Alaska Division of Geological & Geophysical Surveys

RAW DATA FILE 2017-6 ORTHOIMAGE

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ABSTRACT

The State of Alaska Division of Geological & Geophysical Surveys (DGGS) produced an orthorectified aerial optical image mosaic (orthoimagery) over an area extending from milepost (MP) 17 to approximately MP 24.5 on the Alaska State Highway 7 (Haines Highway) north of Haines along the Chilkat River in southeast Alaska (fig. 1). The aerial photogrammetric survey from which the orthoimagery was derived targeted large debris fans and their alpine source areas on the west side of the Takshanuk Mountains (fig. 2) in support of cryosphere hazards mapping and monitoring efforts. Aerial photographs and Global Navigation Satellite System (GNSS) data were collected on May 26, 2014, and were processed using Structure-from-Motion (SfM) photogrammetric techniques to create the orthoimagery. For the purpose of enabling open access to geospatial datasets in Alaska, this collection is being released as a Raw Data File with an open end-user license. All files can be downloaded from the DGGS website (http://doi.org/10.14509/29736).

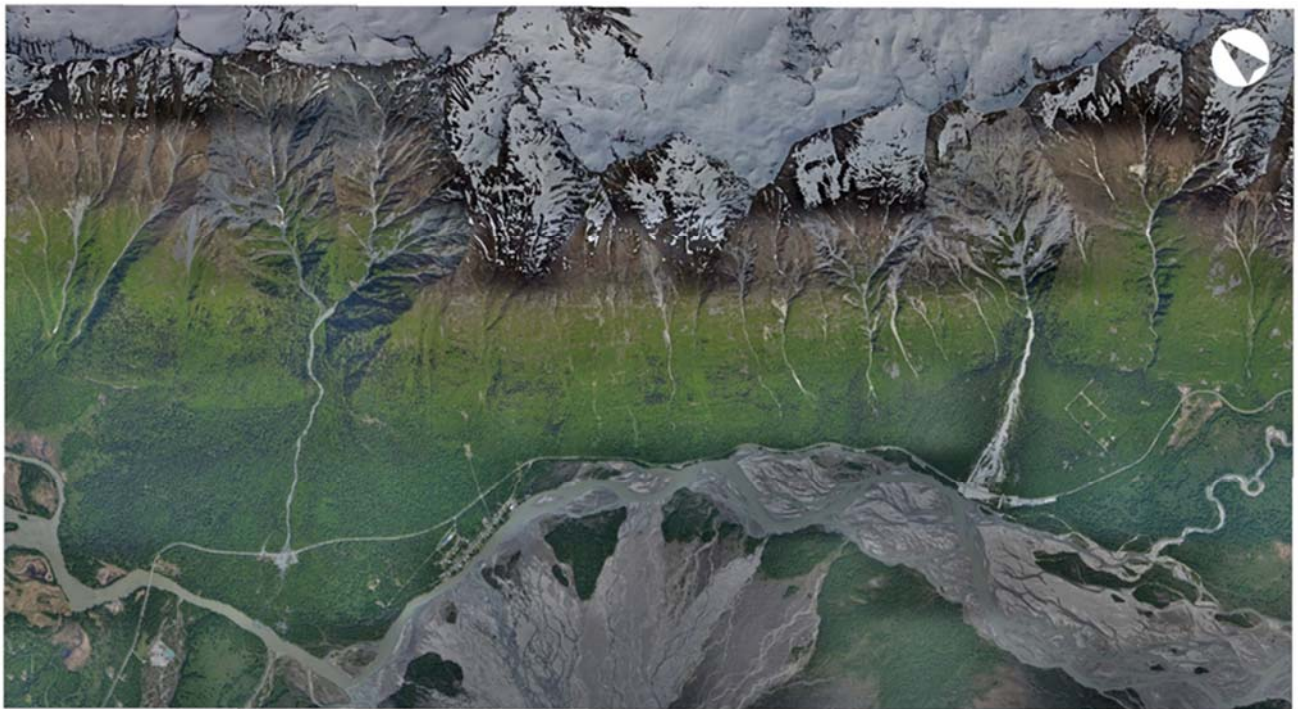

Figure 1. Orthoimage of the west slope of the Takshanuk Mountains and the Chilkat River valley. Debris flow channels can be seen at MP 19 and MP 23 along the Haines Highway north of Haines, Alaska.

