Earth Syst. Dynam. Discuss., referee comment RC2
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Comment on esd-2022-5

Anonymous Referee #2

Referee comment on "The biogeophysical effects of idealized land cover and land management changes in Earth system models" by Steven J. De Hertog et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2022-5-RC2, 2022

Review on De Hertog et al.

The manuscript investigates local and non-local climatic effects of LCLMC by three ESMs using four unique idealized experiments under the current climate. The study involves much work and brings novelty to the scientific community. I recommend accepting it after considering the comments below that could help to improve the paper.

Main comments

- As I understand and as the abstract states, there is much uncertainty in the three models on the central questions of the study. The differences are well explained for each model, but could you go one step further and give overall conclusions (taking into account various model biases, etc.) and specific recommendations to the model developers on reducing this uncertainty?
- As the other reviewer recommended, please consider revising the structure. It may be helpful for the reader if some text on the differences of the results (experiments/models/local and non-local effects) could be summarized in a table. Many findings are hidden in the text. A table that summarizes what models agree on disagree with, and overall conclusions would be helpful.

- Could you add some info on how the PFTs distribution differs spatially among the models in the year 2014 (I expect they all may deviate from LUH2)? Can part of the inter-model differences be attributed to this? Also, is there a large inter-model difference in the distribution of forest types? (deciduous and evergreen forests may have very different implications for albedo). Similarly, can you state that any afforestation (from any previous land cover and to any type of forest) causes warming

in the north and cooling in the tropics? Is it universal, or can you make some conclusions (although this may require additional analysis), e.g., conversion of specific forest type to forest gives more/less warming to make more implementable conclusions?

Minor comments

- Figures: consider adding a row of ensemble means of three models to some figures where appropriate
- Figures 2 and 3: consider merging these two figures
- Line 91: Second,
- Line 159: space missing
- Lines 160-170: Explanation of the methods. As I understood from the text, if the grid has at least some forest, then the grid becomes 100% forest. If it does not have forest but has other vegetation, then this vegetation becomes forest in a ratio of different forest types determined via latitudinal averaging. Is this so? The explanation requires clarification as it is quite misleading in its current state.
- Line 165: for forest PFTs or for grids that have forest PFTs?
- Line 182 and around: Please double-check the letters of figure panels shown in text, they do not always match
- Lines 351-354: "conditions in which the frozen soils are less extensive throughout the year which causes a soil warming". Please revise the sentence to make it clearer
- There is much warming in the CROP experiment simulated by EC-EARTH due to local effects (fig. 5), but I cannot see to what local effects can this warming be attributed to in the decomposition analysis.
- Figure 5 and C1 seem to have the same legend but vary. What are they standing for?
- There seems to be a mix-up as the appendix does not always give info that is promised in the text, and there is no Appendix D that you refer to.
- Line 354: less cooling
- Lines 388-400: Although you mention that Boysen et al. (2020) already show the biophysical impact of LULMC on AMOC, I think this finding deserves more discussion.
- Line 458: both in both?