Anonymous Referee #3

Räsänen and colleagues investigate CO2 and CH4 fluxes from mounds of fungus-growing termites and adjacent soil at selected sites in Kenya. They chose plots in open grassland and bushland and investigate diurnal courses of fluxes. Results highlight the scaling of mound volume to CO2 flux density and lower CH4 emissions compared to literature values from soil and grass-feeding termites. The authors also stress the importance of active or dead mounds in the landscape for upscaling fluxes.

Overall, the paper is well written, methods are well established, the topic is of relevance for greenhouse gas emission budgets as fluxes from termites are still understudied and flux estimates are associated with high uncertainties. A few plotting issues should be addressed. I particularly enjoyed reading the discussion section.

Beside some general thoughts, here are a few points that should be considered in the revision of the manuscript:

- I noticed that the title had already been modified at an earlier stage, but does "Assessing" really fit? What's been assessed? I'd just leave the word out.

We thank the referee for all the helpful comments and suggestions.

Thank you for this suggestion. We have modified the title to read "Carbon dioxide and methane fluxes from mounds of African fungus-growing termites"

- No local collaborators as co-authors? In times where "helicopter science" is highly debated, it is hard to understand why not a single person from the region or with local expertise made it to the list of co-authors. I'm not saying that random people from the street should be chosen and I fully agree that a co-author must have made a considerable (scientific) contribution to the study, but weren't there any African institutions involved where people could have been invited to contribute? Please, at least consider this in the planning phase of any upcoming field studies abroad.

We agree that so-called helicopter science is problematic, and local scientists should be involved in research projects. This has indeed been a case in many of projects and publications in Africa by our group (see e.g. Räsänen et al., 2017; Wachiye et al., 2020; 2022). However, there are not always local scientists interested in specific research topics and in such cases including a local name just as token would not be ethical. Thus in this paper we happen not to have any local scientists, unlike many of our other papers.

Räsänen, M., Aurela, M., Vakkari, V., Beukes, J. P., Tuovinen, J.-P., Van Zyl, P. G., Josipovic, M., Venter, A. D., Jaars, K., Siebert, S. J., Laurila, T., Rinne, J., and Laakso, L.: Carbon balance of a grazed savanna grassland ecosystem in South Africa, Biogeosciences, 14, 1039–1054, https://doi.org/10.5194/bg-14-1039-2017, 2017.

Wachiye, S., Merbold, L., Vesala, T., Rinne, J., Räsänen, M., Leitner, S., and Pellikka, P.: Soil greenhouse gas emissions under different land-use types in savanna ecosystems of Kenya, Biogeosciences, 17, 2149–2167, https://doi.org/10.5194/bg-17-2149-2020, 2020.

Wachiye, S., Pellikka, P., Rinne, J., Heiskanen, J., Abwanda, S., and Merbold, L.: Effects of livestock and wildlife grazing intensity on soil carbon dioxide flux in the savanna grassland of Kenya, Agriculture, Ecosystems & Environment, 325, 107713, https://doi.org/10.1016/j.agee.2021.107713, 2022.

- Abstract, Line 20-21: The fact that there is a 35% decrease of CO2 fluxes in the wet season compared to the dry season is unexpected. Maybe already indicate here the potential reasons.

This is an unexpected result. However, we cannot not completely explain this pattern in the discussion so we have opted not to include the potential reasons in the abstract. We suggest that the contrasting seasonality between the two study sites could be related to the availability and quality of food sources that termites can utilize. Bushlands have generally more abundant and diverse food sources than grasslands where the grasses are a highly competed food source. This could potentially explain the contrasting seasonality patterns between the two habitats and the higher seasonal variance in gas fluxes observed at the grassland than at the bushland site.

- Carefully check the reference list. Not all papers cited in the text are listed.

Thank you. We have added references for Brümmer et al., 2009, Amara et al., 2020 and Jamali et al., 2011.

- Figure 1 is overall very nice. What is the source of the above-ground biomass data?

We have added the corresponding references to the caption text (Amara et al., 2020; Pellikka et al., 2018).

