Responses to second set of minor reviewer and editor comments for the article "Mapping Antarctic Crevasses and their Evolution with Deep Learning Applied to Satellite Radar Imagery"

We would again like to thank both reviewers and the editor for taking the time to read and consider this article, which has led to its considerable improvement. After changes made according to initial responses by the reviewers, reviewer #2 was happy to endorse the submission of the manuscript. Our responses to the final minor comments made by the editor and reviewer #1 are tabulated below. We have implemented all of the suggestions of both.

Changes to figures are minor, consisting of replacing "Buttressing Ratio" with "Buttressing Number" and "B" with "κ" in figure 7, and reordering the bottom row of images in figure 10 so that the results for Fimbul Glacier appear before those of Crosson/Dotson. There are minor changes to the text made following the suggestion of reviewer #1 to further proof read the manuscript which have not been detailed below. These can be seen, along with the changes detailed below, in the accompanying difftex document.

Responses to minor comments from the editor:

	Editor	
ID	Editor Comment	Response
A	Please address the remaining suggestions from Reviewer #1 (I count eight of them).	I have implemented the reviewers suggestions and written responses to each comment in the table below.
B	The tense is inconsistent across the manuscript parts, especially for some of the text added in the revision. The methods are currently a mix of past and present tense. Results mix present, past simple, and past perfect ("we have compared"). The past perfect tends to appear most in the text added in response to reviewer suggestions. Please revise. It is not required to write the entire manuscript in a single tense, but it should not waver within a section. The past perfect should be absent, or at least very rare.	Thank you for pointing out these inconsistencies. I have modified the manuscript to make the tenses more consistent. The methods section is still largely written in the present tense as it reflects the fact that the processing is ongoing with the acquisition of new Sentinel-1 data. The exception is where we describe the training of the neural networks, which is now all in the past tense. I have also removed most of the past perfect, a lot of which was in section 4.7. I hope you find it easier to read now these changes have been made.
C	Please revise text to avoid any nested parentheses and consecutive parentheses, such as the following: Line 100 In short, we train the networks initially on a small training dataset of pairs of SAR backscatter images and rasterized calving front positions (manually annotated, and used to train the network in (Surawy-Stepney et al., 2023)) (Fig. 3 (a)). No need to worry about 3 (a) causing nesting issues; I believe the copy editing will remove these to make it just 3 a.	Thank you for pointing these out. I have attempted to remove all instances of nested parenthises.

D	Consider reordering the panels of Figure 6 so that Crosson is consistently depicted either first or second. As it is now, Crosson is in the second row (panels d-f) but comes first in the final row (panel g, i).	This is a good suggestion. I have reordered the panels in the bottom row of Figure 6 to be consistent with the Fimbul-Crosson ordering of the top two rows.
E	Line 590 "Though the features in S23..." is an incomplete sentence	Thanks for noticing this. The sentence structure has been changed here and in the previous sentence from: "Overall, with bounds for the range of the I23 data set to (0.01, 0.1), we see a relatively good agreement between S23 and I23, with both picking up the large-scale patterns of fracture on the Crosson Ice Shelf and displaying relatively little on Dotson Ice Shelf (Fig. 10 (a)-(c)). Though the features in S23 are higher contrast, with lower background noise." to: "Overall, with bounds for the range of the I23 data set to (0.01, 0.1), we see a relatively good agreement between S23 and I23. Both pick up the large-scale patterns of fracture on the Crosson Ice Shelf and display relatively little on Dotson Ice Shelf (Fig. 10 (a)-(c)), though the features in S23 are higher contrast, with lower background noise."
F	Line 639 typo, it says "L23" but this is not correct, likely should be L20	Thank you for spotting this typo, it has been amended in the revised manuscript.

Responses to minor comments from Reviewer #1:

