MEaSUREs Weekly-To-Monthly Greenland Outlet Glacier Terminus Positions from Sentinel-1 Mosaics, Version 1

USER GUIDE

How to Cite These Data

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

Black, T.E. and I. Joughin. 2022. *MEaSUREs Weekly-To-Monthly Greenland Outlet Glacier Terminus Positions from Sentinel-1 Mosaics, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/DGBOSSIULSTD. [Date Accessed].

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set consists of sub-seasonal, digitized (polyline) ice front positions for 219 outlet glaciers in Greenland. For 199 glaciers, ice front positions are digitized at a monthly resolution. For 20 glaciers in northwestern Greenland, ice front positions are digitized at a 6–12 day resolution, depending on the availability of satellite imagery. Ice front positions are derived from Sentinel-1A and Sentinel-1B synthetic aperture radar (SAR) mosaics.

1.1 Parameters

This data set provides ice front (terminus) positions and open-ended bounding boxes that intersect one another to define glacier area at a point in time. It also provides point locations with associated glacier names.

1.2 File Information

1.2.1 Format

The data files are provided as ESRI shapefiles (`.shp`, `.shx`, `.dbf`, and `.prj`).

1.2.2 File Contents

The data set includes three shapefiles. The `glacier_termini` shapefile provides all available terminus positions for the data coverage period, digitized as polylines. The `glacier_boxes` shapefile contains open-ended bounding boxes used to define the glacier areas associated with the termini. The `glacier_points` shapefile contains point locations and names for all glaciers in the data set.

Table 1 and Table 2 describe the attributes that are included in the `glacier_termini` and `glacier_points` shapefiles. The `glacier_boxes` file includes only one attribute, `Glacier_ID`.

Table 1. Attributes of Glacier Termini Shapefile

Attribute	Description	Values
Glacier_ID	Unique numerical ID assigned to each glacier (used consistently across all data files)	1–239
Quality_Fl	Quality flag	0. no flag 1. terminus position estimated or uncertain, see Section 2.3 for details

Attribute	Description	Values
Image_ID[1]	Unique identifier for image used to digitize terminus position	SEN1_NSIDC_0723_Vx_YYYYMMDD_yyyymmdd • x - Sentinel mosaic version • YYYYMMDD - Mosaic start date • yyyymmdd - Mosaic end date
Image_Title[1]	Title of image used to digitize terminus position	S1s_TTT_RRRRRR • S1s - Sentinel satellite, S1A or S1B • TTT - Track • RRRRRR - Orbit
SourceDate	Year, month, and day of image used to digitize terminus position	YYYY-MM-DD

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

Table 2. Attributes for Glacier Points Shapefile

Attribute	Description	Values
GlacierID	Unique numerical ID assigned to each glacier (used consistently across all data files)	1–239
Official_N	Officially recognized glacier name	Values are standardized to match "Official_n" attribute in database of Greenland glacier names (Bjørk et al., 2015)
Greenlandi	Greenlandic glacier name	Values are standardized to match "New Greenlandic" attribute in database of Greenland glacier names (Bjørk et al., 2015)
Alternativ	Alternative glacier name	Includes, e.g., foreign or Old Greenlandic name (Bjørk et al., 2015) or other recognized names
Temp_Res	Temporal resolution at which glacier's terminus is digitized	Monthly or weekly, see Appendix A for a list of glaciers with the 6–12 day temporal resolution

1.2.3   Naming Convention

This data set comprises the following three data files, with the version number specified in the file name:

- glacier_termini_v01.shp
- glacier_points_v01.shp
- glacier_boxes_v01.shp

1.3 Spatial Information

1.3.1 Coverage

The data cover the Greenland Ice Sheet with the following bounding box:

- Southernmost Latitude: 59° N
- Northernmost Latitude: 84° N
- Easternmost Longitude: 15° W
- Westernmost Longitude: 73° W

1.3.2 Resolution

The source imagery mosaics used to produce the termini have a nominal ground resolution ranging from 15 m to 50 m.

1.3.3 Geolocation

Table 3 provides information for geolocating this data set.

