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Earth System Dynamics Discussions

Interactive comment on "Radiative forcing and feedback by forests in warm climates – a sensitivity study" *by* U. Port et al.

Anonymous Referee #1

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General Comments:

The primary aim of this paper is to assess the biogeophysical effects and related feedbacks of vegetation and soil color on the ice-free climate of the early Eocene, in comparison with the pre-industrial climate. Overall, this study nicely links previous vegetation/climate interaction studies that focused only on pre-industrial climate or only on deep-time paleoclimate. In that sense alone, this work is a valuable examination of the difference in feedbacks that govern climate in an ice-free world, and has implications for our understanding of these feedbacks in the tropics, as well as in future climate scenarios.

The study examines feedbacks and radiative forcing in equilibrated GCM experiments of early Eocene and pre-industrial climate. The results indicate that the effect of forests

on radiative forcing in warmer (Eocene) vs. cooler (pre-industrial) climates does not vary much, but that the feedbacks are quite different, are very interesting, and are an important contribution to our understanding of warm climate dynamics.

Overall, this paper is in good shape and nearly ready for publication, following some minor clarifications and editing.

Specific Comments:

The methods and simulation setup is fairly clear. There is some ambiguity that may be clarified with careful editing (see my technical comments). The use of the linear regression approach by Gregory (2004) is an efficient way to estimate equilibrated impacts of changes in forcing on temperature. The authors have adequately communicated necessary assumptions and sources of uncertainty in using this approximation. They have also provided a careful explanation of the equilibrated initial conditions used in the experiments.

I have only a couple of specific questions:

In the simulation set-up, how did you choose the latitude marking the boundary between tropical and extra-tropical trees (Fig. 2)? In the Eocene, there is tropical vegetation well into the mid-latitudes. It looks as though the boundary is around 30 degrees. If it was done this way to facilitate comparison between the Eocene and pre-industrial, please state so. (This is addressed, in a way, in the last paragraph of the paper – perhaps include this sooner.)

The beginning of section 3, 'Methods', seems to indicate that these are 'transient simulations'. . .If so, which forcing is varying in time in these simulations? I think these are not really 'transient simulations', rather they are 'unequilibrated simulations', as the approach of Gregory (2004) is applied to avoid having to run the simulations to full equilibrium. If indeed, there is a transient forcing in these experiments, this needs to be clarified (although, there doesn't seem to be such a forcing).

Technical Corrections:

There are sections of the paper where the wording is a bit unclear, and as a result, I had to read through several times before I felt I understood the point. I believe that this could be clarified by a VERY thorough editing by a native English speaker. I have commented on some of the more unclear sections below, but have not marked every instance where the wording seemed a bit cumbersome. (Examples: at the end of section 2.2, the text states "...we seek to investigate the biogeophysical effect of vegetation in a warm, nearly ice-free background climate instead of to simulate the early Eocene..." Should be 'simulating'. Also: in section 4.1, 3rd paragraph, 3rd line: '...composes of the cloud adjustment on one hand...' Should be 'consists of the cloud adjustment...').

Pay especially close attention to the wording in sections 3.1 and 3.2, in the descriptions of the calculations of the radiative forcing perturbations in the different experiments, as these sections are quite technical. This took several readings to follow the method. I think this could be made much clearer.

The paper could also be organized a bit more cleanly. For example, at the end of the Introduction (lines 14-26) on page 2580, there is a discussion of the choice of soil albedo immediately after a very brief mention of the use the linear regression technique by Gregory (2004). These paragraphs would be better suited somewhere in the 'Model and experiments' and 'Methods' sections. In light of the previous studies mentioned in the Introduction, the last paragraph should provide a clear overview of the goals of the work, and the overall aim of the study, rather than details of the experiments. This would make for a better transition into the discussion of the models.

The last sentence in the abstract could be worded more clearly: "We conclude that the radiative forcing by forests varies little with the climate state, while most subsequent feedbacks depend on the climate state." ...Is this sentence referring specifically to the albedo-effect? Is 'climate state' general wording referring to whether the climate is in it's 'Eocene state' or 'pre-industrial' state? This is a bit confusing if you haven't already

read the paper.

In Section 2.2, there is a detailed evaluation of the early Eocene equilibrated initial conditions. As those initial conditions come directly(?) from Heinemann et al. (2009), it seems that this section could be made more concise with more references to Heinemann et al., who include a comparison with proxies in their paper. As it is, this section reiterates what is presented in Heinemann et al. However, if the initial conditions used here are not precisely what is presented in Heinemann, then the full evaluation is necessary.

There is no reference in the text to Table 2.

Figure 1: Should be Huber and Caballero 2011 (not 2010, in the legend). Also, in the caption, 'cycles' should be 'circles'

Interactive comment on Earth Syst. Dynam. Discuss., 6, 2577, 2015.