

***Interactive comment on* “Different sensitivities of litter decomposition and nutrient release to ultraviolet radiation” by Weiming Yan et al.**

Weiming Yan et al.

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Received and published: 8 January 2019

1: Yan et al. conducted a meta-analysis to compare the sensitivities of litter mass loss and nutrient release to UV manipulation. This study has the potential to contribute to the current literature on the roles of UV radiation in terrestrial biogeochemical cycles. Response: Thank you for your detailed review and helpful suggestions on the manuscript. We have revised the manuscript according to your comments. Each comment is addressed below, and the revised manuscript can be found in the Supplement.

2: However, there are significant issues with the presentation of results and the use of English language. Several figures are very hard to understand because of poor figure captions and missing methodological details. As there have been three meta-

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analyses on the same general topic of the UV effects on decomposition processes, a significant portion of the results did not offer much new information. The UV effects on litter mass loss and nutrient release were not compared in a statistically meaningful way. Response: Thank you for your suggestions. We agree with your statement that there have been three meta-analyses on the same general topic of the UV effects on decomposition processes. One of these studies mainly emphasized the litter weight remaining and its chemistry under elevated UV radiation (Wang et al. 2015), and the others examined only the litter weight remaining under changes in UV-B radiation (King et al., 2012; Song et al., 2013a). In general, the loss of litter mass increases as decomposition time increases, but nutrient release may show a different pattern. For example, the nitrogen (N) remaining in litter was shown to increase after fifteen months of photodegradation of litter decomposition in semiarid Mediterranean grasslands (Almagro et al., 2017). Thus, to better understand the C and nutrient release from litter, clarification of the correlation between mass loss and nutrient release during litter decomposition under changes in UV radiation is urgently needed. To clarify the effects of UV radiation on litter decomposition, especially its effects on C and nutrient release during the litter decomposition process, we conducted this study. Our main goal was to resolve the conflicting results presented to date and to clarify the response of nutrient release to UV radiation, which may differ from that of the rate of litter mass loss. We have revised the relevant sections of the revised manuscript accordingly. In addition, we have added the results of the statistical analysis of nutrients release and mass loss under UV changes relative to ambient environment conditions, and we have carefully revised the figure captions. The paper has been edited for English language by American Journal Experts. We believe the quality of the manuscript as been markedly improved.

3: Abstract, the abstract does not include any result regarding the comparison of UV effects on litter mass loss and nutrient release, which was supposed to be the main research question, judging from the title. Response: Thank you for your comments. We apologize for the lack of information on UV effects on litter mass loss and nutrient

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release. Following your suggestion, we have added the relevant results to the abstract. We did not compare the sensitivities of litter mass loss and nutrient release in this study; accordingly, we have revised the title to ‘Responses of litter decomposition and nutrient release to ultraviolet radiation: a meta-analysis.’

4: Page 1 Lines 20, 25, ‘sensitivity’ is a vague term. Please define how sensitivity was quantified. Response: Thank you for your comments. Our use of the term sensitivity was in appropriate because we did not evaluate differences; thus, we have deleted this term from the manuscript.

5: P1L22-24, I cannot follow this sentence. If the key is ‘three-stage pattern’, then describe what these three stages are Response: Thank you for your comment. We have revised the text to ‘In addition, mass loss and nutrients release under UV radiation varied over the decomposition process...’

6: P1L25, the final sentence was too generic. It’s not clear how this study helps to move the field forward. Response: Thank you for your comments. We have revised the sentence to make it more specific as follows: ‘Overall, changes in UV had considerable effects on both litter mass loss and nutrient release, suggesting that changes in UV radiation may greatly impact C and nutrient cycling in terrestrial ecosystems.’

7: Introduction, in general, I find the introduction quite wordy and lack of focus. For example, the authors discussed the specific UV effects on decomposition twice in two paragraphs. Some knowledge gaps that the authors identified have been studied by previous meta-analysis, e.g., the effects of precipitation (P3L14-15) and the effects of experimental duration (P4L26). Please think carefully about the unique contributions of this study and highlight them in the introduction Response: Thank you for your suggestion. Accordingly, we have deleted the redundant sentences and adjusted the structure to clarify the focus of the introduction section. For example, we merged the fourth paragraph with the second one. We agree with your comment that effects of precipitation (P3L14-15) and experimental duration (P4L26) on decomposition have been studied.

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However, whether the effect of UV change on decomposition remains consistent over time and how litter decomposition varies over time remain unclear. We have revised the relevant sentences in the introduction section of the revised manuscript to include this information.

8. P2L7, UV radiation doesn't directly contribute to photosynthesis or C fixation. Response: Thank you for your comment. It is true that UV radiation does not directly contribute to photosynthesis or C fixation; thus, we deleted the sentence.

