

Interactive comment on “No long-term effect of land-use activities on soil carbon dynamics in tropical montane grasslands” by Viktoria Oliver et al.

Anonymous Referee #1

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General Comments:

The study aims to investigate grazing and burning effects on montane tropical grassland soils. Soil carbon dynamic was investigated on two different sites with four combination of land management by gaining labile and stabile fractions along with decomposition measurement and soil C fluxes. Due to the complex design (4 management combination at only two sites, different sampling depth) and different used methods, it is challenging to work out clear effects of the management system on soil C dynamic and its long/short-term implications.

One critical point may be that differences in carbon stocks at Ajanaco found by this study (170? Mg C ha⁻¹) and (253 Mg C ha⁻¹) by an previous study (Oliveras et al.

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2014) are substantial (larger than differences between management systems). The authors related the difference to spatial heterogeneity (L.383). If there is such a high variability, how can differences related to management differences?

The work is based on a concept of different soil organic matter pools and stability. However, it is not stated which separated soil fraction correspond to which pool and stability. Therefore I cannot understand how the authors can make a statement on the effect of long-term stability of the different management systems. Moreover, as grazing is excluded only for one year before experiments started? Burning took place 6-8 years before soil sampling and grazing activity was excluded one year (?) before sampling and measurements? One main finding – as stated in the abstract (.L49-51)- is that long-term C storage on occluded LF and HF is not impacted. What did you mean by long-term? One year? After the concept the occluded LF has a slower turnover compared to the free LF. Consequently effects of grazing may be not visible after one or two years in the occluded fraction. Or if so, what does this implicate for soil carbon dynamics? If the proportion of recalcitrant soil C increases after burning in the occluded, what are the consequences for long-term storage? Does burning favour C-sequestration? Can be long-term effects gained by relatively short-term experiments? In this sense, please check title and the discussion section.

The cited literature could be improved: New literature and concepts about stability of SOC could improve the manuscript, such as Schmidt et al. 2011, Nature 478, 49-56. In addition, a literature overview about density fractions is missing. E.g. one tropical study is cited for many tropical, temperate and boreal studies. L.118. The same citation is used for a generally ranking of the results. L.-401-402. Including literature about density fraction and turnover times could improve the manuscript. On the other hand general statements (management history; L.60-61) are documented with 5 citations.

Specific comments:

L.40-42. I would suggest including only percentage of soil C and not bulk soil to improve

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readability.

L.46-47: As autotrophic respiration was not measured, I would omit these speculations in the abstract.

L. 49-51: Please specify what you mean by long-term

L.58-65: How often are these grasslands burnt? Every 10-20 years, once for pasture establishment? How important is burning for these systems?

L.69: What do you mean by soil C balances?

L.92-101: see general comment on new literature on SOC stability and ecosystem properties (e.g. Schmidt et al. 2011)

L.124/L: Which particle-sizes were separated? Where are the results?

L.133: please specify different management systems

L.133-134: please specify labile and stable OM pools

L.135-137: Which environmental drivers do you mean except soil temperature and VWC? Please specify the objective

Table 1: I would like to have the given information (BD, pH C:N, Soil C) at least for both sites and different depth (and management system). For me it is not clear which soil is described in Table 1.

L.163-164. please add information: How long were these sites were grazed / not grazed and about fire frequency.

L.185: How were the bi-monthly measurements extrapolated to gain annual emissions? What is the uncertainty of the annual emission? The annual emission is only based on 6 measurement days – without information on soil temperature course of the year. Soil respiration is driven by soil temperature (L270), but measurements only included day measurements at a very low frequency. What do you want to express with the annual

emission rates?

L.203-208: Does the free LF included (living) roots or were they sorted out before? (This would have major implications for the yield of free LF), see also comment L.299

L.203-223: I am missing information about soil C recovery in density fractions: bulk soil measured = 100%, sum of soil C in density fractions = ?%

L.261-262: Does at Acjanaco grazing and burning significantly increase soil CO₂ fluxes? From Figure 2, I do not get the impression.

L.269: How is season defined? By soil temperature and VWC? Are soil temperature and air temperature not strongly correlated?

L. 299: belowground carbon stock = soil carbon stock + living roots?

L.300-305: and L381-383. Comparison of soil carbon stocks of Acjanaco from different studies Oliveras et al. 2017 submitted and Oliveras et al. 2014): If there is a high spatial variability (170 vs 253) how can be differences found at the different sites (grazed-ungrazed-burned-not burned) traced back to differences in management and not also to spatial variability? Please check carbon stock 152 vs 170. I have difficulties to account the number of replicates of soil C sampling (from design description I got the impression of 4 replicates, Table 2 : n=3. Eventually a small graphic with sampling design would help to understand the experimental design.

L. 362. As heterotrophic respiration is not measured: may enhances..., as it is a speculation

L 364: Is the N loss reflected by different C/N ration in soil?

L.376: It would be nice to have a range of soil C stocks found in montane grassland soils

L.385-L399. There was no effect of burning on total soil C and no significant effect of grazing on total soil C. However grazing had a more negative effect on total soil C.

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please clarify.

L.401-411: Please expand literature and discussion. In addition, please check the number cited (10%) and carefully consider the land use type. I do not understand L 403-404. It would be nice to have the range of free LF found in tropical soils in order to rank and interpret the gained results (L 403-406).

L.413-420: Does this mean that burning favours long-term stabilisation of soil C as charcoal? It is stated (L49-51), that the long term storage in the occluded fraction was not negatively impacted, but has a positive effect?

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