Comment on tc-2022-55

Anonymous Referee #1

Referee comment on "Seasonal land ice-flow variability in the Antarctic Peninsula" by Karla Boxall et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-55-RC1, 2022

The authors present a comprehensive analysis of the glacier flow variability of the GVIIS tributaries. The analysis relies on Sentinel-1 data and is backed up with independent Landsat measurements. Overall the paper is well structured and most sections of the analysis are well performed. However, there are some issues that must be addressed:

Most important, the authors state that surface meltwater cannot be the trigger of the observed seasonal variations. However, I am not convinced by the presented justification. Recent publications indicate the warming and also increased surface melt on the AP (e.g. Carrasco et al. 2021, Banwell et al. 2021). So, the authors should also consider surface meltwater in the discussion of their findings or provide evidence that surface meltwater can be neglected as a potential driver. (see also comments below, abstract, discussion, and conclusions need to be adjusted accordingly)

Moreover, the description of the methodology has some shortcomings. Please provide here more precise information and be always clear on which region (spatial extent), i.e. whole glacier or just the 10km² areas, is your analysis and interpretation based. Please justify the interpolation in Fig.6 and explain the applied approach. The error analysis should be also extended. See detailed comments below for some specific issues.

Here are also some questions that came to my mind regarding your analysis. Could you please address them?

Why is the ice flow higher in March-November for wide regions further inland of the grounding line (GL) and why is it lower during summer?

Why is the speedup only visible close to the GL. Why is there now speed up further up?

Is there any correlation of speedup with altitude (either the area affected by the speed up or the general hypsometric profile or hypsometric index of the glaciers)? Difference Alexander Island vs. AP?

Tides are also affected by the season. Could the seasonal changes of the tides affect the glacier, in particular the GL? E.g. stronger tides lead to a wider grounding zone.

Detailed comments:

l10: What about the short-term summer speed ups reported by Seehaus et al. 2015 and

Seehaus et al. 2016 at Dinsmoor-Bombardier-Edgewoth Glaciers at Sjögren Inlet.

L39: Why is it vulnerable?

L53: Does the velocity field represent the long-term average?

L56: Source of flowlines?

L69: You list publications regarding meltwater lakes from 2017 onwards and say that such studies lead to the identification of GVIIS as a potential site for future ice shelf disintegration, identified in a study from 2013. That's somehow inconsistent

L85: please explain "seaward extent". The glaciers are flowing into an ice shelf.

L98: Did you apply any multi-looking or filtering? What about the coregistration of the images? Some more technical information would be nice.

L100: Could you please provide an overview of the used imagery

L103: Did you prove this assumption? You should use your velocity measurements to

prove it.

L119: Please describe here briefly how the uncertainty was estimated and what is a "valid pixel". This would be beneficial for the reader

L122: This information should be provided in section 3.1. and here you can refer to 3.1.

L127: Here you can refer to Friedl et al. 2021 as well. Their study is based on the same satellite data.

L130: what is sigma? The average of all pixels?

L136ff: Unclear explanation. You are using intensity tracking, thus you measure also displacements in azimuth direction and not only in range (LOS) direction. For sure, the shifts in the phase center depth can affect your measurements. But please rephrase this section to be more clear. Did you account for this shift in LOS direction? How much would it be? Any suggestion on how to estimate the bias? A brief statement would be nice at the end of this section.

L152: On which spatial scales did you apply the analysis. Throughout the whole glacier area? Only for the 10km² areas next to the GL? Please clarify

L153: Is this analysis based on the monthly mosaics or single velocity fields?

L165: Do you remove pixels that had no coverage for a specific month or even for single SAR image pairs? Please clarify.

L167: What about very slow-flowing regions? Will they be discarded? (or did you analyze fast-flowing regions only?, see comment above)

L193: feature tracking

Fig.3: Why is the pattern so noisy? Any explanation? Could you also include the glacier numbers in the upper maps?

Fig.4: How did you compute the error bars? How did you compute the mean monthly velocity for the period 2014-2020? Please provide more information or a link to the respective section. Fig. A2 indicates that for several glaciers the availability of monthly means was quite limited (1-3 measurements, e.g. flowline 16, 10 ...) How did you account for this issue in your analysis?

L262: Maybe there was a switch between effective and ineffective subglacial drainage. This might explain the late-summer slowdown. At some other glaciers, a late summer or even March/April minima is also visible.

And the late winter slowdown might be caused by a lack of bed lubrication at all. Well, that is just pure speculation from my side. Some studies at Columbia Glacier or also in Greenland revealed similar patterns. (e.g. Moon et al 2014, Vijay and Braun 2017…)

*L271: Maybe surface melt onset is earlier on Alexander Island as compared to the glacier's origination from the AP. Any correlation with average glacier altitude or surface melt data from climate modeling data?

L287: Why did you apply any interpolation? Just show the pure data.

Fig.6: Please use different colors or line styles to illustrate the SAR derived average velocity contours. How did you generate the heat-map? Please provide more information on how you computed the density. Please do not interpolate the density, if the interpolation is causing such strong artifacts (see comment above).

L291ff: Please show at least one example in Fig.6. Otherwise, it is difficult to figure out this issue.

L320: You should also mention the more recent warming on the AP which overlaps strongly with your observation period (reported by Carrasco et al. 2021). This should be considered in your discussion. There is also a strong surface melt anomaly in 2019/2020 reported by Banwell et al. 2021 on Alexander Island and at least close to the GL next to the AP. So you should consider also the option of surface meltwater as a driver for seasonal fluctuations

L324ff: Please revise and account also for potential surface meltwater availability (see comment above)

Fig. A1: On many panels, the glacier names are covered by black lines.

Fig. B1: Could you please include the central flowlines of the glaciers and glacier numbers.

Fig.C…: what about 2019-2020?

Table D1: Could you also include the most dominant frequency