Metadata Report

Project Name

Heave Ho Landslide, Snow Basin Road (UT-226), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project (November 2021)

Summary

The Heave Ho landslide is located along the side of Snow Basin Road (UT-226) in Morgan County, Utah. The Utah Geological Surveys (UGS) began acquiring sUAS survey data for this landslide in November 2020. Using Structure from Motion (SFM), the landslide was surveyed in November 2021.

Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Elizabeth Williams

- 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)

41.210288°, -111.843369°

- Site conditions

Mid-day, cool temperature, clear skies

- Date/time spent at each site

Flights conducted on 11/15/2021 at approximately 12:30 PM

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

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 20.61 cm using all 6 GCPs. GCP error was 20.41 cm horizontal and 2.87 cm vertical.

- Alignments
- Collection methods

204 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, g20aus geoid.

Products

- Date of dataset collection

11/15/2021

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 8.16 mm/pix, DEM resolution 3.26 cm/pix, Point density – 939 points/m^2

- Horizontal Accuracy

20.41 cm

- Vertical Accuracy

2.87 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.
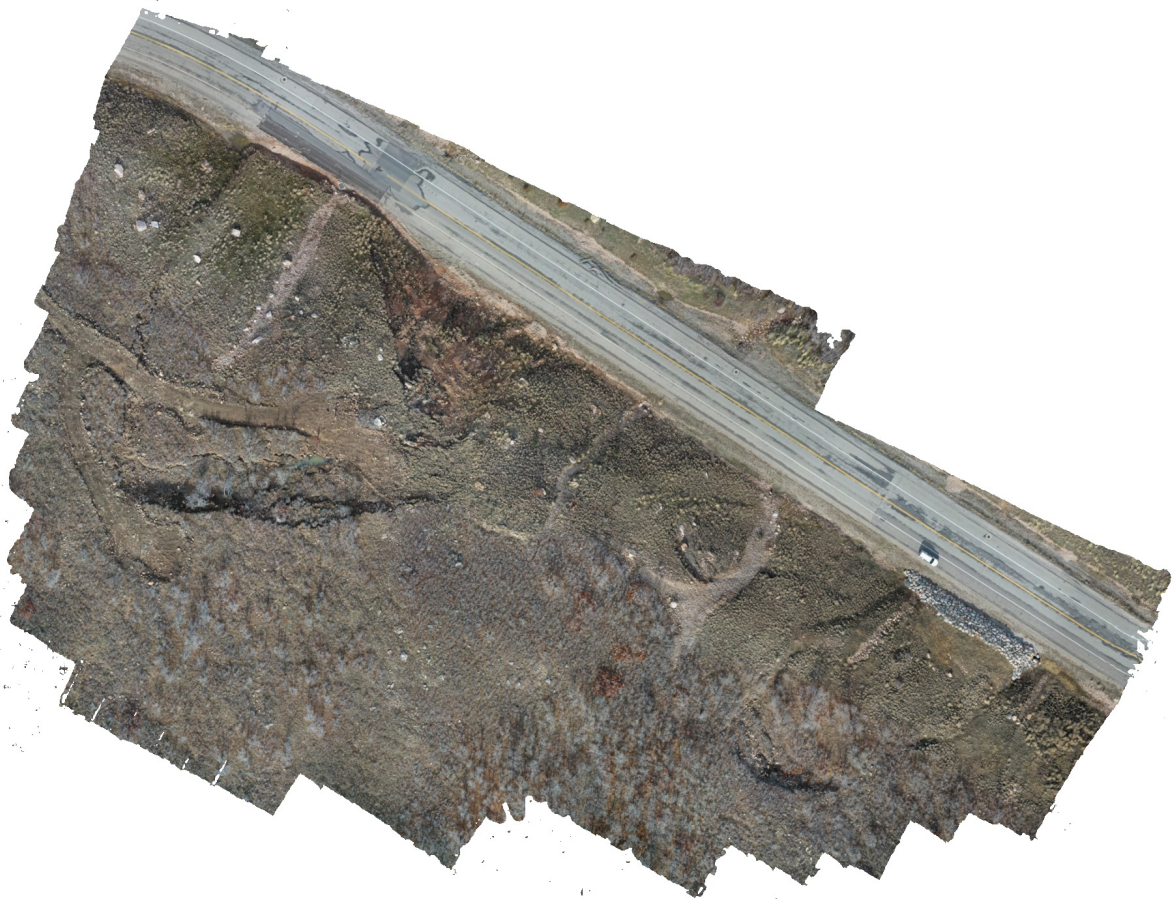
Misc Notes

