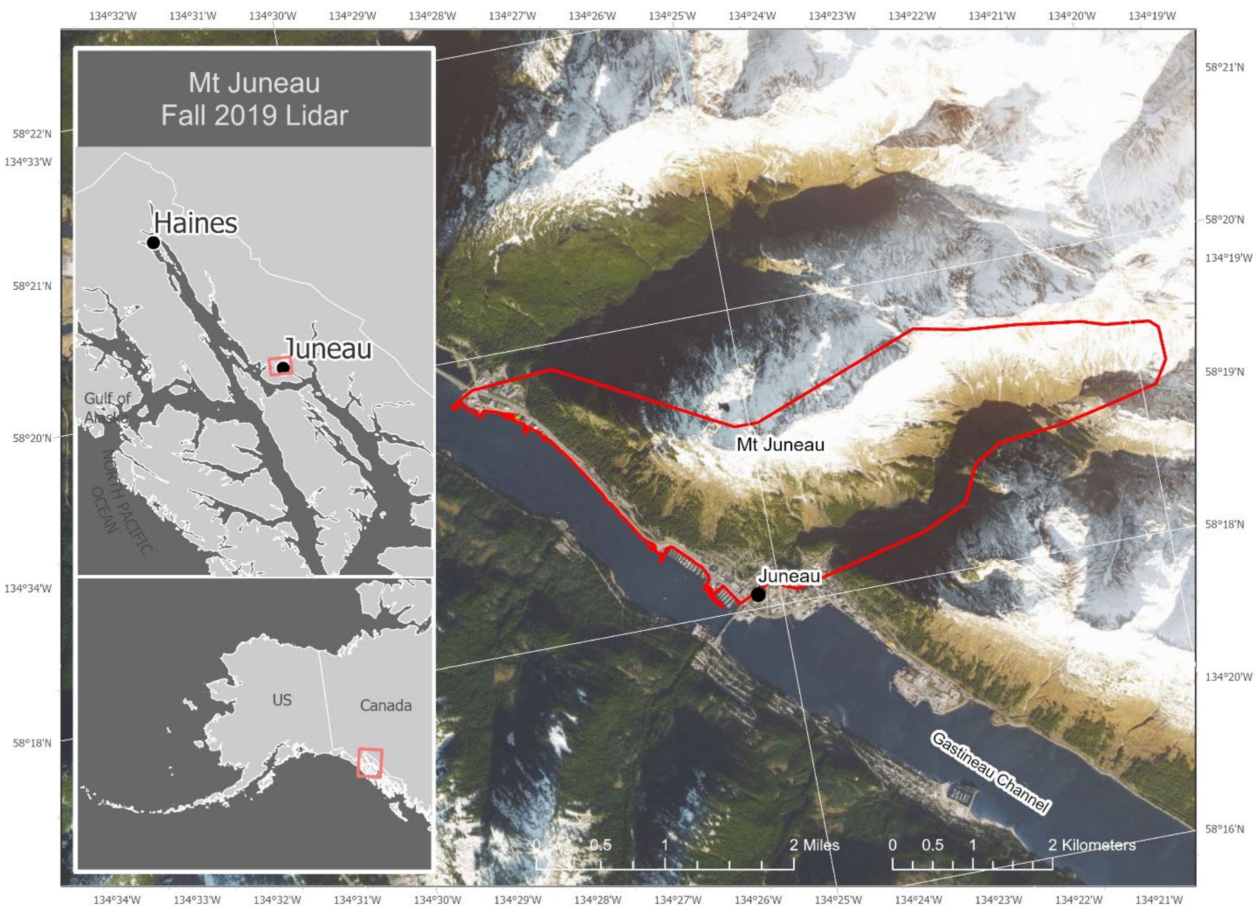
LIDAR-DERIVED ELEVATION DATA FOR MOUNT JUNEAU, SOUTHEAST ALASKA, COLLECTED SEPTEMBER 6, 2019

Katreen Wikstrom Jones and Gabriel J. Wolken

Raw Data File 2021-12



Location map of survey area with orthometric image.

