PHOTOGRAMMETRY-DERIVED DIGITAL SURFACE MODEL AND ORTHOIMAGERY OF THE USIBELLI GROUP TYPE SECTION, SUNTRANA CREEK, ALASKA

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Raw Data File 2020-2

Oblique aerial view northward of part of the Usibelli Group type section along Suntrana Creek near Healy, Alaska. Light-gray outcrop of Healy Creek Formation at lower-right of photograph is approximately 100 m wide, for sense of scale. Photograph by T.M. Herriott (May 10, 2018).

This report has not been reviewed for technical content or for conformity to the editorial standards of DGGS.

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INTRODUCTION

The Alaska Division of Geological & Geophysical Surveys (DGGS) conducted a photogrammetric survey in the Suntrana Creek area near Healy, Alaska (fig. 1). This survey includes most of the type section for the Cenozoic Usibelli Group (Wahrhaftig, 1987), an economically significant coal-bearing succession (Stanley and others, 1992; Ridgway and others, 1999; Wartes and others, 2013). Aerial photographs and Global Navigation Satellite System (GNSS) data were collected on May 10, 2018. We processed these data using structure-from-motion (SfM) photogrammetric techniques (for example, James and Robson, 2012; Eltner and others, 2016) to create a digital surface model (DSM) and orthorectified aerial optical image (that is to say, orthoimage; fig. 2) of the surveyed area. This Raw Data File provides open access to, and an open end-user license for, these data products, which are available for download free of charge from the DGGS website (doi.org/10.1450/30425).

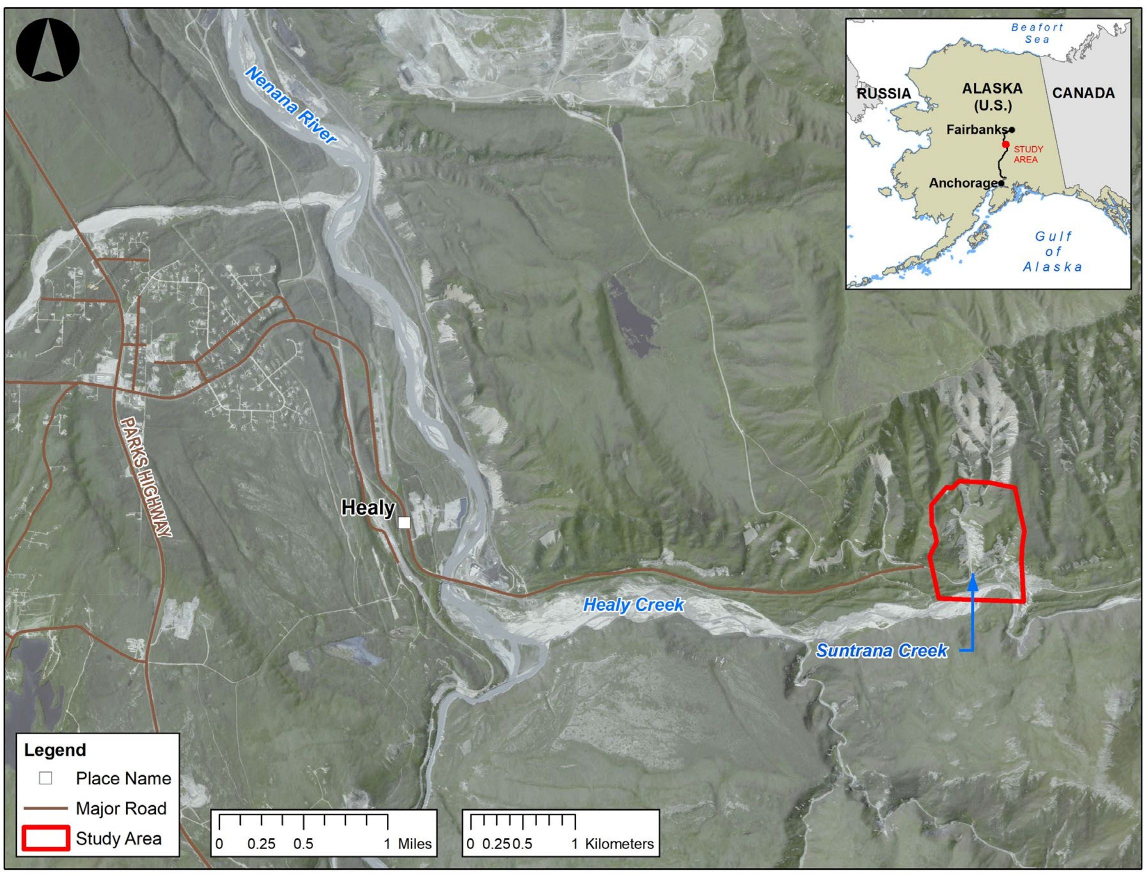

Figure 1. Location map of the Suntrana Creek photogrammetric survey area near Healy, Alaska. Red polygon delineates coverage of the digital surface model and orthoimage.

