

## ***Interactive comment on “Soil organic matter dynamics in a North America tallgrass prairie after 9 years of experimental warming” by X. Cheng et al.***

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Received and published: 9 March 2011

General Comments: Through their work Cheng and colleagues have compiled a valuable dataset describing soil C and N response to warming in a grassland ecosystem. The work presented in this manuscript has scientific value, especially considering the duration of the warming experiment (9 years). There is increasing interest among the scientific community in understanding the role of C3-C and C4-C species contribution to soil organic C dynamics in response to climate change and global warming in particular. Therefore this work has a place in the scientific debate and I believe it is of interest to the readership of Biogeosciences. The methods seem appropriate for this type of

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study and to test the hypotheses. However, I do believe the structure and the depth of the paper could be greatly improved to match the high standards of Biogeosciences. For example, even though the paper focuses primarily on changes in soil C and N content and decomposition, the Authors during the 9-yr experiment have collected enough information concerning NPP, species shifts due to warming, etc., to make their argument on soil processes more compelling. Unfortunately the Authors fail to do so in the present submission. Response: Thanks for the constructive comments. We have addressed all these questions point-by-point in revising the original manuscript (MS). Indeed, as referee's suggestion, integration of carbon decay and changes in NPP and species shifts will make the MS much more convincing. We cited these previous studies to support our issues in Introduction (Lines 104-110) and Discussion (Lines 325-346) sections.

In addition to – and to reinforce - what I stated above, I have a number of concerns that I would like to bring to the attention of the Editor. My concerns relate primarily to the presentation of the results and the context. Also, I do believe that the Authors should consider having their manuscript reviewed by English-speaking colleagues or take advantage of the many resources available to Authors whose native language is not English. I have found a large number of grammar errors and imperfections I highlighted (although keep in mind this is not an exhaustive list) in my technical corrections below. Response: We double-checked the grammatical errors and one of co-authors, Rebecca Sherry (English native speaker), improved the MS for grammar and English phraseology throughout the revised MS.

I will provide specific examples in the following sections, but overall I found a general lack of context that becomes particularly burdensome in the introduction and in the discussion. What I mean is that each paragraph seems to lack focus and to drift from one topic to another without dealing with any one topic in a thorough manner. What I was taught and I remind to my students all the time is that each paragraph should have a “stand alone” opening sentence that anticipates what the entire paragraph will deal

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with. The conclusive sentence of each paragraph should give a hint of what the next one will be. I noticed that many passages very briefly deal with important issues (e.g. effect of warming on C3 and C4 species abundance) without providing any (very much needed) explanation or justification of why this specific trend or factor or mechanisms is relevant in the context of the present work. Also, the paper would benefit from including some discussion on existing knowledge concerning metabolic pathways of C3 and C4 plants (e.g. Hobbie and Werner 2004) and their effect on organic matter decomposition (e.g. Wedin et al. 1995). Response: These are very useful suggestions. We have addressed all these questions carefully. We added some conjunctions and sentences to focus on one topic, and added some transitional words to drift from one topic to another in the Introduction and Discussion sections. We give some explanations of important issues and relation to this present study in Introduction section, and also cited references (Hobbie and Werner 2004; Wedin et al. 1995) to support metabolic pathways of C3 and C4 plants and on organic matter decomposition in the revised MS (please see Lines 85-94).

To conclude, and before I move on to providing specific comments and technical corrections, I suggest that the Authors thoroughly revise this manuscript and make the effort of dealing with each interesting piece of data systematically, consequentially, and thoroughly. Response: Thank you so much again for specific comments and technical corrections. In response, we have addressed all comments and suggestions carefully. We hope that the revised Ms is now satisfactory for publication.

Specific comments 1. It is important for all of us dealing with soil organic C-related science to be rigorous when it comes to terminology. We are all aware of the lack of standard terminology in our field, which often causes misunderstandings and opens the way to heated debate, hence it is critical that within one paper terms are used consistently and are defined up front, if needed. One example is the use of the term "old C", which is unclear if it refers to age of C or C before vegetation shift. Also, in a few passages the Authors talk about Y (=any) factor affecting SOM. It is important that

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the Authors define if they refer to SOM amount, decomposition, accumulation or what else? Response: Changes made. Please see Lines 63-65, Lines 244-245, and Line 268.

