

Interactive comment on “ADISM v.1.0: an adjoint of a thermomechanical ice-sheet model obtained using an algorithmic differentiation tool” by J. McGovern et al.

J. McGovern et al.

mcgovej@gmail.com

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1 Introduction

We thank the first anonymous reviewer for their comments on our manuscript. We note that the reviewer has taken a predominantly negative view of the work, largely on the basis of a perceived lack of scientific contribution, and a descriptive approach which rehearses already well-known ideas. Unfortunately, it seems clear that the reviewer has fundamentally misunderstood the purpose and scope of the journal, and hence has not evaluated the manuscript according to the appropriate criteria. We elaborate

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on this view below, as well as answering the other, specific points made by the reviewer.

2 Scientific originality and descriptive approach

The main issue the reviewer has with the paper is that “it does not bring any original contribution to knowledge/understanding in the field of interest”. Unfortunately, this demonstrates a fundamental misunderstanding of the Geoscientific Model Development journal (GMD).

GMD is rather different in aim from most journals. Its primary purpose is to facilitate the publication of descriptions of numerical models, rather than being a place to explore new science. As such, it is to be expected that the models described in its pages may be based on established ideas and principles, and do not need to be innovative in this respect. What is important is that the detail of the model's approximations and numerical methods are described accurately and with reasonable completeness. The inclusion of the model code as a supplement is encouraged, so that any subsequent scientific work which uses the model is based on code of known provenance.

As the recent GMD Editorial () states, “it is not a requirement of a GMD paper that it contains novel scientific discoveries. The review itself should focus on the clarity and rigour of the model description or development. . .”. Furthermore, the Editorial makes it clear that for model description papers (of which our manuscript is one), what is required is “the underlying science of the model, details of numerical schemes, examples of model output, user manuals and source code”. In this context, the reviewer's comment that “The computational software (forward and adjoint codes) may be a useful tool for the glaciological community” indicates strongly that the description of the model should be published. Consequently, we strongly disagree with the conclusion reached by the reviewer, and reassert that the manuscript represents an entirely appropriate submission to GMD.

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3 Other comments

The reviewer makes a number of other comments which we seek to address here.

- **Additional references** — we thank the reviewer for bringing these to our attention. They will be added to the revised version of the paper, and discussed appropriately in the introduction.
- **Section 2: AD description can be found elsewhere** — We do not present a detailed description of the whole of AD, which can be found in other papers. Rather we give an overview of some of the theoretical basis of AD for the benefit of glaciologists who may not be familiar with it. As glaciology is a multidisciplinary subject, we have tried to strike a balance between technical accuracy and accessibility to non-mathematicians. As background, it is clearly necessary for what follows, and we make no apology for including it.
- **Section 3: the description of the forward model is ‘classical’** — See comments above about the purpose and scope of GMD.
- **Section 4: the adjoint description is too technical** As noted above, it is expected that there will be more technical material in GMD papers than in papers in other journals. Material relating to the compiling and running of the code is in the supplement. However, technical material describing the physics of the forward model and the way the adjoint was obtained with the OpenAD tool (Section 4) belong in the body of the text, and not in the supplement. This is so as to properly describe the model development as a whole, and to inform other workers of some of the pitfalls of applying AD to existing codes.
- **Section 5: validation of forward model** — We note the reviewer’s criticism of the validation exercise, although little detail is given on how these could be

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improved. The reviewer states that “no error quantification is presented”. We acknowledge that we could have compared the model with the exact solutions of Bueller et al ; , and we will do this in our revised paper. However, it is also necessary to evaluate the performance of the model for the Greenland domain. Since we do not expect the model to reproduce the true geometry of the Greenland Ice Sheet very accurately, the evaluation is necessarily less rigorous. In the case of the EISMINT3 comparison, the original model outputs from that experiment were not available, and no numerical metrics were available for application to our model output. Output from ADISM was therefore only compared by eye with the EISMINT3 plots of steady state surface elevation. The reviewer rightly notes that this is less than ideal. A better comparison would be to compare the ADISM output with that from a comparable, established model (e.g. Glimmer-CISM). We will do this in our revised paper.

- **Discussion: 500-times speed-up.** As the reviewer notes, the speed-up is grid-size dependent. We will clarify this in our revised paper.

References

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