Review of 'Seasonal dynamics of Totten Ice Shelf controlled by sea ice buttressing'

General comments:

Greene et al. investigate velocity variations on the Totten Ice Shelf and examine the physical mechanisms that may cause these variations. Overall, the authors have succeeded in providing a denser velocity time series than previous studies and a thorough analysis of the top candidates for causing ice shelf flow variations. The paper is well written and figures are clear and appropriate. The title, abstract, and general organization are accurate, thorough, and logical.

Some revision is needed to provide consistent messaging across the paper regarding the temporal limitations of the data. The authors emphasize the importance of capturing seasonal variations, but do a somewhat poor job of acknowledging and discussing the seasonal limits of their own study. Figures 2 and 7 make this point nicely. The authors have captured more temporal coverage than previous studies, but the data still has large time gaps. There is, for example, no data to confirm that speedup begins in October – that is simply when the measurements begin in earnest and show a continued speedup from there. Similarly, I see no justification for assuming a nice seasonal sine wave as the "mean" seasonal behavior (page 5, line 10). The authors do not refer to other studies with data that might fill their time gaps or other evidence for this assumption of time evolution. Studies of seasonal velocity in Greenland outlet glaciers show a wide variety of annual patterns, including sudden slowdowns and speedups as well as more gradual changes. Why couldn't more dramatic events occur during the data gaps for Totten Ice Shelf? The authors acknowledge this on page 13, paragraph 2, but this point should be raised earlier and must be clearly reflected in the whole paper. Other instances where the overall paper obscures a point made at a specific spot in the paper are highlighted below – these need to be addressed to craft a cohesive full manuscript.

Detailed comments (by page/line number):

1/17. Briefly mention what the "more complex picture" is.

3/17+. It's odd to have data separated only into spring or autumn. What about summer and winter? The authors talk about all different seasons throughout the manuscript, so it becomes unclear what season is what and how the data fit into those seasons. Clarity is needed on what spring/summer/fall/winter means and what data fits into each season.

3/26. Indicate the location of the 'mid-shelf ice rumple' in Figure 1.

5/7. Why is there no overlap in the areas used for MODIS velocities v. GoLIVE velocities?

5/9+. The authors state here that 'the timing of springtime acceleration cannot be accurately determined for any given year'. Yet, language in other parts of the manuscript suggest that it can (e.g., in Figure 7 caption – '*begins* with the breakup of landfast sea ice'). The whole manuscript needs to reflect the limits of the data.

6/1-3. Here the authors use the seasonal sine wave approximation to give information about seasonal cycle amplitude, maximum, and minimum. The problems with assuming this seasonal cycle are mentioned in the general comments. Thus, it's unreasonable to give these metrics – they have little scientific or practical value.

6/6. I recommend against referencing Zwally et al. 2002. While it was the initial paper that set off the wave of research on the 'Zwally effect', it is now a poor reference for understanding the complex relationships between hydrology and glacier flow. In fact, Tedstone et al. (Tedstone, A. J., P. W. Nienow, N. Gourmelen, A. Dehecq, D. Goldberg, and E. Hanna (2015), Decadal slowdown of a land-terminating sector of the Greenland Ice Sheet despite warming, *Nature*, *526*(7575), 692–695, doi:10.1038/nature15722.), which demonstrates a long-term slowing on land-terminating areas despite increased melt, is a better reference at this point. A word of caution on the larger discussion of subglacial hydrology in the manuscript. At times (e.g., this paragraph) there is a clear distinction between the processes of subglacial hydrology that might actually influence the ice shelf v. subglacial hydrology and its influence on grounded ice (which constitute most citations in the paper). At other points, however, this point can feel muddled. Unfortunately, using the 'TIS' acronym does not help and makes it easier for the reader to forget that the study is focused on an ice shelf instead of grounded ice. As the authors go through revisions, please be conscious of keeping the fact that you are looking at *ice shelf* speeds forefront in the readers' mind.

8/19-21. This sentence is confusing and the part about the constant 300 m offset does not make sense.

10/8. Always specify '*sea* ice' if that is the subject. Check the full manuscript for this clarification.

13/last paragraph (onto next page). This paragraph discusses some specific details of the Li et al. (2016) paper without ever pulling back to the big picture of that paper to discuss this study's overall influence on interpretations of the Li et al. paper. Are the Li et al. conclusions still good ones or should the larger conclusions be reinterpreted? Also, while it's fine to point the reader to these references, try to craft this manuscript to cover all the major points so that reference to the other paper directly is not a necessity to get to the primary points regarding its (re)interpretation. The reader should come away with a sense of the pertinent conclusions of Li et al. and how they may be shifted (or not) – not only an understanding of how very specific details should be considered. This comment can be applied to any previous study the authors want to comment on.

14/14. Remove 'strength' – this paper does not include a scientific assessment of sea ice strength.

14/20. This final sentence is more declarative than I think the data supports.

14/25. Regarding 'may have aliased some previous measurements of interannual variability' – as mentioned earlier, discuss directly what these previous studies say and what the new outlook is after applying the data from this paper.

14/29+. This paragraph mixes *inter*annual basal melt and velocity changes and *intra*-annual basal melt and velocity change. I agree that the authors have done a nice job of showing how seasonal basal melt variations cannot explain seasonal speed variations, but I don't think the authors have shown that multi-year thickness changes could not play a role in multi-year speed trends.

Typos, etc. (by line number):

2/13. All instances of 'mélange' should have the correct accent added.

3/23. 'Throughout' is more correctly 'during' since there is no winter data to show the timing of speed changes.

Figures:

Figure 6. In the MODIS images it looks like the sea ice is not in contact with the glacier ice. Is there a shadow effect? Something else? Please explain/clarify.

Figure 7. Specify '*sea* ice thickness'.