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

Agisoft Metashape Metadata Report

Processing Report
Heave Ho Landslide, November 2021, Snowbasin Access Road, Morgan County, Utah
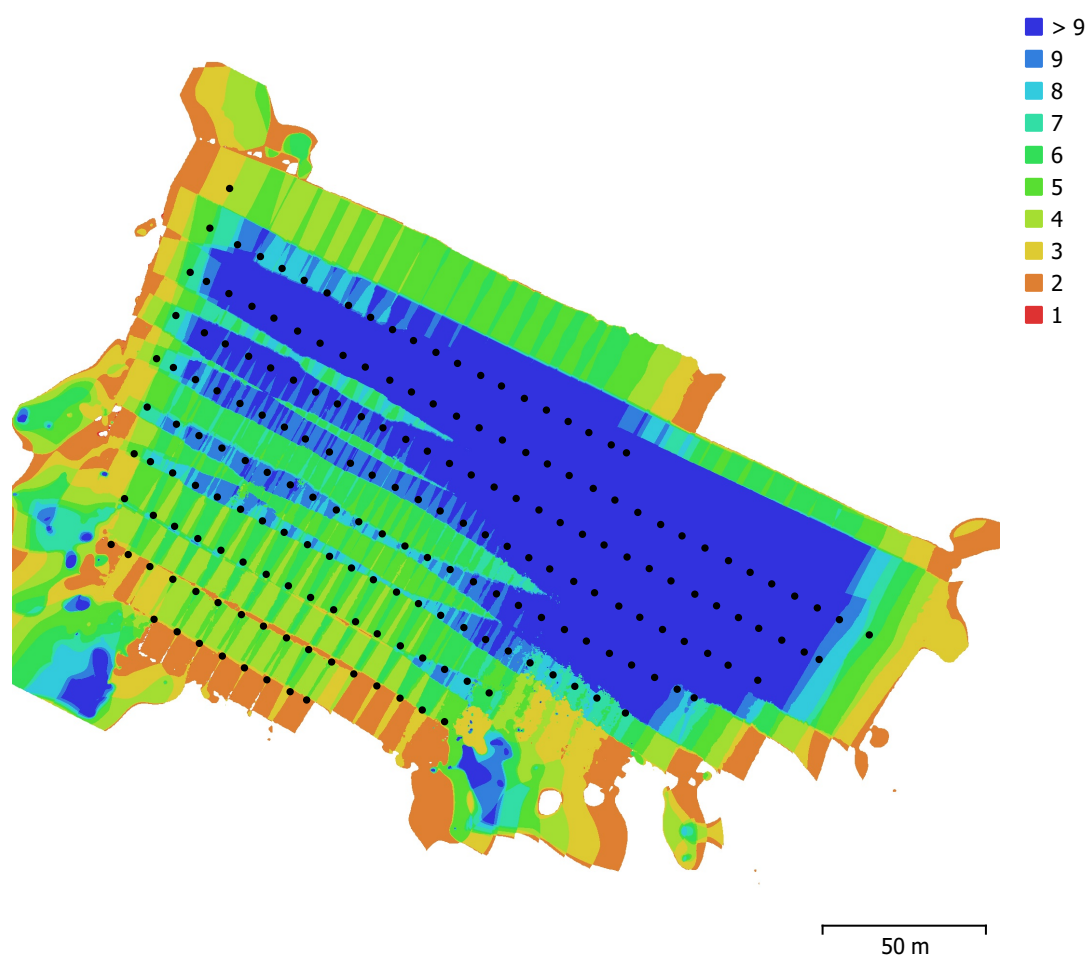**17 November 2021**

Survey Data

■	> 9
■	9
■	8
■	7
■	6
■	5
■	4
■	3
■	2
■	1

50 m

Fig. 1. Camera locations and image overlap.

