

Dear Editors and Reviewers,

We have made changes to the manuscript to align with reviewer comments, which we outline below by listing the reviewer comment (RC), our author response (AR), and then where in the revised manuscript the authors' change can be found (AC). For clarity, we cite the line numbers for the clean manuscript first, and if there is a difference in the document with the tracked-changes we clarify that. This way we hope it is easier to directly find the change in both the clean manuscript and the track-changes version with the added text in blue and removed text in red.

Also for ease of following the changes, where a reviewer has requested a change in word choice, or to correct a typo or syntax error, we only report the author change (AC) as no response is needed. For more complex changes we provide a response explaining how we edited the manuscript.

Additionally, we have also updated the affiliations of author Gang Tang.

Beginning with Reviewer 1:

RC1: “51: “For” should be replaced with “Due to”.

AC: Changed on line 52

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RC1: “55: You mention Figure A3 before Figure A1 and A2, so A3 should be the first figure.”

AR: We have edited this section slightly, now we introduce the figures in the order they are presented in the Appendix by adding sentences first in Section 2.1, line 46, referencing the plot of Kleinen *et al.* data in Figure A1. Then in section 2.1.1, starting in line 56 we have added a sentence about Figure A2, as we felt it was more logical to introduce the results in full before addressing the subset of data plotted in A3.

AC: Lines 46 and 56-58 include additional material to reference the plots in the correct order.

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RC1: “60: “evidence” should be “evident”.”

AC: Changed on line 64.

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RC1: “61: “only taking” should maybe be rephrased to “which only includes”.”

AC: Changed on lines 65-66

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RC1: “67: I’d suggest removing “then”, as it’s not needed. Maybe add a reference for the “Nelder-Mead method”.”

AR: “Then” was removed and a reference for Nelder-mead has been added. **AC:**Changed in lines 71 and 272

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RC1: “71-72: Why did you simultaneously fit the five SSPs, but you separately fit the RCPs?”

AR: This was a case of our writing being unclear, and has now been corrected to say that two fits were done: One for Kleinen using all SSPs simultaneously, and one for Zhang using the RCPs simultaneously.

AC:Lines 75-76 have been slightly reworded for clarity.

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RC1: “74: Regarding “Values from Kleinen et al. (2021a) were assumed to be on the high end of sensitivity”: Did you mention what the values are yet? That might make this easier to follow.”

AR: No, we had not mentioned those values yet, we have added that in including a reference to the table in the Appendix.

AC:Lines 78-79 now include explicit reference to the 52.6 Mt/K slope found with the Kleinen data up to the year 2300.

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RC1: “76: Could you maybe make it clearer why those studies were not usable for calibration?”

AR: Yes, we have added some context now explaining that the short time-spans looked at in Zhang *et al.* (2025) were useful as reasonableness-checks but not good for calibrating for the full 21st century.

AC:Lines 80-83 now explain the limitations of these studies.

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RC1: “78: Maybe say “close to” instead of “near”, as it seems to fit better in this context.”

AC:Corrected in line 85

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RC1: “79: “This setup” — > It’s not exactly clear from the previous sentence what setup you’re referring to here. Maybe rephrase this.”

AR: This phrase is now changed to “This distribution” to make clear we are referring to the spread of temperature sensitivities.

AC:Changed in line 85

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RC1: “84: Instead of “wetlands emissions” I’d say “wetland emissions”.”

AC: Changed in line 89, or line 90 in the tracked-changes document.

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RC1: “85: The end of the sentence is missing a colon.”

AC:Added a period to the end of line 91.

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RC1: “88-89: It isn’t completely clear to me what you mean with “This also serves to fix the intercept E_0 ...”. Maybe explain this a bit more to make it clearer.”

AR: In hindsight, this line was redundant, and has been removed as it isn’t adding useful information. The only important parameter is the temperature sensitivity, or the slope of the linear model.

AC:Removed in line 94.

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RC1: “100: “(ibid)” should be removed or corrected.”

AC:Removed in line 106.

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RC1: “101: Why was 2105 chosen here and not 2100 like elsewhere?”

AR: The models were run up to 2105 to account for any numerical issues or errors at the boundary. By running up to 2105, we can present up to 2100 with no discontinuities.

AC: This was clarified with additional material in lines 107-108.

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RC1: “127: Remove the unnecessary “ after (under higher temperature).”

AC:Corrected in line 141.

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RC1: “127-129: This seems like a repetition of what you said in the previous sentences, so why repeat it here? If there is additional information here, maybe rephrase it to make it clearer.”

AR: We agree this was repetitive, these redundant sentences were removed with minor edits the previous sentences to reference the scale of CO_2 being only a few ppm, as this was the only extra information in the the redundant sentences.

AC: The redundant lines were removed, they can be seen in red in lines 141-144 in the manuscript with tracked changes. Line 141 is now the end of that paragraph.

