

## ***Interactive comment on “Role of vegetation change in future climate under the A1B scenario and a climate stabilisation scenario, using the HadCM3C earth system model” by P. Falloon et al.***

**Anonymous Referee #1**

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Role of vegetation change in future climate under the A1B scenario and a climate stabilisation scenario, using the HadCM3C earth system model by Falloon et al

This manuscript describes results from global climate model experiments including both an interactive carbon cycle and a dynamic vegetation model under two scenarios of future climate conditions. With a combination of experiments they are able to isolate the impact of feedbacks from dynamic vegetation (i.e. changes in not just the functioning but distribution of vegetation) under changing climate conditions. They find that there are impacts on the global carbon cycle as well as regional impacts on precipitation and temperature. They conclude that because the addition or removal of forest

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cover is being considered as part of climate mitigation strategies we must consider both biogeochemical and biogeophysical effects of these plant cover changes.

Major comments:

Overall this paper could use a clearer message of the new results and insights. Although the simulations are with a model or under new scenarios which have not previously been discussed in the literature, the manuscript is very descriptive and lacks an overarching storyline. The authors compare their work to other recent papers and show how their work differs in each case, but an overall message throughout the paper of what this study finds is still missing. Section 4.4 is the stated goal of the paper, but if this is the main point then quantification of changes and analysis earlier on could be more tailored to making these points.

The results section of this paper entirely descriptive and lacking in analysis making it difficult to interpret. Almost all of the information in this section could be presented in a few tables (much of it is in Table 2 I assume) and the most relevant points can be added to the discussion section. I recommend that the authors either greatly condense this section or remove it entirely. If the authors choose to keep the results section it needs significantly more insight into what the numbers presented imply. Alternatively much of this information could be moved to the supplement.

The words "shrub" and "scrub" are both used throughout the manuscript to describe plant types represented by this model. I would be surprised if there were PFTs or combinations of PFTs for both of these categories - are these intended to be different? This point was very confusing. From the list of plant types on 7610 In 10 and In 24 I have to assume that the authors are using shrub and scrub interchangeably. Please choose one and be consistent.

Specific Comments:

Section 4.1: There is a lot of focus on the May 2008 paper. I understand that this

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is where the 2C20 simulation comes from, but I wonder what the authors are hoping the reader to learn from the comparison with the results of this other model. This comparison needs a clearer focus and message.

Section 3.3: I would like to see a quantification of the impact clouds on changes in albedo - how much change in albedo is there during cloud free conditions? The authors should be able to quantify this.

7604 ln25: also Pongratz et al 2010

7605 ln13: also Foley 1994

7608 first half: also consider Lawrence and Swenson 2011

7614 ln10: a map of the AMZ and HIGHLAT regions would be helpful. It could go in the supplement if necessary

7615 ln17-19: Is it possible to put any sort of standard deviations on these numbers? Does the model vary vegetation fraction at all in the long control run?

7617 ln2: "Changes in soil carbon seem to explain much of the global total carbon trends." I expect that the authors have sufficient information to answer this question more definitively. (Also line 7617 ln19, "appear to be")

7620 ln17-18: Is the change over land only due to albedo or have the authors just assumed that change in temp over land must be due to albedo? This sentence does not make that clear.

7623 ln6: Winter and spring where—Boreal seasons or local seasons? If local seasons how are these defined in the Tropics? Please use months to be more clear.

7630 ln13: The authors indicate that they do not find large temperature increases in water limited regions - where is this discussed in the text? I didn't see a discussion of the water availability to plants. How does water stress drive PFT distribution changes in this model?

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7635 ln13: Why do grasses not replace lost trees in the Amazon? Is the main loss of latent heat flux evaporation or transpiration? I would expect it to be transpiration, but this sentence indicates otherwise

7635 ln13: "Summer" is ambiguous - please use months.

Fig 1. The axis labels are too small to read

Fig 2. The layout of this figure could be improved. If possible make the maps larger. The labels are on top of each other. Some whitespace could be removed and only one colorbar is needed.

Fig 3. The colorbar boxes are too small to see the colors.

Fig 5. The maps are very small and difficult to see and only one color bar is needed.

Supplemental Material: Image quality in the supplemental figures is poor and the text is difficult to read.

References:

J. Pongratz, C. H. Reick, T. Raddatz, and M. Claussen. Biogeophysical versus biogeochemical climate response to historical anthropogenic land cover change. *Geophysical Research Letters*, 37, Apr. 2010.

J. A. Foley, J. Kutzbach, M. T. Coe, and S. Levis. Feedbacks between climate and boreal forests during the holocene epoch. *Nature*, 371(6492):52–54, Sep 1 1994.

D. M. Lawrence and S. C. Swenson. Permafrost response to increasing arctic shrub abundance depends on the relative influence of shrubs on local soil cooling versus large-scale climate warming. *Environmental Research Letters*, 6(4):045504, Oct-Dec 2011.

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