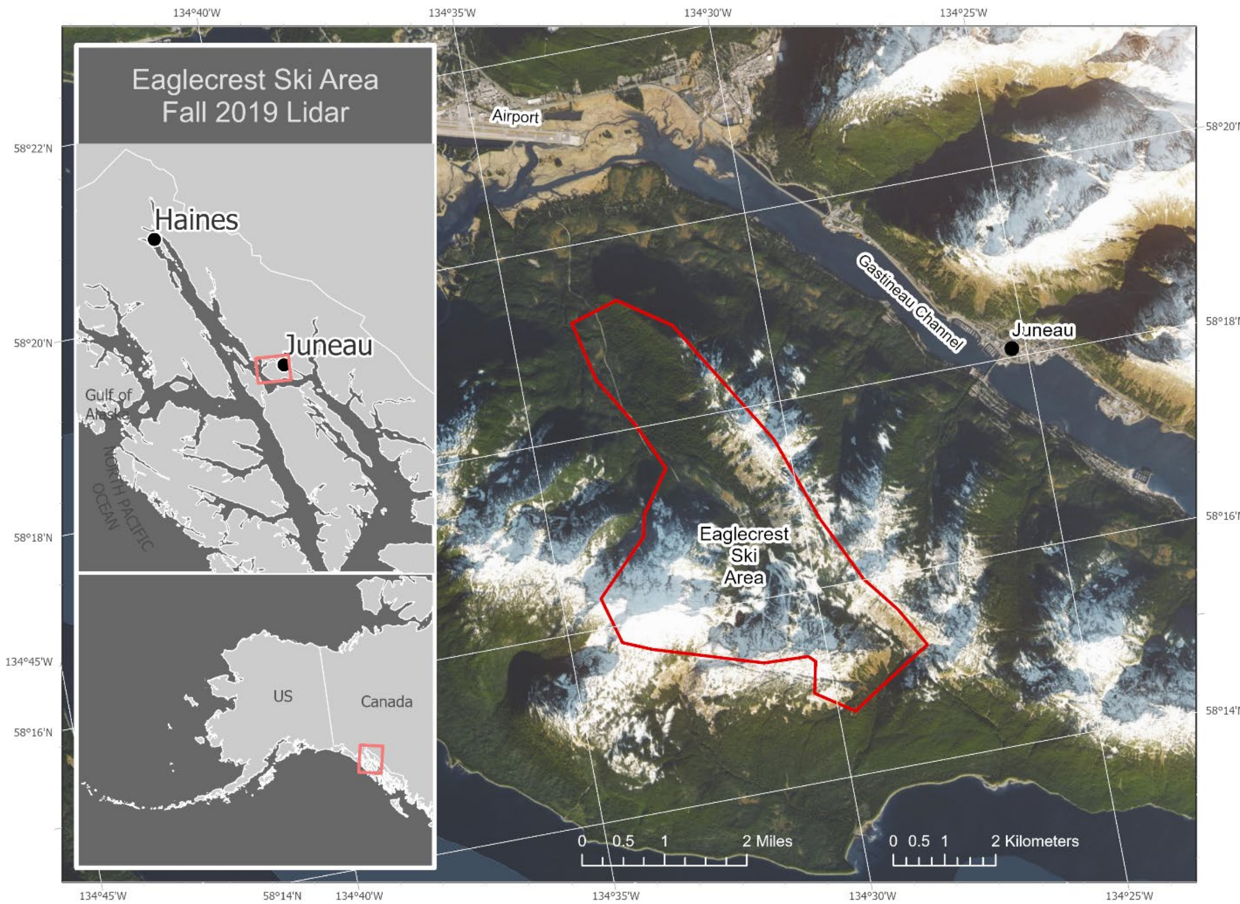
LIDAR-DERIVED ELEVATION DATA FOR EAGLECREST SKI AREA, SOUTHEAST ALASKA, COLLECTED SEPTEMBER 6, 2019

Katreen Wikstrom Jones and Gabriel J. Wolken

Raw Data File 2021-10



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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LIDAR-DERIVED ELEVATION DATA FOR EAGLECREST SKI AREA, SOUTHEAST ALASKA, COLLECTED SEPTEMBER 6, 2019

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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 Eaglecrest ski area and surroundings on Douglas Island, 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. Aerial lidar were collected on September 6, 2019, and ground control data were collected on September 8, 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/10.14509/30729.

