Response

In this study, Wang and co-authors investigate how a piece broke off iceberg A68 when it collided with the seafloor near South Georgia in 2020. While our understanding of iceberg-ground collisions are limited and there is a need to find ways to represent these processes in models, I don't see a clear path for this manuscript to contribute a significant advancement. Two central concerns are

(1) The documentation of the collision and resulting breakup is not new. Huth et al (2022) presented on this rather clearly, including a representation of the breakup in their modeling account, which uses a bonded-particle iceberg [I am not a co-author of that paper]. Therefore, the contribution here would be to gain fundamental insight into the physical processes of how iceberg-ground collisions drive breakup, and I don't believe this is convincingly provided. This brings me to my 2nd comment.

Response: Thank you for your comments. We appreciate your attention to previously published study (Huth et al. 2022) in the field. We also cited it heavily in this research. Huth et al. 2022 did an excellent study on iceberg calving when it drifts in the ocean, and the primarily cause of the calving was from ocean current, which can be seen from the title "Ocean currents break up a tabular iceberg". Huth et al. (2022) is probably the first research paper on modeling of tabular iceberg calving with a numerical model. However, the main focus of this study was not about collision with seamount triggering iceberg calving, but ocean currents shear. This is quite different from our research, which focuses on iceberg calving triggered by collision with sea mount.

Huth et al. (2022) also provide one set of parameters for iceberg calving study when drifting in the ocean. Using this model, they modeled the evolution of A68a from December 9 to 23. The iceberg calving around December 17 was also shown in Figure 2a (Huth et al. 2022). However, the calving line was not validated with remote sensing results. Moreover, the sensitivity of different parameter on iceberg calving was not discussed as can be seen from the last paragraph of Huth et al. (2022).

The breakup of A68a caused by collision with seafloor was reported by different media, website and Huth et al (2022). While it is also true that the calving

discussed in our study was modeled by Huth et al (2022), there are several important distinctions that set our main finding apart and contribute to its novelty.

Our research is new because we are the first to show the grounding status of A68a when it drifted close to the South Georgia Island. Figure 6b and 6c in our study clearly showed these results and two rift lines was shown during the collision with sea mount. This finding is not discussed in Huth et al (2022), and a highlight of our research.

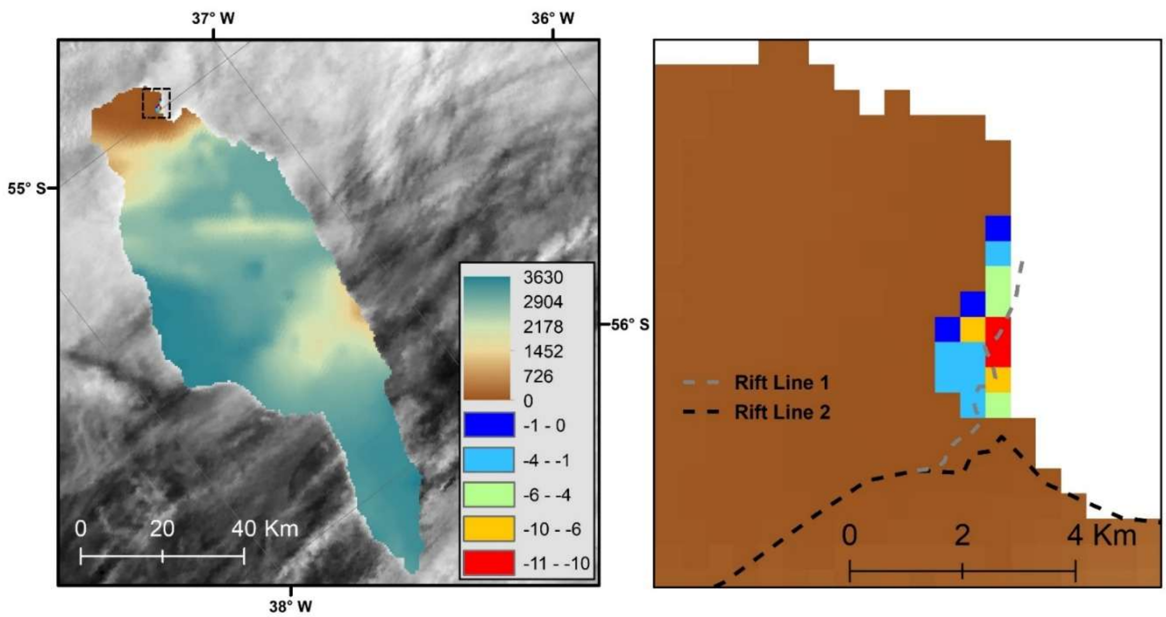
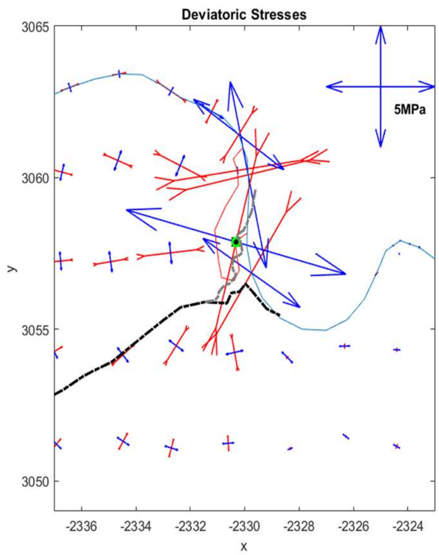
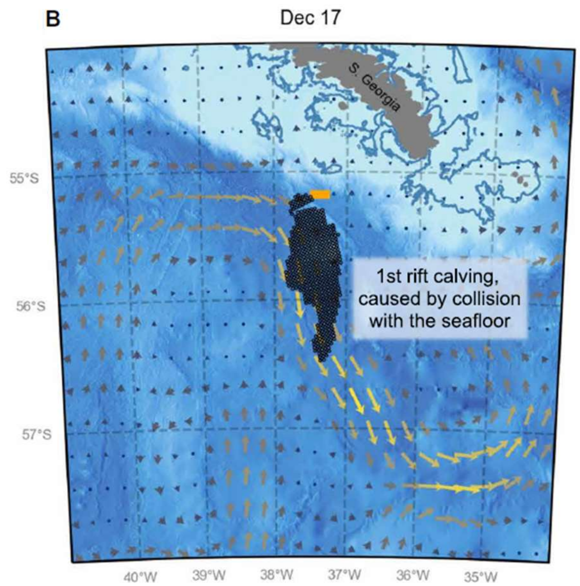


