Methane gas emissions from savanna fires: What analysis of local burning regimes in a working West African landscape tell us

Paul Laris et al.

You - as the contact author - are requested to individually respond to all referee comments (RCs) by posting final author comments on behalf of all co-authors no later than 12 Jun 2021 (final response phase). Please log in using your Copernicus Office user ID 590183 at:
https://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Feditor.copernicus.org%2Fbg-2020-476%2Ffinal-response&data=04%7C01%7Cpaul.laris%40csulb.edu%7C83b124bd0f144b144bb108d91d134bca%7Cd175679bacd34644be82af041982977a%7C0%7C0%7C637572790994410786%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=6HbGR%2FaoJsIeorokKgUdc22LnIvWfr8z20kNc0Rmkw8%3D&reserved=0**Comment types**: **AC** – author | **RC** – referee | **CC** – community | **EC** – editor | **CEC** – chief editor | : Report abuse

We wish to thank all reviewers for their comments. Below we seek to address all major comments and suggested changes as best we can and we also made nearly all minor changes recommended (a few we could not decipher).

One important point is that our study was not originally designed to statistically test the factors that cause changes in methane emissions. It was designed to determine the emissions from fires set in accordance to local burning practices on "working" landscapes. As such, the kinds of grasses and the types of savanna vegetation that burn ***differ in important ways over the course of a dry season.*** *It is thus difficult to isolate factors such as fuel moisture or grass type. A couple of the reviewers questioned, how can fuel moisture rise from early to mid-dry season. The answer, as one reviewer later noted, is because they are not the same grasses—perennials are not burned in the early season, for example, thus we have no emission values for them during that season and this explains how fuel moisture values increase in mid-season (when perennials are burned), before declining in late-season.*

We did the following analysis on the 36 fire sample set:

*Bivariate statistical analyses were performed to test the significance of the difference of means (t-tests) in CH_4EF by season (EDS and MDS) and by fire direction (head fires and back fires) and in MCE by season and fire direction. F-tests established the similarity of variances, all t-tests were done with pooled estimates of variance. These were done in the OpenOffice Calc spreadsheet (Apache Software Foundation 2021) and PAleontological STatistics (Hammer et al. 2001), with effect sizes (Cohen's d) and post-hoc power calculated in G*Power (Faul et al. 2009). We used bivariate regression analysis to look for correlations between the two dependent variables—methane EF and density—and independent variables—Byram's fire intensity, percent grass biomass, total fuel moisture, and Viney fuel moisture (a function of ambient temperature and humidity). These were done in Calc and power was estimated in G*Power*

All detailed findings are in the revised manuscript.

General comments #2

This paper is potentially an important field-based study focusing on methane gas emissions that can provide useful savanna fire characteristics values suitable for West Africa. The authors quantified, compared, and analyzed these values by fire type and by seasons. Finally, the authors linked their findings to some practical fire management implications. I have a few specific comments that can help to improve the paper. I also suggest the authors carefully check if the reported values in the text are consistent with those in the tables.

Specific comments

Line 28: the value of 0.862 should be better clarified in the text, how is it calculated?

We deleted reference to this average value from the text.

Line 80: From a fire modeling perspective, emission factor was usually simplified defined in most global fire models(1, 2), I am thinking if you can add some "discussion" about the possible implications of your study to the fire modeling field to broaden the interests of this paper.

Good, importance here is change in emissions over time and link to policy

Line 138: what is the relationship between cool, hot dry season and early, middle, later dry season? *We clarified importance of this in text. During the cool dry season, the Harmattan wind blows strongest. It is desiccating and thus has strong impact of fuel moisture drop as well as fire weather. Note that the winds are strongest in mornings and weak in afternoon when local people tend to set fires.*

Line 157: clarify what is "time of day", ignition time? *Clarified in text.*

Line 175: more description of "burn efficiency" is needed *Clarified in text see above, changed to "patchiness"*

Line 226: delete a replicated "in" *done*

Lines 243, 252: The same symbols and/or units (for example, "Area" in equation 5 but "BA" in equation 6) should be used in equations 5 and 6 to better see their difference.

Corrected in text

Line 271: Where did these values come from? I cannot see 4.62%, 4.09% in Table 1.

The table includes the "total" fuel moisture, cure rate + Viney

Lines 306, 308: Similar to the previous comment, 3.47 or 3.3? 2.5 or 2.9? Please check all of the values carefully. If I misunderstood, please clarify this in the text.

Corrected

Line 308: The authors should also be consistent with the number of digits after the decimal point in the text and in the tables.

Done

Line 311: 313.4 kW/m to 109.0 or 366.9 to 124.8 in Table 3? Did I misunderstand something?

Corrected

Line 425, 427: 2 or 3 digits after the decimal point? should be consistent.

Corrected

Tables 1-3: I suggest using "early dry season (EDS)", "mid-dry season (MDS)", and "late dry season (LDS)" to replace "early", "middle", and "late", respectively *Done*

1. S. Hantson *et al.*, The status and challenge of global fire modelling. *Biogeosciences* **13**, 3359-3375 (2016).
2. F. Li *et al.*, Historical (1700–2012) global multi-model estimates of the fire emissions from the Fire Modeling Intercomparison Project (FireMIP). *Atmos. Chem. Phys.* **19**, 12545-12567 (2019).

We a*dded a paragraph on this point to discussion and the first reference*

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