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Interactive comment on "Methane and nitrous oxide fluxes from the tropical Andes" *by* Y. A. Teh et al.

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RESPONSE TO ANONYMOUS REFEREE 2

The authors would like to thank the referee for the insightful and complimentary remarks provided on our work. We have sought to address the referee's key concerns below:

Major suggestions

1. Terminology and labelling: We will modify the text and figure legends to ensure that terminology is consistent throughout. Because "habitats" are a more readily understood concept by general readers, we will use this terminology, rather than "elevation bands" in the figures.

Also, for Table 3, the Dry and Wet Season headers were incorrectly positioned in the draft version of the text, and this error will be corrected in the final version of the manuscript.

2. Oxygen methodology: We utilised a silicone gas sampler technique to collect soil gas from the profile (Clark et al., 2001, Kammann et al., 2001). References and further details of this method will be provided in the final version of the text.

Regarding the high soil oxygen measurements under high water-filled pore space conditions; the soil oxygen samplers were buried in upper 0-10 cm depth of the soil. Soil-atmosphere gas exchange can be very rapid across this depth, even at high soil moisture contents. Comparable studies of soil oxygen dynamics from other high moisture tropical soils shows a similar range of soil oxygen contents under saturating soil moisture conditions. Thus, the high soil oxygen contents observed here even when soils were very wet is not surprising (Teh et al., 2005, Silver et al., 1999).

3. Denitrification potential experiment: It is important to clarify that soil samples for the denitrification potential experiment were in fact collected from the lower part of the rhizosphere. Roots were still present in this region of soil, although in lower densities than at the soil surface. The final version of the text will be amended to reflect this, as the present phrasing of the text (i.e. page 17406, line 1 "were collected from beneath the rooting zone") perhaps creates a misleading impression of soil properties to the reader.

Soils from the lower part of the rhizosphere were sampled because nitrate was thought to be the principal driver of N2O flux, and we wanted to compare potential denitrification rates with available soil nitrate data (collected by resin bags). Following established protocols, resin bags were placed in the lower portion of the rhizosphere, just below the zone of highest fine root density (Templer et al., 2005). Thus, when collecting soils for quantifying potential denitrification, samples were collected from the same depth as the resin bags, in order to enable us to better link potential denitrification rates with measures of nitrate availability.

The referee is correct to point out that a potential caveat arising from our soil sampling design is that we may in fact underestimate soil denitrification potential. However, the wider goal of this laboratory study was to establish if the relative differences among study sites reflected patterns of N2O fluxes and available nitrate observed in the field, rather than quantifying absolute rates of denitrification. The final version of this manuscript will be revised to acknowledge this possible issue.

4. Statistics: We will revise the text to report non-parametric statistical results, given the referee's concerns. The data were re-analysed using non-parametric equivalents to repeated measures ANOVA, one-way ANOVA and linear regression; e.g. Generalized Linear Models, Wilcoxon/Kruskal-Wallis, Poisson regression and Spearman's Rank correlation. The statistical patterns reported here were consistent irrespective of whether parametric or non-parametric tests were used, with three notable exceptions. First, Kruskal-Wallis analysis suggests that N2O fluxes varied significantly among topographic features, with the highest N2O fluxes from flat landforms. Second, Wilcoxon signed-rank test showed that N2O fluxes were lower in the wet season than during the dry season Third, Spearman's Rank and Poisson regression suggest that water-filled pore space (WFPS) and soil oxygen are equally good predictors of net CH4 flux, whereas prior parametric analyses suggest that soil oxygen was the single best predictor of net CH4 flux. Furthermore, re-plotting of the net CH4 flux-soil oxygen data using the non-transformed data does indeed show a threshold effect, with net CH4 flux accelerating below $\sim$5% soil oxygen. In the final version of the text, we will revise section 3.4 (Relationships between gas fluxes and environmental variables) to reflect these new findings, and Figure 3 will be re-plotted using the non-transformed data to better illustrate the threshold effect.

5. Title, abstract and flux terminology: The referees concerns are duly noted, and the title, abstract and body of the text will be revised accordingly.

Minor suggestions

6. P17399, L17: This study does in fact hypothesize that abiotic production by plants may account for discrepancies in the global CH4 budget.

