ICESat-2 L4 Grounding Zone for Antarctic Ice Shelves, Version 1

USER GUIDE

How to Cite These Data

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

Li, T., G. J. Dawson, S. J. Chuter, and J. L. Bamber. 2022. *ICESat-2 L4 Grounding Zone for Antarctic Ice Shelves, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/RI67B92708M9. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/IS2GZANT

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data set provides an Antarctic ice shelf grounding zone geolocation product, including the landward limit of ice flexure caused by ocean tidal movement (Point F), the seaward limit of ice flexure (Point H), and the break in surface slope (Point I_b) based on the ATLAS/ICESat-2 ATL06 Land Ice Height data set acquired between March 2019 and September 2020.

1.2 File Information

1.2.1 Format

Data are provided as HDF5 formatted file. HDF is a data model, library, and file format designed specifically for storing and managing data. For more information about HDF, visit the HDF Support Portal.

The HDF Group provides tools for working with HDF5 formatted data. HDFView is free software that allows users to view and edit HDF formatted data files. In addition, the HDF - EOS | Tools and Information Center web page contains code examples in Python (pyhdf/h5py), NCL, MATLAB, and IDL for accessing and visualizing ICESat-2 files.

1.2.2 File Contents

Data is structured into three groups referring to the different grounding zone features:

- Point_F (landward limit of tidal flexure)
- Point_H (inshore limit of hydrostatic equilibrium)
- Point_I_b (break in slope)

Within each data group are the following parameters listed in Table 1:

Table 1. Parameter description

Name	Description	Unit
beam	Beam information: left beam ("l"), right beam ("r"), or beam pair ("pair"). 'l', 'r', 'pair' denote if the grounding zone feature is calculated from left-beam repeat-track data group, right-beam repeat-track data group, or beam-pair repeat-track data group.	N/A
beam_pair	Beam pair number	N/A
latitude	Latitude of the grounding zone feature, WGS84, North=+	°N

longitude	Longitude of the grounding zone feature, WGS84, East=+	°E
nominal_error	Nominal uncertainty for ICESat-2-derived grounding zone feature expressed as a static value: 80 m for Point F, 560 m for Point H, and 10 m for Point I_b	m
repeat_cycles_no	Number of repeat cycles used in the grounding zone calculation	N/A
tide_range	Tidal range (available only for Point F and Point H)	m
track	The Reference Ground Track (RGT) number	N/A

1.2.3 Naming Convention

The data file is called: IS2GZANT_v01.h5

1.2.4 Browse File

A .jpg browse file (Figure 1) is provided showing the ICESat-2 derived landward limit of tidal flexure (Point F), the inshore limit of hydrostatic equilibrium (Point H), and the break in slope (Point I_b).

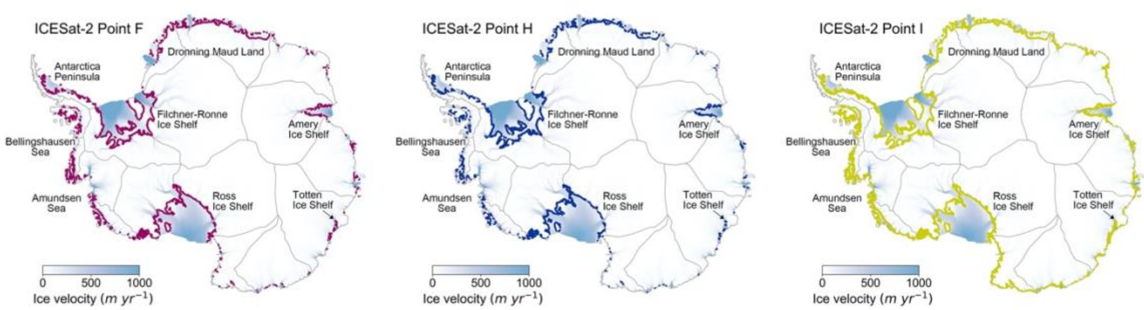

Figure 1. Browse file IS2GZANT_v01_browse.jpg

1.3 Spatial Information

1.3.1 Coverage

This data set has the following spatial bounds:

Northernmost Latitude: 60° S
Southernmost Latitude: 90° S
Easternmost Longitude: 180° E
Westernmost Longitude: 180° W

1.3.2 Resolution

Not applicable

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
Ellipsoid/spheroid	WGS 84
Units	degree
False easting	N/A
False northing	N/A
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs
Reference	https://epsg.io/4326

1.4 Temporal Information

1.4.1 Coverage

30 March 2019 – 30 September 2020

1.4.2 Resolution

18 months

2 DATA ACQUISITION AND PROCESSING

2.1 Background

An ice shelf grounding zone is defined as the region between the landward limit of tidal flexure where the ice is not influenced by ocean tides and the inshore limit of hydrostatic equilibrium where the ice is floating in full hydrostatic equilibrium (Li et al., 2022, Brunt et al., 2010).

