

# Second review of Stap et al. 2018

The revised manuscript is greatly improved from its original form with regards to the scientific material and with regards to the clarification of the author's methodology. I am providing my comments on the current version of the manuscript. Most of these are minor technical corrections/ language suggestions.

## Comments and suggested technical corrections

1. The abstract does not include results on the findings of the efficacy factor. Please incorporate the efficacy factor estimate into the abstract.
2. In the beginning of the abstract the authors start by discussing the ECS from climate simulations and then they mention about correcting them to compare to paleodata. But I don't think this is what the paper is about; isn't the whole method of the paper to instead correct paleodata to compare it more directly to ECS from climate models?
3. Page 1 line 6: "This renders the **prevailing** approach"
4. Page 1 line 13: "does not consider **differences in** efficacy"
5. Page 2 line 4: "fast feedbacks **e.g. through such as those involving changes to .....** changes.
6. Page 2 line 5: "climate models, **as** for instance"
7. Page line 10: The authors say the long term changes "are not taken into account in the quantification of ECS", but I think what they mean is that they "are not taken into account in the course of estimating ECS from proxy data."
8. Page 2 line 14: "**global globally** averaged"
9. Page 2 line 17: There are two things wrong with this sentence. Firstly, the "sole effect" of CO2 is not simply the ECS, it also includes the response of land ice and vegetation to the increased radiative forcing, but which operate on timescales belong the ECS. One wouldn't want to give the impression that those processed do not involve CO2. Secondly, the ECS is not the "sole effect" of CO2 also in the sense that it includes the primary effect from CO2 but also the secondary effect of feedbacks from short-term processes. I think it should say "... the effect of CO2 changes as the accompanying short-term feedbacks, as described by the ECS can be estimated"
10. Sentence on page 2 spanning lines 27–29 is convoluted. Please rephrase it
11. Page 2 line 29: "**Hence, In this manner**, we can assess"
12. Page 3 line 4: "in this section, we **recapitulate first summarize** the approach to obtaining climate sensitivity from paleo data **that has been** used in"
13. Page 3 line 6: "We **also then** discuss **the our** main refinement **we make in this study to that approach**, ..... refinement that **is meant to unify unifies** the dependent variables ..."
14. Page 3 lines 10-11: This is the third repeat of the definition of ECS (previously mentioned at the start of the Abstract and the Introduction). Please remove it.
15. Page 3 line 12: "such as **those involving changes to** ice sheet ..... **changes** are kept constant"
16. Page 3 line 14: "**taking** the ratio ... **over to .....** **leads to yields**"
17. Page 3 line 20: "**perturbation record**"

18. In the comment spanning pages 3 and 4 that discusses the use of the PALEOSENS members' approach to estimating climate sensitivity from paleodata, also mention the use of the approach to estimating sensitivity within modelling studies (e.g. the PALEOSENS paper itself and Chandan and Peltier, 2018, CP).
19. Page 4 lines 2–3: This is not the best way to phrase it. I like what the authors had in the original version of the manuscript. Please revert back to that version.
20. Page 4 Line 11: In **this way the course of those studies**"
21. The first paragraph on page 6 should be re-written as it is very raw in its current form
22. Page 6 line 5: "dependent variables **have has** to be unified. .... **nominator denominator**"
23. Page 6 Lines 17-19 are a repeat of what was said in lines 16–18 on page 4. Please unify the underlying material into one appropriate location.
24. Page 7 Line 7: "**In brief The simulation are could be** forced by solar insolation **which** changes due to orbital (O) variations, **and further** by land ice (I) change..."
25. Page 4 Line 10 "reference experiment (OIC) all **input data these factors** are varied"
26. Page 8 Line 19: "cannot be directly obtained (**e.g.** from proxy-based datasets) and is hence a-priori unknown"
27. Page 8 Line 23: "The **investigated** dataset **to be investigated** contains .... **for the past 800 kyr.** Although **it the dataset** covers the past 5 Myr, here we focus **only** on the ... constrained by high-fidelity **ice core measurements of CO2 data within ice cores**"
28. Page 8 Line 28: "**The revised formulations of for  $\Delta R_{CO_2}$  following from** Etminan et al 2016 leads to "
29. Page 8 Line 31: "ice sheet model ANICE (de Boer et al. 2014) . **ANICE was** forced by .... to a reference PI climate. **The temperature anomalies were** obtained from a benthic"
30. Page 9 Line 6: "function of **the** NH temperature"
31. Removed the reference from line 7 on page 9, as its not needed in the context of that comment and it is already referred to twice in the preceding 6 lines.
32. Page 9 Line 9: "Therefore, these results are **here considered to be** more similar to those **of from** proxy-based reconstructions than **of those from** climate model-based simulations"
33. Page 9 Line 18: "Shakun (2017) compiled **the simulated model based estimates of the** relative impact ..... using **a an ensemble of 12-member** climate models **ensemble** and **found a range of estimated w to be ...**"
34. Page 9 Line 24: "CLIMBER-2 results (**section 3**). The difference may be related **either** to the fact"
35. Page 10 Line 14: "Finally, we have **shown assessed** the **importance usefulness** of considering"