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Climate of the Past Discussions

Interactive comment on "Re-evaluating the link between the Laacher See volcanic eruption and the Younger Dryas" *by* James U. L. Baldini et al.

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We thank the reviewer for reading our manuscript, and for their helpful and supportive comments that have improved the manuscript. Our responses to Reviewer #4's comments have been uploaded as a supplement.

Please also note the supplement to this comment:
https://www.clim-past-discuss.net/cp-2017-147/cp-2017-147-AC8-supplement.pdf

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2017-147, 2017.

Reviewer #4 Comments and Responses:

Comment #1: The subject of the Younger Dryas cooling is one of considerable interest and fascination in the scientific community. Here, most research has been dominated by one theme that the cooling was triggered by a freshwater flood, or rerouting of meltwater, to the North Atlantic ocean. The idea that the YD cooling might have been triggered by a volcanic eruption has received much less attention and is very interesting.

Response #1: As the reviewer notes, there has been essentially no modern research on whether or not the Laacher See eruption could have triggered the YD, largely because the evidence available suggested that the LSE predated the onset of YD cooling (GS-1) by ~200 years. Given that the last few published review papers on the YD do not even mention volcanism, we feel that this is a valuable (and novel) contribution, and we are glad that the reviewer finds it interesting.

Comment #2: Overall, I really enjoyed the paper. It's very well written, easy to follow, and provides a nice break from the more typical meltwater-trigger hypothesis. Indeed, I found the discussion about the sensitive of climate to intermediate ice volume conditions, and the alignment of this 'ideal' configuration, to the timing of the YD very enlightening.

Response #2: We thank the reviewer for these supportive comments.

Comment #3: But whether a volcano actually triggered the YD is hard to tell from this paper. Yes, there was an eruption around the time of the YD cooling, but did it really produce a 1000-yr cooling? As such, the manuscript would have been vastly improved if the authors had done their own climate modeling. I think it would have been fantastic to try and see whether a volcano could have triggered a YD-like cooling. Indeed, the authors note that previous studies (fig 2) released 10-time LESS SO2 to the atmosphere than what is estimated here. Whether these experiments should be undertaken, I will leave that up to the authors, but I'm not going to rejecting this paper simply because they were not carried out.

Response #3: We really appreciate the reviewer's perspective on the inclusion (or not) of modelling. Although we agree that modelling is important, we feel that this is outside the scope of the current submission, and best left for future research. The reason is outlined at length in our response to Reviewer #2's comment #2, as well as in new text that we have added to discuss relevant models. Essentially, model simulations of the response of AMOC to volcanic forcing over the last 1000 years have yielded ambiguous results, with some models predicting that eruptions strengthen AMOC, and others predicting a weaker AMOC. Still others suggest initial strengthening, followed by long-term weakening. We strongly feel that under the considerably less-well constrained deglacial conditions, modelling results would be even more ambiguous, and results would not necessarily be robust. We hope that this manuscript would provide the motivation for substantial future modelling work on the triggering of the YD by the LSE, and we feel that modelling support (or not) would need to come from multiple climate studies conducted over several years.

Comment #4: Finally, I wasn't sure if the MWP-1b discussion was really needed. The existence of this period of rapid sea level rise is still very much debated, as is its source, with various camps arguing back-and-forth over an Antarctic or Laurentide contribution.

Fig. 1.