



# Antarctic Grounding Lines From COSMO-SkyMed X-Band DInSAR, 2020–2022, Version 1

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## USER GUIDE

### How to Cite These Data

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

Milillo, P. and N. Ross. 2026. *Antarctic Grounding Lines From COSMO-SkyMed X-Band DInSAR, 2020–2022, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.  
<https://doi.org/10.5067/BDGNK13MK73U>. [Date Accessed].

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National Snow and Ice Data Center

# TABLE OF CONTENTS

1	DATA DESCRIPTION .....	2
1.1	Summary .....	2
1.2	Parameters .....	2
1.3	File Information .....	2
1.3.1	Format .....	2
1.3.2	File Contents .....	2
1.3.3	Naming Convention .....	3
1.4	Spatial Information .....	4
1.4.1	Coverage .....	5
1.4.2	Resolution .....	5
1.4.3	Geolocation .....	5
1.5	Temporal Information .....	5
1.5.1	Coverage .....	5
1.5.2	Resolution .....	5
2	DATA ACQUISITION AND PROCESSING .....	5
2.1	Background .....	5
2.2	Acquisition .....	5
2.3	Processing .....	6
2.4	Quality, Errors, and Limitations .....	7
3	VERSION HISTORY .....	7
4	ACKNOWLEDGMENTS .....	7
5	REFERENCES .....	7
6	DOCUMENT INFORMATION .....	8
6.1	Publication Date .....	8
6.2	Date Last Updated .....	8
	APPENDIX A .....	8
	Glaciers/Ice Shelves by Geographic Region and Area .....	8

# 1 DATA DESCRIPTION

## 1.1 Summary

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This data set contains grounding lines for major glaciers and ice shelves in East Antarctica, West Antarctica, and the Antarctic Peninsula, plus corresponding Differential Interferometric Synthetic Aperture Radar (DInSAR) interferograms (phase and coherence), generated from X-band SAR data acquired by the COSMO-SkyMed mission between 30 April 2020 and 10 June 2022.

## 1.2 Parameters

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Antarctic glacier/ice shelf grounding lines

Interferometric Phase

Interferometric Coherence

## 1.3 File Information

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### 1.3.1 Format

ESRI shapefile

GeoTIFF

### 1.3.2 File Contents

All grounding lines are stored within a single ESRI shapefile. The grounding lines were manually mapped from interferograms generated from two pairs of SAR images. Images within a pair are separated by one day, while acquisition intervals between pairs are 16, 32, 48, or 64 days.

The grounding line shapefile includes the following attributes:

Table 1. Shapefile Attribute Names and Descriptions

Name	Description
Area code	Area identifier (1 – 18). See Figure A - 1 and Table A – 1 in Appendix A
Glaciers	Glacier(s) included in grounding line
Land	Antarctic region name. “Coats,” “Dronning Maud,” “Ellsworth,” “Enderby,” “George V,” “Graham,” “Marie Byrd,” “Victoria,” or “Wilkes.”
Location	Geographic region. “East,” “West,” or “Peninsula.”
Primary1	Acquisition date (YYYYMMDD), first, or “primary” image, pair 1

Name	Description
Secondary1	Acquisition date (YYYYMMDD), second, or “secondary” image, pair 1
Primary2	Acquisition date (YYYYMMDD), first, or “primary” image, pair 2
Secondary2	Acquisition date (YYYYMMDD), second, or “secondary” image, pair 2
DD	Acquisition date string from corresponding interferometric phase and coherence GeoTIFF file names. E.g., DD = “20210117_20210118-20210218_20210219”, with Area code = 3, corresponds to interferogram “NSIDC-0806_V01.0_A03_20210117_20210118-20210218_20210219_ifg” (See Table 2 below for details about the GeoTIFF file naming convention.).
Revisit	Revisit interval, defined as the number of days between Primary1 and Primary 2. Revisit intervals are multiples of 16 days from 16 to 64 days.
Time	Image acquisition time (HHMMSS)
Coherence	Average coherence of the corresponding interferogram, from 0.0 to 1.0.

The interferometric phase and coherence for each grounding line is available as separate GeoTIFF files.

