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Biogeosciences Discussions

Interactive comment on "Fluxes of CO_2, CH_4 and N_2O from soil of burned grassland savannah of central Africa" *by* S. Castaldi et al.

Anonymous Referee #3

Received and published: 1 July 2010

The paper by Castaldi et al. provides valuable data on soil GHG fluxes in a poorly studied region. What makes the paper especially valuable is the presentation of data including the effect of burning, the most frequent ecosystem disturbance in this region, on GHG fluxes. The subject of the study fits well in the scope of Biogeosciences. In principal, the quality of the presented data is sufficient and makes them worth being published in Biogeosciences. However, the paper suffers from some major and many smaller problems and flaws, which should be addressed by the authors before publication.

One major drawback of the study is that only two field campaigns of moderate duration were conducted, one in the dry season shortly after burning, and one in an intermediate short dry period within the growing season. That means on the one hand that no

pre-burning measurements were conducted on the burned plot(s). On the other hand, the very important period of rewetting at the onset of the rainy season was missed, which represents the major phase of GHG and NO emissions in this kind of ecosystem. Simulating this re-wetting by a single watering event with 30 mm of water, as done in the study by Castaldi et al., is certainly not sufficient to simulate a rewetting of a whole ecosystem with repeated rainfall events. From experience one knows that usually several rain events are required to trigger substantial GHG emissions in these ecosystems which can then dominate the annual budget. This has to be addressed in the discussion.

Another important issue is the question of (true) replicates. To me it has not become clear from reading through the Materials and Method section, how many true replicates were used, i.e. how many independent experimental plots were established. This has to be made clear by the authors and has to be addressed in the discussion.

I fully support all the comments of referees #1 and #2, especially the need for revising the language. Therefore, I limit my specific comments to additional problems I have spotted.

Specific comments:

Abstract: The abstract is very long (>470 words), I suggest shortening it significantly.

p. 4093, l. 24-25: "The study site was chosen in Congo Brazzaville which is highly representative for this type of ecosystem management." Here you say that the country you have chosen is highly representative for the type of ecosystem management. What about the representativeness of your particular experimental location, not only in terms of fire regime, but also with respect to climate, given the fact that the site is close to the coast (i.e. it might subject to a different particular local climate other than most of the tropical grasslands might experience), and soil characteristics, given the fact that your site is characterized by a very high sand content, i.e. very low water-holding capacity and very poor nutrient content.

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p. 4094, l. 15: According to the coordinates of your experimental site, Pointe Noire airport meteorological station is approx. 60 km away from your site and closer to the coast than your site. How representative are the Pointe Noire climate data for your site?

p. 4095, l. 13-14: What is the quantitative contribution of "totally uncombusted material" in the burned treatment? This has implications for the difference between burned and unburned treatment.

p. 4095, l. 18: Do you think that one area (no true replicates) of 20 m2 is sufficient for rain exclusion, given the fact that at least four sub-plots with four different watering regimes (no watering and watering 15, 7 and 1 day prior to gas sampling) were fit into this 20 m2?

p. 4095, l. 23: Give the size of the sub-plots.

p. 4096, l. 1: "CO2, N2O and CH4 fluxes were measured from each plot on 4 replicates." Until this point it has not become clear for the reader how many plots you had (unless I missed something). One can guess that you had one plot each for control, burned, rain exclusion control, rain exclusion burned. But it's just a guess. Were there true replicates, at least of control and burned, i.e. several plots for each treatment?

p. 4096, l. 13: What do you mean with "measured in correspondence of each chamber"? Within the collar of each chamber? Outside the collar? If so, how far away from the collar? Have you replicated your soil temperature and moisture measurements?

p. 4097, l. 3: What do you mean with "burned x control"? I thought you had unburned control, burned, rain exclusion control, rain exclusion burned?

