SnowEx23 Mar22 IOP Snow Depth Measurements, Version 1

USER GUIDE

How to Cite These Data

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

May, L., S. Stuefer, C. Vuyovich, K. Elder, B. Osmanoglu, H.P., Marshall, M. Durand, D. Vas, A. Gelvin, K. Liddle Broberg, and J. Maakestad. 2024. *SnowEx23 Mar22 IOP Snow Depth Measurements, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/086OMZDJP2W6. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX23_MAR22_SD

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

The data set contains snow depth measurements from two regions of Alaska, USA collected during the March 2022 intensive observation period (IOP) as part of the NASA SnowEx 2023 field campaign. The study sites include three boreal forest sites 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 site in the North Slope region (Arctic coastal plain). Snow depth measurements collected from the study sampling sites during the subsequent field season are available as SnowEx23 Mar23 IOP Snow Depth Measurements, Version 1.

1.2 File Information

1.2.1 Format

Data is provided in a single comma-separated values (.csv) file.

1.2.2 File Contents

The data file contains 16 columns, described in Table 1.

Table 1. File Description

Column Header	Description
State	State in the United States
County	Borough in the state of Alaska
Study Area	Study area
Plot ID	Plot ID
ID	Measurement ID
Date	Date of measurements
Time	Local time, Alaska Standard Time
Latitude	Latitude (decimal degrees)
Longitude	Longitude (decimal degrees)
Northing	Projected y-coordinate in UTM N6, WGS84 (meters)
Easting	Projected x-coordinate in UTM N6, WGS84 (meters)
Elevation	Plot elevation (m)
Depth	Snow depth (cm)
Equipment ID	Datalogger serial number

Instrument	Instrument MagnaProbe=MP, Pit ruler=PR
Version	Version number

1.2.3 Naming Convention

The data file is named `SNEX23_MAR22_SD_AK_20220308_20220323_v01.0.csv`, where `SNEX23` refers to the SnowEx 2023 field campaign, `MAR22` refers to March 2022, `SD` refers to snow depth, `AK` refers to Alaska, and `20220308_20220323` represents the 08 March 2022 to 23 March 2022 data collection period, and `v01.0` represents Version 1.

1.3 Spatial Information

1.3.1 Coverage

Northernmost latitude: 70.0902954° N
Southernmost latitude: 64.6817507° N
Easternmost longitude: 147.2396956° W
Westernmost longitude: 149.9726275° W

1.3.2 Resolution

Point measurements

1.3.3 Geolocation

The following tables provide information for geolocating this data set

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	WGS 84/ UTM Zone 6 North
Longitude of true origin	-147
Latitude of true origin	0
Scale factor at longitude of true origin	0.9996
Datum	WGS 1984
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
Reference	https://epsg.io/32606

1.4 Temporal Information

1.4.1 Coverage

08 March 2022 to 23 March 2022

1.4.2 Resolution

Data points were collected one time.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Snow depth was measured in March 2022 as part of the reconnaissance trip during the planning phase for the NASA SnowEx 2022 – 2023 Alaska campaign (Vuyovich et al., 2023). Measurements were taken in the vicinity of snow pit locations and along transects using a magnaprobe. Three boreal forest study areas, Farmers Loop Creamers Field (FLCF), Caribou Poker Creeks Research Watershed (CPCRW), and Bonanza Creek Experimental Forest (BCEF) were visited, and one tundra study area, the Arctic Coastal Plain (ACP).

Every site visited within the study area was assigned a Plot ID. Plot IDs were classified using one or two letters followed by a three-digit site number series (ex. EN900 or I800). In boreal forest sites the two letters reference the vegetation class and snow class. For the tundra site the letter references the tundra snow class. Transects were identified with the code TRAN, followed by a one-digit number. The letter codes are described in the table below.

