MEaSUREs Annual Greenland Outlet Glacier Terminus Positions from SAR Mosaics, Version 2

USER GUIDE

How to Cite These Data

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

Joughin, I., T. Moon, J. Joughin, and T. Black. 2021. *MEaSUREs Annual Greenland Outlet Glacier Terminus Positions from SAR Mosaics, Version 2*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/ESFWE11AVFKW. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0642

National Snow and Ice Data Center

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1   DATA DESCRIPTION

This data set consists of annual, digitized (polyline) ice front positions for 239 outlet glaciers in Greenland. Ice front positions are derived from Sentinel-1 and RADARSAT-1 synthetic aperture radar (SAR) mosaics, with gaps in annual coverage filled using Landsat-7 and Landsat-8 panchromatic imagery. Data are available for the following winter seasons:

2000–2001
2005–2006
2006–2007
2007–2008
2008–2009
2012–2013
2014–2015
2015–2016
2016–2017
2017–2018
2018–2019
2019–2020
2020–2021

1.1 Parameters

1.1.1   Parameter Description

Data are provided as annual shapefiles of ice front (terminus) positions digitized as polylines. A separate glacier ID shapefile is also available that contains point locations and names for glaciers in the data set. Table 1 and Table 2 describe the attributes that are included in the termini shapefiles and the glacier ID shapefile, respectively:

Table 1. Attributes For Ice Front Location (Termini) Shapefiles

Attribute	Description	Values
Glacier_ID	Numerical ID for each glacier across all data sets	1 – 239
Quality_Fl	Quality flag	0. no flag 1. terminus position estimated or uncertain (see Section 2.4) 2. position uncertainty improved or verified using Landsat imagery 3. Landsat-7 scan-line corrector (SLC) failure affected digitization.
Image_ID	Unique identifier for image used to digitize terminus position	See Table 3. "Naming Convention For Image_ID Attribute"
Sensor	Satellite source of image used to digitize terminus position	LC08 – Landsat-8 LE07 – Landsat-7 RAD1 – Radarsat-1 SEN1 – Sentinel-1
SourceDate	Year, month, and day of image used to digitize terminus position	YYYY-MM-DD

Table 2. Attributes For Glacier ID Shapefile

Attribute	Description	Values
GlacierID	Numerical ID for each glacier (used consistently across all data sets)	1 – 239
POINT_X	X-coordinate, glacier point location	See "Table 5. Geolocation Details".
POINT_Y	Y-coordinate, glacier point location	See "Table 5. Geolocation Details".
GrnlndcNam	Greenlandic glacier name	Values are standardized to match "New Greenlandic" attribute in database of Greenland glacier names (Bjørk et al., 2015).
Official_n	Officially recognized glacier name	Values are standardized to match "Official_n" attribute in database of Greenland glacier names (Bjørk et al., 2015).

Attribute	Description	Values
AltName	Alternative glacier name	Includes e.g., foreign name or Old Greenlandic name (Bjørk et al., 2015), or other recognized names.

The following table describes the naming conventions in the Image_ID attribute (the source images used to digitize glacier terminus positions):

Table 3. Naming Convention For Image_ID Attribute

Satellite	ID Naming Convention
Sentinel-1[1]	SEN1_NSIDC_0723_Vx_YYYYMMDD_yyyymmdd • x – Sentinel mosaic version • YYYYMMDD – mosaic start date • yyyymmdd – mosaic end date
RADARSAT-1[2]	RAD1_NSIDC_0633_Vxx_20_YYyy • V[xx] – Radarsat mosaic version number • YY – last two digits of mosaic start year • yy – last two digits of mosaic end year
Landsat[3]	LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX • L = Landsat • X = Sensor ◦ C = OLI/TIRS combined ◦ O = OLI-only ◦ T = TIRS-only ◦ E = ETM+ ◦ T = TM ◦ M = MSS • SS = Satellite (07 = Landsat 7, 08 = Landsat 8) • LLLL = Processing correction level (L1TP, L1GT, or L1GS) • PPP = WRS path • RRR = WRS row • YYYYMMDD = Acquisition year, month, day • yyyymmdd = Processing year, month, day • CC = Collection number (01, 02, …) • TX = Collection category (RT = Real-Time, T1 = Tier 1, T2 = Tier 2)

