

Interactive comment on “Multiple steady-states in the terrestrial atmosphere-biosphere system: a result of a discrete vegetation classification?” by A. Kleidon et al.

A. Kleidon et al.

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1. The conclusion that a discrete vegetation scheme can result in multiple steady states may seem trivial, but it has not been explicitly stated before and previous studies that used the BIOME model could likely have chosen such a setup. So the purpose of this study is well justified.
2. We considered focussing on areas of strong atmosphere-land coupling. However, the different initializations yielded such different climates for different vegetation classes that the transition region from vegetated to non-vegetated surfaces shifted substantially so that this evaluation would not necessarily provide much meaningful insight.
3. Clearly, the emergence of multiple steady states also depends on other factors, and

the reviewer states one example of the value of bare ground albedo. We think the reviewer's comment is adequately addressed by stating that there are other means that can result in multiple steady states.

4. We added references to the presentation of the conceptual model. (see also response to reviewer #2).

5. We agree that oceanic feedbacks can play an important role, but it was not the focus of this study to investigate the role of oceanic feedbacks on the emergence of multiple steady states in vegetation. We therefore think that our model setup is adequate for the purpose of this study.

6. We modified the description of the vegetation model to make it clearer and consistent to Kleidon (2006). Also we added the reference to Lunkeit et al (2004), which has all parameter values of the model. Kleidon (2006) only describes the most recent modifications of the vegetation model.

7. The leaf cover is too low in some tropical regions because of low precipitation biases in some areas, as described in the Methods section.

8. We do not understand the comment about intermediate vegetation states and local feedbacks.

9. In order to derive the lines in Fig. 1 from our model simulations would require substantially more simulations as well as the use of an offline model. We do not see the added insight in doing so.

10. The conclusion that multiple steady states may originate from a discrete vegetation classification may seem too obvious to the reviewer, but previous studies have utilized such an approach and so far no study has pointed this out. We agree that the statement that multiple steady states necessarily disappear in a better representation of vegetation is not proven in the paper. We have rewritten parts of the conclusion section and describe that it would require further investigations.

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11. The underestimation of productivity in our scheme is not resulting from the truncation scheme, because the levels are centered at the middle of the interval, not at the edges, so that the truncation scheme does not directly result in a low productivity bias. It is nevertheless quite clearly a consequence of the discrete vegetation parameterization, and, as can be seen in Fig. 3, is a very clear and consistent trend in a range of climatic variables that we think is an important result of the study.

12. We have modified the captions of Fig. 3 and Fig. 4.

13. Figs. 4 - 6 have been supplied in color – we are surprised that the reviewer's copy did not have color figures.

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