

Thank you to both reviewers for taking the time to re-review our manuscript, and for your positive comments about the edits we have made. We have detailed our responses to the new set of reviews below.

Yours sincerely,

Felicity Holmes (on behalf of all co-authors)

Reviewer 1:

General comments

This is my second review of the manuscript by Holmes et al. which presents numerical modelling simulations of Ryder Glacier to project sea level rise contribution by the year 2300. The manuscript is substantially improved over the previous version and I greatly appreciate the authors efforts to address my comments, in particular improving the abstract, introduction, and including a more thorough presentation of the model relaxation and control simulations. On a second read through I have a few remaining line comments prior to publication that are detailed below.

Thanks for your positive comments about the changes we have made since the last review.

Specific comments

Line 6: change “to Ryder Glacier” to “of Ryder Glacier”

Changed

Line 8: “degree” would be better with a temperature, suggest changing to “amount of ocean warming”

Changed

Line 17: Suggest removing second instance of “current” in this sentence

We have removed the first instance of ‘current’

Line 25: This sentence would be more concise as “...uncertainties on the future behaviour of this region are considered larger than other sectors of the ice sheet”

We have changed this sentence in accordance with your suggestion

Line 40: It’s slightly confusing to the reader that you say “reasonably stable” here and then in a couple of lines say it has “periods of both advance and retreat”. Suggest rephrasing here, to make it clear there has been little net retreat over the past 15 years.

We have changed ‘remained reasonably stable’ to ‘shown little net movement’

Line 52: I think “knock-on impacts” could be clearer, or just removed to be “and the potential impact on sea level rise projections”

We have changed ‘knock-on impacts’ to ‘and the potential impact on sea level rise projections’

Line 57: Consider adding a reference to Ruckamp et al. 2019: Calving Induced Speedup of Petermann Glacier

The reference has been added in

Line 67: Suggest removing “rather puzzling”, it is a bit of a vague statement

We have removed this phrase

Line 76: I suggest labelling Sherard Osborn fjord on Figure 1 so the reader knows where it is.

Sherard Osborn fjord has been labelled in Fig.1a

Line 130: You state “CESM2” and “RACMO” datasets, but do not mention these again when you introduce the specific datasets. In the rest of the methods make it clear where you use SMB from RACMO and CESM2 (e.g. line 139). I also think this sentence would be better at the start of this paragraph, when you first introduce SMB forcing in the model. Then go onto detailing the SMB- elevation feedback.

The reference datasets are now introduced before we talk about the SMB-elevation feedback. We have added in e.g. that the historical SMB was from RACMO/ the future datasets are CMIP6 forced RACMO when they are specifically introduced later in the methods.

Line 243: Heading might be better as “Terminus” retreat.

The heading, as well as the first sentence of the section, has been changed so that ‘Margin’ is now called ‘terminus’

Line 246: Change “spin-up” to “relaxation”, spin-up hasn’t been used anywhere in the text before.

Changed

Figure 7: This figure is much improved and easier to interpret. I suggest making the circles a bit bigger and making the text (especially the SMB Gt/yr) less cramped to improve readability. The legend font could be smaller.

The circles are bigger, more room is given for the text, and the legend font size has been decreased.

Line 324: The statement here “Ryder Glacier is not expected to follow the same trajectory as the Greenland ice sheet as a whole” makes me wonder why you have compared the exact values for your simulations to those of previous Greenland wide studies in the earlier part of this paragraph. It is of course interesting to compare the impact of atmospheric versus

oceanic forcing and SMB versus discharge between your study and Greenland wide ones, e.g. ISMIP6, but direct comparison of mm SLE might be less useful.

We have added a sentence clarifying that we cannot make more targeted comparisons due to a lack of previous studies focusing on Ryder, hence explaining why we are forced to compare our results for Ryder to results from studies focusing on the entire ice sheet

Line 359: Be careful here, marine-ice sheet instability is not just acceleration and thinning over a retrograde slope, but rather than this ice loss is irreversible. I would rephrase to something along the signs of “may be an indication of marine ice sheet instability”

We have changed this sentence to ‘..highlighting the strong coupling between bedrock topography and mass loss’

Line 378: “This trend of an acceleration” reads a bit awkwardly, suggest rephrasing.

We have rephrased this sentence (removed ‘trend of an’)

Lines 447-455: I was also expecting a statement in this paragraph about how the bathymetric sill in Ryder fjord prevents warm water intrusion, perhaps you could include this and add something about how you think this may play a role in future projections. - update - I see this statement about the sill appears further down in the model limitations section, but I’m not sure it is a model limitation really, just a potential control on melt rates. I would suggest moving into Section 4.3 (here).

We have moved this discussion point to sect. 4.3

Reviewer 2:

I would like to thank the authors for revising the manuscript in response to the reviewers’ comments. The revisions have significantly improved the clarity and overall quality of the manuscript. At this point, I have only a few minor suggestions, which are described below. I recommend the publication of this manuscript in TC following minor revisions.

Thank you for your comments on our revised manuscript

Specific comments:

L104: “... so that is varies linearly...” => ...so that it varies linearly...

Changed

L111: “...set to equal half of the maximum melt rate below the floating tongue.”: Why is it set to half of the maximum basal melt rate? Please clarify and add a reference.

We have added in clarification of this point – that the melt rate for grounded fronts was set to correspond to recent behaviour in the absence of any recorded melt rates (or ocean temperatures) for this terminus.

L177-184: This part reads more like a discussion. Consider moving this paragraph to the Discussion section.

We have moved part of this section to the discussion and left a shortened version.

L248: “Here, ...” => “In the Ctrl simulation, ...”

Changed

L283: “the spike in frontal velocities up to 900 m/yr...”: Isn’t the spike in the mean frontal velocity 2,000 m/yr in Fig. 6a?

Changed

L290: (Fig. 7b) => (Fig. 7f)

Changed

Figure 6 (caption): “Where the pink and green lines meet, ...” => “Where the magenta and green lines meet, ..”

Changed