### 1.3.3 Naming Convention

#### 1.3.3.1 Shapefile

An ESRI shapefile is a vector data storage format that comprises multiple files. The grounding lines shapefile for this data set is named “NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines,” which consists of the following files:

- NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines.shp (main file)
- NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines.shx (index file)
- NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines.dbf (dBase file)
- NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines.prj (projection definition file)
- NSIDC-0806\_V01.0\_20200430-20220610\_grounding-lines.cpg (codepage file)

“NSIDC-0806” in the file name is the data set’s authoritative ID at NSIDC, while “V01.0” indicates the major and minor version numbers: Version 1.0, the initial release. “20200430-20220610” refers to the data set temporal coverage (i.e., 30 April 2020 – 10 June 2022) using the YYYYMMDD date format.

#### 1.3.3.2 GeoTIFF Files

Each grounding line in the shapefile described above has a corresponding interferogram data granule that consists of two GeoTIFF files: one for the interferometric phase and a second for the coherence.

GeoTIFF files utilize the following naming convention:

## Example

NSIDC-0806\_V01.0\_A14\_20220524-20220525\_20220609-20220610\_ifg

↳ NSIDC-0806\_V01.0\_A14\_20220524\_20220525-20220609\_20220610\_ifg\_phase.tiff

↳ NSIDC-0806\_V01.0\_A14\_20220524\_20220525-20220609\_20220610\_ifg\_coh.tiff

## Convention

NSIDC-0806\_Vnn.n\_A[area code]\_[YYYYMMDD\_YYYYMMDD]-[yyyymmdd\_yyyyymmdd]\_ifg\_[type].[ext]

The following table describes the variables in the GeoTIFF file naming convention:

Table 2. GeoTIFF File Name Variables and Descriptions

Names	Description
NSIDC-0806	“Antarctic Grounding Lines From COSMO-SkyMed X-Band DInSAR, 2020–2022” data set
area	Area code (see Table A - 1 in “Appendix A   Glaciers/Ice Shelves by Geographic Region and Area”). E.g., “A01” is Area 1.
YYYYMMDD_YYYYMMDD	Image Pair 1 acquisition dates. E.g., “20220524_20220525” indicates the first SAR image in pair 1 was acquired on 24 May 2022 and the second on 25 May 2022.
yyyymmdd_yyyyymmdd	Image pair 2 acquisition dates. E.g., “20220609_20220610” indicates the first SAR image in pair 2 was acquired on 9 June 2022 and the second on 10 June 2022.
type	Phase (“phase”) or coherence (“coh”)
Vnn.n	Data set major (nn) and minor (n) version number. V01.0 indicates Version 1 (initial release).
ext	File extension. “tiff” = GeoTiff

## 1.4 Spatial Information

Grounding lines are provided for major glaciers and ice shelves in East Antarctica, West Antarctica, and the Antarctic Peninsula, grouped into 18 separate regions. Figure A - 1 in “Appendix A | Glaciers/Ice Shelves by Geographic Region” shows the locations of each region. Table A - 2 in the appendix lists the spatial coverage for each region.

## 1.4.1 Coverage

Northernmost: 65.283019° S

Southernmost: 80.800035° S

Easternmost: 164.932733° E

Westernmost: 142.976744° W

## 1.4.2 Resolution

50 m × 50 m

## 1.4.3 Geolocation

Data are provided in the WGS 84 / Antarctic Polar Stereographic ([EPSG:3031](#)) projection.

# 1.5 Temporal Information

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## 1.5.1 Coverage

30 April 2020 – 10 June 2022

## 1.5.2 Resolution

Interferograms were generated from two pairs of SAR images, with repeat acquisitions between pairs of 16, 32, 48, or 64 days.

# 2 DATA ACQUISITION AND PROCESSING

## 2.1 Background

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With its 3-cm-wavelength X-band radar and 1-day repeat pass, the COSMO-SkyMed (CSK) constellation can produce coherent DInSAR signals and accurate grounding lines maps for even fast-flowing Antarctic glaciers, thus overcoming key limitations of Sentinel data. However, the CSK constellation does not operate under an open data policy. This data set, derived exclusively from COSMO-SkyMed DInSAR, was created to expand the availability of freely accessible grounding lines to the scientific community.

