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Climate of the Past Discussions

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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O'Ishi and Abe-Ouchi present an interesting study on the impact of vegetation changes during the LGM on climate and carbon storage. The paper is well written and thought out in general and my suggestions are mainly presentational issues, with the exception of some additional offline experiments which I feel would benefit the paper. Hence I have recommended major revisions only to account for the potential need for additional offline experiments.

Specific comments:

1. Overall, the paper would benefit from some reworking of the main figures. Since the

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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.

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

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 focussed 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:

U. Ehret, E. Zehe, V. Wulfmeyer, K. Warrach-Sagi, and J. Liebert Hydrol. Earth Syst. Sci. Discuss., 9, 5355-5387, 2012

Hagemann, Stefan, Cui Chen, Jan O. Haerter, Jens Heinke, Dieter Gerten, Claudio Piani, 2011: Impact of a Statistical Bias Correction on the Projected Hydrological Changes Obtained from Three GCMs and Two Hydrology Models. J. Hydrometeor, 12, 556–578. doi: http://dx.doi.org/10.1175/2011JHM1336.1

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

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

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.

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,

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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

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.

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)?

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.

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).

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.

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

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.

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

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

added/presented? See for example these papers:

Falloon PD, Jones CD, Ades M., Paul K 2011. Direct soil moisture controls of future global soil carbon changes ; an important source of uncertainty. Global Biogeochemical Cycles, 25, GB3010, doi:10.1029/2010GB00393

Jones C, McConnell C, Coleman K, Cox P, Falloon P, Jenkinson D & Powlson D (2004). Global climate change and soil carbon stocks; predictions from two contrasting models for the turnover of organic carbon in soil. Global Change Biology 11, 154-166 doi: 10.1111/j.1365-2486.2004.00885.x.

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

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

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)

Collins, W. J., Bellouin, N., Doutriaux-Boucher, M., Gedney, N., Halloran, P., Hinton, T., Hughes, J., Jones, C. D., Joshi, M., Liddicoat, S., Martin, G., O'Connor, F., Rae, J., Senior, C., Sitch, S., Totterdell, I., Wiltshire, A., and Woodward, S.: Development and evaluation of an Earth-System model – HadGEM2, Geosci. Model Dev., 4, 1051–1075, doi:10.5194/gmd-4-1051-2011, 2011

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

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

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

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

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.

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