Review: egusphere-2024-1775

In this manuscript, the authors describe a clever adjustment of a species distribution model to make it work for burned area. They apply it to the different biomes in Brazil, generating parameter set distributions that can be used to quantify uncertainty in burned area drivers, for both natural and non-natural fire as well as their combination. The authors then go through the biomes discussing the various ways they are similar or different in terms of burned area drivers.

I think this is quite a cool method and application, but the paper itself could use some work in terms of organization, presentation, and clarification. I also have some substantive critiques of the work itself—nothing disqualifying, but still things that should at least be discussed. For that reason I'm recommending major revisions and would be happy to review the next version.

Substantive critiques

- Lumping forest plantation in with croplands seems like an odd choice, considering that drivers of fire in those might be very different. Why did you do this?
- Why didn't you consider deforestation? The use of fire to clear forest is an important driver of burned area.
- Consider separating the southeast Amazon (where there is the most land use and deforestation) from the rest to avoid overestimation of NON burned area. If not, explain why, and discuss it in more depth than the one sentence at lines 855-858.
- Optimizing over 2002-2009 might result in parameters that don't work well for 2010-2019, since those two periods have very different deforestation dynamics. This should be discussed, perhaps in the part of the Discussion where you mention how random partitioning of the data into training and testing datasets can cause problems. The issues you raise there are valid, but it would have avoided this problem!

Suggestions re: presentation

- The last two paragraphs of the Introduction focus too much on fire as a negative force; some Brazilian ecosystems rely on fire for their continued existence! What would happen to the Cerrado if it never burned? Indeed, the authors acknowledge this early in the Methods.
- Fig. 1:
    - Consider regridding the natural/non subplot to 0.5°, showing fraction of each per gridcell. This would make it easier to compare to the maps in the B part.
    - (Also other figures) The bit in the center of this screenshot is mostly just a black mass, obscuring the data you're trying to show there. Consider decreasing the thickness and/or opacity of biome boundary lines.

- All multi-plot figures should have labels for *each* subplot (a, b, etc. according to the GMD guidelines). (As an example of the problem, see what I had to do in my Fig. 1 comment above.)
- Eq. 1 seems unnecessary.
- Eqs. 1 and 2 should have “i" subscripts on the left-hand side.
- Consider marking in Table 1 the variables that got selected.
- Line 354: mention again here that the optimization was over 2002-2009.
- Fig. 5 is hard to parse. I suggest supplementing it with histograms of simulated burned area for each biome, including a vertical line showing the observed value.
- Table 2: Consider converting this to a figure with boxplots rather than a table.
- Rather than the light-pink to dark-pink color scale used on maps (which are often very hard to distinguish), consider something that has different colors. E.g., viridis: https://matplotlib.org/stable/users/explain/colors/colormaps.html
- Fig. 6: As with Fig. 6, consider supplementing with histograms.
- 468-494: This would really benefit from a figure, with for each region either a bar graph showing mean bias or a box plot showing the distribution of biases. It’s easier to get information from a single figure than from three paragraphs of text.
- Figs. 8-10
    - 10^{th}/90^{th} percentile potential color bars should be symmetrical around zero
    - Likelihood potential color bar: 0-20 and 20-40 are hard to distinguish
- Sect. 3.2: Again, the very verbose explanations here would be very much helped by figures like a bar plot showing, for each region and ALL/NAT/NON, the fraction where it: sees more burning with real values than the median, less burning, etc. This is 8 pages of pure text that is at best hard to get any coherent patterns from, and at worst (as it is for me) actually impossible to focus on well enough to even read. With figures, you could then limit text to only the results that are somehow interesting. (The maps are not in and of themselves good summaries of the regional patterns, because it’s hard to judge total area in each category.)
- 803-819: This seems to fit more in an Introduction or maybe Methods section, as it’s not really tied in with the results at all. How do your results inform what you’ve written here?

