

**We thank the two reviewers for taking their time to review our revised manuscript and for sharing valuable comments. Below, we provide pointwise response to comments raised where applicable.**

## **Comments from Reviewer #1**

The authors have carried out a thorough and thoughtful revision that addresses all of my original comments in an appropriate and helpful way. The figure revisions and added points of clarification within the text are appreciated. While I agree with the other reviewer that the article is long and that there may be opportunities to make it somewhat more concise, there is value in the synthesis that documents differences in model configuration and how insights gained therein are applied to the interpretation of the study's results is likely to be quite helpful to others working in this specific domain of climate science. If shortening the article is deemed necessary to enhance appeal to a broader readership, I recommend that details removed from the main manuscript be transferred to the supplement so as to conserve the value such details add for those working in the same domain.

### **Interdisciplinarity:**

Amali et al. 2024 is a work of interdisciplinary Earth system science in that the study of BGC and BGP temperature effects of historical LUC requires consideration of literature on LUC, land carbon sink, and atmospheric, sea ice, and ocean dynamics as well as how these components interact. This study therefore bridges several sub-disciplines of Earth system science. This study also considers feedbacks emerging from historical LUC in a non-trivial way.

### **Scientific merits:**

As stated in the initial review:

“The study's findings both align with and expand upon previous work. For example, the finding that near-surface temperature increase from BGC is greater than BGP for historical LUC aligns with the findings within the existing literature. However, the regional analysis in Amali et al. adds nuance to this story in that the regional effect of BGP on near-surface temperature can be significant depending on location. Also significant is the study's contribution to our understanding of the BCG effect on near-surface temperature change at the gridcell level. Furthermore, the findings of this study demonstrates similar model spread and estimates to previous similar studies using LUCID or CMIP5 data, and identifies some reasons related to model architecture that contribute to this result.”

The discussion is both thorough and balanced. Amali et al. add significant value through their consideration of individual model configurations and how these give way to the differences seen across the 13 models considered in this study. The authors neither understate nor overstate the significance of their conclusions.

### **Technical quality:**

Are the scientific approach and applied methods valid? Are the results and conclusions presented in a clear, concise, and well structured way, including a reasonable number and quality of figures and tables and appropriate use of English language?

While the scientific approach and methods were initially considered to be sound, technical improvements to the text and figures have noticeably increased the manuscript's clarity. As mentioned above, it may be worthwhile to take the time to shorten this article to help it reach a wider audience, while conserving the significant value added in the presentation of differences in model configurations by moving these or other details less relevant to researchers in related fields to the supplement.

**Suitability:**

This manuscript certainly fulfils the criteria for an original research article. It is stylistically complete, containing all of the sections one would expect of such an article. In addition, all sections are thorough and well-developed.

**Recommendation to the editor:**

I recommend that this article be accepted subject to minor revisions to remove some of the detail from the main manuscript with the potential of relocating it to the supplement to enhance the article's appeal and useability for a broader audience within Earth system science.

**Response to Reviewer #1**

Dear Reviewer,

Thank you for your thoughtful and supportive feedback. We sincerely appreciate the time and effort you have taken to review our revisions and your recognition of the interdisciplinary value, scientific merit, and technical quality of our work.

We also appreciate your suggestion regarding shortening the manuscript to enhance accessibility for a broader audience. While we understand this concern, after careful consideration, we believe that the level of detail currently included is necessary to ensure the comprehensiveness and scientific rigor of the study. The synthesis of differences in model configurations and their implications for interpreting results is central to the study's contributions, and further condensation could risk omitting critical context needed for proper interpretation. Given that our findings aim to guide researchers working within this domain of Earth system science, we believe that maintaining the current structure best serves both clarity and completeness.

Once again, we truly appreciate your insightful comments and your support in strengthening our manuscript.

## Comments from Reviewer #2

The authors have revised their initial submission and sufficiently addressed my previous comments. Below are some minor additional comments on this revised version.

1. line 374 - "For instance, sub-grid transitions allow models to account for mixed land-use types within a grid cell more precisely, leading to refined estimates of land carbon fluxes in areas where land use transitions over time." This sentence implies that the models not listed just before it do not have sub-grid transitions, but I believe that some of them do. Or maybe I don't understand the use of "sub-grid transitions" here. Could be clarified.

