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Interactive comment on “Global and regional effects of land-use change on climate in 21st century simulations with interactive carbon cycle” by L. R. Boysen et al.

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Reply to the interactive comment of B. van den Hurk (Referee)

We are thankful for your constructive and positive comments which help to improve the quality of the manuscript. Below you will find our reply to each of your comments.

List of comments & Reply:

- In the abstract, read before reading the whole manuscript, some confusion is raised when first displaying numbers of land carbon loss followed by the land carbon gains due to the CO₂-fertilization. I think it would be useful to give a

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single-sentence explanation on that you try to disentangle the different relevant processes, coming to carbon pool changes that can mutually compensate.

Reply: We will add the following sentence to embed our results better into the abstract.

“Modifications of land carbon storages by LULCC are disentangled in accordance with processes that can lead to increases and decreases in carbon storages.”

“Global land carbon losses due to LULCC are simulated by all models: 218, 57, 35 and 34 GtC by MPI-ESM-LR, MIROC-ESM, IPSL-CM5A-LR and CanESM2, respectively. On the contrary, the CO₂-fertilization effect caused by elevated atmospheric CO₂ concentrations due to LULCC leads to a land carbon gain of 39 GtC in MPIESM-LR and is almost negligible in the other models.”

- P446-L5: also positive feedbacks could be reduced when the carbon pools are smaller, I would assume.

Reply: The land carbon source could indeed also be decreased under LULCC (due to management and replacement of natural vegetation) and with it the positive feedbacks. We will change the sentence as follows:

“However, LULCC reduces the size of the land carbon sink and sources and thus may reduce these climate feedback effects.”

- -L18: swap “both” and “,”

Reply: Will be done.

- P447: somewhere here I would appreciate the explicit notion that Brovkin’s experiment is in fact L2A.

Reply: This is done on P448 L20 where we explicitly introduce the simulations RCP and L2A with the reference to Brovkin et al., 2013.

- P449-L17: rephrase as “: :by LULCC which thus affects: : :”

Reply: Will be done.

- P450-L12: Suggest to include the temperature change over the 21st century in table 4, to support the percentages mentioned here

Reply: This is a good idea and we will include this into the table 4. The temperature increase for L1B (fossil fuel forcing only) relative to 2006 is 3.02K (MPI), 4.73K (MIR) and 3.6K (CAN).

Additionally: The increase is 8% for MPI-ESM (and not 9% as stated wrongly in the text).

- -L17: Why would vegetation cover changes have an effect on the BGC effects, which are not bound to any location due to the well mixing.

Reply: That is true. However, the conversion of vegetation leads to modification of local BGC-induced temperature signals. For example, we found a warming in all models in Australia where trees have been replaced by pastures (Fig. 1b). We will comment on this in the text.

- P451-L17: Pitman et al (2009) noted that IPSL also showed warming in the extratropics, due to particular assumptions in the seasonality of LAI for crops.

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Reply: We will add a sentence (in L19) “Note that the IPSL model also showed warming in the extratropics, due to particular assumptions in the seasonality of LAI for crops (Pitman et al., 2009).”

- P452-L18: Insert “for the global land area” before “the models coherently: : :”

Reply: We will modify the sentence as suggested.

- -L22: Some discussion on which pasture properties actually show that it is important to include them would be welcome here. What are pastures different from grasslands, for instance?

Reply: In most ESMs, pastures are simulated with the characteristics of grassland but protected from natural hazards such as fires. Here, we point out that the exclusion of land cover transformations to pastures/grasslands (e.g. as in CAN) may lead to underestimated BGP cooling effects (see table S1).

- P454-L4: A reference to fig 3a is given but there is no fig 3b.

Reply: Of course this reference will be corrected to Fig. 3!

- P457-L15: Replace “no” by “not”

Reply: Will be done.

- Table 5: Somewhere in the text the current mass of atmospheric carbon could be given to form a baseline to compare this TRCE to the climate sensitivity defined by the temperature change after doubling the amount of atmospheric CO₂.

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Reply: We will add in the text that the conversion factor for CO₂ is 2.12 PgC/ppm.

- Fig 3: can be printed a bit bigger for clarity

Reply: Will be done.

Interactive comment on Earth Syst. Dynam. Discuss., 5, 443, 2014.

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