Biogeosciences
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Interactive comment on "Understory vegetation plays a key role in sustaining soil microbial biomass and extracellular enzyme activities" *by* Yang Yang et al.

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Received and published: 15 March 2018

The manuscript 'Understory vegetation plays a key role in sustaining soil microbial biomass and extracellular enzyme activities" by Yang and co-authors describes interesting findings and documents well the role of understory vegetation on soil nutrient dynamics, microbial community composition and extracellular enzyme activities.

Response: We would like to thank you for the helpful and constructive comments, which would further improve the manuscript. We have carefully revised our manuscript to take account of your comments and suggestions. Please find below our responses (blue font) to comments (repeated in an italic font).

1. The manuscript addresses relevant scientific questions within the scope of the journal, and the results are interesting, but the interpretation could be still a bit more elaborated.

Response: We have modified the Discussion section according to your comments.

We have deleted the repeated sentences "Studies in the past have shown that a source of soil C and nutrients, such as rhizosphere secretions, fine root turnover (Liu et al., 2012) and the SOM decomposition rate (Wu et al., 2011; Liu et al., 2012; Zhao et al., 2013), decline when the understory vegetation is removed"; we have deleted the too far reached sentence "Our results suggest that bacterial and fungal biomass were better indicators of the changes in understory management practices in the Chinese fir plantation (arbuscular mycorrhizal species) than actinomycetes".

We have revised the sentences "The decreased values of the POC/SOC ratio (Table 1) suggest that POC changed more than SOC when understory vegetation was removed. The changes in the POC concentrations indicated that understory vegetation intact improved soil sustainability and productivity in Chinese fir forests, since aggregate stability and POC concentrations were related (Bouajila and Gallali, 2010)." to "The decreased values of the POC/SOC ratio after understory vegetation was removed (Table 1) suggest that POC declined more than SOC when understory vegetation was removed. This was indicated that intact understory vegetation improved soil sustainability and productivity in Chinese fir forests, since aggregate stability and POC contents were related (Bouajila and Gallali, 2010). This also means that when understory vegetation was removed, the decomposition from POC to SOC could occur at higher rates".

We have revised all of the microbial biomass to PLFAs content; we have already analyzed the biomarker of 16:1w5, which is considered as the indicator of arbuscular mycorrhizal fungi (AMF). And we confirmed our speculation "The PLFAs content of AMF was marginally lower (P = 0.053) after understory vegetation was removed (Fig,

A1). The amounts of soil AMF are controlled by plants, and specific AMF may only grow when specific plants are present (Hart et al., 2001). If plant communities change over time, their mycorrhizal partners will also change (Kaiser et al., 2010)".

We have considered the publication by Kaiser et al 2010 on how belowground C allocation affects microbial dynamics to illustrate the possible reasons for the decreased enzyme activities after understory vegetation was removed.

We have explained why AP was higher reflected the P limitation in the area, "In highly weathered red soil in southern China, P is the most limiting element, and most soil P is presented in organic form or is immobilized by high contents of Al and Fe (Margalef et al., 2017). Soil microorganisms may produce more phosphatase to mineralized organic P and release phosphate to meet their demand for P (Allison and Vitousek, 2005). The activity of AP is the highest of all the enzymes we assayed, which could reflect the fact that P was limiting nutrient in the study area".

2. The authors draw some comprehensible conclusion on the importance of understory vegetation to improve soil C sequestration. However they also conclude that high AP rates indicate P limitation, which, if they want to show it must be more elaborated (see. e.g. Margalef et al 2017, or Sinsabaugh et al 2008), and also it might be worth to compare the effect of the treatment on enzyme rates normalized by microbial biomass C (or total PLFAs).

Response: In highly weathered red soil in southern China, P is the most limiting element, and most soil P is presented in organic form or is immobilized by high contents of Al and Fe (Margalef et al., 2017). Soil microorganisms may produce more phosphatase to mineralized organic P and release phosphate to meet their demand for P (Allison and Vitousek, 2005). In our study, the activity of AP is the highest of all the enzymes we assayed, which could reflect the fact that P was limiting nutrient in the study area. And we have analyzed the specific enzyme activities normalized by total PLFAs and SOC contents, as well as the stoichiometry of enzyme activity through calculating the ratios

of C/N and C/P acquisition activity, as indicated by ratios of $\ln(\alpha G+\beta G+\beta X)/\ln NAG$ and $\ln(\alpha G+\beta G+\beta X)/\ln AP$, respectively.

3. Also the authors speculate that understory removal could have induced a shift in arbuscular (or other) mycorrhizal fungi composition, maybe it would be interesting to show more details on shifts in fungal marker composition (e.g. 16:1w5 compared to the other markers).

Response: We analyzed the biomarker of 16:1w5, which was considered as the indicator of arbuscular mycorrhizal fungi (AMF). And we found that the PLFAs content of AMF marginally declined after understory vegetation was removed (P = 0.053), which confirmed our speculation "The amounts of soil AMF are controlled by plants, and specific AMF may only grow when specific plants are present (Hart et al., 2001). If plant communities change over time, their mycorrhizal partners will also change (Kaiser et al., 2010)."

4. There was also some temporal variation in PLFAs, so why not pay them more attention? The methods seem to be sound, but it would be helpful to state a bit more details on the RDA, were absolute PLFAs analyzed or group means, or relative marker composition? And were enzyme rates log transformed? More specific comments are in the supplement.

Response: The data we used in the text was the average data of April, July and November. And we just present soil abiotic and biotic properties, such as PLFAs contents, and extracellular enzyme activities in different months in the Supplementary Material. And we will discuss the temporal variation of PLFAs and enzyme activities in the modified version of the manuscript.

The PLFAs data we used was absolute PLFA data. We have made a matrix with individual PFLAs to illustrate the RDA, but the result was not well, so we use the group PLFAs of bacteria, fungi and actinobacteria.

We have calculated the soil potential enzyme activities, and we also have analyzed the specific enzyme activities normalized by total PLFAs and SOC in the modified version of the manuscript.

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