

## ***Interactive comment on “Historical CO<sub>2</sub> emissions from land-use and land-cover change and their uncertainty” by Thomas Gasser et al.***

### **Anonymous Referee #1**

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#### General points

In this study, the authors investigated the historical carbon emissions caused by land-use change using a reduced-form Earth system model, OSCAR. They conducted a series of ensemble simulations to obtain the best guess and its associated uncertainty of the land-use-induced emission. The estimated historical cumulative emission,  $206 \pm 57$  Pg C, is substantial and looks consistent with those obtained by previous global carbon budget studies. Land-use change is an important anthropogenic CO<sub>2</sub> source and related to various human activities such as agriculture and urbanization. Therefore, clearly, this study falls within the journal scope and will carry implications on the global carbon budget.

On the other hand, the methodology they adopted is slightly complicated. They pro-

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posed a unifying approach for the bookkeeping model and dynamic global vegetation models, but I could not understand how these approaches were integrated into the OSCAR model. It was impressive for me that the model allowed a large number (10,000) of ensemble simulations, but how biogeochemical parameterizations were perturbed was not adequately described. Although the authors provided long appendix, the methodology should be clarified in the main text (section 2.).

The evaluation of the loss of additional sink capacity (LASC) is the remarkable feature of this study, although it looks to depend heavily on previous studies such as GCP2019 and FRA2015. Overall, the manuscript is well-written and I recommend a few amendments as seen below.

#### Specific points

Line 79: Please provide more specifications of the OSCAR model, such as spatial resolution, spin-up method, time step, etc.

Line 83: Can you explain more about the “10,000 different biogeochemical parameterizations”?

Line 92: In general, Results section should present exclusively the outcomes obtained in the present study and so should not include citations to other studies. The present “3. Results” section looks more like a “Results and Discussion” section. Please consider restructuring of the manuscript.

Line 107: Can you specify what is “the change in empirical constraint” responsible for the larger LASC?

Line 223: Please explain what are the “seven categories of LUCCC activities”, in a consistent manner with those in the 2. Overview of the methodology section (only three activities in Line 69–70).

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