Figure 6b and 6c in our manuscript.

Additionally, we are the first to find that two rift lines existed during the collision. Using Ua modeling results, we clearly pointed out the break up was initiated from calving line 1 (gray line in figure7c), not the calving line 2 (black line in figure 7c). This finding was not appeared in Huth et al (2022), which is another highlight of our research.

Thirdly, we analyzed the sensitivity of grounding status, drifting velocity and rotating velocity during collision with Ua and find the nonlinear response in glacier model to these changes. These are the most important findings of our research, contributing to better understanding of iceberg-seafloor interaction. This is also important complement of Huth et al (2022) as they mentioned in the last paragraph, page 5 "nor did we document the sensitivity to parameters …"





Comparison of Figure 7c in our manuscript (the left figure) and calving of A68a (the right figure) in Huth et al (2022)

We want to draw your attention that the two rifts mentioned in Huth et al (2022) is not the same two rifts appeared in our study. Our two rifts are all from one calving event related to collision with seamount. However, the two rifts mentioned in Huth et al (2022) are from two different calving event, one from collision with seamount, the other from ocean water shearing. We hope these did not confuse you in the review process.

(2) The authors use Ua to model this collision and breakup. This is a rather befuddling choice of model, since Ua is an idealized large-scale ice flow model using a shallow shelf approximation. My understanding is that it is designed to model viscous creep of ice sheets/shelves over long time periods and at large spatial scales, not the rapid and comparatively small-scale fracture of icebergs. The choice of this model is not justified in the text, nor are potential issues with temporal or spatial resolution discussed in any way.

Response: Thank you for your feedback and raising the concern regarding the applicability of Ua in iceberg calving modeling. To be honest, we were uncertain about this until we saw the comparison of remote sensing with modeling outputs (The maximum tensile stresses appeared on rift line 1 and was

perpendicular to rift line 1, figure 7c in our manuscript). As few models were used to study iceberg calving, it is important to make a first try. We extract the calving line using remote sensing images and found the collision of A68a with sea mount can trigger large tensile stresses perpendicular to rift line 1, which indicates Ua can replicate the interaction of iceberg with seamount. Although there is no calving law applied or glacier cannot break off in Ua, it is important to try and complement the model in the near future.

However, we did not follow Huth et al (2022), who used a threshold of tensile stress to tell ice breaking, as the character of icebergs calved from different ice shelf of Antarctica may be different. We are not sure what threshold should be universally used to tell the calving of one iceberg. That's why we did the sensitivity analysis of grounding status, drifting velocity and rotating velocity during collision with Ua. We find the maximum tensile stresses changes nonlinearly with change of these parameters. We believe Ua works well in iceberg calving modeling as the change of the maximum tensile stresses was clearly shown in Ua output and the location and direction of the maximum tensile stresses makes sense when comparing with rift line extracted with remote sensing.

As no calving law is applied and ice cannot break in Ua, we made a diagnostic, rather than prognostic running of Ua and no temporal resolution issue exist in our study. All grid data input to Ua were at a spatial resolution of 1 km.

One way forward I can see for this study to become a valuable contribution is through validating that the Ua model can indeed meaningfully represent such fracture events. This could be done for example by comparing it to a model that represents the iceberg as an elastic/brittle object (which is the relevant rheology on the fast time scales of fracture events). This would entail a considerable amount of extra work and lead to a fundamental reframing of the study.

Response: We did do the comparison of remote sensing with Ua output in this study. According to Benn et al., 2007, Cuffey & Paterson, 2010, and Alley et al. 2008, when stresses exerted on an iceberg exceed some threshold, fracture tends to occur and develop perpendicular to the maximum tensile stresses. From Ua modeling output, we found that the location of the maximum tensile

stresses was on rift line 1 and the maximum tensile stresses was perpendicular to the rift line, facilitating rift occurrence. Also, Ua modeling suggested a large enough maximum tensile stresses when iceberg A68a collided with the seamount, which tends to break the iceberg. These indicates that Ua works in iceberg-seafloor interaction and Ua modeling results make sense.