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

USER GUIDE

How to Cite These Data

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

Joughin, I. 2017. *MEaSUREs Greenland Image Mosaics from Sentinel-1A and -1B, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/8LCCSFWL7L28. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/nsidc-0723

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DATA DESCRIPTION

The mosaics are generated from the original source data, instrument parameters, and satellite orbital characteristics. The data have been mapped to grey scale values in the range of 0 - 255 (bytes) using a nonlinear stretch to allow visual discrimination of topographical features within the images. As a result, the pixel values for each year are only qualitatively comparable.

1.1 Parameters

The mosaics provided in this data set consist of uncalibrated C-SAR radar backscatter.

1.1.1 Parameter Description

In SAR applications, backscatter is the ratio between the power of a radar pulse transmitted to the target and the power scattered back towards the antenna.

1.1.2 Sample Data Record

Figure 1. Sample mosaic of data collected from 25 January 2015 to 02 February 2015 (file name: S1A_2015-01-25_2015-02-05_mosaic_v01.jpg). Contains modified Copernicus Sentinel data (2015-2017), acquired by the European Space Agency, distributed through the Alaska Satellite Facility, and processed by Joughin, I.

1.2 File Information

1.2.1 Format

The following formats are available in this data set:

- GeoTIFF (.tif)
- Shapefiles (.dbf, .prj, .shp, .shx)
- GDAL Virtual Data Set (.vrt)
- Image pyramids (.vrt.ovr)
- JPEG (.jpg)
- Extensible Markup Language (.jpg.aux.xml)
- Graphics Interchange Format (.gif)

1.2.2 Directory Structure

Data are available via HTTPS in the `https://daacdata.apps.nsidc.org/pub/DATASETS/nsidc0723_MEASURES_image_mosaics_v01/` directory. Within this directory are 84 folders and two video files (.gif). The folders are each named by year-month-day (YYYY-MM-DD), where the date corresponds to the first date of the mosaic epoch. The .gif files are named upernavik_v01.gif and greenland_v01.gif.

Each folder contains 12 files, where the date corresponds to the first date of the mosaic epoch. Each mosaic product spans either a 12- day (prior to 9/28/2016) or 6-day (starting 9/28/2016) period. Each mosaic is available in Geographic Tagged Image File Format (GeoTIFF) as a set of four tiles geographically divided by North, Northeast, Northwest, and South regions posted at 50 m, which is approximately equivalent to the image resolution after multi-look averaging. In addition, the following ancillary files are available:

- Shapefiles for each product that provide the dates for the individual images used in each mosaic. In addition to the date, the shapefile specifies the track (relative orbit), orbit (absolute orbit) and satellite (Sentinel 1A/B (S1A/B)).
- Geospatial Data Abstraction Library (GDAL) .vrt files, which allow the 50 m GeoTIFFs to be opened as a single file in geographical information system (GIS) programs
- OVR files (.vrt.ovr) that contain image pyramids to facilitate rapid viewing of the 50 m mosaics
- 1-km Quicklook images (.jpg and .jpg.aux.xml) that provide some geolocation information

1.2.3 Naming Convention

This section explains the file naming conventions with examples of each file type. Tables 1 through 3 describe the variables for each naming convention.

1.2.3.1 Shapefiles

Naming Convention: S1A/B_[start_date]_[end_date]_v01.[ext]

Example File Names:

- S1A_2015-01-01_2015-01-12_v01.dbf
- S1A_2015-01-01_2015-01-12_v01.prj
- S1A_2015-01-01_2015-01-12_v01.shp
- S1A_2015-01-01_2015-01-12_v01.shx

Table 1 describes the variables used in the Shapefile naming convention.

