Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
https://doi.org/10.5194/acp-2021-1086-RC1, 2022

Comment on acp-2021-1086

Lorraine Remer (Referee)

Referee comment on "South American 2020 regional smoke plume: intercomparison with previous years, impact on solar radiation, and the role of Pantanal biomass burning season" by Nilton Évora do Rosário et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-1086-RC1, 2022

The authors present an observational analysis of intraseasonal and interannual characteristics of regional fire counts, smoke aerosol optical depth (AOD) and its radiative consequences for the South American dry season. The focus is on the unusual severity of the regional smoke pall in 2020 and the apparent significant increase of fire activity in a specific biome, the Pantenal. The authors cite news reports and agency news releases that capture the public's fascination with the event. Thus, the authors begin the study already with a qualitative understanding and expectation of results. However, there are questions that can only be answered with quantitative analysis.

- How much of the **smoke anomaly** is due to anomalous fires in the Pantanal and how much is due to other factors?
- If due to other factors, how much is due to enhanced fire activity in other biomes and how much due to anomalous meteorology?
- Is the smoke anomalous only in terms of aerosol loading, or have intrinsic optical properties changed?
- What effect does the anomalous smoke have on the radiative balance and what consequences does this have?
- How anomalous is this activity, not only in recent memory, but over scales spanning generations?
- What caused the anomalous fire activity in the Pantanal?

The authors present analysis that address most of these bullet points. There's a significant paper in this work, but I have to say that they don't pull the analysis together in a way that clearly provides the answers. Because of that I will recommend Major Revisions.

I have no need to remain anonymous. This is Lorraine Remer writing.

Points to address are as follows:

- What is meant by **smoke anomaly** in this study? (a) Is it the overall smoke loading over the entire continent? (b) Is it just the smoke over the Pantanal? (c) Is it the smoke over the population centers of the Brazilian southeastern coast? At times, while reading, I had the feeling that the authors meant it to be (a), and then (b) and then (c). All of these are interesting, but the authors need to clarify when they are considering each one.

Let's assume that the main point is (b) because that is what Figure 6 addresses, although Figure 7 is more tuned to (a). Then I'm going to ask, "Why?". Why do we care specifically about how much smoke is over the Pantanal? It is a very small area from the regional perspective. I would think the question of "how much do Pantanal fires contribute to the regional big picture" to be the more interesting question rather than, "is the smoke above the Pantanal due to local or transported smoke". I mean, both questions are interesting, but the big picture is the bigger picture.

If the authors find smoke and its consequences directly over the Pantanal to be the primary question to address, then they need to introduce the reason for this in the introduction… "The Pantanal represents a unique island of biodiversity in the region and smoke hanging over this area for up to six weeks has the potential for diminishing surface shortwave flux, stopping photosynthesis, interfering with primary productivity that has consequences as it cascades up the ecosystem." Or something like that. I know that that this is touched on here and there, but the paper needs to be structured in a way that makes this the primary focus.

If the authors are indeed looking more at the big regional picture (a) then there needs to be analysis presented " XX% of regional smoke is produced by the Patanal, representing only yy% of the regional surface area."

Or something like this. Or the authors could go in both directions. The paper is short. It could support two specific sections, one addressing (a) and one addressing (b). I don't need it to do both. I just need some clarity and focus communicated.

2. Is there any insight gained from direct scatter plots of smoke vs. fire counts, and SW flux vs. AOD? Scatter plots of monthly means, for example, taking the points shown in Figure 2 and just throwing them into scatter plots. 4 month x 6 years. That's a 24 point scatter plot. The more fire counts, the more AOD, right? But if the Pantanal is more affected by advection than by local fires, there won't be much correlation. And maybe 2020 stands out, as an outlier. I don't know. It's just that right now the only thing I gain from Figure 2 is that 2020 is weird for both fire counts and smoke in the Pantanal, but that smoke weirdness lags fire weirdness by one month. There are a lot of words describing this figure, but few of those words point to the focus of the study.

