**Response to reviewers**

Ice Shelf Calving due to Shear Stresses: Observing the Response of Brunt Ice Shelf and Halloween Crack to Iceberg Calving using ICESat-2 Laser Altimetry, Satellite Imagery, and Ice Flow Models
Ashley Morris, Bradley P. Lipovsky, Catherine C. Walker, and Oliver J. Marsh

**Overall Comments:**
I thank the authors for their thorough response to my previous review comments. I found the description of the algorithm in the methods section to be much clearer in the revised manuscript. And I am really pleased to see that the authors have expanded the modelling component of their manuscript and appreciate the additional work this must have required. The rationale for the modelling component is now very clear, and the results provide new insight into rift propagation and calving mechanisms, which is a great additional result from the observational data you have generated.
I suggest that the manuscript be published after a couple of clarifications, and some very minor technical corrections.

We thank the reviewers at all stages of review for their careful assessment of the manuscript drafts, and for their suggestions that have greatly improved the manuscript. The suggestions for furthering the modeling component of the research in particular has yielded significant improvements and additional results.

**Minor/Technical Comments:**

L5: suggest 'rift development', rather than 'rift propagation, widening, calving, and stabilization'.

We thank the reviewer for the suggestion to make this sentence more concise, but in this instance we have chosen to maintain the original wording as it describes the rift processes in which shear stresses play a role.

L8: suggest removing reference to 'inboard rift' as it is not used anywhere else in the manuscript and seems unnecessary here.

As pointed out by the reviewer, the reference to Halloween Crack as an "inboard rift" is not used elsewhere in the manuscript. We have removed as suggested.

L61: you could include something extra here to emphasise the new things that paper does compared to the last version, e.g. 'proposes first steps to include shear stresses in commonly used ice sheet calving laws based on the findings of our model analysis'.

The last paragraph of the introduction describes what is done in the remainder of the manuscript. As pointed out by the reviewer, this did not include reference sufficient reference to the results arising from the extension to the modeling work; the order of sentences has been changed and a

sentence similar to the one suggested by the reviewer (and consistent with the wording in the abstract) has been added.

Figure 1: inset box is labelled 5f, but it should be 4f (as in the caption)

We thank the reviewer for their very detailed reading of the manuscript here! The inset box label has been corrected.

L185: why choose 5 m/a for uniform error? Based on your own exploration of the data? Or another paper that used this method? Would be good to see that explained here.

To the best of our knowledge, no error field is provided with the feature tracked velocity fields derived using Sentinel-1 image pairs and the SNAP toolbox. We therefore had to make an assumption about the error field. Velocity errors can arise as a result of co-registration error (which is generally small) and cross correlation errors (which can be large locally). We attempted to minimize cross-correlation errors by preforming cross-correlation on multiple image pairs and selecting the pair for each model time period on which cross-correlation had preformed best, as well as using an averaging filter to suppress noise. We performed test runs of the ice flow models with different uniform  error fields, before proceeding with the uniform value of 5 m/a in the X and Y directions. We have expanded the text in the manuscript to specify that we performed additional tests before proceeding with the uniform 5 m/a assumption.

L199: …importance ‘of’ various factors control’ing’ rift…

The suggested language corrections have been implemented.

L207: this is the only part of the methods section – the model boundary conditions – that I think could be slightly clearer. So along the boundaries you specify (MIR, BIS/SWIT divide, grounding zone) you apply Dirichlet boundary conditions? If so, it clears up another question I had about how you simulate the buttressing provided by MIR if the domain of the model is drawn to exclude MIR itself – you prescribe the ice velocity at the MIR boundary?

Thanks to the reviewer for flagging this important omission from the previous manuscript draft. The main grounding line of the ice shelf, the grounding line of the ice shelf at McDonald Ice Rumples, and the divide between Brunt Ice Shelf and Stancomb-Wills Ice Tongue (the eastern boundary of the model domain) are the areas through which ice enters the model domain. Dirichlet boundary conditions are applied/ice velocity at the boundary is prescribed. We have specificied in the manuscript that Dirichlet boundary conditions are applied at the grounding lines and divide.

L480: … HC opening rate provide consistently …

The suggested language corrections have been implemented.

L482: … evolution of ‘the’ system of …

The suggested language corrections have been implemented.

L485: Why ‘Halloween Crack’ not HC here?

“Halloween Crack” has been abbreviated to HC, consistent with the remainder of the manuscript.

Supplement

Additionally, we updated the numbering convention of sections, figures, tables and equations in the supplement to be consistent with the standards of The Cryosphere, and changed the colour of some plots in figures S20 to S23 to reduce visual distortion for readers with colour-vision deficiencies.