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

2022
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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THE SEAL OF THE STATE OF ALASKA

ALASKA DEPARTMENT OF NATURAL RESOURCES

LIDAR-DERIVED ELEVATION DATA FOR MOUNT JUNEAU, SOUTHEAST ALASKA, COLLECTED SEPTEMBER 6, 2019

Katreen Wikstrom Jones[1] and Gabriel J. Wolken[1]

INTRODUCTION

The Alaska Division of Geological & Geophysical Surveys (DGGS) used aerial lidar to produce a classified point cloud, digital surface model (DSM), digital terrain model (DTM), and intensity model of Mount Juneau, Southeast Alaska, during near snow-free ground conditions on September 6, 2019. The survey provides snow-free surface elevations for deriving snow depth distribution models with repeat surveys during snow-covered conditions. Ground control data were collected on September 5, 2019, and aerial lidar were collected on September 6, 2019, and subsequently processed in a suite of geospatial processing software. This data collection is released as a Raw Data File with an open end-user license. All files are available here: https://doi.org/10.14509/30731.

LIST OF DELIVERABLES

Classified Points

DSM and DTM

Intensity Image

Metadata

MISSION PLAN

Aerial Lidar Survey Details

DGGS used a Riegl VUX1-LR laser scanner integrated with a global navigation satellite system (GNSS) and Northrop Grumman LN-200C inertial measurement unit (IMU). The lidar integration system was designed by Phoenix LiDAR Systems. The sensor can collect up to 820,000 points per second at a range of up to 150 m. The scanner operated with a pulse refresh rate of 50,000 pulses per second in the alpine areas and 400,000 pulses per second over forested areas at a scan rate between 80 and 220 lines per second. We used a Bell 206 JetRanger to survey from an elevation of ~130 m above ground level, at a ground speed of ~30 m/s, and with a scan angle set from 80 to 280 degrees. The total survey area covers ~14 km^2 (fig. 1).

Weather Conditions and Flight Times

We flew the aerial survey on September 6, 2019, with departure at 12:20 pm from Juneau International Airport, Alaska, and landed back at Juneau International Airport at 4:30 pm. The second part of the survey, covering Mount Juneau, started at 2:30 pm from Mount Anderson on Douglas Island (fig. 1). The weather throughout the survey was clear with no wind.