## 2.2 Acquisition

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This data set was generated from SAR data acquired in horizontal transmit and horizontal receive mode by the CSK-2 and CSK-4 satellites. All SAR scenes were provided by the Italian Space Agency (ASI).

## 2.3 Processing

Each double-difference DInSAR interferogram (794 in total over) was generated using two pairs of SAR images. Images within each pair are separated by one day, with the first, or “primary” image acquired by the CSK-4 satellite and the second, or “secondary” image by CSK-2. The revisit interval between pairs, defined as the number of days between the two primary images, is an integer multiple of the satellites’ 16-day repeat cycle: 16, 32, 48, or 64 days.

Interferograms were processed using GAMMA software following the workflow schematic shown in Figure 1. As the DInSAR interferogram generation process reveals vertical motion, grounded ice appears as fringe-free areas, and grounding lines can be manually mapped by identifying the most inland fringe, i.e., where vertical glacier displacement is observed. A complete description of the methods used to generate this data set is available in Ross et al., 2025.

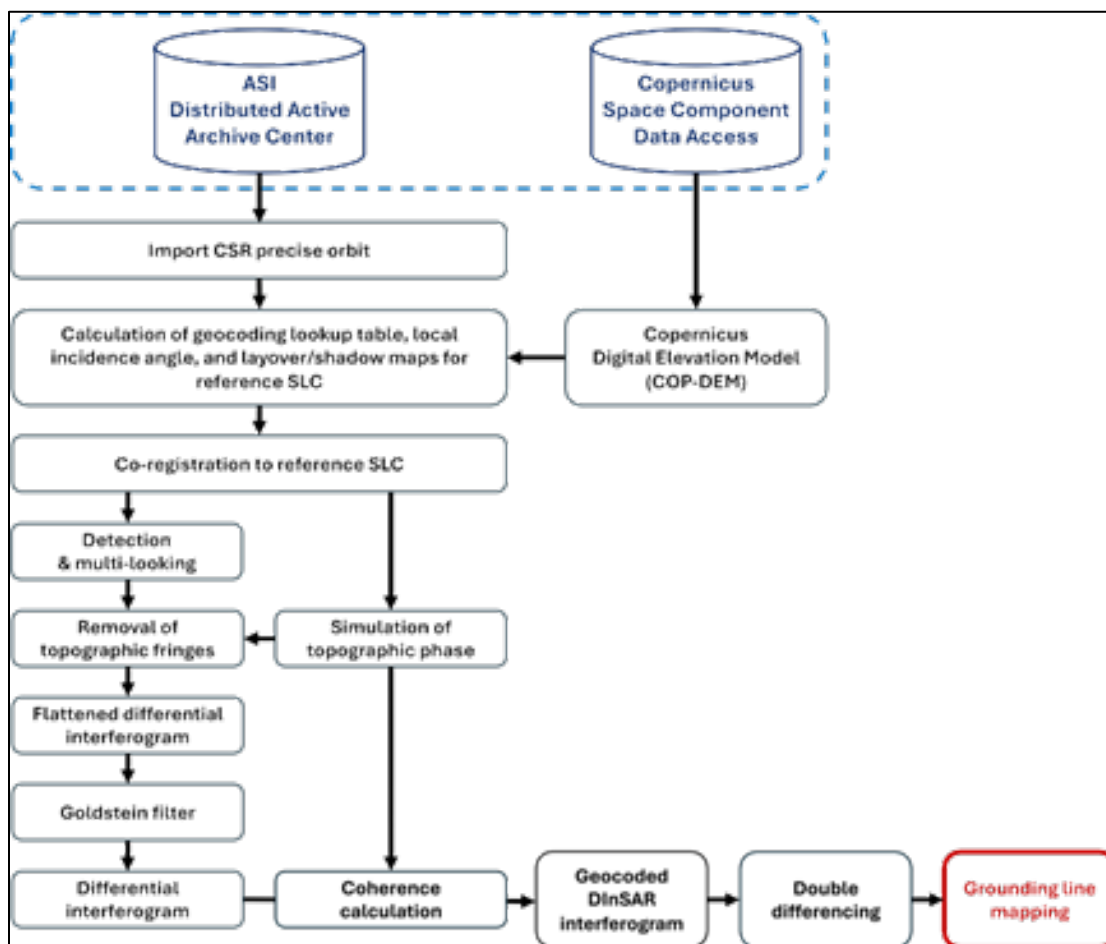


Figure 1. Data processing algorithm (Ross, et al., 2025)