2. Line 43-45. Add reference to support this statement. Response: Change made.

3. Lines 47-48. Please delete this sentence as it is unclear and partly incorrect. Response: We removed this sentence in the revised MS.

4. Line 75. One could argue that all C found in soil and in any aggregate size (hence not only in the LF) derives from "decomposing plant tissue". I would recommend rephrasing. Response: We rephrased this sentence. Please see Lines 76-78 in the revised MS.

5. In the methods it is not clear that SOC fractionation was conducted for all aggregate sizes, with the only exception of the smallest aggregates. Please clarify in the text. Also, add reference to line 167. Response: We summarized fractionations in Table 1. The paragraph (Lines 175-185) described aggregate fraction, while the paragraph (Lines 186-197) described density fraction of each aggregate size. And we also added reference in Line 181 in the revised MS.

6. Similar veg. cover (in terms of C3 versus C4 species) in control and heated plots? Lines 237-238: the two parts of the sentence do not mirror: one deals with changes in total C content and the other talks about delta N. Response: For warming induced increases in C4 species, vegetation cover of C3 versus C4 species was different in the warmed plots from the control plots. We re-wrote this sentence; please see Lines 271-274 in the revised MS.

7. Line 241. 'The aggregate distribution was not affected by warming or clipping (Table 2).' This is not what Table 2 represents. Please rephrase and elaborate. Response: We added Fig. 1 (Weight distribution among aggregate size classes under four treatments after nine years of warming and clipping.) in the revised MS.

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8. I am using Table 2 for this example, but the same could apply to other passages: Because results deal with C content in relation to i) aggregate size, ii) heated and unheated plots, iii) clipped and non clipped plots, I think the best way to present the results is to tackle one issue at the time. As it is now, lines 241 to 246 include bits of every result without dwelling into the great deal of data that is presented in Table 2. I use this as an example of how some of the paragraphs lack focus. For instance, it is not clear if, when saying that 'macroaggregates contain more C than microraggregates' (lines 243-244), the Authors refer to this as an effect of warming or if it is simply the way C gets distributed within aggregates of different size. Similar considerations apply to the next paragraph (lines 247-251). Response: We re-organized the Results section by these suggestions in the revised MS.

9. Line 247-248. I do not see how the Authors drew such conclusion from Table 2. In fact, there is no indication of any significant difference in delta 13C due to warming across all aggregates. Response: We rephrased these sentences. Warming resulted in slightly increases in delta 13C across all aggregates but significant increase in delta 13C in LF of macroaggregates. We acknowledged this question in the Discussion section (Lines 427-435) in the revised MS.

10. Line 252. " : : all aggregate sizes : : " does it mean within each aggregate size or taking them all together? This distinction is very important. Please clarify. Response: We mean each aggregate size, and we clarified that.

11. Line 267-268. Table 3 does not indicate a significant changes in delta 13C in warmed soils in "all density fractions and all aggregate size". Plus, this section, based on its title, should focus on C and N across density fractions only, whereas the previous one should focus on aggregate size. Response: We rephrased this sentence and also re-organized the Results section by suggestions.

12. Line 281-282. What do the Authors mean by "whole soils" versus "all aggregate sizes"? Please clarify and avoid using new terms. Response: "whole soils" mean "total

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soils" (see Line 268). "all aggregate sizes" mean "every aggregate size".

13. The discussion section (line 288 and ongoing) should start by providing an overview of the findings or their significance. In any case, the opening statement should refer to the current study or clearly indicate that previous work done at these sites/ other similar experiments indicate X and Y. Consider splitting and rephrasing. Response: This is a very useful suggestion. We added an overview of the findings in the revised MS (see Lines 325-326).

