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Interactive comment on "N_2O, NO, N_2, and CO_2 emissions from tropical savanna and grassland of Northern Australia: an incubation experiment with intact soil cores" *by* C. Werner et al.

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We would like to thank Reviewer 1 for the thorough review and helpful comments as well as the generous words about our manuscript. In the following, we outline how the paper will be improved in response to the specific comments.

Specific comments

- **P8401: No essential generalization was done. What is the main message of the paper? How existing data are improved? The conclusion made in the last sentence is rather uncertain - and no clue why it is so.**

  We reworded the abstract to a) highlight the message of the paper more clearly, b) include the new aspects included in response to comments by Rev.2 and c) to highlight the message of the paper more clearly. We especially highlight the key findings: very low N_2O emission, varying magnitudes of observed pulse emissions, and dominance of N_2 emission among gaseous N losses.

- **P8401 L13-16:Your figures (43.2 %) does not match total N_2 loss. Please describe more carefully what you mean - does data for N_2 are presented for all tested regimes? The similar text in conclusion is more clear.**

  The 43.2 % refer to the fractional contribution of NO to total gaseous N emissions recorded for $30°C$ / 50 % WFPS incubation settings (given in Table 3). This was the strongest contribution of NO to the total gaesous loss of all recorded incubation settings. In order to be more precise we suggest to change the sentence from:
  "The total atmospheric loss of nitrogen was dominated by N_2 emissions (82.4-99.3 % of total N lost), although NO emissions contributed almost 43.2 % at 50 % SM and 30$°C$ ST." to:
  "The total atmospheric loss of nitrogen was generally dominated by N_2 emissions (82.4-99.3 % of total N lost), although NO emissions contributed almost 43.2 % to the total nitrogen loss at 50 % SM and 30$°C$ ST incubation settings (contribution of N_2 at these settings was 53.2 %)."

- **P8401-8403 (L7), Introduction from the beginning till the L7 of Page 8403 is rather far from the topic of the paper. It might be shorten substantially,**

omitting the general knowledge about nitrogen cycle and importance of savanna. One - two sentences with references for people looking for more detailed information would be enough. On the other side in introduction is missing clear research hypotheses - why you did the study, what you want to discover, or what are the current problems, the novelty and relevance of the research has to be clearly stated.

We shortened the introduction and reduced the length of section about biogeochemical processes details while maintaining the essence to help readers unfamiliar with the topic. We also added a research hypothesis.

- **P8403 L21-27: Do you plan to study fire effect in your incubation experiment? If yes, the research hypotheses should be proposed. If no, this part of Introduction can be shortened.**

  Relevant text was: *"Fire is another characteristic forcing in all savanna ecosystems (Bond and Keeley, 2005). In addition to direct pyrogenic emissions (loss of trace elements to the atmosphere during combustion), fire also effects physico-chemical and biological processes, and can thus have a significant direct or indirect effect on processes and controls of N cycling and N_2O/ NO soil–atmosphere exchange (Bustamante et al., 2006; Levine et al., 1996; Rondón et al., 1993; Serça et al., 1998; Weitz et al., 1998)."*
  This section was included to give a more complete picture of driving forces of tropical savanna soil-atmosphere exchange of trace gases. Since we did not consider pyrogenic effects in this experiment we removed the sentence.

- **P8404 L3-6: The importance and relevance of N_2 emission measurements was not described. Is this a novel contribution in large pool of data on**

nitrogeneous gases emission? I would add more in this part, as it is also highly relevant to your study.

This is due to the reluctantly accepted but nowadays well proven failure of the widely used acetylene-inhibition technique to quantify N_2 loss from soil (e.g., Felber et al. 2012). In a recent review article, Butterbach-Bahl et al (2013) reported that N_2 emission have been reliably quantified so far only for upland soils of 12 natural and agricultural ecosystem. This severe lack of N_2 measurements currently strongly impedes our understanding of nitrogen biogeochemistry and mass balances from site to global scale. We expanded this paragraph.

