

Interactive comment on “Palaeo plant diversity in subtropical Africa – ecological assessment of a conceptual model of climate–vegetation interaction” by V. P. Groner et al.

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We thank the anonymous referee #1 very much for comments and suggestions, and we address here the main issues arising out of the comment.

“I understood that the authors revisited a previous study presenting a conceptual model regarding the potential effect of plant diversity on climate-vegetation feedbacks published by Claussen. However, I found the approach not up to date.”

As mentioned, the purpose of the presented work was the revision of Claussen et al., (2013), including an assessment of the study and an extension of the model by plant types after pollen reconstructions within the possibilities of the model structure.

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We did not aim to go towards a new class of models. We are aware of the limited applicability of our conceptual approach, that is why we propose not to complicate it any further but to step towards a DGVM for future studies. However, we think that conceptual niche-based models can still contribute to the understanding of diversity-stability relationships.

“It’s now clearly stated that niche based models are not the adequate tools to answer such questions and dynamic vegetation models should be used. For example, today, dynamic vegetation models are explicitly describing the competition for resources (light, water, nutrients...) that cannot be described by niche based models [...] Generally when it comes to vegetation function DVM should be preferred to niche based models (just usefuls to describe potential vegetation distribution). “

The niche concept is the underlying principle in the study by Claussen et al., (2013) that we built our work on. We picked up this concept and extended it in the range of possibilities. The focus lies on the relationship between vegetation cover and precipitation, and the distinction between plant types by different precipitation thresholds – niches in terms of moisture requirements – appeared obvious. Other models provide of course many opportunities for more detailed and more accurate simulations of vegetation serving different purposes. However, there are only few model studies considering the effect of diversity on the stability of climate-vegetation systems in a way it was approached by Claussen et al., (2013), and we see the simplicity of conceptual models and the isolated consideration of parameters as an advantage. As mentioned above, we aim to perform future studies with a DGVM in order to consider more processes. The land surface model JSBACH that is part of the Earth System Model we use - MPI-ESM - has compared to other DGVMs a very simple representation of ecosystem processes and a very limited number of interactions implemented. Baudena et al., (2015) showed that JSBACH overestimates tree cover because competition via only NPP favors trees irrespective of water availability, and fire is fostered disproportionately by woody vegetation as compared to grasses, resulting in a negative

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grass-fire feedback. JSBACH does not account for processes such as root, light, and nutrient competition, fire resistance, shading effects, recruitment, age stages. Conceptual studies in the first place can provide important background information for building in plant-plant interaction and plant-climate feedback in JSBACH.

“Identically, DVM can also give insights when it comes to the impact of an atmospheric CO₂ concentration increase, which is important when it comes to water uses efficiency.”

The effects of changing atmospheric CO₂ concentrations on plant growth and water use efficiency are doubtlessly very important, especially for future projections of vegetation and climate as well as studies of the deep past. However, changes in atmospheric CO₂ concentrations were of minor importance during the mid-Holocene compared to changes in precipitation patterns. CO₂ changes are therefore not of interest in our study.

“Secondly, the vegetation composition seems to be mainly driven by bioclimatic limits in this study and particularly mean annual amount of precipitations. Recent studies show that for a identical amount mean annual amount of precipitation the vegetation composition can be drastically different depending of the seasonnality of these precipitations during the year.”

It is true that plant growth not only relies on mean annual precipitation but also on seasonality, a parameter that changes over time. We use mean annual precipitation to define our plant types following up on White’s classification (1983) where he uses requirements in mean annual precipitation. Even though it would be very interesting to follow changes in seasonality that go in conjunction with insolation changes towards the end of the Holocene, the consideration of seasonality is not provided for in the model formulation and the effort to implement it would be unproportional.

“I would have liked also a figure presenting a temporal comparaison between recorded pollen data and model’ simulation to estimate (at least visually) the model accuracy.”

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Unfortunately, we do not have the pollen data set from Hely et al., (2014), so we cannot present a graphical comparison of pollen and our simulations. We contacted the authors and requested the data, but we did not receive a response. Our comparison is based on the text by Hely et al., (2014) as well as the evolution of “number of taxa” and “number of occurrence” (Fig.3 in Hely et al., (2014)).

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