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Climate of the Past Discussions

Interactive comment on "Technical note: Pleistocene climate sensitivity to CO_2 forcing is path dependent in reconstructions" *by* Roger M. Cooke and Willy P. Aspinall

Anonymous Referee #1

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This paper is about linear regressions in paleo data between global mean temperature change ΔT and radiative forcing of CO_2 (called ΔF CO_2), from which, in principle the slope of the regression (ΔT / ΔF CO_2) might be used as a paleo-data based estimate of climate sensitivity S.

The paper is set up as "technical note" which should, according to the guides to authors "report new developments, significant advances, and novel aspects of experimental and theoretical methods and techniques which are relevant for scientific investigations within the journal scope".

Actually, I can not see any of such things in this draft. One might argue, that the authors

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make a case, that such linear regressions gives different response if the regression lines are forced through the origin, as suggested by some authors. Here, the authors try to argue for those regressions which allow an offset / bias in y, while others have argued, that maybe a non-linear regression might therefore be necessary to account for a state-dependency (von der Heydt et al., 2016; Köhler et al., 2017). Furthermore, they argue that regressions differ for glaciations or deglaciations (what they call partitioning by path). This is nothing new, and has been analysed in Figure 3 in Köhler et al. (2017), although for the relation of ΔT and ΔF caused by CO_2 and land ice, but see below on the difference and how useful it is to make the distinction (as done by the authors) for only ΔT and ΔF CO_2.

Being a technical paper, I do not even see progress in the regression analysis. The two data sets analysed do not consider the uncertainties in the individual data points, which are known to influence the regression analysis, and the resulting r^2 largely, e.g. see Press et al. (1992). Though, these uncertainty in both x and y has been included in other studies (e.g. Köhler et al., 2017; Snyder, 2019) (so, again no progress).

Furthermore, if paleo data are used to estimate for climate sensitivity from it, which is a measure typically used for an estimate of global warming as response to a doubling of CO_2 it is absolutely necessary to account for slow feedbacks in the climate system, mainly the land ice albedo feedback (PALAEOSENS-Project Members, 2012). If not accounted for the resulting S will be much too high and is completely useless for any application on future climate change (e.g. for $2\times CO_2$). For example, the number for S only caused by CO_2, called $S_{[CO_2]}$, based on data of the last 800 kyr was 3.1 K/(W/m^2), which is reduced to 1.1 K/(W/m^2) if land ice is considered (called $S_{[CO_2,LI]}$, and down to 0.7 K/(W/m^2) if all the available greenhouse gases and slow feedbacks are included, then called $S_{[GHG,LI,AE,VG]}$, see Table 2 in PALAEOSENS-Project Members (2012).

Thus, the given “explanation” of 64% of temperature change by CO_2 radiative forcing is only stating a statistical relation, but no explanation at all, and is due to a lot of missing processes simply wrong.

This paper brings nothing new, and what it shows is in all aspects too short and too simplified. It therefore should be rejected without any further revision. Even a major effort can not bring it to a paper suitable for publication, not for a general research paper and certainly not in the category of a technical note.

Minor issues:

1. Martínez-Botí et al. (2015) is a paper on the Pliocene and temperature and CO_2 said to be taken from that paper are certainly also only taken from somewhere else. Thus, the original references are missing here, eg CO_2 is taken from the ice core community.

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