p. 4097, l. 14-15: "...50 g of sieved soil samples were repacked into columns (10 cm height, 5.5 cm inner diameter)..." According to my calculation the columns had a volume of approx. 238 cm3. If the columns were completely filled with soil, this should have resulted in a bulk density of approx. 0.2 g cm-3. Compared to the bulk density

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of undisturbed soil (1.43 g cm-3) in field, under these circumstances the laboratory incubation seems to tell a completely different story, given the influence of air- and water-filled pore space on trace gas formation and consumption. If the columns were not completely filled, it would be good to have an idea of the headspace volume.

p. 4097, l. 22: Closing the incubation vessels for 24 h is a very long time. Have you tested for linearity of gas evolution and have you measured oxygen concentrations during the 24-h closure period?

p. 4099, l. 10: In line with referee #2, the authors should check the number here (2 or 20 ml), as this is crucial for the quality of measurements. If a 2-ml sample loop were flushed only with 2 ml of sample gas, then this would lead to erroneous results as a sample loop should be flushed with ten times its volume to be sure to remove all air that has been in the loop prior to sample injection.

p. 4103, l. 20: "N2O emission was significantly stimulated by burning. . .". This sentence suggests that you applied burning also in the lab, which was not the case, I assume. I suggest rephrasing to "N2O emission was significantly stimulated in the soil from the burned plots. . .", or something along these lines.

p. 4104, l. 11 + 13: "Net nitrification was almost completely blocked. . .": As net nitrification is not a biochemical process in itself, but the sum of nitrate production and consumption, it cannot be "blocked", but it can only be positive, negative or zero.

p. 4107, l. 27: Don't cite papers "in preparation". Replace "in preparation" with "unpublished data", and remove this reference from the reference list.

p. 4108, l. 1-5: There is also evidence that at very dry conditions methanotrophic organism cease activity, lowering the methane uptake rate. This leads to the unexpected observation that methane uptake increases upon watering (e.g. Schnell & King, 1996, J Appl Environ Microbiol 62, 3203-3209).

p. 4110, l. 25-26: "Overall data indicate that fire might reduce the GHG emissions into

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the atmosphere. . .": I cannot follow this conclusion, as in this paper no CO2, CH4 and N2O losses due to the fire itself were estimated. This fire-induced GHG release can be substantial and needs to be either determined experimentally or estimated using literature data, if a whole ecosystem assessment of GHG emissions is aimed at. As this was not done in this work, the sentence has to be rephrased to "Overall, our data indicate that fire might reduce soil GHG emissions to the atmosphere in grasslands characterized by similar soil characteristics. . .", or the authors have to come up with an estimate of fire-induced, direct GHG losses.

Minor language and technical issues:

p. 4094, l. 19: What do you mean with "aerial biomass"? Aboveground biomass?

p. 4096, l. 8: I suggest writing "gas-tight syringes (Hamilton, CITY, STATE, COUNTRY)" instead of "Hamilton syringes". Not everyone might be familiar with this term.

p. 4096, l. 9: You mean "gas-tight vials", not "glass tight vials"?

p. 4097, l. 17: ". . .33% for burned and 37% for unburned soil. . .": Percent of what?

p. 4098, l. 15: Whatman filter

p. 4098, l. 16: potentiometric analysis

p. 4099, l. 11: frontflush

p. 4107, l. 20: Replace "frequency" with "abundance"

p. 4108, l. 11: Replace "consequent to" with "as a consequence of"

p. 4109, l. 18: coincide

p. 4109, l. 21: plants

p. 4111, l. 2: derive from

Table 1: Header: Replace "Different letters in apex" with "Different superscript letters",

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and “two-Way” with “two-way”; replace “a-amino-N” with “α-amino-N” in the left column

Figure 1: Change y-axis label to “volumetric water content (%)”; enhance the font size

Figure 2: Change unit of y-axis to “g CO2 m-2 d-1”; enhance the font size

Figure 3: Change unit of y-axis to “g CO2 m-2 d-1”; enhance the font size

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Interactive comment on Biogeosciences Discuss., 7, 4089, 2010.