Clarification needed

- Please replace the use of “MaxEnt” with “maximum entropy” when talking about the concept. This would avoid ambiguity given the species distribution model called MaxEnt that the authors discuss.
- 36-38: Unclear
- 106-107: This needs explanation. How were “negative impacts” defined? And does this number properly account for land that was burned multiple times? The link provided in the citation does not answer these questions.
- “Fires reaching” terminology is confusing. E.g., lines 132-133: “fires reaching natural vegetation (NAT) and fires reaching non-natural vegetation (NON)”—it sounds like you’re looking at individual fires, but what about fires that burned both? In reality I don’t think you’re talking about individual fires, because you probably wouldn’t have used the raw MODIS data in that case. I would rephrase lines 132-133 as “burned natural vegetation (NAT) and burned non-natural vegetation (NON)” (and rephrase similar text to match).
- 139-148:

    - It's unclear at this point whether biome is a variable in your model or just something you'll consider when interpreting the results. If the latter, move this to Sect. 2.5. (After looking at Table 1, it looks like it is indeed not actually in the model.)
    - This bit also doesn't fit with the beginning of the paragraph (land use).
- 197-212:
    - Justify these metrics *before* describing them, not after.
    - Are "classes" here just NAT/NON or forest/grassland/crop/etc.?
- Table 1 caption: "Initial" list? I guess this means before removal as described in Sect. 2.2; mention that.
- 225:
    - Clarify that you removed just one of each pair of highly-correlated variables.
    - How did you choose which of each pair to remove?
- 238: What do you mean, "Initially"?
- 258-270: Explain that you tested the *combination* of linear and power relationships, and that you did not constrain your parameters *a priori* to require positive or negative relationships.
- 331-333: How is Q parameterized?
- 348-351: How were these definitions of "too wide" and "too narrow" determined?
- 356: Same question about 50%.
- 418-419: Define "uncertainties." Is this just "difference between 10^{th} and 90^{th} percentiles"? And is it 10% (i.e., uncertainty *relative* to the mean/median) or 10 *percentage points*?
- Figs. 5-6, 8-10: Are percentiles here defined based on likelihood? Or is it burned area?
- 454-457: Didn't you already stratify fire based on vegetation type—NAT and NON? Or do you mean *within* those categories?
- For sensitivity tests: Did you always change members of a given group in the same direction? E.g., for Group 1, did you compare Temp–0.05/Precip–0.05, Temp+0/Precip+0, Temp+0.05/Precip+0.05? In that particular case, the perturbations would work against each other, reducing the apparent sensitivity. What you should do is perturb everything in each group so they work *together* in each direction. You may have, but I don't think you actually say that anywhere.
- Figs. 8-10
    - Sensitivity plots: Is this the relative difference between the +0.05 and –0.05 runs? Why is it always positive?
    - Where do the likelihood numbers come from? Medium likelihood values (40-60%) being considered "not confidently predictable" is very confusing. This is not the same way that likelihood is treated in e.g. Fig. 6.
- 852-854: Is this something that's *not* reflected in your results? If so, what are the implications of that?
- 897: Remind the reader what variables are in Group 3. And is that number all positive influence? Is there any additional area of negative influence?
- 959-960: This sentence is unclear, especially the second half.
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Corrections

- 57, 58: in citations, replace semicolons with "and"
- 132: LULC abbreviation not defined.

- Fig. 3 is very low-resolution, and text is too small.
- 288-289: Code must be associated with a DOI and included in Code and Data Availability section.
- The last power term in Eq. 9 is $(m - s)/s$. If, as you say at line 325, $\lim_{s \to \infty} m/s = BF$, then that power should become $BF - 1$, but Eq. 10 has that backwards $(1 - BF)$.
- 379: "student" should be capitalized.
- Throughout: Author names should be in Title Case, not CAPITALS.
- Fig. 5 is very low-resolution.
- Table 2 (if kept as a table and not converted to a figure; see "Suggestions re: presentation") needs to be an actual table, not a screenshot. This is critical for legibility and accessibility.
- Fig. 6
    - Very low-resolution.
    - These are not best and worst likelihoods (i.e., maximum and minimum) as the caption says, but rather 90th and 10th percentile.
- 502: Should "Specifically" be "For example"?
- 931: "Perilous" might not be the right word; I'm not sure what it's trying to say in this context.