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 aircraft to survey from an elevation of ~130 m above ground level, at a ground speed of approximately 30 m/s, and with a scan angle set from 80 to 280 degrees. The total survey area covers 26 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 first part of the survey, covering Eaglecrest Ski Area, started and ended on Mount Anderson and was completed by 2:20 pm (fig. 1). The weather throughout the survey was clear with no wind.

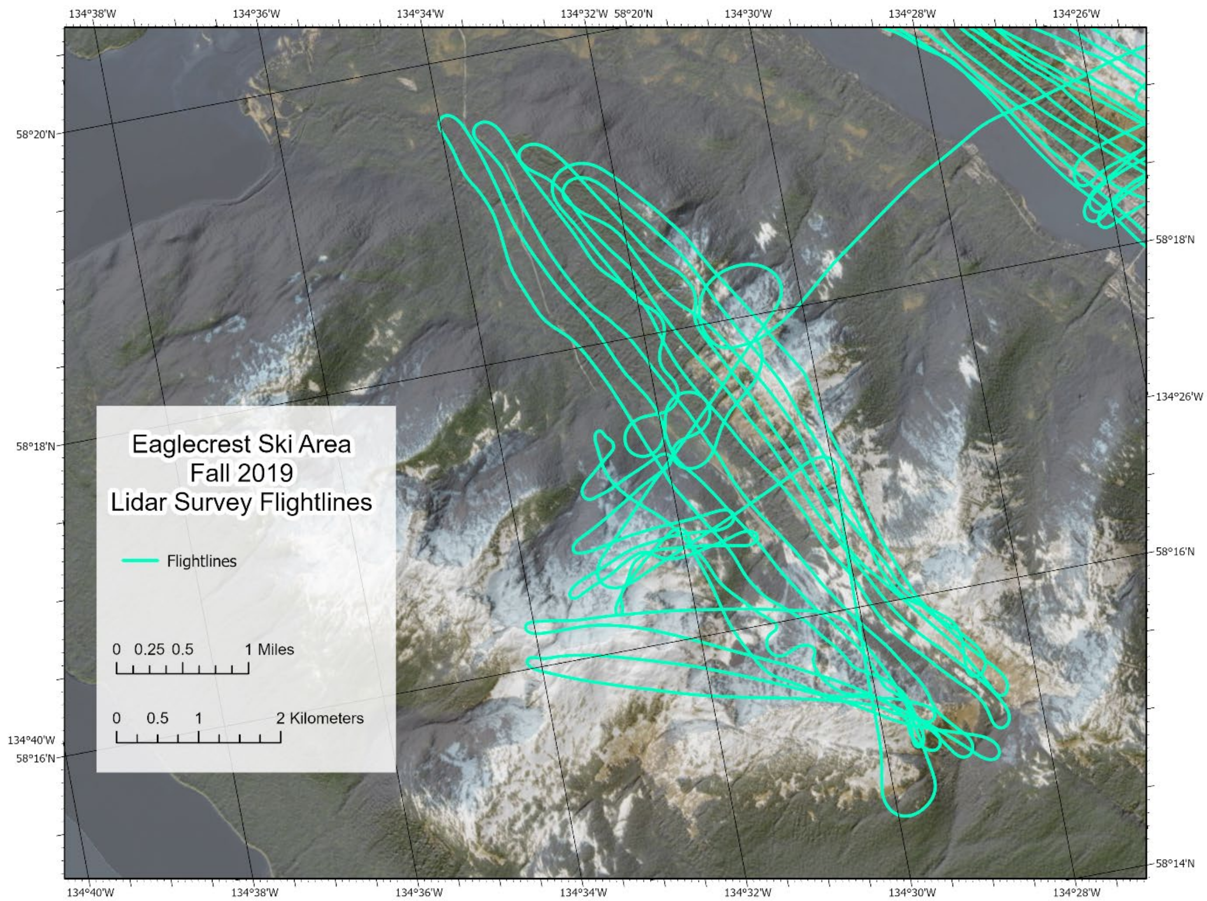

Figure 1. Project flightlines.

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 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 point 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 10.6 cm and the average density is 10.84 pts/m^2.

Digital Surface Model

The DSM represents surface elevations including heights of vegetation, buildings, bridges, etc. The DSM is a single band, 32-bit GeoTIFF file of 1-meter 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 1-meter 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.

