Sentinel-1 ice surface velocities of Svalbard (https://doi.org/10.5880/fidgeo.2021.016)

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Table of contents

3. Data Description

The data set comprises Sentinel-1 scene pair-velocity fields, as well as monthly and annually averaged velocity mosaics over Svalbard for the period January 2015 - November 2020. The data are provided as GeoTIFF rasters in UTM (scene-pair velocity fields) and polar stereographic north (mosaics) coordinate reference systems at a spatial resolution of 200 m and were derived by applying a well-established intensity offset tracking algorithm (Strozzi et al., 2002; Wegmüller et al., 2016; Friedl et al., 2018; Wendleder et al., 2018; Seehaus et al., 2018). For tracking, we used consecutive pairs of single or dual polarized Sentinel-1 SLC (Single Look Complex) TOPS (Terrain Observation with Progressive Scans in azimuth) SAR (Synthetic Aperture Radar) images recorded in IW (Interferometric Wide swath) mode at a pixel spacing of ~14 m in azimuth (az) and ~3 m in range (r), and a spatial coverage of ~250 x 250 km. For the time from 2015 to 2016, Sentinel-1 imagery is available at a minimum repeat cycle of 12 days and from 2016 onward at a minimum repeat cycle of 6 days.

1.1. Sampling method

The Sentinel-1 data were obtained from the ASF (Alaska Satellite Facility) DAAC (Distributed Active Archive Center), https://search.asf.alaska.edu. In case of dual polarized acquisitions (HH+HV or VV+VH), we only used the HH or VV channels for the processing.

1.2. Data processing

Scene pair-velocity fields were generated by applying intensity offset tracking (feature tracking and speckle tracking) on two subsequent Sentinel-1 images (master and slave scene), using a window size of 250 x 50 pixels and a step size of 50 x 10 pixels. The results were (1) UTM-geocoded and orthorectified with the help of an external digital elevation model (3 arc second TanDEM-X Global DEM, Wessel et al., 2018), (2) filtered with an effective three-step filter approach (Lüttig et al., 2017) that removes > 99% of erroneous measurements and (3) corrected for remaining coregistration errors based on the median of the filtered range- and the azimuth-velocities measured over ice-free ground. The effective time stamp of each velocity field is derived as the mean date of the acquisition dates of the master and the slave scene.

Annual and monthly mosaics were derived from all filtered and corrected scene pair-velocity products that have a time stamp between 1 January–31 December of a year and between the first and the last day of a month, respectively. Before mosaicking, all scene-pair velocity fields were reprojected to polar stereographic north. We calculated the weighted means of the x- and y-velocity components, the velocity magnitude, the acquisition date, the time separation between the images, the displacement angle relative to true north, as well as the number of measurements per pixel. Additionally, we calculated the weighted standard deviation and the weighted standard error for the x and y velocity components, as well as the velocity magnitude. For averaging we took the SNR (Signal to Noise Ratio) of each velocity measurement pixel as weight.

4. File description

Scene pair-velocity products and mosaics are provided as GeoTIFF rasters. The coverage files, containing the footprints of the Sentinel-1 scenes, are provided as shapefiles (.shp). The corresponding metadatafiles are text files (.txt). Quicklooks of the scene pair-velocities and the mosaics magnitudes ($m\ d^{-1}$) are in .png format.

1.3. File inventory

The data are organized in three main folders: (1) Scene_Pair_Velocities, (2) Mosaics and (3) Coverage.

The Scene_Pair_Velocity folder contains subfolders for each orbit (Orbit_xxx), Frame (Frame_xxx) and scene pair-velocity (region ID_orbit_frame_mean date). Each scene pair-velocity folder contains a metadatafile (.txt) and a quicklook (.png), as well as two subfolders: (1) results and (2) coverage. The results folder contains the scene pair-velocity products in GeoTIFF format. The coverage folder contains a shapefile of the footprint of the velocity products.

The Mosaics folder contains two subfolders: (1) Annual_Mosaics and (2) Monthly_Mosaics. The Annual_Mosaics folder contains all annual velocity mosaic rasters (.tif), quicklooks (.png) and metadata files (.txt). The Monthly_Mosaics contains all monthly mosaic rasters (.tif), quicklooks (.png) and metadata files (.txt).

The Coverage folder contains a shapefile of all Sentinel-1 footprints that have been used to generate the data set. The shapefile contains the corresponding orbit and frame of each footprint as attributes, and can be used to conduct spatial data searches.

