

Interactive comment on “Comparing the influence of net and gross anthropogenic land use and land cover changes on the carbon cycle in the MPI-ESM” by S. Wilkenskjeld et al.

Anonymous Referee #2

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This paper considers the impact on the modeled carbon cycle that arises from considering net land-use changes vs. gross land-use changes, where the latter considers changes between land-use states within a grid-cell that do not result in a net difference in the fraction of the grid-cell occupied by the various land-use states. Shifting cultivation is given as an example of a gross land-use change, where agricultural land is abandoned and an equivalent area of land is cleared within that same grid-cell in a single time-step.

This is a well-written paper on an important topic for Earth System modeling. The issue of net vs. gross land-use changes is often not well understood or appreciated by modeling groups and this paper really highlights why it is important to consider

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gross land-use changes, as well as pointing to the need for more research on this topic to ensure the gross land-use changes being used by Earth System models are as accurate as possible.

I recommend this paper for publication subject to the minor comments listed below:

1. Throughout the paper the authors refer to the land-use datasets used by their model as the “Harmonized Land-use Protocol”, or simply the “Harmonized Protocol”. However, the official name for this dataset is the “Land-use Harmonization Dataset”.
2. In the abstract and section 1 the authors state that gross land-use changes do not affect the net vegetation distribution. However, it should also be noted that although the net areas of natural vegetation, cropland, and pasture might not change, the underlying natural vegetation could be quite different (e.g. a mature forest could become a very young regenerating forest). Under a changing climate the re-growing vegetation could also potentially be different from the original natural vegetation within a grid-cell.
3. In section 2.1 the authors state that the off-diagonal matrix elements are obtained from an external datasets, without stating what that dataset is. I assume they are referring to the Land-use Harmonization dataset discussed elsewhere in the paper?
4. Why do the authors not include RCP6.0 in their set of experiments?
5. I would also like the authors to mention in the Discussion section that gross land-use changes can also impact the biophysical properties of the Earth System (e.g. surface roughness, albedo, etc) as well as ecological impacts (e.g. young regenerating forest instead of old-growth forests, reduction in habitat for biodiversity, etc).
6. In section 5 the authors state that Hurt et al. 2006 made a simple assumption that shifting cultivation occurs in “the tropics”. However, it should be noted that in Hurt et al. 2011 (the paper that the Land-Use Harmonization datasets are based upon) this assumed area of shifting cultivation was improved and based upon the map of Butler (1980).

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7. The authors should state that not all Earth System models are currently able to model gross land-use changes, and that this should be an area for further model development over the next few years.
8. Some minor grammatical and typographical corrections:
 - a. Page 5445, line 6: "exhibit" should be "exhibit"
 - b. Page 5449, line 10: "whithout" should be "without"
 - c. Page 5451 line 14: remove "ares"
 - d. The sentence on page 5458 lines 2-3 is worded in a confusing way ("the reduction of converted area in general increases with decreasing resolution"). It would improve the readability of this paragraph if this sentence could be re-worded

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