

## ***Interactive comment on “Holocene biome changes in Asia – an analysis of different transient Earth system model simulations” by Anne Dallmeyer et al.***

### **Anonymous Referee #3**

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#### General comments:

Thank you for putting together all the material.

The first part of this paper describes biome changes over the entire Asia region between the mid-Holocene and pre-industrial period using several different transient climate simulations. Through sensitivity experiments, the authors also investigate the causes of the biome changes in Asia. The second part of this paper describes biome changes at two transition zones (between forest-type and non-forest-type biomes) in Asia over the last 6000 years using the transient climate simulations and a few pollen-based biome reconstructions. In order to simulate biomes in Asia, the authors use a slightly modified BIOME4 equilibrium vegetation model. As a result, most of the results

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depend on the BIOME4 model.

Although the authors slightly modified and recalibrated the BIOME4 model for pre-industrial CO<sub>2</sub> concentration (280 ppm), readers may not understand how to validate the model. Therefore, the authors need to validate the modified BIOME4 model performance quantitatively. I think this is a key process for this study because your study really depends on the vegetation model. Moreover, if possible, the authors should use more than one model in order to reduce the dependence of the results on the choice of vegetation model.

The authors select one pollen-based biome reconstruction for each target transition zone, but the data does not represent sufficiently the feature of the large regions. Therefore, if possible, the authors should use more than one data for the target regions. You might download more pollen data from Neotoma database (<http://www.neotomadb.org>).

Despite of these remarks, I think that it is a very interesting paper.

#### Specific comments

L 1. The title might be a little vague for me because your target period is during the last 6000 years, not the entire Holocene.

L 31. “since the mid-Holocene”? for “during the Holocene”. Your study focuses on the changes in climate and vegetation over the last 6000 years, not the entire Holocene.

L 41. “during the Holocene”, As mentioned before, do you check the entire Holocene?

L 80. How many plant functional types (PFTs) do we need to describe the vegetation in Asia? How many PFTs are used in the current Earth System models? Does BIOME4 vegetation model have enough PFTs for the aim?

L 91. Why do you choose BIOME4 vegetation model? Can you choose other vegetation model(s) in this study?

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L 115. “280 ppm” for “280ppm”

L 115-129. How do you calibrate and validate the BIOME4 model for pre-industrial CO<sub>2</sub> concentration (280 ppm)? You should show the modified BIOME4 model performance quantitatively using the any data/observations. I do not know whether the model works better or not in the Figure 2, map-map comparison.

L 123. “1200 °C” for “1200°C”

L 125. “280 ppm” for “280ppm”

L 126. “CRU TS3.10” for “CRU TS3.1”; why don’t you use a newer reference climate data (e.g., CRU TS3.21 or TS3.22)?

L 132. “0 ka” or “0 ka BP” for “0k” because of the consistent abbreviation between model and data (?)

L 135-139. As mention before, you have to show your modified BIOME4 model performance quantitatively. Compared to the original BIOME4 model, does your BIOME4 model simulate a better biome distribution in Asia? Why don’t you use BIOME 6000 data for your model validation?

L 165. “6000 years ago, 6 ka” for “6000 years before present (henceforth referred to as 6k)” or “6 ka BP” for “6k” because of the consistent abbreviation between model and data (?)

L 226. “The simulated biomes”? for “the model-based biome reconstructions”

L 241. You should evaluate the mid-Holocene biome distribution using BIOME 6000 data in Asia because we do not know your model results are consistent with observed data or not.

L 243-261. How do you choose the target regions (95-125°E, 32-52°N) and (60-180°E, 15-80°N)? I mean Figure 3 also show large vegetation changes occur at eastern Siberia (tundra vs. taiga) and west-central Asia (60-80°E, 50-60°N; grassland vs.

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cool/cold forest).

L 254. If possible I would like to see the Figure 4 information using the 0 ka simulated biomes and reference data. Which is a larger differences of biomes between 6 ka/ vs. 0 ka and 0 ka vs. reference data?

L 271-272. The results from the sensitivity experiments show the real vegetation response or just BIOME4 response? If we use different vegetation models, do we get different results, for example cloud cover is a key factor of vegetation changes (it is opposite to L 275)? Nemani et al. (2003, Science) also shows the similar results about geographic distribution of potential climatic constraints to plant growth.

L 357. About Figure 11, less/more what? What does the x-axis shows, fractional changes in biome or . . . ?

L 357. Why do you use only two reconstructions? Can you use more pollen data from Neotoma database (<http://www.neotomadb.org>)?

L371. “The overall change in biome composition since the mid-Holocene”? for “The overall change in the Holocene biome composition”

L 380-383. You should consider the vegetation model deficits too. Your results really depend on BIOME4 vegetation model.

L 398. “Local”? for “regional”

L 405-412. Even if vegetation reconstructions for Asia are sparse, you should use available data (i.e. BIOME 6000 data) for your simulated biomes at the pre-industrial and mid-Holocene first.

L 410-412. Please put any references.

L 431. Your simulations focus on the last 6000 years, not “during the Holocene”

L 439. “500 years” for “500years”

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L 496. "More pollen records are needed to evaluate the simulated results." I understand your argument, but please use available dataset and show us the results first.

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