SnowEx17 Ground Penetrating Radar, Version 2

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:Webb, R., D. McGrath, K. Hale, and N. P. Molotch. 2019. SnowEx17 Ground Penetrating Radar, Version 2. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/G21LGCNLFSC5. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX17_GPR

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

Please refer to table 1.

Table 1. Parameters

Parameter	Description	Units
Two-way travel time	Time between the transmission of the ground penetrating radar (GPR) signal and the reflection of that signal back to the transmitting device from the base of the snowpack	nanoseconds, ns
Snow depth	Calculated from two-way travel time, assuming a velocity of 0.235 m/ns	meters, m
Snow water equivalent (SWE)	Calculated from snow depth, assuming a density of 325 kg/m3	centimeters, cm

1.2 File Information

1.2.1 Format

Data are provided in Comma-Separated Value (.csv) format.

Extensible Markup Language (.xml) files with associated metadata are also provided.

1.2.2 File Contents

Each plain text file includes 12 columns of data. Column titles and descriptions are shown below:

1. COLLECTION: Collection information in the format of GPR_[LineNumber]_[date]:

Table 2. Column Definitions

Variable	Description
GPR	Short for Ground Penetrating Radar
[LineNumber]	Value associated with the raw file
[date]	Date in mmddyy format

2. TRACE: Trace number corresponding to the raw data files; each trace is the individual recording of a received signal from the GPR pulse
3. LONG: Longitude
4. LAT: Latitude
5. ELEV: Elevation, in meters (m)
6. TWTT: Two-way travel time, in nanoseconds (ns), of the interpreted ground surface reflection
7. THICKNESS: Snow depth, in meters (m)
8. SWE: Snow water equivalent (SWE), in millimeters (cm)
9. X: Easting, calculated from the recorded longitude
10. Y: Northing, calculated form the recorded latitude
11. UTM_ZONE: UTM grid zone for the calculated easting and northing
12. More details about column definitions can be found in the SnowEx17 Ground Penetrating Radar Column Definitions document.

1.2.3 Naming Convention

The data files are named:

SnowEx17_GPR_Version2_Week1.csv

SnowEx17_GPR_Version2_Week2.csv

SnowEx17_GPR_Version2_Week3.csv

1.2.4 File Size and Volume

The data files are between 50 and 85 MB.

1.3 Spatial Information

1.3.1 Coverage

Data were collected in the Grand Mesa, Colorado study area:

Northernmost Latitude: 39.11115° N

Southernmost Latitude: 38.99350° N

Easternmost Longitude: 107.85785° W

Westernmost Longitude: 108.22367° W

1.3.2 Resolution

Point measurements

1.3.3 Geolocation

All data falls within the project coordinate system WGS 84 / UTM Zone 12 North (Table 3).

Table 3. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	WGS 84 / UTM Zone 12 North
Longitude of true origin	-111
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	32612
PROJ4 string	+proj=utm +zone=12 +datum=WGS84 +units=m +no_Defs
Reference	https://epsg.io/32612

The plain text files indicate that all geographic coordinates fall within UTM Grid Zone 12S. This designation corresponds to the intersection of longitudinal projection zone 12 and latitudinal projection zone S, as shown in Figure 1. Users should be aware that UTM Grid Zone 12S falls within the projected coordinate system WGS 84 / UTM Zone 12 North.