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RC1: “Figure 1: It’s difficult to see, if the quantiles are also shown for MAGICCv7.5.3. If they are included, maybe make them more visible.”

AR: Slight corrections to Figure 1 and its caption have been made. First, the overlapping quantiles can’t be seen in Figure 1a because the difference is too small. And there is no overlap in 1e because the v7.5.3 natural emissions were constant. In 1c, we tried making overlap clearer while retaining the colour-coding of the original by darkening the upper and lower limits. Thick solid lines represent the median in v7.6, thick dashed lines are the median for v7.5.3. Thin solid lines are the upper and lower quantiles for v7.6, and thin dashed lines are for v7.5.3. This is also explained now in the caption, which we hope helps the reader see that the overlap is only between the highest quantiles of v7.5.3 and the lowest quantiles of v7.6.

AC: Figure 1 has been replaced with a slightly altered version including the darkened lines and lighter colours for 1c. The caption of Figure 1 has also been expanded to explain the data more explicitly.

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RC1: “In the figure caption: “CH4 emissions between in MAGICC” should not have the “in”.”

AC: Corrected in the Figure 1 caption.

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RC1: “Figure 2 caption: 1. 3: “lotted” should be “plotted”.”

AC: Corrected in the Figure 2 caption.

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RC1: “6: “for for” should be “for”.”

AC: Corrected in the Figure 2 caption.

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RC1: “152: It should be “Figure 3 shows” instead of “Figure 3 plot”.”

AC: Corrected in line 164, or in the tracked-changed document line 167.

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RC1: “154: “The C1 and C1 scenarios” should probably be “The C1 and C2 scenarios”.”

AC: Corrected in line 164, or in the tracked-changes document line 169.

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RC1: “158-159: I would rephrase this either saying “so too” or “is also increased”, not both.”

AC: Corrected in lines 170-171, corresponding to line 173 in the tracked-changed PDF.

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RC1: “195-196: Maybe explain a bit more what kind of progress or new information you expect to obtain from CMIP7 compared to CMIP6 models and why.”

AR: The hope is for an iterative process, as this study helps with boundary conditions for what current models expect with regard to methane emissions, but as new improvements to wetlands modelling are published these in turn can feed into improving MAGICC’s calibration.

AC: An additional sentence clarifying this was added to lines 208-210, corresponding to lines 211-213 in the tracked-changes manuscript.

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Per Reviewer 2:

RC2: “Section 2.1: It should be better described and justified why only the two models are used for calibration? Is it the extent of the periods they cover?”

AR:

AC: Lines 44-45 in section 2.1 clarify our use of models covering at least the 21st century, with lines 80-83 clarifying that the Zhang *et al.* (2025) data weren’t useful for this reason.

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RC2: “Line 76: Why are other models/studies mentioned not suitable for calibration? They could at least be used in fitting the early half of the current century? In addition to Im *et al.* (2025), which horse until 2050, the same ESM is also used with interactive wetland in CMIP6 that extents to 2100, and with different sets of anthropogenic emissions, which may impact the feedbacks.”

AR: Im *et al.* (2025) was not available until this paper was nearly done, and it was decided to go forward with submission with what we had. It is true other results are now available that could further refine calibration, but at the time we set up this study the only studies we could get relevant data for (21st century, temperatures and emissions’ time series provided) were these two. Further work will follow up this study with more calibrations if not new models of temperature sensitivity altogether.

AC: These points are clarified in lines 80-83

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RC2: “Lines 101-102: The probabilistic approach and the choice of 600 draws should be better described and justified, not only by referring to Sloughter and Nicholls (2025).”

AR: This was a useful point to clarify, and we now explain what the probabilistic draws represent: That they are used to emulate the spread of uncertainty in climate parameters by drawing random combinations from pre-defined distributions for each parameter. 600 is the default used in testing new versions, but this is itself an input that could be changed by future users.

AC: These details are now clarified with extra sentences in lines 109-112.

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RC2: “Line 124: The processes should be briefly mentioned. Especially, a short discussion would improve with respect to CH₄ oxidation as it will be different under different SSPs and RCPs due to differences in chemical composition and impacts on OH.”

AR: This discussion has been expanded, clarifying how CH₄ oxidation adds to CO₂ concentrations, and how CH₄ interacts with OH, as well as clarifying that MAGICC (both versions) account for increase temperatures increasing the speed of this reaction. I.e. higher temperatures lead to shorter tropospheric lifetimes for CH₄. The full technical details, including the equations, are still left to Meinshausen *et al.* (2011a) but the added details in this paper should help understanding how CH₄ behaves in both v7.5.3 and v7.6 of MAGICC.

AC: Additional sentences in lines 135-138.

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RC2: “Line 154: “The C1 and C1....”, the second C1 should be corrected to C2.”

AC: Corrected in line 166, which in the tracked-changes version is line 169.

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Again we express our thanks to the reviewers and editors for all their comments which have improved this manuscript.

Trevor Sloughter, PhD, on behalf of all the authors
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