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Interactive comment on "An optimized treatment for algorithmic differentiation of an important glaciological fixed-point problem" *by* Daniel Goldberg et al.

Anonymous Referee #1

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This paper presents an application of the adjoint fixed point iteration proposed by Christianson (1994) to the MITgcm ice flow model. The paper describes motivates the algorithm, describes the basic principles and the implementation and demonstrates its usability on two problems. Overall, the article is well written and demonstrates the benefits of Christianson's algorithm over applying AD "naively".

I only have a few technical comments:

* Section 5: It would be interesting to state the solver tolerances, and the number of required Picard iterations.

* Lines 463ff: The performance of the LU-solver will degenerate with the size of

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the problems, as direct solvers typically scale worse than well-preconditioned linear solvers. Hence, this sentence should be phrased more carefully.

* Figure 2: From the text description it is expected that for a forward tolerance of 10-9, the error would be 0 (as it is assumed as the ground truth). Adding this data point results in a big jump from 10-9 to 10-8. What is the reason for this?

* Table 5: It would be interesting and usefull also list (and discuss) the required Picard iteration numbers that were used in the forward/adjoint solves.

* The references should be checked for correct spelling (e.g. names in titles should be captitalized)

* Lines 469-484: This paragraph is essential and I would have liked to read it earlier. The question that this paragraph adresses is: The adjoint equations are linear, so why does one need to perform a (computationally expensive) Picard iteration at all?

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