

Clim. Past Discuss., referee comment RC2 https://doi.org/10.5194/cp-2021-54-RC2, 2021 © Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.

## Comment on cp-2021-54

Anonymous Referee #2

Referee comment on "Early Holocene cold snaps and their expression in the moraine record of the eastern European Alps" by Sandra M. Braumann et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-54-RC2, 2021

## **Summary of the manuscript**

This manuscript presents 27 new Be-10 dates on the timing of Holocene glacial advances in the Eastern Alps of Europe and correlates them with inferred meltwater events within the North Atlantic. Their findings corroborate previous studies from the Western Alps and peripheral regions of the North Atlantic, which is glacial advances in those regions were the result of cold atmospheric temperatures being advected eastward from the Atlantic, and that the Atlantic was cold as a result of a slowdown in AMOC, which was a result of enhanced freshwater input from the Laurentide Ice Sheet.

## **Summary of my assessment**

This manuscript was an absolute delight to read! Scientifically, the results support the conclusions (with a few very minor exceptions, discussed below) and the discussion was beyond interesting, it was enlightening. Aesthetically, the writing was silken, the figures were beautiful, and the logical organization of the manuscript was thoroughly evident. In my opinion, this paper should be published with a few moderate and several minor revisions.

## **Major Points**

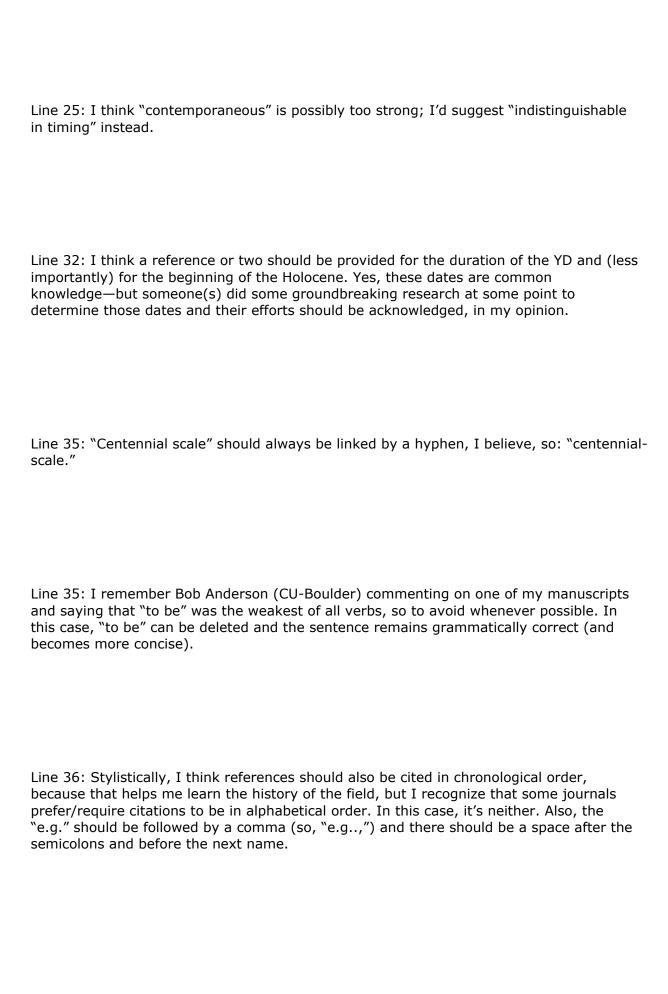
As I said, I have no "major" issues with this paper. I do, however, have three "moderate" points for the authors to consider:

