SnowEx17 Ground Penetrating Radar, Version 1

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. 2018. *SnowEx17 Ground Penetrating Radar, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.5067/NPZYNEEUGQUO. [Date Accessed].

National Snow and Ice Data Center

TABLE OF CONTENTS

1   DATA DESCRIPTION

1.1 Parameters

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	nanoseconds, ns
Snow depth	Calculated from two-way travel time, assuming a velocity of 0.234 m/ns	meters, m
Snow water equivalent (SWE)	Calculated from snow depth, assuming a density of 335 kg/m$_3$	millimeters, mm

1.2 File Information

1.2.1 Format

Data are provided in plain text (.txt) format.

1.2.2 File Contents

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

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

Table 2. Column Definition

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

2.   TRACE: Trace number, corresponds 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. TWT: Two-way travel time, in nanoseconds (ns), of the interpreted ground surface reflection
7. SNOW DEPTH: Snow depth, in meters (m)
8. SWE: Snow water equivalent (SWE), in millimeters (mm)
9. EASTING: Easting, calculated from the recorded longitude
10. NORTHING: Northing, calculated form the recorded latitude
11. UTM_ZONE: UTM grid zone for the calculated easting and northing
12. TRANSECT: Transect number

More details about column definitions can be found in the SnowEx17 Ground Penetrating Radar Column Definitions document.

1.2.3 Naming Convention

Data files utilize the following naming convention:

SnowEX17_GPR_Week[#]_transects.txt

Table 3. File Naming Convention

Variable	Description
SnowEx17_GPR	Short name for SnowEx17 Ground Penetrating Radar
#	Week (1, 2, or 3) in which the data was collected
transects	Items surveyed with the ground penetrating radar

Examples:

SnowEX17_GPR_Week1_transects.txt

SnowEX17_GPR_Week2_transects.txt

SnowEX17_GPR_Week3_transects.txt

1.2.4 File Size

Plain text files range in size from approximately 18.5 MB to 22.5 MB.

The total data set is approximately 60 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, details of which are presented in Table 4.

Table 4. 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	50000
False northing	0
EPSG code	32612
PROJ4 string	+proj=utm +zone=12 +datum=WGS84 +units=m +no_Defs
Reference	https://epsg.io/32612

NOTE: 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.
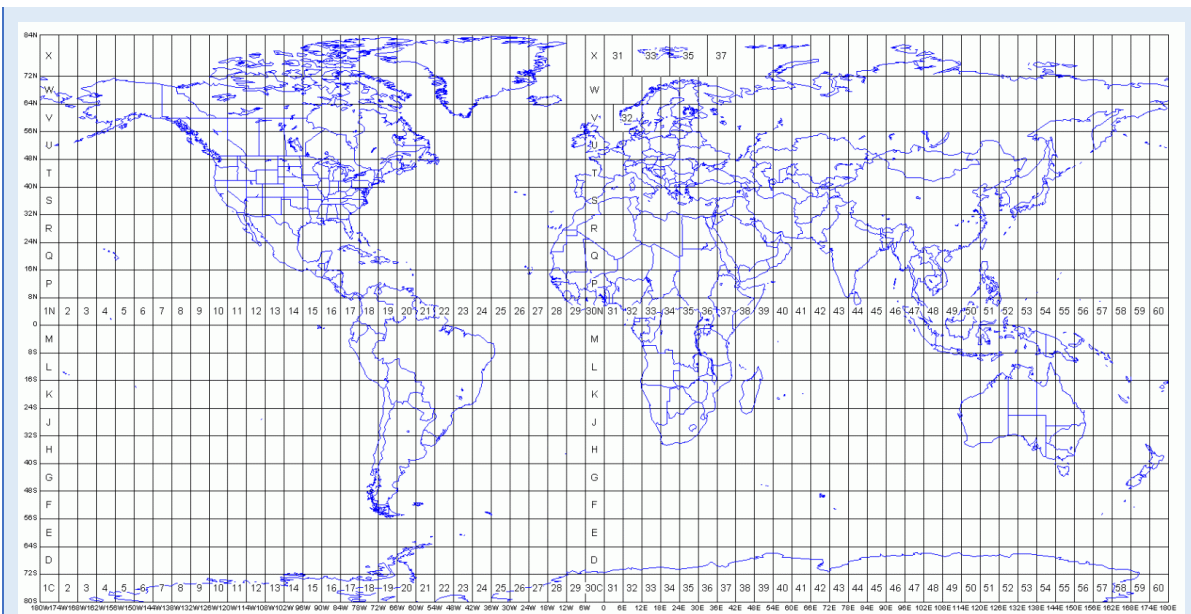
Figure 1. UTM Grid Zone

1.4 Temporal Information

1.4.1 Coverage

08 February 2017 to 23 February 2017

Data collection was separated into three weeks:

> Week 1: 08 February 2017 - 10 February 2017
> Week 2: 14 February - 17 February 2017
> Week 3: 21 February - 23 February 201

2   DATA ACQUISITION AND PROCESSING

2.1 Acquisition

Ground penetrating radar (GPR) surveys were conducted using a MALA Professional Explorer (ProEx) control unit and a shielded 1.6 GHz antenna. Both the MALA 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 as a technical reference.

2.2 Processing

Raw data files were processed in MALA RadExplorer and ReflexW2D software. Data were processed line by line for time-zero correction and background noise removal. In all instances, the ground surface was semi-automatically picked.

Snow depth (meters, m) was calculated from the two-way travel time by assuming a velocity of 0.234 m/ns. This assumption represents the average velocity calculated from comparisons between ground penetrating radar data and manual snow depth measurements.

Snow Water Equivalent (millimeters, mm) was calculated from the estimated snow depth by assuming a density of 335 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 Professional Explorer (ProEx) control unit. More information about this instrument can be found on the Mala Proex website.

3 RELATED DATA SETS

Other SnowEx Data Sets

4 RELATED WEBSITES

NASA SnowEx

5 CONTACTS AND ACKNOWLEDGMENTS

Ryan Webb

Institute of Arctic and Alpine Research

University of Colorado – Boulder

4001 Discovery Drive, Rm N202

Boulder, CO 80309

Daniel McGrath

Department of Geosciences

Colorado State University

Katherine Hale

University of Colorado - Boulder

Noah Molotch

University of Colorado - Boulder

6 DOCUMENT INFORMATION

6.1 Publication Date

20 July 2018

6.2 Date Last Updated

16 August 2018