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

Paul Laris et al.

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.

Review #3

This study conducts several site experiments using an approach grounded in the burning practices of people who set fires to working landscapes and collect fire-related data in West African Savanna. They find that in the dry season, methane emission factors ranged from 2.86 g/kg to 3.71 g/kg and methane emission densities ranged from 0.981 g/m^2 to 1.102 g/m^2. Overall, the results improve estimates for savanna fire emission and have important implications on earth system model development and policy making. However, I have some concerns about the presentations and hope the authors can further improve this study.

My major concern is that the connections between fire emissions and environmental factors are not explored in depth. For example, the study measured simultaneous meteorological conditions including temperature, air humidity and wind speed. How these parameters affect the fire emissions of CH_4? The authors need to plot some figures to show the relationships between emissions and weather conditions, and to identify the possible driving factors determining the differences of emissions at different stages. To make the results more robust, the author should add more discussion about (1) the possible causes of the differences in fire-related variables at early, mid-, and late dry season and (2) reasons for different change trends among variables in dry season. In addition, the representativeness of the selected two sites and uncertainties of experiment methods need to be discussed explicitly.

We added a section on statistical analysis, this was not the main purpose of our paper as we state above. The purpose was to present data on more realistic fires (based on actual human practices and landscapes). We do present the findings of the statistical analysis in the revision.

This manuscript is full of tables, one or more of them can be converted into figure (figures) to make the information more intuitive.

We removed one table and added several figures

Pay attention to the consistency of tenses in the manuscript. For example, “finds” in Line 22 and “found” in Line 23.

Done

Acronyms should be marked in the main body at the first time, not just in the abstract. For example, the author does not specify what does “MCE” stands for in the main body.

Done, added section on MCE

Line 191-195: The unit of *I* in *equation (1)* is wrong. The unit of product of *H (kJ/kg)*, *w* (kg/m^2), and *r* (m/sec^1) might be $kJ/m/sec^1$.

We doubled checked units, they are correct

Line 272: “12.04% and 3.65% in the LDS” might be “12.04% in the MDS and 3.65% in the LDS”. Reviewer: Comments on ms bg-2020-476-manuscript-version1

Corrected, thank you

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