June 10th 2018

A Response to Reviewers

Dear Anja Rammig,

We would like to thank you and the two reviewers for the thoughtful and valuable suggestions on our manuscript entitled "Understory vegetation plays the key role on sustaining soil microbial biomass and extracellular enzyme activities" (bg-2017-545). We have carefully revised our manuscript to take account of your and the two reviewers' comments and suggestions. Please find below our responses (color-coded blue) to Editor's and Reviewer's comments (repeated in an italic font). The page and line numbers mentioned here refer to the latest revision of our unmarked manuscript.

Comments from Editor

Although the reviewers acknowledge that the manuscript has improved, there are still major issues. In particular, the manuscript needs professional language editing. Additionally, please provide a more focused introduction and a concise discussion that does not over-interpret the findings. Please revise your manuscript according to the referees' suggestions.

Response:

We appreciate the opportunity that the editor and the associate editors have given to us to improve our manuscript and we look forward to publishing our manuscript in your journal. We have revised our manuscript in line with the reviewer's comments. Please refer to the following responses for details.

In addition, we have our revised version manuscript professionally edited by a native English speaker colleague, Dr Professor Deborah Ballantine from the United International College, Beijing Normal University-Hong Kong Baptist University.

Comments from Reviewers

Anonymous Referee #1:

Please fallow my comments and answer the questions.

Serious flaws of scientific speech.

Introduction is not targeting the purpose of the study

Please find my specific comments attached

Response:

We are very grateful for your comments, and we have revised the manuscript following your specific comments attached.

1. Line 13 revise "The aim of this study was to determine" to "We determined".

Response:

We have revised "The aim of this study was to determine the role of understory vegetation in

controlling soil abiotic and biotic properties, such as PLFAs contents, and extracellular enzyme activities." to "We determined the degree to which the soil abiotic and biotic properties, such as PLFAs and extracellular enzyme activities, were controlled by understory vegetation."

2. Line 16 wrong word context is wrong

Response:

We have revised the sentence to "We established a paired treatment in a subtropical Chinese fir plantation, which comprised one plot from which the understory vegetation and litter were removed (None) and another from which the litter was removed but the understory vegetation was left intact (Understory)."

3. Line 19 Do not use abbreviation in the abstract if not needed as here

Response:

We deleted the abbreviation in the abstract that are not needed.

4. Line 23 Name it as referred in literature it is an enzyme activity ratio; name it do not show equation in the abstract

5. Line 24 rephrase "which may mean that less labile carbon (C) inputs led microbes to produce more enzymes comes at C cost relative to N cost"

Response:

Considering the comment of 26 Anonymous Referee #3, we have revised this sentence to "the ratio of C-acquiring to N-acquiring enzymes was also higher, in the None treatments than in the Understory treatments. This suggests that the microbes invested more in C acquisition than N acquisition because the carbon (C) inputs were less labile."

6. Line 28-29 "Understory vegetation alters soil microbial biomass, which may influence the decomposition of soil organic matter, by changing soil carbon inputs" What can you expect from it? Does it change enzyme systems? Are there trends to SMC? What does it mean to sustain soil quality? Which of your treatments reflect the best soil quality? Are easily available substrates fueling decomposition?

Response:

According to the comment 28 of Anonymous Referee #3, we have revised this sentence to "More extracellular enzymes that degrade soil organic matter are produced when there is understory vegetation, which leads to losses of soil C. On the other hand, the soil C sink is maintained by increased inputs of C. We can therefore conclude that understory vegetation contributes to C sequestration in Chinese fir forests and suggest that understory should be maintained to sustain soil quality in subtropical Chinese fir plantations."

7. Line 33 The introduction should be re-worked and focused to the hypothesis

Response:

We have re-written the Introduction following your comment 8-18.

8. Line 44-46 This sentence is only partly correct as plants other soil organisms produced enzymes too.

Response:

We have revised this sentence as "Individual enzyme activities can reflect the substrate availability, the

nutrient requirements of microorganisms and plants, and the strategies used by microbes and plants to maintain the nutrient balance when the soil environment changes (Burns et al., 2013; Nannipieri et al., 2018)."

9. Line 46-47 grammar

Response:

According to the comment 6 of Anonymous Referee #3, we have revised this sentence to "By studying how the enzyme activities and ratios change when the understory vegetation is removed, we hope to improve our understanding of how the storage of C in soil is influenced by the understory vegetation, and how microbial nutrient acquisition is affected by microbial biomass and soil nutrients."

10. Line 48-49 time; grammar

Response:

According to the comment 7 of Anonymous Referee #3, we have revised this sentence to "Studies have shown that understory vegetation-induced changes in soil properties are closely related to climate, soil type, plant species, and time (Li et al., 2013; Nilsson and Wardle, 2005; Zhang et al., 2014)."

