

Earth Syst. Dynam. Discuss., referee comment RC2
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Comment on esd-2020-93

Wei Li (Referee)

Referee comment on "Modelled land use and land cover change emissions – a spatio-temporal comparison of different approaches" by Wolfgang A. Obermeier et al., Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2020-93-RC2>, 2021

The difference in Eluc estimates between DGVMs and bookkeeping models has been reported in many previous studies but never been quantified by decomposing into more specific fluxes like LASC. The authors filled this research gap using fractional simulations by various DGVMs. The analysis is very detailed and comprehensive with precise definitions of different LULCC fluxes and components and corresponding quantifications. It is a significant step in disentangling the Eluc components on top of Pongratz et al. (2014) and Gasser & Ciais (2013) and has important implications on the definition of Eluc in the global carbon budget and implementing climate mitigation measures. The manuscript is well written with clear description and detailed supplementary materials. I see no major flaw in this manuscript and thus suggest this work for publication with few minor revisions.

I have some concerns that may need some clarification and discussion.

Although the LASC explains the Eluc difference between DGVMs and bookkeeping models, it would be better to address whether LASC exists in the real fluxes of carbon emission and sink, i.e. whether can be observed. If I understood correctly, positive LASC represents the loss of potential carbon sink and thus didn't physically exist, i.e. this part of CO₂ wasn't released into the atmosphere. For the negative LASC like in reforestation, this part should be physically stored in the biomass or soil C pools, right?

As the authors stated, the timing of LULCC matters. Therefore, from my understanding, estimation of the accurate LASC for a specific LULCC event (a deforestation event in 1950 for an example) needs simulations similar to the S0 and S4 but using the climate and CO2 status when the LULCC event occurs (i.e. 1950) instead of the pre-industrial climate and CO2 status. Although the authors came to this point somewhere in the text, it would be better to emphasize this point explicitly.

The attribution to climate and CO2 in Sect. 2.2.2 is rather uncertain. Is there any observation data (e.g. FACE + warming experiment field data) that can be used to validate this attribution method?

Fig. 5-7 show results from each DGVM, but not reported in the text. Could add one or two sentences to say which models always give high e.g. LASC in Fig.5 or all models are similar?

L29-30: "high-latitudes" usually refers to boreal region. I think much early agricultural expansion occurred in the temperate regions. May rephrase.

L248: bookkeping -> bookkeeping

L253, L256: What are the numbers in the brackets?

L274: What are the pulses of the purple line in Fig. 2c?

L312-313: Why reforestation increased fLULCC_pd?