Number of images:	204	Camera stations:	199
Flying altitude:	35.4 m	Tie points:	44,088
Ground resolution:	8.16 mm/pix	Projections:	160,736
Coverage area:	0.0387 km²	Reprojection error:	0.624 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
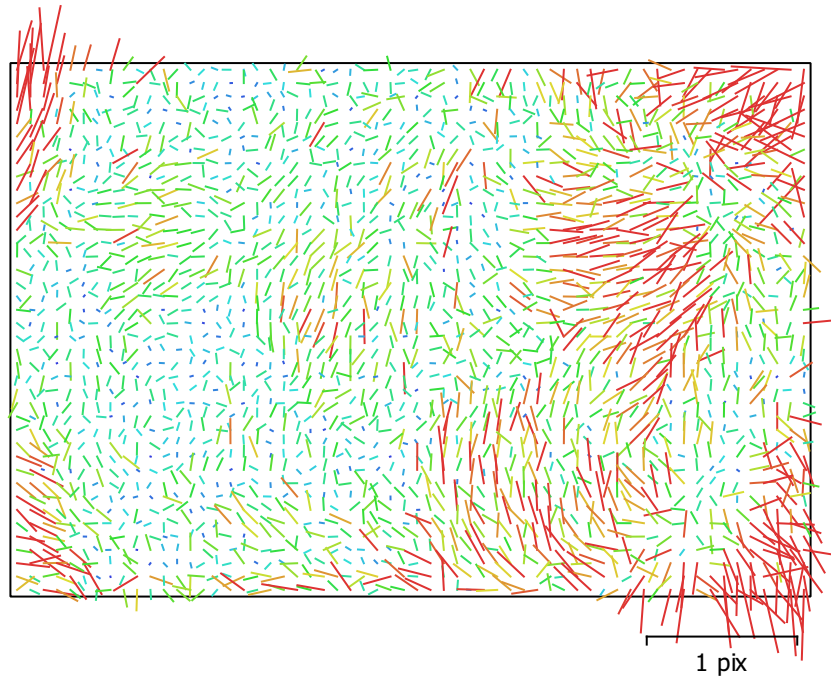
Fig. 2. Image residuals for Test_Pro (10.26mm).

Test_Pro (10.26mm)

204 images

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

	Value	Error	Cx	Cy	K1	K2	K3	P1	P2
F	**4256**								
Cx	**1.58902**	0.089	1.00	0.04	-0.02	0.04	-0.04	0.69	0.01
Cy	**-16.34**	0.081		1.00	-0.01	0.00	-0.00	0.05	0.70
K1	**-0.0164745**	0.0001			1.00	-0.95	0.89	-0.02	-0.01
K2	**0.0223664**	0.00039				1.00	-0.98	0.03	-0.00
K3	**-0.0273372**	0.00045					1.00	-0.03	0.01
P1	**-0.000278178**	6.5e-06						1.00	0.03
P2	**-0.000107735**	6.1e-06							1.00