## 2.4 Quality, Errors, and Limitations

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Coherence provides a quantitative metric of significant radar signal changes between acquisitions and can indicate the relative quality of an associated phase interferogram. For this data set, interferograms have an average coherence of 0.79 in West Antarctica; 0.81 in East Antarctica; and 0.76 in the Antarctic Peninsula.

The provided coherence interferograms offer a visual reference for determining the quality of their corresponding phase interferograms. In addition, the “coherence” attribute in the grounding lines shapefile reports the average coherence of the interferogram used to map the given grounding line.

Additional details are available in the “Technical Validation” section of Ross, et al.

## 3 VERSION HISTORY

Version 1 (initial release)

## 4 ACKNOWLEDGMENTS

### 4.1 Investigators

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The investigators wish to thank the Italian Space Agency (ASI<sup>1</sup>) for providing the COSMO-SkyMed data used to generate this data set.

## 5 REFERENCES

Ross, N., Milillo, P., & Dini, L. (2025). Antarctic grounding line delineation from the Italian Space Agency COSMO-SkyMed DInSAR data. *Scientific Data*, 12(1). <https://doi.org/10.1038/s41597-025-06023-3>

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<sup>1</sup>Agenzia Spaziale Italiana, Rome, Italy

## 6 DOCUMENT INFORMATION

### 6.1 Publication Date

June 2026

### 6.2 Date Last Updated

June 2026

## APPENDIX A

### Glaciers/Ice Shelves by Geographic Region and Area

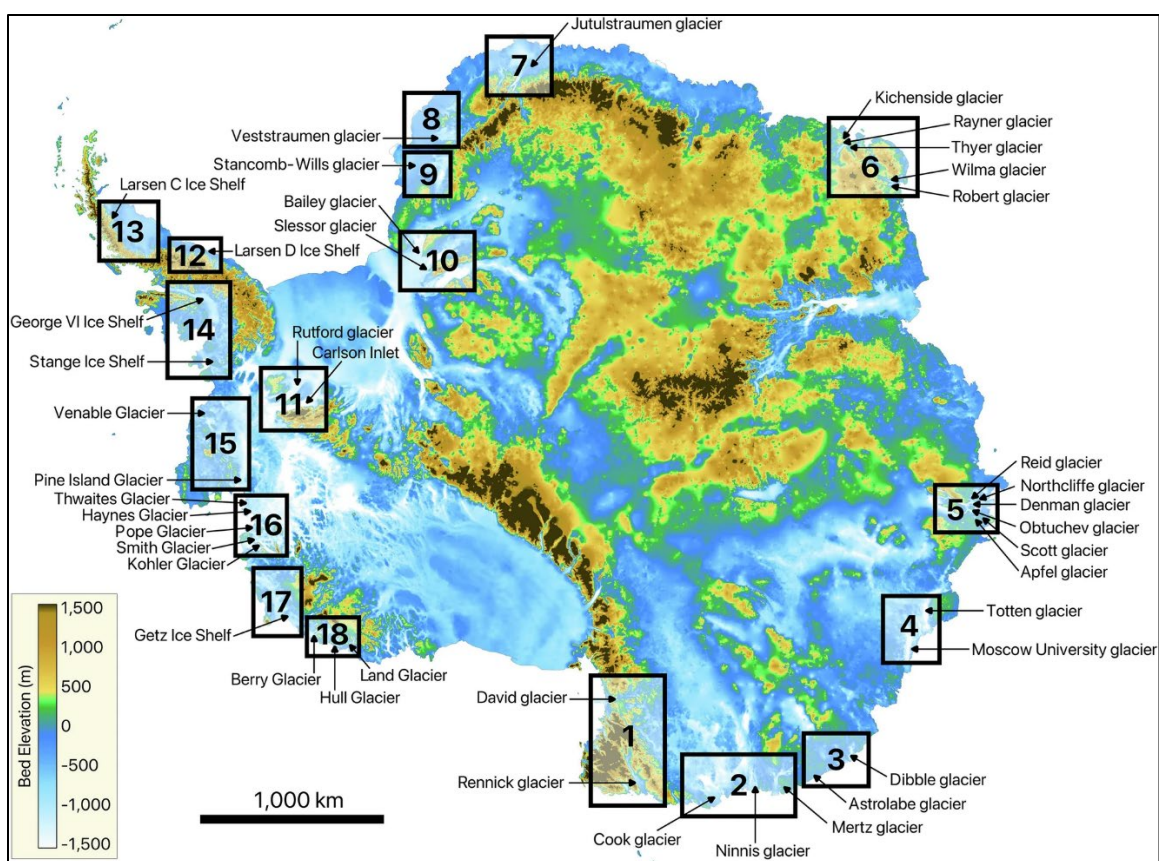


Figure A - 1. Glacier Locations By Area (Ross et al., 2025)

The following table, adapted from Ross et al., 2025, lists the total number of interferograms for each region in Figure A – 1 (above) as well as the names and number of grounding lines for each glacier/ice shelf in the region.

Table A - 1

Area	Interferograms	Glacier / Ice Shelf	Location	GL/Glacier
