SnowEx17 Senator Beck 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:

Marshall, H. and A. Gleason. 2020. *SnowEx17 Senator Beck 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/K7P8PB6EO1HO. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX17_SMP2

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Parameters

1.1.1 Parameter Description

Table 1. Data File Parameter Descriptions

Parameter	Description	Units
Depth	Depth of snow measurement	Millimeters (mm)
Force	Force required to drive a motorized probe into the snow at a constant measurement speed of 20 mm/s	Newtons (N)

Sample Data Record

Below is a sample of data file `SnowEx17_SMP2_L37a_20170220.csv`.

# SMP Serial Number: 19	
# Date: 2017-02-20	
# Time (UTC): 22:28:22	
# Lat: 37.906028747558594	
# Lon: -107.71479797363281	
# Total Samples: 411400	
# Depth (mm)	Force (N)
0	0.324259
0.004132	0.049593
0.008264	0.050864
0.012397	0.050864
0.016529	0.050864
0.020661	0.049593
0.024793	0.050864

Figure 1. The header and first seven rows of data for file `SnowEx17_SMP2_L37a_20170220.csv`.

1.2 Format

Data files are provided in Comma Separated Values (.csv) format; files are space-delimited.

Brows images (.png) and Extensible Markup Language (.xml) files with associated metadata are also available.

1.3 File Contents

Data were recorded for eight snow pits at Senator Beck Basin, CO.

1.4 File Naming Convention

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

`SnowEx17_SMP2_<PitID>N_YYYYMMDD.xxx`

Table 2. File Naming Convention

Variable	Description
SnowEx17_SMP2	Short name for SnowEx17 Senator Beck SnowMicroPen (SMP) Raw Penetration Force Profiles
<PitID>	Pit, trench, or transect identifier
N	Identifies and differentiates between three SMP units used in the field, where: A = SMP Serial Number 2 B = SMP Serial Number 34 C = SMP Serial Number 40
YYYY	4-digit year of survey
MM	2-digit month of survey
DD	2-digit day of survey
.xxx	Indicates file type: .csv or .png

Example file names:

SnowEx17_SMP2_L39c_20170220.csv
SnowEx17_SMP2_L40a_20170220.csv

1.5 File Size

CSV (.csv) files range from approximately 1.2 MB to 9.5 MB.

Browse images (.png files) range from approximately 17 KB to 32 KB.

1.6 Spatial Coverage

Northernmost Latitude: 38.0º N

Southernmost Latitude: 37.8º N

Easternmost Longitude: 107.65 ° W

Westernmost Longitude: 107.8 ° W

1.6.1 Spatial Resolution

Profiles were acquired at eight unique snow pits, with a vertical resolution of 0.004 mm.

1.6.2 Projection and Grid Description

All snow pit locations are reported in geographic coordinates within UTM Zone 13N. Refer to Table 3 for details.

Table 3. Geolocation Details

Geographic coordinate system	**WGS 84**
Projected coordinate system	WGS 84 / UTM zone 13N
Longitude of true origin	-105 (13N)
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	32613 (13N)
PROJ4 string	+proj=utm +zone=13 +datum=WGS84 +units=m +no_defs
Reference	https://epsg.io/32613

1.7 Temporal Information

Data were collected between 06 February 2017 to 20 February 2017.

1.7.1 Temporal Resolution

Measurements were made at a single point in time and were not repeated.

2 SOFTWARE AND TOOLS

2.1 Software and Tools

CSV files can be read with any text editor or word processing program capable of reading ASCII text files.

XML files can be read with Web browsers such as Firefox and Internet Explorer.

Python code for vertically smoothing the raw SMP profiles, and converting force to snow microstructure parameters, is available at: https://github.com/m9brady/SMP_to_CSV

3 DATA ACQUISITION AND PROCESSING

3.1 Background

Spatial variability in snow microstructure was measured during SnowEx 2017 using the rapid sampling capabilities of the SnowMicroPen (SMP). The SMP acquires high vertical resolution (~250 measurements per mm) profiles of the force (measured in Newtons, N) required to drive a motorized probe into the snow at a constant measurement speed of 20 mm/s. Typical force measurements range from 0.01 N for soft snow up to 75 N for very hard snow. The SMP has a maximum depth of 1.80 m.

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 covert the force measurements to snow microstructure parameters.

3.2 Data Acquisition Methods

Two to five SMP profiles were performed at eight snow pits over the course of two weeks (06 February to 20 February 2017). All profiles were collected alongside snow pit observations and 6-18 GHz Frequency-Modulated Continuous Wave (FMCW) radar profiles.

3.2.1 Processing Steps

- The SMP generates a data file (.pnt) and header file for each profile measurement.
- Relevant fields from the header file (date, time, latitude, longitude, etc.) were stripped and inserted to the top of the data file.

- Data files are converted to .csv files.

3.2.2 Quality, Errors, and Limitations

Potential sources of uncertainty include the probe not entering the snowpack orthogonally to the surface (due to imprecise placement of the instrument base) and shifting of the probe during measurement due to snowpack settling.

4 REFERENCES AND RELATED PUBLICATIONS

Johnson, J. B. and M. Schneebeli. 1999. Characterizing the microstructural and micromechanical properties of snow. Cold Regions Science and Technology 30(1-3): 91-100.

Proksch, M., H. Löwe, and M. Schneebeli. 2015. Density, specific surface area, and correlation length of snow measured by high-resolution penetrometry. J. Geophys. Res. Earth Surf. 120:346–362, DOI:10.1002/2014JF003266.

Marshall, H. P. and J. B. Johnson. 2009. Accurate inversion of high-resolution snow penetrometer signals for microstructural and micromechanical properties. J. Geophys. Res. Earth Surf. 114(F04016)

4.1 Contacts and Acknowledgements

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4.2 Related Data Collections

SnowEx17 SnowMicroPen (SMP) Raw Penetration Force Profiles at Grand Mesa, CO

SnowEx Data | Overview

4.3 Related Websites

SnowEx Project at NASA

SnowMicroPen

5 DOCUMENT INFORMATION

5.1 Document Creation Date

25 June 2018

5.2 Date Last Updated

29 April 2020