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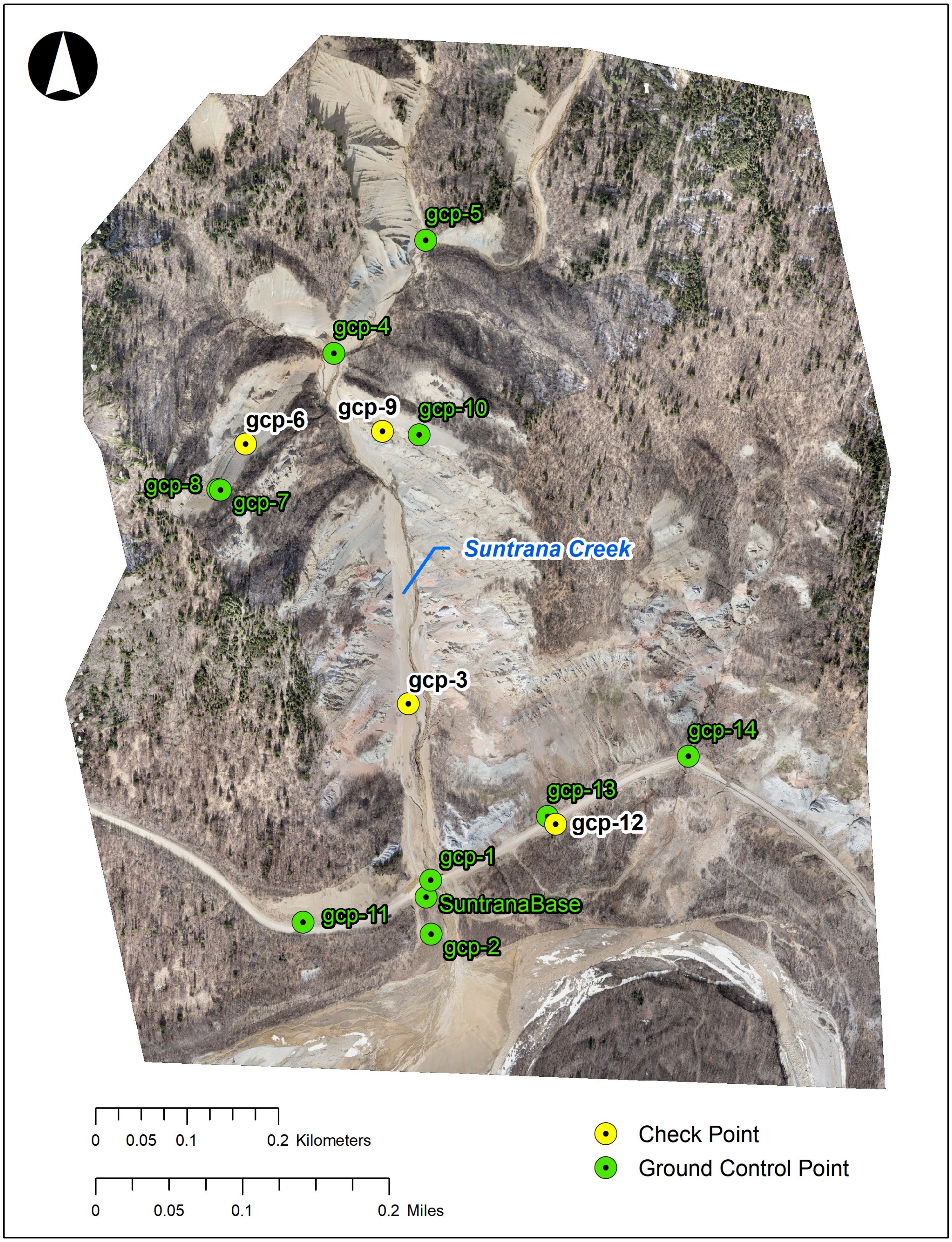

Figure 2. Orthoimage (this study) of the Suntrana Creek area. The ground control points and check points are marked. Photographs were acquired May 10, 2018.

DATA ACQUISITION

Aerial photography was conducted from a Robinson R44 helicopter at an above-ground-level flying height of approximately 100 m. We employed a Nikon D850 digital single-lens reflex camera with a Nikon AF-S NIKKOR 24mm f/1.8G ED lens. The design ground sample distance (GSD) is 1.8 cm. Each photograph is 45.4-megapixels (8256 x 5504 pixels); images were recorded in a 14-bit, losslessly compressed NEF (RAW) file format. Twenty-one north–south-trending, near-nadir-view flight lines were flown with approximately 60 percent side-lap (that is to say, frame overlap between adjacent flight lines); sequential frames were collected to yield at least 75 percent end-lap. Two additional east–west-trending, near-nadir-view flight lines, as well as two oblique-view flight lines of the Suntrana Creek valley walls, were also flown, further bolstering the photographic dataset and ensuring convergent imagery geometries in a critical part of the survey area. The dataset ultimately comprised 568 photographs (see below), and the total area surveyed is approximately 1 km^2.