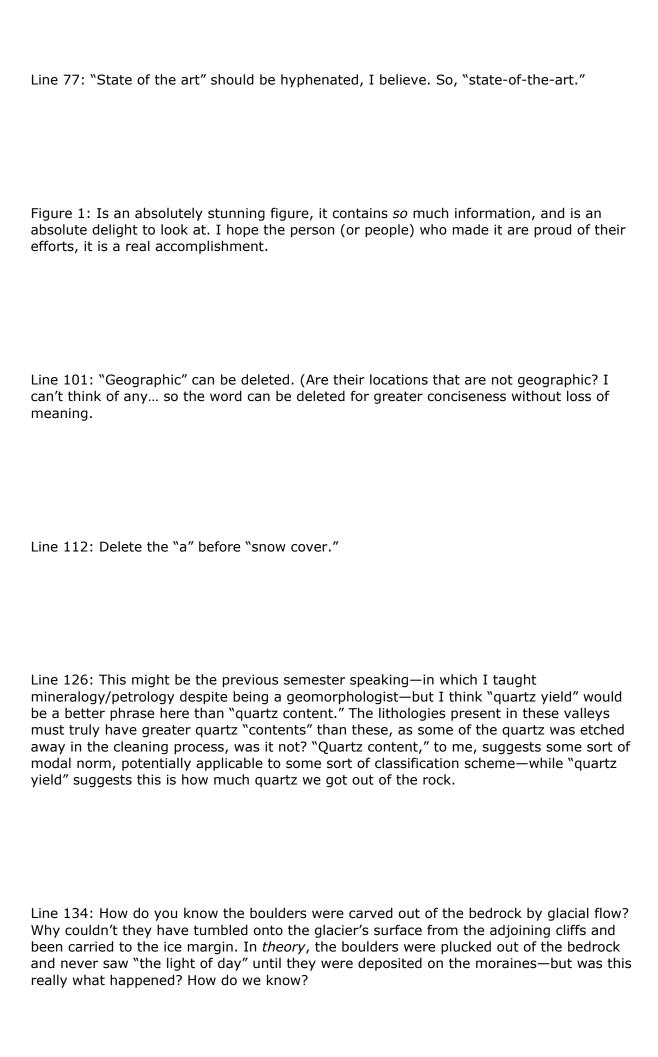
First, there is a slight age inversion between MFI 4 (dated to  $10.8 \pm 0.7$  ka) and MFI 3 (dated to  $11.2 \pm 0.8$  ka). While these two events are indistinguishable in timing from each other based on the Be-10 dates, we know from the geomorphology that MFI 4 must be older than MFI 3. While this apparent age inversion is noted on line 407, it isn't (as far as I noticed) mentioned again. Thus, the discussion on lines 437-441 seems strange. The authors say MFI 3 falls within the PBO (defined as 11.30-11.15 ka in Europe), but MFI 4 does not. In reality, MFI 4 must have preceded MFI 3, so if only one of them is associated with the PBO, it's more likely MFI 4. In short, I don't see how both of the following could be true: (1) MFI 3 correlates with the PBO and (2) MFI 4 postdates the PBO and correlates with a summer cooling detected in Swiss and Austrian lake sediments.

Second, I was surprised that the authors did not acknowledge the possibility that the boulders dating to c. 700-1500 years ago (JAM-18-07, JAM-18-16, and LAR-19-23) were actually deposited more recently (c. the  $18^{th}$  century?) and contain inherited nuclides from prior exposure. The evidence from these two valleys for glacial advances c. 500 CE and c. 1300 CE is tenuous, in my opinion. The data *permit* glacial advances at those times, but the evidence is not compelling. I was pretty skeptical of glacial advances at those times in these two drainages—until I read about the evidence elsewhere in the Alps for glacial advances at those times (e.g., the boulder from Ochsental dating to 1500  $\pm$  40 years, the sediment and peat profiles from various glacial forefields in the Eastern Alps, and the documented glacial advances in the Western Alps at those times. In light of the evidence from elsewhere in the Alps for glacial advances at c. 500 CE and 1300 CE, I think the interpretation presented by the authors—that these two valleys also hosted ice advances

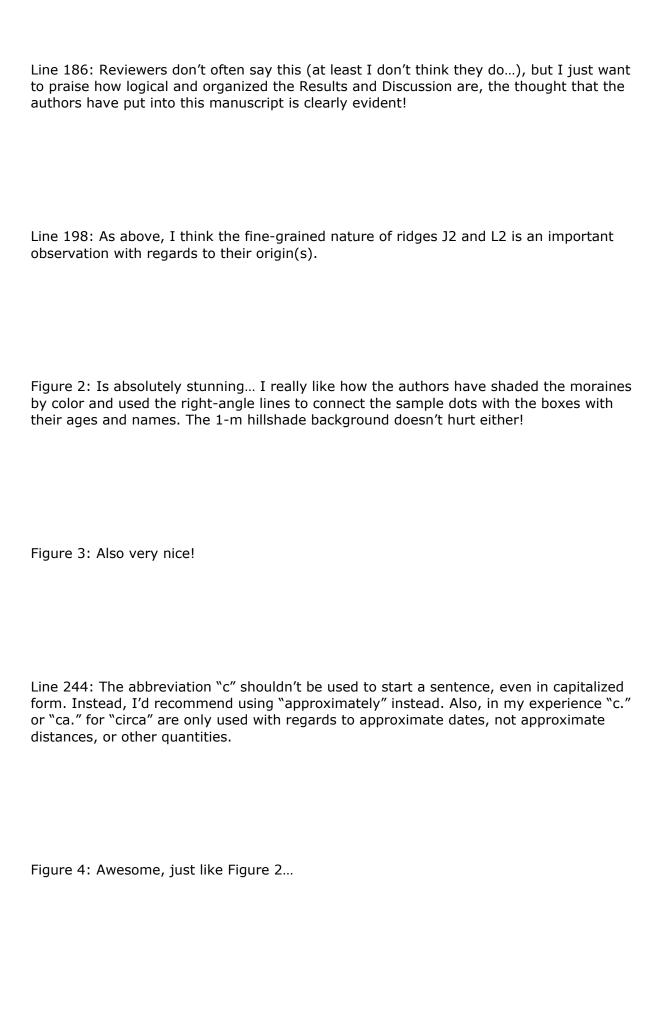
at those times—is reasonable, but the alternative possibility, that these three samples contain inherited nuclides from prior exposure should be discussed in the text.
Third (and perhaps less importantly than the two previous points), I find it curious that both valleys have moraine ridges just outside the LIA margins that are ~8-10 m wide, rich in fine-grained sediment, and devoid of boulders. While the authors suggest these ridges (J2 and L2) might be equivalent to the c. 10 ka Grüne Kuppe moraine in the adjacent landscape of Ochsental (lines 452-465), the fine-grained nature of these ridges seems anomalous—and suggests to me that they have a different origin from the boulder-rich ridges (moraines) present in these alpine valleys. In particular, I wonder if J2 and L2 might be some sort of push-ridge associated with the LIA advance? That's speculative, of course, but no more speculative (in my opinion) than their potential association with the Grüne Kuppe moraine. In any event, the true age of the undated J2 and L2 ridges is <i>not</i> an essential point to this manuscript—but their fine-grained nature <i>does</i> seem anomalous and cry out for an explanation.
Minor Points
Line 16: I think there should be a hyphen between ice and margin.
Lines 20-21: I think the MFI should be listed in chronological order, so oldest first.