Table 1. Naming Convention for Shapefiles

Variable	Description
S1A/B	Indicates which Sentinel satellite provided the data: S1A=Sentinel 1A S1B=Sentinel 1B
start_date	date of first image used in the mosaic period (YYYY-MM-DD)
end_date	date of last image used in the mosaic period (YYYY-MM-DD)
v01	version number
.ext	File extension. The shapefile format consists of four files: .dbf (database file) .prj (projection information) .shp (shapes) .shx (shape indices)

1.2.3.2 Browse JPEGs and Metadata files, GDAL Virtual Files, and GDAL Image Pyramid Files

Naming Convention: S1A/B_[start_date]_[end_date]_mosaic_v01.[ext]

Example File Name:

- S1A_2015-01-01_2015-01-12_mosaic_v01.jpg
- S1A_2015-01-01_2015-01-12_mosaic_v01.vrt
- S1A_2015-01-01_2015-01-12_mosaic_v01.vrt.ovr
- S1A_2015-01-01_2015-01-12_mosaic_v01.jpg.aux.xml

Table 2 describes the variables used in this data set's Browse file naming convention.

Table 2. Naming Convention for Browse Files

Variable	Description
S1A/B	Indicates which Sentinel satellite provided the data: S1A=Sentinel 1A S1B=Sentinel 1B
start_date	date of first image used in the mosaic period (YYYY-MM-DD)
end_date	date of last image used in the mosaic period (YYYY-MM-DD)
mosaic	denotes that the file is a multiyear mosaic file
v01	version number
.ext	File extensions: .jpg (JPEG) .vrt (GDAL virtual format) .vrt.ovr (GDAL OVR pyramid format) .jpg.aux.xml (Extensible Markup Language)

1.2.3.3 GeoTIFFS

Naming Convention: S1A/B_[start_date]_[end_date]_[region]_v01.tif

Example File Names:

- S1A_2015-01-01_2015-01-12_south_v01.tif
- S1A_2015-01-01_2015-01-12_northwest_v01.tif
- S1A_2015-01-01_2015-01-12_northeast_v01.tif
- S1A_2015-01-01_2015-01-12_north_v01.tif

Table 3 describes the variables used in this data set's GeoTIFF file naming convention.

Table 3. Naming Convention for GeoTIFF Files

Variable	Description
S1A/B	Indicates which Sentinel satellite provided the data: S1A=Sentinel 1A (1 January 2015 to 27 September 2016) S1B=Sentinel 1B (28 September 2016 to 01 April 2017)
start_date	date of first image used in the mosaic period (YYYY-MM-DD)
end_date	date of last image used in the mosaic period (YYYY-MM-DD)
region	regions of Greenland: north, northeast, northwest, or south
v01	version number

1.2.4 File Size

File sizes vary depending upon file types:

- GeoTIFF (.tif) files range from 16 MB to 195.4 MB
- Browse images (.jpg) range from 83 KB to 365 KB
- Geolocation (jpg.aux.xml) files are 1 KB each
- Shapefiles range from 1 KB to 2 KB
- GDAL virtual (.vrt) files are 3 KB each
- GDAL OVR (.vrt.ovr) files are approximately 503 MB

1.2.5 Volume

The total data volume of this data set is 52 GB.

1.3 Spatial Information

1.3.1 Coverage

The study area lies within the following bounding box:

- Southernmost Latitude: 60° N
- Northernmost Latitude: 82° N
- Easternmost Longitude: 20° W
- Westernmost Longitude: 70° W

1.3.2 Resolution

Spatial resolution is 50 m x 50 m.

1.3.3 Projection and Grid Description

1.3.3.1 Projection

GeoTIFFs are provided in a polar stereographic grid with a standard latitude of 70° N and rotation angle of -45° (sometimes specified as a longitude of 45° W). With this convention, the y-axis extends south from the North Pole along the 45° W meridian (EPSG 3413).

1.3.3.2 Grid

The 50 m mosaics are provided as a set of 4 tiles, divided and named by geographic region: North, Northeast, Northwest, South.

1.4 Temporal Information

1.4.1 Coverage

The temporal coverage for this data set is from 01 January 2015 to 01 April 2017.

1.4.2 Resolution

Temporal resolution for data acquired between 01 January 2015 to 27 September 2016 is 12 days.