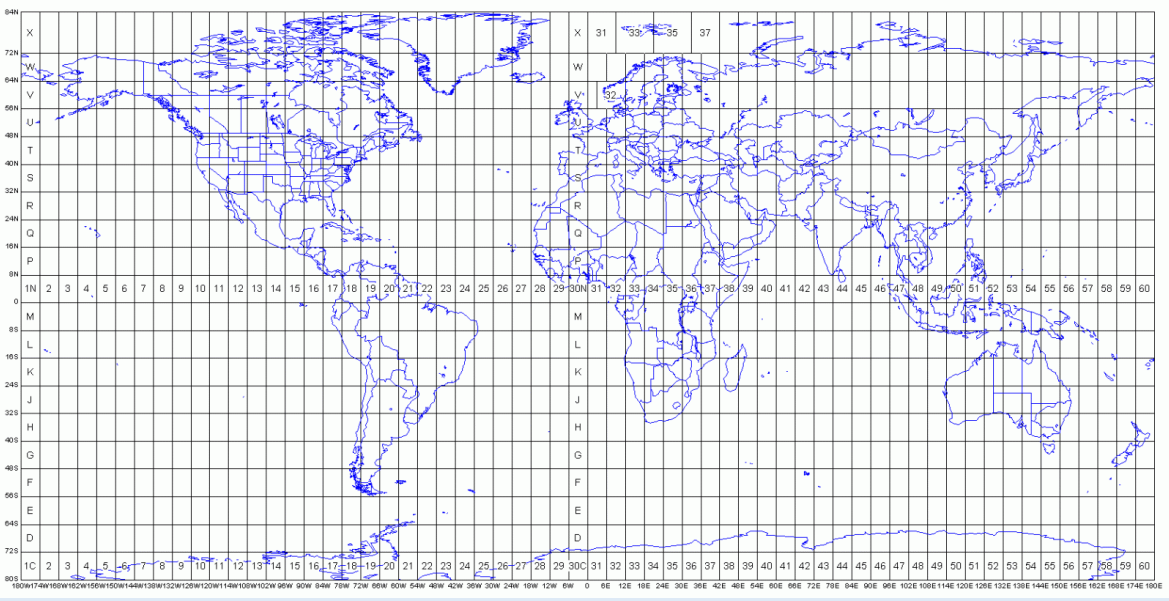

Figure 1. UTM Grid Zones

1.4 Temporal Information

1.4.1 Coverage

Data collection occurred over three weeks:

Week 1: 08 February 2017 - 10 February 2017

Week 2: 14 February 2017 - 17 February 2017

Week 3: 21 February 2017 - 25 February 2017

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

Ground penetrating radar (GPR) surveys were conducted using a MALA Geosciences Professional Explorer (ProEx) control unit and a shielded 1.6 GHz antenna. Both the MALA Geosciences ProEx unit and antenna were pulled in a plastic sled behind users, who were on skis, snowshoes, or snowmobiles. Manual snow depth measurements were taken in parallel to GPR surveys but only used to estimate the two-way travel time velocity needed to calculate snow depth.

Data were collected along transects at the Grand Mesa, Colorado study site. Transects were walked in their entirety, with some transects surveyed more than once (multiple days apart). When there was sufficient time available, grids were surveyed alongside individual transects to build a more robust dataset of directional spatial patterns. Additional grids corresponding to the locations of terrestrial lidar (light detection and ranging) scans were also surveyed for future comparisons.

Field Notes are available.

2.2 Processing

Raw data files were processed in MALA RadExplorer and ReflexW2D software. Data were processed by applying a time-zero correction, dewow filter, linear gain, and high-pass filter over a 30-trace window. The GPR had a horizontal resolution of approximately 0.8 m, a sample rate of 0.05 ns, and an average trace spacing of approximately 0.15 m when pulled behind a snowmobile or approximately 0.07 m when towed by a skier or snowshoer. In all instances the base of the snow pack was semi-automatically picked using a phase-following algorithm.

Snow depth (meters, m) was calculated from the two-way travel time by assuming a radar velocity of 0.235 m/ns. This assumption represents the average velocity calculated from comparisons between ground penetrating radar data and manual snow depth measurements.

Snow Water Equivalent (centimeters, cm) was calculated from the estimated snow depth by assuming a density of 325 kg/m3. This assumed density was based on snow pit observations.

2.3 Quality, Errors, and Limitations

Uncertainty of snow depth is approximately 3.5 cm.

A known source of error was that the GPR path along the transects and manual snow depth measurements did not always align precisely.

2.4 Instrumentation

2.4.1 Description

Data were collected using a MALA Geosciences Professional Explorer (ProEx) control unit. More information about this instrument can be found on the MALA Ground Penetrating Radar website.

3 RELATED DATA SETS

SnowEx Data | Overview

4 RELATED WEBSITES

NASA SnowEx

5 CONTACTS AND ACKNOWLEDGMENTS

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6 VERSION HISTORY

Version Number	Version Summary
2.1	Minor version update to reflect the addition of "Week 3" data. This "Week 3" data covers the period between 21 February and 25 February 2017 The Version 1 "Week 3" file only included data from 21 February to 23 February 2017, but the Version 2 "week 3" file contains GPR measurements from terrestrial glider plots, which extended to 25 February 2017
2	Changes to this version revolve around how the data were processed and the file structure. They include: Updated the radar velocity (0.2284 m/ns) used to convert the two-way travel time to snow depth Updated to the density (325 kg/m3) used to calculate snow water equivalent SWE is now reported in cm not mm Removed column 12 (Transect #) from the data files Removed "Week 3" data (21 February to 23 February 2017)
1	Initial Release

7 DOCUMENT INFORMATION

7.1 Publication Date

20 July 2018

7.2 Date Last Updated

18 February 2020