

Response to referee #1

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.

Line 109: Typo

Response: Corrected! Thank you.

Line 152: Better just “Forest formations”

Response: Corrected! Thank you.

Line 165: What is the difference here between fire influence and fire disturbance?

Response: This was a mistake. This sentence was meant to be written as “This model framework enables the simulation of global vegetation dynamics, including the influence of fire disturbance”. It was corrected.

Lines 262-263: I gather that these refer to moist and seasonal tropical forests in the LPJmL models, but I missed a more explicit definition of what they are and where they are in Brazil, since they are the basis for your comparisons throughout the parametrization procedure.

Response: Thank you very much for your comment. A more explicit definition of TrBE and TrBR with their corresponding vegetation in Brazil was included (lines 226-236). "The Cerrado trees exhibit considerable morphological and physiological differences compared to other tropical forest trees growing in closed canopy and wet environments. In LPJmL, these forests are represented by the Tropical Broadleaved Evergreen Tree PFT (TrBE), reflecting the Amazon and the Atlantic rainforests, and by the Tropical Broadleaved Raingreen Tree PFT (TrBR), representing seasonal closed forests. In contrast, Cerrado vegetation is shaped by allometric relationships, and traits such as wood density, specific leaf area (SLA), rooting depth, and bark thickness, which together create a distinctive vegetation structure and functioning highly adapted to seasonal drought and fire occurrence. To incorporate these characteristics into the LPJmL-VR-SPITFIRE model, we used a combination of literature data and field observations to derive and calibrate the relevant parameters for the new Tropical Broadleaved Savanna tree (TrBS) parametrization.

A summary of all parameters and data sources used is provided in Table 1 and 2, with detailed explanations below."

Table 1: Acronym should be defined here or in the table heading.

Response: The definition for the SLA acronym was added. Thank you.

Line 283: Remove 'already'.

Response: Corrected. Thank you!

Figure 2: Improve illustration of dotted line in the legend.

Response: Legend was improved. Thank you!

Lines 323-324: Go ahead and update this number to the fourth collection since it will be released in the next few days. Spoiler: aprox. 10.5 million hectares burned in 2024.

Response: The burned area for the Cerrado biome was updated for the 2024 MapBiomias collection. Thank you!

Line 434: 2024?

Response: The referred date was corrected to 2024. Thank you!

Line 437: Why not 2019?

Response: This was a typo! All the analysis and comparisons considered a 30-year time series from 1990 to 2019. It was corrected in the text. Thank you!

Lines 441-445: I don't understand the adoption of this approach, instead of simply filtering the burned areas of MapBiomias in each year for selecting of fire on native vegetation only.

Response: Thank you for your comment. We tested both approaches for MapBiomias burned area and the outcomes were identical. However, since we excluded human land use in our LPJmL simulations and MapBiomias Fogo inevitably has anthropic lands, we needed to weigh the LPJmL output for human land use by using the human land-use fraction map. We then decided to use the same approach for MapBiomias to keep the consistency of the comparison.

Line 442: 2024?

Response: Corrected. Thank you!

Line 447: 2024?

Response: Corrected. Thank you!

Line 487: I feel that comparing total carbon between the QCN and the modeled simulations would also be interesting. This also leads to another question I have: you didn't mention the role of the TrBS PFT modeling to improve fuel biomass estimates in the Cerrado. Don't you think this is also important to assess?

Response: Thank you for your comment. We couldn't estimate fuel biomass from LPJmL because live woody biomass is still not included as burnable matter in SPITFIRE, making it difficult to establish a comparison with QCN. This is further explained in the discussion section, as you also pointed out. Regarding the total carbon comparison, we chose to show what we considered the most interesting results in our main text, but we now added a figure comparing total carbon in the supplementary file.

Line 521: Remove "the".

Response: Corrected. Thank you!

Line 623: It is Figure S8.

Response: Corrected. Thank you!

Line 656: You mean, readily burned?

Response: Thanks for your comment. We have changed the sentence to be clearer. "Our parameterization of the savanna tree PFT produced a vegetation type with high flammability, yet is well protected against lethal fire damage"

Line 666: This whole paragraph is slightly repetitive with what was said already in a previous paragraph (lines 601-612).

Response: Thank you for your comment. We merged the information from this paragraph with the information of the previous paragraph (Lines 601-612) and created a more concise text discussing the limitations of human ignition sources in SPITFIRE. "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 (MapBiomass 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 MapBiomass, 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)."

Line 672: in the.

Response: Corrected. Thank you!

Line 731: Now is the time.

Response: The link to our code was added. <[10.5281/zenodo.16965740](https://zenodo.org/record/16965740)>