

Dear authors,

I am pleased to review this manuscript as this is a most relevant and timely paper as it sheds light on an important topic as the authors point out. Much work has been attributed to the landfast ice in the Arctic, but less so in the Antarctic. The paper presents a pan-Antarctic dataset and preliminary analysis of the landfast ice extent in the Antarctic from 2000 to 2018. This is a novel effort and I recommend this for publication in *The Cryosphere*. Furthermore, the manuscript is well prepared as it is concise and well written. In particular the introduction, which is straight to the point and encompasses the relevant literature.

I mostly have minor comments and suggestions, but would like to see two main issues being addressed prior to publication related to the description of methods as well as discussion of uncertainties. In short, I think the first part of the methods should be clarified better and elaborated on. The second part of the methods should be moved to a separate subsection or preferably a discussion section with some more discussion about accuracy and caveats.

With best regards,  
Your reviewer

#### **Description of methods:**

I am not confident I understand what you have done strictly based on this manuscript. As I think it would be good if this paper stands by itself, I am suggesting that you spend some more time elaborating on the methods.

For instance, it is not clear to me how you create the composites. Could you be clearer in terms of this being a mosaic of overlapping imagery or if you are considering just one acquisition for each location and this being a composite of the two channels. Either way, it would be helpful with a couple of sentences addressing how they are created and the number of images typically incorporated.

The steps in the methods are quite clear in themselves, but it would help if the outcome of each step is described as well. This is how I interpret your initial steps:

- For any given location and for all 15-day periods in your dataset, you download all available images and create multiple composite images based on available channels (how do you do this?). Hence, for this location, you have several images (how many roughly?)
- Then you detect the edges in all these composites resulting in multiple 1 km resolution (binary datasets?) indicating locations of edges in each composite.
- Then you sum the binary datasets and thus higher numbers more strongly indicate persistent edges at the timescale of 15 days. By doing this you reduce the number of composites down to one product?

- You then multiply the edges with the median-filtered composite. But which one, if you have multiple composites for this region? Also, please spend a sentence on describing how this results in confidence as opposed to just the edge product. What is the range of values prior to normalization?
- Finally, the result is a product of landfast ice edge with 1 km spatial and 15-day temporal resolution. However, how do you eliminate lower confidence edges based on the histogram analysis?

If you could attempt to clear up any of misunderstandings and make this a little easier to follow, it would be great. I suggest a figure where the reader can associate each step with a figure panel (or alternately a schematics). Basically, modifying Figure 1 to incorporate the other steps as well.

#### **Accuracy estimates:**

At line 190 you describe: "In the case of a manually-extracted ice edge pixel, it reflects the sum of the ice edge change plus the digitisation error." And you seem to imply that there are no errors in this data? Could you elaborate about this in the manuscript and discuss the accuracy of the Canny edge detection in general based on your pixel spacing and in terms of misclassification in the case of slow moving non-stationary ice in fjords and stationary drifting ice pinned between icebergs or by onshore winds over consecutive 15-day periods? I suggest as before to move some of this discussion into either a discussion section or as a subsection to the methods section and discuss caveats a little more deliberately.

You define landfast ice as stationary for 15 days as opposed to earlier 20 days. A 3-week timeframe is to my knowledge more common. Why did you make this choice and how will this impact the analysis and the potential misclassification of temporarily stationary pack ice etc.

Is the manual delineation very labor intensive e.g. is it sometimes difficult to determine where to draw the line with potentially large consequences for the ice extent? Do you have suggestions for how to mitigate this or how your approach could be improved in the future resulting in a larger than 58% success rate? If you could discuss this slightly in the manuscript, that would be very interesting. Could you even provide some speculation into whether other sensors could enhance the analysis?

I realize and appreciate that you have written a quite concise paper and don't want to delve too much into the details. However, I suggest some more clarity and elaboration around these two points.

#### **Minor comments and questions**

Line 65 - 74 move to discussion

Line 78: I don't see the "in prep" reference in the bibliography. If not included there, take out.

Table 1: Avoid the word very as in “very high”

Line 81: Replace “the new” with something like “the fast ice time series presented here” to make it clear that it is not a new one described in Table 1.

Line 95: Can you clarify how the composites are created? Do you mean creating a mosaic or merging the channels?

Line 97: Is this manual updating done every year and for the entire coastline? Is this labor intensive if to be done with necessary accuracy?

Line 112: “layer of clouds”?

Line 115: Here as well as prior in the manuscript, the use of parenthesis could be toned down by reformulating.

Line 123: Again, not sure if parenthesis is needed here.

Line 126: I am not familiar with the plural form “cloud”. Clouds?

Line 125: You have already said this. Take out.

Line 133: Missing oxford comma

Line 139 and 140: It would be great if you could elaborate here on what you mean by summing edge products. Do you just sum binary pixel values of edge/no edge?

Line 139: Do you mean successive 15-day periods, meaning several periods? If so, how many?

Line 142: Try to limit redundancy, you have already stated that the composites are cloud-free

Line 143: Could you provide a short explanation for the Median filter. For instance, what is this gradient value range? Is there a threshold used to determine whether the edge is stationary and for how long?

Line 148: Is this something you define. If so, make that clear. Otherwise, please provide reference.

Line 162: In the methods section below Line 162 looks like the start of a discussion to me. I recommend creating a discussion section and placing much of this there. Some of it also belongs more in the introduction perhaps.

185: Like before, no need for parenthesis

Line 215: Missing space

Line 244: What indicates this in the plot? The discontinuity in the plot?

Line 248: What do you mean with edges vary? The detected edges or the actual ice edge? You mean vary over time when the ice edge is assumed constant? Please explain better.

Line 263: Please be consistent with the use of notations for in-line lists e.g. 1, a, or i.

Line 266: Missing space

Line 271: Please clarify this sentence as it is not clear what you mean by complexity dataset and linkages between what.