Two-dimensional Velocities of Ice Mélange from Jakobshavn Isbræ, Greenland, Version 1

USER GUIDE

How to Cite These Data

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

Cassotto, R., M. Truffer, M. Fahnestock, J. Amundson, and J. C. Burton. 2021. *Two-dimensional Velocities of Ice Mélange from Jakobshavn Isbræ, Greenland, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/FKPL8IY02XWS. [Date Accessed].

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National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set provides velocity components and resolved speeds for the proglacial ice mélange at Jakobshavn Glacier, Greenland. The data were collected using terrestrial radar interferometry (TRI) at 3-minute intervals for the nine-day period from 01 August 2012 to 09 August 2012. An ice mélange is defined as a tightly packed collection of ice bergs and sea ice which abut the terminus of a glacier.

1.1 Parameters

The parameters for this data set include:

Ice flow velocities, vx and vy and the magnitude of velocity, vv in meters per day of ice mélanges for the proglacial fjord at Jakobshavn Ibrae's Glacier, Greenland.

1.2 File Information

1.2.1 Format

NetCDF (.nc) using CF 1.7, Climate and Forecast, metadata conventions.

1.2.2 File Contents

The following table provides a description of the variables found in the NetCDF file for this data set.

Table 1. File Variables and Descriptions

Variable	Description
time	Midpoint of 3-minute sample interval (seconds since 2012-08-1)
time_bnds	Start and end time of each 3-minute sample period
transverse_mercator	Coordinate reference system definition (see geolocation section for details)
vv	Velocity magnitude meters/day
vx	Velocity in the x direction (east); meters/day.
vy	Velocity in the y direction (north); meters/day
x	X-coordinate in Cartesian system
y	Y-coordinate in Cartesian system

1.2.3 Naming Convention

This data set contains one file named, "`melange_velocities_20120801_20120809_v01.nc`"

Table 2. File Name Variables and Descriptions

Variable	Description
melange_velocities	parameter measured
20120801	Start date of data sampling in the format: YYYYMMDD
20120809	End date of data sampling in the format: YYYYMMDD
v01	Data set version number in the format: v0#
.nc	NetCDF file extension

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 69.25°
Southernmost Longitude: 69.12°
Westernmost Longitude: 50.02°
Easternmost Longitude: 49.51°

1.3.2 Resolution

15 m

1.3.3 Geolocation

The following tables provide information for geolocating this data set

Table 3. Transverse Mercator EPSG: 32622

Geographic coordinate system	WGS 84
Projected coordinate system	WGS 84 / UTM zone 22N Transverse Mercator
Longitude of true origin	-51
Latitude of true origin	0
Scale factor at longitude of true origin	0.9996
Datum	World Geodetic System 1984
Ellipsoid/spheroid	WGS 84
Units	meters
False easting	500000

False northing	0
EPSG code	32622
PROJ4 string	proj4.defs("EPSG:32622","+proj=utm +zone=22 +datum=WGS84 +units=m +no_defs");
Reference	https://epsg.io/32622

Table 4. Grid Details

Grid cell size (x, y pixel dimensions)	15 m x 15 m
Number of rows	1388
Number of columns	997
Geolocated lower left point in grid	N/A

1.4 Temporal Information

1.4.1 Coverage

01 August 2021 to 09 August 2012

1.4.2 Resolution

3-minute intervals

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Ice mélange comprises a densely packed mixture of sea ice and iceberg ‘grains’, up to 1,000 m or more in length (Cassotto et. al., 2021), which abut the terminus of a glacier. Ice mélange rheology – granular interactions among the sea ice and individual icebergs within an ice mélange – can affect tidewater glacier calving and dynamic mass loss from major ice sheets.

This data set exploits recent developments in terrestrial radar interferometers (TRIs) to observe grain-scale ice mélange dynamics before and after calving events.

2.2 Acquisition

At Jakobshavn Isbræ, a perennial ice mélange in the inner fjord extends more than 10 km from the glacier’s calving face. Two GPS-synchronized TRIs with substantially overlapping fields of view, placed approximately 1.9 km apart along the southern fjord wall, scanned the glacier terminus and

ice mélange every 3 minutes from 01 August 2012 to 09 August 2012. Scan times were synchronized using GPS time codes.

2.3 Processing

Raw data from each TRI were processed independently to single-look complex images, multi-looked by 15 in range (to an effective range resolution of 11.25 m), and used to create 3-minute displacement interferograms. The interferograms were then filtered using an adaptive filter and unwrapped (converted from relative phase measurements to absolute phase displacements) using a minimum cost flow technique.

Although this technique unwrapped the majority of interferograms cleanly and consistently, some unwrapping errors of 1–2 integer cycle slips occurred. These errors were corrected by calculating a smoothing spline, fit to the shorter of daily intervals or inter-calving periods, and applying it to each pixel in the unwrapped interferograms.

After the phase unwrapping errors were corrected, observed displacements were converted to line-of-sight (LOS) speeds. The resulting 2,397 interferogram pairs were used to create 2D velocity fields with northing and easting velocity components (Voytenko et al., 2017) which were then converted into speeds in the direction of flow (i.e., non-LOS).

To remove geometric distortions that occur when the radars have similar look angles, the phase-based velocities were scaled by using image correlation software to compute mean velocities from radar backscatter images that were unaffected by LOS geometry issues. This scaling is described in detail in the “Methods” section of Cassotto et al., (2021).

To produce the final maps, scaled speeds were reprojected to UTM zone 22N and posted to a 15 m x 15 m grid.

2.4 Quality, Errors, and Limitations

Mélange speeds are estimated to be accurate within ±2.8 m/day, based on comparisons with image-correlation derived speeds. Shear margins, where differences of 10 m/day were typical, were excluded from the error analysis, as they are challenging for image-to-image correlation and lie outside the main ice mélange (See “Methods,” Cassotto et al., (2021).

In addition, a small fraction of isolated pixels contain noise that appear as exceedingly high velocities (e.g., 10’s km/day).

Lastly, the splining approach used to correct unwrapping errors produces smoothly varying velocity fields but at the expense of obscuring transient signals due to rolling icebergs or calving events from the terminus.

The following are mean velocities with standard deviations for this data set:

Table 5. Mean and Standard Deviation Values for Velocity Parameters

Parameter	Mean (meters/day)	Standard Deviation (meters/day)
vx	-42	38
vy	13	19
vv	46	40

2.5 Instrumentation

2.5.1 Description

GAMMA Remote Sensing Ground Portable Radar Interferometers (GPRI-II), a real-aperture Ku-band instrument with a wavelength of 1.74 cm and range of 16 km.

3 SOFTWARE AND TOOLS

Use Panoply or similar software to access the data.

4 CONTACTS AND ACKNOWLEDGMENTS

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5 REFERENCES

Cassotto, R.K., Burton, J.C., Amundson, J.M. et al. (2021). Granular decoherence precedes ice mélange failure and glacier calving at Jakobshavn Isbræ. *Nature Geoscience* 14, 417–422. https://doi.org/10.1038/s41561-021-00754-9

Voytenko, D. et al. (2017). Acquisition of a 3 min, two-dimensional glacier velocity field with terrestrial radar interferometry. *Journal of Glaciology* 63, 629–636. https://doi.org/10.1017/jog.2017.28

6 DOCUMENT INFORMATION

6.1 Publication Date

02 August 2021