IceBridge ARES L1B Geolocated Radar Echo Strength Profiles, Version 1

USER GUIDE

How to Cite These Data

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

Holt, J. W., M. Truffer, C. Larsen, M. S. Christoffersen, and B. S. Tober. 2021. *IceBridge ARES L1B Geolocated Radar Echo Strength 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/X2H7MP5DBTYP [Date Accessed].

We also request that you acknowledge the author(s) of this data set by referencing the following:

Holt, J. W., M. Truffer, C. Larsen, M. S. Christoffersen, and B. S. Tober. 2019. *Glaciers on the Brink: New Alaskan Ice Thickness Constraints from Operation IceBridge Airborne Radar Sounding*. AGU Fall Meeting 2019 (December 9–13), San Francisco, CA, United States. https://ui.adsabs.harvard.edu/abs/2019AGUFM.C43B..07H/abstract

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/IRARES1B

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

Radar echograms acquired by the Arizona Radio-Echo Sounder (ARES) over glaciers in Alaska.

1.2 File Information

Detailed information on the data format and processing is available in the "OIB Alaska Radar HDF5 Format Description and Processing Information" document on the data set landing page.

1.2.1 Format

The data are provided as HDF5-formatted files.

1.2.2 Directory Structure

The HDF5 file structure is shown in Figure 1, followed by a description of the groups and parameters.

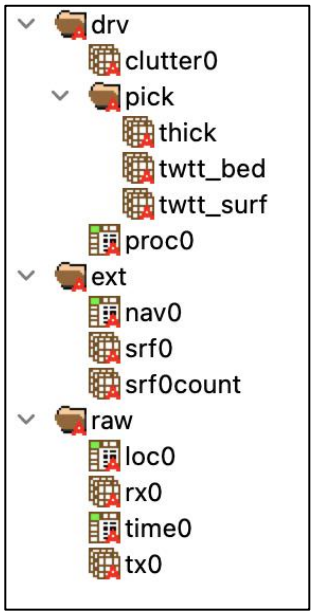

Figure 1. HDF5 file structure as shown in HDFView.

1.2.2.1 drv

- `clutter0`: Surface clutter simulation to aid interpretation of the data

- pick: subgroup that includes thickness of the glacier in meters (`thick`), interpreted two-way travel time to the bed (`twtt_bed`), and two-way travel time to the lidar-derived surface (`twtt_surf`)
- `proc0`: Processed data derived from `/raw/rx0`

1.2.2.2 ext

- `nav0`: Positions derived from the GPS used for the IceBridge lidar
- `srf0`: Surface elevation derived from the IceBridge lidar data in meters
- `srf0count`: Number of lidar points used for each derived surface elevation

1.2.2.3 raw

- `loc0`: GPS position log from the radar
- `rx0`: Raw data acquired by the radar
- `time0`: Time tag for each trace in the raw data
- `tx0`: Information about the transmitted signal

NOTE: The `twtt_surf` parameter is calculated from `srf0` and `nav0` in the `/ext/` group. Some files have an empty `/ext/` group and thus do not include the `twtt_surf` parameter.

1.2.3 Naming Convention

The files are named according to the following convention, which is described in more detail in Table 1:

`IRARES1B_YYYYMMDD-hhmmss.h5`

Table 1. File Naming Convention

Variable	Description
`IRARES1B`	IceBridge ARES L1B Geolocated Radar Echo Strength Profiles data set
`YYYYMMDD`	Date that data acquisition began for the granule (year, month, day)
`hhmmss`	Time that data acquisition began for the granule (hour, minute, second)

Example:
`IRARES1B_20150826-200755.h5`

1.2.4 Browse Files

Browse images of the radar data, surface clutter simulation, and airplane track are provided as .png files (Figure 2). The images use the same file naming convention as the data files, for example:

