Climate of the Past Discussions

Clim. Past Discuss., referee comment RC1
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Comment on cp-2021-106

Anonymous Referee #1

Referee comment on "Late Pleistocene glacial chronologies and paleoclimate in the northern Rocky Mountains" by Brendon J. Quirk et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-106-RC1, 2021

This manuscript presents valuable new data from the northwestern USA from an area where more study has been needed. Furthermore, it also provides valuable and important modeling simulations (constrained by the evidence) that allow authors to infer possible or likely temperatures and precipitations that expanded the glaciers that formed the glacial deposits. Having both in the same paper is done quite elegantly by the authors. The authors then use their findings to discuss possible changing climates south of the Laurentide and Cordilleran at the end of the last deglaciation.

Despite my numerous comments, and some items I think need to be revised, I enjoyed reading the paper and look forward to seeing it in print eventually. I would put my rating as moderate revisions, as none of them should be that difficult for the authors to address. My most important comments probably are how the cosmogenic nuclide data are calculated and presented (see below). This may affect the interpretations; not in a major way, but enough that they should be addressed. Also, see other major comments below (i.e., not just clarifying or typos).

In general, it is well organized and written, but there are some awkward and even at times unclear sentences, a few grammar problems, and a few typos, that are easy enough to fix (below) before publication

Lines 20-21 – near former ice sheet margins?

Line 22. results, which show?

22-25. This sentence is awkward or confusing as it seems two parts? One is explaining

conditions that caused LGM (late or peak?) I think, other part of sentence is timing for end of LGM? I suggest two sentences.

41-43..Pleistocene…Pleistocene… (awkward writing)…cosmogenic nuclide chronologies..

56. in some areas, they coalesced….

90-91 – how do you know 200 m thick and in excess of 300 m? can you add one more sentence saying how derived (lateral moraines, other?). Or give a reference?

100-101 – same question as 90-91. Just mention briefly or give a reference(?).

126. If no numerical ages, how did Fullerton "identify" a bull lake and pre bull lake? Maybe say Fullertin inferred?

128. please give a 1s or 2s calibrated (for 14C) age range here, or the uncertainty that the online calibration software gives.

136-137. Some of this is albeit beyond this manuscript to address. But. I think the way this is phrased is slightly awkward.I do not fully understand their comparison to the global LGM as discussed. The timing of maximum extent of the LGM sensu stricto, that is the coldest part, may have varied slightly around the world. And, although maximum limits sensu stricto were maybe before 19 ka (Clark et al), there was still a lot of ice around until at least 18 ka and even later in places, as shown here. I think there is a bit of apples and bananas being compared in the 136-137 line. Yes, middle Pinedales were not as extensive as maximum Pinedale extent (global LGM?) by definition. Does it mean still local LGM conditions? Not 'clearly postdated.'

A point is, how do the authors interpret or see the global LGM as defined in Clark et al.? In terms of how Clark et al define the global LGM (ice sheets, Volume, Sea level?) and do the authors agree it is apples and apples to compare their findings? Simply saying younger than Clark et al LGm does not give reader context for how Clark et al (2009) define it , and what this paper shows? Maybe the authors can clarify.

143- this text or other paper's text?

148-149. same comment. I am not sure what it means to say 'critically after the end of the global LGM' How is the global LGM defined compared with their mountain glaciers? If all rocky mountain recorded being discussed here go to 18 ka-17ka, maybe that is the end of the local LGM?

157. They interpreted…

166-167 – awkward writing.

183. …on their crests?

Figure 2

caption. Would be helpful to say which scaling scheme used (Lm, St, LSD?).

Also, in text, you say there are bedrock samples? Which are bedrock? Caption states all red circles are boulders? Maybe use a different color symbol?

Also, relevant to a comment below, can you say if there are Bull Lake moraines shown on Figure 2? If so, how far from the Pinedale as mapped? I cannot help but ask (see below), given the info provided in this manuscript, whether any Bull Lake deposits if they exist (?) could be early Pinedale?

For example, in top image are there right lateral Bull Lake moraines visible in imagery?

If yes, I know too late, but one or two samples in future work would help determine if indeed they are Bull Lake or early Pinedale? If Bull Lake does not exist in field area, obviously my comment is not relevant.

Lines 203+ Maybe I am missing it, but can you mention where your moraine cosmo samples are in the context of frontal or lateral moraines? If only in the frontal moraines, for example, could there be less earlier landforms preserved (due to later outwash, etc)? That is, versus the laterals? Even a sentence or two.

206. typo/grammar

238 – was this measured more precisely?

In the Cosmo section

A little more info is needed here or in background. Semi arid? So, relatively dry so not a ton of snow to cover boulders through spring? Are boulders in a forest? Or areas sampled not forested (one image has a thin forest). Any samples above tree line, so not have to worry about trees or forest floor (e.g.,snow, fire)

More important though: 1) While I agree in principle with the idea of using a local production rate calibration (promontory point), I recall this rate was slightly higher (or at least different) than other rates. While this may be correct, and it is indeed higher here (compared to the rest of the world?), I think the authors should at least use another production rate for comparison and mention this. Maybe the SPICE rates (Fenton et al) or even one of the other coherent rates at mid-high Northern Hemisphere latitudes.

