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Interactive comment on "Drivers of atmospheric methane uptake by montane forest soils in the southern Peruvian Andes" *by* S. P. Jones et al.

Anonymous Referee #1

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General Comments Jones and co-authors present a very comprehensive and well-written study about rates of CH4 uptake by forest soils in the southern Peruvian Andes. Since there are only few ecosystem CH4 flux measurements from tropical montane forest regions, this study is very valuable and provides additional information on this subject. Interestingly, their results differ from other studies. Hence, there does not seem to be any general trend in CH4 fluxes along elevation gradients in tropical montane forest regions. Contrasting results make it very complicated but very fascinating. The authors try to explain this discrepancy but remain very speculative throughout the discussion. Wolf et al (2011) got a deeper insight into the soil "black box" by conducting incubations of soil samples from different soil horizons. Finally, they identified a stratification of CH4-uptake activity within the soil profile that highlights the heterogeneity of methane cycling processes in organic soils of tropical montane forests. After such

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a study by Wolf et al. (2011), it would be nice to identify hot spots of CH4 consumption and/or production within soils of their region and how that correlates with available nitrate, ammonium, oxygen etc. Furthermore, the discussion about N-inhibition or N-limitation of CH4 consumption and/or production is very speculative without having any information about present methanotrophic or methanogenic community composition and/or activity, especially when the results are so different. Other processes, as well, may eventually lead to the observed positive correlation between net CH4 flux and nitrate concentrations. Dependent on the nutrient status of the respective forest type, increased soil nitrate availability may stimulate plant growth that accelerates organic carbon availability via root exudation for methanogens and other microorganisms and finally lead to an increase of CH4 production in anoxic microsites and a decrease of net CH4 consumption (see Bodelier et al. 2011). What is with phosphorus (see Wolf et al. 2011)? I think that nutrient status of the diverse vegetation including the deep roots within organic-rich soils of tropical montane forests may play an important role in structuring microbial community composition and activity that may be as important as soil structure and precipitation. However, the present study is very valuable and provides more information than countless artificial laboratory incubation studies but complementary incubations and a combined approach including microbiological and biogeochemical methods may have the potential to explain the underlying processes (see. Christiansen et al. (2015); McCalley et al. (2014)).

Specific Comments I would remove the word significantly throughout the text. It is in almost every sentence of the “Results” section. I think it is enough if you say that A is higher than B or A influences B. If something is not significant there is no difference or influence. Additionally, you define statistical significance at $p<0.05$. That is enough, I think.

Page 7, Line 5+6: How did you measure particle density and porosity?

Page 4+5: Could you clarify how many plots were installed, in total?

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Page 9, Line 22. . . and Table 3; Figure 4: As far as I understand, you have 3 plots per elevation (these are your independent samples if you say they were randomly selected; n=3). Now, you can do linear regression between your variables of interest among these three points but in my opinion you are not allowed to do linear regression among all samples (9 plot means) of the elevation gradient because they are not independent! You can check whether your forest type means differ from each other but not a linear regression among 9 plot means.

References Bodelier. 2011. Interactions between nitrogenous fertilizers and methane cycling in wetland and upland soil. Current Opinion in Environmental Sustainability 3: 379-388.

Christiansen et al. 2014. DOI: 10.1007/s10533-014-0026-7

McCalley et al. 2015. Methane dynamics regulated by microbial community response to permafrost thaw. doi: 10.1038/nature13798.

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