MEaSUREs InSAR-Based Ice Velocity Maps of Central Antarctica: 1997 and 2009, Version 1

USER GUIDE

How to Cite These Data

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

Scheuchl, B., J. Mouginot, and E. Rignot. 2012. *MEaSUREs InSAR-Based Ice Velocity Maps of Central Antarctica: 1997 and 2009, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/MEASURES/CRYOSPHERE/nsidc-0525.001. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/nsidc-0525

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

Data are provided in the following formats:

- Binary (.dat) with an ENVI text header (.hdr)
- NetCDF (.nc)

1.2 File and Directory Structure

Data are available on the HTTPS site in the https://n5eil01u.ecs.nsidc.org/MEASURES/NSIDC-0525.001/ directory. Data files are stored in the ../1997/ and ../2009/ subdirectories. Table 1 provides a list of the available files along with descriptions. Note that YYYY in the file name stands for either 1997 or 2009. For example, Central_Antarctica_ice_velocity_1997.nc is a NetCDF file containing the 1997 data set:

Table 1. File names and descriptions

File Name	Description
Central_Antarctica_ice_velocity_YYYY_binary.dat	Binary file (big endian) with velocities
Central_Antarctica_ice_velocity_YYYY_error.dat	Binary file (big endian) with error estimates
Central_Antarctica_ice_velocity_YYYY_binary.hdr	ENVI header file for corresponding velocity .dat file
Central_Antarctica_ice_velocity_YYYY_error.hdr	ENVI header file for corresponding error .dat file
Central_Antarctica_ice_velocity_YYYY_info.txt	ASCII text file with additional information
Central_Antarctica_ice_velocity_YYYY.nc	NetCDF file

1.3 File Size

Files range in size from 3 KB to approximately 90 MB.

1.4 Volume

The total size of all data files is approximately 360 MB.

1.5 Spatial Coverage

This data set spans the continent of Antarctica:

Southernmost Latitude: 90° S
Northernmost Latitude: 72° S
Westernmost Latitude: 180° W
Easternmost Latitude: 180° E

See Figure 1 below for a map that shows the spatial coverage.

1.5.1 Spatial Resolution

Data are provided at 900 m spacing.

1.5.2 Projection and Grid Description

The velocity map is provided in Polar Stereographic Projection with a latitude of true scale at 71° S.

1.6 Temporal Coverage

The mosaics were assembled from RADARSAT-1 data that was acquired in 1997 and RADARSAT-2 data acquired in 2009. See Table 3 for a description of the temporal and spatial coverage of the satellite source data.

1.7 Parameter or Variable

These maps provide ice velocity data for Central Antarctica for the years 1997 and 2009, at 900 m spacing. Each data point contains information on the velocity in meters per year in the x and y direction, as defined by the polar stereographic grid (vx and vy respectively). An error estimate for the velocity magnitude is also provided. These estimates, however, should be used more as an indication of relative quality rather than absolute error. Additional information on the error estimates is provided in the 3.3.1 section below as well as in Rignot et al., 2011b and Mouginot et al., 2012.

1.7.1 Variable Description

Table 2 contains descriptions for each of the variables in this data set:

Table 2. Variable Descriptions

Variable	Description
vx	Ice Velocity in the x-direction (m/yr)
vy	Ice Velocity in the y-direction (m/yr)
err	Estimated error in velocity (m/yr)

1.7.2 Sample Data Record

In Figure 1, Panels a and b are low-resolution versions of the digital mosaics of ice motion in Central Antarctica: (a) RADARSAT-2 in 2009 (b) overlaid on the MODIS Mosaic of Antarctica and color coded on a logarithmic scale. Panel c shows the difference in speed for the region. Blue tones indicate a deceleration, red tones indicate an acceleration. The dark red regions in the ice shelf edges (Ross Ice Shelf near Roosevelt Island and Filchner Ice Shelf) indicate pre-calving events (Scheuchl et al., 2012).

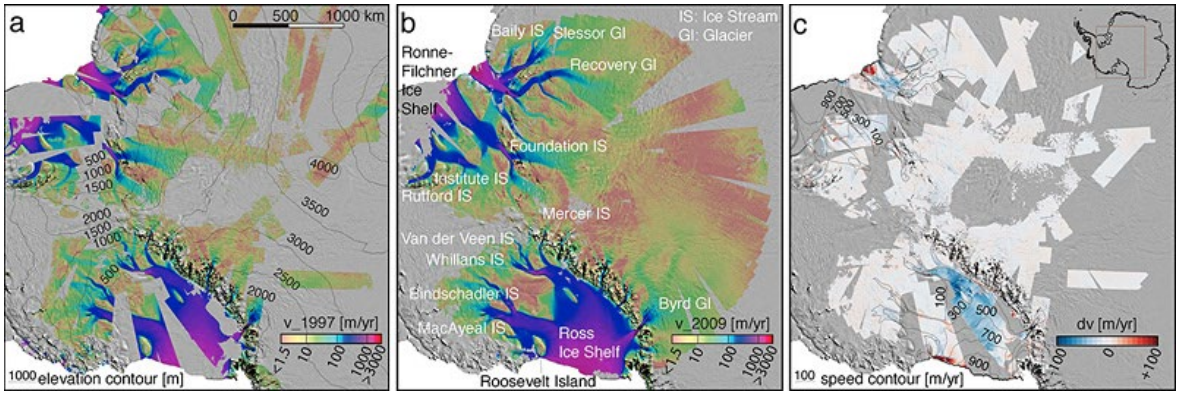

Figure 1. Satellite Radar Interferometry Based Ice Surface Velocity Maps for Central Antarctica Derived using Data from RADARSAT-1 in 1997

2 SOFTWARE AND TOOLS

2.1 Software and Tools

The data may be accessed using a variety of software tools. For more information about accessing NetCDF files and a list of resources, visit NetCDF Resources at NSIDC.

