Metadata Report

Project Name

Tanner Gulch Debris Flow, Little Cottonwood Canyon, Salt Lake County, Utah – Aerial reconnaissance & volume calculation project

Summary

Tanner Gulch in Little Cottonwood Canyon experienced a large debris flow on the evening of August 8, 2019. This flow did not have enough energy to reach Utah Highway 210 (Little Cottonwood Canyon road), but moved substantial amounts of debris down the canyon. We used Structure from Motion (SFM) to create a 3D model of the debris flow deposit.

Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Adam P. McKean, Matthew C. Morriss

- Additional team members

Rich E. Giraud

Site Information

- Site description

Debris Flow in Tanner Gulch in Little Cottonwood Canyon, Salt Lake County, Utah

- Site objective

Collect SFM data for a debris flow that occurred on August 8, 2019

- Site location (GPS cords and/or map)

40.574151°, -111.701980°

- Site conditions

Mid-morning, warm temperature, clear day

- Date/time spent at each site

Flight conducted on 9/4/2019 at approximately 11 AM

OpenTopography

Survey Results

- ● Equipment used

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

- ● GPS solutions

5 GCPs were surveyed using the Utah Reference Network (TURN) real-time kinematic network and processed in UTM North Zone 12, WGS 84 datum, g12aus geoid.

- ● Errors

Overall point cloud error was 1.58 cm using all 5 GCPs. GCP error was 1.34 cm horizontal and 0.85 cm vertical.

- ● Collection methods

134 images were acquired at 40 m altitude at nadir. 25 images were collected at 80 m altitude at nadir. 105 images acquired at variable altitude at nadir in manual flight mode. 40 m and 80 m altitude images were acquired with automatic camera positions, overlaps, and orientations using Pix4D Capture software running on an iPad. Variable altitude images were captured using manual flight controls with photo acquisition every 3 seconds using DJI Go 4 software. GCPs were provided by installing orange, black, and white bucket lid targets for visibility in images.

Products

- ● Date of dataset collection

9/4/2019

- ● Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- ● Spatial resolution

Ground resolution – 1.56 cm/pix, DEM resolution 6.22 cm/pix, Point density 259 points/m^2

- ● Accuracy

Horizontal - 1.34 cm, Vertical – 0.85 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 (v 1.5.3)

Misc Notes

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

Agisoft Metashape

Processing Report
Tanner Gulch Debris Flow - August 2019, Little Cottonwood Canyon, Salt Lake County, Utah
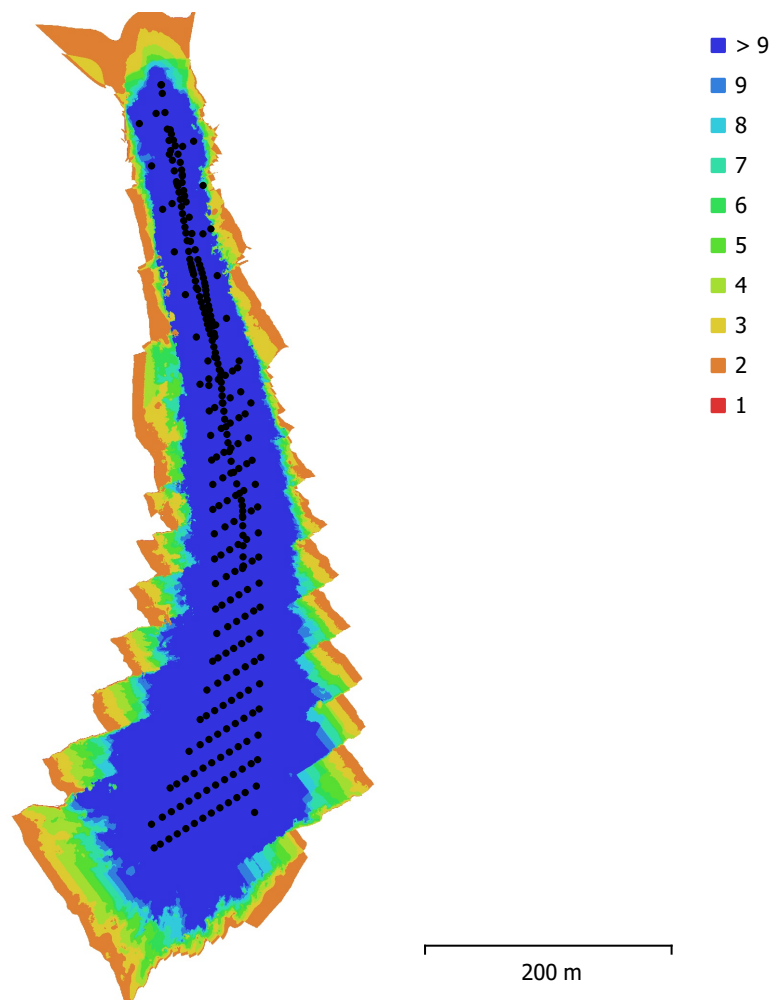
05 September 2019

