



SnowEx20 Boise River Basin SnowMicroPen (SMP) Raw Penetration Force Profiles, Version 1

USER GUIDE

How to Cite These Data

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

Mason, M. and H. P. Marshall. 2023. *SnowEx20 Boise River Basin SnowMicroPen (SMP) Raw Penetration Force Profiles, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.
<https://doi.org/10.5067/1SF2KW5EIGOB>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX20_BR_BSU_SMP



National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

Table 1. Parameters

Parameter	Description	Units
Depth	Depth of snow measurement (0 mm represents the top of the snow surface, with depth decreasing downward into the snow pit)	millimeters (mm)
Force	Force required to drive a motorized probe into the snow at a constant measurement speed of 20 mm/s	Newtons (N)

1.2 File Information

1.2.1 Format

Data are provided as .csv files and .pnt files. Browse images are formatted as .png files.

1.2.2 File Contents

This data set is organized into 29 granules, each representing a single snow pit. Included within each granule are three files: (1) a .csv file, which contains field observations for each SnowMicroPen (SMP) profile including a data header and measured depth and force values (see Figure 1); (2) a .pnt file, which contains the proprietarily formatted raw SMP instrument data (see Section 2.3 for additional information on how to read this data); and (3) a browse image file (.png) which presents a graphical depiction of the SMP force profile for each snow pit (see Figure 2.)

# Date: 2020-01-24	
# Time (UTC): 22:06:55	
# Lat: 43.758827209472656	
# Lon: -116.09017181396484	
# SMP Serial Number: 19	
# Total Samples: 290400	
Depth (mm)	Force (N)
0	1.019826951
0.004132231	0.053407396
0.008264462	0.053407396
0.012396694	0.053407396
0.016528925	0.058493815
0.020661156	0.053407396
0.024793387	0.049592582

Figure 1. The header and first six rows of data from SNEX20_BR_BSU_SMP_S19M0670_IDBRBU_20200124.csv

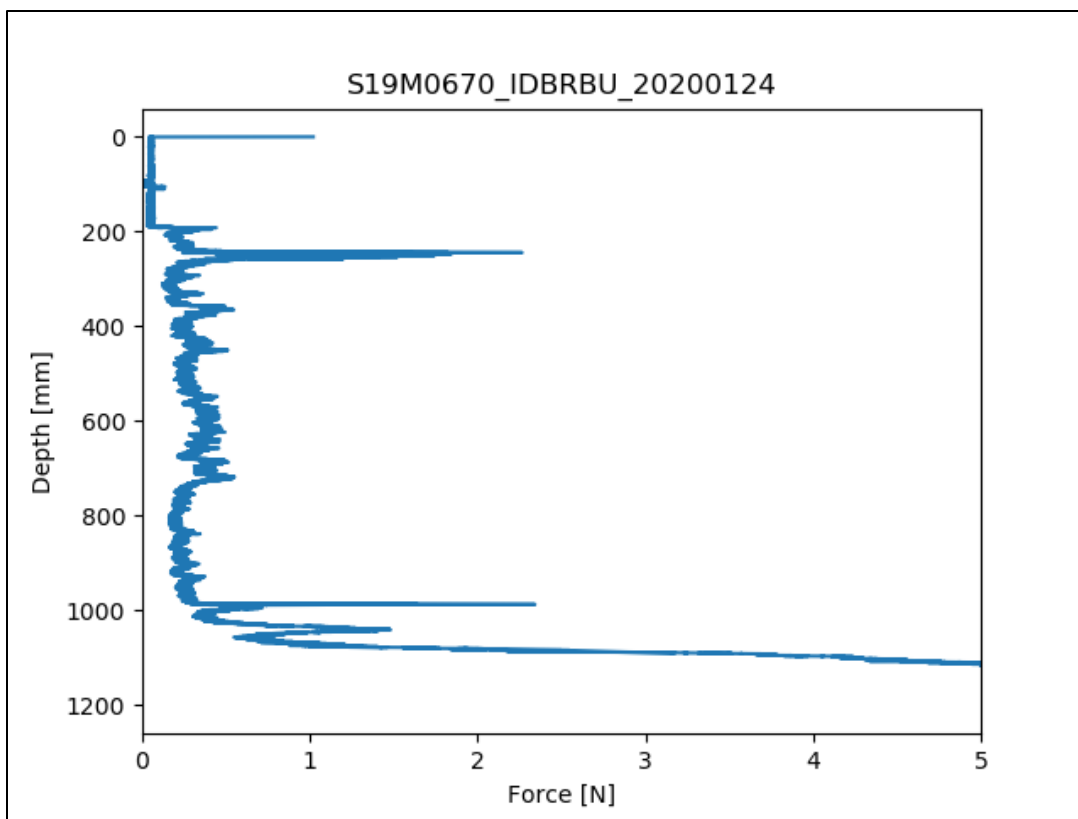


Figure 2. Sample browse image and force profile from SNEX20_BR_BSU_SMP_S19M0670_IDBRBU_20200124.png.

