

Interactive comment on “Uncertainties in the land use flux resulting from land use change reconstructions and gross land transitions” by Anita D. Bayer et al.

Anonymous Referee #1

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Summary: In this paper the authors use a dynamic global vegetation model (DGVM) to calculate the ecosystem carbon stocks and fluxes that result from the use of different land-use change reconstructions. Several historical period land-use datasets are used – three that have a global domain and one that has a European domain. In addition, two of the historical land-use datasets provide gross land-use transitions rather than simply the net land-use transitions in each grid-cell, and the effect of gross vs. net transitions on the carbon stocks and fluxes is investigated along with the uncertainties arising from the choice of land-use dataset used. It is an interesting study because the representation of land-use within DGVMs and climate models is very uncertain, and also very important.

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Recommendation: I recommend this paper for publication subject to the following

1. The authors should clarify exactly which version of the HYDE dataset is being used in this study. In Table 1 they cite Klein Goldewijk 2015 but that paper is not listed in the Reference section. They also state that they are using the version of HYDE and the version of LUH used in Le Quere et al. 2015. However those datasets should be identical for global areas of cropland and pasture, although they are apparently not identical in this study (from Figure 1). A statement that the version of HYDE used in this study is not the same as the version of HYDE used as an input to the LUH dataset would be helpful. In addition, if the version of LUH used in this study is indeed the same one used in Le Quere et al. 2015, it would be good to state that this version of the LUH dataset differs from the standard LUH dataset used in most CMIP5 experiments.

2. In the abstract the authors state that the main reason that gross land-use transitions have previously not been included in carbon modeling studies is the lack of detailed information on historical gross land-use changes. However, I would also argue that until recently many carbon models were not able to use even the simple gross land-use changes provided by land-use datasets.

3. Another clarification: the LUH dataset includes shifting cultivation only in some locations within the tropics (based on the map of Butler 1980). There are currently several places in the paper where it is implied that shifting cultivation occurs throughout the tropics.

4. Although the authors use both net and gross land-use transitions in this study, they do not describe how they determine the net transitions for the LUH dataset (which by default provides gross transitions) or the HYDE dataset (which does not provide transitions at all – just land-use states). The calculation of net transitions should not be difficult in either case, but a brief description should be included for completeness in the methods section.

5. The lack of wood harvest is a limitation of the modeling approach used by the authors

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and it would be good to include some more discussion of this. Wood harvest is one of the largest land-use transitions in terms of both area and carbon emissions. Although the spatial pattern of wood harvest is uncertain, national data on wood harvest amounts and areas are available. When comparing the effects of including only net vs. gross transitions it is important to consider that wood harvest is a gross transition that is currently not included in this study.

6. The Discussion section begins by stating that a key uncertainty in estimating C stocks and fluxes from land-use stems from the choice of LUC dataset used. I think it would be good to rephrase this opening statement slightly to remind readers that historical reconstructions of land-use are inherently uncertain, and it is not just the choice of LUC dataset that introduces uncertainty. For example, *all* LUC datasets used in this study show a peak in LU transitions around 1950-1960, although there is some evidence that this is likely due to the reconstruction process itself (i.e. the merging of two or more data sources during that time period).

7. In the Conclusion section the authors state that the consideration of multiple LUC reconstructions exploring the full range of reasonable assumptions is needed. This was actually a central component of the paper of Hurtt et al. 2011 in which those authors performed a large sensitivity study by varying all model inputs and decision parameters to explore a range of possible land-use reconstructions.

8. Also in the Conclusion section the authors state that the differences in C stocks and fluxes predicted by the HYDE and LUH datasets is surprising given that they are based on the same data inputs etc. However, it appears that two different (inconsistent) versions of these datasets were used – see comment 1 above.

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