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Interactive comment on "Influence of climate variability, fire and phosphorus limitation on the vegetation structure and dynamics in the Amazon-Cerrado border" *by* Emily Ane Dionizio da Silva et al.

Anonymous Referee #1

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General comments: This manuscript investigates the drivers of the savanna-forest border in South America. The authors examine the effects of climatic variability by forcing the model using two different datasets, of phosphorus limitation by altering Vmax based on two different phosphorus datasets and by running simulations with fire on and fire off.

The manuscript attempts to answer the long standing question about the actual drivers of the cerrado-amazon biome boundary and is the first to test the effects of phosphorus limitation in the cerrado. The simulation results for the Amazon region using the

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regional phosphorus map (PR) are very similar to those produced by Castanho et al. (2013) given it is the same data and essentially the same model. The comparison between the global and regional phosphorus map is interesting as is its extension into the cerrado. It would be interesting to see which most closely matched satellite derived biomass data (Saatchi/Baccini/Avitabil) for the entire study area, my guess is that the PR simulations would – you talk about the biomass distributions across the Amazon region anyway, it would be useful if the reader could visualise this in some way.

There is one aspect of the manuscript/model which causes me particular concern, how do you simulate such low biomass and predominantly grasslands and savanna in the cerrado area with fire turned off? Precipitation ranges between ca. 1000 & 2000 mm/yr in this area (maps of your forcing data would remove the need to guess the precipitation range which generated these results). It is generally accepted that above ca. 800 mm/yr, fire (or some other limiting factor) is necessary to prevent the formation of closed canopy forest/woodland vegetation formations (e.g. Hoffmann et al., 2012). Your results (Fig. 6) however show that, in an area where precipitation is well above this threshold, neither phosphorus limitation nor fire are necessary to explain the presence of what looks to be about 65% of the distribution of c4 dominated vegetation formations in the cerrado. This result is incredible; you need to explain how/why your model behaves like this. The result contradicts most of the savanna ecological literature and needs to be discussed and justified in detail.

Overall the manuscript presents novel, interesting results and a potentially new (but not discussed) perspective on the drivers of mesic savanna distributions. The manuscript is let-down by the presentation quality to such an extent that it makes it difficult to assess the scientific significance of the work; the text needs careful re-editing, methods need to be more detailed to allow the assessment of their validity, the presented but not discussed new perspective on the drivers of mesic c4 dominated vegetation formations needs particular attention.

Specific comments: The manuscript needs to be carefully edited to improve English,

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currently it is difficult to understand and cumbersome to read. In many instances this does not detract from the message however there are places where I cannot understand what the authors are trying to convey.

I would be reluctant to conclude that inter-annual climate variability in general does not play a role in determining the transition. Also, sometimes you write climate variability and sometimes inter-annual climate variability, these are two very different things; make it clear that when you refer to climate variability you are actually talking about the difference between two datasets used to force your model. How different are the CA and CV data? Some plots in the supplementary materials would be useful.

I would like you to state how you calculate your sample sizes, how big your sample sizes are, their means and standard deviations for all of your statistical tests. This is missing from the methods which makes it difficult to assess the appropriateness of the statistics used.

I'm quite impressed that your biomass falls from west to east (Fig. 5 T1-T4) in the absence of fire, it appears that your simulated biomass responds well to reductions in precipitation /& increased dry season length. Other models don't appear to respond this well, see Fig.3 in Galbraith et al. (2010). Looking at the biomass produced by IBIS (INLAND is based on this) for the cerrdo (Plate 2.b in Foley et al. (1996)) it would appear that the biomass you are simulating is much lower than that presented by Foley.

The simulated biome distributions are excellent, however, I'm very surprised to see such large savanna and grassland extents in the absence of fire (Fig. 6). Most models would simulate relatively high biomass tropical evergreen or deciduous forest in the absence of fire, in fact, most models simulate relatively high biomass tropical evergreen or deciduous forest in the presence of fire (e.g. Fig. 4 in Bond et al. (2005), Fig. 2 in Smith et al., (2014) and Plate 7 in Foley et al. (1996) – INLAND is based on IBIS so I'm wondering why there is such a big difference). Based on your results you are simulating savanna and grassland through most of the cerrado (these are also "Very robust") with

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fire turned off, does this mean the presence of the cerrado/c4 dominated vegetation does not depend on fire? How/why does the model simulate these vegetation types in areas with such high precipitation in the absence of fire? Has the model been re-tuned, if so how?

Technical corrections: 1. There are many grammatical errors and confusing sentences throughout the manuscript. 2. T5 missing from Fig. 1. 3. It could be made more clear what Fig. 3b is showing. 4. It is incredibly difficult to distinguish the different greys used in Fig. 5. 5. Line 502: T2 and T3 show the highest average correlations not T3 & T4. Following this it is stated that biomass in these transects are (Fig. 5 b & d) are underestimated due to lower water availability. T2, T3 and T4 mostly overestimate, not underestimate, biomass, apart from the simulations with fire in which case it would be due to the presence of fire? Additionally, it would be useful if it was indicated in Fig. 5 somewhere which points are cerrado and which are forest. The text refers repeatedly to cerrado and forest points but I can't tell which are which from the figure and need to constantly refer to Fig. 1. See also my greyscale comment. 6. I would recommend leaving the discussion to the discussion section to remove repetition (e.g. line 272 "reinforcing . . .", line 311 "which is relevant") however this can be very difficult. 7. Line 661 – the author list repeats itself.

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