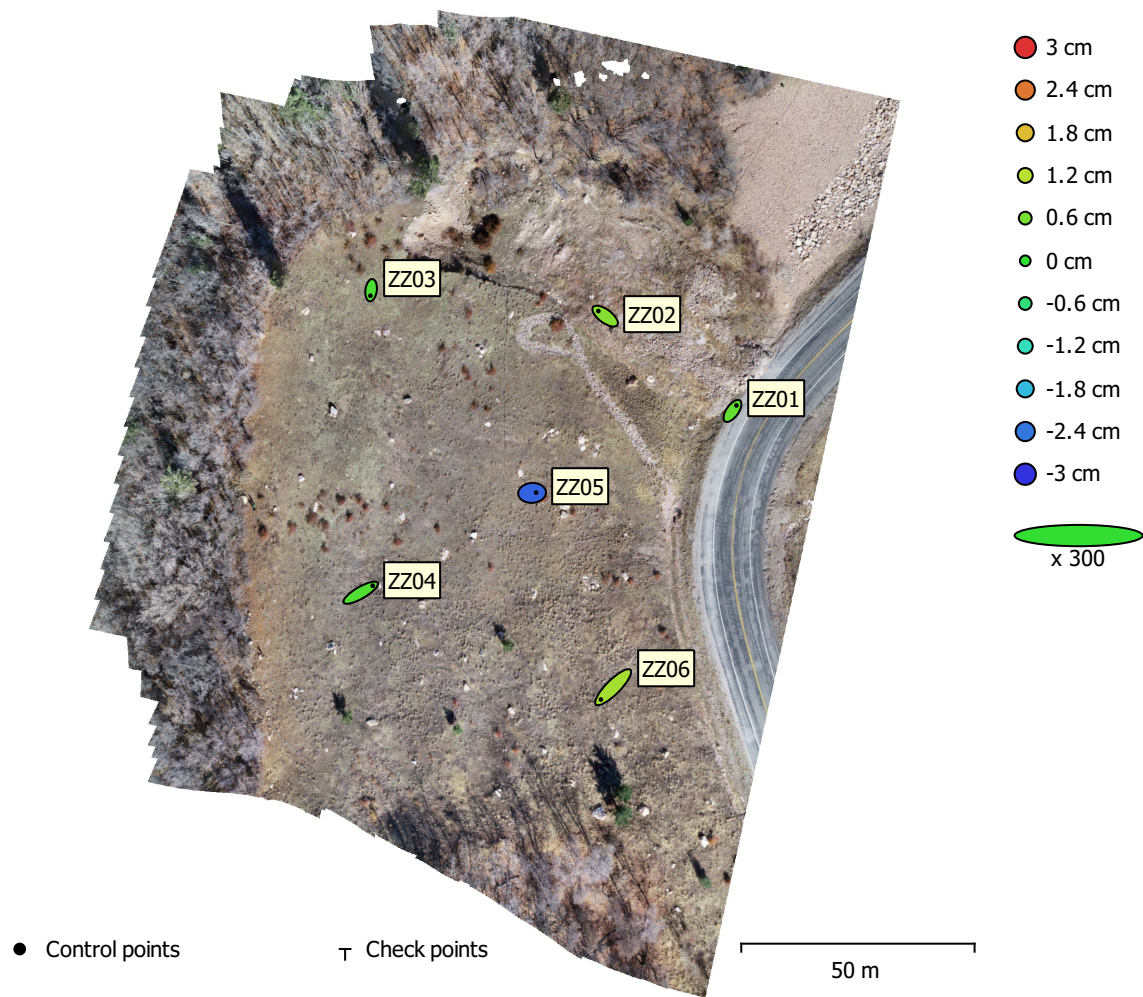


Fig. 3. GCP locations and error estimates.

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)
6	1.12592	0.986145	1.19126	1.49673	1.91293

Table 3. Control points RMSE.

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

<b>Label</b>	<b>X error (cm)</b>	<b>Y error (cm)</b>	<b>Z error (cm)</b>	<b>Total (cm)</b>	<b>Image (pix)</b>
ZZ01	0.560844	0.786349	0.417921	1.0524	0.208 (7)
ZZ02	-0.974215	0.721875	0.744291	1.42273	0.203 (7)
ZZ03	-0.100599	-0.782051	0.215948	0.817531	0.399 (9)
ZZ04	1.71436	0.993852	0.264196	1.99914	0.317 (17)
ZZ05	0.570077	0.0405408	-2.584	2.64645	0.267 (39)
ZZ06	-1.7517	-1.75911	0.996239	2.67496	0.302 (55)
<b>Total</b>	<b>1.12592</b>	<b>0.986145</b>	<b>1.19126</b>	<b>1.91293</b>	<b>0.293</b>

