Response to referee #3

Dear referee, thank you very much for reviewing our manuscript and adding your comments and input. We considered all your comments and responded to each of them as specified below.

Sec. 2.2: water stress mortality. I lack explanation why it appears as a separate topic in Methods if no results are reported later related to that, no comparison of results with this type of mortality included and without it.
Response: Thank you for your comment. This was a new function implemented into the LPJmL-VR. We included results and discussion regarding the implementation of the water stress mortality function into the supplementary file.

Sec. 4.2: While discussion on Amazon part is clear, I think one cannot expect an improvement here from the inclusion of Cerrado type. For the reader, it would be easier to follow the discussion if it was kept closer to the results, consequences of implementation of this PFT. For example, it would be interesting to discuss why the regional distribution of burned areas within Cerrado domain has improved in some areas but worsened in others. Also L647-648, this is not related to discussion of these results, while important for the model in general and can be moved to conclusion
Response: Thank you for your comment. We reformulated this part of the discussion to focus more on the Cerrado biome while still mentioning the Amazon. "In Savannas, there is often extensive use of fire for land management purposes. Specifically, in the Cerrado, fire in natural areas is associated with the use of fire for deforestation and pasture management, with fire escaping to natural areas, while in areas of mechanized agriculture and planted forests, owners rather protect the areas against fire. In SPITFIRE, however, ignitions are represented solely as a function of population density, and the model does not explicitly capture the diverse fire management regimes common in these regions. This simplification contributes to the underestimation of burned area along the Caatinga border, where expanding deforestation and intensive land management interact with natural fire regimes, as well as in southeastern Amazonia, where large-scale pasture management fires may escape and affect adjacent rainforest (MapBiomas Fogo, 2024; Cano-Crespo et al., 2015). To mitigate this, we weighed both validation data and model outputs by the human land-use

fraction from MapBiomas, thereby excluding grid cells with extensive anthropogenic land use from the analysis. Recent attempts to better incorporate anthropogenic fire management into models (Perkins et al., 2024) could enhance Cerrado fire simulations, which is particularly relevant given the increasing pressures on the biome and the ongoing shifts in fire regimes (da Silva Arruda et al., 2024). Nevertheless, even with improved fire–vegetation dynamics, simulations of future trajectories of these dynamics will remain constrained if key vegetation traits, such as deep root water uptake, are not adequately represented (D'Onofrio et al., 2020; Baudena et al., 2015)." We also excluded the sentence from lines 647-648.

L498-499: ET and GPP, the authors report no improvement, but could some numbers please still be put there in the sentence, not sending the reader to supplementary? It would be also nice to have some other numbers in the discussion (more quantitative comparison with previous studies).
Response: Thank you for your comment. We included a more quantitative and detailed description of the ET and GPP improvements in our main text.

Minor comments:

L126-130: report numbers that are good to have in mind thinking of the impact of the work done: this is a large biome, and it is not represented in the models. I suggest moving this information to the Introduction.
Response: Thank you for your comment. We moved this information to the Introduction.

L 134: 'classification system, characterized by a rainy season' – please rewrite
Response: Thank you for your comment. The phrase was rewritten as "According to the Köppen–Geiger classification, the region's climate is predominantly tropical savanna (Aw) with a rainy season from October to April and a dry season from May to September."

L147-150: I suggest moving these two sentences to the end of this section. There you already mention impact of fire on the vegetation formations, which you define later, in the next sentence.
Response: Thank you for your comment. We moved these phrases to the end of the paragraph.

L192 *phen* should always be written with small letters even if it starts the sentence.
Response: Corrected. Thank you!

L283: ‘earlier in their lifecycle’: I see from the figure at smaller heights. Fig. 2 does not show how quickly the trees grow, so I am not sure if ‘earlier’ is the correct word
Response: Thank you for your comment. In LPJmL, k_{root} is one of the parameters that defines how trees allocate carbon during their development. In this case, making them invest carbon in root development at a higher rate compared to other trees in the model. Root depth and tree height are also linked in the model as they “compete for carbon” in tree development. To reflect that, we changed the sentence for “We reflect this by modifying the shape parameter of the logistic root growth function (k_{root}, Table 1), enabling TrBS to develop deeper rooting depths already at relatively small tree sizes (Fig. 2), enhancing their belowground competitiveness.”

L328-329: a bit awkward definition of VPD, it is just the difference between actual and saturation water vapour pressure. Also VPD was mentioned earlier but is explained only now.
Response: Thank you for your comment. We changed this sentence to make the definition clearer “VPD is the difference between the saturation water vapor pressure and the actual water vapor pressure in the air and is influenced by both temperature and relative humidity”. Also, we moved the definition to lines 214-215 where we first mentioned this parameter.

L337: this is easy to read as alpha multiplied by VPD. I'd suggest make ‘VPD’ a subscript to avoid it.
Response: Corrected. Thank you!

L444: ‘we weighed the burned area’: can you provide the formula or describe better how?
Response: Thank you for your comment. We reformulated the paragraph to be clearer about the weighting. “For the spatial distribution of annual burned area, we created a map of the human land-use fraction based on MapBiomas 9.0 land-use data (MapBiomas, 2024), using the mean value from 1990 to 2019 (Fig. S5). Because our simulations consider only potential natural vegetation (PNV), we multiplied both the validation and modeled area maps by this human land-use fraction. This weighting accounts for fire occurrences in

human-managed areas and allows a more consistent comparison between simulated and observed burned area."

L488-492: these two sentences largely repeat each other.
Response: Thank you for your comment. We rewrote the sentences to avoid redundancy. "The inclusion of TrBS PFT significantly improved the simulated above- and belowground biomass patterns across Brazil compared to simulations without it, leading to an improved representation of the 'upside-down forest' in central Brazil (Fig. 5)."

L 492: Fig. 5 should be referenced in the next sentence, which discusses the ratio.
Response: Corrected. Thank you!

L575: not sure 'enhances' is the right word here, 'impacts' could fit better.
Response: Corrected. Thank you!

L576-578 about improved simulations: I am not sure I agree with the whole statement. Total burned area yes, improved, also its temporal dynamics but spatial distribution of burned area has become somewhere better somewhere worse.
Response: Thank you for your comment. We rewrote the sentence "TrBS improved simulations of carbon allocation, particularly below- to aboveground biomass ratio, and better represented fire behavior, especially the temporal dynamics of burned area."

L609 'future trajectories' of what?
Response: Thank you for your comment. This paragraph was excluded and merged with the paragraph from lines 666-679. The sentence was rewritten in a clearer way. "Nevertheless, even with improved fire–vegetation dynamics, simulations of future trajectories of these dynamics will remain constrained if key vegetation traits, such as deep root water uptake, are not adequately represented"

L620 remove 'Nevertheless' it does not fit these sentences
Response: Corrected. Thank you!