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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 #1

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General comments

This paper by Jamali et al. presents data on CO2 and CH4 fluxes from soil and termite mounds in North Australian tropical savanna. Gas fluxes and gas concentrations inside the termite mounds were measured from February to November 2009 every four to six weeks with closed dynamic chambers with a fast greenhouse gas analyzer at four different sites, including one ephemeral wetland site, not far from Darwin, NT, Australia. Gas concentrations inside the mounds were also determined with the fast GHG analyzer from air sampled with a syringe connected to a nylon tube reaching into the mound interior. At every time point and site, flux measurements were replicated 5-7

times for the dominating termite species. Additionally, soil and mound temperatures as well as gravimetric soil moisture content was determined at each sampling date at each site.

The objective of the paper was to "investigate the relative importance of CH4 and CO2 fluxes from soil and termite mounds" and to study the relationship between mound gas fluxes and gas concentrations. The authors found that termite-related CO2 fluxes were 5-46 larger than termite CH4 fluxes on a CO2-equivalent basis at the different sites, but that the termite CO2 + CH4 flux contributed only 0.3-0.8% to the total soil flux on a CO2-equivalent basis at the different sites. They also found significant relationships between termite mound CO2 and CH4 fluxes, between mound CO2 concentrations and mound CO2 fluxes, mound CH4 concentration and mound CH4 fluxes, and finally mound CO2 concentrations and mound CH4 fluxes. However, there were large interspecific differences between the ratio of mound CO2 to CH4 fluxes, but also between mound gas concentrations and corresponding gas fluxes, making the application of a simple generic regression function between e.g. mound CO2 and CH4 fluxes, or between mound CO2 concentrations and CH4 fluxes impossible, rather requiring the establishment of species-specific relationships.

The paper presents valuable data on the importance of different termite species for total soil CO2 and CH4 emissions and especially the relationship between the two gas fluxes themselves as well as between the gas concentrations inside termite mounds and the related gas fluxes. The paper reveals that there are consistently strong relationships between the two gas fluxes and also between the gas concentrations inside the mounds and the gas fluxes out of the mounds in the different termite species, pointing towards the termites themselves as dominant source of the two gases inside the mounts. However, the authors also found significant interspecific differences with respect to slopes of the regression lines between the different parameters, unfortunately impeding the establishment of generic relationships across termite species.

The presented work is solid, and the data add important information to the understand-

ing of the role of termites in ecosystem gas fluxes. Especially the very clear picture of the tight link between mound gas concentrations and mound gas fluxes is new in this detail presented and helps to disentangle pure soil microbial-derived gas fluxes from termite-derived gas fluxes. The significant interspecific differences in this respect call for further more detailed studies of gas formation and consumption processes in the different species and their mounts. At the end, though, the authors have missed to clearly state that the termites' contribution to total soil gas fluxes is only of minor importance. This should be taken into account for the discussion and conclusions, especially with respect to management effects on termite abundance and, hence, on gas fluxes. To summarize, I recommend publication of this paper after the specific comments below have been addressed properly.

Specific comments

p. 17314, 1st sentence: You state that you "investigated the relative importance of CH4 and CO2 fluxes from soil and termite mounds" in this study, but you never come back to this objective, i.e. you never give any relative number of the contribution of termite-related CO2 and CH4 fluxes to total soil fluxes, although you present the absolute numbers in Table 6. For getting the right perspective right at the beginning of the paper, you should already mention in the Abstract that termite-related CO2-e fluxes contributed 0.3-0.8% to total soil CO2-e fluxes at the four sites of your study.

p. 17318, l. 1f: Isn't it problematic to infer total termite-related fluxes for a specific site, if fluxes are measured for a species that only represents 10-21% of the total termite population, as it was the case for site 1 and 2?

p. 17319, l. 21f: Even though you cite your own work here, please provide the basic information with respect to time of the day at which the measurements were performed, chamber closure time, calibration procedure for the gas analyzer, sensitivity of the gas analyzer to temperature changes (i.e. instrument drift).

p. 17319, chapter 2.2: How did you calculate the "truly" mound-derived gas flux, i.e.

how did you quantify/estimate the area that was covered by the measured mound within your chamber frame? In other words, how did you differentiate between soil-derived and mound-derived gas fluxes in your chambers? This is crucial information for the upscaling.

p. 17320, l. 8-10: Were the analyses of mound air done in the field? I assume that you get a pulse-function-type curve when you inject gas to the fast GHG analyzer. How did you analyze these curves? Did you apply a standard of known gas concentration in the same way? Please add this basic information here.

p. 17320, l. 15-16: Did you also analyze the water content of the mound material? If not, why not?

p. 17320, l. 23-24: Why did you analyze the relationship between gas fluxes from termite mounds with SOIL moisture, and not with the moisture content of the mound material, as you have done analogously with temperature? This difference might be relevant, as you also discuss (chapter 4.3) the importance of the microbial activity in mound walls for total mound CO2 (and perhaps also for CH4) fluxes. Thus, looking at the relationship between mound fluxes and mound water content would have been more appropriate.

p. 17324, l. 6: The significant relationship of soil CO2 fluxes with soil water cannot be seen in Fig. 2.

p. 17326, l. 24-26: This is per se not a reason for the lowest CO2-e emissions at the wetland site. These specialized termites could still fully compensate the lack of other termite species in terms of GHG emissions. What seems more obvious is a strong contribution of microbial respiration to mound CO2 efflux, which would explain the obvious covariance between soil and mound CO2 fluxes not only at this wetland site, but also at the other sites.

p. 17327, l. 1-2: If soil microbial activity is inhibited by high soil moisture (or water

saturation), then litter should accumulate, and not litter accumulation be inhibited.

p. 17330, l. 1f: Somewhere in this last paragraph of the discussion the statements should be put into the perspective that the contribution of termite-derived CO2+CH4 emissions on a CO2-e basis were less than 1% of total soil CO2-e emissions, at three of the four sites even less than 0.4%.

Table 2: Add information on the feeding guild for the different termite species (e.g., wood-feeding, grass-feeding, soil-feeding).

Technical corrections

Order of references in the main text: should be either alphabetical or chronological. Currently it is neither nor.

p. 17318, l. 13: Change “dominate” to “dominant”

p. 17319, l. 7: Does the “2” mean “twice” here?

p. 17321, l. 16: What is the difference between “preceding” and “antecedent”? The latter should read “successive” or so, shouldn’t it?

p. 17324, l. 9: Change “Fig. 3” to “Fig. 2”.

p. 17326, l. 6f: Here you should also mention the relative contribution of termite-related GHG fluxes as compared to soil-derived fluxes, i.e. between 0.3% and 0.8%.

Table 4: Change “sOIL CH4 flux“ to “Soil CH4 flux”

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