

## ***Interactive comment on “Individual- and stand-level Stem CO<sub>2</sub> efflux in a subtropical *Schima superba* plantation” by L. W. Zhu et al.***

**L. W. Zhu et al.**

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Dear Editor and Reviewer,

We thank you for your helpful comments and suggestions. Following are our responses to reviewer's comments to our manuscript.

General Comments: This paper present interesting and quite novel data on a major portion of ecosystem carbon dioxide flux – stem respiration – from a subtropical plantation. Stem respiration is very difficult to measure and, particularly, to scale up to ecosystem-wide flux estimates. So their efforts are welcome, and will be of interest to a significant portion of the Biogeosciences readership, but i have some significant reservations. I recommend that the paper is accepted subject to major revision. My

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main issues are: (1) The whole manuscript needs to be checked over by a native English speaker. There are numerous spelling and grammar errors; (2) The statistical methods are not described at all in the methods section and their description of the tree measurements is unclear so it is difficult to interpret the results of their statistical tests; (3) The discussion is very long, and at times it is not clear what all the discussed papers/results have to do with their study. Several times, what should be presented as reasonable possible explanations of their observation based on other studies come across as conclusive statements of fact. On a related topic, large sections of the results and discussion are devoted to temperature responses of stem respiration but this seems unwarranted given that they appear to find only an extremely weak relation between respiration and temperature (Figure 6), with the exception of a mysterious statement on Page 3302, Lines 17-19.

Response: Firstly, the language mistakes have been corrected carefully such as spelling errors. Besides, the spelling and grammar errors of this manuscript also will be checked by copy-editing system of this Journal (BG Language Copy-Editing Service) as long as we submit the revised manuscript. The comparison of stem respiration or temperature response (Q10) between the seasons was examined by t test. The description of statistical analysis has been added to the section of Materials and Methods (Page 3296). We have checked the discussion roundly and shortened them. Especially for the section of effect of the temperature on stem respiration some discussions have been removed due to weak relevant to our topic (the followings were removed: Lines 11-19 in Page 3298, Lines 1-14 and 22-25 in Page 3299, Lines 7-13 and 26-29 in Page 3300, Lines 6-7 and Lines 14-16 in Page 3301, Lines 5-7, 10-13 in Page 3302. Page and line number is one in discussion paper.).

The following is response to specific comments.

1.Comment: Page 3290, Line 8) “scaling scalar” seem strange/redundant, i suggest you change to “as the scalar for”.

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Response: We wanted to express “the unit for calculating the stand-level respiration”. So we have corrected “the scaling scalar” to “the scalar” in the revised manuscript.

2.Comment: Page 3290, Line 15) I wonder if you should remove this sentence, since it raises quite a lot of questions/confusion which you don't have space to address in the abstract. For example, it's not immediately obvious why vertical variation in fluxes would cause stand-level values to be underestimated. Also, it's difficult to say whether your standlevel fluxes are really underestimates, the one assumption you've identified (all stems respire at the same rate as that measured at 1.3 m) would push it in that direction but other, unmeasured factors could counterbalance this.

Response: We agree with the comment, and have removed that sentence (Line 15 in Page 3290). Because in this study we estimated the stand-level stem respiration based on the data from the measurements at 1.3-m height. According to the vertical variation it only showed that stem respiration at 2-m height was higher than 1.3-m height. We assumed that stem respiration at the higher location was higher. So the conclusion of the underestimation was drawn. We also think it will be persuasive to draw a conclusion when measurements at the different heights are made in the future.

3.Comment: Page 3290, Line 19) Could help either here or at the start to have a short sentence with the big picture context of the study, as justification/motivation.

Response: A short sentence has been added to the start of abstract (Page 3290), that is, “Stem respiration was an important, but poorly studied component of total forest ecosystem respiration”.

4.Comment: Page 3290, Line 21) Remove first “the”. This sentence seems a bit bizarre, global change research is a massive field, forest carbon is an important component but surely not the main focus? I expected the Zach et al (2008) reference for this statement to be some general review of global change/forest research but it's a very focused study of stem respiration along an elevational transect in Ecuador...how does this reference support your statement?

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Response: We have removed that sentence. Because we want to express that forest carbon is important in the global carbon. So a sentence “Forest carbon pool is an important carbon pool in the terrestrial ecosystem.” has been added to the start of introduction.

