

Interactive comment on “Biogeophysical feedbacks trigger shifts in the modelled climate system at multiple scales” by S. C. Dekker et al.

Anonymous Referee #1

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This manuscript addresses the scientifically important question of multiple steady states in the climate-vegetation system. The authors show that multiple steady states can result solely from different initializations of the vegetation biomass and not necessarily as a consequence of discretized vegetation classes as shown by Kleidon (2007). The authors then applied a stepwise perturbation analysis to quantify spatially the sensitivity of the climate-vegetation system within the model to changes in biomass.

I have a few comment and suggestions listed here in decreasing order of importance.

1) I ask the authors to address the potential problem of using fixed rather than proportional perturbations. As I understand from the manuscript, in grid cells where the biomass is less than the negative perturbation amount, the new biomass is set to zero. This setup seems like it will overestimate the susceptibility of regions with low biomass

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compared to a setup with where the perturbation is a proportional reduction (e.g. 50%) in biomass.

2) I would advise against the term "multiple equilibria" and instead recommend "multiple steady states". Steady state implies that the means of the time derivatives are zero for the system properties of which you are interested. That is to say that the inputs equal the outputs. In the case of vegetation within SimBa, the mean net primary productivity is equal to the maintenance respiration plus the litter flux. Equilibrium is a special case of steady state which does not apply here.

3) The authors should also use consistent terminology throughout the paper when referring to either the "sustainability" or "susceptibility" index. Susceptibility index seems like the better fitting choice.

4) In Section 2.1: More precisely, it is the change in biomass per time step that is calculated as $NPP - RES - LIT$.

5) Fig. 2: The sentence of the paragraph is unclear, as a suggestion "Different global mean steady states were found for the D and G simulations."

6) Fig 3: I suggest using a raster plot rather than contours considering the relatively coarse spatial resolution of the simulations.

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