This data set provides an Antarctic ice shelf grounding zone mapping, including the landward limit of ice flexure caused by ocean tidal movement (Point F), the seaward limit of ice flexure (Point H) and the break in surface slope (Point I_b) derived from ATLAS/ICESat-2 data collected between March 2019 and September 2020.

2.2 Instrumentation

The Advanced Topographic Laser Altimeter System (ATLAS) instrument on the Ice, Cloud and land Elevations Satellite-2 (ICESat-2) utilizes a photon-counting lidar and ancillary systems (GPS and star cameras) to measure the round-trip time of photon pulses from ATLAS to Earth and back again and to determine the geodetic latitude and longitude of these signal photon pulses on the Earth's surface. For more details on the ATLAS instrument see the user guide for ATLAS/ICESat-2 L3A Land Ice Height (ATL06).

2.3 Acquisition

The locations of the Antarctic grounding zone were derived using the ATLAS/ICESat-2 L3A Land Ice Height, Version 3 (ATL06, V3) product between March 2019 and September 2020 which included seven repeat cycles (3-9) where cycles 4 and 9 are not complete. The ATL06 elevation is calculated by averaging individual photon data over a 40 m length segment, at an along-track distance of 20 m for each of the six beams of ATLAS. Details for ATL06 are described in Smith et al. (2019) and on the ATL06 data set landing page.

2.4 Processing

The estimation of the grounding zone is based on detecting the limits of tidal flexure of the floating ice due to ocean tides and the inflections of surface slope associated with the grounding line, using two automatic techniques developed from ICESat-2 repeat-track analysis. The processing steps are summarized below. For more details see Li et al., 2022.

- Categorized ICESat-2 ATL06 data into nine distinct repeat-track data groups, including six single-beam repeat-track data groups, and three beam-pair repeat-track data groups, which were corrected for the across-track slope, following the processing steps described in Li et al. (2020).
- Calculated the mean absolute elevation anomaly (MAEA) defined as the average of the absolute value of all elevation anomaly profiles (Li et al., 2020). The region where the MAEA is close to zero is regarded as fully grounded ice, while the region where it reaches its maximum and becomes stable with ocean tide predictions is regarded as floating ice shelf in hydrostatic equilibrium with the ocean water.
- Estimated Point F as the point where the gradient of the MAEA first increases from zero and the second derivative of the MAEA reaches its positive peak.
- Estimated Point H as the point where the gradient of the MAEA finally decreases to zero and the second derivative of the MAEA reaches its negative peak (Li et al., 2020).

- Estimated the Point I_b as the location where the slope changes most rapidly inside the grounding zone (Bindschadler et al., 2011, Brunt et al., 2010).
- Validated the derived grounding zone locations using the ICESat-2 crossover analysis on Filchner-Ronne Ice Shelf and Ross Ice Shelf and against several previously published grounding zone products over the Antarctic continent (Li et al., 2022).

2.5 Quality, Errors, and Limitations

The typical uncertainties for the ICESat-2-derived Points F, H and I_b are 80 m, 560 m, and 10 m, respectively. See Li et al., 2022 for more details on uncertainty assessment.

3 VERSION HISTORY

Version 1 (May 2022).

Note: Version 1 of this data set was derived from Version 3 of ATL06.

4 RELATED DATA SETS

- ATLAS/ICESat-2 L3A Land Ice Height (ATL06)
- ICESat-Derived Grounding Zone for Antarctic Ice Shelves

5 CONTACTS AND ACKNOWLEDGMENTS

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6 REFERENCES

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7 DOCUMENT INFORMATION

7.1 Publication Date

26 May 2022

7.2 Date Last Updated

26 May 2022