

Comment on esd-2021-2

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Community comment on "Reduced-complexity model for the impact of anthropogenic CO₂ emissions on future glacial cycles" by Stefanie Talento and Andrey Ganopolski, Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-2-CC2>, 2021

This is an interesting paper and I feel the many steps in the modelling process are relatively well described. While I think it is reasonable to use conceptual models for this kind of study, there are a few assumptions which I find a little questionable and should be justified better (or the implications of which should be discussed in more detail). After having read the paper, I have read the comments made by other reviewers and I am inclined to agree with many of the points raised by Reviewer 1.

In particular, I think the following assumptions require further discussion:

- The constraining the minimum ice volume to the pre-industrial levels is not well justified in my opinion and its impacts are unclear. As others have commented here in the reviews, perhaps at least considering other past warmer periods is necessary if this study is to be seriously considered as realistic, particularly for the warmer high emissions scenarios.
- Likewise, constraining the ice volume to not glacialate for the first part of the record – what effect does this have if this constraint not included? Does the model often glacialate without it? Although it seems unlikely, I don't think there is so much evidence against this being a possibility that it can simply be prescribed.
- What might be the impact of the assumption that natural and anthropogenic CO₂ signal are separate and can be linearly combined? This was also raised by the reviewers.
- One point which I had not thought of, but was mentioned by Reviewer 1 (their comment 3) and I think is worth echoing relates to the choice of the Pearson's correlation threshold of >0.7 and the 'accepted' simulations out of the full 'valid' set. Are the 'accepted' simulations in general those with higher correlations?

I have a few other queries which the authors may want to consider clarifying:

- I am curious to know do you have an explanation of why the 10kyr time lag between the natural and 500PgC scenario in Figure 8?
- Line 422: Does the low 500 PgC scenario suggest a scenario where some of the CO₂ already emitted is drawn back down? This value is less than what has already emitted as quoted from the Le Quere et al. 2018 paper. I think this should be clarified.
- Finally, it might be useful to reference a technical report on a similar topic that was produced for SKB (similar to Nagra who funded this work), where probabilistic future projections (or maybe 'scenarios' is a more appropriate word, following on from Reviewer 1's comments) are shown. The report is available here https://www.researchgate.net/profile/Jens-Ove_Naelslund/project/Climate-and-radioactive-waste/attachment

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