SnowEx20 Grand Mesa IOP CSU 1GHz GPR, Version 1

USER GUIDE

How to Cite These Data

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

Bonnell, R., D. McGrath, R. Webb and H.-P. Marshall. 2021. *SnowEx20 Grand Mesa IOP CSU 1GHz GPR, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/S5EGFLCIAB18. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX20_GM_CSU_GPR

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data set contains the results of 1GHz ground-penetrating radar surveys conducted at Grand Mesa, Colorado during the SnowEx20 campaign. Data include two-way travel time, calculated snow depth, and calculated snow water equivalent.

1.2 File Information

1.2.1 Format

All data is collected in a single comma-separated value (.csv) file.

1.2.2 File Contents

The .csv file contains 11 columns with the parameters listed in Table 1.

Table 1. Data Parameters

Name	Description	Unit/Format
Date [mmddyy]	Date using six digits representing month, day and last two digits of year	[mmddyy]
Time [HHMM]	Four digits representing the hour and minute within the day. For this data set this column is not used and consists of NaNs.	[HHMM]
Longitude [DD]	Longitude	o
Latitude [DD]	Latitude	o
ElevationWGS84 [mae]	Elevation (meters above ellipsoid)	mae
Easting [m]	Easting	m
Northing [m]	Northing	m
UTM_Zone	Universal Transverse Mercator zone	N/A
TWT [ns]	Two-way travel time	ns
Depth [cm]	Snow depth	cm
SWE [mm]	Snow water equivalent	mm

1.2.3 Naming Convention

The single data file is named `SNEX20_GM_CSU_GPR_IOP_1GHz_v01.csv`.
`SNEX20_GM_CSU` refers to the SnowEx 2020 Grand Mesa, Colorado data and `IOP_1GHz` represents that the data was taken during the intensive operation period and at 1GHz GPR frequency.

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 39.040º N
Southernmost Latitude: 39.015º N
Easternmost Longitude: 108.00° W
Westernmost Longitude: 108.25° W

1.3.2 Resolution

Point Measurements

1.3.3 Geolocation

The following table provides information for geolocating this data set.

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs
Reference	https://epsg.io/4326

In addition to latitude/longitude in WGS 84 (epsg.io/4326) the data file also contains northing/easting in WGS 84 / UTM zone 13N (epsg.io/32613).

1.4 Temporal Information

1.4.1 Coverage

06 February 2020 – 09 February 2020

1.4.2 Resolution

Not applicable

2 DATA ACQUISITION AND PROCESSING

2.1 Background

This data set was collected with a Sensors & Software 1GHz ground penetrating radar (GPR) as part of the SnowEx 2020 Intensive Observation Period (IOP) at Grand Mesa, Colorado between 06 February 2020 and 09 February 2020.

2.2 Acquisition

The GPR surveys were conducted using a Sensors & Software control unit and a shielded 1 GHz antenna. The control unit and antenna were pulled in a plastic sled behind an operator, who used snowshoes or a snowmobile. Individual GPR traces were geolocated using an Emlid RS2 (L1/L2) GPS receiver.

2.3 Processing

The GPR traces had a sample rate of 0.1 ns. Raw data files were processed in Matlab and ReflexW software.

Data were processed by applying a time-zero correction, dewow filter, equidistant trace interpolation, and subtracting average filter applied over approximately 60 traces. Depending on the mode of transport, traces either had 0.3 m spacing (when pulled behind a snowmobile) or 0.1 m spacing (when pulled behind an operator walking on snowshoes). The base of the snowpack was manually picked following a consistent positive phase at the snow-ground interface.

GPS measurements were made with an Emlid RS2 receiver operated in post-processed kinematic (PPK) mode. The rover was post-processed in RTKlib, an open-source program package for global navigation satellite system (GNSS) positioning, using observations from an Emlid RS2 receiver base station at the field site. Due to a recording error in the base station, observations on Feb 8, 2020 were not post-processed.

Measured two-way travel times were converted to snow depth and snow water equivalent using the mean of pit-measured snow densities (273 kg/m^3) and an empirically derived radar velocity from Kovacs et al. (1995).

2.4 Quality, Errors, and Limitations

Uncertainty of snow depth is approximately ±3.5 cm as calculated from the radar wavelength (McGrath et al., 2019). Comparisons of two-way travel time were made at cross-over locations to ensure agreement.

2.5 Instrumentation

Data were collected using a Sensors & Software pulseEKKO PRO ground penetrating radar (GPR) system and a 1 GHz antenna.

3 SOFTWARE AND TOOLS

The .csv files can be accessed using software that reads ASCII text.

4 VERSION HISTORY

Table 3. Version History Summary

Version	Release Date	Description of Changes
V1	08 July 2021	Initial release

5 RELATED DATA SETS

SnowEx at NSIDC | Data Sets

6 RELATED WEBSITES

SnowEx at NSIDC | Overview

SnowEx at NASA

7 CONTACTS AND ACKNOWLEDGMENTS

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8 REFERENCES

Kovacs, A., A. J. Gow & R. M. Morey. (1995). The in-situ dielectric constant of polar firn revisited. Cold Regions Science and Technology, 23(2), 245-256, https://doi.org/10.1016/0165-232X(94)00016-Q.

McGrath, D., R. Webb, D. Shean, R. Bonnell, H.-P. Marshall, T. H. Painter, N. P. Molotch, K. Elder, C. Hiemstra, L. Brucker. (2019). Spatially Extensive Ground-Penetrating Radar Snow Depth Observations During NASA's 2017 SnowEx Campaign: Comparison With In Situ, Airborne, and Satellite Observations. Water Resources Research, 55, 11, https://doi.org/10.1029/2019WR024907.

9 DOCUMENT INFORMATION

9.1 Publication Date

08 July 2021

9.2 Date Last Updated

08 July 2021