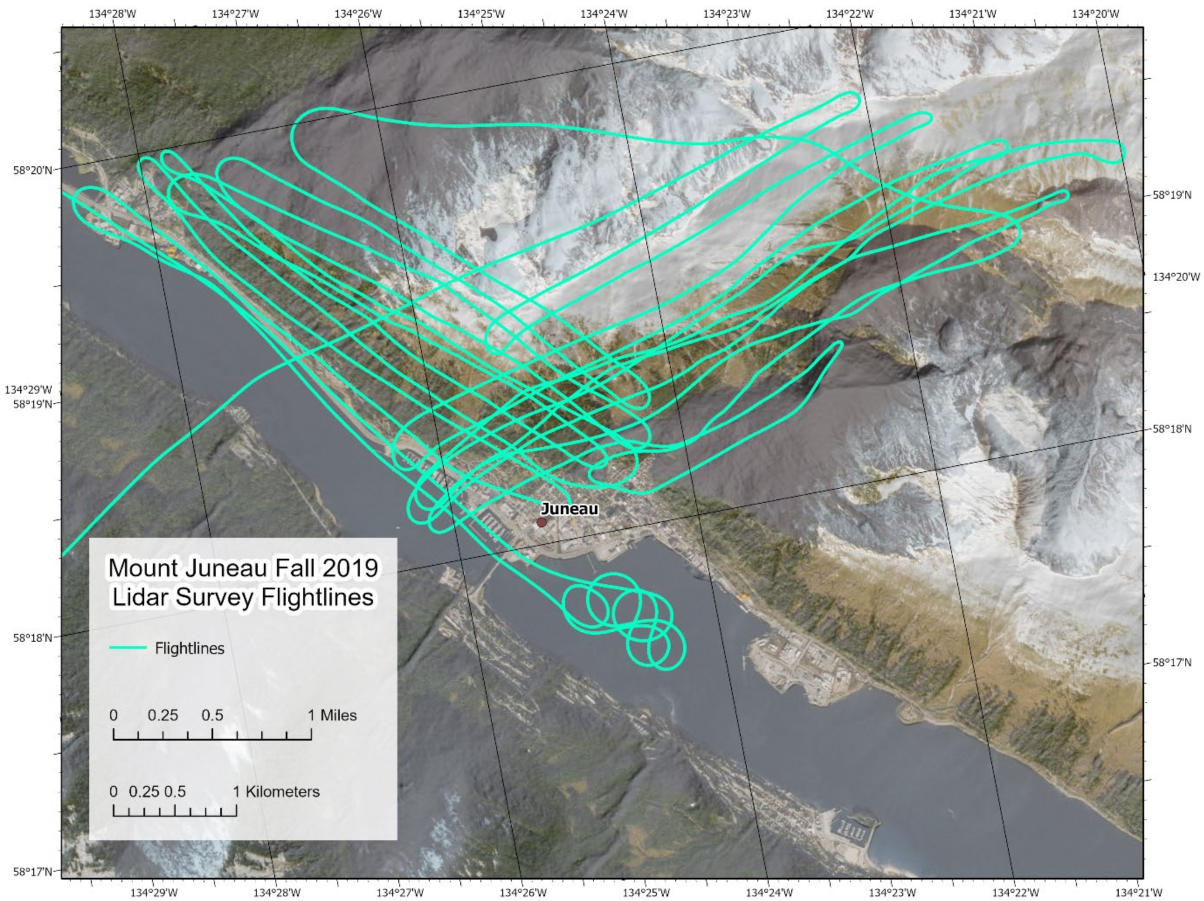

Figure 1. Project flightlines.

PROCESSING REPORT

Lidar Dataset Processing

We processed point data in SDCimport software for initial filtering and multiple-time-around (MTA) disambiguation. MTA errors, corrected in this process, are the result of ambiguous interpretations of received pulse time intervals and occur more frequently with higher pulse refresh rates. We processed Inertial Measurement Unit (IMU) and Global Navigation Satellite System (GNSS) data in Inertial Explorer and we used Spatial Explorer software to integrate flightline information with the point cloud. We calibrated the point data at an incrementally precise scale of sensor movement and behavior, incorporating sensor velocity, roll, pitch, and yaw fluctuations throughout the survey.

We created macros in Terrasolid software and classified points in accordance with American Society for Photogrammetry and Remote Sensing (ASPRS) 2014 guidelines. We gave careful attention to the interpolation of the project's ground surface to compensate for inconsistent penetration through low vegetation as a function of the scan angle. Once classified, we applied a geometric transformation and converted the points from ellipsoidal heights to GEOID12B (Alaska) orthometric heights.

We used ArcMap to derive raster products from the point cloud. The DSM was interpolated from maximum return values from the ground, vegetation and building classes using a binning method. The DTM was interpolated from all ground class returns also using a binning method and minimum values. In ArcMap, we produced an intensity image using closest-to-mean binning.

Classified Point Cloud

Classified point cloud data are provided in compressed LAZ format. Data are classified in accordance with ASPRS 2014 guidelines and contain return and intensity information. The average pulse spacing is 7.5 cm and the average density is 15.58 pts/m^2.

Digital Surface Model

The DSM represents surface elevations including heights of vegetation, buildings, powerlines, etc. The DSM is a single band, 32-bit GeoTIFF file of 50-centimeter resolution. No Data value is set to -3.40282306074e+38 (32-bit, floating-point minimum).

Digital Terrain Model

The DTM represents bare earth elevations, excluding vegetation, bridges, buildings, etc. The DTM is a single-band, 32-bit float GeoTIFF file of 50-centimeter resolution. No Data value is set to -3.40282306074e+38.

Lidar Intensity Image

The lidar intensity image describes the relative amplitude of reflected signals contributing to the point cloud. Lidar intensity is largely a function of scanned object reflectance in relation to the signal frequency, is dependent on ambient conditions, and is not necessarily consistent between separate scans. The intensity image is a single-band, 32-bit float GeoTIFF file of 1-meter resolution. No Data value is set to -3.40282306074e+38.

