

Reply to referee comments

Remaining comments:

Several of my remaining comments are rebuttals to the initial response to reviewers. I include the original reviewer comment in italicized black text, followed by the author response in red, with my clarification/rebuttal in bolded black text below.

We thank the reviewer for carefully reading the revised manuscript. Please see below our reply to your comments in red. Texts in blue are our reply to the first-round review comments.

On line 30, the authors added a new citation to “The IMBIE Team 2020”. There is a newer version of the IMBIE assessment found here:

Otosaka, I. N. et al.: Mass balance of the Greenland and Antarctic ice sheets from 1992 to 2020, Earth Syst. Sci. Data, 15, 1597–1616, <https://doi.org/10.5194/essd-15-1597-2023>, 2023.

This is a helpful suggestion. The citation is replaced.

Original comment:

It would be useful to understand how this lag compared across years at GPS3, or even compared to lag time at GPS2. Another recommendation on this theme would be to provide corresponding text in the main manuscript that describes the relationships seen in the scatter plots (which include all years superimposed). The plots by themselves are not super informative, and difficult to discern how correlations vary (or remain consistent) across years.

“Figure 4 was obtained by subtracting a general trend, stacking data in each year, and taking a mean of the results from six years (Figure S3). As it is seen in Figure S3m, the discussion of the lag between ice speed and temperature peaks is only possible after stacking and taking a mean of available data. It is not possible to discuss seasonal or year-to-year variations based on Figure S3m. We thank the suggestion and encouragement of the reviewer. However, our six-year data set is just enough for the discussion presented in the manuscript, but not sufficient for detailed analysis of seasonal or year-to-year variations.

I understand that Figure 4 shows the mean of six individual curves from figure S3. These curves are used to determine the mean temporal lag between temperature and speed. Using the curves in Figure S3, can the authors describe how the temporal lag varies inter annually? 2 hours is the mean of 6 six years, but it would be informative to readers to understand if this lag is consistent year-to-year, or

exhibits variability in sign and/or magnitude. What is the range in temporal offsets between curves during the six-year study period?

We do not include the suggested analysis because we are not able to provide reliable results and useful discussion. Diurnal variations in temperature and speed in each year are not smooth enough to obtain accurate time lag between the peaks (Figure 1). It is difficult to compare the plots to say which year the lag is greater. A quantitative analysis was possible only after averaging curves for six years. We thank the encouragement, but would like not to discuss year-to-year variations.

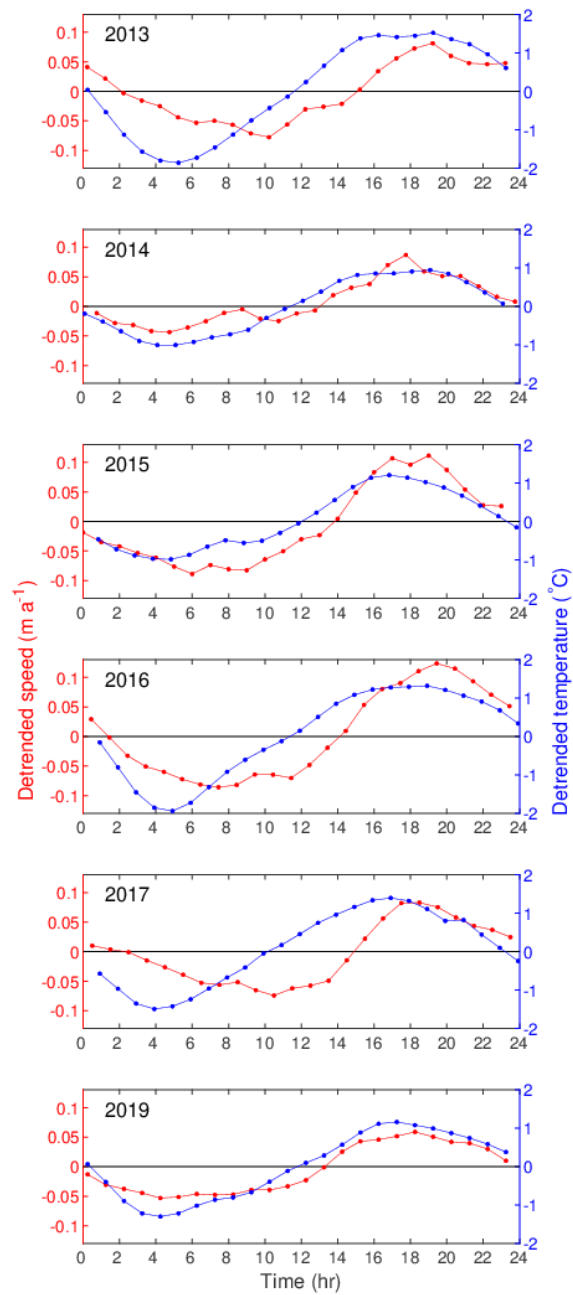


Figure 1: Diurnal variations in the detrended ice speed (red) and temperature (blue). Each curve was obtained by connecting values averaged in each year.