1	44	David	East	9
		Rennick	East	35
2	21	Cook	East	11
		Mertz	East	3
		Ninnis	East	7
3	30	Astrolabe	East	6
		Dibble	East	24
4	30	Moscow University	East	27
		Totten	East	3
5	11	Apfel, Denman, Northcliffe, Scott, Obtuchev, Reid	East	11
6	23	Robert, Wilma	East	14
		Rayner, Thyer, Kichenside	East	9
7	60	Jutulstraumen	East	60
8	38	Veststraumen	East	38
9	32	Stancomb-Wills	East	32
10	46	Bailey	East	46
		Slessor	East	
11	44	Carlson	West	12
		Rutford	West	32
12	20	Larsen D Ice Shelf	Peninsula	20
13	26	Larsen C Ice Shelf	Peninsula	26
14	168	George VI Ice Shelf, Stange Ice Shelf	Peninsula	168

Area	Interferograms	Glacier / Ice Shelf	Location	GL/Glacier
15	17	Venable	West	9
		Pine Island	West	8
16	45	Thwaites, Haynes, Pope, Smith East, Smith West, Kohler	West	45
17	80	Getz Ice Shelf	West	80
18	59	Berry	West	35
		Hull	West	4
		Land	West	20

Table A - 2. Spatial Coverage By Area

Area	Spatial Coverage
1	E: 160.548100, S: 70.042279 to E: 163.667233, S: 76.019250
2	E: 142.567517, S: 67.788806 to E: 154.051003 S: 68.492552
3	E: 132.250259, S: 66.441734 to E: 139.899851 S: 67.206825
4	E: 117.386901, S: 67.007226 to E: 122.188982 S: 67.281392
5	E: 98.251349, S: 65.868760 to E: 101.480672 S: 66.895037
6	E: 46.500241, S: 67.162457 to E: 57.140578 S: 67.907505
7	W: 2.338229, S: 72.364217 to E: 1.161683 S: 70.978101
8	W: 16.676576, S: 73.237093 to W: 13.400414 S: 74.961762
9	W: 16.131058, S: 75.051715 to W: 21.862558 S: 75.778063
10	W: 31.313189, S: 78.635275 to W: 29.334618 S: 80.800035
11	W: 78.155355, S: 77.170496 to W: 85.371511 S: 78.830970
12	W: 61.557967, S: 69.201519 to W: 63.031344 S: 72.471614
13	W: 62.205758, S: 65.283019 to W: 68.960531 S: 65.339881
14	W: 67.272814, S: 70.371562 to W: 79.390945 S: 74.581537
15	W: 101.390571, S: 75.552888 to W: 85.153526 S: 72.668170
16	W: 102.111776, S: 75.150651 to W: 114.658088 S: 75.330595
17	W: 33.569707, S: 74.589518 to W: 116.981690 S: 74.427708
18	W: 131.315660, S: 74.838375 to W: 142.976744 S: 75.579964