Survey Data

Fig. 1. Camera locations and image overlap.

Number of images:	259	Camera stations:	259
Flying altitude:	72.6 m	Tie points:	56,944
Ground resolution:	1.56 cm/pix	Projections:	223,244
Coverage area:	0.106 km²	Reprojection error:	0.719 pix

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

Table 1. Cameras.

Camera Calibration
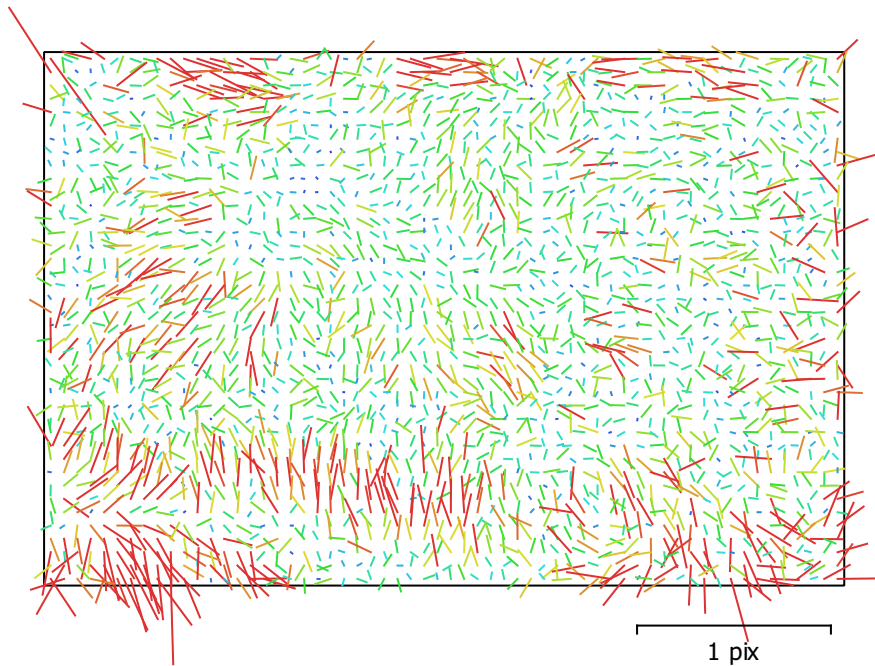

Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

259 images

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

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	P1	P2
F	**4279.83**	0.31	1.00	-0.09	-0.66	0.27	-0.01	0.18	0.04	-0.02	-0.22
Cx	**1.28417**	0.13		1.00	0.09	0.03	0.34	-0.01	-0.01	0.64	0.14
Cy	**-14.8559**	0.23			1.00	-0.60	-0.00	-0.12	0.00	0.13	0.41
B1	**-15.6509**	0.052				1.00	-0.04	-0.01	-0.04	-0.08	0.11
B2	**-1.65776**	0.041					1.00	-0.02	-0.01	-0.01	0.02
K1	**-0.00668661**	3.9e-005						1.00	-0.82	0.04	-0.28
K2	**-0.0016643**	7e-005							1.00	-0.04	0.01
P1	**-6.40553e-005**	7e-006								1.00	0.18
P2	**-0.00034542**	7.8e-006									1.00