Table 2. Calibration coefficients and correlation matrix.
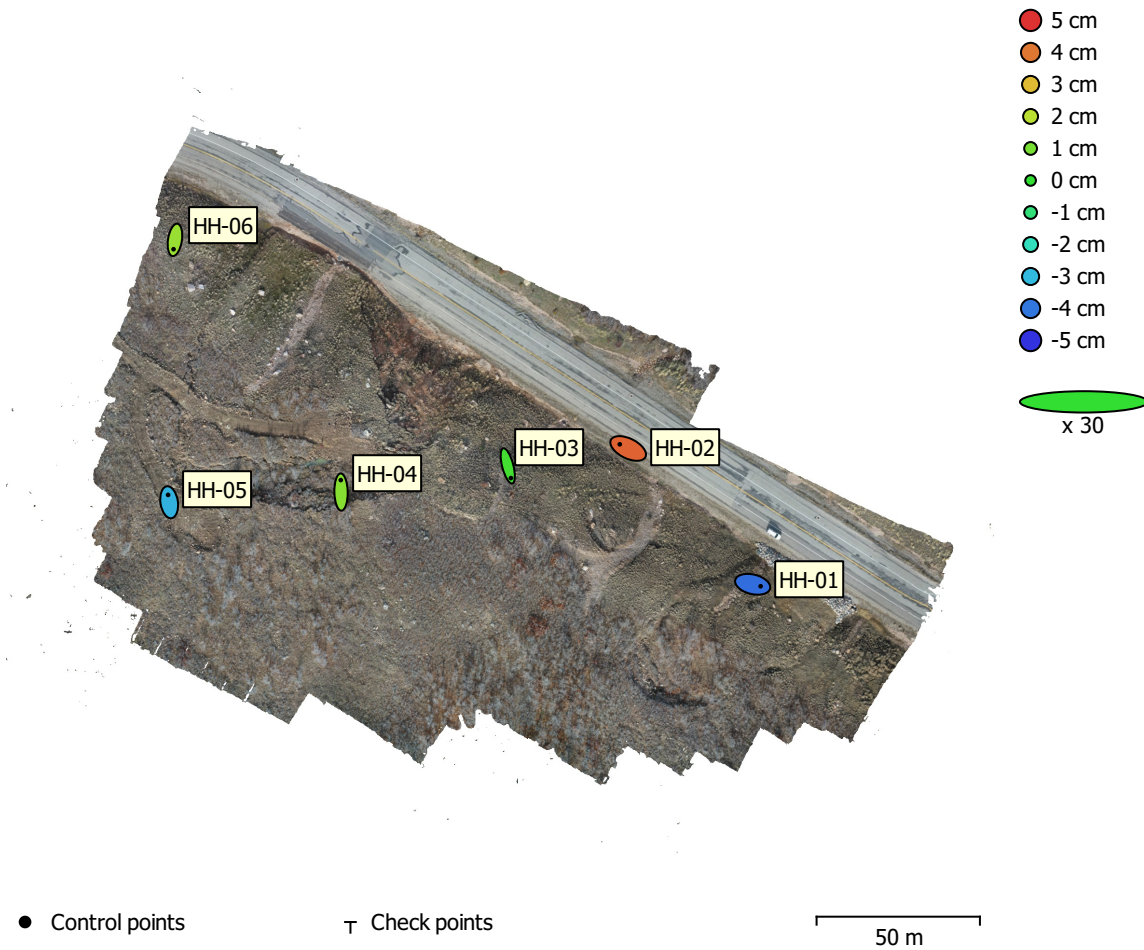
Ground Control Points

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)
6	10.1033	17.7358	2.87319	20.4117	20.6129

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)
HH-04	-0.48834	24.4175	1.2421	24.454	2.835 (6)
HH-02	-17.128	8.47375	4.3016	19.5877	2.569 (15)
HH-05	-2.21297	14.9834	-3.16182	15.4724	2.521 (4)
HH-06	-2.87991	-19.0168	1.50467	19.2924	5.016 (4)
HH-03	6.46537	-24.8406	0.255708	25.6694	2.109 (12)
HH-01	16.2437	-4.01752	-4.14225	17.2383	1.976 (15)
Total	**10.1033**	**17.7358**	**2.87319**	**20.6129**	**2.623**

Table 4. Control points.