[1]See MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B (NSIDC-0723)

[2]See MEaSUREs Greenland Ice Sheet Mosaics from SAR Data (NSIDC-0633)

[3]Landsat source images retain the USGS naming convention. For more information, see "What is the naming convention for Landsat Collections Level-1 scenes?"
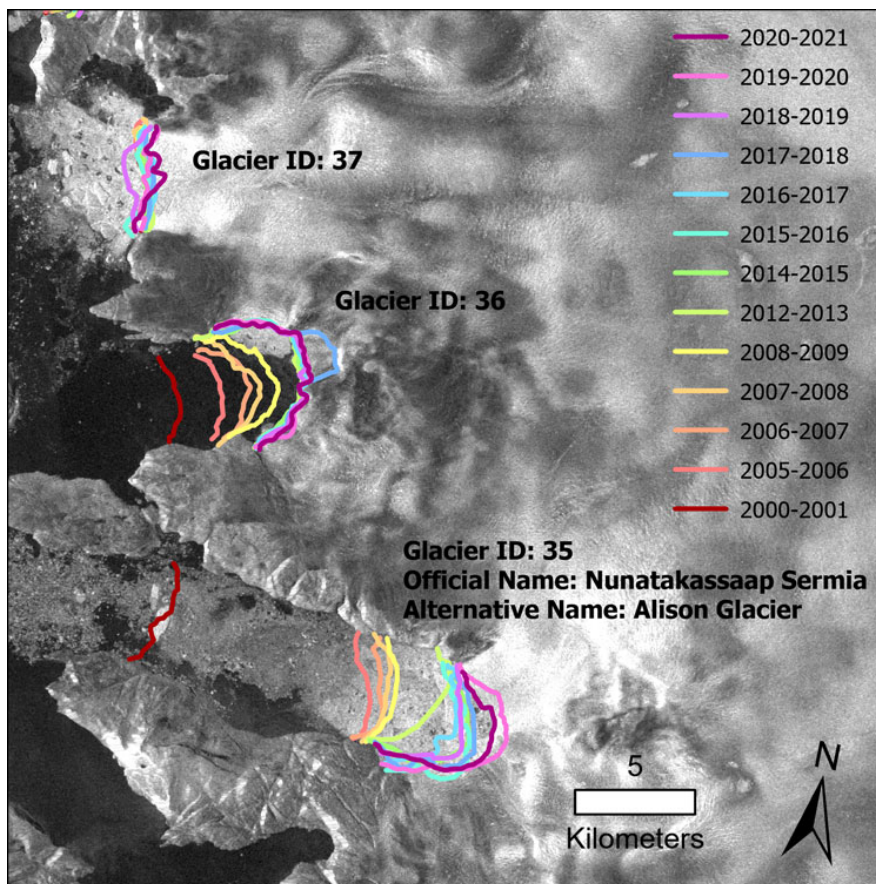
1.1.2   Sample Data Record

Figure 1. Example Data Visualization

1.2 File Information

1.2.1   Format

Data are provided as Esri shapefiles. A shapefile is a vector data storage format that contains
multiple files. The shapefiles in this data set include the following files:

.shp – stores the feature geometry

.shx – stores the index of the feature geometry

.dbf – dBASE table that stores the attribute information

.sbn, .sbx – stores the spatial index of the features

.prj – stores the coordinate system information

.cpg – specifies the code page for identifying the character set to be used

.xml – metadata file

1.2.2   Directory Structure

Data are available from NASA's Earthdata Search or via direct download. When using the direct download option, the top-level directory contains subfolders—one for each winter season—that store the termini shapefile for that winter. Subfolder names correspond to the date of the earliest data in that winter's termini shapefile. Table 4 lists the folder name for each winter season. Note: the glacier ID shapefile is located in the subfolder for the 2000–2001 winter season.

Table 4. Glacier Termini Data Directories

Folder Name	Winter Season
2000.09.30	2000–2001[*]
2005.12.24	2005–2006
2006.01.06	2006–2007
2007.11.22	2007–2008
2009.01.04	2008–2009
2013.01.15	2012–2013
2015.02.07	2014–2015
2016.02.02	2015–2016
2017.02.01	2016–2017
2018.02.02	2017–2018
2019.02.03	2018–2019
2020.02.04	2019–2020
2021.02.04	2020–2021

[*]Includes the shapefile described in "Section 1.2.3.1 | Glacier ID Shapefile".