- Sections on gas flux measurements: What is the sensitivity of the gas flux calculation to the mound volume? Have you done some calculations and could this be considered in the uncertainty estimation? Also, how stable, i.e. “how linear” was the concentration increase? Was Equation (2) really the best fit? Could you see any saturation of the concentration increase during chamber closure? And would have probably another method for flux calculation been better?

The mound fluxes are high, and we were directly measuring the gas concentrations every second using the gas analyzer. The gas concentrations were linear and no saturation was observed in the concentrations (Figure 1 in this document). Therefore, the Eq. 2 was the best fit for the data. It is unlikely that the flux calculation introduces large uncertainty to the flux to mound volume relationship. The results show that the dead mounds should not be considered when establishing these relationships.

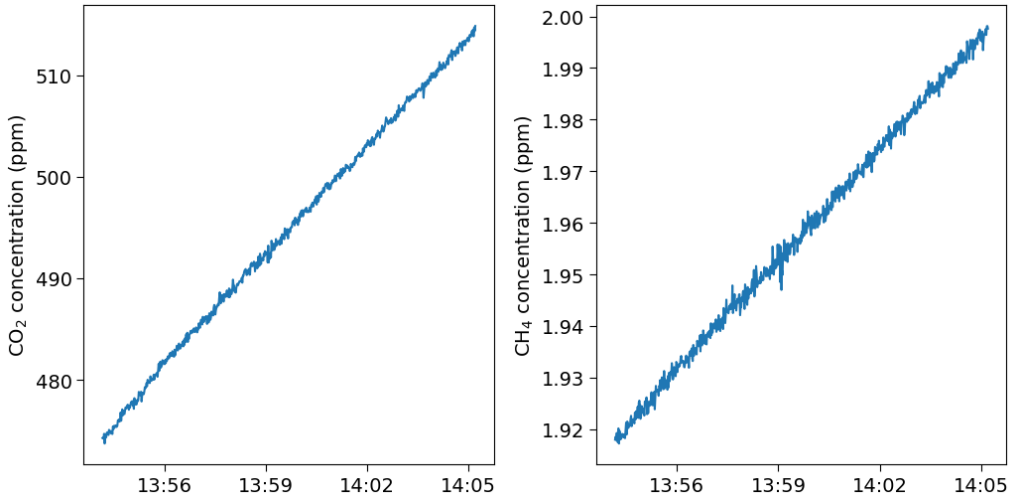

Figure 1. Example raw concentration measurements recorded from the MR1 mound.

- Page 7, Line 8: How did you assure gas tightness? Was the collar smoothly inserting into the soil?

The PVC was custom made to cylindrical shape to fit the collar size. Tight rubber band was used to tighten the PVC sheet against the collar. In the field measurements, the collar was inserted to soil surface and then surrounding sand was used to insulate the collar so that there is no leak between collar and soil surface. No indication of leakage was observed in the measurements except during the measurement of the S5 mound that was excluded because mound did not fit inside the chamber (Fig. S1 and S2).

- Section 2.3: Very nice setup regarding air mixing!

Thank you.

- Section 2.4: How can nest temperatures from another year be used in this study? How comparable would they be? Isn't nest temperature correlated with air temperature, soil temperature, wind speed? Or was just the relative diurnal course taken into account?

It is true that the nest temperatures are from a previous study (Vesala et al., 2019b) and we have clearly pointed that out when presenting the results. We think presenting these mound temperature results help to set the context for the environmental conditions. The main point is presented in the Fig. 3d which can be compared to the diurnal flux measurements in Fig. 5. The soils are sandy in this area which typically have lower spatial variance in soil temperatures. Furthermore, we present data only during the period with no rainfall.

- Page 9, Line 3: "of" missing between "amount" and "woody"?

Corrected

- Figure 3 (a): Rainfall should not be plotted as time series, but as a bar graph. Here it is the daily sum.

Corrected

- Figure 3 (b) and (d): x-axes labels, ticks at 0, 6, 12, 18, 24

Corrected

- Figure 4: The caption does not really tell what the lower panel shows, although it is quite obvious. Please add. A ratio should not be shown as a bar plot, but rather as points.

Thank you. We have indicated the panels (a,b,c) and explained what each panel shows in the caption. We have plotted the ratio as a bar to help the reader compare the two sites and two seasons.

- Figure 5, x-axes labels, ticks at 6, 12, 18, 24

Corrected