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Interactive comment on "Effect of legume intercropping on N_2O emission and CH_4 uptake during maize production in the Ethiopian Rift valley" *by* Shimelis G. Raji and Peter Dörsch

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This study looking at soil N2O and CH4 in agricultural systems of Sub-Saharan Africa addresses a signiïňĄcant gap in the body of literature exploring GHG exchange in intensively-managed soils, both through its location in an understudied area, and the aim to understand the relationship between inter-crop timing and N2O emissions. Although the article does need to be further edited for grammar/phrasing, it is generally well written. However, there are some issues with clarity I'd like to see addressed, which I expand on below.

Specific comments: Note: Phrases in quotations are suggested changes.

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Response: We thank the reviewer for recognizing the validity of our study, and particularly for noticing our efforts to elucidate the relationship between intercrop timing, legume biomass development and N2O emissions.

Introduction Line 40: Specifically define what CSA means in terms of management. The previous sentence defined intensification as 'increased use of inorganic fertilizers', and then CSA is introduced as, 'in contrast...' but the text doesn't in fact provide a contrast, instead outlining the ideals of the CSA concept.

Response: The reviewer is right. We remove 'by contrast' because there is no contrast.

Line 82: As you go on to explain, abundant NH4 can inhibit methanotrophs, but may not always. Important to make that distinction here.

Response: We agree. The sentence has been rephrased using conditional "... might inhibit methanotrophs" to avoid misunderstanding.

Materials and Methods

In general, please try to provide as much detail as possible, grouping information in a way that it is easy to find.

Line 120: "The field experiment was conducted for two years (2015-2016) at the Hawassa..."

Rephrased

Line 128-145: List exactly what the six treatments were, before going on to give details about planting and fertilizer application. Also, be specific about what happened when in each treatment, including when and how the legumes were mulched and applied.

Response: Thank you for drawing our attention to this omission. We now added a detailed treatment description including the exact timing of mulching.

Line 147: Were there live plants in the chambers during sampling or were those first

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removed? Response: Legumes were included in the chambers, on average 3 lablab plants and 4-5 crotalaria plants.

Line 149: Are the chambers used in this study the same as those in Rochette et al.? If not, as the chambers were custom-made, a bit more detail about them would be useful. Some information to include: The chambers did not have permanent bases, correct? How deep into the soil were they pressed?

Response: No, they were not identical to the chambers devised by Rochette et al. (2008). By accident we cited the wrong study by Rochette et al. (2008). This ref has now been replaced by Rochette, P., Eriksen-Hamel, N.S.: Chamber measurements of soil nitrous oxide flux: Are absolute values reliable? Soil Sci. Soc. Am. J., 72, 331-342, 2008, which gives a general outline of the static chamber method. The chambers did not have permanent bases but were pushed gently about 3 cm into the soil and sealed with moist clay from outside. The insertion depth is now added to the text.

Was the volume provided in the text (Line 148), the volume before or after the chamber was pressed into the soil? How much time was there between deployment and the first sample? Were they always measured in the same location? Do you think that soil disturbance from deployment may have affected the samples? Were the chambers vented?

Response: The number given in the text denotes the chamber volume after pushing it into the soil. The chambers were deployed randomly within the same maize row of each treatment plot to avoid disturbance. The chambers were not vented, but the sampling septum was removed when pressing the chambers into the soil to avoid perturbation of the concentration gradient. This information has now been added.

Line 153: The four samples were at 0, 15, 30 and 45 minutes? Or 15, 30, 45 and 60?

Response: Immediately after closing the chamber and sealing with soil, sampling starts (1 minute) and then at 15 minute intervals, hence 0, 15, 30, 45 minutes. The text has

been changed accordingly.

Line 172: Were all results less than R2=0.85 rejected? (I.e. were net 0 emissions/uptake rejected?) If so, do you think that may have biased your results?

Response: No fluxes were rejected. Regression coefficients were generally >0.85

Results

Line 243: “Irrespective of legume species, the highest emission rates...”

Corrected

Line 244-247: What about the sixth treatment? Was it significantly different than that?

Response: Thank you for drawing our attention to this. N2O emissions were significantly higher than in the fertilized control in both the 3-weel lablab and the 3-week crotalaria systems. The text is changed accordingly.

Discussion

In this section, it would be helpful to go back to the original hypotheses and specifically outline how the results compared and why.

Response: We added a sentence contrasting the findings discussed in chapter 4.1. with our original hypothesis.

Line 333: Provide range from Pelster et al.

Done

Line 341-342: Is that consistent with other mulching studies?

Response: There are not many studies to compare our results with, particularly not in SSA. Moreover, findings on the effect of mulching on N2O emissions are inconsistent, presumably because they depend on weather (soil moisture) as in our study. See also Basche et al. (2014), doi:10.2489/jswc.69.6.471

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Line 344: You provide a topic sentence here, which ends with: species, inter-cropping time and weather. I'd suggest following that up by expanding on each of those in the order you present them in that sentence.

Response: The text is now rearranged and expanded following the reviewer's suggestion.

Line 353: Can you provide a reference for 'notoriously high'?

Response: We added Flessa et al (1995) who measured in various cropping systems, including cover and catch crops.

Line 363-366: Remove details of how the data was analyzed (that is in the results section) and just focus on the meaning of the results shown in the figure.

Removed

Line 380-382: Is that consistent with other mulching studies?

Response: Increased N cycling in spring after mulching is occasionally observed. We added Campiglia et al. (2011) as a reference for this

Line 386-389: I don't understand this. Something was at par and then not significantly different? Please rephrase and perhaps provide a reference to the Table/Figure with the results that you are discussing.

Rephrased

Line 487: Provide reference to Table/Figure.

Done

Tables and Figures

Note that these should always be able to stand alone (i.e. all necessary information required to understand them should be included). For all tables and figures, please deïňĄne any abbreviations (i.e. Table 1 – DMY), remove references to previous sec-

tions (i.e. Table1–refer to M/M, Fig. 5–refer to Fig. 2), and include basic information about the study (e.g. Table 1 – N inputs from forage legumes and fertilizer application in plots of maize inter-cropped with legumes 3 and 6 weeks after planting.)

Response: We thank the reviewer for the these editorial remarks which we follow eagerly

Technical corrections:

Line 114/115: Rephrase.

Response: The sentence was rephrased to: “Choosing legume species, and sowing date and accounting for potential N inputs from legume intercrops, thus could allow to for better management of legume intercropping in SSA with reduced GHG emissions”

Line 212: Capitalization.

Done

Line 314: Remove neither/nor and just use ‘or’.

Done

There are many small editing errors in the Discussion that need to be corrected. Some examples:

Line 334: Owing?

Rephrased

Line 337: “was too small”

Fixed

Line 371: “owing to early”

Fixed

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Line 374: “legume and main crops”

Fixed

Line 380: Capitalization

Table 1 – consider reformatting using spacing rather than lines, as the bold lines make it difficult to read

Reformatted

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