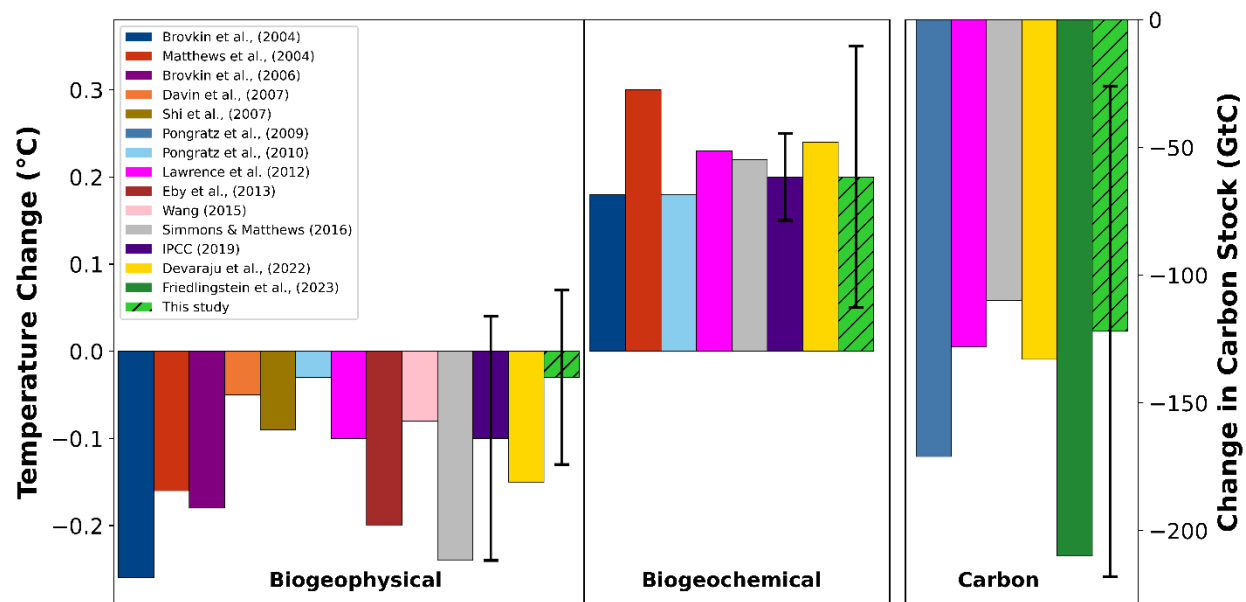
**Response:** *Thank you for bringing this to our attention. We have clarified the sentence, and it now reads: "For instance, annual LUC emissions of CanESM5, CMCC, IPSL, and UKESM are very similar (Fig. 1c), which might reflect that these models share a common approach: all of them implement net sub-grid transitions, explicitly consider explicit grassland simulations, and do not represent pasture or grazing. Models that implement net sub-grid transitions, such as these, allow for a more precise accounting of mixed land-use types within a grid cell, leading to refined estimates of land carbon fluxes in areas where land use transitions over time."*

2. 535 - "In magnitude, the warming pattern around Greenland can only be seen in the BGP contribution, which we attribute to mechanistic non-local LUC-induced effects on ocean currents and sea ice" (also a few other mentions of this warming around Greenland in the paper). This would be a relevant citation:  
<https://doi.org/10.5194/egusphere-2024-2087>  
Bauer, V., Schemm, S., Portmann, R., Zhang, J., Eirund, G. K., De Hertog, S. J., and Zibell, J.: Impacts of North American forest cover changes on the North Atlantic Ocean circulation, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2024-2087>

**Response:** *Thank you for your suggestion. We have added the citation to our manuscript.*

3. Figure 7. I think the labels help. If you put the biogeochemical, carbon labels at the bottom they would not interfere with the bar plots.

**Response:** *Thank you for your suggestion on Figure 7. We have modified the figure and placed the label at the bottom of the figure. The updated Figure 7 is as shown below.*



**Figure 7:** Biogeophysical, biogeochemical effects, and changes in carbon stocks quantified in this study (hatched green bars) compared with other studies. Where vertical lines exist, they represent the standard deviation of estimates. See Supplementary Table S2 for the studies and their estimation periods.