SnowEx23 Laser Snow Microstructure Specific Surface Area Snow-off Data, Version 1

USER GUIDE

How to Cite These Data

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

Hale, K., H.P. Marshall, S. Stuefer, and C. Vuyovich. 2024. *SnowEx23 Laser Snow Microstructure Specific Surface Area Snow-off Data, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/9SY1H2L0BY0X. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX23_SSA_SO

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set reports vertical profiles of snow reflectance and specific surface area (SSA) from two study sites in 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 and a coastal tundra environment in the North Slope region of the northern Alaska coastal plain. Reflectance was measured *in situ* using an A2 Photonic Sensor IceCube (1310 nm). Measured reflectance values were converted to SSA during data processing following the methods of Gallet et al., (2009). Snow-on SSA data from these same study sites were collected in March 2023 and are available as SnowEx23 Laser Snow Microstructure Specific Surface Area Data, Version 1.

1.1 Parameters

This data set characterizes snow microstructure, including sample signal in mV, reflectance in %, SSA in m^2/kg, and sample top height in cm. The data files also include a column for comments.

NOTES: 'Sample top height' is the vertical measure from ground surface to the snow top and is equivalent to the 'top depth' measure in the 2017 SSA data set (SNEX17_SSA). The name was changed in the 2020 data set (SNEX20_SSA), 2023 snow-on data set (SNEX23_SSA), and in this data set to better represent the physical measured property.

Previously published SSA data sets (SNEX17_SSA and SNEX20_SSA) include an additional parameter: 'spherical equivalent diameter (deg)' or 'optical equivalent diameter (DO)'. This data set does not include an equivalent diameter parameter. However, the data providers indicate this parameter can be easily calculated from the provided data.

1.2 File Information

1.2.1 Format

Data files are provided in Comma Separated Values (.csv) format.

1.2.2 File Contents

All files begin with a 15-row header that specifies the date and time of acquisition, Field Campaign, pit ID, location (in UTM), instrument, profile ID (where A, B, and C refer to the labeled profiles taken at each snow depth interval), operator, timing, notes, total snow depth and calibration values. An example header is shown in Figure 1 below:

#Date (yyyy-mm-ddTHH:MM)	2023-10-22T1553					
#Name field campaign	SnowEx 2023 October 2023					
#Pit_ID	D672					
#UTM_Zone	6					
#Easting	394950					
#Northing	7614320					
#Instrument	IS3-RS-22-01US					
#Profile_ID	D672 profiles A B and C					
#Operator	Kate Hale					
#Timing						
#Notes						
#Total_snow_depth(cm)	32					
#Spectralon						
#Calibration Values (mV)	57.8	114.7	245.3	548.7	835	1362.8

Figure 1. Header example for SNEX23_SSA_SO_ FLCF_20231028_DN050_ICECUBE _v01.csv.

Sample data begin on row 16 of the spreadsheet, with a header featuring 4 columns of data and 1 column of comments (see Figure 2):

Profile	Sample signal(mV)	Reflectance(%)	SSA(m2 kg-1)	Sample_top_height(cm)	Comments
A	528	49.5	48	32	
B	616.6	56.16	69.6	32	
C	627.9	56.98	72.9	32	
A	624.1	56.7	71.8	29	
B	638.3	57.73	76.2	29	
A	567.4	52.52	56.6	26	
B	579.6	53.43	59.6	26	
A	551.7	51.33	53	23	
B	549.4	51.15	52.5	23	
A	546.9	50.96	52	20	
B	541.7	50.56	50.8	20	
A	625.2	56.78	72.1	17	
B	561.8	52.1	55.3	17	
C	490.2	46.53	40.8	17	
A	612	55.83	68.2	14	
B	406.7	39.63	27.9	14	
C	423.7	41.07	30.2	14	
A	358.7	35.45	22.2	11	
B	395.6	38.67	26.5	11	this layer represents all that is below it

Figure 2. Example data for SNEX23_SSA_SSO_UKT_20231022_D672_ICECUBE_v01.csv.