IRARES1B_20150826-200755.png

IRARES1B_20150826-200755_clutter.png

IRARES1B_20150826-200755_map.png

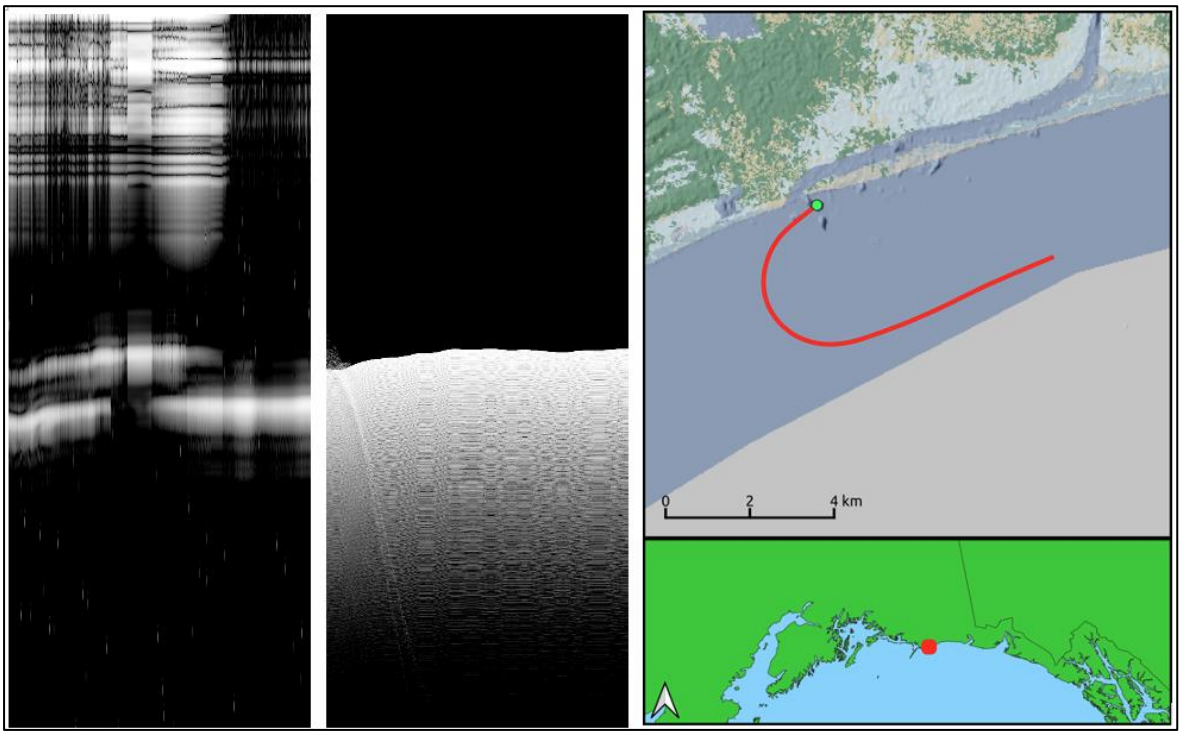

Figure 2. Example browse images from left to right: radar data, surface clutter simulation, and airplane track.

1.3 Spatial Information

1.3.1 Coverage

The data were collected over Alaska:

Northernmost latitude: 63º N
Southernmost latitude: 56º N
Easternmost longitude: 129º W
Westernmost longitude: 157º W

1.3.2 Resolution

Along-track spacing of radar soundings varies but is approximately 5 m. The vertical resolution of the radar signal in ice is 17 m (5 MHz bandwidth) or 35 m (2.5 MHz bandwidth).

1.3.3 Geolocation

The following table provides information for geolocating this data set:

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	N/A
Longitude of true origin	Prime Meridian, Greenwich
Latitude of true origin	N/A
Scale factor at longitude of true origin	N/A
Datum	World Geodetic System 1984 ensemble
Ellipsoid/spheroid	WGS 84
Units	degree
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs +type=crs
Reference	https://epsg.io/4326

1.4 Temporal Information

1.4.1 Coverage

26 August 2015 to 13 May 2021

Information on Operation IceBridge campaigns is available on the mission website.

1.4.2 Resolution

Data were collected during biannual campaigns, however, repeat coverage varies.

2 DATA ACQUISITION AND PROCESSING

2.1 Instrumentation

ARES is an airborne ice-penetrating radar developed by the Terrestrial And Planetary Investigations and Reconnaissance (TAPIR) lab at the University of Arizona. The low-frequency signals transmitted by the radar allow it to penetrate temperate ice greater than a kilometer thick.

2.2 Acquisition

ARES was flown on a DHC-3 aircraft and collected data as part of NASA Operation IceBridge campaigns. The campaigns focused on mapping ice thickness for the major glacier systems in Alaska, along with repeat scanning lidar measurements of the glacier surfaces.

2.3 Processing

The raw data underwent the following processing steps:

1. **Raw data format to HDF5 conversion**. Each raw data trace was shifted by a constant offset to account for instrument delay.
2. **Rolling mean removal**. A rolling, windowed mean was subtracted from each trace to remove constant offset and noise.
3. **Pulse compression**. Chirped data were pulse compressed using an ideal reference chirp with a boxcar amplitude window.
4. **GPS synchronization**. Timing data recorded per-trace by the GPS were used to extract high-quality positioning data from the GPS record associated with the University of Alaska-Fairbanks (UAF) lidar.
5. **Lidar surface extraction**. A per-trace surface location was extracted from Icebridge lidar data (IceBridge UAF Lidar Scanner L1B Geolocated Surface Elevation Triplets, Version 1)
6. **Surface clutter simulation**. Surface clutter was simulated using a digital elevation model.

2.4 Quality, Errors, and Limitations

Crossover agreement was examined for a large set of intersecting tracks on the Malaspina Glacier, and 95% of crossovers were within 34 meters.

3 RELATED DATA SETS

IceBridge UAF Lidar Scanner L1B Geolocated Surface Elevation Triplets (ILAKS1B)

IceBridge UAF L1B HF Geolocated Radar Echo Strength Profiles (IRUAFHF1B)

4 RELATED WEBSITES

Operation IceBridge at NASA

Operation IceBridge at NSIDC

5 DOCUMENT INFORMATION

5.1 Publication Date

June 2023

5.2 Date Last Updated

April 2024