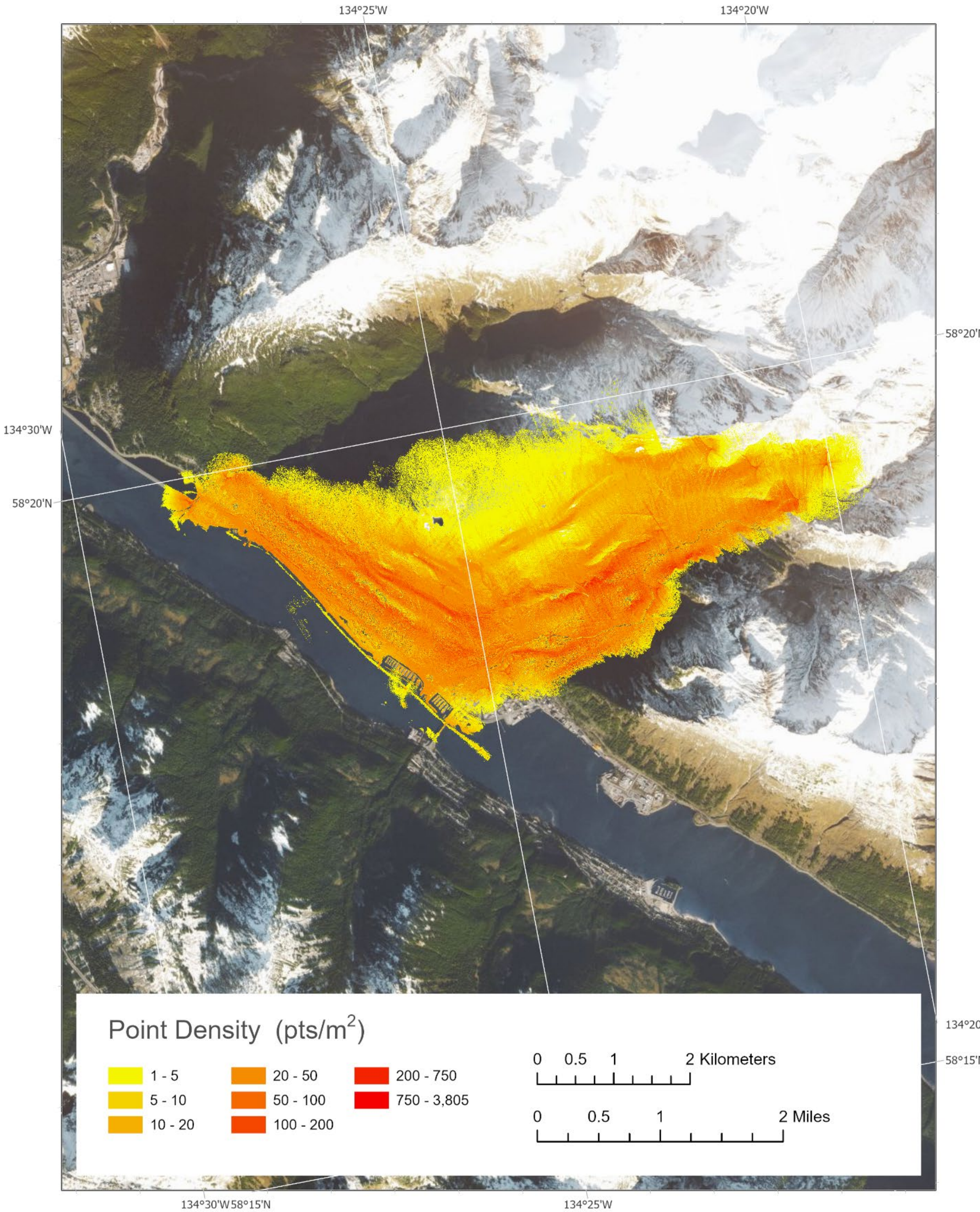

Figure 2. Ground point density for the survey displayed as a 1-meter raster.