11. Line 54 "The effects of understory vegetation on soil microbial biomass also varied" widely; show ranges from literature

Response:

We have revised this sentence to "The effects of understory vegetation on soil microbial biomass vary by ecosystem-type."

12. Line 55 "fungi to bacteria ratio (F/B)" mention the values

Response:

Wu et al. (2011) found that understory vegetation removal respectively reduced fungal PLFAs and F/B ratio by 30% and 34% in the 2-year-old plantation and reduced fungal PLFAs and F/B ratio by 43% and 39% in the 24-year-old plantation. Zhao et al. (2013) found that Understory removal significantly reduced fungal biomass at 0–5 cm soil depth, and F/B values were smaller at 0–5 cm depth when understory was removed than remained. But we did not describe the values in the manuscript.

13. Line 56 indirect citation here

Response:

We have revised this sentence as "but Murugan et al. (2014) found that the bacterial and saprophytic fungal biomass increased, and ectomycorrhizal fungi and arbuscular mycorrhizal fungi reduced after understory vegetation was removed from eucalyptus plantations."

14. Line 62 Missing the flow. Strongly disconnected statements

Response:

We have revised this sentence to "Huang et al. (2014) reported that soil enzyme activities decreased in a subtropical alpine coniferous forest, while Lin et al. (2012) found that they did not change in a *Pinus sylvestris var. mongolica* plantation, when understory vegetation was removed. The current information about the responses of soil enzyme activities to understory vegetation removal is therefore inconsistent."

15. Line 72 no connection

Response:

We have deleted the sentence "As a shallow-rooted and fast-growing tree species, the Chinese fir competes intensively with understory vegetation for soil nutrients and moisture (He et al., 2015)."

16. Line 73 Enzyme activities as well as other indicators of microbial activity or in a broader sense of soil quality indicators should be introduced here. Especially the ratios were calculated such as enzyme activity C to P ratio or the specific enzyme activity. What does it mean for microbes when litter enters the soil? Show the pavement of the road reaching your topic.

Response:

Considering your comment 38, we have added the information of microbial activity indicators, such as specific enzyme activity and enzyme ratios, in the second paragraph of the Introduction. See Line 51-56. And we created Table A2 to illustrate the enzyme indicators and the explanation of these indicators.

17. Line 74 revise "In this study" to "Therefore"

Response:

We have revised "In this study" to "Therefore".

18. Line 75 delete "Earlier studies reported that the labile C release from below-ground C input decreased when understory vegetation was removed (Liu et al., 2012)."

Response:

We have deleted this sentence.

19. Line 85 revise "red soil" to "is classified as Udults using the USDA-NRCS soil taxonomy (Soil Survey Staff, 1996)"

20. Line 86 add "is" after "which"; revise "forms" to "formed"

21. Line 87 delete "and is classified as Udults using the USDA-NRCS soil taxonomy (Soil Survey Staff, 1996)"

Response:

We have revised this sentence to "According to the USDA-NRCS soil taxonomy (Soil Survey Staff, 1996), the soil in this area is dominated by Udults, which forms from red sandstone and sandy conglomerate and has moist and dry Munsell values of 7.5 YR 5/6 and 7.5 YR 6/6, respectively."

22. Line 98 revise "with" to "within"

Response:

We have revised this sentence to "The two subplots in a plot with the same treatment were distributed across each plot to avoid the effects of slope (Fig. 1) and their results were averaged."

23. Line 100-101 delete "For the None treatment, we removed all litter and understory vegetation from the plot. For the Understory treatment, we removed the litter from the plot, but left the understory vegetation intact."

Response:

We have deleted this sentence.

24. Line 102 revise "in" to "at"

Response:

We have revised the sentence "the amount of understory vegetation at the research site was about 6236 kg ha^{-1} under natural conditions." to "The amount of litter and understory vegetation at the study site amounted to about 1020 and 6236 kg ha^{-1} $year^{-1}$, respectively, under natural conditions."

25. Line 110 revise "when" to "during"

Response:

We have revised "when" to "during".

26. Line 116 revise "in the method of" to "by"

Response:

We have revised this sentence to "Particulate organic carbon (POC) was determined as outlined by Garten et al. (1999)."

27. Line 120-123 not clear suggest to split the sentence

Response:

We have revised the sentence to "Soil phospholipid fatty acids (PLFAs) were extracted following the procedure outlined by Bossio and Scow (1998), and were determined with a gas chromatograph (Agilent 6890N). Soil total PLFAs were represented by various PLFA biomarkers; gram positive bacteria (G^+) were represented by i14:0, i15:0, a15:0, i16:0, i17:0, and a17:0, and gram negative bacteria (G^-) were represented by 16:1ω7c, cy17:0, 16:1ω9c, and cy19:0. The total bacterial PLFAs were represented by biomarkers of G^+ and G^-. The total fungi PLFAs were represented by arbuscular mycorrhizal fungi (AMF) biomarkers 16:1ω5, as well as 18:1ω9c, 18:2ω6c, and 18:3ω6c, and the actinobacterial PLFAs were represented by 10Me16:0, 10Me17:0, and 10Me18:0 (Bradley et al., 2007; Denef et al., 2009)."