Line 24: I think "millennial scale" should be hyphenated.









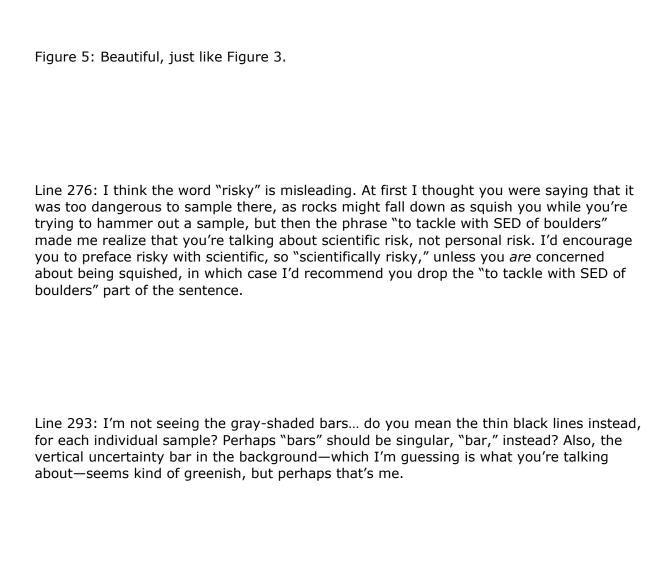
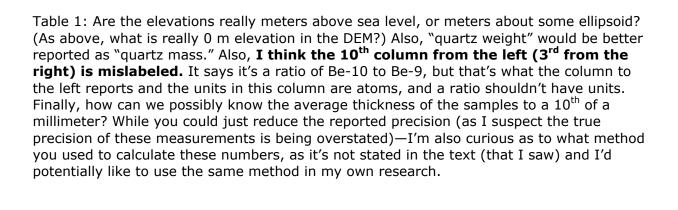


Figure 6: Also, while we're talking about Fig. 6, I don't really understand the differences between the three types of uncertainty you report on the mean age, and I think other readers might also struggle. I understand total uncertainty (reported in red) is the production rate and spike uncertainty added in quadrature, but I don't really understand the importance of the difference between the 1-sigma uncertainty (±16 years) and the standard error of the mean (±9). I guess I would have thought they were the same thing, with the "standard error of the mean" being the correct term and the "1-sigma uncertainty" being the not-really-100%-approved-by-statisticians version of the "standard error of the mean." Your paper isn't the place to teach readers about statistics—but a few sentences somewhere in the text about the differences between these things would help me (and I think others) out. (Thanks for considering this request!)

Line 300: I think "supplements" should be capitalized, and the final "s" in it dropped. So, "Supplement."

