

Earth Syst. Dynam. Discuss., referee comment RC1  
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## Comment on esd-2022-5

Anonymous Referee #1

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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-RC1>, 2022

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This manuscript evaluates the local and non-local effects of land use and land management change (LULMC) under present-day climate in three state-of-the art Earth system models. To do so the authors use a dedicated set of experiments of different idealised land use states.

The manuscript is methodologically sound and presents an important contribution to understanding the biogeophysical impacts of LULMC. In particular, the use of three different ESMs enables to provide a more comprehensive picture on the uncertainties and robustness of the simulated features. The number of simulations, ESMs, and variables discussed make a fairly dense reading of the results, which, in my opinion, could be somewhat improved by following a more rigid structure (see below).

Main comments:

The results and section 3.2.1 in particular are hard to follow. Consider clearly separating local and non-local (e.g. move ln 349f to ln 358) and sticking to one order in which you discuss the models in each section (e.g. CESM, followed by EC-Earth, then MPI) throughout the results (or manuscript in general).

Non-local effects - Winkler et al (2017) recommend prescribed SSTs to isolate non-local LCC effects from background climate. Using a dynamic ocean as done here has the advantage to identify non-local LULMC impacts such as the cooling/warming response in the north Atlantic in CESM. However, it also seems to blur the non-local effects from LULMC and background climate judging based on the appendix figures' widespread - and seemingly robust (?) - non-local effects. I feel this should be discussed to give an indication on how robust these non-local effects are (not requesting another simulation, although this would be instructive in really separating those non-local effects).

Minor comments:

In 23 Depending on the land use forcing higher estimates exist (139 PgC for the last 1000 years in Kaplan et al 2011).

Kaplan, Jed O., Kristen M. Krumhardt, Erle C. Ellis, William F. Ruddiman, Carsten Lemmen, and Kees Klein Goldewijk. "Holocene Carbon Emissions as a Result of Anthropogenic Land Cover Change." *The Holocene* 21 (5): 775–91.  
<https://doi.org/10.1177/0959683610386983>.

In 103ff In the CESM description it would be informative to add the horizontal resolution (currently buried in In 159)

In 125 If possible give grid resolution TL255 as degree or km2 equivalent

In 128 This seems important, could you please state briefly what happens instead?

In 160 consider moving the information on the grid resolution into the model description

In 181 - Do you mean "the native parameterization of irrigation"?

In 274 Are the 0.1 W m<sup>-2</sup> the global imbalance?

In 338-344 Consider moving this into the discussion.

In 354 - Please clarify, do you mean MPI-ESM shows a similar pattern to CESM in the local effects?

In 365ff - Consider moving this extended comparison to other published work into the discussion.

In 390 - So really just the extratropics, not most of the globe?

In 482 - "This indicates that extra-tropical afforestation is dominating the global picture for these models due to a strong albedo response largely counteracted by the turbulent heat fluxes" - Unclear to me, do you mean that the albedo response to extra-tropical afforestation is dominating the global energy balance response to afforestation?

In 574 - irrigation as an adaptation strategy? Surely only where there is no future water stress as the authors point out further down. Is there any specific reference supporting this idea?

In 660 - URL missing

In 696 - space missing