28. Line 137 centrifuged or shaked? If centrifuged why?

Response:

It's centrifuged. Because the absorbance we measured was small, and the repeatability of the data was not good before centrifuge. So we modified the method of DeForest (2009), and the repeatability of the absorbance was much better after centrifugation.

29. Line 137 "then moved" wording

Response:

We have revised "moved" to "transferred".

30. Line 138 "microplate fluorometer" product and brand

Response:

We have added the product and brand of the microplate fluorometer (SynergyH4, BioTek).

31. Line 138-139 delete "We had eight replicate sample wells for each assay."

Response:

We have deleted "We had eight replicate sample wells for each assay."

32. Line 142 "Data we used were the average data of April, July and November. N=18, n=3." grammar rephrase here and everywhere else

Response:

We have revised this sentence to "Data were means ± standard errors."

33. Line 147 "of all soil" between treatments right?

Response:

We have revised the sentence "We investigated the relationships among soil abiotic properties, PLFA contents and enzyme activities of all soil using redundancy analysis (RDA, CANOCO, version 4.5) and Pearson correlation analysis (SPSS 17.0).." to "We investigated the relationships between the soil abiotic properties, PLFA contents, and enzyme activities for the two treatments using redundancy analysis (RDA, CANOCO, version 4.5) and Pearson correlation analysis (SPSS 17.0)."

34. Line 149 revise "with" to "using"; delete ". The" and add "including a" before "significance"; revise "was" to "of"

Response:

We have revised the sentence "Figures were generated with SigmaPlot (Version 10.0). The significance level was $P < 0.05$." to "Figures were generated using SigmaPlot (Version 10.0). A significance level of $P < 0.05$ was applied throughout."

35. Line 153 "decreased by xxx%"

Response:

According to the comment 8 of Anonymous Referee #3, we have revised this paragraph to "The results suggest that the soil abiotic properties were influenced by the understory vegetation management (Table 1). The contents of DOC, POC, SOC, NH_4^+-N, and TN were 18%, 25%, 12%, 34%, and 8% lower in the None treatments than in the Understory treatments ($P < 0.05$), respectively. The SMC and POC/SOC were also 4% and 15% lower in the None treatments than in the Understory treatments, respectively ($P < 0.05$). There were no significant differences between the contents of NO_3^--N, ST, pH, and the SOC/TN ratios in the None and the Understory treatments ($P > 0.05$)."

36. Line 162 "though" why though

Response:

We have revised this sentence to "Specifically, the bacterial and fungal PLFAs were 26% and 20% lower ($P < 0.05$) in the None treatments than in the Understory treatments, respectively, but there were no significant differences between the G^+, G^-, or actinobacterial PLFAs in the two treatments ($P > 0.05$)."

37. Line 170-171 revise "were not changed" to "did not change"

Response:

We have revised this sentence to "but the potential activities of acid phosphatases did not differ significantly ($P > 0.05$) between the two treatments."

38. Line 172-174 "Soil C/N and C/P potential acquisition activity was indicated by the ratios of ln(αG+βG+βX)/lnNAG and ln(αG+βG+βX)/lnAP (Fig. 3c). The ratios of ln(αG+βG+βX)/lnNAG increased by 6.0%, while the ratios of ln(αG+βG+βX)/lnAP was not changed after understory vegetation was removed." It is not clear whether you mean ratio of total soil C vs total soil N content or enzymes. Clarify here and everywhere else; Suggest to create a table with abbreviations of soil quality / microbial activity indicators incl. an explanation of the indicator and the calculation; Grammar

Response:

We have revised this sentence to "The ratio of lnC_{enz}/lnNAG was 6% higher in the None treatments than in the Understory treatments, but the ratios of lnC_{enz}/lnAP were similar for the different treatments. The trends were enzyme-specific when normalized by the total PLFAs (Fig. 3d and e). The specific activities of the C-acquiring enzymes, i.e., αG_{PLFAs}, βG_{PLFAs} and βX_{PLFAs}, were 40%, 22%, and 41% higher, respectively, in the None treatments than in the Understory treatments ($P < 0.05$), but the specific activities of N- (NAG_{PLFAs}) and P-acquiring enzymes (AP_{PLFAs}) were not significantly different between the two treatments ($P > 0.05$)."