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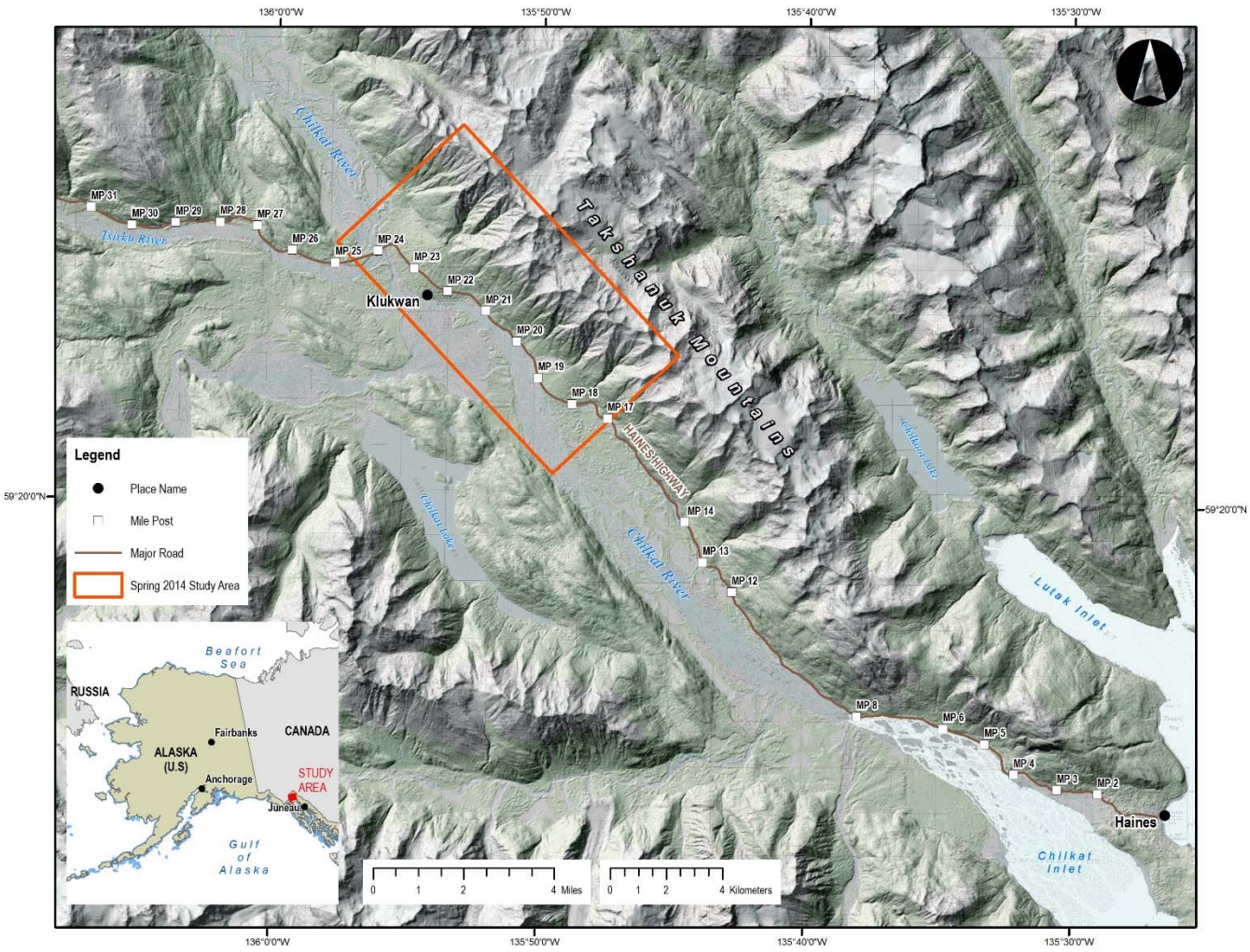

Figure 2. Location map of debris flow channel aerial photography survey (study area; May 2014) and the photogrammetrically-derived orthoimage along Alaska State Highway 7 (Haines Highway).

DATA ACQUISITION

The State of Alaska Division of Geological & Geophysical Surveys contracted Fairbanks Airborne Remote Sensing to collect digital aerial photographic data on May 26, 2014, using a fixed-wing (Cessna 180) airborne platform. The aerial photography survey was planned so flight lines and photograph frequency provided 60 percent side lap and 80 percent end lap coverage, with an average above-ground-level flying height of 1341 m, resulting in 872 photos with 0.21 m ground sample distance (GSD). The total area surveyed was 106.9 km^2.