7. P17401, L 15: The revised manuscript will include a map of the study site.

8. P17403, L19: Please see point 2 above.

9. P17404, L2: Suggestions will be taken.

10. P17404, L14: Suggestions will be taken.

11. P17405, L15: Suggestions will be taken.

12. P17406, L1: Please see point 3 above.

13. P17407, L 4: Please see point 4 above.

14. P17407 L21: Please see point 1 above. Also, "puna" will be replaced by "montane grasslands" in the revised manuscript.

15. P17408, L1: Suggestions will be taken.

16. P117409, L1-18: Suggestion will be taken. Only WFPS will be refereed to in the body of the text.

17. P17410, L15: NO2- is correct as this is the section where we discuss the results for this compound.

18. P17410, L21: Suggestions will be taken.

19. P17411, L11-L19: Suggestions will be taken.

20. P17412, L8: See point 1 above.

21. P17414, L2: See point 16 above.

22. P17414, L12: Suggestions will be taken.

23. P17415, L3: Suggestions will be taken.

24. P17415, L18: Suggestions will be taken.

25. P17419, L8: Soil C content in organic and mineral soil horizons is high in this habitat, and may also promote denitrification to N2, as the referee suggests.

26. P17429, Table 1: Suggestions will be taken.

27. P17430, Table 2: The rooting zones numbers are based on earlier published work by other members of the ABERG consortium (Zimmermann et al., 2009, Girardin et al., 2010).

28. P17431, Table 3: See points 1 and 2 above.

29. P17433, Table 5: Suggestions will be taken.

30. P17434, Fig 1: See points 1 and 4 above.

31. P17435, Fig 2: See point 4 above.

32. P17436, Fig 3: See point 4 above.

33. P17438, Fig 5: The means comparisons are within a given flux category among elevation bands. An error was made in labeling the bars for the multiple comparisons tests. The corrected figure appears in the supplementary material. The overall trend is that upper montane forest showed the lowest fluxes of 15N-N2O, 15N-N2 and total denitrification, whereas lower montane forest showed the highest fluxes of 15N-N2O and total denitrification (the latter driven by the high 15N-N2O component flux). An enlarged version of this explanation will appear in the final version of the text, with more detail discussion of each component flux.

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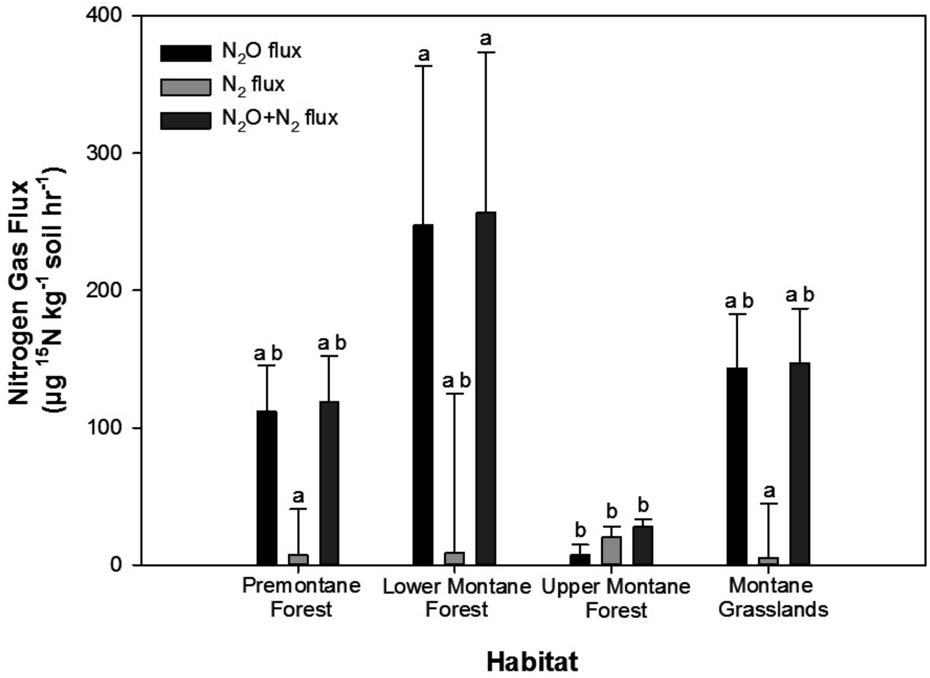

Fig. 1. Corrected Figure 5 (see point 33)