We have also added the information of microbial activity indicators, such as specific enzyme activity and enzyme ratios, in the second paragraph of the Introduction. See Line 51-56. And we illustrate the calculation of specific enzyme activity in Line 138-140. We created Table A2 to illustrate the enzyme indicators and explanation of these indicators.

39. Line 180 delete "The relationships between different PLFA contents and soil abiotic properties are shown in Fig. 4 (a)."

Response:

This sentence was deleted.

40. Line 181 "different PLFA contents" (Fig 4). Split the sentence here;

To which indicators it was significant?

How do you explain the orthogonal ones cos (90)?

Response:

We used RDA to analyze the relationships between soil PLFA contents and soil abiotic properties. Monte Carlo Permutation Test showed that ST, SMC, NO_3^--N, NH_4^+-N, DOC, SOC and SOC/TN were the main factors that significantly influenced soil PLFA contents. And we have revised this sentence as "The first (RD1) and second (RD2) ordination axes explained 62.0% and 15.5% of the total variability in the different PLFAs, respectively. Soil temperature, SMC, NO_3^--N, NH_4^+-N, DOC, SOC, and SOC/TN were mainly correlated with RD1 (Fig. 4a). Ammonia nitrogen and DOC were positively correlated with bacterial, actinobacterial, and total PLFAs, and SOC was positively correlated with G^-, bacterial, fungal, and total PLFAs ($P < 0.05$) (Table A3)."

41. Line 188 "The contents of DOC, NO_3^--N, NH_4^+-N were mainly related to RD2 ordination axis". Write in the MS what does it mean? What does it reflect?

Response:

Here RDA was used to analyze the relationships between soil potential enzyme activities and soil abiotic properties. It meant that the contents of DOC, NO_3^--N, and NH_4^+-N were the main factors that influenced soil potential enzyme activities.

42. Line 203 revise "C" to "liable C"

Response:

We have revise "C" to "liable C".

43. Line 204 revise "originated from decomposition of the understory vegetation root residues" to "root residues"

Response:

We have revised this sentence to “and the residues from the roots of understory vegetation may also decompose in the soil (Li et al., 2013).”

44. Line 205 revise “lost” to “loss”

Response:

We have revised “lost” to “loss”.

45. Line 207-210 Please connect the two sentences and rephrase them in a focused manner.

46. Line 209-210 “maybe because more labile C input from root exudates have resulted the accumulation of SOM and promoted the mineralization of organic N simultaneously” not clear find better explanation

Response:

We have revised this sentence to “Previously, researchers found that the soil N contents increased when the amount of N taken up by plants decreased during tree girdling experiments (Kaiser et al., 2010) and in soils without live roots (Loeppmann et al., 2016a). However, we found that the soil N increased when the understory vegetation remained intact, which suggests that the amount of available N released from plant roots and SOM degradation exceeded the amount taken up by plants.”

47. Line 211 revise “more” to “stronger”

Response:

We have revised “more” to “stronger”.

48. Line 212 delete “was”

Response:

We have revised this sentence to “Since POC is related to aggregate stability, the soil in Chinese fir plantations will be more productive when the understory vegetation remains intact (Bouajila and Gallali, 2010).”

49. Line 214 delete “This also means that”; delete “the” and revised to “we observe increased decomposition”

Did you measure that? I think no!

Response:

We did not measure the decomposition. So we have deleted the sentence “This also means that when understory vegetation was removed, the decomposition from POC to SOC could occur at higher rates.”

50. Line 217 delete “including bacterial and fungal PLFA biomarkers”; revise “after” to “when”

51. Line 218 delete “in this study”

Response:

We have revised this sentence to “Consistent with our hypothesis, total PLFAs declined when the understory vegetation was removed (Fig. 2).”

52. Line 218-219 revise “Previous studies reported decreases” to “It is known that”; complete sentences

Response:

We have revised this sentence to “It is known that fungal biomass decreases when understory

vegetation was removed (Wu et al., 2011; Liu et al., 2012; Zhao et al., 2013).”

53. Line 219 delete “was”

54. Line 220 delete “(P=0.053)”; revise “may reflect” to “reflected”

Response:

We have revised this sentence to “The PLFAs in AMF were lower in the plots with no understory vegetation (Fig. A1), which reflects the reduced plant diversity.”

55. Line 222-224 “Compared with other fungi, mycorrhizal fungi depends highly on belowground C allocation by plants, thus, the reduction of fungal PLFA content was mainly related to the reduction of mycorrhizal fungi (Kaiser et al., 2010)” Grammar and sense not clear

Response:

We have revised this sentence to “Other studies have suggested that decreases in the fungal PLFAs were mainly related to a reduction in mycorrhizal fungi, as mycorrhizal fungi are more dependent on below-ground C allocation by plants than other fungi (Kaiser et al., 2010).”

