Earth Syst. Sci. Data Discuss., referee comment RC1
https://doi.org/10.5194/essd-2021-106-RC1, 2021

Comment on essd-2021-106

Tazio Strozzi (Referee)

Referee comment on "Global time series and temporal mosaics of glacier surface velocities derived from Sentinel-1 data" by Peter Friedl et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-106-RC1, 2021

A new global data set of Sentinel-1 glacier surface velocities that covers 12 major glaciated regions outside the polar ice sheets is presented. This is a very welcomed data set, congratulations to the authors for their efforts! By making all data freely accessible via the interactive web portal, your work is indeed a valuable contribution to open science. The portal with the Sentinel-1 glacier surface velocities is intuitive and data sets can be easily searched, downloaded and analysed. A comparison with velocity maps we produced within the ESA Glaciers_CCI project (https://climate.esa.int/en/projects/glaciers) revealed an outstanding quality of the data.

The manuscript is carefully written with very accurate descriptions of methods and results. I have three major comments and a series of small amendments and suggestions to be included in a minor revision of the manuscript.

1. Agreed that with your data set you are able to provide continuous glacier velocity-time series all year round independently from weather conditions and sun illumination, but the quality of results obtained from Sentinel-1 is better in winter than in summer. In particular, often during the summer the coverage with valid data is more restricted than in winter because of snow and ice melt and thus loss of coherence (or speckle). This point should be somewhere mentioned in the description of the data.

2. What is the effect of the coarse Sentinel-1 spatial resolution on small glaciers, in particular over mountainous areas? Is there a minimum size below which the Sentinel-1 results are no more accurate? Is there an underestimation of the ice velocity measured with Sentinel-1 over small glaciers? Please discuss this point in your manuscript. One way to study the performance of Sentinel-1 over small mountainous glaciers would be a comparison to Sentinel-2, e.g. over fast moving surging glaciers in the Himalayas.

3. I couldn’t find any indication in your paper about use of ascending and descending Sentinel-1 data. Are you processing both directions and combine the results? Or just of the two? Have you done any comparison, e.g. over Svalbard? And for other regions? In principle, ascending and descending Sentinel-1 data could be also employed for a 3D decomposition of the ice velocity vector.

Here the list if minor points:

l. 11. What do you mean by “near” global? What is not covered? Certain regions? Or glaciers, e.g. small ones?

ll. 13-14. By writing that velocity is derived “by applying feature and speckle tracking“ you give the impression that two algorithms are used. Instead, the technique is based on tracking persistent patterns of intensity values in both images, which are either formed by surface features such as crevasses (feature tracking) or correlated radar speckle (speckle tracking). This point can be better explained also in the abstract. Same applies to the conclusions (l. 481).

ll. 38-39. Actually, Ice Velocity is a product of the ECV Ice Sheets and Ice Shelves (https://gcos.wmo.int/en/essential-climate-variables/ice-sheets-ice-shelves). For glaciers, the products are only Glacier Area, Glacier Elevation Change and Glacier Mass Change (https://gcos.wmo.int/en/essential-climate-variables/glaciers/ecv-requirements).

l. 30. Why “only”? I would remove this adverb.

l. 48. In addition to sun illumination and polar night, past coverage of optical velocity data is restricted by other constraints of historical missions (e.g. acquisition capacity, image quality, …).

l. 83. Add “slant” to the resolution of about 3 m.

l. 84. You can possibly explain why data are available at HH or VV polarization, i.e. VV polarization is the default mode over land, while HH polarization is the default mode over polar regions (see
e.g. https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario).

ll. 205-207. If you want, you can add here that by applying this procedure the possible bias introduced by strong, short-term summer speed-up events is removed from the annual means.

ll. 285-287. I would not consider the surges of Austfonna Basin 3 and Negribreen too similar, because the stepwise frontal acceleration of Austfonna Basin 3 lasted at least five years with winter velocities much smaller than summer ones, while that of Negribreen lasted only two years with only a slight slow-down during winter.

l. 302. Tunabreen already surged in 2004,
see https://doi.org/10.1016/j.quascirev.2014.11.006, that may explain the short duration of only 2 years, the relatively low maximum velocities, and the absence of a clear seasonal velocity pattern.

l. 384. Sentinel-1 and not Setinel-1.

l. 487. What do you mean by 6-day repeat data available for overlapping orbits? 6-day repeat is over the same orbit.

l. 506. Also the archives of past JERS-1 SAR data (1992-1998) are now freely and openly available.