1.4. File naming convention

The scene pair-velocity products and the mosaics follow the naming conventions shown in **Table 1.**

Scene-pair velocity products

dis_mag+S1_20200417T061446_0505_1_9_1_9_1_9_S1_20200423T061528_5275_1_9_1_9_1_9+250-50_50-10_0.00-0.08_2_geo_filtered_corrected.tif

a) b) c) d) e)

a) Product type:

dis_mag: velocity magnitude (m d^{-1})
dis_az: azimuth velocity component (m d^{-1})
dis_r: range velocity component (m d^{-1})
dis_ang: displacement angle relative to the sensor's heading angle
dis_N_ang: displacement angle relative to true north
ccp: cross-correlation peak coefficient
ccs: cross correlation function standard deviation
loc_inc: local incidence angle

b) Master scene: S1_yyyymmddThhmmss_Product UID_burst start (sub-swath 1-3)_burst stop (sub-swath 1-3)

c) Slave scene: S1_yyyymmddThhmmss_Product UID_burst start (sub-swath 1-3)_burst stop (sub-swath 1-3)

d) Processing parameters:

window size (r)–window size (az)_step size (r)–step size (az)_initial ccp threshold–final ccp threshold_oversampling factor

e) Processing level:

geo: geocoded
geo_filtered: geocoded and filtered
geo_filtered_corrected: geocoded, filtered and corrected

Mosaics

07_mag_stack_2020_04.tif

a) b) c)

a) Region: Region number (see Fig. 1)

b) Product type:

mag_stack: weighted mean of the velocity magnitude (m d^{-1})
mag_sd_stack: weighted standard deviation of the velocity magnitude (m d^{-1})
mag_se_stack: weighted standard error of the velocity magnitude (m d^{-1})
y_stack: weighted mean of the y velocity component (m d^{-1})
y_sd_stack: weighted standard deviation of the y velocity component (m d^{-1})
y_se_stack: weighted standard error of the y velocity component (m d^{-1})
x_stack: weighted mean of the x velocity component (m d^{-1})
x_sd_stack: weighted standard deviation of the x velocity component (m d^{-1})
x_se_stack: weighted standard error of the y velocity component (m d^{-1})
N_ang_stack: mean displacement angle relative to true north
count_stack: number of measurements per pixel
date_stack: mean acquisition date per pixel (days since 1 January 1900)
time_sep_stack: mean time separation per pixel (days)

c) Date: yyyy (annual mosaic), yyyy_mm (monthly mosaic)

5. References

Friedl, P., Seehaus, T. C., Wendt, A., Braun, M. H., and Höppner, K. (2018): Recent dynamic changes on Fleming Glacier after the disintegration of Wordie Ice Shelf, Antarctic Peninsula, The Cryosphere, 12, 1347–1365, https://doi.org/10.5194/tc-12-1347-2018

Lüttig, C., Neckel, N., and Humbert, A. (2017): A Combined Approach for Filtering Ice Surface Velocity Fields Derived from Remote Sensing Methods, Remote Sensing, 9, 1062, https://doi.org/10.3390/rs9101062

Seehaus, T., Cook, A. J., Silva, A. B., and Braun, M. (2018): Changes in glacier dynamics in the northern Antarctic Peninsula since 1985, The Cryosphere, 12, 577–594, https://doi.org/10.5194/tc-12-577-2018

Strozzi, T., Luckman, A. J., Murray, T., Wegmuller, U., and Werner, C. L. (2002): Glacier motion estimation using SAR offset-tracking procedures, IEEE Trans. Geosci. Remote Sensing, 40, 2384–2391, https://doi.org/10.1109/TGRS.2002.805079

Wegmüller, U., Werner, C. L., Strozzi, T., Wiesmann, A., Frey, O., and Santoro, M. (2016): Sentinel-1 Support in the GAMMA Software, Procedia Computer Science, 100, 1305–1312, https://doi.org/10.1016/j.procs.2016.09.246

Wendleder, A., Friedl, P., and Mayer, C. (2018): Impacts of Climate and Supraglacial Lakes on the Surface Velocity of Baltoro Glacier from 1992 to 2017, Remote Sensing, 10, 1681, https://doi.org/10.3390/rs10111681

Wessel, B., Huber, M., Wohlfart, C., Marschalk, U., Kosmann, D., and Roth, A. (2018): Accuracy assessment of the global TanDEM-X Digital Elevation Model with GPS data, ISPRS Journal of Photogrammetry and Remote Sensing, 139, 171–182, https://doi.org/10.1016/j.isprsjprs.2018.02.017