

Assessing the sensitivity of the Vanderford Glacier, East Antarctica, to basal melt and calving

Author Responses to Referee Comments

5 Lawrence A. Bird Felicity S. McCormack Johanna Beckmann
Richard S. Jones Andrew N. Mackintosh

Dear Cheng Gong:

We thank both reviewers for their additional review of our manuscript and are pleased that they support its publication in The Cryosphere. Below, we provide a brief response (in blue)
10 to the reviewers final comments (in black).

Sincerely,

Lawrence Bird and co-authors

Reviewer #1 - Benjamin Gatraer

General comments

15 I greatly enjoyed reading this revised manuscript, and found the amendments made to the abstract, introduction, and discussion to greatly improve the clarity of the work. The considerable efforts which the authors made in these revisions, and in further experiments to answer questions raised in the initial reviews, add to the quality of the work and allow the significance of their results to shine more apparently to the reader.

20 I feel that the responses to the initial review are more than satisfactory, and feel much more confident in recommending this paper to be accepted for publication. In my re-reading of the paper, I found no major outstanding research questions which were unaddressed. However, I did find myself distracted by inconsistencies in formatting which I have flagged below. Most of these comments do not reflect on the scientific quality of the manuscript, and I do not think
25 the manuscript needs further referee review.

We are glad that the reviewer feels the revised manuscript is improved from the initial submission and is now ready for publication.

Specific comments

1. The sentence starting on line 64 and ending in “quantifying the relative contributions of these processes on grounding line retreat and mass loss is essential” could be stronger and less vague if it specified explicitly what this knowledge is essential to. This comment is a question of motive and subjective writing style, and does not require correction.

We have amended this sentence to end with an explicit statement of why this work is important:

“... quantifying the relative contributions of these processes on grounding line retreat and mass loss is essential to better understanding the vulnerability of the region to a changing climate.”

2. The text does not always clearly distinguish between the “Vincennes Bay ice shelves” (i.e. line 48) and the “Vanderford Glacier ice shelf” (i.e. line 410). Figure 1 shows a region of connected floating ice labeled as the “Vincennes Bay ice shelf” (singular) with no specific label for the “Vanderford Glacier ice shelf.” Elsewhere, the term “Vincennes Bay ice shelves” (plural) is used, and it is not clear whether this term is used to refer to all of the ice shelves in the study domain. In some places, it is implied that the plural “Vincennes Bay ice shelves” does not include the Underwood Glacier ice shelf (line 353). The language used does not prevent understanding the broader results and implications, but was somewhat confusing when trying to really read in depth. Minor edits to clarify this language and make it consistent with the labeling in Fig. 1 would be helpful.

We have amended the use of “Vincennes Bay ice shelves” to “ice shelves within Vincennes Bay” or “ice shelves across Vincennes Bay” for clarity. We have added a label for the “Vanderford Glacier ice shelf” to Fig. 1 and amended to figure caption to include:

The Vanderford Glacier ice shelf is not explicitly defined by Mouginot et al. (2017), but here we use “Vanderford Glacier ice shelf” to refer to the portion of the Vincennes Bay ice shelf that includes the main trunk of the Vanderford Glacier.

3. Lines 69–71 use a numbered itemization to present the research questions. These could be dropped, which I think would improve the flow of the sentences without sacrificing clarity. Additionally, on line 73, “we are able to infer” can be replaced with simply “we infer,” which is more direct. These comments are a question of subjective writing style, and do not require correction.

We chose to leave the numbered itemisation of the research questions for clarity. We replaced the “...are able to infer...” on Line 73 with “...can infer...” to improve readability.

60 4. Figure 3 contains the word “bold” in bold font, which I found unnecessary and slightly
distracting. Consider formatting in regular font.

We have reformatted the word “bold” to use regular font, as suggested by the reviewer.

65 5. Some figures, specifically Fig. 5 and Fig. 9, have labels with a much smaller font size
that is difficult to read without zooming in. While I did not find this to be a significant
obstacle, it does negatively affect the presentation quality of the paper.

We have increased the size of Fig. 5 and the size of axis labels on Fig 5. and Fig. 9 to improve
readability of both figures.

Technical corrections

70 1. **Volume above floatation in gigatonnes** The clarification of units in the figure cap-
tions, while helpful, does not resolve the fact that volume cannot be measured in units
of mass. While I agree that gigatonnes are a helpful unit to use for the purposes of com-
parison with other studies, the measure describes mass above floatation, not volume. All
of the analysis appears to use mass above floatation, and it is incorrect and unnecessary
to call it a volume. The IPCC reports, when using units of gigatonnes, refer to changes
75 in mass.

We appreciate the reviewer highlighting this point again. To prevent ambiguity and improve
clarity, we have decided to simply report all references to *VAF* and ice volume in km^3 , rather
than gigatonnes. We have updated Fig. 6 and 7, accordingly, and adjusted the values and
units reported on line 237.