9. P2L27, this is a good place to discuss the indirect effects of UV radiation. Response: Thank you for your suggestion. Following your suggestion, we moved the content addressing the indirect effects of UV radiation to this section and have carefully revised the text.

10. P3L4, the term 'photodecomposition' needs to be defined. Response: Thank you for your comment. Photodegradation is the breakdown of organic matter via solar radiation. We have defined the term in the revised manuscript.

11. P3L4, try 'sparse vegetation' Response: Thank you for your suggestion. We have used 'sparse vegetation' instead of 'little amount of vegetation' in the manuscript.

12. P3L19-30, this is the 2nd time the authors described the specific pathways through which UV radiation affected decomposition processes (1st time: P2L23-27). Please try pooling these materials together Response: Thank you for your comment. Follow your suggestion, we have adjusted the structure and merged the content together.

13. P3L29, explain 'the effects of UV enhancement _on the soil_'. Response: Thank you for your comment. For clarity, we have revised the sentence to 'Experimental studies of the effects of UV enhancement on plants have shown increases, no change or decreases in litter decomposition (Newsham et al., 2001; Hoorens et al., 2004; Song et al., 2013b) as well as the experimental results of litter decomposition when the soil under UV enhancement (Moody et al., 2001; Gehrke et al., 1995).'

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14. P4L10-24, this paragraph introduces the main novelty of this study: the UV effects on C vs. nutrient release. Consider highlighting this instead of burying it at the end of introduction. Response: Thank you for your comment. We have revised the introduction to highlight the novelty of this study.

15. P4L13, King et al. 2012 Biogeochemistry also included a meta-analysis. Response: Thank you for your comment. We have read the study carefully and have added relevant information to the manuscript.

16. P4L18, compared to previous meta-analyses, this study included a smaller number of published studies (i.e., 54) due to the goal of comparing C vs. nutrient release. I don't find it fair to criticize the sample sizes of previous studies Response: Thank you for your comment. We apologize for the inaccurate comment regarding these studies. We have revised the sentence to focus on the different purposes of these studies.

17. P4L27, I don't understand how the authors defined 'datasets'. A paired observation or a published experiment? Response: Thank you for your comment. The term datasets refers to sets of paired observations. We have revised the text to state 'paired observations.'

18. P5L19, what are the chemical properties included in this study? Please list all of them here. This is a good place to explain how 'C/N/P remaining' or 'C/N/P release' were calculated. In addition, does 'wood' mean woody tissues or leaves of woody species? Response: Thank you for your comment. Following your suggestion, we have added information on the relevant chemical properties and the calculation of 'C/N/P remaining' and 'C/N/P release'. In the previous version of the manuscript, 'wood' referred to the leaves of woody species; we have replaced this term with 'leaf source (forest or grassland)' in the revised manuscript.

19. Results, direct and indirect effects of UV radiation represent fundamentally different processes. One involves exposing litter to various levels of UV radiation, while the other refers to growing plants under UV manipulation and then accessing decay processes.

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Figure 2 is the only place where the direct and indirect were differentiated, but I find it impossible to understand. I have the impression that the direct and indirect effects were mixed together in most figures, except in Figure 2. I strongly believe that mixing the two is wrong. Response: Thank you for your comment. The direct and indirect effects of UV radiation on litter decomposition has been studied by Song et al. (2013a). Our study mainly focused on the effects of UV enhancement or attenuation on litter mass loss and nutrients rather than on the direct and indirect effects of UV radiation. In addition, dividing the effects into direct and indirect effects would have reduced the sample size in the analyses, increasing the potential uncertainty in the meta-analysis. Thus, we pooled the direct and indirect effects of UV radiation in most of the figures.

20. In all figures, it's not clear how sample size was counted. Does it include the number of replicates in original studies? Response: Thank you for your comment. The sample size was calculated as the number of paired observations; it does not include the number of replicates in the original studies. We have added this information to the methods section of the revised manuscript.

21. Figure 1, are the results about the 'direct effects' only? What does the error bar represent? It is more intuitive to show 95% confidence intervals with error bars. Response: Thank you for your comment. Fig. 1 shows the results for both the direct and indirect effects. The values in the figure are the weighted response ratios, and the error bars represent standard error. Black symbols indicate significant differences ($p < 0.05$) between the response ratios and zero.

22. Figure 1, I find it very surprising that there were less published studies on C remaining than on P remaining. Response: Thank you for your comment. There were fewer published studies addressing C remaining than addressing P remaining among the included studies in this meta-analysis.

23. Figure 2, I am having a hard time understanding this figure. Were soil and plant supposed to represent direct and indirect effects, respectively? Response: Thank you

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for your comment. 'soil' and 'plant' represent direct and indirect effects, respectively, in this figure. We have added this information to the figure legend for clarity.