14. Line 308-310. This sentence is not clear and saying that finer texture soils are resistant to change not only is not accurate (probably not even true unless you clearly specify what you are referring to exactly), but does not mean much in the context of this paper. I would recommend deleting this sentence or rephrasing by being very clear. Also, these soils had higher clay content before warming anyway Response: We removed this sentence in the revised MS.

15. Line 310-311. If these are results from previous work I would be very clear about that as it is good practice not to introduce new data or new information in the discussion and certainly I do not recommend referring to figures and tables in the discussion. Please fix this. And plus, why would we expect changes in bulk density? Response: We rephrased this sentence in the revised MS (see Lines 347-349).

16. Line 314-316. I do not argue the results, but then this shift in vegetation (which by the way deserves more in depth discussion) probably did affect C decomposition and accumulation in these soils within treatments. 17. Line 316-318. I would revisit the available literature to see if shifts in C3 and C4 spp. relative proportion results in different SOC accumulation as a consequence of different decomposition rates or internal fractionation occurring during organic matter break down. Response: We respond questions 16 and 17 together. We re-organized this paragraph by suggestions in the revised MS (see Lines 351-355).

18. Line 319-329. What about warming and clipping treatments? Does the present

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study add anything to this discussion? Response: Warming induced increases in C4 plant, but clipping did not significantly change plant species composition. We focus on warming treatment in this present study.

19. Line 351-352. This sentence is way too simplistic and the previous statements do not provide enough information to support this. Please consider revising. Response: We re-wrote this sentence in the revised MS (see Line 387-390).

20. Figure 1. If results in panel b are "warming-induced", what is causing difference, or lack of, in C4-derived C in panel a? Capital letters in panel a seem to contradict what panel b represents. Please clarify. Response: The title of "Figure 3" in the revised MS is "Fraction of C4-derived C of aggregate size classes under four treatments after nine years of warming and clipping (a), and warming-induced increases in the fraction of C4-derived C of aggregate size classes in warmed soils (b)". In panel b, "warming-induced" mean fraction of C4-derived C in the warmed plots minus fraction of C4-derived C in the controlled plots. Whereas, in panel a, fraction of C4-derived C mean percentage of C4-derived C under four treatments. So Capital letters in panel a and b are different.

21. Figure 2 is difficult to read and results could be represented by representing them in an additional column to Table 2. Response: Table 4 (original Table 2) contained too much data. We need four columns to add Figure 4 data (original Fig. 2). So we kept Fig. 4 in the revised MS.

22. There is no reference to Figure 3 in the result section. Please add the reference where appropriate or delete the figure, which is anyway difficult to read and does not add much to the discussion. Response: There is Figure 5 (original Fig. 3) in the Results (Lines 308-310) and Discussion (Lines 401-411) section.

Technical corrections Line 4, Line 69. Spiotta need capital S. Line 52. Accelerates instead of accelerate. Line 54. " : : have reported THAT warming: : :". Line 60. Delete article and start sentence with "Changes in : :". Line 70. Use "to separate SOC fractions that differ: : ." and delete "the bulk soil". Line 75. Use "fractionation" as above

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instead of "separation", for consistency. Line 85. Delete "such as, the" and start with "Changes". Line 87. "Furthermore the soil: : :". Line 88. "..by the biotic and abiotic factors: : :". Line 91. Use " : : has been suggested to: : ." instead of " : : enhanced: : :". Line 92. Do not use "The" at the beginning of the sentence. [I am not going to edit every single grammar error or inaccuracy. I hope the examples I provided above plus a few more listed below will be sufficient to inform the Authors on the work that needs to be done to improve the manuscript from a grammar point of view] Line 226-228. This part seems to repeat what is in line 223-226. Line 258-259. Use largest instead of highest. Line 267. I would not use the term "trend" in this context. Line 322-324. I do not think it is correct to say that results 'support a conceptual model'. Instead say that "results are in line with: : ." or something like that. Line 338. Please check punctuation. Line 349-350 "the evidence" "as shown in this study" Avoid repetitions. Response: All technical corrections made. In "2.5 Statistics" section, Lines 255-257 do not repeat Lines 252-255 in the revised MS.

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Interactive comment on Biogeosciences Discuss., 7, 8381, 2010.

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