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

# Digital Elevation Model

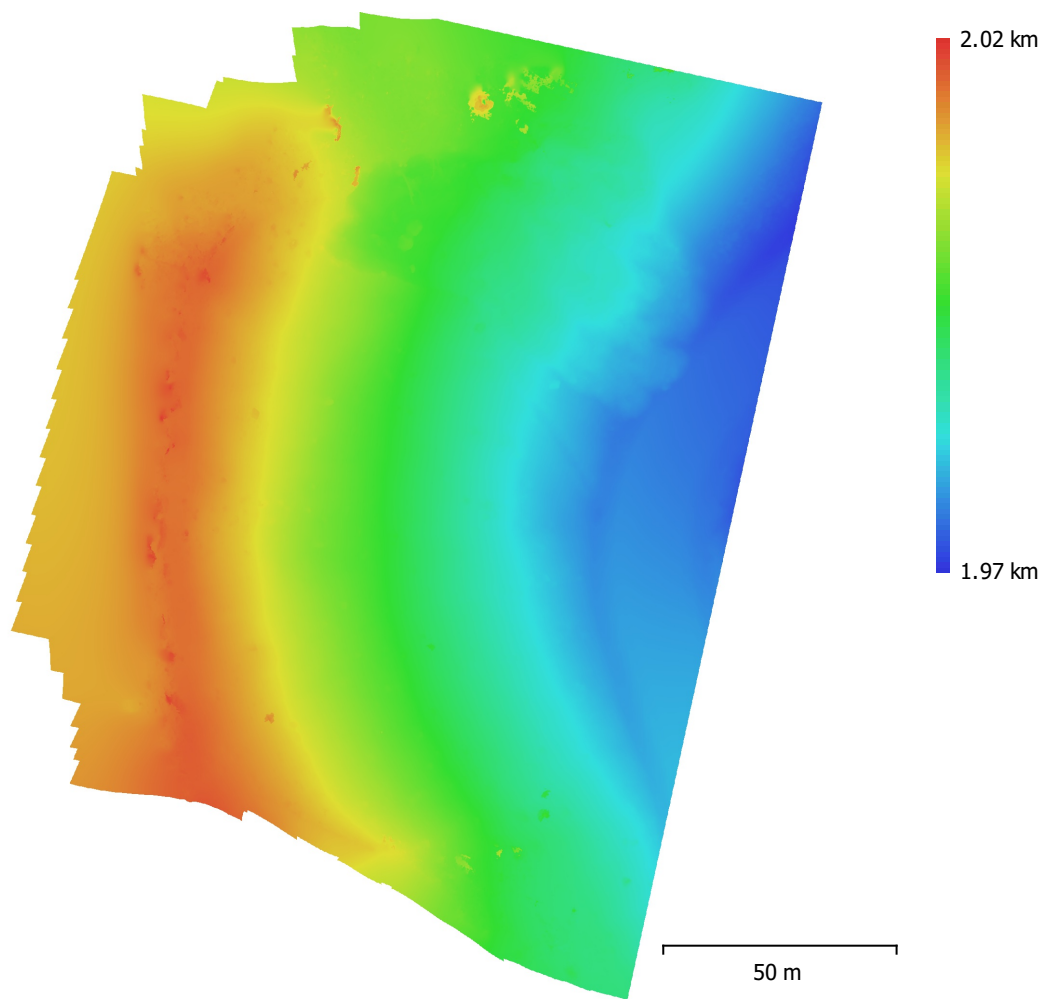


Fig. 4. Reconstructed digital elevation model.

Resolution: 4.23 cm/pix  
Point density: 558 points/m<sup>2</sup>



# Processing Parameters

## General

Cameras	395
Aligned cameras	381
Markers	6
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	332,337 of 361,040
RMS reprojection error	0.184031 (0.588784 pix)
Max reprojection error	0.557727 (46.163 pix)
Mean key point size	2.78908 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	6.27111

## Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Yes
Key point limit	40,000
Tie point limit	6,000
Adaptive camera model fitting	Yes
Matching time	12 minutes 36 seconds
Alignment time	3 minutes 50 seconds

## Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	19 seconds

## Dense Point Cloud

Points	16,749,954
Point colors	3 bands, uint8

## Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Processing time	47 minutes 3 seconds

## Dense cloud generation parameters

Processing time	53 minutes 52 seconds
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## Model

Faces	3,349,940
Vertices	1,678,454
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

## Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive

## Reconstruction parameters

Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Processing time	11 minutes 6 seconds

## Texturing parameters

**General**

Mapping mode	Adaptive orthophoto
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	No
UV mapping time	32 seconds
Blending time	7 minutes 32 seconds

**DEM**

Size	4,506 x 5,492
Coordinate system	WGS 84 (EPSG::4326)

**Reconstruction parameters**

Source data	Dense cloud
Interpolation	Enabled
Processing time	17 seconds

**Orthomosaic**

Size	16,443 x 19,988
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

**Reconstructors**

Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	9 minutes 4 seconds

**Software**

Version	1.5.3 build 8469
Platform	Windows 64