24. P7L16, please consider merging UV-B and UV-(A+B) results in the figure 1. Response: Thank you for your suggestion. We merged the UV-B and UV-(A+B) results in Fig. 1 and have moved the UV-B and UV-(A+B) results to the supporting information.

25. P8L1, you mean 'results from field experiments'? Response: Thank you for your suggestion. We have replaced 'A field experiment' with 'The results from field experiments.'

26. Figure 4, if one experiment lasted exactly 4 months, was it categorized as '2-4' or '4- 6' months? Please add text in the figure to cue readers about UV amendment vs. Attenuation. Response: Thank you for your comment. When one experiment lasted exactly 4 months, we categorized as 2-4 months. We have added information regarding the categorization to the section 'Data analysis' and have added information regarding UV enhancement and attenuation to the figure.

27. Figure 4, there are not enough data over 500 mm precipitation to draw reliable conclusion Response: Thank you for your comment. We have presented the results as bars instead of in a regression plot in Fig. 4, as proposed by Reviewer #1, and we have written the description of the results in the manuscript.

28. P8L25-26, use of stats is questionable. The authors need to compare the slopes with 1 statistically. Response: Thank you for your suggestion. We have added the results of statistical analyses of differences in nutrient release and mass loss between UV enhancement or attenuation and ambient environment. The corresponding text has been revised to 'Various effects of changes in UV radiation on the RRs of remaining nutrients and weight remaining were found (Fig. 6). The slope of the RRs of remaining C and N and the weight remaining under UV attenuation were 1.31 and 1.23, respectively, however, the effects of both UV enhancement and UV attenuation on the relationship between each of C, N and P and mass loss relative to the ambient environment were

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not significant ($p>0.05$). Interestingly, UV enhancement significantly promoted the lignin release compared with the ambient environment ($p<0.01$).'

29. P9L5-9, a summary of key results will be more useful to start the discussion. Response: Thank you for your suggestion. The original sentence was redundant to information presented in the introduction section. Following your suggestion, we have revised the beginning of the discussion section to 'In the present study, a meta-analysis was performed to assess the effects of UV exposure on the dynamics of litter decomposition and nutrient release. We found that leaf sources (grassland or forest), experimental condition (field or laboratory), experimental duration, and exposure type (direct or indirect effects) affected litter decomposition and nutrient release under UV exposure.'

30. The discussion overall does not offer much original interpretation of data. In many places, it repeats the results or cites the findings from literature (e.g., P9L20-25, P9L6-10). Response: Thank you for your comment. Following your comments and those of Reviewer #1 comments, we have carefully revised the manuscript. We have added information, including some explanations of results, such as 'UV enhancement promoted litter decomposition, mainly due to the enhancement of photodecomposition as well as to the high initial litter N content; litter decay showed a significant relationship with N concentration (Figs. S6 and S7).'

31. P9L14-15, this should be presented in the results. Response: Thank you for your suggestion. We have moved the sentence to the results section.

32. P10L20, you mean no effects were observed in the lab? Response: Thank you for your comment. Our intended meaning is that no effects were observed in the lab. We have added this information to the revised manuscript.

33. P11L7, Figure 4 presents the data in an interesting way. I consider it a stronger component of the manuscript. However, it is debatable whether the temporal patterns clearly show three different stages. For example, the UV attenuation results seem

to follow a two-stage pattern. Response: Thank you for your comment. Mass loss showed three different stages over decomposition time under UV enhancement. During the early stage (0-4 months), UV enhancement did not impact mass loss or nutrient release. However, UV enhancement significantly promoted mass loss during the intermediate stage (4-18 months). This result indicated that UV enhancement can accelerate litter decomposition given a sufficient period of UV accumulation, consistent with the results of Wang et al. (2017). However, the UV attenuation results seemed to follow a two-stage pattern, with a significant reduction in mass loss during the early stage; the effect diminished as the decomposition time increased. We have revised the text to 'In the present study, litter decomposition also varied with decomposition time under UV enhancement and attenuation; the effects of UV enhancement on decomposition exhibited three-stage temporal dynamics (Fig. 4). UV enhancement did not impact mass loss during the early stage (0-4 months) but significantly promoted litter decomposition during the intermediate stage (4-18 months). These results indicate that UV enhancement can accelerate litter decomposition given a sufficient period of UV accumulation (Wang et al., 2017) as well as accelerate nutrient release. However, UV attenuation significantly reduced litter decomposition during the early stage, and the effect strength diminished as the decomposition time increased.'

Please also note the supplement to this comment:

<https://www.biogeosciences-discuss.net/bg-2018-445/bg-2018-445-AC2-supplement.zip>

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2018-445>, 2018.

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