Fourteen GNSS points were collected as real-time kinematic occupations with a Trimble R8 GNSS receiver; 10 of these points were employed as ground control points and four were designated as check points, as described below (fig. 2). A Trimble R7 GNSS receiver with Zephyr-2 antenna was deployed as a base station near the road at the mouth of Suntrana Creek and used as horizontal and vertical control for real-time kinematic baseline adjustments.

DATA PROCESSING

GNSS

The Trimble R7 Zephyr-2 base station position was corrected using the NGS Online Positioning User Service (OPUS) with the IGS08 (EPOCH:2018.3559). Real-time kinematic baselines of ground control points and check points were differentially adjusted with the corrected base station coordinates using Trimble Business Center processing software.

Photogrammetry

The NEF format aerial photographs were imported into Adobe Photoshop Lightroom, optimized for consistent white balance and exposure parameters, and exported as high-quality JPEG files. The 568 photographs selected for SfM processing were imported into Agisoft Photoscan Professional software (Version 1.2.3 build 2331) on a Windows desktop computer. Prior to alignment, image masks were developed as necessary and the photographs were georeferenced using 10 of the GNSS points (fig. 2). The photographs were processed in Photoscan to edit the sparse point cloud, optimize the bundle block adjustment, construct the dense point cloud and triangulated irregular network geometry, and export the natural color (RGB) orthoimagery GeoTIFF file.

DATA PRODUCTS

Data files available for download are tiled DSM and natural color (RGB) orthoimage GeoTIFFs. All data are projected in UTM Zone 6 North (meters) using the NAD83 (2011; EPSG 6335) horizontal datum and NAVD88 (Geoid12A; EPOCH 2010.00) vertical datum. Data product areal coverage is 0.92 km^2.

Digital Surface Model

DSMs represent elevations of all surfaces, including vegetation, vegetation-free land, bridges, buildings, etc. The DSM is a single-band, 32-bit float GeoTIFF file, with a GSD of 2.5 cm. The “No Data” value is set to -9999.

Orthoimagery

The orthoimage is a four-band, 16-bit unsigned GeoTIFF file, with a GSD of 2.5 cm. The “No Data” value is set to 256.

Data Quality

Four of the GCPs were designated as check points (fig. 2) to assess horizontal accuracy of the data products by comparing these four GNSS-derived points with their locations on the orthoimage (fig. 2). The mean offsets (residual) are -0.0190 m in the X-direction and 0.0197 m in the Y-direction, with standard deviations of 0.0311 m (X-direction) and 0.0512 m (Y-direction) and mean absolute errors of 0.0275 m (X-direction) and 0.0379 m (Y-direction) (table 1). No horizontal transformation is applied because the horizontal mean offsets are less than the DSM’s scale of 2.5 cm per pixel. Vertical accuracy of the DSM is evaluated by comparing the elevation values of the same four check points in the photogrammetry-derived DSM to the GNSS-derived elevation values. The mean vertical offset (Z-direction) is -0.0209 m, with a standard deviation of 0.0379 and mean absolute error of 0.0320 cm (table 1). No vertical transformation is applied.

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Table 1. Horizontal and vertical accuracy assessment of the digital surface model and orthoimage. All data are projected in UTM Zone 6 North (meters) using the NAD83 (2011; EPSG 6335) horizontal datum and NAVD88 (Geoid12A; EPOCH 2010.00) vertical datum. Abbreviations: MAE—mean absolute error; SD—standard deviation.

Check Point	Easting (X)	Northing (Y)	Elevation (m)	Horizontal offset X (m)	Horizontal offset Y (m)	Elevation offset Z (m)
gcp-3	408846.069	7082444.554	477.554	-0.0483	-0.0366	-0.0433
gcp-6	408667.616	7082729.528	567.821	-0.0034	0.0862	0.0095
gcp-9	408817.988	7082743.539	544.923	-0.0413	0.0249	-0.0626
gcp-12	409007.892	7082312.519	454.974	0.0170	0.0041	0.0128
			Mean	-0.0190	0.0197	-0.0209
			SD	0.0311	0.0512	0.0379
			Range	0.0653	0.1228	0.0754
			MAE	0.0275	0.0379	0.0320
Total check points = 4						
Suntrana Creek 2018 digital surface model cell size = 0.025 m						
Suntrana Creek 2018 orthoimage cell size = 0.025 m						

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