56. Line 412 “One paired plot design treatments.” grammar sentence incomplete

Response:

We have revised the title of the Fig. 1 as “Paired-plot design treatments with understory vegetation and litter removal (None), and understory vegetation intact and litter removal (Understory), the same abbreviations are used below”.

57. Line 414 revise “(PLFAs) contents”

Response:

We have revised the title of the Fig. 2 as “Soil phospholipid fatty acids (PLFAs) in the different understory vegetation treatments”.

58. Line 415 “None None, U Understory”?

Response:

We have deleted “None None, U Understory”.

59. Line 417 “Data was the average data” not clear; delete “The same below”

Response:

This sentence has been revised as “Data are the means ± standard errors. The same abbreviations apply to Fig. 4.”

60. Line 420 revise “(a) soil potential hydrolase activities” to “Soil potential hydrolase activities (a)”; revise “(b) soil potential oxidase activities” to “soil potential oxidase activities (b)” and so on; “(c) Soil C/N and C/P potential acquisition activity” enzyme activity ratios, sounds better and is used similar elsewhere please change throughout the MS

Response:

We have revised the title of the Fig. 3 as “Soil enzyme activities in the different understory vegetation treatments. Soil potential hydrolase activities (a), soil potential oxidase activities (b), enzyme activity ratios (c), soil hydrolase activities normalized by total PLFAs (d). αG α-1,4-glucosidase, βG β-1,4-glucosidase, NAG β-1,4-N-acetylglucosaminidase, βX β-1,4-xylosidase, AP acid phosphatase, PPO phenol oxidase, PER peroxidase. The same abbreviations apply to Fig. 4.” And we revised “Soil

C/N and C/P potential acquisition activity" to "enzyme activity ratios" throughout the manuscript.

61. Line 507 "Fig. 2 (a)" Why is the total PLFA content so low and what are total FLFAs?

Response:

The total PLFA contents were very low in the red soil. Our total PLFA contents are comparable to those of Dong et al. (2015).

And it's PLFAs, not FLPAs, we have revised it.

62. Line 518 "Fig. 3(a)" nmol g^{-1} dry soil h^{-1} and everywhere else in the MS

Response:

We have revised the unit of potential enzyme activities as "nmol g^{-1} dry soil h^{-1}" throughout the manuscript.

63. Line 520 "Fig. 3(c)" Why is this insignificant as the other one is?

Response:

Different lowercases represent significant differences among the None and Understory treatments ($P < 0.05$). And we have changed this figure, so that it could be read easier. See Line 532.

64. Line 521 "Fig. 3(d)" Please check the units for specific enzyme activity; "aG" Here it is sig. different and it is not for NAG. Explain why?

Response:

We have changed the unit of specific enzyme activity as h^{-1}. And we used a paired-sample t-test to assess the differences of enzyme activities between None and Understory treatments. The results showed that the specific enzyme activity of aG was significant different between None and Understory treatments, but the specific enzyme activity of NAG was not.

65. Line 558 "Data was the average data of April, July and November. N=18, n=3. The same below" See my comments above

Response:

Considering your comment 59, we have revised this sentence as "Data were means ± standard errors. The same abbreviations are used below."

Anonymous Referee #3:

The authors did a proper job on considering the suggestions by the reviewers and included several additional results in their study.

Also the manuscript improved, but I see still some points that should be targeted.

Sometimes sentences are particularly long, which makes following them confusing.

In the discussion and conclusion the results are a bit over-interpreted. Since there are no measurements how understory removal affected root biomass (did fine roots decrease because there are less plants growing, or did fine roots increase because there is less competition of fir trees with understory) is not quite clear - and mentioned as explanation in both directions...

I think the authors show nicely that the C content of the soil is changing, that the microbial biomass is

decreasing, and that the C-substrate targeting hydrolases are relatively increasing (and also per microbial biomass), so there is actually a higher demand from a microbial point of view for C, which can maybe explain the larger reduction of soil C - and this would indicate that less labile C might be is available (and actually support that the with understory removal the root biomass and exudate inputs have decreased).

For further comments please see the attached pdf!

Response:

We are very grateful for your comments.

We have revised the discussion and conclusion in the manuscript line by line following your specific comments attached. See the specific response below

1. Line 20 "xxx respectively declined by 4%, 18%, 25%, 12%, 34% and 12%" this is very hard to follow, and moreover, were all of these changes significant?

Response:

We have revised this sentence as "The dissolved organic carbon (DOC), particulate organic carbon, soil organic carbon, ammonia nitrogen (NH_4^+-N), and total nitrogen contents and soil moisture were 18%, 25%, 12%, 34%, 8%, and 4% lower in the None treatments than in the Understory treatments, respectively ($P < 0.05$)."