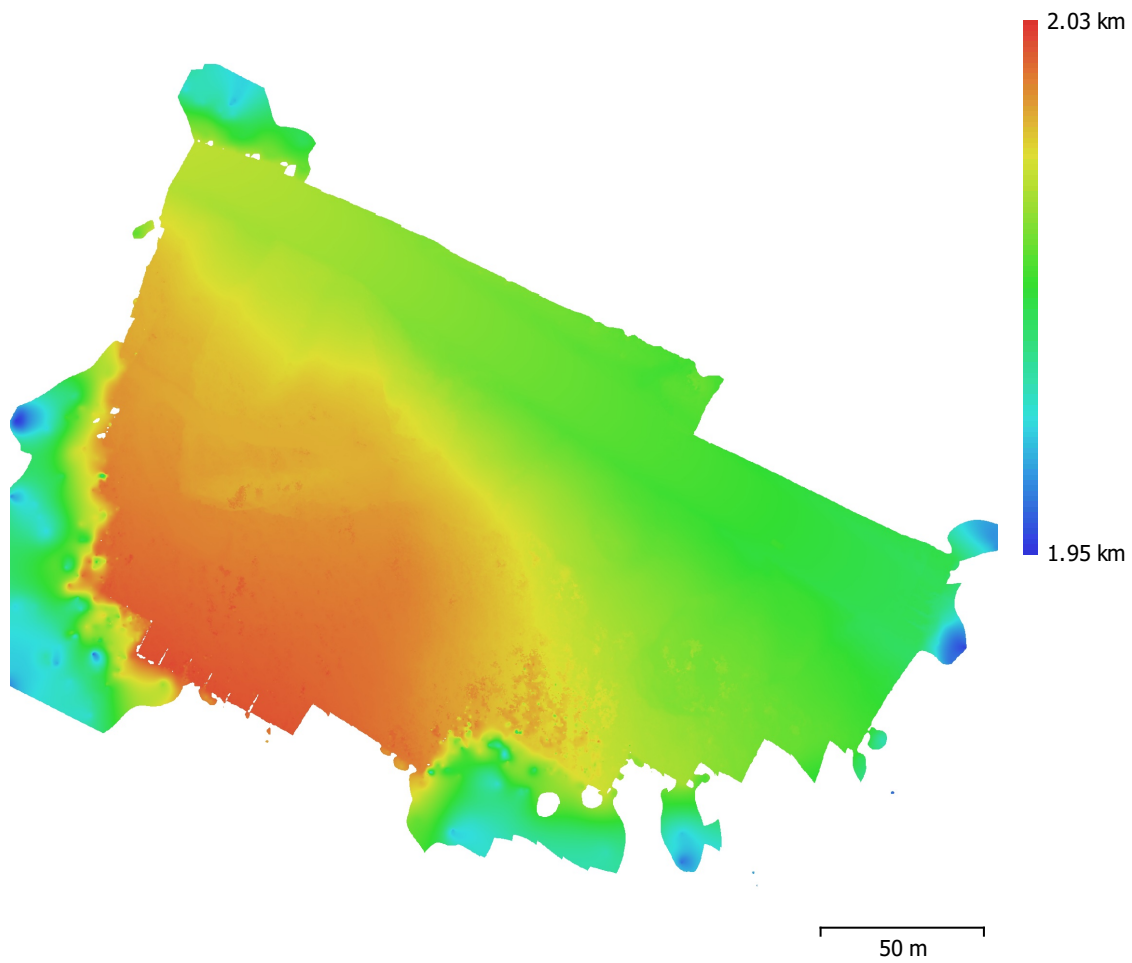X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

Fig. 4. Reconstructed digital elevation model.

Resolution: 3.26 cm/pix
Point density: 939 points/m²

Processing Parameters

General

Cameras	204
Aligned cameras	199
Markers	6
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	44,088 of 52,422
RMS reprojection error	0.277457 (0.62355 pix)
Max reprojection error	3.34353 (13.1116 pix)
Mean key point size	2.39155 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.10444

Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Key point limit per Mpx	1,000
Tie point limit	1,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	4 minutes 10 seconds
Matching memory usage	3.19 GB
Alignment time	21 seconds
Alignment memory usage	249.93 MB

Optimization parameters

Parameters	cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	1 seconds
Date created	2021:11:17 16:02:11
Software version	1.7.4.13028
File size	4.47 MB

Dense Point Cloud

Points	40,242,013
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Max neighbors	40
Processing time	19 minutes 15 seconds
Memory usage	1.90 GB

Dense cloud generation parameters

Processing time	5 minutes 38 seconds
Memory usage	3.86 GB
Date created	2021:11:17 17:59:08
Software version	1.7.4.13028
File size	528.12 MB

Model

Faces	8,021,194
Vertices	4,022,332
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Max neighbors	40
Processing time	19 minutes 15 seconds
Memory usage	1.90 GB

Reconstruction parameters

Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Strict volumetric masks	No
Processing time	24 minutes 54 seconds
Memory usage	22.19 GB

Texturing parameters

Mapping mode	Generic
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	Yes
UV mapping time	5 minutes 5 seconds
UV mapping memory usage	3.01 GB
Blending time	3 minutes 19 seconds
Blending memory usage	3.12 GB
Blending GPU memory usage	1.55 GB
Date created	2021:11:17 17:59:09
Software version	1.7.4.13028
File size	374.14 MB

DEM

Size	11,069 x 9,690
Coordinate system	WGS 84 (EPSG::4326)

Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	36 seconds
Memory usage	306.36 MB
Date created	2021:11:17 18:41:44
Software version	1.7.4.13028
File size	123.21 MB

Orthomosaic

Size	37,028 x 29,919
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

Reconstruction parameters

Blending mode	Mosaic
Surface	Mesh
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	8 minutes 33 seconds
Memory usage	4.23 GB
Date created	2021:11:17 18:36:45
Software version	1.7.4.13028

File size	5.73 GB

System

Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	31.92 GB
CPU	Intel(R) Xeon(R) CPU E5-1630 v4 @ 3.70GHz
GPU(s)	Quadro M4000