2) the authors need to give St, Lm, and LSD in a table. All three scaling schemes. There is a reason the output gives all three scaling schemes, especially still Lm/St.

3), and say what is the difference between them? Between LSD and Lm, for example? So reader knows what is possible range?

Now, it is possible LSD is the most accurate for this part of the globe, and some would say likely, however, if you can make a statement that differences are only a few (?) or 5%, that would help the reader see it does not even matter.

284 to 296. Can you give a reader an idea how much this 'secondary stuff' really matters?

<5% difference in your final values (assuming reasonable variability of these tuning knobs)?

374 – which on figure 2 are bedrock samples? Is everything not on yellow in figure 2 bedrock? Perhaps use a different symbol color on figure 2?

Figure 4. What are the errors? The internal or external uncertainties in the table? For comparison to each other from the same field areas, I would only show the internal errors on this plot, which is really just showing us the results compared to one another. Also, I have no sense of whether Lm or St are significantly different, if you are to use those schemes – even if you have a reason to prefer LSD (fair enough).

Yep, bedrock notoriously has inheritance, even at middle latitudes. Not surprised.

Table 1. I would have a separate Table 2 with all three scaling schemes, St, Lm, and LSD. There is a reason they are output. If you feel the need for space issues, perhaps put in supplement with AMS ratios.

Figure 5. the modeling adds a very nice touch to the study.

463. Just to confirm double check, you said earlier you recalculated literature ages (licciardi and Pierce) and are also presenting these with promontory point production rate, in LSD space?

More important though, 17.5 +/- 0.6 and 18.2 +/-0.5 overlap at 1 sigma (or 1 SEM), so you cannot say they are different. I agree, taken at face value it seems so, but statistically you cannot. The 16.9 ka is younger indeed.

I would give an (n=x) after each 'ka' when presenting the mean ages. So, the reader has an idea of the robustness of the mean.

Also, you could just compare the analytical (internal) uncertainties, as the sites are so close to each other the differences in scaling probably can be considered negligible.

471 moraines…?

479. See comments above about this comparison. What is global as defined by Clark et al in relation to outer middle pinedale?

536-537. Could middle Pinedale just be the same extent as early Pinedale, so you do not see the latter preserved?

Also, I do not have a sense of where the 'inferred' Bull Lake is. It is not shown on Figure 2 or 1. Can you rule out that some of what has been traditionally mapped as Bull Lake in this area could be early Pinedale? Not that I am arguing for this, and the authors may see it as an extreme devil's advocate position, but as I do not have any sense of where the Bull Lake is on Figure 2, so I ask the question.

566. Mumma et al (2012) attributed.

Figure 6. The modeling work is very nice and authors should be commended. One question – is the modeling giving an 'annual temperature' ? On plots such as this, and in the text, is the reader seeing annual temperature or do authors interpret this as an annual temperature? Or a summer temperature (which drives ablation)? This might make the discussion even more informative than it is already.

608-616. See comment above for Figure 6 regarding how the reader should think about these temperatures – annual or summer? I assume PMIP is annual.

647. …range…

….648. Stadial…

Figure 7. Just remind reader that squares and error bars represent 10Be ages +/- 1s (or something else?). they mention the 18.2 ka, so I have impression we are looking at both mean ages and individual bedrock ages plotted? Hence, just please clarify.

557. need to define lateglacial somewhere. I get the impression authors are discussing more than just YD and ACR time? Not sure, hence please clarify.

662. timing of terminal moraine abandonment. Please clarify precisely what is meant. Do authors mean findings of early Pinedale elsewhere versus what they found? Or abandonment of terminal moraines no matter what their age in a given area, terminal moraine abandonment whether 23ka or 18-17 ka?

Or do they mean – as I understand - instead that the timing of terminal or maximum moraine formation is variable….? The timing of maximum glacial expansion? Hence, writing not clear.

677 – same comment as prior.

678. Somewhere define lateglacial as they use it.

Figure 8. I wonder if panel D would be more readable or visually better to have a legend on the left side (instead of defining all these things in the caption). Just a suggestion.

Other

Define what normalized against? Normalized (or standardized) to what?

Also, remind reader if panel D items are based on cosmo dating or modeling? Discussed in text, but maybe good to remind reader briefly how these symbols are plotted (model results? Cosmo based?)

693. See comments above about LGM. I am not sure what this means – is this then a local LGM?

704 – see above comment about temperature.

707 typo.

Supplement. Need legend of colors and other info – black line, white line, etc. Also, probably should add what background image is. May be obvious, but cannot hurt to repeat it, so figure cation stands alone, reader does not have to go back through main paper to understand figure.

Supplement table.

1) If you have the concentration or density of the spike added (carrier), that would be almost equally important (not quite, but useful), to add. This would be in ppm typically. In text you just give a value of 1000 ppm I recall – was it measured more accurately?

Also, please add whether you subtracted 10/9Be ratios of blanks from 10/9Be ratios of samples, or you calculated 10Be atoms actually in the blank, and subtracted this # from 10Be atoms in each sample?