2. Line 23-25 "The soil ln(αG+βG+βX)/lnAP (βX: β-1,4-xylosidase; AP: acid phosphatase) increased when understory vegetation is removed, which may mean that less labile carbon (C) inputs led microbes to produce more enzymes comes at C cost relative to N cost" the sentence is a bit weird, probably better split in two parts.

Response:

According to the comment 4 of Anonymous Referee #1 and your comments 26, we have revised this sentence as "The specific activities of C-acquiring enzymes were as much as 41% higher ($P < 0.05$), and the ratio of C-acquiring to N-acquiring enzymes was also higher, in the None treatments than in the Understory treatments. This suggests that the microbes invested more in C acquisition than N acquisition because the carbon (C) inputs were less labile."

3. Line 37 revise "and changing" to "and can change"; revise "under" to "below"

Response:

We have revised this sentence as "When the understory vegetation is removed from forest ecosystems, soil processes are influenced, such that the above-ground plant diversity and biomass decrease (Lamb et al., 2011; Fu et al., 2015) and the characteristics of the below-ground rhizodeposits change (Li et al., 2013)."

4. Line 39 Leaf litter also brings nutrients back to the soil (especially in nutrient poor soils this might be important to consider).

Response:

In Line 40-43 "The understory vegetation absorbs water and nutrients from soil (Wang et al., 2014), and also releases carbohydrates back to the soil as discarded root cap and border cells; mucilage and exudates from roots (McNear Jr, 2013), and cellulose, hemicelluloses, and lignin from leaf litter

(Loeppmann et al., 2016a, b)."

5. Line 44 "Individual enzyme activities" they can also indicate substrate availability.

Response:

According to the comment 8 of Anonymous Referee #1, we revised this sentence to "Individual enzyme activities can reflect the substrate availability, the nutrient requirements of microorganisms and plants, and the strategies used by microbes and plants to maintain the nutrient balance when the soil environment changes (Burns et al., 2013; Nannipieri et al., 2018)."

6. Line 47 and the consequences for soil C storage

Response:

Considering the comment 9 of Anonymous Referee #1, we revised this sentence to "By studying how the enzyme activities and ratios change when the understory vegetation is removed, we hope to improve our understanding of how the storage of C in soil is influenced by the understory vegetation, and how microbial nutrient acquisition is affected by microbial biomass and soil nutrients."

7. Line 48 revise "were" to "have been shown to be"

Response:

We revised the sentence "The influences of understory vegetation on soil properties were closely related to climate, soil type, plant species, 48 and how long the manipulations have been applied (Li et al., 2013; Nilsson and Wardle, 2005; Zhang et al., 2014)." to "Studies have shown that understory vegetation-induced changes in soil properties are closely related to climate, soil type, plant species, and time (Li et al., 2013; Nilsson and Wardle, 2005; Zhang et al., 2014)."

8. Line 152-154 "The contents of various soil organic C (including DOC, POC, and SOC) and N (including NH4+-N and TN) fractions, SMC and POC/SOC ratios were respectively 4%, 18%, 25%, 12%, 34% and 12% lower in the None treatment than in the Understory treatment ($P < 0.05$)" this sentence is a bit hard to follow... maybe mention the % decrease together with the C or N pool... were these decreases significant?

Response:

We revised this paragraph as "The results suggest that the soil abiotic properties were influenced by the understory vegetation management (Table 1). The contents of DOC, POC, SOC, NH_4^+-N, and TN were 18%, 25%, 12%, 34%, and 8% lower in the None treatments than in the Understory treatments ($P < 0.05$), respectively. The SMC and POC/SOC were also 4% and 15% lower in the None treatments than in the Understory treatments, respectively ($P < 0.05$). There were no significant differences between the contents of NO_3^--N, ST, pH, and the SOC/TN ratios in the None and the Understory treatments ($P > 0.05$)."

9. Line 200 "understory vegetation root residue also incorporated into soil" I don't understand the argumentation...

Response:

It meant that understory vegetation root residue would be decomposed in the understory vegetation removal treatment. And We have revised this sentence as "The roots of the Chinese fir trees may take over the space previously occupied by the understory vegetation and may increase their exudation to

compensate for the reduced C inputs (Li et al., 2016), and the residues from the roots of understory vegetation may also decompose in the soil (Li et al., 2013)."

10. Line 201-202 "The increased quantities of C secreted by Chinese fir roots" how do you know/test that in your experiment the trees exuded more C?

Response:

We did not measure the root exudates of Chinese fir, but the roots of the Chinese fir trees may take over the space previously occupied by the understory vegetation (Li et al., 2016), because there is less competition.