- **P8411 L11: The value for microbial C does not match the data presented in Table 1. Please check!**

  Unfortunately an error ocurred when composing Table 1 (microbial biomass data and NH_4, NO_3 data presented was wrong). The numbers given in the text for microbial biomass are correct, however. The sentence discussing NH_4 and NO_3 concentrations was based on the corrupt table and thus wrong. We corrected the relevant sentence in the manuscript from:
  AAmmonium and nitrate concentrations were low for all sample sites and ranged from 1.5 - 2.8 and 0.04 - 0.1 μg N g^{-1} sdw, respectively (both nutrient concentrations were highest at locations T1P1 and T3). to: *Ammonium concentrations were low for the soil samples from the savanna transect positons ranging from 2.4 to 3.9 μg N g^{-1} sdw, but almost a magnitude higher for the sampled grassland site (23.5 μg N g^{-1} sdw). Nitrate concentrations did not vary significantly between the two sampled sites (T1: 5.5-12.1 μg N g^{-1} sdw, T3: 9.7 μg N g^{-1} sdw).*

- **P8421-8422: Section 4.4. N_2 and total nitrogen losses. I found this part most interesting and novel in the article, authors should emphasize these**

observations also in Introduction (the need for N_2 and total N gases estimates for upland savanna soils) and in the conclusion.

As mentioned above, we extented the sections discussing N_2 emissions throughout the manuscript.

- **P8424 L19 Conclusion 4 - it would be better to say directly how moisture influence pulse intensity.**

  We changed the sentence from:
  Pulse emissions of varying magnitudes (dependent on the amount of moisture added) were observed for N_2O, NO and CO_2, but they were short-lived (24-72 h). Again, three of the cores displayed a different emission pattern with no initial response, but prolonged elevated N_2O after the first days. to:
  Pulse emissions were observed for N_2O, NO and CO_2 immediately after water addition, but they were only short-lived (24-72 h). The magnitude of pulse emissions was positively correlated with soil moisture addition for CO_2 and N_2O, but negatively correclated for NO. Three of the cores displayed a different N_2O emission pattern with no initial pulse response, but prolonged elevated N_2O after the first days.

- **Table 1: microbial biomass C was only about 0.3% of total organic C for T1P1 and maximumum 1.1% for T1P5, that is extremly low for soil. The values of microbial C are stable and do not correlate with total C as it should be.**

  As outlined above, there was incorrect data provided in Table 1. When using the correct data, the ratio is still very low (0.35 - 1.51 % of Corg). However, the microbial biomass now generally follows the observed Corg values (but T3P1 has more than double the amount of microbial C then T1P1, which has almost double

the amount of total Corg). We rephrased the paragraph and checked that data is now correct.

- **P8405 L9-10 Mistake? The phosphorus and superphosphate is the same or not?**

  The reported numbers are correct. But as stated, the addition of superphosphate and urea was 100 kg per ha each. The amount of phosphorus added was reported to be 50 kg per ha (as stated in the manuscript).

- **P8418 L17: soil-atmosphere fluxes?**

  This was indeed a typo, inserted *"exchange"*

Interactive comment on Biogeosciences Discuss., 11, 8399, 2014.

Table 1: Physico-chemical properties of the sampled soil and mean microbial biomass (sampling depth 0-15 cm, * g C / N g [dry weight] soil^{-1}.

Land use	Pos.	Soil texture (%)			Density (g cm^{-3})	Org. C (%)	Total N (%)	pH	Microbial biomass		NH_4^+ (*)	NO_3^- (*)
		Sand	Silt	Clay					C	N		
Savanna	T1 P1	81	12	7	1.4	2.8	0.1	5	97.5	18.4	3.1	12.1
	T1 P3	87	8	5	1.5	0.8	0.04	4.4	81.8	21.0	3.9	7.2
	T1 P5	87	10	3	1.7	0.7	0.05	5.1	61.0	14.5	2.4	5.5
Pasture	T3 P1	68	17	15	1.5	1.5	0.1	4.6	222.1	23.6	23.6	9.7

Fig. 1. Table 1