Uncertainty in Land Carbon Fluxes Simulated by CMIP6 Models from Treatments of Crop Distributions and Photosynthetic Pathways.

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We are grateful to the referees for their comments and suggestions, which we have used to improve the manuscript. Below we describe the modifications we have made to the manuscript in response to the comments.

Comment 1

I appreciate the authors' efforts to address my previous comments. However, I still have one remaining concern related to Major Comment 1 from the last round of review.

Specifically, I remain concerned that using c3PftFrac and c4PftFrac as proxies for C3/C4 crop fractions is problematic and not well justified. These PFT fractions do not necessarily represent crop fractions, as they are largely influenced by natural trees and grasses. A straightforward test would be to check if the c3PftFrac/c4PftFrac is consistent with C3/C4 crop fractions in models providing both variables.

Response to Comment 1

This is a good point. Like we stated earlier to evaluate biases in the estimated values of C_3 and C_4 crops obtained from cropFrac × c3PftFrac and cropFrac × c4PftFrac in the models where this was applied (CESM2, CESM2-WACCM, CNRM-ESM2-1 and CNRM-CM6.1) we conducted a reliability analysis. We determined the similarity between the calculated distribution of C_3 and C_4 crops and LUH2 distribution using kernel density estimates (KDE) (Silverman 1986, Chen 2017) and spatial probability distributions (Chiang et al., 2021). We also visually compared the spatial distribution of these values to the LUH2, UKESM1 and MPI-ESM-1-2-HAM - two models that provided their C_3 and C_4 crop fractions to check if they are consistent. Our results show that the values obtained from the calculation are not inconsistent with other models and LUH2 in terms of magnitude, range and spatial distribution. The results added to the supplement in Figures S7 and S8 show that the resulting C_3 and C_4 crop fractions are consistent with the LUH2 and the other models that explicitly provide them. Figures S9 to S13 shows the level of similarity between the C_3 and C_4 crop cover we obtained and the LUH2 data and the consistency between the C_3 and C_4 we obtained from our approach with those models that explicitly provide their C_3 and C_4 crop coverage in terms of the overlap area between the models' and the LUH2 C_3, C_4 and total crop cover. Overall, our reliability analysis and kernel density estimates show that the result obtained for C_3 and C_4 crop cover are consistent with LUH2 data and those of the other models that explicitly provide them. So, I suppose we have done the comparison you are suggesting.

Just to reiterate, given that C_3 and C_4 variables are not available for some models in the CMIP archive, we had to make the calculation cropFrac × c3PftFrac or cropFrac × c4PftFrac to enable us to do a comprehensive model intercomparison. And we have added a note to the discussion that models' reporting of their C_3 and C_4 crop fractions (cropFracC3 and cropFracC4) would allow for more robust analysis of the role of croplands in carbon flux simulation and the differences in the photosynthetic pathways.