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# *Interactive comment on* "Greenland Ice Mapping Project: Ice Flow Velocity Variation at submonthly to decadal time scales" *by* Ian Joughin et al.

**Anonymous Referee #2**

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Review of: Greenland Ice Mapping Project: Ice Flow Velocity Variation at submonthly to decadal time scales

Joughin, Smith and Howat provide an assessment of new velocity data products being produced and distributed as part of the GIMP. They discuss the introduction of Sentinel 1a/b radar data into their datastream and the production of annual, winter, quarterly and monthly velocity products. There are no significant changes in processing methodologies from earlier documentation (Joughin, 2002; Joughin et al., 2010; 2017). The manuscript focuses on the agreement of Sentinel 1a/b with earlier results and the tradeoffs between temporal averaging and temporal resolution. The authors go on to demonstrate the scientific utility of their new dataset by: (1) contrasting sessional and interannual changes in flow for two major tidewater glaciers, (2) examine long-term



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trends over an area of land terminating ice in south west Greenland and (3) describing commonalities in glacier change for large sectors of the ice sheet.

Overall opinion:

Overall the paper and respective data are valuable contributions to the glaciology community and The Cryosphere is an appropriate venue for this type of paper. I do however have relatively minor concerns regarding the scientific analysis and conclusions presented in the manuscript.

General comments:

Sentinel 1a/b

The description of how the data was processed is straightforward but I found the validation against other data sources lacking. The authors identify some areas of large disagreement between TSX and Sentinel 1 derived flow velocities (e.g. as shown in Figure 3) that they qualitatively suggest are largely a function of sensor resolution. It would be very helpful if the authors could provide a more extensive statistical validation / comparison between TSX and Sentinel 1 derived datasets.

Jakobshavn and Koge Bugt

The authors contrast recent changes in flow occurring for two major tidewater glaciers. While I personally found the comparison thought provoking, the conclusions seemed somewhat speculative. In particular the authors argue that changes in the terminus extent resulted in a large observed slowdown of the Jakobshavn glacier in 2017. This is not clearly agued from the data presented. Without a quantification of the uncertainties in ice thickness and bed elevation it is very difficult to discern the likelihood that changes in the terminus position contributed to the 2017 slowdown. Are the authors able to rule out changes in basal or lateral drag upstream of the terminus as a possible cause of the slowdown? What was the cause of the glacier advance during the winter of 2016 and why, unlike other years over the past decade, did it maintain floating tongue





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in the summer of 2017. If the front of the glacier was indeed floating in 2017 I believe that the authors should be arguing that it is the position of the grounding line and not the terminus position that is modulating flow. While, as previously documented by the authors, there is a clear correlation between seasonal speedup and terminus position, the contribution of terminus position to the 2017 slowdown seems much more tenuous and likely requires more detailed study than provided here. I would suggest that the authors remove discussion of the role of terminus position on the 2017 slowdown or that they significantly expand their analysis to better support their assertions.

The discussion of bedrock erosion at Koge Bugt and the extrapolation to the “last stands” of glaciers in a warming world seemed to me to be tangential to the presented analysis and highly speculative. I would suggest that the authors remove this discussion or greatly expand their analysis to support their assertions.

Southwest Greenland Ice Sheet Trends

I have read the ongoing discussions between Tedstone et al. and the authors concerning the conclusions presented in this section and it seems to me that the disagreement largely stems from sampling periods, trend duration, and the definition of significance in trend. I would be very curious to see how well Figure 7 b agrees with the difference map presented in Tedstone et al. when a significance mask isn’t applied. Also if the authors average over many points they could potentially increase the signal to noise allowing for the identification of subtle changes in grounded ice flow speed.

Specific Comments:

p3, l9-28 It would be highly valuable to provide an assessment of velocities generated using only the orbit vectors vs those generated using GCPs

p4, l5 It would be helpful if the “additional weightings” were listed here.

P7, l12 I would suggest applying formal error propagation to represent errors in velocity (I believe it’s ev = (ex*vx + ey*vy)/v instead of using the “combined standard deviation”





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P11, l8 The trends shown in Tedstone et al. are presented as % total change from a reference velocity. From the results presented in Figure 7 it is not obvious that the results presented in the two papers differ significantly.

Figure 3: Not sure where distance starts from. Could line segment indicators of A – A' and B-B' be added to the inset.

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