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Biogeosciences Discussions

Interactive comment on "The relationship between termite mound CH_4/CO_2 emissions and internal concentration ratios are species specific" *by* H. Jamali et al.

Anonymous Referee #2

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Review of the paper: The relationship between termite mound CH4/CO2 emissions and internal concentration ratios are species specific

The paper presents data on annual soil plus termites CO2 and CH4 fluxes for 4 savanna areas of Australia and analyses in detail the relationship between internal mound concentration and observed mound flux for both gases, over different termites species. The paper presents several interesting and useful observations which are useful in terms of interpretation of field data for this quite complicated issue represented by GHG from termites, for which a relatively small number of studies is available. However a revision of the paper is needed. Several paragraphs need to be better explained,

clarified or revised. The methodological part also needs a much better description relatively to flux and conc determination and some considerations on how the proposed measurements done by los gatos instrument and dynamic chambers compare with all the other published values made by GC and static chambers. Also the part relative to the uncertainty associated to the observed relationship between variable is missing. This point is quite relevant given that the reported relationships are proposed as alternative methods for CH4 flux determination and are given the limitation of being specie specific. In both cases it would be important to know which uncertainty we introduce.

Specific comments on each section are reported.

Introduction

Page 17315 lines 25-27. However, the general assumption that CH4 is the largest emitted greenhouse gas from termites may not be realistic. I would change this sentence because: a) to say "general assumption" either refer to something widely accepted or when it is related to science not widely investigated, as in this case, then we need to mention who has made this assumption; b) I don't really think this is the general knowledge about termite fluxes, the global emission of these gases from Sanderson literature review and extrapolations gives 19.7±1.5 Mt CH4 yr-1 (413.7 Mt COequ) and 3500 ± 700 Mt CO2 yr-1, exactly the ration in the order of magnitude found by Brummer et al. 2009 you are citing . So even if considered in COeq CH4 is significantly less than CO2. And this is a quite established result, given that Sanderson arrives to this total starting from review from all over the world. For this reason I would reconsider the entire paragraph from 17315 line 25 to 17316 line 8.

Page 17316 lines 22-26: It is not clear if in this study you measured fluxes from termites directly or termites mounds and related it to termite biomass, please specify. All the paragraph is not clear for a reader who did not read your article, there are several assumptions which are not obvious. Please rephrase.

Another indirect method for estimating mound CH4 flux could be based on the relation-

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ship between mound CH4 flux and CH4 concentration inside that mound (Khalil et al., 1990). If valid, the advantage of this method is that it takes into account the proportion of CH4 produced inside a mound by termites that is not emitted to the atmosphere due to both the gas diffusion barrier imposed by mound wall and CH4 oxidation by methanotrophs in mound wall material (Sugimoto et al., 1998).

Again this paragraph is not clear to me. You say that you found a correlation between internal CH4 conc and mound flux. This would mean that knowing the internal CH4 conc you can predict the methane flux outside the mound. Then you add that the advantage of the method is that it takes into account CH4 oxidation and diffusion limits to internal CH4. Here again we miss some piece of information because the reader does not know if this relationship is valid for the same species always, or depends on other factors (mound size, mound age, mound primary mineral material, mound level of wetness, etc). In the latter case we could agree, in the second no. So you need to define all of this better if you want to mention it.

Page 17317 lines 5-9:Taking into consideration what just said above, your assumptions which introduce the objectives of the work need to be better defined in terms of what is certain and what is not. We just said that it is not clear if your CH4 flux vs. CH4 conc is always true, the same could apply to CO2 flux vs. CO2 conc, so that the extrapolation of CH4 fluxes from CO2/CH4 ration would become highly uncertain. Please in the premise constraint the uncertainty.

Objectives:Your 5 objectives are fine if constraints to the uncertainty in the extrapolation have been already dealt with in some your previous work, otherwise a 6th objective should be to see if changing conditions can change the relationship between internal conc and external fluxes and CO2/CH4 ratio.

Methods

Paragraph 2.2

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Please give details on your chambers, shape, material, size, eventual equilibrators of pressure, connection to gas analyser, etc. Given that the experimental set up is relevant it would be good that the experimental set up with los gatos analyzer is described with some details here rather than refer to a published paper. Please specify the amount of gas volume that los gatos apparatus need to flash the cell and the system and its flux rate (l/min) so that the reader has an idea of the dimension of air circulation inside the chamber per unit of time.

