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Climate of the Past Discussions

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

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Thank you for the comments and suggestions. We have addressed these point-by-point 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."

We have reduced the length of the section on cloud sensitivity and moved the SST and TEX 86 calibration part to the results section where the model-data comparison is discussed.

"(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 ?"

There is a dry bias in the model here, and Hunter et al. (2013) have also found a lack of trees growing in these regions due to this when using TRIFFID with HadCM3. We have now included this explanation in the paper. We have also included extra information on the different PFTs and how they are calculated by TRIFFID in the methods section.

"(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)."

The western boundary current moves northwards and there are some changes in MOC that result in this warm pool. We have added a subsection on ocean dynamics into the results section to describe these changes in circulation in more detail and expand on the physical mechanisms.

"(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."

p. 4718, l. 25-30 explains why the warming over Antarctica is larger in DJF than in JJA for DYN simulations compared to SHRUB simulations when CO2 is doubled. This difference is due to the changes in vegetation (due to the reduction in albedo when trees replace shrubs and water vapour feedbacks from plant productivity). We have now stated this explicitly in this paragraph, instead of just referring to "albedo". The energy balance section also explains in more detail why the shrub simulations have a lower (annual) climate sensitivity compared to the dynamic vegetation simulations.

"(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."

The logic of having the EBM after the rest of the results is because the results section presents vegetation and climatological changes, and then the EBM explains these temperature differences in terms of various factors. We believe that it makes more sense to do it this way, than to present an explanation of the temperature differences before the temperature differences are presented.

References:

Hunter, S. J. et al., (2013) Modelling equable climates of the Late Cretaceous: Can new boundary conditions resolve data-model discrepancies?, Palaeogeography, Palaeoclimatology, Palaeoecology 392, 41-51

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