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Interactive comment on "The transferability of adjoint inversion products between different ice flow models" *by* Jowan M. Barnes et al.

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We thank the referee for their review, which will be helpful in improving our manuscript.

In response to the point about section 4, we would argue that similarities and differences between the inversion outputs are of great interest. The nature of inversion is that infinite solutions are possible, even when using the same inversion method, due to the ill-posedness of the problem. Our three models use different methods, and so there is theoretically no reason to assume that they would produce similar results. Through inversion processes, it could be possible to produce velocity fields with low misfit compared to velocity measurements, but with fields of B or Betaˆ2 which do not physically represent the system. This is why we feel it is important to examine and compare the

fields of B and Betaˆ2 before moving on to their application in transient simulations, and that the misfit alone is not necessarily an indicator of the quality of the inversions.

Regarding the transient simulations, a factor of 2 in the sea level contribution may sound large, but it is important to assess this within the right context. Several examples are listed in section 5.2, but this review makes it clear to us that significant expansion on this point, and some detail of other studies we are referencing, is required in the text to highlight the significance of our results. As one example, the control experiment in the initMIP-Antarctica comparison (Seroussi et al., 2019) shows a range of sea level contributions between -243mm and +167mm for the whole of Antarctica, with different models using different initialisation procedures. Within this range are a few examples of simulations run with the same models which differ by factors >3 due to differences in their initialisation. This, and results from other referenced studies, will be explicitly stated to aid in contextualising our results.

We agree with the referee that running diagnostic and transient simulations in all three models rather than just one is a good idea, and it is a point which the authors will act on. We hope that this will eliminate any doubt over the quality of the models we are using, reinforce our argument and help us to build a stronger case.

In general, the argument for Úa inverting for B across the entire domain is simply that we do not have definite information about the value of B. Not inverting for it assumes that there is zero uncertainty in the initial values imposed, which is not true. In the context of this work, we set out to compare the inversions produced by our models implementing their normal methods, and to show that despite the variety in the methods the results are physically robust. The difference in the B inversion is part of the variability between our methods, and not one of the controlled variables. An explanation to this effect will be added into section 2. The result of Úa turning off inversion for B is looked at in the appendix, section A2 (column c in Fig. A2). In this experiment, the speed misfit is higher, as the referee expects. The distribution of Betaˆ2 in this case remains consistent with the other experiments. This is mentioned in the main text (although perhaps needs to be emphasised) in section 4.4.

In response to specific comments: There are indeed artifacts which need to be fixed in Fig. 6c. This will be done. Line 235 refers to the misfit (Vdiff), and the wording will be updated to clarify this.

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