80 2. **Inconsistently hyphenated words** Compound words such as “ice shelf,” “ice front,”
“ice sheet,” and so on, are inconsistently hyphenated throughout the paper. As open and
closed constructions are both valid, and TC does not appear to provide a clear style guide,
the authors should choose one and stick with it for all instances of the word. There should
also be consistency in the way attributive constructions of compound words are written.
85 For example, if “sea level” becomes “sea-level” when used as a modifier (i.e. “sea-level
rise,” line 29), then all instances of open compound words should be hyphenated when
used as modifiers. Examples where modifiers are not hyphenated are “grounding line
retreat” (i.e. line 2), “ice front positions” (Fig. 4 caption, line 8). In addition, there are
inconsistencies when compound words have hyphenated modifiers. The best construction
90 makes it clear that the modifier applies to the entire compound word. For example, “sub-
ice shelf” (i.e. line 4) is not the most clear construction. An open compound of “ice shelf”
should become “sub—ice shelf” with an en dash. A closed compound of “ice-shelf” should
become “sub-ice-shelf” with two hyphens. There are too many cases of these words to
reference all of them here, but these issues occur in the main text, captions, figures, and
95 abstract, and should be consistent. At the very least, there should be consistency for a

given compound word in how it is written when it is a standalone noun, when it is the modifier, and when it is modified.

We have removed all reference to “ice-shelf” and “ice-front” and use simply “ice shelf” and “ice front” throughout. We chose to leave the use of “sub-ice shelf” for consistency, rather than using a closed compound formulation for this phrase.

3. **Hyphens as ranges** Per the TC style guide, un-spaced en dashes should be used to denote ranges, but only in cases where no confusion with “a minus b” is possible. A range of numbers should be specified as “a to b” or “a. . . b.”

For example, on line 190:

105 10 - 100 m yr⁻¹

should instead read:

10 to 100 m yr⁻¹

And on line 48:

Fig. 2a-b

110 should instead read:

Fig. 2a–b

These ranges appear throughout the main text, captions, and tables, and should be amended.

We have updated all ranges to include the word “to” when the range includes numbers and to use en dashes when referring to ranges of figures.

4. **Inconsistent capitalization in figure headings** Some figure and table headings and labels are in title case, while others are in sentence case. In some figures, these are inconsistent across similar labels and headings. These should be consistent, and in sentence-style capitalization (i.e. capitalize the first word and proper nouns only). For example, in Fig. 1, “Ice Surface Velocity” and “Vincennes Bay Ice Shelf” are in title case, while “TG basin” and “VB basin” are in the correct sentence case. This issue occurs in Figs. 1–8, 10, and Table 1. Additionally, “x” and “y” are coordinate system variables, and should be treated as mathematical characters when used as axis labels, not as text characters which would be capitalized.

We have updated figures and tables to use sentence case throughout, and use “Easting” and “Northing” in place of “X” and “Y” for figure coordinate labels.

Small typos

We thank the reviewer for their thorough review and flagging these typographical errors. We have reviewed each of these small typos and made corrections/amendments accordingly. We note that the Fig. 7 caption still overlaps the page number; however, since the caption is still legible and final production of the manuscript will address this, we have not worked to reformat this here.

Reviewer #2 - Tyler Pelle

General comments

This is a re-review of Bird et al. (2024) manuscript on modeling of the Vanderford Glacier system in East Antarctica. Thank you to the authors for taking the time and care to complete a series of adjustments to the paper. I think the responses are comprehensive and that you have been balanced and fair in your responses. In particular, it was helpful to see the additional model runs assessing the impact of the 500 year spin-up versus starting the forcing perturbation after the 2 year relaxation period; this is excellent support for the methodological choices. There is good detail in the additional text, both in the manuscript and supplement. Overall, I think this paper provides valuable insights into the forcing required to drive observed magnitudes of retreat of Vanderford Glacier, with important implications for future observational and modeling studies. Thus, I think this will make an excellent contribution to The-Cryosphere. I only have one minor comment, but this will be very easy to address and after, I am happy to see this work published.

We are glad that the reviewer feels the revised manuscript is improved from the initial submission and is now ready for publication.

Specific comments

Figure 6b and associated explanation: Thank you for your explanation regarding retreat in the Weertman $M_{Davidson}$ simulation. Given that this looks like a large grounding line response in the figure but is only due to localized ungrounding of a small ice pocket, it would be helpful to add the figure-2 you provided in the reviewer response document to the supplement and then add a sentence in the main text that points to this figure and explains what is actually happening there.

We thank the reviewer for this suggestion and have added this figure to the Supplementary Information (Fig. S2), adjusted all other supplementary figure numbers accordingly, and added the following text to line 225:

160 “...The M_{Davison} experiment with the Weertman friction law shows rapid grounding line retreat of ~ 2.5 km (Fig. 6b); however, this arises due to minimal ungrounding of a localised area and is not indicative of notable or widespread grounding line retreat. Ice re-grounds rapidly once the perturbation is removed (Fig. S2)...”

References

165 Mouginot, J., Scheuchl, B., and Rignot, E.: MEaSURES Antarctic Boundaries for IPY 2007-2009 from Satellite Radar, Version 2, Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center., <https://doi.org/10.5067/AXE4121732AD>, 2017.