General remarks:

The paper demonstrates a method for detection of glacier surge events that is straightforward, well described/presented, and (to my knowledge) novel. The authors demonstrate how the Normalized Difference Index of SAR backscatter may be a useful measure both for the detection of potential surge events as well as in the interpretation of a specific event when combined with optical satellite imagery and ice velocity measurements. The method provides a way to detect potential surge events on a global scale using relatively straightforward and fast processing, especially with the use of the GEE platform. While it is difficult to exactly estimate the accuracy and false alarm rate of the proposed method in detecting surges (due to the limited amount of validation data sets), the authors have presented a comparison with SAR surface velocity data for two of the areas of interest, which does show encouraging results. The authors also describe the (current) limitations to the method, namely that visual inspection of the NDI images along with auxiliary data such as optical images is required to identify surge events and that other physical phenomena than surges could lead to similar signatures in the NDI measurements. My comments mainly concern clarifications on the used data (e.g. polarization, resolution) and validation.

Specific comments:

- **Line 26 + Line 36 (+Supp. Mat. Section 1):** The GRD images are "detected" SAR images, meaning that they measure intensity (i.e. not amplitude, but amplitude squared). The intensity images must then be calibrated and converted to the unitless backscatter coefficient (which is almost always converted to dB scale). This pre-processing is done automatically in GEE, as far as I can tell from the documentation. Therefore, "amplitude images" should be changed to "backscatter images".

- **Line 36:** Maybe it is worth noting that Sentinel-1 coverage depends on the acquisition plan, meaning that certain areas of interest may have infrequent coverage.

- **Line 41:** How much multi-looking (i.e. spatial averaging) is applied to the SAR images? (For the GRD images in IW mode, they are provided either as "Medium Resolution, MR" or "High Resolution, HR", dependent on the amount of multi-looking). Did you test multiple levels of multi-looking to determine if the reduction in speckle noise and/or the reduction in resolution affect your results significantly?

- **Line 47:** You mention using only cross-polarization images (VH or HV) for all your NDI measurements. Is there any specific reason for this? Since you are looking for general changes in the surface roughness, I would not necessarily expect cross-polarization to yield a much different/better result than co-polarization (VV/HH). Have you looked at an example event using both cross-polarization-based NDI and co-polarization-based NDI for comparison (similar to how you investigated the difference between ascending/descending tracks in Supplementary Material Section 2)?

- **Line 50:** I would consider specifying more explicitly that, based on your experiments, for a given area you expect to see (roughly) the same detection of surge activity from descending and ascending tracks, as SAR acquisition artefacts tend to affect glacier surroundings more than the glacier surface (with a reference to your Supplementary Material Section 2). This is an important result for a potential operational/automated implementation of your method.

- **Line 149:** “We compare the results from our method with surge detection from surface velocity measurements for Alaska and Svalbard. The two methods largely identify the same surge activity.” I think this sentence could be slightly misleading. My impression (based on Supplementary Material Section 4) is that for Alaska, you did not check the velocity fields of all glaciers in the region for surges, which is what you did for Svalbard. This means that, potentially, there could be a number of ‘False Negatives’ in the Alaska region (i.e. surges indicated by surface velocity measurements but not by your method). I would suggest mentioning more explicitly that you do not check for these False Negatives for the Alaska region (under Section 3.3 or in the Discussion).

- **Supp. Mat. 4.1/Fig. S5:** I think you should add a table containing an estimate of the change in velocity for the various Svalbard glaciers (for instance computed as a spatial average over a specific part of the glacier). It is difficult to see the magnitude of the velocity change for many of the glaciers, due to the wide color scale. For the Alaska cases, where the colorbar is adjusted per glacier, it is easier to visually note velocity changes, so a table with estimates is not as necessary (in my opinion).

- **Supp. Mat. 4.2 (Fig. S7):** You mention that Walsh Glacier Tributary shows a strong decrease in surface velocity during 2015-2017, but as far as I can tell from Figure S7, the velocity shows little change from 2015 to 2016, then an increase from 2016 to 2017.

- (Purely as a suggestion for future investigations (not to be incorporated in the current paper): I wonder if interferometric coherence could provide additional useful information, e.g. by estimating coherence for a number of 6- or 12-days pairs during one winter and comparing with estimates from the following winter).

Technical corrections:

- **Figures 1+2:** I would suggest increasing the resolution/size of the images (it is difficult to see the insets in Figures 1d and 2c).

- **Figure 1 text:** I would change “maximum brightness” to “maximum backscatter” to be consistent.

- **Supp. Mat. Fig. S3**: the LOS arrow is hard to distinguish from the background. I would consider changing the color/size of it.