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Comment on essd-2021-46

Anonymous Referee #3

Referee comment on "Greenland ice velocity maps from the PROMICE project" by Anne Solgaard et al., Earth Syst. Sci. Data Discuss.,
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Review of
Solgaard et al.
Greenland ice velocity maps from the PROMICE project

This manuscript describes in detail an ice velocity (IV) products derived within the framework of the Programme for Monitoring of the Greenland Ice Sheet (PROMICE).
IV products generated span an observation period of 24 days, are provided every 12 days and posted about 10 days after the last acquisition in the observation period. They are provided at 500 m posting in Polar Stereographic projection. The authors describe the Sentinel-1 data and ancillary data sets used for product generation, detail the automated product generation process and provide a comprehensive error assessment.

General comment:
This is one of several projects generating IV products for the Greenland ice sheet. The authors mention a number of other products in the introduction. What would be interesting here is how PROMICE IV fits within this lot given that the products are assessed in detail with slow moving areas as well as compared against GPS measurements. The authors encourage feedback from the community, so some information for the community through an inter-comparison of products as part of the product assessment would be considered an asset. The comparison with sub-sets of the product is a good first step, but seems insufficient.

The manuscript lacks justification regarding some of the product parameter choices. These parameters seem to be data driven (as opposed to science driven), which is fine, but some more discussion of tradeoffs would be helpful. Section 6 addresses some of this, but it does not fully explain all decisions.
- What drives the 500 m grid? Is this a suitable choice for all glaciers is Greenland, and if not, what percentage of glaciers is affected?
- Why the 24 day (two S1A cycles) observation period? What is gained by averaging more (or less) data, what is lost? The discussion on page 19 does not feel sufficient.

- What drives the 10 day lag? It should be said that product generation 10 days after the last acquisition is impressive, the question is: Would 11 or 15 days be sufficient, is there anything to be gained for this to be 9 days?
- With Landsat-8 and Sentinel-2 openly available, why the focus on Sentinel-1 for the product? This is not meant as criticism but a request for justification of the choice.

Section 3: Precision orbits
The web site provided http://aux.sentinel1.eo.esa.int/POEORB/ is outdated as of early March 2021. ESA has switched to another site (tbc) for the new orbits. Information for the products you refer to are still on the old site (as per review submission). Please provide the new site information as well.

Section 4.5: Culling
The existing time series data set is used to provide an average velocity to drive the culling of outliers. Seasonal variation of the ice speed is mentioned as an issue as it can exceed 200%. Would a seasonally limited average make a difference here, given that 4 years of data are already available?

Section 5: Error
While not a big issue in Greenland, floating tongues have a tidal driven vertical displacement component that will be interpreted as speed if not corrected. At the very lest, this should be accounted for in the error.

Section 5.4: Ionosphere
The biggest impact of ionosphere perturbations are in azimuth direction. The available data are acquired in a way that for quite few regions you have ascending and descending data acquisitions available. Why not use the range - range components available in those regions to minimize the error?

Section 7: Validation
The detailed validation against GPS measurements is appreciated.
Here, the evaluation of other existing Greenland IV products would have been a useful add on
Are the GPS data also available as a product? If so, please provide access information.

Section 9: Summary and Outlook
Please provide the initial motivation for the product upfront
Page 24, lines 25,26:
" The PROMICE ice velocity product presented was originally intended primarily to calculate ice discharge through marine terminating glaciers of the GrIS as done in Mankoff et al. (2020)."

Figures:
General comment: Sub-figures are not consistently named

Figure 2:
Based on the coverage maps the products have regionally different number of IV estimates and this number varies by season (with more Tracks covering the ice sheet during Winter). This is mentioned in Section 6 (page 19). Are the numbers for the estimates on a per pixel basis provided in the product somewhere? This seems relevant when comparing different maps.

Figure 3:
With the observation period set to 24 days, the minimum and maximum pair numbers are known and could be reflected in the figure.

Figure 4:
Figure 4 and the corresponding discussion on page 9 would benefit from an assessment how many data points are culled (vs. how many outliers are not culled) for the various parameter selections.

Figure 5:
Figure 5 would benefit from a couple of insets providing more spatial detail of the culling.

Fitures7, 8:
Figures 7 and 8 would benefit from being placed on the same page (or they should be combined to a single figure)

Figure 9:
Figure 9 has sub plots, should they not be a) and b)? Also, sub-figure annotation is inconsistent between figures.
Product coverage is shown in multiple figures (1,2,5,(7,8),9,10), most of which provide spatial information. There is no such spatial information for the errors characterized by the STD shown in Figure 9. It would be useful to add the errors to one of the figures showing example maps (maybe Fig 1).
Figure 9 product coverage indicates that culling is depending on the season. This seasonality is of interest and could be shown in more detail.
The authors use the STD as a proxy to estimate the error of the product. Does this hold in the presence of strong ionospheric perturbations? In such cases the worst streaks are culled but still have large area offsets causing a higher error in the product.