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Discussions

Interactive comment on "Effects of precipitation on soil respiration and its temperature/moisture sensitivity in three subtropical forests in Southern China" *by* H. Jiang et al.

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Responses to review2 comments

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âĂŤ General comments âĂŤ

The authors present soil respiration results from a precipitation manipulation experiment in subtropical forests. This is a valuable data set that can provide the scientific community with new insight on the relative importance of moisture and temperature changes for a key C cycle flux with implications for climate change in subtropical

forests. There is a clear need for the type of study presented here, and the scientific design and methods are sound. However, significant changes should be made in the justification, presentation and interpretation of the study results before publication.

Response: We are very grateful to this reviewer's evaluation of our manuscript and to very constructive and detailed comments. We have carefully studied all the comments and integrated them into this revision. Mainly, we added the ecological justification of the potential impacts of changing precipitation on moisture sensitivity (pages 5 lines 7-16), the presentation of the model that includes both temperature and moisture parameters (pages 4 lines 1-23), and the model interpretation involving microbial biomass and fine roots data in the introduction section (pages 3 lines 14-28) as suggested. The point-by-point responses are detailed below. We hope that these changes are adequate to address the reviewer's concerns.

âĂŤ Specific comments âĂŤ

1. The question of changing temperature sensitivity of soil respiration with changes in soil moisture needs more study and I agree with the authors that data are lacking for subtropical areas. I also think that the precipitation manipulation approach is necessary to tease apart the confounding influences of temperature and moisture on seasonality of respiration rates. However, the potential impacts of changing precipitation on moisture sensitivity need to be re-considered by the authors. For example, what is the ecological justification for this question? This needs to be adequately examined in the introduction. Upon examining this, the authors might find that their methodological approach to quantifying moisture sensitivity is inappropriate for this type of system. Ecosystems that experience a wide range of moisture levels often display a non-linear response of respiration to moisture changes that is completely consistent with their experimental findings of changing moisture sensitivity to respiration. The way that the authors have presented the moisture sensitivity findings does not constitute a novel contribution to the field. We have known for decades that soil respiration is most sensitive to moisture as moisture increases from dry to moderately wet conditions. At some

higher level of moisture content, the soil pores begin to fill and oxygen (the electron acceptor for CO2 production via respiration) concentrations drop, thus respiration will reach an asymptote or even decline with increasing soil moisture. The authors have simply confirmed this pattern by experimentally manipulating moisture levels. This manuscript could increase its novelty by taking this concept somewhere new - are there important feedbacks with plant productivity (or root biomass) that change the shape of this function?

Response: In this revision, we added ecological justification of the potential impacts of changing precipitation on moisture sensitivity in the introduction section. We agree that the general pattern of soil respiration response to soil moisture should be nonlinear and revised the sentences to acknowledge this fact (page 4, line 6-16). In practices, however, the linear regression could be a useful approximation in many different ecosystems, as we demonstrated here and in some other studies (Schwendenmann and Veldkamp, 2005; Luo and Zhou, 2006; Zhang et al., 2006; Scotta et al., 2007; Deng et al., 2012). These linear empirical models under ambient condition were thought to be capable of extrapolating soil respiration under future climate changes in some ecosystems. In this study, we suspected that such linear regression of soil respiration and soil moisture on annual scale was probably due to the seasonal correlation between soil moisture and temperature, or phenological processes. In addition, precipitation changes may change the highest and lowest values of soil moisture in an ecosystem, in turn alter the phenological process, substrate input or microbial activity, which would lead to functional change. If so, even though the field measured soil respiration is well relationship with soil moisture in the ecosystem, modeling prediction of soil respiration with varying moisture sensitivity (nonlinear) may be more accurate,.

2. Related to this, I do not understand the need for using three different model structures to examine temperature and moisture sensitivity of respiration. I suggest using only the model that includes both temperature and moisture parameters in the same model, unless the authors can justify using all three and tie this into their hypothe-

ses. However, I think the moisture term is inappropriate for this type of system and the model structure should be reconsidered.

Response: The ecological justification of linear model was stated in the introduction section. In this revision, we revised discussion section, and mainly discussed the model that includes both temperature and moisture parameters as suggested.

3. The hypotheses lack adequate justification in the introduction. The introduction should lead into the specific questions addressed by the hypotheses. A major problem occurs in the introduction, found at the end of the third paragraph. The authors state that “the changing precipitation pattern will have a significant impact on the soil carbon stock of subtropical forests in Southern China”. While few would disagree with this statement, it is problematic because the authors do not examine soil carbon stocks in this paper. Soil respiration is not synonomous with “soil carbon stock” and one cannot be inferred by the other. This relates to a concern about the general mood of the introduction. The authors do not make it clear that soil respiration is controlled by both autotrophic processes and heterotrophic processes. Changes in temperature sensitivity of soil respiration may not translate into changes in soil C stocks and therefore, “soil C feedbacks to climate change” cannot serve as a justification for this study. The introduction needs more focus, needs more emphasis on the role of plants in soil respiration, and needs to better develop the need for investigating impacts of changing precipitation on moisture sensitivity of soil respiration. Also, why did the authors decide to study three different forests? It seems like the three sites generate a moisture gradient; if that is the justification, it needs to be specified.