	Reviewer 1	
ID	Reviewer Comment	Response
1	To ensure that the manual annotations were generated without any potential subjective bias from the labelers to match the neural network predictions, it is important to add a statement in the paper affirming that the manual annotations in this particular chosen area were created independently, without seeing the neural network predictions.	Thank you for this suggestion, I agree that it is important to make this clear. The first sentence of the paragraph has been lengthened from: "... we have compared the monthly mosaics to 3 manually annotated Sentinel-1 IW SAR frames." to: "... we compared the monthly mosaics with 3 manually annotated Sentinel-1 IW SAR frames, created independently, without reference to the crevasse maps."
2	Regarding the buttressing number, please remember to change the buttressing number to ratio in Figure 7, B should also be κ.	Thank you for pointing out this inconsistency. I have changed the remaining instances of "buttressing ratio" to "buttressing number" and have changed B to κ in figure 7.
3	Line 102: The added sentence is not complete.	I am not certain which line is being referred to, as the sentences around line 102 appear complete to me. However, the first sentece has been changed from: "In short, we train the networks initially on a small training dataset of pairs of SAR backscatter images and rasterized *calving front positions* (manually annotated, and used to train the network in (Surawy-Stepney et al., 2023) (Fig. 3 (a))." to: "In short, we initially trained the networks on a small training dataset consisting of pairs of SAR backscatter images and manually annotated *calving front positions*, the same as those used to train the network in Surawy-Stepney et al. (2023) (Fig. 3 a)."
4	Line 107: "presence of intensity gradients" → "presence of intensity spatial gradients, i.e. edges,"	I have made the change as suggested.
5	Regarding the $D \in (0, 1)$ notation. Note that if D can be 0 and 1, the notation would be $D \in [0, 1]$	Thank you. The use of $(0, 1)$ was intentional to convey that D is never 0 or 1 in practise (as we use Leaky ReLU activation functions in the network rather than, for example, ReLU activations, and we initialize the network parameters randomly). But you are right to say that the use of $[0, 1]$ is more appropriate as 0 and 1 are included in the set of possible outcomes. I have changed this in the manuscript.

6	In figure 10d, the MODIS MOA2004 map should be changed to MOA 2009 (reference below), which was the version used to produce the map in Lai et al 2020. Haran, T., Bohlander, J., Scambos, T., Painter, T. & Fahnestock, M. MODIS Mosaic of Antarctica 2008–2009 (MOA2009) Image Map (NSIDC, 2014).	Thank you for pointing out this mistake in the reference, I have rectified this in the revised manuscript.
7	Line 637-639: As L20 is from images with 125m resolution, intuitively it should capture larger scale features including rifts and smooth expressions of basal crevasses. Regarding rifts not captured in L20, one should not directly compare Fig10 (a,b,e,d) with L20 as those images are not from 2008-2009. Rifts occurring in 2021 may not have appeared in 2008-2009. Did the authors check that in MOA 2009 there are rifts on the Crosson Ice Shelf that are not detected by L20?	This is true, though the difference in resolution is significantly less than the spatial scale of the rifts and surface depressions on Crosson and Dotson Ice Shelves. I believe that the difference in visibility of the surface depressions in the optical and SAR imagery is more to do with the fundamentals of the imaging rather than the resolution of the images. Regarding the rifts in the MODIS image from 2009 vs the SAR images from 2021, there are a greater number of rifts on the central Crosson Ice Shelf in the former than the latter. Some of those visible in 2021 are visible in the MODIS image, though some have lengthened and widened as they have been advected during the intervening years. I have changed some of the wording of this sentence from: "On Crosson Ice Shelf, the large central rifts visible in Fig. 10 (a), (b), (e) and (d) do not appear in L20 (e), while the flowband features in L20 (many of which appear not to be crevasses) do not appear in S23." to: "On Crosson Ice Shelf, the large central rifts visible in Fig. 10 (d) do not appear in L20 (e), while similar rifts are prominent features in (a-c). Additionally, the flowband features in L20 (many of which appear not to be crevasses) do not appear in S23."
8	Finally, regarding the authors' responses to item 12."Whether the network fills in the gap depends on the width of the rift and the presence of icebergs/melange in the void space between the rift walls. However, this makes little difference in determining the effect on ice dynamics as stresses can't be transmitted through ice that sits between, but is disconnected from, the crevasse walls." I think this is untrue, because the melange's existence in the rift would affect the stress bounty conditions at the rift walls, and affect the ice dynamics.	This is fair enough. You can imagine a situation in which the mélange does change the dynamics of the ice and the assumption that there is nothing in the void space would overestimate the "damage" in the region. It is still perhaps arguable that in order to view changes in fracture denisty as meaningful, it is more sensible for the crevasse map to locate the crevasse walls than to fill in the void space once the crevasses get to a certain size. I have added a sentence on this in section 6.2 ("Trends in Fracture Density as a Meaningful Measure of Structural Change") to bring this to the reader's attention: "Finally we note that, as our fracture maps primarily locate crevasse walls, the widening of crevasses, which could have conceivable dynamic implications, is not measured as a change in fracture density."