Response to reviewer

Reviewers' comments:

Anonymous Referee #2: The manuscript fits well with the SOIL aims and scope. In general, it is well-organized and presented. And I would recommend this paper for publication. I would just suggest some points that I hope may be useful for the authors.

A: Thanks for the nice words and guidance! We have deeply considered all the reviewer suggestions. Detailed responses are provided below.

1. From the general perspective, I have noticed that the authors have calculated the N_2 in addition to N_2O in the results. However, they have not mentioned that data on the discussion. I was wondering if the authors could relate the data mentioned to the genes and the completion of the denitrification process, for example.

A: Thank you for bringing this to our attention. We have discussed it now in the Discussion section also. We have less data from the modeling, which made it difficult to analyze them with the abundances of genes. However, we checked it again and will use statistical techniques (machine learning) to compare them as well.

2. L 89: Hypothesis (5) is not clear. Does it mean optimal?

A: Thank you for the comment. The hypothesis is stated as "*sorghum (Sorghum bicolor x Sorghum sudanense) is a prospective crop to cultivate in temperate climate.*" This hypothesis considers sorghum as a crop that maximizes agricultural productivity while minimizing resource use and environmental impact (e.g., N_2O emissions, N losses). Thus, yes, it does mean optimal.

However, that hypothesis "*sorghum is a prospective crop to cultivate in temperate climate*" is a bit too general. We have excluded this hypothesis from the manuscript as suggested by other reviewers.

3. L 120: I understand that the corresponding corrections where made for the calculations when using the chamber extensions.

A: Yes, the use of chamber extensions is considered in the calculations. The total volume of the chamber was updated in the calculations when the extensions were used. As chamber extensions increase the total volume of the chamber, it is essential to adjust the calculations accordingly.

4. L 130: It would be important to state how much time lasted from the soil sample collection until analysis.

A: Thank you for pointing this out. The samples for microbial analyses were analysed three months after the last sampling in a running order. The microbial samples were stored in the freezer at −20 ˚C, as soon as possible to stabilise the samples and prevent further microbial processes from

happening before further analyses. Soil chemical analyses were done 5 months after the sampling. Critically labile elements were measured as soon as possible after the sampling.

5. L 183 – L 185: Here it would be important to explain what data is parametric and what non-parametric as ANOVA is a parametric test and the Spearman's rank a non-parametric one.

A: Thank you for highlighting this. This is correct. We have now modified our statistical analyses according to the reviewer's suggestion to prevent any false positive or negative results.