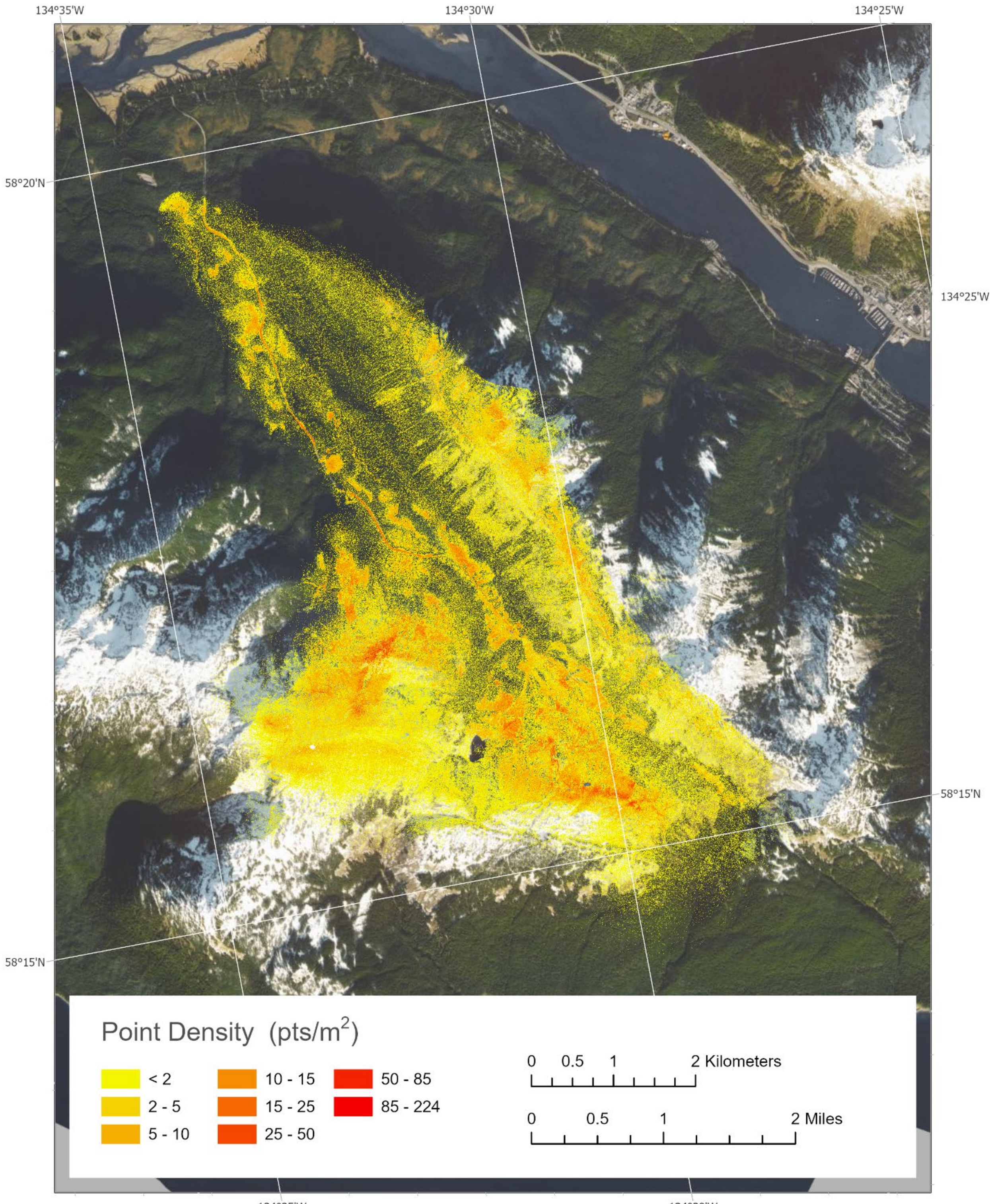

Figure 2. Ground point density for the survey displayed as a 1-meter raster.

SURVEY REPORT

Ground Survey Details

We collected ground control and check points on September 8, 2019. We deployed a Trimble R7 GNSS receiver with Zephyr-2 antenna at the parking lot near the Eaglecrest Ski Area lodge. 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 60 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 +9 cm between 47 control points and the point cloud (appendix 1). We reduced this offset to -0.6 cm by performing a vertical transformation of the lidar point data. We used 13 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 5.6 cm (appendix 2). We evaluated the relative accuracy for this dataset as the interswath overlap consistency and measured it at 1.3 cm RMSE.

Data Consistency and Completeness

This is a partial release dataset. Data for Eaglecrest Ski Area were collected at the beginning of the day (September 6, 2016), and the survey continued over to Mount Juneau after completion of this portion. There was no over collect except for aircraft turns that were eliminated from the dataset. The data quality is consistent throughout the survey.