Paragraph 2.3 Again here define what is an FFGA writing it's extended name, and define the necessary infos to understand the experimental procedure, direct injection? Which volume? Which conditions. . .etc, in the field, in the lab, calibration..etc, etc.

Another important point could be to know if a GC measurement of CO2 and CH4 is equal to the one by FFGA. The reason I say this is because the most common approach to measure CH4 is GC and few groups use los gatos for this kind of experiments. Very frequently measurements by static chambers-GC tends to underestimate fluxes measured by IR or different kinds of lasers. Also for some species like CH4 many laser setups tend to have problems in resolving the bands for CH4 and water vapor. So the question here is if the two techniques are comparable and you have scientific evidence of this or instead we could surely apply your results to determinations by FFGA but extrapolate to GC with a certain caution or a defined uncertainty.

Results

Page 17322 line 7 – Looking at Fig. 1 A meridionalis seems equally not well defined as T. hastilis although the lack of response to rain occurs in different periods for the two sampled species. Isn't it?

Page 17323 line 10 No distinct seasonal patterns were observed in soil CH4 flux at TERC, CDNP and HS savanna sites This is quite an unexpected result. Soils from seasonally dry ecosystems usually are characterized by a defined distinction in dry and wet CH4 soil fluxes (see review by Castaldi et al. 2006). In these soils CH4

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oxidation is surely an important contribution to the net CH4 exchange, and during the wet season reduced gas diffusion should decrease the sink and increase occurrence of CH4 production hotspots, plus probably also stimulate termites activity. In any case I would expect, as found often in literature to see a good sink during the dry season and a small sink or little source in the wet.

Page 17324 line 18. It is true that the 4 regressions are all significant, however, the first two show a clear distribution of point along the regression slope, whereas the 3rd and 4th appear like a quite scattered group of points driven by fewer points. I expect that the error associated to the 4 regression should be very different, small in the former cases and much bigger in the latter, thus making the relationship robust only for the first 2 cases. This should be mentioned and described in the results.

Discussion Page 17326 lines 17-20. There are two mistakes in this sentence: first the total COeq flux in HS wetland is higher than in HS savanna, second in Table 1 we cannot find mound basal areas reported. Page 17326 lines 24-26. Again it is mentioned that HS wetland CO2eq fluxes are the lowest. However looking at table 5 I calculate the sum of CH4 plus CO2 equal to 6.5 and 8.3 for HS savanna and HS wetland, respectively.If you make wrong calculations also the discussion should be revised where you try to explain the observed differences. However, I think that error should be reported together with annual estimates in Table 5 so to have clearly the evidence that maybe 6.5 and 8.3 are not so different to justify too many speculations. Page 17327 lines 9-11: are you sure that on the base of the few measurements done, we can drive such conclusion? What about A. meridionalis

Page 17327 lines 15 net “annual uptake”: add “annual

Page 17327 lines 21 the shift refers to a passage from something to something else, where is the shift here? Do you want to say that on annual base the site is a net source differently from the other sites?

Page 17327 lines 21: do you expect this only to be a particular feature of Northern

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Australia? I don't think so.

Page 17328 lines 1-2 this accuracy or uncertainty should be mentioned and discussed.

Page 17328 lines 3-4.I don't understand how this sentence justify the previous. Why different accuracy should be related to different CO2/CH4 ratios for a given specie?if you don't clarify this the logical passage for the next long paragraph is missing.

Page 17329 lines 20-21: here again could be interesting to compare the error associated to the extrapolation of CH4 fluxes starting from CH4 concentrations, for one species, with the error associated to the extrapolation from one specie to another. I think that the key point of the paper is to propose a method to improve uncertainty in extrapolations using other approaches, so uncertainty must be discussed.

Page 17330 lines 5-9: It doesn't seem from Sanderson 1997 estimates of termite biomass density that semiarid savannas present overall higher density of termite biomass than humid areas, it would be worth to check your statement.

Conclusions

Conclusions need to be revised. They should just summarize the main findings you have and you can be sure about and we can mention in future works or use as starting points for future investigation

Page 17330 lines 20-21. I think this is an already known concept. Maybe you can say that this study confirms or supports previous observations that. . .. . .

Page 17330 lines 24-25: This can be more a suggestion in the discussion than a conclusion because you really did not test this in a focused experiment, for example using the same relationship to predict measurement for the same specie taken in the same site the next year or in a different sites.

Page 17331 lines 3-6:again this is speculation and not a conclusion as you only know wall thickness among the mentioned variables.

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Table 4 – correct sOIL CH4 flux

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