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Interactive comment on "Improved simulation of fire-vegetation interactions in the Land surface Processes and eXchanges dynamic global vegetation model (LPX-Mv1)" *by* D. I. Kelley et al.

Anonymous Referee #1

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The manuscript "Improved simulation of fire-vegetation interactions in the Land Surface Processes and eXchanges dynamic global vegetation model (LPX-Mv1)" described a new version of the LPX-M model which has many improvements over the original version. Re-parameterisation of lightning ignitions, fuel drying rate, fuel decomposition rate, rooting depth, adaptive bark thickness, and resprouting have been introduced into the new model with specific aiming to improve the model performance in grassland and savanna ecosystems. The authors used a benchmarking system to test the impact of each parameterisation on model performance in Australia. The topic is important and the content will be helpful for other modelers and data analyzers. The manuscript is well structured and written, although some portion of the paper can be shortened.

Overall, I think this paper is appropriate for publication in GMD after addressing the following concerns.

General comments

The manuscript (e.g., section 4) can be written more concisely. Some related tables and figures can be moved to the supporting material (see the following specific comments for detail).

The authors only evaluated the model performance in Australia and claimed the modified version improved the simulation. It would be interesting to see whether this improvement is at a cost of deteriorating model performances in other regions.

Specific comments:

Page 934, Line 24 - Page 935, Line 2: The beta value given here for the original LPX is extremely small. Given this small beta value, I don't understand the meaning of equation (1) in partitioning the CG lightning. Unless P(wet) is 1 (i.e., every day in this month is a wet day), the CG(dry)/CG fraction derived from Equation (1) is always very close to 1 (e.g., with only one dry day in a month, $(1-P(wet))^{beta} = (1-30./31.)^{0.00001} = 0.99996566071$). This essentially assigns all CG lightning strikes to dry days in a month, not "removes all strikes in months with more than two wet days" as stated by the author. And the blue line in Figure 2b should be a straight line with value of 1. By the way, the beta value for the original LPX given in Prentice et al (2011) was 0.001, which may still result in unrealistic dry-wet-CG partitioning.

Page 935, Line 7-10: "This problem can be corrected by...", but it is not clear to me whether it is actually corrected using this way in LPX or LPX-Mv1?

Page 936, Line 10: Please change (1-1/exp) 63% to (1-1/exp) = 63%.

Page 939, Line 7-11: The unit for L given here (flash/m2/month) is different from that in Fig 2a (flashes/km2/day). If possible, please use consistent unit.

Page 940, Line 7-8: Equation 10 seems to provide a more realistic partitioning. But will the removing all lightning in wet days result in an underestimation of the fire ignition? Meteorological conditions in wet days may be unfavorable for fire ignition and spread, but due to their large numbers, the wet day CGs may still be able to start significant amount of fires (especially in partially wet days).

Page 940, Line 15-17: Please update the reference of Pfeiffer and Kaplan (2013) with new title and new model name.

Page 951, Line 23-28: AVHRR is not originally designed for fire detection. The burned area simply scaled from AVHRR active fires does not provide much additional information than the GFED burned area. Unless the authors explicitly state the advantages of using AVHRR burned area, I don't think it is necessary to include a comparison to this dataset in this paper.

Page 957, Line 19-22: It is hardly to draw the conclusion from Figure 8 that LPX-Mv1-rs performs better than LPX-Mv1-nr in representing the transition from forest to grassland.

Page 957, Line 16-28: There is not much fire in Southwestern Queensland. Probably a typo here for 'northwestern Queensland' ?

Page 959, Line 8-9: "Adaptive bark thickness has not been included in any vegetation model before" is duplicate of "Adaptive bark thickness and post-fire aerial resprouting behaviour have not been included in DGVMs until now" in Line 5-6 of the same page.

Page 976, Table 1: It would be beneficial to readers if the authors include the sources for each PFT-specific parameters in this table.

Page 977, Table 2: Some PFTs are not consistent with that in Table 1 (e.g., TN and BN in Table 2 vs. BNE in Table 1). Please make the notations consistent throughout the paper.

Page 978, 980, Tables 3 and 5: The contents in these two tables are good summaries of previous studies and have been used in this study to derive the recruitment penalty

for resprouting PFTs and post-fire recovery. However, I think it is better to move them to the supporting material for reference only in order to shorten the paper. Also, some information from these studies has already been presented in other place (e.g., Fig 7).

Page 983, Table 6: The 'Bootstrap mean' and 'Bootstrap SD' have not been mentioned in the main text. If the 'bootstrapping experiment' is equivalent to the 'randomly resampled' null model described in Page 952, please make a note of it.

Page 984, Table 7: Some items are not clearly defined. For example, what is 'mean ratio'? What are 'NME', 'MPD', 'MM' standing for? Readers may have to resort to Kelley et al (2013) for understanding the whole table.

Page 991, Fig. 1: If possible, please highlight the modified modules or parameters in this study. It is not worthwhile to include a same figure that was already published in an early paper.

Page 992, Fig. 2: (a) It seems there is a lower limit of the CG fraction. Did you set a threshold in the calculation?

Page 996, Fig. 6: When alpha > 0.5, it seems the modeled (LPX or LP-Mv1-rs) sum of tree fraction and grass fraction is close to 1, while the observed sum fraction is much smaller than 1. Could you explain this discrepancy?

Page 997, Fig. 7: What does the horizontal dashed line stand for (close to 90%)?

Page 998, Fig. 8: The authors did not provide an extensive discussion on the differences between modeled tree covers using LPX-Mv1-rs with crop masking and without crop masking. Panel (e) to (g) can be moved to supplementary material.

Page 1000, Fig. 10: The green and blue colors in a) are very difficult for me to differentiate. Please consider using another pair of colors.

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