ACKNOWLEDGMENTS

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APPENDIX 1: GROUND CONTROL POINTS

GCP	Easting (m)	Northing (m)	Known Z (m)	Laser Z (m)	Dz (m)
1	528486.081	6459522.844	340.244	340.180	-0.064
2	528436.024	6459583.006	344.272	344.190	-0.082
3	528411.813	6459596.857	346.257	346.200	-0.057
4	528418.870	6459572.357	347.456	347.400	-0.056
5	528418.702	6459564.392	347.561	347.500	-0.061
6	528419.612	6459563.291	347.556	347.460	-0.096
7	528420.708	6459564.253	347.563	347.510	-0.053
8	528393.385	6459532.438	353.305	353.310	0.005
9	528417.707	6459536.867	350.048	350.030	-0.018
10	528429.498	6459523.342	350.501	350.320	-0.181
11	528494.851	6459481.734	341.245	341.030	-0.215
12	528590.524	6459442.178	351.424	351.280	-0.144
13	528605.957	6459404.407	355.705	355.870	0.165
14	528590.753	6459314.200	367.051	367.110	0.059
15	528592.109	6459256.464	374.267	374.260	-0.007
16	528591.401	6459156.843	381.694	381.620	-0.074
17	528592.131	6459100.189	386.138	386.170	0.032
18	528617.116	6459041.912	397.151	397.240	0.089
19	528685.880	6459032.783	409.025	408.860	-0.165
20	528847.654	6459034.724	435.937	435.800	-0.137
21	528929.129	6459043.786	449.172	449.040	-0.132
22	528979.286	6459020.082	457.511	457.410	-0.101
23	529010.667	6458962.163	465.630	465.500	-0.130
24	528884.816	6458681.429	527.881	527.770	-0.111
25	528872.960	6458680.609	527.033	526.950	-0.083
26	528865.894	6458682.555	526.742	526.690	-0.052
27	528833.319	6458682.944	526.048	525.960	-0.088
28	529211.411	6458627.572	493.189	493.090	-0.099
29	529052.852	6458886.328	469.838	469.600	-0.238
30	529021.906	6458937.335	467.640	467.460	-0.180
31	528924.141	6459044.522	448.468	448.370	-0.098
32	528107.299	6460185.504	345.660	345.580	-0.080
33	528129.723	6460127.319	346.483	346.390	-0.093
34	528139.119	6460099.407	346.483	346.370	-0.113
35	528130.967	6460058.759	348.984	348.850	-0.134
36	528145.307	6460027.800	349.225	349.100	-0.125
37	528161.109	6459998.367	348.503	348.320	-0.183
38	528179.275	6459965.557	347.750	347.730	-0.020
39	528194.575	6459938.165	347.251	347.090	-0.161

40	528230.654	6459918.141	345.123	344.980	-0.143
41	528248.119	6459898.767	344.392	344.260	-0.132
42	528255.418	6459876.063	343.824	343.680	-0.144
43	528265.820	6459859.073	343.421	343.300	-0.121
44	528296.979	6459821.596	341.983	341.880	-0.103
45	528308.712	6459806.897	341.478	341.380	-0.098
46	528321.416	6459785.351	341.445	341.370	-0.075
47	528332.792	6459768.088	341.358	341.240	-0.118
Average dz (m)	-0.090				
Minimum dz (m)	-0.238				
Maximum dz (m)	0.165				
Average magnitude error (m)	0.105				
Root mean square error (m)	0.117				
Standard deviation (m)	0.076				

APPENDIX 2: CHECK POINTS

Check Point	Easting (m)	Northing (m)	Known Z (m)	Laser Z (m)	Dz (m)
1	528462.404	6459543.281	343.705	343.630	-0.075
2	528400.851	6459611.170	346.335	346.390	0.055
3	528419.870	6459565.302	347.537	347.580	0.043
4	528562.975	6459446.581	348.990	349.060	0.070
5	528595.390	6459211.026	379.073	379.160	0.087
6	528792.269	6459044.513	426.309	426.230	-0.079
7	528892.853	6458680.324	528.738	528.660	-0.078
8	529182.196	6458580.164	503.324	503.280	-0.044
9	528100.612	6460219.546	345.058	345.070	0.012
10	528136.211	6460045.847	349.412	349.400	-0.012
11	528207.082	6459916.965	346.781	346.730	-0.051
12	528276.804	6459840.674	342.716	342.710	-0.006
13	528347.848	6459745.494	341.412	341.410	-0.002
Average dz (m)	-0.006				
Minimum dz (m)	-0.079				

Maximum dz (m)	0.087				
Average magnitude error (m)	0.047				
Root mean square error (m)	0.056				
Standard deviation (m)	0.057				