A Nikon D800 camera with AF-Nikkor 28mm f/2.8D lens was used to collect 36.2-megapixel JPEG photographs (7360 x 4912 pixels per image) which were compressed for optimal quality. During the aerial survey, the photograph center coordinates were determined using a custom intervalometer that linked the camera shutter release with Global Positioning System (GPS) event markers created by an

onboard Trimble 5700 receiver and a dual-band Novatel roof-mounted antenna approximately 1 m above the camera, with a background sampling frequency of 5 Hz. A GPS base station with a Trimble 5700 receiver and a Zephyr antenna sampling at 1 Hz was placed approximately 100 km from the survey area, and was used to differentially correct the aerial survey GPS data using post-processing kinematic (PPK) methods.

Ground-based GNSS surveys of stable, photo-identifiable ground control points (GCPs) and check points were conducted by DGGS scientists between fall 2014 and fall 2015 utilizing identical GNSS Topcon HiPer II rover and base units.

DATA PROCESSING

GNSS

Aerial survey GNSS data were processed by DGGS using PPK methods in Topcon Positioning Systems, Inc., Magnet Office Tools commercial GNSS software. The HiPer II base station position was corrected using the National Geodetic Survey OPUS with the IGS08 (EPOCH: 2014.7342) solution. The base station was used as the vertical and horizontal control. GNSS data were collected and processed in WGS84 (G1674) using the WGS84 ellipsoid.

The National Geodetic Survey VDatum tool was used to transform GNSS data to the North American Datum 1983 (NAD83; 2011) European Petroleum Survey Group Well Known Identification Number (EPSG) 6337 and the North American Vertical Datum of 1988 (NAVD88; Geoid12A; EPOCH 2010.00). The coordinates are projected in UTM Zone 8 North and are in meters.

Aerial survey GNSS data (event marker coordinates) were manually correlated to each image using the image timestamp to create a camera exterior orientation file for import into the photogrammetric software. The exterior orientation file provides the X, Y, Z position of the camera for each photograph taken during the survey. Yaw, pitch, and roll information were not recorded during the flight.

GCPs and checkpoints were differentially corrected using PPK and static methods with respect to an existing benchmark at the Haines airport (HNS D; PID: AI4905).

PHOTOGRAMMETRY

Aerial stereo-photographs were imported into the commercially-available Agisoft Photoscan Professional software. This photogrammetric software uses an SfM algorithm to identify matching pixels in overlapping photographs and triangulate their common ground position to create a 3-dimensional point cloud (x, y, z coordinates) that defines the ground surface. Specifically, Photoscan was used to align the aerial photographs, edit the sparse point cloud, optimize the bundle adjustment, construct the dense point cloud, build a DSM, orthorectify the image mosaic, and export natural color RGB, tiled orthoimage GeoTIFFs. Photoscan's native mosaic blending and color correction tools were used in exporting the orthoimagery.

DATA PRODUCTS

The data files available for download are tiled, natural color (RGB) orthoimages. All data are projected in UTM Zone 8 North (meters) using the NAD83 (2011; EPSG 6337) horizontal datum and NAVD88 (Geoid12A; EPOCH 2010.00) vertical datum.

ORTHOIMAGERY

The orthoimage is a three-band, 8-bit unsigned GeoTIFF file using LZW compression. The orthoimage has a GSD of 0.21 m per pixel, and the "No Data" value is set to 0. Variable lighting in the orthoimages may result from variable sky conditions during the time of data acquisition.

DATA QUALITY

Horizontal accuracy of the orthoimagery was assessed by comparing the locations of ten checkpoints to the same point in the orthoimagery (fig. 3). The mean offset (residual) was -0.14 m in the X-direction and -0.02 m in the Y-direction, with a standard deviation of 0.29 (0.20, Y-direction) and a root-mean-square error (RMSE) of 0.31 (0.27, Y-direction) (table 1). No horizontal transformation was applied because horizontal offsets were not identified at or above the pixel scale (i.e., 0.21 m GSD).