2.2 Quality Assessment

A detailed description and quality assessment of this product are provided in Scheuchl et al. (2012).

3 DATA ACQUISITION AND PROCESSING

3.1 Theory of Measurements

These data sets were generated using a speckle tracking technique (Michel and Rignot, 1999) to derive slant range and azimuth displacements from the InSAR data. The quality of the result was further improved for areas of slow flow where the unwrapped interferometric phase of tracks can be

used in range instead of range offsets from speckle tracking (Rignot et al., 2011b). Assuming surface parallel flow, a digital elevation model was used to calculate the two-dimensional displacement field. Tide correction (per track) and velocity calibration (per track and using multiple tracks together) was applied to obtain the two-dimensional ice velocity. The method is described in Rignot et al., 2011b and Mouginot et al., 2012, with a detailed discussion of the tide correction in Scheuchl et al., 2012. Three data cycles are available in 2009. The resulting two velocity products per track were combined to reduce data noise.

3.2 Data Acquisition Methods

Ice velocities for the Antarctic Ice Sheet were derived from satellite synthetic aperture radar interferometry (InSAR) data acquired in:

- 1997 by RADARSAT-1, a satellite developed by the Canadian Space Agency (CSA);
- 2009 by RADARSAT-2, a collaboration between CSA and MacDonald, Dettwiler and Associates Ltd.

RADARSAT-1 data acquisitions were made between 9 September and 20 October 1997 as part of the first Antarctic Mapping Mission (AMM). RADARSAT-2 data acquisitions in 2009 represent the first, and so far only, complete coverage of Central Antarctica with interferometric SAR data and were part of a multi-SAR-sensor effort to provide interferometric SAR coverage of the entire Antarctic continent during the International Polar Year (IPY). RADARSAT-2 data acquisitions in 2009 were coordinated through the IPY Space Task Group.

The final mosaics represent 102 (1997) and 128 (2009) satellite tracks and more than 500 orbits of radar data. Table 3 describes the data sources used in this data set:

Table 3. Temporal and spatial coverage of source satellite data (Scheuchl et al., 2012)

RADARSAT-1 (1997)	**ST2**	**ST3**	**ST4**	**ST5**	**ST6**	**ST7**
Range Spacing	8.1 m	11.6 m	11.6 m	11.6 m	11.6 m	11.6 m
Azimuth Spacing	5.3 m	5.0 m	5.1 m	5.2 m	5.0 m	5.2 m
Incidence Angle	28.0°	34.1°	36.7°	39.5°	44.3°	47.2°
Number of Tracks	46	10	12	12	9	13
RADARSAT-2 (2009)			**ST5**	**EH4**		
Range Spacing			11.8 m	11.8 m		
Azimuth Spacing			5.1 m	5.1 m		
Incidence Angle			41.3°	57.0°		
Number of Tracks			43	85		
Coverage (lat)			77.5° to 87°	86.5° to Pole		

3.3 Derivation Techniques and Algorithms

3.3.1 Error Sources

The precision of ice flow mapping varies with the geographic location, the technique of interferometric analysis, the time period of analysis, the repeat cycle, and the amount of data stacking. Refer to 3 for futher details. The error estimates for both RADARSAT-1 and RADARSAT-2 are given at ±6 m/year, with the largest contribution from ionospheric perturbations (Rignot et al., 2011b). Error estimates provided with this data set take into account the following sources:

- error of speckle tracking and interferometric phase analysis, respectively
- errors caused by ionospheric perturbations (strongest in the azimuth direction, stronger in EAIS compared to WAIS because ionospheric perturbations are more abundant near the magnetic pole)
- data stacking (reduces the error noise as the square root of the number of interferometric pairs averaged)
- respective weight of each instrument in the mosaicking

The total error is computed as the square root of the sum of the independent errors squared. More details on the error estimates are provided in Rignot et al. (2011b) and Mouginot et al. (2012).

4 REFERENCES AND RELATED PUBLICATIONS

Michel, R., and E. Rignot. 1999. Flow of Glaciar Moreno, Argentina, from Repeat-Pass Shuttle Imaging Radar Images: Comparison of the Phase Correlation Method with Radar Interferometry*, J. Glaciol*. 45, 93100.

Mouginot, J., E. Rignot, and B. Scheuchl. 2012 (in revision). Mapping of Ice Motion in Antarctica Using Interfero-Metric Synthetic-Aperture Radar Data, *Remote Sensing.*

Rignot, E., J. Mouginot, and B. Scheuchl. 2011a. Antarctic Grounding Line Mapping from Differential Satellite Radar Interferometry, *Geophys. Res. Lett.,* 38, L10504, doi: 10.1029/2011GL047109.

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Scheuchl, B., J. Mouginot, and E. Rignot. 2012 (in press). Ice velocity Changes in the Ross and Ronne Sectors Observed Using Satellite Radar Data from 1997 and 2009, *The Cryosphere*. doi: 10.5194/tc-6-1019-2012.

4.1 RELATED DATA COLLECTIONS

- MEaSUREs InSAR-Based Antarctica Ice Velocity Map
- MEaSUREs Antarctic Grounding Line from Differential Satellite Radar Interferometry
- NASA MEaSUREs Data at NSIDC
- The Antarctic Glaciological Data Center (AGDC) at NSIDC

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- The Canadian Space Agency and MacDonald, Dettwiler and Associates Ltd. (RADARSAT-2)

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6 DOCUMENT INFORMATION

6.1 DOCUMENT CREATION DATE

19 September 2012

6.2 DOCUMENT REVISION DATE

20 December 2021