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Interactive comment on "High-resolution mapping of circum-Antarctic landfast sea ice distribution, 2000–2018" *by* Alexander D. Fraser et al.

Anonymous Referee #3

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This manuscript presents a novel algorithm for determining pan-Antarctic fast ice area over 15-day epochs. It has been applied to an 18-year record of MODIS imagery to produce the first pan-Antarctic dataset of fast ice edge area. It marks significant improvements over existing algorithms that were regional in nature and required more manual interpretation to define fast ice edges. This is timely and important work as it fills a significant gap in the knowledge of Antarctic fast ice area variability. This will benefit both scientific investigations and logistical operations in key areas of the Antarctic coastal environment.

The manuscript is well-written and concise, and I recommend it for publication in Earth System Science Data with minor revisions. I have divided my comments into three sections; general comments on the manuscript, minor comments on the manuscript

and comments on the data set.

General comments on the manuscript

I found the description of the algorithm in the methods section somewhat difficult to follow. I would recommend creating a flow-diagram to better illustrate how the algorithm is applied in general This diagram could then refer to Figure 1 to illustrate outputs at various steps in the algorithm. I would also like to see more detail on some aspects of the algorithm. For example, how does the algorithm deal with cases where both thermal and visible imagery are available when generating the 15-day cloud-free composite images? I would also like to see some discussion in the results section on whether there were observed differences between fast ice area products generated from visible and thermal composite images. Further, I would like to see more justification for choosing a 1-km, 15-day epoch for identifying landfast sea ice, and more discussion on how the choice of this epoch influences the generated fast ice extent products.

I would also like to see more discussion on the fast ice distributions shown in Figure 2. Antarctic fast ice extent can be temporally variable on a regional scale, and I would argue that this variability is not captured by presenting pan-Antarctic maximum and minimum distributions. For example, the fast ice edge in McMurdo Sound in 2016 was significantly farther from the coast than shown in Figure 2 (see, for example MYD02.A2016350.0410.006).

The authors state that the number of images contributing to the composite was increased relative to the Fraser et al. (2019) algorithm (Lines 114 + 115). I would like to see more details on how this was accomplished, particularly since the epoch was reduced from 20 to 15 days. If I understand correctly, the auto-determined fast ice edge moved an average of ~ 10 km in a 15-day period. How does this compare to previous regional studies?

The authors state that four adaptive thresholds are set when computing fast ice edge confidence, but then do not describe how these thresholds are utilised in the algorithm.

Please provide this detail.

Minor comments on the manuscript

Line 7: visible-thermal infrared imagery – change to "compositing visible and thermal infrared imagery".

Line 38: change ", but at a poorer spatial resolution of âĹij6.25 km (Nihashi and Ohshima, 2015) to limit its" to ", but a poorer spatial resolution of âĹij6.25 km (Nihashi and Ohshima, 2015) limits its"

Lines 65 – 75: this would fit better in the results section.

Line 66: suggest re-order "It also has a multitude of potential scientific and operational uses, given the wide-ranging importance of fast ice" to "Given the wide-ranging importance of fast ice, it also has a multitude of potential scientific and operational uses."

Line 68: remove "developed"

Line 95: Can you estimate how time intensive it is to update the coastlines and ice shelf edge positions on an annual basis?

Line 96: it is not clear what is meant by "change in".

Line 104: where are the data provided?

Line 139: what is meant by "successive"?

Line 139 + 140: provide more detail by what is meant by "sum over".

Line 142: Provide more detail on how the absolute value of the gradient for the composite image was calculated.

Line 149: remove "are set".

Lines 154 – 158: how time intensive is it (on average) to undertake manual processing of fast ice edges? How are the lead-detection images used in the manual processing?

Line 178: replace "Here and" with "Here, "

Lines 195 + 197: provide more detail on how the mean fast ice edge separation between composite subsequent images is calculated, e.g. how do you determine which pixel in the second image to "match" with the pixel in the first image?

Line 202: explain what is meant by "... all remaining manually-determined pixels ..."

Line 223: replace "journal" with "manuscript".

Line 248: confirm whether the time period over which these variations have been calculated is 15-days.

Comments on the data set

In the data set's README file, it states that the latitude of true scale is 70 N. This should read 70 S.

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-99, 2020.