The resolution for data acquired from 28 September 2016 through 01 April 2017 is 6 days.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The interactions between radar signals and the ground depend upon many factors, such as the density and dielectric properties of surface materials, vegetation cover, surface roughness at the scale of the signal's wavelength, topographic variations, and the instrument's look angle and signal polarization. The image resolution is particularly affected by signal strength, chirp pulse length and bandwidth, return signal integration time, and the time between pulse transmissions.

For a detailed discussion of SAR theory, see SAR Theory/Interpreting Images (PDF, 82.4 KB). For general information about the mathematical derivations and theories behind SAR processing algorithms, see Scientific SAR User's Guide (PDF, 296 KB).

2.2 Acquisition

Copernicus Sentinel-1A and -1B satellite imagery were acquired by the European Space Agency (ESA) and archived and distributed through the Alaska Satellite Facility.

2.3 Processing

The Alaska Satellite Facility provided all source data as Level-1 burst Single-Look Complex (SLC) data, including digitized voltage values, instrument calibration constants, satellite timing, attitude, and position information. The SLC burst data were processed to full multi-burst SLC scenes using the GAMMA Modular SAR Processor (MSP) package.

The data have been mapped to grey scale values in the range of 0 - 255 (bytes) using a nonlinear stretch to allow visual discrimination of topographical features within the images. As a result, the

pixel values for each year are not directly comparable; however, if no change has occurred, they should be relatively consistent from scene to scene.

The mosaics are produced from four descending and two ascending tracks. In some cases, the image tracks overlapped, but at any given pixel, only one image was used. If the overlapping images were ascending (Tracks 74 and 90) and descending (Tracks 26, 112, 141, 170), the descending image was used (see the shapefile attribute field to determine track direction). If two parallel images overlapped, the top polygon in the shapefile should correspond to the image that was included in the mosaic. In some locations, it is possible that one mosaic will have ascending geometry and another descending geometry because of missed acquisitions (i.e., a consistent geometry is used whenever sufficient data are acquired). In such areas, mountains and other topography features will appear to be illuminated from opposite sides. If the images are flickered between, the different viewing geometries can give the impression of large shifts, even though the data are generally well registered. For regions with like-viewing geometry, the co-registration is far better than the 50-m posting, except in cases where the topography is extreme.

In instances where no viable data were available, a blank mosaic was generated.

2.4 Quality, Errors, and Limitations

2.4.1 Error Sources

Except in regions of extreme terrain, geometric accuracy is better than a single 50 m pixel (Joughin et al, 2016).

2.4.2 Terrain Correction

The data were terrain corrected with MEaSUREs Greenland Ice Mapping Project (GIMP) Digital Elevation Model, Version 1, (Joughin et al, 2016). Due to this correction, some slight differences in registration relative to MEaSUREs Greenland Ice Sheet Mosaics from SAR Data, Version 1 mosaics exist.

2.5 Instrumentation

2.5.1 Description

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

3 SOFTWARE AND TOOLS

GeoTIFF files can be viewed with a variety of Geographic Information System (GIS) software packages including:

Blue Marble Geographics Global Mapper
QGIS
GDAL
Esri ArcGIS

For details about the shapefile format, see the ESRI Shapefile Technical Description white paper (PDF, 124 KB). The VRT format is discussed in detail on the GDAL Virtual Format Tutorial Web page. The ArcGIS Resource Center's Raster Pyramids and OVR Pyramid Files help pages provide more information about raster data set downsampling.

4 RELATED DATA SETS

Greenland Ice Sheet Mapping Project (GIMP)

5 RELATED WEBSITES

MEaSUREs at NSIDC | Overview

6 CONTACTS AND ACKNOWLEDGMENTS

Dr. Ian Joughin
University of Washington
Applied Physics Laboratory
1013 NE 40th Street
Box 355640
Seattle, Washington 98105
USA

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7 REFERENCES

Joughin, I., B. E. Smith, I. M. Howat, T. Moon, and T. A. Scambos. 2016. A SAR record of early 21st century change in Greenland. *Journal of Glaciology* 62(231): 62–71. doi: http://dx.doi.org/10.1017/jog.2016.10.

8 DOCUMENT INFORMATION

8.1 Publication Date

June 2017

8.2 Date Last Updated

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