Table 3. Vegetation and Snow Class Codes

Letter Code	Description
Boreal Forest Sites	
D	Deciduous Forest
E	Evergreen Forest
W	Wetlands
B	Below average snow class
N	Neutral or average snow class

TRAN	Transect
Tundra Site	
I	Ice cover (lake / river)
N	Neutral (windward)

2.2 Acquisition

Snow pits were dug at each study site and were located using various GPS devices. At each snow pit location a team dug a snow pit and recorded its depth. An additional team member snowshoed in a spiral out and away from the snow pit taking snow depth measurements. The target spacing was approximately one to three meters between each measurement. Additional snow depth measurements were taken along a transect or in an X pattern at the FLCF, BCEF, and ACP sites.

Snow depth measurements were collected using either a metric ruler or a GPS-enabled magnaprobe. Rulers were used exclusively to measure snow pit walls, with data physical recorded in the pit sheets. Magnaprobes were used to measure snow depths in sampling spirals and transects outside of the snow pit. The magnaprobe consists of a 1.3 m long rod with a moveable basket that uses a data logger, GPS unit and a magneto restrictive material inside the rod to record snow depth and locations in seconds (Sturm and Holmgren, 2018). The operator inserts the probe into the snow until it reaches the ground, while the basket remains on the snow surface. The operator then pushes a button for every measurement that records the depth, GPS location, elevation, date, and time into the data logger attached to the unit. Note: pushing the button prior to the magnaprobe reaching the ground results in an erroneous data measurement, which will be removed during data processing.

2.3 Processing

Snow depth data was processed in one of two ways, depending on the method of data acquisition:

2.3.1 Magnaprobe Data

1. Downloaded raw data from the magnaprobe
2. Calculated latitude and longitude and convert to WGS84/UTM zone 6N
3. Eliminated erroneous measurements and data errors including instrument misfires, zero values, and GPS related data errors
4. Exported data to a single .csv file

2.3.2 Pit Ruler Data

1. Extracted pit depths and locations from pit book sheets
2. Calculated latitude and longitude in decimal degrees

3. Exported data to a single .csv file

Once all magnaprobe and pit ruler data were exported to the .csv file, the dataset was sorted based on study area and plot ID.

2.4 Quality, Errors, and Limitations

2.4.1 Location Errors

GPS systems of various accuracies were used to geolocate the measurements. The accuracy of the handheld GPS units, used to mark the location of the pit ruler measurement, varies between 3-15 m depending on canopy conditions. The accuracy of the magnaprobe GPS is approximately 3 m in open areas and <15 m in forested areas.

2.4.2 Depth Errors

Depth errors are known to be associated with magnaprobe probing. Over-probing can occur due to the insertion of the probe into thawed soil or vegetation/organic layers. Under-probing can occur due to vegetation or ice layers within the snowpack. Snow surface compaction or cratering, caused by the magnaprobe basket, can be an additional source of error; this is more prominent after new snow. The error due to over-probing is close to zero for frozen soils and 5-10 cm in soft substrates. The error due to cratering is estimated to be around 1 cm.

3 VERSION HISTORY

Table 4. Version History Summary

Version	Date Implemented	Impacted Temporal Coverage	Description of Changes
v01.0	July 2024	08 March 2022 to 23 March 2022	Initial release

4 RELATED DATA SETS

SnowEx23 Mar23 IOP Snow Depth Measurements, Version 1

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

SnowEx23 Snow Water Equivalent, Version 1

5 RELATED WEBSITES

NASA SnowEx

NSIDC SnowEx | Overview

6 REFERENCES

Sturm, M., and Holmgren, J. (2018). An automatic snow depth probe for field validation campaigns. Water Resources Research, 54, 9695–9701. https://doi.org/10.1029/2018WR023559

Vuyovich, C., Stuefer, S., Durand, M., Marshall, H. P., Osmanoglu, B., Elder, K., Vas, D., Gelvin, A., Larsen, C., Pedersen, S., Hodkinson, D., Deeb, E., Mason, M., & Youcha, E. (2023). NASA SnowEx 2023 Experiment Plan. https://snow.nasa.gov/sites/default/files/users/user354/SNEX-Campaigns/2023/NASA_SnowEx_Experiment_Plan_2023_draft_20June2024.pdf

7 DOCUMENT INFORMATION

7.1 Publication Date

July 2024

7.2 Date Last Updated

July 2024