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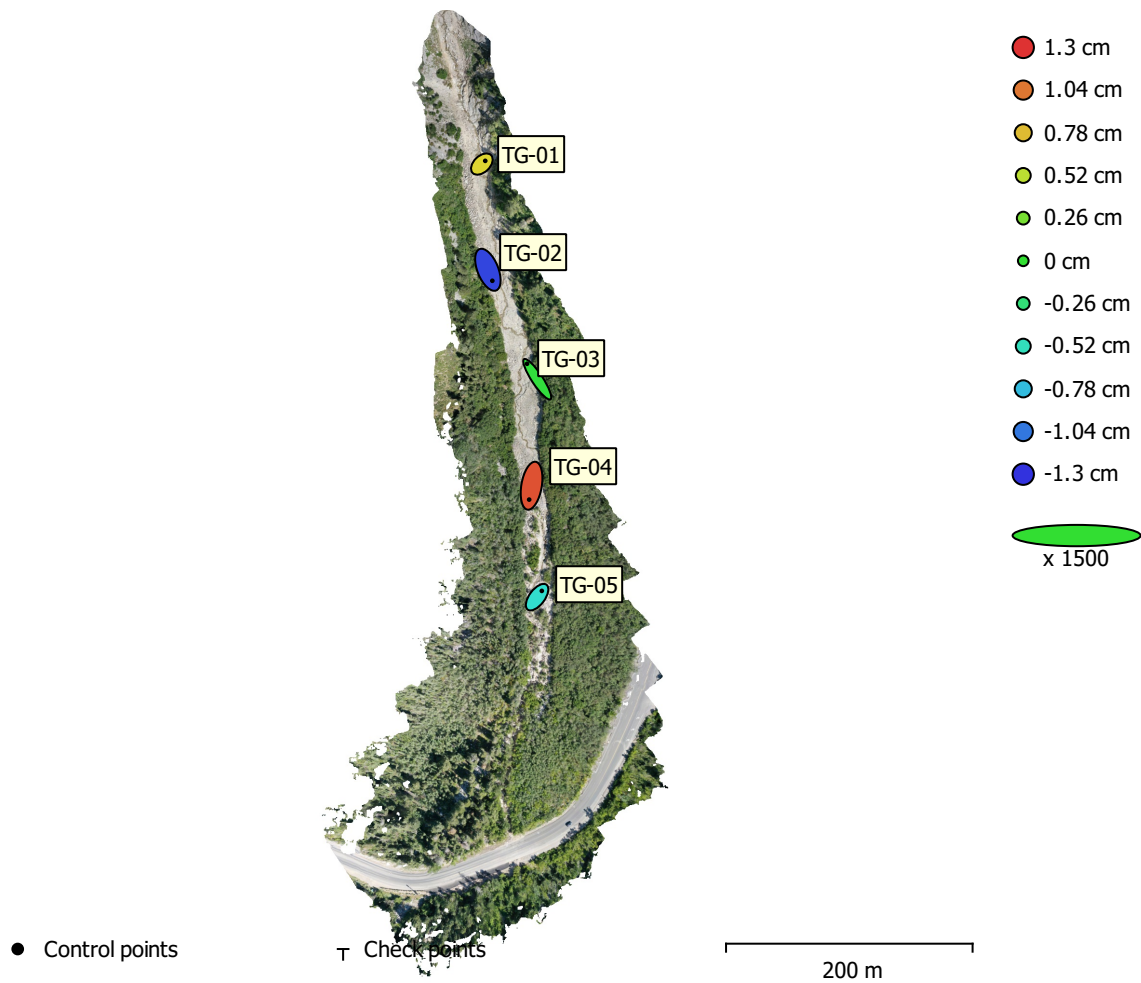
Ground Control Points

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)
5	0.617785	1.18845	0.86311	1.33943	1.59343

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)
TG-01	0.365612	0.348806	0.682204	0.848964	0.220 (15)
TG-03	-1.10182	1.67303	-0.0396708	2.00365	0.315 (21)
TG-02	0.482338	-1.19317	-1.23006	1.78027	0.186 (24)
TG-05	0.511469	0.6774	-0.586624	1.03179	0.280 (25)
TG-04	-0.2576	-1.50293	1.18348	1.93023	0.328 (28)
Total	**0.617785**	**1.18845**	**0.86311**	**1.59343**	**0.276**

Table 4. Control points.

