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Biogeosciences Discussions

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

S. C. Dekker et al.

s.dekker@geo.uu.nl

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Response to Anonymous referee 1

1. I ask the authors to address the potential problem of using fixed rather than proportional perturbations. Reply: In our experimental set-up we indeed have chosen to use a fixed perturbation. Referee 1 points out that in case of negative fixed perturbations, in which the new biomass is set to zero if the original amount of steady state biomass was less than the amount of the negative perturbation, an overestimate of susceptibility could be found. For the D- run this is not the case, because we have shown that no significant differences were found as all global mean biomass states lower as Deq (D equilibria) are attracted by Deq. For the other negative perturbations G- and G-- (but also the D+ and D++ perturbations) indeed differences in susceptibility will be

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found (see also point 3b by referee 2, point 4). However, by setting up our modelling experiment we explicitly choose for fixed perturbations because we are interested in a map of potential multiple steady states. Using a proportional perturbation will have the big disadvantage that grid cells with small amounts of biomass will be perturbed with small perturbations. It is not likely that multiple equilibria will be found with these small perturbations. This will be highly relevant in for instance Sahel/Sahara region (also mentioned by referee 2). So the results of fixed perturbation are relevant in that sense. Indeed the choice of our experimental design needs to be more clarified in 2.2. We will add this in a small paragraph justifying our experimental approach.

2. I would advise against the term "multiple equilbria" and instead recommend "multiple steady states" Reply: We would like be ready to change the term multiple equilibria into multiple steady state but we do not understand the argument of referee 1. Indeed a steady state means that input equals output; as far as we know equilibrium is a synonym of that. You can have two conditions; one if input and output are zero (often referred to static equilibrium) and one if input minus output equals zero (often referred to dynamic equilibrium). For this paper, we suggest to keep the general term multiple equilibria.

3. The authors should also use consistent terminology throughout the paper when referring to either the "sustainability" or "susceptibility" index. Reply: Indeed this is a typo. We will change sustainability to susceptibility at L20, P10988.

4. In Section 2.1: More precisely, it is the change in biomass per time step that is calculated as NPP - RES - LIT. Reply: Indeed this is true and we will change it in the revised manuscript

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." Reply: Indeed the last sentence of the heading is unclear and will be changed to: Different global mean steady states were found between the two equilibria Deq and Geq.

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6. Fig 3: I suggest using a raster plot rather than contours considering the relatively coarse spatial resolution of the simulations. Reply: We agree that the model set-up was with relatively coarse spatial resolution but still we think that we can use contour plots for Figure 3 and Figure 6 as we have used the 'no significant' index for cells showing no differences and we have included for Figure 6 the histograms of the land cover distributions. Further the contour plots show a more easily interpretation of the susceptibility-patterns as compared to the raster plots (as seen below).

Figure 6-alternative: Raster plot of Susceptibility map (S indexes) from D to G with positive perturbations (a) and from G to D with negative perturbations (b); ns means no significant differences between the old and perturbed biomass state, meaning Si=0. Insets show histograms of land cover distributions of Si.

Interactive comment on Biogeosciences Discuss., 6, 10983, 2009.

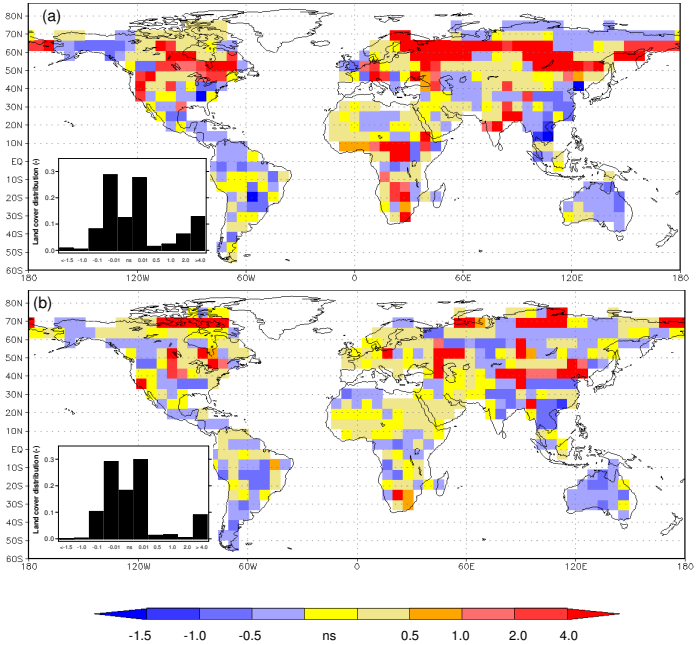

Fig. 1. Figure 6-alternative: Raster plot of Susceptibility map

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