Review by Anonymous Referee #1

Summary

This paper presents a new workflow built on OGGM that allows improved inversion of glaciers and the construction of dynamically consistent states suitable for use as initialisation for prognostic simulations. The method is applied to idealised versions of four glaciers as a proof-of-concept and shown to work quickly and effectively in refining the coarse initial guess at the glacier profile derived using two different current methods and then running forward to hit the target 2020 state across all four glaciers and regardless of whether the glaciers are assumed to be advancing, retreating or in dynamic equilibrium.

This is a very thorough, well-written paper that convincingly presents the new workflow. The only thing missing is an application to real cases, but that is very deliberately set outside the scope of this paper by the authors; I only hope that they do shortly follow up with such a study! Certainly, as presented, the method is undeniably effective in the synthetic cases included in this paper. Otherwise, I have only a few comments of a very minor nature, so I recommend the paper be accepted subject to minor revisions. Congratulations to the authors – this looks very promising!

Thank you!

Page and line numbers refer to those in the clean version of the revised manuscript.

Major Comments
- None

Minor Comments
- p.1, l.4: OK, even in the tortured world of academic acronyms, I'm really struggling to see how the authors are getting AGILE out of 'Open Global Glacier Data Assimilation Framework'. Obviously, the setup can be given any name the authors want, but the way it's currently written implies it's some sort of acronym that the reader should be able to derive from the words and it...just...isn't? At least not without just picking an entirely random subset of letters. Either call it OGGDAF (don't call it OGGDAF), or write it as something like 'We present the Open Global Glacier Data Assimilation Framework, named AGILE' to make it clear that it's just a name that the authors like rather than an abbreviation of something in the long-form name. I'd be tempted to say change it in the paper title too, but I think that would make the title a bit unwieldy, so just making the change in the abstract and then in the introduction at l. 65 should suffice to unconfuse the reader.

- Figure 1: I might suggest adding, either to the caption or as a legend in the figure, something explaining that the things in green are the control variables that the model is trying to match. They're all listed in the caption, so it's not too bad to make the logical jump, but including the colour information somewhere would help the reader.

  Thank you for the suggestion. We have added the color information to the caption as:

  "The mismatch between the model output and observations **(depicted in green)**,..."

  Just to clarify wording, the observations shown in the figure are not the same as the control variables. The control variables refer to the model parameters that are iteratively adjusted to minimize the cost function and reduce the mismatch with the observations. These control variables are not directly shown in the figure. To avoid such confusions in the future we adapted a sentence in the caption:

  "If the cost function has not reached a minimum, all control variables **(i.e., the unknown variables we aim to estimate)** are updated simultaneously …"

- p.6, l.132: Were they discussed in Section 1? The introduction definitely covers the context, but I don't think it specifically discusses the choice of these particular variables and their implications in reality, unless l.75-79 is meant? Which is a quite high-level summary and doesn't name the specific variables. Possibly, I'm getting confused, but maybe there needs to be some additional information in the introduction, or this reference needs to be modified.

  Those are listed and discussed in L24 - L36, but we have not explicitly linked this. With implications for real world application we meant the discussion about shifting towards glacier-specific observations as datasets have become available (L25-L29). To make this connection to Section 1 more clear we adapted the sentence at L132 as following:

  "The choice of these variables and the implications for real-world applications **were** discussed in Sect. 1**: these are the currently available global datasets used by the glacier models participating in GlacierMIP3."**

- p.9, l.233-234: Might be worth adding where these glaciers actually are so the reader can understand better that they do represent a range of different climates (I certainly know where Aletsch and Baltoro are, I think I have a rough idea for Peyto, no idea for Artesonraju)

  We agree that this additional information helps readers better understand the climatic diversity of the selected glaciers. We have added the mountain range and continent

- Figure 3 caption: typo for Aletsch ('Altesch')

  Thank you, corrected .

- Figure 4 caption: 'Panels a and d show…', 'Panels c and f illustrate...'

  corrected

- Figure 5 caption: same idea – if you've got two panels showing something, don't put the verb in the 3rd-person singular.

  corrected

- Figure 6 caption: 'The gray shaded area…', 'after 20 iterations.'

  corrected

- p.18, l.408: 'where the number of model runs increases substantially…' - 'a lot' is a bit colloquial

  corrected

- p.21, l.428: 'depending on if'

  corrected