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

Digital Elevation Model
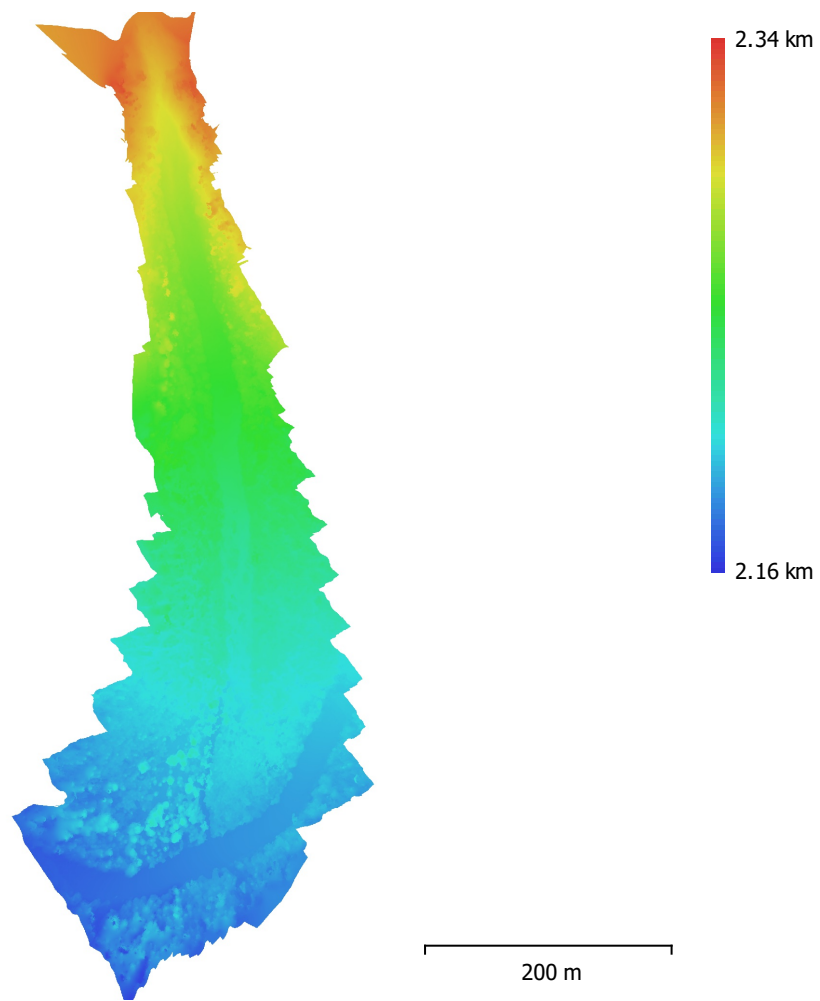
Fig. 4. Reconstructed digital elevation model.

Resolution:	6.22 cm/pix
Point density:	259 points/m²

Processing Parameters

General

Cameras	259
Aligned cameras	259
Markers	5
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	56,944 of 66,074
RMS reprojection error	0.246047 (0.71901 pix)
Max reprojection error	2.07328 (18.0851 pix)
Mean key point size	2.64773 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.46116

    Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Yes
Key point limit	40,000
Tie point limit	1,000
Adaptive camera model fitting	Yes
Matching time	5 minutes 10 seconds
Alignment time	33 seconds

    Optimization parameters

Parameters	f, b1, b2, cx, cy, k1, k2, p1, p2
Adaptive camera model fitting	No
Optimization time	2 seconds
Software version	1.5.3.8469

Dense Point Cloud

Points	57,874,410
Point colors	3 bands, uint8

    Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Processing time	12 minutes 6 seconds

    Dense cloud generation parameters

Processing time	22 minutes 41 seconds
Software version	1.5.3.8469

Model

Faces	11,574,882
Vertices	5,806,184
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

    Depth maps generation parameters

Quality	Medium
Filtering mode	Mild
Processing time	12 minutes 6 seconds

    Reconstruction parameters

Surface type	Arbitrary
Source data	Dense cloud

General

Interpolation	Enabled
Strict volumetric masks	No
Processing time	54 minutes 34 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 41 seconds
Blending time	22 minutes 39 seconds
Software version	1.5.3.8469

DEM

Size	7,158 x 14,890
Coordinate system	WGS 84 (EPSG::4326)

Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	1 minutes 6 seconds
Software version	1.5.3.8469

Orthomosaic

Size	18,389 x 51,503
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

Reconstruction parameters

Blending mode	Mosaic
Surface	Mesh
Enable hole filling	Yes
Processing time	15 minutes 36 seconds
Software version	1.5.3.8469

Software

Version	1.5.3 build 8469
Platform	Windows 64