Original comment:

Request for more clarity: Were 2013, 2014 and 2017 the only years where precipitation was recorded during the study period?

The automatic weather station was operated during the field campaigns as described in Line 147. Precipitation was detected in 2013, 2014, 2016, 2017 and 2018 as shown in Figure 2a-f. It is not clear for us why the reviewer misunderstood.

This comment was based on the discussion in Section 5.3 “speed up due to rain” which states that “The glacier responded differently to precipitation events in 2013, 2014, and 2017” and (as well as Figure 6 that shows precipitation during only years 2013, 2014, and 2017). If precipitation also occurred in years 2016 and 2018 (I think the authors meant 2019 instead of 2018 here), then this should also be included in the discussion, even if no coincident speed up was associated with observed precipitation. It’s not clear why results from all years (when precip was recorded) were not included.

Now, I see the point. Thank you for the clarification. And yes, I meant 2013, 2014, 2016, 2017, and “2019”. We discuss and show additional plots only for 2013, 2014 and 2017 because these precipitation events are heavier than the others. For weaker precipitation events, ice speed change was not noticeable (Figure 2). To make it clear, we state that our focus is heavy precipitation events with >1 mm per hour (Line 308).

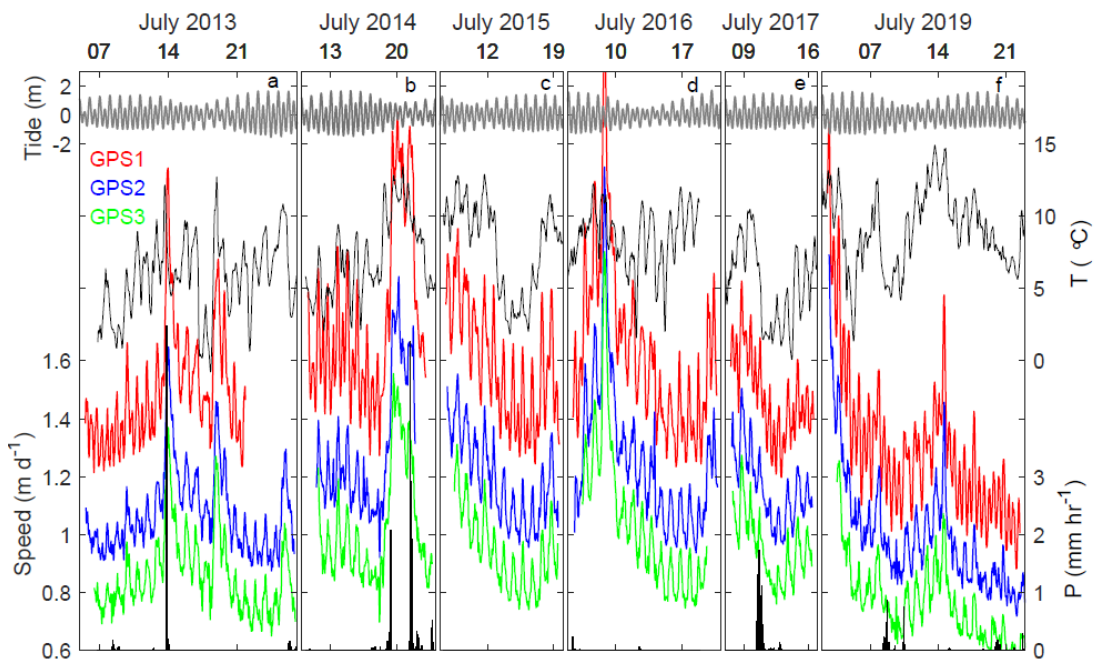


Figure 2: Ice speed at GPS1–3 (red, blue, and green), tidal height (grey), air temperature (black) and precipitation (bar).

Original comment:

Line 170 – how is significant acceleration defined here? Based on a threshold rate of change?

We write, for example, “the glacier significantly accelerated (Line 187)”, “significant year-to-year variations (Line 211)” and “semidiurnal variations are less significant (Line 237)” to refer to substantially large changes in ice speed. I understand that the word is used for “statistical significance”, but here we use it in place of “substantial”, “notable”, “considerable”. We believe this usage is usual and our texts are not confusing.

I find the use of significant here to be confusing and suggest language like “rapid acceleration” or “substantial year to year variability” would be more appropriate in this context.

We appreciate this help with language. We have corrected “significant” to other words: “large variations” (Line 11), “substantial contribution” (Line 40), “accelerated to a large extent” (Line 187), “substantial year-to-year variations” (Line 211), “rapid and large glacier accelerations” (Line 312), and “substantially accelerated” (Line 454).

Original comment:

Scatter-plots (for example, in figure 9): Consider using a colormap that avoids very similar colors. It is difficult to discern the years shown in light blue and darker blue (2013 and 2019).

Thank you for pointing out this. The dark blue markers (2013 data) are replaced by dark grey for Figures 5g–i (see below) and 9g–i.

I am not seeing the updated figures, as described above, reflected in the ‘tracked changes’ version of the revised manuscript.

Thank you very much for pointing out my fault. The figures (Figs 5 and 9) are replaced.