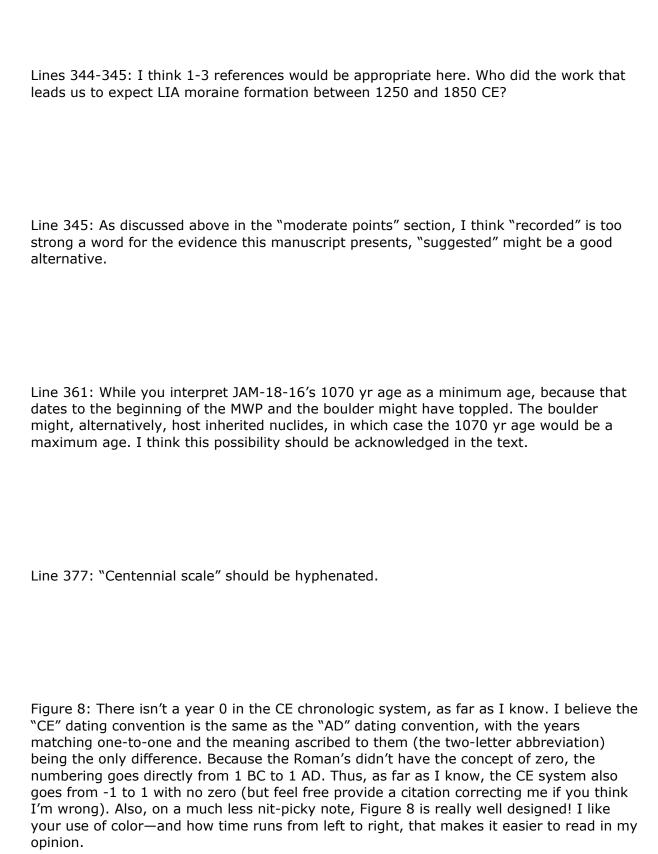


Line 313: "11 230" should be reported as "11,230" or, alternatively, all the other 5-digit ages should be reported in the same fashion, with a space between the  $3^{rd}$  and  $4^{th}$  digits.

Lines 323-327: This advancement—of adding a late spike of Fe to help process small-volume samples—seems worth of a sentence in the abstract, in my opinion. It's a really methodological advancement for cosmo, I think, and well worth highlighting, in my assessment.

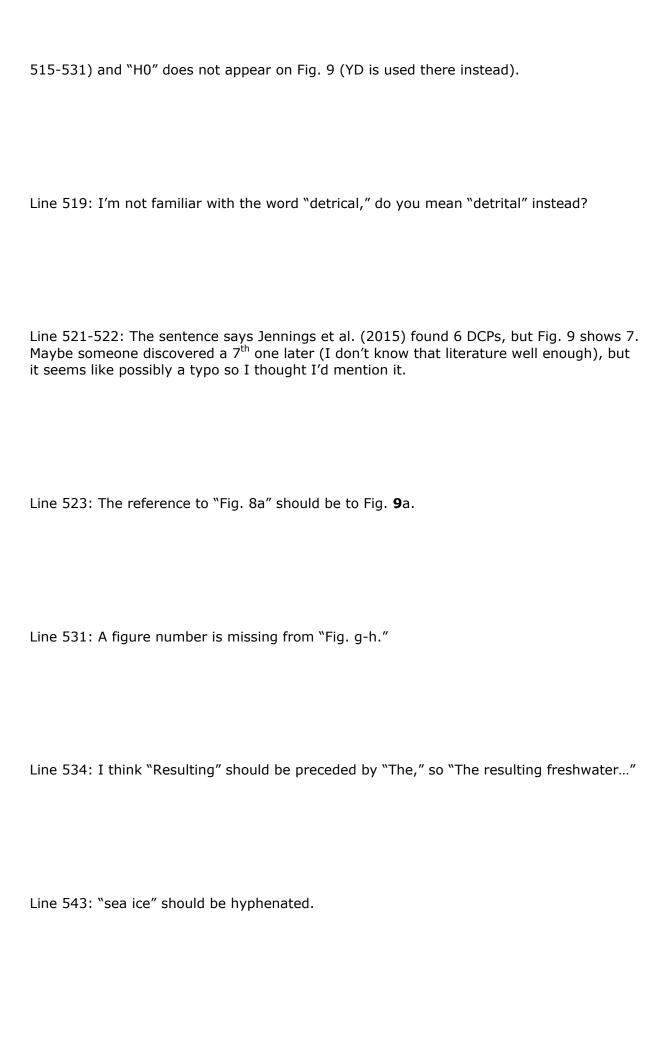
Table 2: Same 4 points as for Table 1 above.

Figure 7: Same comment about the meaning of the reported statistics (i.e., what's the difference between the 1 sigma uncertainty and the standard error of the mean) as for Figure 6. In other words (in case my point/uncertainty has been unclear), what are these two statistical calculations telling us? When would/should we refer to one and when should we refer to the other?











Line 632: Is "inatura" supposed to be capitalized? (I don't know but it seems likely to me.)
The Supplement: Once again, it's really nice that you included multiple photos of every boulder, I like your thoroughness!
Supplement, 5 <sup>th</sup> line to the caption for Table A2: I think the "therefore" in "and was therefore used to quantify" should be deleted, its unnecessary (the sentence makes sense without it).
One final note: thanks so much for submitting this manuscript to Climate of the Past. I know reviewers don't often tack on such comments—but your manuscript was such a delight to read, and the figures were so well made!