Review of "Four North American glaciers advanced past their modern positions thousands of years apart in the Holocene"

October 16, 2023

Letter

Dear Editor,

Upon re-reading the manuscript, it is clear that the authors have put substantial consideration into the comments from both reviewers, and the manuscript is very much improved.

From my perspective, there are minimal scientific comments regarding the manuscript at this point. However, in my opinion there are many places where the language can be imprecise and the writing can be clarified or condensed. Again, these are matters of discretion for the editor and authors, however, I believe that by addressing these issues the quality of the paper will increase substantially. The list below includes some places where improvement is likely needed. But, it is not exhaustive and additional changes might be needed. There are also a few minor scientific comments and suggestions.

With these comments, minor revisions are likely necessary, and I do not believe I need to see the manuscript again. However, I am available as the editor wishes.

Again, hopefully these comment prove useful and congratulate the authors on there near-completion of this work.

Specific comments

- Line 59: "We attempt to minimize the complexities of comparing glaciers to one another by focusing on glacier area change rather than area alone, which should control for the differences in hypsometry and background climate.": I am not sure what is meant precisely by this comment as both area and area change are a result of hyposmetry and background climate.
- Line 67: "more heterogeneity than expect": what would you expect? some rephrasing needed.
- Line 128: What does "internal" mean?
- Figure 2: Would this figure be improved if a title was added to each row for instance *Exposure* for the first, *Burial* for the second, and *Re-exposure* for the third? That way readers can easily translate the process in the figure to the terminology in the text.
- Paragraph at Line 174: Because the Monte Carlo method is discussed, I would recommend making the two parameters evaluated very explicit here.
- Line 177: I am not sure how this list can be "exhaustive" especially given the parameters shown in the paragraph starting at 199 and the temporal discretisation presented in the model. Is it necessary to include? Also, if it is an exhaustive list, would this be a "grid search"? If so, explaining this would improve the model.
- Line 178: "the model calculates how 14C and 10Be concentrations evolve" change to *the model calculates the evolution of 14C and 10Be concentrations.* Similar issues exist in other parts of the text.
- Paragraph at Line 196: Much of this content was presented in the first paragraph of the section and is closely linked with the next paragraph. Some reorganization of the section might be needed.

- Line 213: "Scenarios that reproduce all nuclide concentrations for all samples at a given glacier are recorded and saved as viable exposure-burial histories" why not write *Scenarios reproducing all nuclide concentrations for all samples at a given glacier deemed as viable exposure-burial histories.*

- Line 217: "overlapping" this term is repeatedly used through out the text. However, I have not found a clear definition of it. To me it seems visually evident in plots in the supplement. However, this needs to be clearly described here, and forgetful readers (like myself), might need a little reminder of what it means when it is discussed in the results.

- Line 230: "The RGI data are from miscellaneous years based on what was available in RGI." This sentence must be more precise or excluded.

- Line 249: "Apparent exposure ages are presented in Table 1 and plotted onto satellite imagery of the glacier forefields in Figure 3." I noticed that the authors seem to include sentences like this at the beginning of paragraphs and sections describing a Figure or Table. The text will be far shorter and more interesting if these comments are omitted. It should be enough just to reference the figure in the text.

- Paragraph at Line 249: it is not clear to me if these are ages from 10Be or 14C. or both. Please describe.

- Line 257: see comment for Line 249.

- Table 1: Would it be helpful to make a row for each glacier that has its average of each column for that glacier? This may make it much easier for readers to extract the key points or messages from the table.

- Line 273: "The second observation is that 14C-10Be sample ratios at JIF Glacier, Kokanee Glacier, and Mammoth Glacier are depressed." Depressed compared to what?

- Line 278-279: "Low ratios are only possible through extensive decay of 14C relative to 10Be, severely limiting the number of plausible scenarios." maybe change plausible scenarios to *plausible climate/glacier scenarios.* Otherwise, a nice sentences that concisely describes an trend in the data. Consider moving to the top of the paragraph, so that it is in the readers' minds as they interpret you findings.

- Section 4.2: Some comments about the meaning of the results might help in this section.

- Line 295: "We plotted. . . ". See comment for Line 249.

- Line 308 - 310: Super interesting. I believe Reviewer 2 made some comments about this in the last draft and to me it is great that the authors pursued this further. One potential thought that I had was to compare these results to "modern erosion rate" from Cook et al., 2020 (which the authors do), then discuss the findings in terms of finding by Ganti et al., 2016 (Time scale bias in erosion rates of glaciated landscapes), for instance. I hope this is not too much of a tangent (more an idea). If it is, please ignore.

- Figure 5: I would recommend adding "Ice Free" to the axis underneath the "Probability of Exposure." This may reduce some confusion for more "glaciology" focused readers may not thinking in terms of "exposure."

- Line 340: "It has also retreated more than the composite of Sierra Nevada glaciers." this needs a citation.

- Table 2: Can this table be organized so that the two most important quantities are right next to each other? For me, the two most important bits of information are response time and %LIA Area. It will make it easier to compare these values.

- Line 374: Why would this be surprising?

- Line 396–398: This is a very complicated sentence. Simplify?

- Line 427: “then it should be replicable by modeling”. Can the section or figures that show how this was not replicated by modeling be shown or referenced?
- Figure 8 caption: “Erosion rates are marked by red vertical tick marks along each scenario (black dashed line), starting from an erosion rate of 0.0 mm yr-1 on the righthand side progressing to 5.0 mm yr-1.” Very nice way to plot this. However, it took me a little bit to understand. Can this be rephrased? would it help to remove some isochrons? No problem if not.
- Lines 477-482: Dirk Sherler, amongst others, has some papers about this. Comments would be improved if this was supported by some observations and citations.
- Line 484: “This interpretation is plotted in Figure 7...” This sentence is a bit confusing and can be omitted by just referencing Figure 7.
- Paragraph at 529: This is probably correct, strictly speaking, but a little bit hard to follow and understand the main message. If the exact figures are needed, then the Table can simply be referenced.