1.2.3   File Naming Convention

1.2.3.1 Glacier ID Shapefile

The glacier ID shapefile (stored in the 2000–2001 subfolder) consists of the following files:

GlacierIDs_v02.0.cpg
GlacierIDs_v02.0.dbf
GlacierIDs_v02.0.prj
GlacierIDs_v02.0.sbn
GlacierIDs_v02.0.sbx
GlacierIDs_v02.0.shp
GlacierIDs_v02.0.shp.xml
GlacierIDs_v02.0.shx

1.2.3.2 Termini Shapefiles

Termini shapefiles comprise the same eight file types as the glacier ID shapefile. They use the following naming convention:

Example File Name

termini_2000_2001_v02.0.shp

Naming Convention

termini_[YYYY_yyyy]_[v02.0].[ext], where:

- YYYY_yyyy = winter season
- v02.0 = version 2.0
- ext = file extension (See "Section 1.2.1 | Format".)

1.3 Spatial Information

1.3.1 Coverage

Data are provided for 239 individual glaciers within the following boundaries:

Southernmost Latitude: 60° N
Northernmost Latitude: 83° N
Westernmost Longitude: 75° W
Easternmost Longitude: 14° W

1.3.2 Resolution

The nominal uncertainty in digitized terminus locations is 50 m, but may be larger if the source imagery exhibits poor contrast at the terminus (e.g., tidewater glaciers with persistent melange). Nominal ground resolution for the source mosaics and imagery ranges between 15 m and 50 m.

1.3.3 Geolocation

The following table provides information about geolocating this data set:

Table 5. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	WGS 84/NSIDC Sea Ice Polar Stereographic North
Longitude of true origin	-45°
Latitude of true origin	70°
Scale factor at longitude of true origin	1

Datum	World Geodetic System 1984
Ellipsoid/spheroid	WGS 84
Units	meters
False easting	0.00000000
False northing	0.00000000
EPSG code	3413
PROJ4 string	+proj=stere +lat_0=90 +lat_ts=70 +lon_0=-45 +k=1 +x_0=0 +y_0=0 +datum=WGS84 +units=m +no_defs
Reference	http://epsg.io/3413

1.4 Temporal Information

1.4.1 Coverage

The following table lists the exact date ranges for each winter season. Note, however, that the date of the source image that was digitized for each glacier's terminus position can lie anywhere within that season's date range. Users should consult the "SourceDate" attribute to determine the exact date associated with a glacier's terminus location.

Table 6. Winter Season Date Ranges

Winter Season	Range
2000–2001	Sep 30, 2000 – Jul 06, 2001
2005–2006	Dec 24, 2005 – Jun 02, 2006
2006–2007	Jan 06, 2007 – Apr 04, 2007
2007–2008	Nov 22, 2007 – Jun 16, 2008
2008–2009	Jan 04, 2009 – Apr 01, 2009
2012–2013	Jan 15, 2013 – May 21, 2013
2014–2015	Feb 07, 2015 – May 03, 2015
2015–2016	Feb 02, 2016 – Aug 25, 2016
2016–2017	Feb 01, 2017 – Aug 12, 2017
2017–2018	Feb 02, 2018 – Jul 14, 2018
2018–2019	Feb 03, 2019 – May 14, 2019
2019–2020	Feb 04, 2020 – Mar 19, 2020
2020–2021	Feb 04, 2021 – Mar 25, 2021

1.4.2   Resolution

One ice front position per year per glacier

2   DATA ACQUISITION AND PROCESSING

2.1 Acquisition

Ice front positions are digitized primarily from base maps in the MEaSUREs Greenland Ice Sheet Mosaics from SAR Data (NSIDC-0633) and MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B, Version 2 (NSIDC-0723) data sets.

2.2 Derivation Techniques and Algorithms

Through 2013, termini were digitized from mosaics of RADARSAT satellite data. Sentinel-1 data were used starting with the 2014–2015 winter season. Starting with Version 2, gaps in mosaic coverage have been filled using Landsat-7 and Landsat-8 data back to the beginning of the data record, such that every winter season now contains terminus locations for all 239 glaciers.