1.2.3 File Naming Convention

Data files utilize the following naming convention which is described in Table 1:

`SNEX23_SSA_SO_[site]_[yyyymmdd]_[pitID]_[instrument]_v[nn].csv`

Table 1. File Naming Convention

Variable	Description
SNEX23_SSA_SO	SnowEx 2023 field campaign snow-off (SO) specific surface area (SSA) measurements

site	General measurement area. Fairbanks sites include: `BCEF` (Bonanza Creek Experimental Forest), `CPCW` (Caribou Poker Creek Watershed) and `FLCF` (Farmers Loop/Creamer's Field). North Slope sites include: `ACP` (Arctic Coastal Plain) and `UKT` (Upper Kuparuk Toolik)
yyyymmdd	4-digit year, 2-digit month, and 2-digit day of data acquisition
pitID	Pit ID for the SnowEx23 Alaska campaign
instrument	Instrument code: `ICECUBE`
nn	Version number: `01`

Example file names:

`SNEX23_SSA_SO_BCEF_20231025_WA491_ICECUBE_v01_v01.csv`

`SNEX23_SSA_SO_ACP_20231017_N524_ICECUBE_v01.csv`

1.3 Spatial Information

1.3.1 Coverage

North Slope (ACP and UKT sites):

Northernmost Latitude: 70.0840º N
Southernmost Latitude: 68.5284º N
Easternmost Longitude: 148.6127° W
Westernmost Longitude: 149.5964° W

Fairbanks (BCEF, CPCW, and FLCF sites):

Northernmost Latitude: 65.1546º N
Southernmost Latitude: 64.7010º N
Easternmost Longitude: 147.4906° W
Westernmost Longitude: 148.2902° W

1.3.2 Resolution

Vertical profiles were obtained at 26 locations across the Fairbanks and Arctic coastal region. The vertical distance between measurements within a single snow pit is 3 cm from the top of the snowpit to the ground surface or void space at the bottom of the snowpack.

1.3.3 Geolocation

The following table provides information for geolocating this data set.

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
Datum	WGS 1984
Ellipsoid/spheroid	WGS 84
Units	meters
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs +type=crs
Reference	https://epsg.io/4326

1.4 Temporal Information

1.4.1 Coverage

17 October 2023 to 28 October 2023

1.4.2 Resolution

Each snow pit was analyzed only once. Sampling duration spanned a period of 10–60 minutes per snow pit, depending on the depth of the snow pit.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Vertical profiles of reflectance to a 1310 nm laser were recorded in the field using an IceCube integrating sphere systems. This device utilizes the relationship between the hemispherical infrared reflectance of snow and SSA. One IceCube instrument was deployed in the field and is denoted in data file names and specified in the header file in #Instrument. The samples prepared for IceCube were 3 cm in height.

2.2 Acquisition and Processing

In the field, a snow sample is illuminated with the instrument's laser. An InGaAs photodiode converts the reflected light to current, and the voltages are converted to reflectance using certified standards. SSA is calculated from reflectance, using custom calibration algorithms for each instrument.

2.3 Quality, Errors, and Limitations

In the field, additional profiles across the same horizontal snow depth were taken if sample signals differed by > 100 mV and the vertical snow layers were determined to be similar. Quality control was performed by visually inspecting graphs of each reflectance, SSA, and equivalent diameter profile. No intercomparison of instrument output was completed because only one IceCube was available.

3 VERSION HISTORY

Table 3. Version History Summary

Version	Release Date	Description of Changes
1	March 2024	Initial release

4 RELATED DATA SETS

SnowEx at NSIDC | Data Sets

SnowEx 2017 Specific Surface Area

SnowEx 2020 Specific Surface Area

SnowEx23 Laser Snow Microstructure Specific Surface Area Data

5 RELATED WEBSITES

SnowEx at NSIDC | Overview

SnowEx at NASA

6 ACKNOWLEDGMENTS

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7 REFERENCES

Gallet, J.C., F. Domine, C. S. Zender, and G. Picard. 2009. Measurement of the specific surface area of snow using infrared reflectance in an integrating sphere at 1310 and 1550 nm, *The Cryosphere* 3:167-182. https://doi.org/10.5194/tc-3-167-2009

8 DOCUMENT INFORMATION

8.1 Publication Date

March 2024

8.2 Date Last Updated

March 2024