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Interactive comment on "Investigating vegetation-climate feedbacks during the early Eocene" *by* C. A. Loptson et al.

Anonymous Referee #2

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The paper by Loptson et al. describes the impact of the vegetation on the global warmth of the Eocene time period. Using numerical models, the authors separately test the influence of higher CO2 levels and of dynamic vegetation. The GCM HadCM3 has been used and the vegetation model TRIFFID accounts for the interactions between the climate and the PFTs. The paper is interesting and the experiments are well described. The results are somehow not surprising; being fairly comparable to previously published papers. While I think that this paper should be published, a number of substantial changes may improve the quality, or at least, the level of physical understanding. I list those changes below:

1) The introduction is a bit long and could be more direct. The part on the cloud sensitivity (p. 4708, l. 7-26) is not directly linked to the paper, I mean, it is ok to cite

those studies in one sentence to explain that a part of the warming may be explained with those changes but here, it is 20 lines on it. Maybe, you could move it to the discussion. The same for the part on the SST and on the calibration issues of the TEX 86 proxy (p. 4709), it is important to inform the reader on these limitations, but, the introduction is maybe not the right place to do it.

2) P. 4713, the part describing the predicted vegetation is very short. In particular, could you provide some explanations on the absence of trees over Africa as well as most of the South America and tropical Asia ? It is very strange ... this brings me to the next step, can you provide the characteristics of the PFTs implemented in TRIFFID (albedo, EP, roughness etc ...) and also the way the model predicts grasses or trees. Maybe, HadCM3-TRIFFID do not predict trees over equatorial latitudes owing to arid conditions though such result would be a bit surprising. How does the atmospheric CO2 influence the TRIFFID simulations ?

3) P. 4717, l.1-5, can you explain why the western Pacific ? I can understand for the Arctic which is very sensitive owing to ice-albedo effect but I am curious to know what happens in the model for the western Pacific, in fact, I suspect some changes in ocean dynamics as the onset of deep-water formation. Figure 8b, can you expand the descriptions and add more physical mechanisms. Why do you have a different behaviour of the model in the high latitudes of the northern hemisphere than the southern hemisphere ? less changes in the sea-ice (snow?) cover over the south pole ? (question true for Fig. 8a and 8b even if the pattern is inversed).

4) P. 4718, 3 figures for one page of explanations, it is hard to follow and the take home message is unclear. In particular, the role of PFTs distribution changes is once again poorly documented. For example, l. 25-30, I do not understand why the vegetation dynamic has a larger effect on a CO2 doubling than the shrub experiences, it is probably due to the characteristics of the vegetation predicted by TRIFFID over Antarctica. At 4x, TRIFFID predicts broadleaf trees while at 2x, it is mainly grasses and shrub.

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5) P. 4720-4722, I am not sure to follow the whole logic of the author but I would present the EBM analysis (which are zonal by construction) before jumping into the lat/lon/seasonal description of the changes in air surface temperature.

Interactive comment on Clim. Past Discuss., 9, 4705, 2013.

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