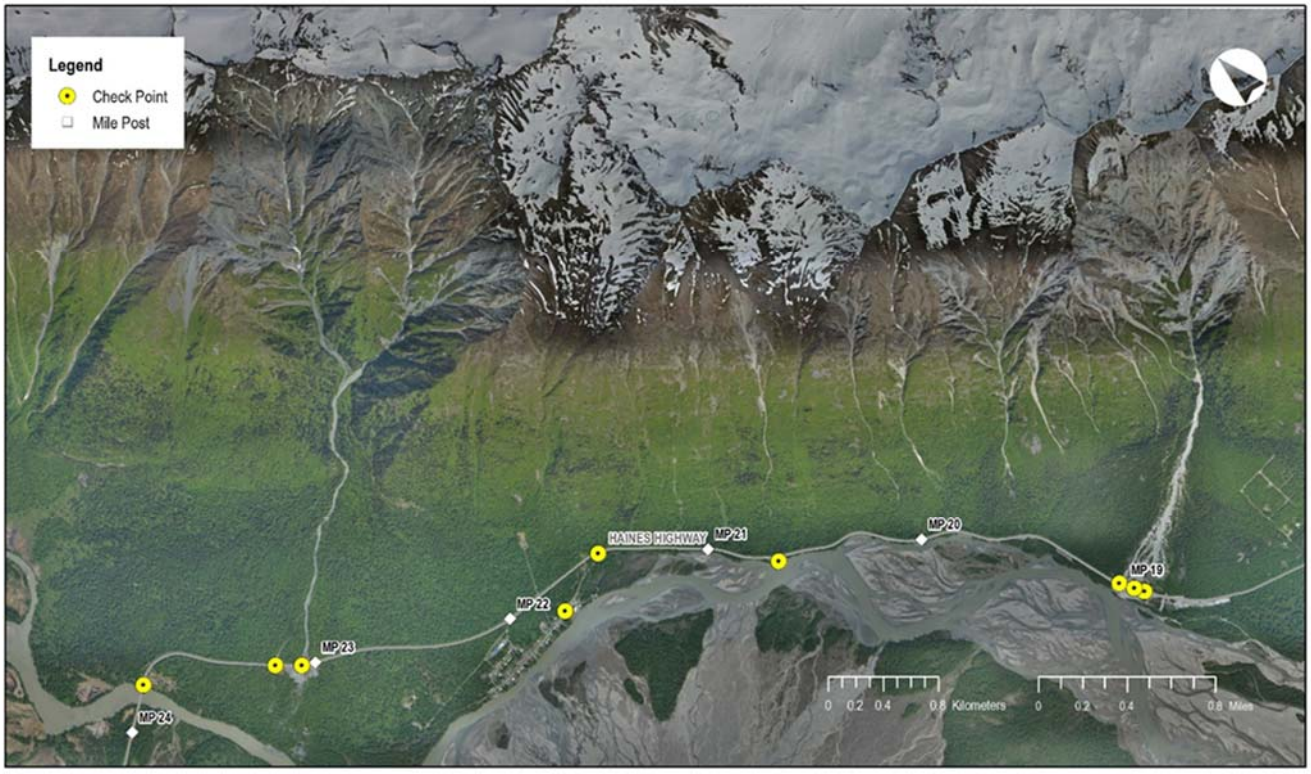

Figure 3. Location of checkpoints used to assess data quality.

Table 1. Accuracy assessment of the orthoimage. All data are projected in UTM Zone 8 North (meters) using the NAD83 (2011; EPSG 6337) horizontal datum and NAVD88 (Geoid12A; EPOCH 2010.00) vertical datum.

Check Point	Easting (X)	Northing (Y)	Elevation (m)	Horizontal offset X (m)	Horizontal offset Y (m)
GCP 3	452602.948	6581826.935	34.676	-0.4569	0.1033
GCP 4	452568.571	6581897.807	35.034	-0.5227	0.1385
GCP 5	452519.326	6582001.337	34.461	0.3609	-0.4284
GCP 9	450948.005	6583924.165	35.909	-0.2439	-0.2644
GCP 11	449625.474	6584805.59	39.426	0.2603	-0.1014
GCP 12	449623.837	6584812.156	39.785	0.0006	-0.2694
GCP 14	448031.266	6585944.579	86.516	-0.2463	0.3903
GCP 16	447899.181	6586085.13	80.603	-0.3015	0.3892
GCP 19	447139.846	6586690.236	41.971	-0.0002	0.1193
GCP 22	450093.91	6584922.773	38.862	-0.2854	-0.2541
			Mean	-0.1435	-0.0177
			Std. Dev.	0.2918	0.2878
			Range	0.8836	0.8187
			RMSE	0.3118	0.2736
Total Check Points = 10					
Spring 2014 cell size = 0.21 m				Difference: SFM - Survey	

ACKNOWLEDGMENTS

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