For Greenland Ice Sheet outlet glaciers, positions have been digitized for termini with widths of roughly 1.5 km or greater. With few exceptions, all glaciers that appear in each winter season's source mosaic and meet the width criteria have been digitized.

In cases where a terminus was highly fractured, its position does not include any areas which were fully detached (fractured). In some cases, this determination may be subjective.

2.3 Quality, Errors, and Limitations

Image quality varies and should be considered on a per-glacier basis. Errors in digitized terminus location may occur due to:

- Image distortion caused by local topography
- Difficulty distinguishing intact glacier ice from an adjacent glacier or sea ice
- Highly fractured terminus areas
- Resolution limits
- Manual digitization error

Polylines cover *roughly* the full width of the active glacier terminus; line ends do not necessarily indicate a junction between ice and rock or any other defined measure of a glacier's edge. As such, this data set should not be used to measure terminus width.

2.4 Instrumentation

2.4.1 Description

For information about the SAR systems used to construct the mosaics from which this data set is derived, see the Alaska Satellite Facility's SAR Basics web page, the Japan Aerospace Exploration Agency (JAXA) About ALOS - PALSAR site, and the European Space Agency's Copernicus Sentinel-1 site. Information on the Landsat-8 OLI sensor is available on the USGS web site.

3   VERSION HISTORY

Consult the following table for this data set's version history:

Table 7. Version History

Version	Description
V2.0 (Oct. 2021)	• Temporal coverage extended through winter 2020–2021. • Gaps in mosaic coverage throughout the data record filled using Landsat-7 and Landsat-8 imagery. Every winter season now contains terminus locations for every glacier. • Data quality flags added for some pre-2014 terminus positions.
V1.2 (Oct. 2017)	Added glaciers to two winters: • 2006/2007 – glaciers 90 and 91 • 2008/2009 – glaciers 1-9, 90, and 91
V1.1 (Aug. 2017)	Minor changes include: • Added data for winters of 2014/2015, 2015/16, 2016/17 • Added new parameter attributes for the new data • Added 29 new glaciers • Provided a new GlacierID file with added glaciers and updated attributes
V1 (Sep. 2015)	Initial release

4   RELATED DATA SETS

Digital SAR Mosaic and Elevation Map of the Greenland Ice Sheet
RAMP AMM-1 SAR Image Mosaic of Antarctica
MEaSUREs Greenland Ice Sheet Mosaics from SAR Data
MEaSUREs Greenland Ice Sheet Velocity Map from InSAR Data
MEaSUREs Greenland Ice Velocity: Selected Glacier Site Velocity Maps from InSAR
MEaSUREs InSAR-Based Antarctica Ice Velocity Map
MEaSUREs InSAR-Based Ice Velocity Maps of Central Antarctica: 1997 and 2009

MEaSUREs InSAR-Based Ice Velocity of the Amundsen Sea Embayment, Antarctica

5   RELATED WEBSITES

MEaSUREs Data | Overview
Alaska Satellite Facility
Canadian Space Agency
Japan Aerospace Exploration Agency

6   CONTACTS AND ACKNOWLEDGMENTS

6.1 Investigators

Ian Joughin

University of Washington

Applied Physics Laboratory

1013 NE 40th Street

Box 355640

Seattle, WA 98105

Twila Moon

National Snow and Ice Data Center

CIRES, 449 UCB

University of Colorado

Boulder, CO 80309-0449 USA

Jonah Joughin

Jonahjoughin@gmail.com

Taryn Black

teblack@uw.edu

6.2 Acknowledgements

These data were generated through a grant from the NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Program. Digitized ice fronts were created by Dr. Twila Moon. Contains modified Copernicus Sentinel data (2014-2021), acquired by the European Space Agency, distributed through the Alaska Satellite Facility, and processed by Joughin, I., T. Moon, J. Joughin, and T. Black.

7 REFERENCES

Bjørk, A. A., L. M. Kruse, and P. B. Michaelsen. 2015. Brief communication: Getting Greenland's glaciers right – a new data set of all official Greenlandic glacier names. *The Cryosphere* 9(6): 2215-2218. doi: https://doi.org/10.5194/tc-9-2215-2015.

8 DOCUMENT INFORMATION

8.1 Publication Date

September 2015

8.2 Date Last Updated

October 2021