SURVEY REPORT

Ground Survey Details

We collected ground control and check points on September 5, 2019. We deployed a Trimble R7 GNSS receiver with Zephyr-2 antenna at benchmark AI4980 in downtown Juneau. It provided a base station occupation and real-time kinematic (RTK) corrections to points that we surveyed with a rover Trimble R8-4 GNSS receiver (internal antenna). We collected a total of 28 ground control points and check points to use for calibration and to assess the vertical accuracy of the point cloud. All points were collected on bare earth or paved surfaces.

Coordinate System and Datum

We processed and deliver all data in NAD83 (2011) UTM8N and vertical datum NAVD88 GEOID12B.

Horizontal Accuracy

We did not measure horizontal accuracy for this collection.

Vertical Accuracy

We measured a mean offset of -19.5 cm between 22 control points and the point cloud (appendix 1). We reduced this offset to +4.4 cm by performing a vertical transformation of the lidar point data. We used six check points to determine the non-vegetated vertical accuracy (NVA) of the point cloud ground class using a Triangulated Irregular Network (TIN) approach. We calculated the project NVA to have a root mean square error (RMSE) of 10.8 cm (appendix 2). We evaluated the relative accuracy for this dataset as the interswath overlap consistency and measured it at 8.4 cm RMSE.

Data Consistency and Completeness

This is a partial release dataset. Data for Mount Juneau were collected at the end of the day (September 6, 2016) after surveying Eaglecrest Ski Area on Douglas Island. There was no over collect except for aircraft turns that were eliminated from the dataset. The data quality is consistent throughout the survey.

ACKNOWLEDGMENTS

These data products were funded by U.S. Geological Survey, Alaska Electric Light & Power Company, and the State of Alaska and collected and processed DGGS. We thank Coastal Helicopters for their aviation expertise and contribution to these data products. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

APPENDIX 1: GROUND CONTROL POINTS

GCP	Easting (m)	Northing (m)	Known Z (m)	Laser Z (m)	Dz (m)
1	533886.8	6462471	7.862	7.740	-0.122
2	533882.5	6462477	7.772	7.660	-0.112
3	533280	6463093	22.978	22.880	-0.098
4	533319	6463070	24.199	23.930	-0.269
5	533293.3	6463089	23.671	23.480	-0.191
6	532374.8	6464059	25.242	24.970	-0.272
7	532378.9	6464052	25.468	25.240	-0.228
8	532393.4	6464035	25.993	25.750	-0.243
9	534003.1	6462986	78.302	77.960	-0.342
10	533986.2	6462979	75.770	75.550	-0.220
11	533946	6462975	70.811	70.450	-0.361
12	534535.2	6462692	62.641	62.270	-0.371
13	534527	6462686	62.880	62.610	-0.270
14	534525.6	6462675	62.837	62.550	-0.287
15	534515.9	6462674	62.898	62.700	-0.198
16	534870.5	6463034	79.470	79.370	-0.100
17	534822.4	6463026	77.654	77.530	-0.124
18	534802.7	6463019	77.285	77.120	-0.165
19	535536.1	6463205	98.095	98.000	-0.095
20	535601.6	6463205	101.482	101.430	-0.052
21	535624.7	6463204	102.962	102.860	-0.102
22	535641.6	6463203	104.214	104.150	-0.064
Average dz (m)	-0.195				
Minimum dz (m)	-0.371				
Maximum dz (m)	-0.052				
Average magnitude error (m)	0.195				

Root mean square error (m)	0.217				
Standard deviation	0.098				

APPENDIX 2: CHECK POINTS

Check Point	Easting (m)	Northing (m)	Known Z (m)	Laser Z (m)	Dz (m)
1	533895	6462458	7.850	7.920	0.070
2	533294.6	6463083	23.603	23.700	0.097
3	532389.9	6464047	25.941	25.850	-0.091
4	533899	6462973	65.860	65.770	-0.090
5	534896.3	6463037	80.780	80.900	0.120
6	535577	6463206	100.122	100.280	0.158
Average dz (m)	0.044				
Minimum dz (m)	-0.091				
Maximum dz (m)	0.158				
Average magnitude error (m)	0.104				
Root mean square error (m)	0.108				
Standard deviation (m)	0.108				