SnowEx23 Oct22 Laser Snow Microstructure Specific Surface Area Low-snow, 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, C. Vuyovich, and J. Meyer. 2024. *SnowEx23 Oct22 Laser Snow Microstructure Specific Surface Area Low-snow, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/CPQ2DA73IZVH. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX23_OCT22_SSA

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Summary

This data set reports vertical profiles of snow reflectance and specific surface area (SSA) collected in October 2022 as part of the NASA SnowEx 2023 Alaska field campaign. Measurements were taken from three snow pits located within the Upper Kuparuk Toolik (UKT) field site, a coastal tundra environment in the North Slope region of the northern Alaska coastal plain. Reflectance was measured *in situ* using a 1310 nm integrating sphere laser device (IceCube) and converted to SSA during data processing (Gallet et al., 2009). SSA data collected from the same study sites in October 2023 and March 2023 are available as SnowEx23 Laser Snow Microstructure Specific Surface Area Data, Version 1 and SnowEx23 Laser Snow Microstructure Specific Surface Area Snow-off Data, Version 1.

1.2 Parameters

This data set characterizes snow microstructure, including sample signal in mV, reflectance in %, specific surface area (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) and also in this data set to better represent the physical property measured.

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.

1.3 File Information

1.3.1 Format

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

1.3.2 File Contents

Data 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 (in standard time), notes, total snow depth and calibration values. An example header is shown in Figure 1 below:

	A	B
1	#Date (yyyy-mm-ddTHH:MM)	2022-10-24T10:21
2	#Name field campaign	SnowEx23 October22
3	#Pit_ID	A767
4	#UTM_Zone	6
5	#Easting	404536
6	#Northing	7616147
7	#Instrument	IS3-RS-22-01US
8	#Profile_ID	A767 profiles A B and C
9	#Operator	Kate Hale
10	#Timing	
11	#Notes	
12	#Total_snow_depth(cm)	15
13	#Spectralon	
14	#Calibration Values (mV)	65.4
15	#	

Figure 1. Header example for file SNEX23_OCT22_SSA_UKT_20221024_A767_ICECUBE_v01.0.csv

The data starts at row 16 with one column indicating the sample profile, four columns of data, and one column of comments.

16	Profile	Sample signal(mV)	Reflectance(%)	SSA(m2 kg-1)	Sample_top_height(cm)	Comments
17	A	353.5	30.64	17	14	variable layering across pit face horizontally for all layers
18	B	445.9	37.62	24.7	14	
19	C	412.5	35.15	21.6	14	
20	A	374.6	32.28	18.5	11	
21	B	421.9	35.85	22.5	11	
22	C	426.9	36.23	22.9	11	
23	A	375.1	32.31	18.6	8	airspace below this layer
24	B	449.3	37.87	25	8	
25	C	423.3	35.96	22.6	8	

Figure 2. Example data for file SNEX23_OCT22_SSA_UKT_20221024_A767_ICECUBE_v01.0.csv

1.3.3 Naming Convention

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

```
SnowEx23_Oct22_SSA_UKT_[yyyymmdd]_[pitID]_ICECUBE_v01.0.csv
```

Table 1. File Naming Convention

Variable	Description
SNEX23_OCT22_SSA	SnowEx 2023 October 2022 field campaign specific surface area (SSA) measurements
UKT	Study site: Upper Kuparuk Toolik (UKT)
yyyymmdd	4-digit year, 2-digit month, and 2-digit day of data acquisition

Variable	Description
pitID	Snow pit ID for the SnowEx23 Alaska campaign
ICECUBE	Instrument
v01.01	Version number

1.4 Spatial Information

1.4.1 Coverage

Northernmost Latitude: 70.0840º N

Southernmost Latitude: 68.5284º N

Easternmost Longitude: 148.6127° W

Westernmost Longitude: 149.5964° W

1.4.2 Resolution

Vertical profiles were obtained at three snow pits located on the Arctic coastal region. The vertical distance between measurements within a single snow pit is 3 cm.

1.4.3 Geolocation

Table 2. Geolocation Details

Geographic Coordinate System	WGS 84
Projected Coordinate System	Transverse Mercator
Longitude of True Origin	N/A
Latitude of True Origin	0°
Scale factor at longitude of true origin	0.9996
Datum	World Geodetic System 1984
Ellipsoid/spheroid	WGS 84
Units	degree
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://spatialreference.org/ref/epsg/32606/

1.5 Temporal Information

1.5.1 Coverage

24 October 2022

1.5.2 Resolution

Each snow pit was measured once; data collection spanned 10 minutes to 1 hour per 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 system. 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 was illuminated with the instrument's laser. An InGaAs photodiode within the instrument converted the reflected light to current, and the voltages were then converted to reflectance using certified standards. SSA was calculated from reflectance, using custom calibration algorithms specific to the IceCube 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

Version	Date Implemented	Impacted Temporal Coverage	Description of Changes
V01.0	February 2025	24 October 2022	Initial release

4 RELATED DATA SETS

SnowEx23 Laser Snow Microstructure Specific Surface Area Data, Version 1

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

5 RELATED WEBSITES

SnowEx at NSIDC | Overview

SnowEx at NASA

6 ACKNOWLEDGMENTS

The authors of this data set would like to acknowledge the contributions of Megan Mason.

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

February 2025

8.2 Date Last Updated

February 2025