11. Line 205 revise "study" to "studies"

Response:

We have revised the sentence "Previous study have found that the reduction of labile root C input resulted in the increment of soil N contents as a result of reduced plant N uptake." to "Previously, researchers found that the soil N contents increased when the amount of N taken up by plants decreased during tree girdling experiments (Kaiser et al., 2010) and in soils without live roots (Loeppmann et al., 2016a)."

12. Line 212 "the decomposition from POC to SOC…" the higher C enzymes (in relation of other enzymes, and per microbial PLFAs) do indicate a higher degradation, but could it be that the decrease of POC could also be the result of decreased inputs? (e.g., understorey leaf and root litter)

Response:

Considering comment 49 of Anonymous Referee #1, we did not measure the decomposition. So we have deleted this sentence.

13. Line 212-213 "the decrease in the SMC by understory vegetation removal (Table 1) reflects that understory vegetation had the ability to hold soil water" maybe start with this discussion point, was this also found by other studies?

Response:

Wang et al. (2014) also found that SMC declined after understory vegetation was removed. And we have revised this sentence as "As also reported by Wang et al. (2014), the SMC decreased when the understory vegetation was removed (Table 1), which shows that the understory vegetation has benefits for soil moisture."

14. Line 230-233 "Consistent with our hypothesis, we found a lower potential extracellular enzyme activity when understory vegetation was removed (Fig. 3), which was in line with the results of Huang et al., (2014), who found soil potential cellulase activity decline after understory vegetation removal, in spite of Lin et al., (2012) found no changes in soil enzyme activities" very long sentence, maybe split in parts.

Response:

We have revised this sentence to "Consistent with our hypothesis and the results of Huang et al. (2014), we found that the potential extracellular enzyme activities were lower when there was no understory vegetation (Fig. 3). However, Lin et al. (2012) did not observe any changes in soil enzyme activities when understory vegetation was removed."

15. Line 236-239 "The potential C hydrolase activity increased while the specific C hydrolase activities normalized by PLFAs decreased with understory vegetation intact, which may reflected that more labile C input may led to the emergence of opportunistic microorganisms (the microorganisms that do not produce enzymes but use enzyme products)" indicating also a high demand of C of the microbial community, right?;

Where does the more labile C come from in the None treatment?

Response:

What we mentioned here is the understory vegetation intact treatment, and more labile C come from in the Understory treatment. We have revised this sentence as "The potential C hydrolase activity was higher when the understory remained intact, indicating the high soil microbial demand for C. The specific C hydrolase activities normalized by PLFAs were lower when the understory vegetation remained intact than when it was removed, which may reflect opportunistic microorganisms (microorganisms that use enzyme products rather than produce enzymes) that emerged in response to an increase in the labile C input (Allison, 2005), and a subsequent decline in the ability of microorganisms to produce C-acquiring enzymes."

16. Line 242-243 "Mycorrhizal fungi vanish when understory vegetation is removed (Fekete et al., 2011), which means there are fewer microorganisms to produce less enzymes." I agree, but your results showed that per microbial biomass the enzyme production was even increased?

Response:

Our results showed that the potential enzyme activity decline. Thus, mycorrhizal fungi vanish when understory vegetation is removed (Fekete et al., 2011), which means there are fewer microorganisms to produce enzymes, so the total amount of enzymes decreases.

17. Line 243-244 "For the understory vegetation remaining and removal treatment, continuous root exudates and discontinuous root residue were incorporated into the soil, respectively." I do not follow the argumentation here...

Response:

We have changed this sentence as "When the understory vegetation remains intact, root exudates are continuously released to soil, but when the understory vegetation is removed, below-ground root residues are the main source of C for the understory vegetation. Thus, the inputs of C with different chemical compositions may have influenced the enzyme activities (Li et al., 2013)."

18. Line 245 "The different chemical composition of SOM" do you have a measure for different chemical composition of SOM?

Response:

We did not measure different chemical composition of SOM. But previous articles exhibited that root exudates and root residues have different chemical composition. Thus, the inputs of C with different chemical compositions may have influenced the enzyme activities (Li et al., 2013).

19. Line 253-255 "Polyphenols are mainly decomposed by PPO, so the decrease in PPO activity may result in an increase in the content of polyphenols that have toxic effects on soil microbes and inhibit hydrolase activities (Sinsabaugh, 2010)." I agree that polyphenols are decomposed by PPO, but this

sentence is a bit lost here... maybe it is better to relate that to changes in soil organic matter quality?

Response:

We have added the sentence that "Oxidative enzymes are responsible for the degradation of poor-quality, chemically complex compounds, such as lignin, aromatic compounds, and phenolic compounds (Sinsabaugh, 2010). Therefore, the lower activities of PPO and PER observed after the understory vegetation was removed may result in an increase in the content of refractory compounds in SOM." See in Line 255-258.

