

Reply to Anonymous Referee #4

Z. Yin, S. C. Dekker, B. J. J. M. van den Hurk, and H. A. Dijkstra

1 General comments

- “This manuscript describes an analysis of how climate and vegetation can interact to produce bimodality-i.e., multiple possible ecosystem states that can exist under a given climate regimes. This is considerably out of my area of expertise, but the ms is well written and generally clear, even for a non-specialist. It’s also interesting, and I appreciate e.g. the spatial distribution of uncertainty is nicely done.”

A: We appreciate that you like our work and method. Thank you very much for your suggestions and comments.

- “First, not enough information is given about the software used and data/code availability (see comment #3 below). For reproducibility this needs to be improved, and ideally all analysis code made available.”

A: We completed the analysis again by the latest version of ‘flexmix’ and we added the version information in the manuscript. In the online supplement we will add that the code and a part of data will be available on request.

- “Second, the analysis excludes areas with human activities. There needs to be more clarity about exactly how much area this comprised, and some discussion about the implications of doing so. Again, see comments below.”

A: True. Indeed, human activities significantly influence the ecosystem and local climate. However estimating human activity is too difficult and beyond the aim of this paper. As already explained in the manuscript we have deleted all W grid cells with human activities following the GlobCover information. As we fully agree with the reviewer we added an extra paragraph in the discussion that of course human activities as deforestation and other land use changes will largely influence the ecosystem and their local climate.

2 Specific comments

1. “Page 18214, line 13: ‘not a sufficient predictor’ is somewhat vague.”

A: Revised as “not sufficient to predict potential land cover change”.

2. “P. 18214, l. 16: same with ‘cannot exclude the probability’ - more specificity would help clarify.”

- A: Revised as “However, these indicators cannot predict stable forest state under the observed climatic conditions”.
3. “P. 18218, l. 6 and throughout: what version of flexmix? What version of R? What is code and data availability? It’s 2016, and in general I expect all code and data (at least that backing the main results) to be included as supplementary info, or posted in a repository. It’s not acceptable to produce results from a black box.”
A: See general comments, we have included the version number in the manuscript.
 4. “P. 18219, l. 6-: what percentage of data were excluded because of human activities?”
A: The percentage depends on the location of the specific grid cell. It varies from 4% to over 80%. Please note that we do not only filter anthropogenic land cover but also some other cover types (e.g., water body, flooded area, etc). In the Discussion we mentioned that some places may be highly affected by human being and highlight the importance of understanding the role of human activities in ecosystem dynamics and climate change.
 5. “P. 18225, l. 5: ‘principle effect’? Do you mean ‘significant effect’?”
A: Revised as “no significant effect on the analysis in principle”.
 6. “P. 18233, l. 17: ‘implication’.”
A: This section is totally re-written.
 7. “P. 18234, l. 1: ‘as the only’.”
A: Corrected.
 8. “P. 18235, l. 1-10: need to also discuss uncertainty of human activities! (Which were excluded from this analysis, right?) Whether the Congo stays as forest or not is probably much more likely to depend on people chopping it down versus climate shifts, no?”
A: One paragraph is added at the end of the Discussion, as:
“Apart from natural factors, human activities (e.g., deforestation, grazing and urbanization) also significantly influence the tropical ecosystem. In fact, based on the GlobCover data we find that over 80 percent of area can be affected by human being in specific climatic grid cells (0.5° resolution). Estimating future the amount and type of land use change is difficult as it involves all different social processes as economy, cultivation culture and policy both on local and global scales. In turn these land use change interacts with climate change as well. Thus its contributions to climate change and ecosystem should be carefully investigated to improve the prediction of potential land cover change.”
 9. “P. 18235, l. 13-24: this conclusion doesn’t add anything new; remove.”
A: Revised as:
“Observed bimodality of woody cover suggest that alternative stable states may exist under the same precipitation band due to vegetation-climate interactions. In

this study we find that bimodality also exists in the density distribution of mean annual incoming shortwave radiation and above ground biomass. The bimodality of climatic variables provide another evidence of strong vegetation-climate interaction in tropical regions. By means of analyzing conditional histograms, we found two stable conditions under which the mode of woody cover can be determined. It indicates that a climatic variable, which should be a measure of the strength of vegetation-climate interactions, can be used to estimate the stability of vegetation states. We also find that the bimodality of woody cover still exists under low mean annual radiation and low above ground biomass. It is demonstrated as the environment where vegetation state is unstable and critical transition can occur.”