Table 3. NSIDC Sea Ice Polar Stereographic North (EPSG:3413)

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	WGS 1984
Ellipsoid/spheroid	WGS 1984
Units	meter
False Easting	0
False Northing	0
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

01 January 2015 to 31 December 2021

1.4.2 Resolution

Outlet glacier terminus positions are sampled at 6–12 day intervals for 20 glaciers and monthly intervals for the remaining 199 glaciers. See Appendix A for a list of glaciers with the 6–12 day temporal resolution. There are occasional temporal gaps due to missed satellite acquisitions.

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

Ice front positions and glacier area boxes have been digitized from base maps in the MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B, Version 4 (NSIDC-0723) data set.

2.2 Processing

Terminus positions and glacier area boxes were traced in mosaics of Copernicus Sentinel-1A and Sentinel-1B images from the MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B, Version 4 (NSIDC-0723) data set. Positions were digitized for termini with widths of roughly 1.5 km or greater. With a few exceptions, all glaciers that appear in the source mosaic and meet the termini 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.

Glacier area boxes are open-ended bounding boxes that approximately follow the path of the glacier. The box is open on the terminus side, and the intersection of a terminus with the box defines a glacier area at a point in time. Glacier points were selected as arbitrary points on the glacier near the terminus.

Complete details are available in Joughin et al. (2016), Black and Joughin (2022), and Black and Joughin (2023).

2.3 Quality, Errors, and Limitations

Image quality varies and should be considered on a per-glacier basis. 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).

Errors in digitized terminus and glacier area box 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

For more information on the SAR satellites Sentinel-1A and -1B, please see the European Space Agency's Copernicus Sentinel-1 web page.

3   SOFTWARE AND TOOLS

Data analysis and visualization code are available at https://github.com/tarynblack/greenland_terminus_seasonality.

4   RELATED DATA SETS

MEaSUREs Data at NSIDC

MEaSUREs Annual Greenland Outlet Glacier Terminus Positions from SAR Mosaics

MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B

5   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. https://doi.org/10.5194/tc-9-2215-2015.

Black, T. E. and I. Joughin. 2022. Multi-decadal retreat of marine-terminating outlet glaciers in northwest and central-west Greenland. *The Cryosphere* 16(3): 807–824. https://doi.org/10.5194/tc-16-807-2022.

Black, T. E. and Joughin, I. 2023. Weekly to monthly terminus variability of Greenland's marine-terminating outlet glaciers. The Cryosphere 17: 1-13. https://doi.org/10.5194/tc-17-1-2023.

Joughin, I., B. Smith, I. Howat, T. Moon, and T. Scambos. 2016. A SAR record of early 21st century change in Greenland. *Journal of Glaciology* 62: 62–71. https://doi.org/10.1017/jog.2016.10.

6 DOCUMENT INFORMATION

6.1 Publication Date

December 2022

6.2 Date Last Updated

January 2023

APPENDIX A –TEMPORAL RESOLUTION OF GLACIER TERMINI

Table A - 1 Glaciers Termini With a 6-12 Day Temporal Resolution

Glacier ID	Glacier Name	Alternative Glacier Name
3	Sermeq Kujalleq	Jakobshavn Isbræ
7	Sermeq Kujalleq	Alianaatsup Sermia
9	Sermeq Kujalleq	Store Gletsjer
13	Sermeq Silarleq	Sermeq Silardleq
17	Kangilliup Sermia	Rink Isbræ
19	Salliarutsip Sermia	Inngia Isbræ
20	N/A	N/A
21	Sermeq	Upernavik Isstrøm
22	N/A	N/A
23	N/A	N/A
24	N/A	N/A
32	Ikissuup Sermersua	Cornell Gletsjer
34	Illullip Sermia	Igdlugdlip Sermia
35	Nunatakassaap Sermia	Alison Glacier
42	Kjer Gletsjer	N/A
46	Sverdrup Gletsjer	Sverdrup Brae
51	Nuussuup Sermia	Kong Oscar Gletsjer
65	Yngvar Nielsen Gletsjer	N/A
71	N/A	N/A
81	Qeqertaarsuusarsuup Sermia	Tracy Gletsjer