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Geoscientific Model Development Discussions
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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.

Anonymous Referee #2

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The aim of this paper is to present an adjoint model of a thermodynamic ice sheet model, based on algorithmic differentiation using open source software. The functionality of the implementation is demonstrated by re-running selected EISMINT benchmarks test. It is stated that the adjoint model is "500 times more efficient" in computing sensitivities compared to deriving sensitivities in the"usual" (forward) way.

We are very skeptic as to whether the paper warrants publication in GMD. This is because the "focus on the clarity and rigor of the model description or development" (quote from the author's response to Reviewer 1, taken from the GMD editorial) is missing that is required when intending to publish not necessarily novel research material in GMD, as is here the case. We consider the material in the sections dealing with ice

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sheet thermodynamics (Section 3) being textbook standard, and definitely don't see a need to present the material in such length. Unfortunately, even the sections devoted to the description of the adjoint model remain do not meet the standards of GMD. E.g., Section 2 is both too brief (2.1) and too specific (2.2-2.4) and thus excludes readers which are not already familiar with adjoint models from really benefiting from the model description. Section 4, presenting the adjoint model, is over-structured and includes technical aspects that are specific to a degree that make the paper "un-interesting" for the non-expert. We suspect that readers that do not yet have experience with adjoint models find it hard to follow the technical description and benefit from it. Section 5 (forward model verification) relies on rather old benchmarks, and Section 6 (testing the adjoint model) seems to be prepared a little hastily as it does not provide all information needed to interpret the results, which definitely require improved visual presentation. The discussion and conclusion section are very 'thin'.

We are aware of the fact the the implementation of an adjoint model is a huge task, and we also acknowledge that it seems to have been achieved successfully. However, in its present form, the manuscript does not warrant publication in GMD.

Specific comments:

5.1. Comparison with EISMINT2 benchmark

EISMINT2 benchmark experiments A and H are repeated. Do we really need a repetition of the description of these old benchmarks? Would not a remark suffice that the present implementation did well, and then just give Table1?

Fig 2: Are the original EISMINT figures very similar to the ones given here? If yes, what is the point of reproducing these figures here?

5.2. Comparison with EISMINT3 Greenland benchmark

We miss a plot here. A plot of these results would be much more interesting than the plots in Fig. 2 because 'no original data were available' (by the way: why is that so?)

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for EISMINT 3, as the authors state. But, the EISMINT 3 is still very outdated as the authors themselves realize ("we are aware that ...") so we are skeptic whether one should at all include this section.

6.1 Adjoint of the model configured according to the EISMINT2 benchmarks

Fig 3: The plots are not very clear. Visualization of results needs major improvement. We have difficulties recognizing what is shown even if the document is enlarged to 300%.

What is a unit perturbation?

6.2 Adjoint of the model applied to Greenland

Order of figures: Fig 5 is mentioned before Fig 4. Irritating.

Fig 5 a: mention should be made on which data set this plot is made. Just 'from observations' is not enough.

Fig 5 and b: what is the spurious ice mass north-west of Greenland? (upper left corner of plot)

Fig 4 a and b: look very alike. Is the point to show that adjoint and forward sensitivities are the same? One almost gets the impression although we don't think that this is what the authors want to convey, unless they are satisfied with showing that their method works ....

What exactly is meant that a perturbation factor of 10ˆ-8 is applied? That sounds very small. It would be interesting to see how adjoint and forward sensitivities differ when different perturbations are used.

We don't understand lines 15-20 in this section.

Section 7. Discussion

Do the sensitivities really have no numerical error at all? What about the numerical

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grid?

Miscellaneous:

Where is Fig 1 a referenced to in the text?

Where is the Supplementary material referred to in the text?

Interactive comment on Geosci. Model Dev. Discuss., 6, 5251, 2013.