SnowEx23 Airborne Lidar-Derived 0.25M Snow Depth and Canopy Height, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Larsen, C.F. 2024. *SnowEx23 Airborne Lidar-Derived 0.25M Snow Depth and Canopy Height, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/BV4D8RRU1H7U. [Date Accessed].

National Snow and Ice Data Center

TABLE OF CONTENTS

1   DATA DESCRIPTION

1.1 Parameters

This data set provides digital terrain models, snow depth, and canopy height, acquired by a scanning lidar system and derived from Point Cloud Digital Terrain Models (PCDTMs) from two regions of Alaska, USA collected as part of the NASA SnowEx 2023 field campaign. The study sites include a boreal forest environment in the Fairbanks region of central Alaska (the Bonanza Creek Experimental Forest, Caribou Poker Creek watershed, and Farmer's Loop/Creamer's Field) and a coastal tundra environment in the North Slope region of the northern Alaska coastal plain (Arctic coastal plain and Upper Kuparuk Toolik). The raw data from which these data are derived are available as SnowEx23 Airborne Lidar Scans Raw, Version 1.

1.2 File Information

1.2.1   Format

The data are available as Geographic Tagged Image (GeoTIFF, 32-bit) files.

1.2.2   File Contents

Each GeoTIFF file contains embedded georeferenced data representing bare earth terrain elevation (DTM), snow depth (SD), or canopy height (VH).

1.2.3   Naming Convention

The data are named according to the following convention and as described in Table 1.

`SNEX23_Lidar_[site]_[file type]_0.25M_[yyyymmdd_yyyymmdd]_V01.0.[tif]`

Table 1. File Naming Convention

Variable	Values	Description
SNEX23_Lidar		NSIDC data set ID
[site]	ACP, BCEF, CPCW, FLCF, UKT	Site code: ACP (Arctic Coastal Plain), BCEF (Bonanza Creek Experimental Forest), CPCW (Caribou Poker Creek Watershed), FLCF (Farmer's Loop/Creamer's Field), and UKT (Upper Kuparuk Toolik)

Variable	Values	Description
[file type]	DTM, SD, CH	File contents: DTM indicates bare earth surface elevation data. SD indicates snow depth measurements. CH refers to vegetation height measurements.
[0.25M]		Spatial resolution: 0.25 meters for all data
[yyyymmdd_yyyymmdd]		Lidar acquisition start and end dates: 4-digit year, 2-digit month, 2-digit day
V01.0		Data set version 1.0

1.3 Spatial Information

1.3.1 Coverage

Northernmost latitude: 64.5 ºN

Southernmost latitude: 70.0 ºN

Easternmost longitude: 148.0 ºW

Westernmost longitude: 148.5 ºW

1.3.2 Resolution

The horizontal spatial resolution is 0.25 m.

1.3.3 Geolocation

The following table provides information for geolocating this data set

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	UTM zone 6N
Longitude of true origin	-147
Latitude of true origin	0
Scale factor at longitude of true origin	0.9996
Datum	WGS 84
Ellipsoid/spheroid	WGS 84
Units	meters
False easting	500000
False northing	0

EPSG code	32606
PROJ4 string	+proj=utm +zone=6 +datum=WGS84 +units=m +no_defs +type=crs
Reference	https://epsg.io/32606

1.4 Temporal Information

1.4.1 Coverage

11 March 2022 to 25 October 2023

1.4.2 Resolution

Most locations were scanned five times, with the exception of UKT, which was scanned four times.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Lidar scanning were performed in two regions of Alaska. The Bonanza Creek Experimental Forest, Caribou Poker Creek watershed, and Farmers Loop/Creamer's Field study sites are located in a boreal forest environment outside of Fairbanks, and the Arctic coastal plain and Upper Kuparuk Toolik study sites are located in a coastal tundra environment in the North Slope region. sites). The resulting data were used to create bare Earth digital terrain model (DTM) products and to derive snow depth and canopy heights digital surface model (DSM) products. The spring and fall (snow on) dates were very tightly coordinated with the ground crews to minimize any time offset between the ground and airborne measurements. The summer snow free measurements were generally scheduled during periods of minimal foliage minimize for best bare earth coverage. The snow free measurements for the two northern sites did not have this same concern and were instead timed to target minimal pond and surface water levels later in the season. Due to the lack of prominent vegetation in the North Slope region, no canopy height models are available for these locations.

2.2 Acquisition and Processing

Lidar scanning were conducted using University of Alaska, Fairbanks instrumentation flown in a contract aircraft operated by Keller Aviation. Raw data was processed using Applanix and Riegl software to create individual flight line point cloud swaths. This data, along with the aircraft

trajectory solution, were further processed in conjunction using BayesMap StripAlign software to improve the data accuracy and reduce swath overlap offsets.

The resulting aligned swaths were then merged to create GeoTiff models using the Quick Terrain Modeler software classification and extraction tool, producing bare earth DTM and canopy DSM models. Canopy height models were created by subtracting the bare earth DTM from the canopy DSM. Snow depth models were created by subtracting the snow-off DTM from the snow-on DTM for each site, with the resulting elevation difference representing the snow depth. No reprojection or warping was done for the model subtractions.

2.3 Quality, Errors, and Limitations

The accuracy of the individual DTM models are estimated to be ~5 cm, with precision estimated to be ~1 mm.

Accuracy of canopy height data is not available for this data set. Known limitations to the canopy models in this data set include difference in lidar signatures at different degrees of leaf-out and the lack of instrument optimization for canopy measurements.

This data set was collected in conjunction with ground measurements, including manually measured snow depth. The accuracy of the snow depth model data will be best assessed by the SnowEx community through the process of comparing the ground measurements with this dataset.

2.4 Instrumentation

The lidar survey was conducted using a Riegl VQ-580ii lidar scanner coupled with an Applanix POS AP60-AV Inertial Navigation unit mounted on a Cessna T206G N7600N aircraft. The scanner used a 1064 nm wavelength laser and had adjustable pulse repetition frequency up to 2000 kHz, typically set to 1200 kHz. The scanner had a rotating mirror that sweeps the beam across 75 degrees (+/- 37.5 degrees off nadir) resulting in shot lines perpendicular to the flight path. When flown at 200 km/hr (110 knots) and 700 m (2300 ft) AGL the swath of points was 1070 m wide with roughly 10 points per square meter. Flight lines were planned with > 50% sidelap to target 20 points per square meter for each survey coverage.

3 VERSION HISTORY

Table 1. Version History Summary

Version	Release Date	Description of Changes
1	March 2024	Initial release

4 RELATED DATA SETS

[SnowEx at NSIDC | Data Sets](#)

[SnowEx23 Airborne Lidar Scans Raw, Version 1](#)

5 RELATED WEBSITES

[SnowEx at NSIDC | Overview](#)

[SnowEx at NASA](#)

6 DOCUMENT INFORMATION

6.1 Publication Date

March 2024

6.2 Date Last Updated

March 2024