20. Line 259 revise "mineralized" to "mineralize"; delete "and release phosphate"

Response:

We have revised this sentence to "Soil microorganisms may produce more phosphatase to mineralize organic P to meet their demand for P (Allison and Vitousek, 2005)."

21. Line 260-262 "The results of Loeppmann et al., (2016a) suggest that the same mechanism applies to N demand in the rhizosphere, as they found that N-degrading enzymes increased when N was limited in the rhizosphere of maize-planted soil. However, we did not find evidence that N demand is controlled by such a mechanism in this paper." see paper by Dijkstra et al 2013 on rhizosphere priming effects.

Response:

We have referenced the paper by Dijkstra et al 2013 on rhizosphere priming effects. "The soil nutrient availability affects rhizosphere priming (Dijkstra et al., 2013). The higher potential NAG activity and higher contents of NH_4^+-N in the treatments with the intact understory vegetation suggest that the energy-rich C compounds released through the roots promoted the production of N-acquiring enzymes that released available N from SOM."

22. Line 267-268 "Chitin, a major structural component of fungal cell wall, and peptidoglycan, a major structural component of bacterial cell wall." put this sentence right after the sentence that ... NAG was lower, when understory vegetation was removed

23. Line 269 revise "fungus" to "fungal"

Response:

We have revised this sentence as "The low potential activity of NAG in the treatments from which the understory vegetation was removed was related to the reduction in the fungal biomass, and reflects the fact that chitin, a major structural component of fungal cell walls (Loeppmann et al., 2016b), can be degraded by NAG (Mganga et al., 2015)."

24. 271-273 "We did not observe any change in AP activities when the understory vegetation was removed, perhaps because Chinese firs, along with their mycorrhizal associates, are the main producers of these enzymes." can you give a reference here? How do you know?

Response:

Because Chinese firs coexist with fungi and forms mycorrhizal associates (Li et al., 2011), and mycorrhizal fungi is one producer of soil acid phosphatase (Rosling et al., 2016). Therefore, we conjectured that Chinese firs were the main producers of these enzymes. We have revised this sentence to "We did not observe any change in the AP activities when the understory vegetation was removed. Because Chinese firs coexist with fungi and form mycorrhizal associates (Li et al., 2011), and

mycorrhizal fungi produce soil acid phosphatase (Rosling et al., 2016), these enzymes were most likely produced by Chinese firs."

25. Line 273-275 "The negative relationships between the potential activity of AP and the content of DOC indicated that increased DOC contents may be linked to increased root exudation which may increase microbial biomass and therefore to increase P acquisition." maybe DOC could also be substrate for microbes, and microbes need also C (ie. energy) for enzyme production. If they don't get C they may not release enzymes to mine for P.

Response:

We have revised this sentence to "The negative relationships between the potential activity of AP and DOC suggest that DOC was the substrate for microbes, and that large amounts of DOC were consumed when producing P-acquiring enzymes."

26. Line 279-281 "The soil C/N potential acquisition activity increased after understory vegetation removal may imply that less labile C inputs are there led microbes to produce more enzymes comes at C cost relative to N cost." This sentence is not really clear. For me it seems that the microbes do not get labile C inputs by the understory, so they invest more in C substrate degrading enzymes (see changes in the rates). For enzyme production both C and N is needed, so I don't understand the conclusion that this comes at C cost relative to N cost?

Response:

We have revised this sentence to "The ratio of C- to N-acquiring enzymes increased after the understory vegetation was removed, which implies that, under lower inputs of labile C, microbes invest more in C-acquiring enzymes than N-acquiring enzymes."

27. Line 284-286 "Therefore, understory vegetation alter soil microbial biomass, which may influence the decomposition of soil organic matter, by changing soil C inputs." I also don't exactly understand this conclusion drawn here... at higher levels of DOC there might be more C available to foster the microbial biomass, but what does the PLFA data show? maybe you can undermine this by relating this to the result that phosphatase activity did not really change normalized to microbial biomass

Response:

According to your comment 28, we have changed this sentence as "Therefore, understory vegetation can contribute to C sequestration by enhancing C inputs to soil, even though C may be lost from soil with understory vegetation through the degradation of SOM by enzymes."

28. Line 287-289 "We suggest that, as part of routine forestry management, understory vegetation should not be removed from, but rather should be maintained in, subtropical Chinese fir plantations." nice result! I would suggest to particularly highlight that understory vegetation can contribute to C sequestration in Chinese fir forests by enhancing C inputs to soil and fostering microbial communities that are not only depending on degrading soil organic matter, which leads to losses of soil C!

Response:

We have revised our results and emphasized understory vegetation can contribute to C sequestration in Chinese fir forests. See Response to comment 27.