IRARES2: IceBridge ARES L2 Bed Elevation and Ice Thickness, Version 1

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This dataset (IRARES2) contains glacier bed elevation and ice thickness measurements derived from the IceBridge Arizona Radio Echo Sounder L1B dataset (IRARES1B)[1], stored in comma delimited ASCII data files. Each IRARES2 data file contains all measurements made from a single IRARES1B observation. When no bed elevation or ice thickness measurements could be made from an IRARES1B observation there is no corresponding file included in the IRARES2 dataset.

A portion of each IRARES2 filename matches the corresponding IRARES1B observation filename, e.g. the IRARES2 file `IRARES2_20190928-235534.csv` contains ice thickness interpretations made from the IRARES1B file `IRARES1B_20190928-235534.h5`.

IRARES1B data were interpreted manually with the Radar Analysis Graphical Utility (RAGU)[2] software and the interpretations were exported to generate the files in the IRARES2 dataset. The fields in each row of an IRARES2 file are defined below. Each row in an IRARES2 file corresponds to a radargram column in an IRARES1B observation. Each IRARES2 file has the same number of rows as the corresponding IRARES1B observation has radargram columns. For IRARES1B radargram columns where no surface elevation information exists or no glacier bed interpretation can be made the corresponding fields in the IRARES2 row (fields 5-7 for surface elevation, fields 8-11 for glacier bed interpretation) are left empty.

The location of the radar provided is generated from a Precise Point Positioning solution for the location of the survey aircraft using a GPS antenna located on the top of the aircraft. No lever-arm correction is applied for the position of the phase center of the radar antenna, which is not well known.

Note, in addition to individual IRARES2 data files, all IRARES2 data were combined into a single comma delimited ASCII data file: `IRARES2.csv`.

trace

Field number:	1
Description:	Radargram column in the IRARES1B observation that this interpretation is derived from which corresponds to the row.

lon_deg_e

Field number:	2
Unit:	Degrees East
Description:	Longitude of the survey aircraft, WGS 84 coordinate system.

lat_deg_n

Field number:	3
Unit:	Degrees North
Description:	Latitude of the survey aircraft, WGS 84 coordinate system.

height_m

Field number:	4
Unit:	Meters
Description:	Height of the survey aircraft above the WGS 84 ellipsoid.

surface_sample

Field number: 5

Description: Zero-based index of the ice surface in the corresponding IRARES1B radargram column.

surface_twtt_s

Field number: 6

Unit: Seconds

Description: Ice surface two way travel time at the speed of light in a vacuum.

surface_height_m

Field number: 7

Unit: Meters

Description: Ice surface height above the WGS 84 ellipsoid. Typically derived from the on-board laser altimeter[3]. For some 2021 data, the surface was derived from CReSIS snow radar data[4]. The surface elevation source is stored within the corresponding IRARES1B data product.

bed_sample

Field number: 8

Description: Zero-based index of the interpreted glacier bed in the corresponding IRARES1B radargram column.

bed_twtt_s

Field number: 9

Unit: Seconds

Description: Glacier bed two-way travel time.

bed_height_m

Field number: 10

Unit: Meters

Description: Height of the interpreted glacier bed above the WGS 84 ellipsoid. Englacial two-way travel time delay (bed_twtt_s - surface_twtt_s) is converted to ice thickness assuming a dielectric permittivity of $\varepsilon_r = 3.15$ and subtracted from surface_height_m.

ice_thickness_m

Field number: 11

Unit: Meters

Description: Thickness of ice from the interpreted glacier bed. Englacial two-way travel time delay (bed_twtt_s - surface_twtt_s) is converted to ice thickness assuming a dielectric permittivity of $\varepsilon_r = 3.15$.

References

[1] J. Holt, M. Truffer, C. Larsen, M. Christoffersen, and B. S. Tober, *IceBridge ARES L1B Geolocated Radar Echo Strength Profiles, version 1*, 2021. DOI: 10.5067/X2H7MP5DBTYP. [Online]. Available: https://nsidc.org/data/IRARES1B/versions/1.

[2] B. S. Tober and M. Christoffersen, *Radar Analysis Graphical Utility (RAGU)*, 2022. DOI: 10.5281/ZENODO.3968981. [Online]. Available: https://zenodo.org/record/3968981.

[3] C. Larsen, *IceBridge UAF Lidar Scanner L1B Geolocated Surface Elevation Triplets, version 1*, 2010. DOI: 10.5067/AATE4JJ91EHC. [Online]. Available: http://nsidc.org/data/ILAKS1B/versions/1.

[4] J. Paden, J. Li, C. Leuschen, F. Rodriguez-Morales, and R. Hale, *IceBridge Snow Radar L1B Geolocated Radar Echo Strength Profiles, version 2*, 2014. DOI: 10.5067/FAZTWP500V70. [Online]. Available: https://nsidc.org/data/IRSNO1B/versions/2.