3. Figure 3 is interesting because of the SSA, but the question I need answered is too hard to find in these plots. Is the SSA different in 2020 or not? Will radiative effects only be controlled by loading, or do changing optical properties play a role? Any thought of trying some 24-point scatter plots here also?

4. I thought Figure 4 was the most informative of the basic plots. Here you see the difference from year-to-year much better than in Figures 2 and 3. In 2020, the Pantanal stands out quite a bit darker than its immediate surroundings. This is the first place that I

considered that local smoke might dominate AOD over the Pantanal. The authors also rightly point out the difference in flow between 2017 and 2020 that explains why the population centers of the southeastern coast were spared in 2017.

5. Figure 5. Have the authors considered an anomaly plot instead of absolute irradiance? Interannual differences are hard to see now.

6. Figure 6. Another good plot. It was very important to do the longer time series. Knowing that 2020 still had unprecedented fire counts in smoke, we see that the anomaly isn't that much greater than in the 2000s. People's memories are short. They forget how bad things were in the previous generation. Although, I didn't see anything interesting in the SW flux plot and I recommend dropping it.

Also, shouldn't there be fire counts that go back another decade? It's not necessary, but it would be interesting. Fire counts were intense in the late 1980s and 1990s.

7. Figure 7. I like this one also. This is a very nice summary of the entire situation over time.

8. Figure 8. I couldn't understand this at all. I couldn't find in it the things mentioned in the text. Maybe it is just me.

9. The three biomes, Amazonia, Cerrado and Patanal are mentioned very early in the introduction, before the map, sort of with the expectation that the reader already knows what they are. I suggest describing each one, as soon as they are mentioned. One thing that I struggled with is the relative sizes of these biomes. Patanal is so tiny. Why does anybody care? Also, Caatinga, Pampas, Mata Atlantica are mentioned with the expectation that the reader knows what these are, and we don't.

10. Lines 85-90. We need more information on the surface irradiance. What is meant by cloud free in terms of footprint size? What is used for aerosol model to make the calculations? If there were to be a change in SSA, would the irradiances that are analyzed reflect that information?

11. Line 92. What is meant by Aqua bouncing?

12. Lines 244-247. These are some of the most important statements in the manuscript. Somehow the paper should be structured to get there. Also, this is where I started wondering about a scatter plot.

13. Lines 252-253. Suddenly the authors start using the word "emissions". There are no emissions analyzed. The authors are working with fire counts, which are not the same as emissions. Then they state that the contribution of emissions from the Pantanal rivals that from Amazonia and Cerrado. In absolute terms Figure 2 shows that the total fire counts from the Pantanal never reaches the total numbers of the other biomes (because of its small area). Where else do the authors find evidence to support that statement?

14. I also note that a lot of statements found in Section 3.3 should really go into the

Conclusions, especially Lines 244 and beyond.

15. The Conclusions are mostly strong and well-stated. There's one sentence in the Conclusions that was not supported in the body of the manuscript. "For Pantanal, 2020 was a very particular year, not exactly due to the aerosol loading over the biome, since in September of 2007 the biome experienced a higher monthly mean AOD, but due to the contribution of the local fire emission to the regional smoke plume. "

There is no analysis that states that the Pantanal contributes XX% of the smoke in the regional smoke plume. Even after all of this analysis, this statement is still based on qualitative discussion. What has this study contributed to supporting this statement that the NYT, BBC and Le Monde have not?

16. Finally, and the most frustrating… Why did the Pantanal burn in 2020? What is fundamentally different about this year that fire erupted in a way unseen for over a decade? Drought? Human intervention or non-intervention? Why? While the paper can be published without anwering this question, it is the question in the reader's mind as they read through the analysis. Why the fire eruption in the Pantanal in 2020? There's an elephant in the room that nobody is mentioning. A paragraph in the Conclusions with some educated hypotheses in a Discussion format would be satisfying.