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Biogeosciences Discussions

Interactive comment on "African biomes are most sensitive to changes in CO_2 under recent and near-future CO_2 conditions" *by* Simon Scheiter et al.

Anonymous Referee #2

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General Comments

This paper considers the lag between a transient and committed vegetation state under changing CO2 and due to the disturbance effect of fire, using the aDGVM. In my view the paper is well written, clearly structured, and presents relevant and interesting results. The study is structured around 4 hypotheses which consider the current vegetation state, the impact of rate of change, the extent of change, and the effects of fire, which are novel and useful. The methods are explained clearly. The definition of equilibrium presented in equation 1 appears logical, although I wonder if there is already a published method for this that has been used in other studies. The results

are presented in a logical way, and the text supports the figures throughout. I believe the conclusions are a valid interpretation of the results and that they are substantial and useful. I have some small comments on specific sections as outlined below, but otherwise I think the paper is of very good quality.

Specific Comments

Line 19 – Include the time period for the Devonian period to give context

Line 28 - Paleocene-Eocene Thermal Maximum (PETM), a period with high carbon emissions some 56 million years ago – It would be nice to see a little more about this period and explain why the carbon emissions were high

Line 50 – is there a reference for this definition of equilibrium? I wonder if there is another method available which has been used in already published studies that can be referred to. I can see the logic of this method but some extra reference to existing methodology, and why it has been altered if necessary, would make this stronger

Section 2.1 Line 110 – There aren't many PFTs represented in aDGVM. However it is mentioned in the discussion that this may cause an underestimation in lag time in forests, and as the study is focused on one savanna location I think it is enough for this study

Line 136 – the performance of aDGVM has been evaluated in terms of vegetation, but what about fire? It would be good to see some evidence that the fire model is reliable, at least for the location picked

Section 3.6 Line 300 – can you give an explanation as to why the carbon debt continues to increase when the tree cover debt decreases?

Fig 3 Bar plot – if fire is suppressed in forests (L384) would you not expect the forest results in figure 3 a and b to be the same, or would there still be some fire?

Also from figure 3, I think it would be worth quantifying the lag time and noting in the

abstract how much longer it takes to reach equilibrium per X increase in CO2, which is an important result

Line 256 – Lags are larger at low and intermediate CO2 mixing ratios and decrease at higher CO2. How does this fit with 'The time until vegetation reaches an equilibrium state. . .. Increase[s] with CO2' (L236)

Line 270 / Figure 5 and 6 – It follows that the time taken for the transient simulations to reach equilibrium is measured, but how is the time taken to reach equilibrium in equilibrium simulations measured? In other words what is the equilibrium simulation initialised from?

Line 289 – I think specifying that the debt is "larger" would be better than "higher" given the values are increasingly negative

Technical Comments

Line 18 – Earth's history?

Line 25 – Define RCP (Representative Concentration Pathway)

Line 91 – Does the a in aDGVM stand for anything?

Line 116 - "This approach allows to model how herbivores" – allows us to model?

Line 228 – "C4 or C3-dominated vegetation if fire is present or absent" respectively.

In most of the figures C4 grassland and savanna is labelled, but woodland and forest is not labelled as C3 despite being referred to in the text as C3

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