Response: In the introduction section, we have examined the specific questions addressed by the hypotheses (pages 5 lines 7-16). We agree that soil respiration is different to soil carbon stock, but changes in soil respiration will influence the carbon stock in terrestrial systems. We re-worded the sentences in the text.

4. The microbial biomass and fine root data are not integrated into the paper and

should be either dropped completely or written into every section of the paper. Currently, the abstract and introduction make no mention of either data types and this is not acceptable. There should be explicit hypotheses involving microbial biomass and fine roots.

Response: We have integrated the microbial biomass and fine root data in the abstract and introduction sections. We think that functional change (defined as changes in model parameters of soil respiration with soil temperature and moisture, or both) could be attributed to the changes in phenological process, substrate or microbial activity (Zogg et al., 1997; Luo et al., 2001; Zhang et al. 2005; Noormets et al., 2008; Deng et al., 2012). Precipitation changes may change the highest and lowest values of soil moisture in an ecosystem, in turn alter phenological process, substrate input or microbial activity, which would lead to functional change.

âĂŤ Specific comments âĂŤ

1. 15669, line 12: Please do not ignore the role of carbon supply. There are many citations supporting the concept that C supply matters for soil respiration, such as Campbell, J.L., Sun, O.J. and Law, B.E., 2004. Supply-side controls on soil respiration among Oregon forests. Glob. Change Biol., 10: 1857-1869. Högberg, P. et al., 2001. Large-scale forest girdling shows that photosynthesis drives soil respiration. Nature, 411: 749-752. Curiel Yuste, J. et al., 2007. Microbial soil respiration and its dependency on carbon inputs, soil temperature and moisture. Global Change Biology, 13: 2018-2035.

Response: We agree that the role of carbon supply in soil respiration, and revised the sentences and added more previous works to acknowledge this fact (page 3, line 16-19).

2. 15669, line 17: this isn't necessarily true for moisture. You cited Falloon et al. 2011 who used a variety of soil moisture-respiration functions, some of which account for changing moisture sensitivity with different moisture levels. This relates back to one of

my "Specific Comments" above.

Response: Corrected. We have revised the sentences to acknowledge this fact (page 5, line 11-12). In practices, linear regression could be a useful approximation in many different ecosystems(Schwendenmann and Veldkamp, 2005; Luo and Zhou, 2006; Zhang et al., 2006; Scotta et al., 2007; Deng et al., 2012).

3. 15669, line 22: A period is needed after "warming" and before "Several"

Response: Corrected.

4. 15669, line 24: "Curriel" should be spelled "Curiel"

Response: Corrected.

5. 15670, line 23: Re-write this sentence to delete the implication that you studied soil C stocks

Response: We made the change as suggested.

6. 15673, line 5: what is the "distance" that you refer to? Is that the distance between the soil surface and the pipes?

Response: The distance is the pipes from the soil surface, which was corrected in the revision.

7. 15673, line 20: soil respiration was measured 3 times for each collar. Were they then averaged together? That needs to be stated.

Response: In order to ensure the measuring stability of the instrument, soil respiration was measured three times for each soil collar. Soil respiration in a collar was calculated as the mean of three time measurements. On this basis, soil respiration in a treatment plot was calculated as the mean of five collar measurements.

8. 15674, lines 14 through 27: Microbial biomass and fine root biomass are not mentioned here. How were they analyzed?

Response: In this revision, we added the analyzed methods of microbial biomass and fine root biomass in the Statistical Analysis section.

9. 15676, line 25: Is this paragraph discussing only data from the ambient precipitation plots? If so, that needs to be stated.

Response: Yes, we stated it in this paragraph of the discussion section (page 14 lines 9-10).

10. 15679, line 12: “Curriel” should be “Curiel”

Response: Corrected.

11. 15679, line 13: do you mean to say “predication” here or “prediction”?

Response: Corrected.

12. 15680, line 14: I disagree - I think it also depends on carbon supply. Do you have a reference to support this statement?

Response: We have revised the sentences to acknowledge the potential impacts of carbon supply in this revision (page 16, line 2).

13. 15680, line 17: insert “was” after “sensitivity”

Response: Corrected.

14. 15681, line 2: replace “abundant” with “an abundance”

Response: Corrected.

15. 15682, line 12: the statement “moisture sensitivities are often assumed to be constant” should be rephrased because it is not true with many models. I do not think the discovery that precipitation altered moisture sensitivity is a novel one.

Response: We deleted the sentences in this revision.

16. 15683, line 29: “Curriel” should be replaced with “Curiel”

Response: Corrected.

17. 15684, line 1: “Curriel” should be replaced with “Curiel”

Response: Corrected.

18. 15691: Include the model in the caption so we know what the parameters mean.

Response: We re-defined and corrected the parameters in the equations (see Table 3, A1 and A2). We hope the tables and figures are clear now.

19. 15694: Orient the panels for different forests side-by-side instead of up-and-down; it is easier to compare the values among forest types that way. Also, it would improve the figure’s clarity to replace the error bars with error bands.

Response: We made the change as suggested (see Fig. 1).

20. 15697: I am not sure the regression lines are adding anything here. If anything, it draws attention to the nonlinear appearance of the relationship between moisture sensitivity and soil moisture. Consider removing.

Response: We drew a nonlinear regression line between moisture sensitivity and soil moisture as suggested (see Fig. 3).

Interactive comment on Biogeosciences Discuss., 9, 15667, 2012.