1.2.3 Naming Convention

Data files are named according to the following convention and as described in Table 2:

SNEX20_BR_BSU_SMP_[pitID]_19[MXXXX]_[YYYYMMDD]_V01.0.ext

Table 2. File Naming Convention

Variable	Description
SNEX20_BR_BSU_SMP	Indicates that this file is part of the SnowEx20 SnowMicroPen (SMP) Raw Penetration Force Profiles data set, collected adjacent to the Boise River (BR) by researchers from Boise State University (BSU)
S19	Identifies the specific instrument (19) used to collect measurements
MXXXX	4-digit measurement (M) number
<pitID>	Snow pit ID, identified by a: <ul style="list-style-type: none"> • 2-digit state code: ID (Idaho) • 2-digit location: BR (Boise River) • 2-digit pit site: BS (Banner Summit - Snotel), B0 (Banner Summit - Open), BU (Bogus Basin - Upper)

Variable	Description
YYYYMMDD	Date of measurement in year-month-day format
V01.0	Version 1
.ext	File extension indicating the data type <ul style="list-style-type: none"> • .csv = comma-separated value data file • .pnt = binary data file • .png = browse image

Example file names:

SNEX20_BR_BSU_SMP_IDBRBU_S19M0670_20200124_V01.0.csv

SNEX20_BR_BSU_SMP_IDBRBU_S19M0670_20200124_V01.0.pnt

SNEX20_BR_BSU_SMP_IDBRBU_S19M0670_20200124_V01.0.png

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 44.30331° N

Southernmost Latitude: 43.75724° N

Eastermost Longitude: 115.23445° W

Westernmost Longitude: 116.0909° W

1.3.2 Resolution

SMP profiles were acquired at a single point, with a vertical resolution of less than 1 mm.

1.3.3 Geolocation

The following table provide information for geolocating this data set

Table 3. 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

18 December 2019 to 24 January 2020

1.4.2 Resolution

Data were collected approximately weekly for a one-month period.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

SMP profiles were collected as part of the SnowEx 2020 Time Series campaign in the Boise River Basin in Idaho, one of thirteen time series sites observed in 2019 and 2020. Profiles were taken at three snow pit locations, identified as the Banner Summit – Snotel pit, the Banner Summit – Open pit, and the Bogus Basin – Upper pit. Measurements were taken using the SnowMicroPen (SMP), a digital snow penetrometer. The data files contain force measurements of the snowpack from the top of the snow surface to the ground. Measurements took place between 18 December 2019 and 24 January 2020.

Snow microstructure parameters, such as density, layering, snow grain type, and snow grain specific surface area (SSA), can be derived from force measurements, but only the raw force profiles are provided in this data set. Users will need to apply algorithms to identify the air/snow and snow/ground interfaces, vertically smooth the raw data, and convert the force measurements to other snow microstructure parameters.

2.2 Acquisition

Three SMP profiles were taken at each snow pit site per observation day, after completion of other snow pit data collection. Corresponding snow pit data can be found in the [SnowEx20 Time Series Snow Pit Measurements, Version 1](#) data set. Each SMP measurement was taken just behind the undisturbed pit wall at approximately 20 cm intervals, such that the microstructure recorded by the SMP profiles corresponds to the snow pit observations.

Field notes and additional details on each SMP acquisition are provided in the SNEX20_BR_BSU_SMP Master Log File ([SNEX20_BR_BSU_SMP_FieldNotes.xlsx](#)), which is available as a technical reference.

Table 4. Master log file column descriptions

Column Header	Description
Date	Date the SMP profile was collected, in Month/Day/Year format
Pit location	Name of pit location
Pit ID	Snow pit ID
SMP instrument #	SMP instrument #
SMP file name	Raw SMP file name
Fname suffix	File name suffix
Flag	Quality flag
Comments	Field notes

2.3 Processing

The binary data file (.pnt) is the proprietary format for SMP profiles. After data collection, raw .pnt data files were converted to csv format using the open source Python package [SnowMicroPyn](#) in conjunction with [additional python tools \(SMP_to_CSV\)](#) available on Github. The script `smp_prep2cover.py` was used to update incorrect dates in the filenames and to append pit IDs.

2.4 Quality, Errors, and Limitations

Beyond omitting erroneous measurements, these data have not been processed further or validated. Likely errors include profiles with negative force values, which can occur when there is ice on the instrument tip. Other areas of uncertainty include the probe not entering the snowpack orthogonally to the surface or minor instrument movement during measurements due to snowpack settling.

2.5 Instrumentation

2.5.1 Description

A single SMP instrument was used during data collection (S19). This instrument has a maximum measurement length of 1.75m, a vertical penetration velocity of 20 mm/s, and the vertical sampling resolution of 4 μm .

3 VERSION HISTORY

Table 5. Version History Summary

Version	Release Date	Description of Changes
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1	September 2023	Initial release
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4 RELATED DATA SETS

[SnowEx17 SnowMicroPen \(SMP\) Raw Penetration Force Profiles at Grand Mesa, CO](#)

[SnowEx17 Senator Beck SnowMicroPen \(SMP\) Raw Penetration Force Profiles](#)

[SnowEx20 SnowMicroPen \(SMP\) Raw Penetration Force Profiles](#)

5 RELATED WEBSITES

[Snow Ex at NSIDC | Overview](#)

[Snow Ex at NASA](#)

6 REFERENCES

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Schneebeli, M., Johnson, J.B. (1998). A constant-speed penetrometer for high-resolution snow stratigraphy. *Annals of Glaciology* 26, 107-111. <https://doi.org/10.3189/1998AoG26-1-107-111>

7 DOCUMENT INFORMATION

7.1 Publication Date

September 2023

7.2 Date Last Updated

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