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Interactive comment on “Influence of dynamic vegetation on climate change and terrestrial carbon storage in the Last Glacial Maximum” by R. O’ishi and A. Abe-Ouchi

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Dear Dr. Faloon

We would like to thank you for your comments and suggestions. We reconstructed the manuscript, include figures, according to your comments.

1. Overall, the paper would bene fit from some reworking of the main Figures. Since the focus is on the impact of vegetation change on climate, then the main Figures should only include changes in vegetation, and changes in climate between the different run sets as appropriate. The maps of absolute values could be kept for the appendices.

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-> We have redrawn all figures which shows the vegetation change and its impact to other variables as far as possible. Some variables are still shown by its absolute value since they help understanding.

2. p5790 line 10 "the strength of photosynthesis"; but impacts on soil carbon decomposition are also important here.

-> We added a sentence about soil carbon decomposition.

3. p5791 line 12, re bias correction: there is an active ongoing discussion about the merits and pitfalls of bias correction for impact studies. This is mainly focused on future predictions but is ultimately of relevance to this study. Please make some comments on this, and the following references may be of benefit:

-> We referred both two papers you suggested and explained how we correct bias in the MIROC-LPJ in section 2.2. Our assumption does not increase or decrease total energy and/or water but just modify the energy and water balance through prediction of bias-corrected vegetation distribution.

4. p5791 line 18: spell out IPCC AR4 please.

-> Modified as your comment.

5. p5791 section 2.1 - please also mention the ocean model resolution.

-> Ocean resolution is T42 as well as atmosphere. This sentence is added in section 2.1.

6. p5792 section 2.2 - please consider comment 3. above regarding bias correction. Also, this section is rather vague on how bias correction is actually performed, and as Ehret et al suggest, more detailed information on the process used would be beneficial. What was bias corrected, and how? It may be useful to include maps of bias corrected and non-bias corrected variables, and their difference, in the appendix.

-> We described how we correct bias in detail. In the Appendix Figure A1, and pointed

out the problem non bias corrected vegetation distribution.

7. p5792 line 26: Falloon et al 2012 present a study of climate impacts of future vegetation change using a model which does include the C cycle. Falloon, P. D., Dankers, R., Betts, R. A., Jones, C. D., Booth, B. B. B., and Lambert, F. H.: Role of vegetation change in future climate under the A1B scenario and a climate stabilisation scenario, using the HadCM3C earth system model, *Biogeosciences* 9, 4739-4756, doi:10.5194/bg-9-4739-2012, | Supplement | (Discussion paper: *Biogeosciences Discuss.*, 9, 7601-7659, doi:10.5194/bgd-9-7601-2012, 2012

-> We add a short explanation why we do not use these full carbon cycle GCM.

8. p5793 section 2.3 - how realistic is the carbon storage in the model for LGM (if possible) and PI? Please compare to observed and other estimates.

-> In section 4.3, we compared our result with former researches. MIROC-LPJ tends to overestimate carbon storage, but shows reasonable response to LGM climate.

9. Figure 1 - were any statistical tests, or signal/noise filters applied (see for example, Falloon et al. 2012 mentioned above - we used control run data for this purpose)?

-> We added information of statistical significance of vegetation effect on temperature and precipitation in Figures 4b and 4d (Order of Figures are changed according to your comment 11). In Figures 4a and 4c, we omitted the significance because it covers almost all area.

10. p5795 section 4.1 - maps of changes in sensible heat flux and sea ice would be useful in the appendix as they are mentioned in the text.

-> We added figures of vegetation induced change of surface albedo, sea-ice, snow cover, sensible heat, latent heat, surface net shortwave and surface net longwave in Figures 5 and 6. Explanation of surface energy balance change is also added in section 4.2

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11. Since the focus of the paper is on vegetation change impacts on climate, a better order for the results section would be: 4.1 vegetation distribution; 4.2 lgm climate and impact of vegetation change); 4.3 carbon impacts (keeping your original titles).

-> The order of result is changed as your suggestion. Order of figures is also modified.

12. p5795 section 4.2 - maps of changes in PFTs/vegetation types between the simulations would be useful in addition, perhaps moving the maps of actual vegetation distribution to the appendix.

-> We think change of vegetation "type" makes confusing because it is index. Instead, we added the difference of total tree PFTs fraction and total grass PFTs fraction in Figure 1 in order to help understanding of reader.

13. p5797 lines 20 & 24: "non linear" - do you mean non additive?

-> We modified these words to "synergy". We also added definite example of "additive" and "synergy" in section 4.1 with result of new offline experiments you suggested.

14. p5798 section 4.3 - it would help focus on the main paper theme if figs 3 and 4 were replaced with maps of changes in carbon storage between experiments, putting the original figures in the appendix.

-> These figures are modified to relative values. Figure 3 is now renamed as Figure 7 in this new manuscript.

15. p5798 lines 3-6 - how realistic are the PI carbon storage estimates? Compare to observations and other estimates.

-> We compared with previous studies. MIROC-LPJ tends to overestimate carbon storage, but shows reasonable response to LGM climate.

16. p5798 section 4.3 - a deeper understanding of the mechanisms involved in carbon storage changes would be achieved by some relatively simple additional factorial experiments, in which only T, P and CO₂ are changed, as in Table 2. Can these be

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added/presented? See for example these papers:

-> We referred these papers you suggested and added offline sensitivity experiment settings in section 3.2.1 and Table 2, and results in Table 3.

17. p5799 lines 19-20 - this sentence doesn't make sense.

-> There is complete sentence in my original tex file. I guess some technical problem in conversion from tex to PDF on CPD website. I will confirm carefully in proof-reading phase.

18. p5800 lines 1-5 - what do these differences in climate mean for vegetation and carbon storage in your simulations?

-> We explained our view of these differences in section 5.1. Generally, these regions have little vegetation and thus carbon storage, effect upon result is limited.

19. p 5801 lines 1-11; does the LPJ model simulate deciduous needleleaf trees, i.e. larch, which are important over Siberia? In the Hadley Centre models (e.g. Falloon et al 2012 mentioned above; Collins et al. 2011)

-> In the LPJ-DGVM, this kind of trees are treated as boreal needle-leaved summer green. It seems there is a positive bias of this PFT in LGM result, as described in section 5.1

20. p5801 lines 7-11 - how do you know what the impacts of improving the fractional representation would be?

-> We just interpolated cooling over forest and cooling over tundra with their fractional coverage. This explanation is added in the manuscript.

21. p5801 lines 12-15 - but also see comment 18 above.

-> We think the difference of climate does not affect carbon storage. At least, it does not change the main result of this manuscript. We explained it in section 5.1

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22. p5801 lines 21-24 - comment 16 is also relevant here.

-> Discussion based on new offline experiments is added in section 5.2

23. p5803 line 13 - replace "qualitatively comparable" with "approximately"?

-> We modified these words to "non-negligible" for better explanation.

24. section 6 - conclusions, needs to make more discussion of the fact that the study only applied one model - since different models (and their vegetation responses) will differ, this would affect results.

-> Discussion about inter-model discrepancy is added in the conclusion. MIROC-LPJ shows reasonable response to the LGM, but the result is considered to be larger member among various models.

Interactive comment on Clim. Past Discuss., 8, 5787, 2012.

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