Review of Brief Communication: **ICESat-2 reveals seasonal thickness change patterns of Greenland Ice Sheet outlet glaciers for the first time**, Taubenberger et al.

This study uses two years of ICESat-2 elevation data to categorize 34 outlet glaciers based on their patterns of seasonal thickness change near the terminus. The classification is based on patterns of detrended dynamic thickness change, which is isolated from the total elevation change using modeled SMB and firn compaction with a reference GIMP DEM. The authors discuss seven main types of seasonal thickness change, show that pattern distribution is spatially heterogeneous, and conclude that the fastest glaciers in their sample undergo spring/summer thickening. The manuscript presents a valuable assessment of seasonal glacier change that leverages the spatial and temporal resolution of new ICESat-2 elevation data and is therefore timely and relevant to ongoing research in the community. The manuscript is well written with a very nice Figure 2 and includes an extensive (and helpful) Supplement. That said, there are several issues with how seasonal change is quantified and presented/discussed (primarily the loss of seasonal signal from detrending a short time series and the limit this method presents for seasonal interpretations) that prevent this manuscript from being more valuable. These changes, described below, do not require assimilating additional data or extensive reanalysis, and can probably be done fairly quickly.

Main comments:

Detrending data:
I wonder if it is useful or appropriate to detrend such short time series, especially at glaciers with only one year of data. This approach can completely alter the characteristics of the seasonal pattern and/or the magnitude of change in a given season (see for example, thinning from Autumn 2019 to Spring 2020 at Nansen glacier in the raw time series as opposed to thickening shown over the same period in the detrended time series).

Timing and description of thickness change:
I think the timing of seasonal thickness change can be presented in a way that is more intuitive. Based on Figure 1 and the supporting text, a given seasonal change is defined by the change from the previous season to the current (for example, an increase in thickness from spring to summer is described as "summer thickening" – as in Figure 1c). However, this description could be misleading to readers. For example, an elevation increase between mid-March (spring) to mid-June (summer) would be considered summer thickening in the text, even though the time over which the change occurred is primarily spring months (April and May).

Instead, I suggest one of two alternatives:

(1) I think it would be more accurate to describe the timing of thickness change by the season that corresponds to the midpoint between two observations. For example, thickening observed between mid-June and mid-September would be centered on early August, or "summer thickening" (as opposed to autumn thickening due to a September end point).

(2) The second alternative is to change the language surrounding seasonal change throughout the manuscript. Rather than describing a pattern as one with “summer thickening,” describe the glacier as one that “thickened from spring to summer.”

Relatedly, the vales plotted in Figure 1 are somewhat challenging to interpret. My understanding is that dH is first derived by comparing ICESat-2 values to those from GIMP DEM, and then the dH time series is shifted so that the first data point (typically in winter) has a value of zero (see the purple dynamic time series in the Supplement). These time series are then detrended, with some examples representative of each seasonal pattern appearing in Figure 1. Due to the detrending, the resulting series then start with a positive or negative wintertime value that is somewhat meaningless. Without carefully reading the methods and cross-referencing the Supplementary figures, I would incorrectly interpret a negative wintertime value to represent wintertime dynamic thinning. In this case, the values themselves are unimportant, but rather it is the *change* between seasonal values that has meaning. I would suggest shifting the time series to begin at zero post-detrending and changing the y-axis label to read “Relative dynamic thickness change”. If the authors elect to forego detrending altogether as I suggest above, a sentence can be added to the figure caption here to describe how values are relative to the initial time series surface. Alternatively, a secondary y-axis could be added to each figure that shows the derivative of thickness change values, or the change between each season.

On excluding seasonal changes greater than 25 meters:
Some justification for the 25m-magnitude seasonal change cutoff, which is used to exclude several glaciers from the analysis, is warranted. Sub-annual thickness changes of similar magnitude have been discussed in the literature (for example, up to 50 m at Jakobshavn in Joughin et al., 2020 and 19 m at Helheim in Bevan et al., 2015).

Joughin, I., E. Shean, D., E. Smith, B. and Floricioiu, D.: A decade of variability on Jakobshavn Isbræ: Ocean temperatures pace speed through influence on mélange rigidity, Cryosphere, 14(1), 211–227, doi:10.5194/tc-14-211-2020, 2020.

Bevan, S. L., Luckman, A., Khan, S. A. and Murray, T.: Seasonal dynamic thinning at Helheim Glacier, Earth Planet. Sci. Lett., 415, 47–53, doi:10.1016/j.epsl.2015.01.031, 2015.

Glacier speed vs seasonal dynamic change pattern, beginning on line 160
Velocity values are taken straight from Rignot and Mouginot 2012, which is cited, but these velocity figures are now ~1 decade older than the ICESat-2 elevation data used in this study. Was a regression performed to conclude a weak relationship mentioned in line 160, or rather a more qualitative assessment? These things considered, I’m not sure this paragraph/analysis adds much to the study as is probably best omitted.

If velocity and dynamic thickness changes are more closely examined in future work, I’d suggest using the seasonal range in glacier speed (perhaps as a % of annual mean speed) as a more appropriate metric to compare against dynamic thickness change patterns. For example, I would hypothesize that glaciers with larger seasonal ranges in velocity to have seasonal thickness patterns that are less sensitive to SMB, due to a larger dynamic thickness change component.

Minor comments:

Line 63
Change “average ice discharges” to “average ice velocities”

Courtrauld, a slow-moving glacier, is reported as having one of the largest total dynamic thickness changes of ~20m. Do the authors have a suggestion for why this could be possible?

This leads me to a related point: while fully incorporating terminus change data from CALFIN might be outside the scope of this paper, it would be useful to note how significant front change plays a role at glaciers with the largest observed change. For example, Courtauld (#150) is a relatively small glacier – did it undergo a rapid retreat and readvance to account for such a large ~20 m dynamic thinning over the 2-year observational period noted above?

On Figure 2
Glacier 34 is classified as having summer thinning (defined in the manuscript as having a decrease between spring and summer in the detrended time series) in 2019, but this is not supported by the figure in the Supplement, which shows thickening in the detrended time series.

Line 191: “Our results reveal little regional coherency in seasonal dynamic thickness change patterns, indicating that atmospheric circulation patterns are not the likely driver of differences in patterns among glaciers”
Was this a hypothesis in the study? What are the mechanisms that could potentially link atmospheric circulation to the dynamic thickness change (SMB removed) over such short time scales?

Consider adding a citation to the recent paper with updated velocity classifications to the intro:

Vijay, S., King, M., Howat, I., Solgaard, A., Khan, S., & Noël, B. (2021). Greenland ice-sheet wide glacier classification based on two distinct seasonal ice velocity behaviors. Journal of Glaciology, 1-8. doi:10.1017/jog.2021.89