5.Comment: Page 3290, Line 26) Replace “ecosystem” with “ecosystems”.

Response: Yes, “ecosystem” has been corrected to “ecosystems”.

6.Comment: Page 3291, Line 3) Remove first “the”.

Response: “the” has been removed.

7.Comment: Page 3291, Line 4) Remove “the”.

Response: “the” has been removed.

8.Comment: Page 3291, Line 6) Remove “the”. This seems quite vague, specify what about the sampling is the main constraint to understanding: equipment, methods, capturing within-tree, between-tree or forest stand variability, or temporal change?

Response: This sentence had been removed. In our paper we did not discuss that how many samples should be took among the different tree species because in this plantation there was only a tree species.

9.Comment: Page 3291, Line 7) Remove “the”.

Response: “the” has been removed.

10.Comment: Page 3291, Line 13) This statement seems quite bold and not well referenced, i’m sure you wouldn’t have to look far to find examples of substantial seasonal changes in foliar respiration

Response: We have removed the statement of foliage respiration. Because in our study only stem respiration was involved and foliar respiration was not involved although we were going to express the meaning of the seasonal variation in stem respi-

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ration compared with foliar respiration.

11.Comment: Page 3291, Line 15) Again, the apparent lack of inter-annual variability in stem respiration probably reflects the general lack of much data on this rather than evidence for a real biological pattern. Do you have references besides Zha et al. For this statement?

Response: We have removed the statement of inter-annual stem respiration. Because in this study the measurements were made only in 2010 and the comparison between the different years was not made although we were going to highlight small intra-annual variation in stem respiration compared with the seasonal variation.

12.Comment: Page 3291, Line 21) Change to “the most reasonable”.

Response: “the reasonable” has been changed to “the most reasonable”.

13.Comment: Page 3291, Line 24) Change to “efflux by other researchers (Ryan”.

Response: “in the other researches” has been changed to “efflux by other researchers”.

14.Comment: Page 3291, Line 26) Remove “the”.

Response: “the” has been removed.

15.Comment: Page 3291, Line 27) Change to “were the main”.

Response: “were main” has been changed to “were the main”.

16.Comment: Page 3292, Lines 3-4) See also Robertson et al. 2010. Global Change Biology.

Response: Robertson et al (2010) conducted a research about stem respiration in tropical zone. So this literature has been added to our paper.

17.Comment: Page 3293, Line 7) Change to “within the IRGA”.

Response: “within IRGA” has been changed to “within the IRGA”.

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18.Comment: Page 3293, Line 9) I think this should be “acquire”. Remove “an”.

Response: “an” has been removed.

19.Comment: Page 3293, Line 13) What do you mean by “unshade”, would “clear” or “transparent” be more appropriate.

Response: Because we want to say that the respiration chamber is not shaded. So “unshade” has been changed to “transparent”.

20.Comment: Page 3293, Lines 18-20) “pretty little” is too colloquial here. I suggest “stems varied little. The canopy”. Replace “density” with “dense”. Line 20 is unclear, i suggest you change to “in similar temperature around the circumference of stems. So”

Response: They have been corrected according to reviewer’s suggestions. “pretty little” had been changed to “stems varied little”. “density” has been corrected to “dense”. “in the similar temperature at the different directions of stems” has been changed to “in similar temperature around the circumference of stems”.

21.Comment: Page 3293, Lines 26) Replace “monitored” with “monitored”. Remove “the”

Response: “monitered” has been corrected to “monitored”, and “the” has been removed.

22.Comment: Page 3294, Line 7) Replace “ennvironmental” with “environmental”.

Response: “ennvironmental” has a spelling error and has been corrected to “environmental”.

23.Comment: Page 3294, Line 16) Change to “diameter. Analysis of the”.

Response: “Ananalysis on the” has been corrected to “Analysis of the”.

24.Comment: Page 3295, Line 15) Change to something like “was standardized to a common”.

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Response: This equation had been removed. We have removed the analysis of the standardized E23. E23 was used to analyze the difference in stem respiration between the two seasons. In the revised manuscript, when comparing stem respiration between the two seasons, the measured stem respiration between the two seasons was analyzed by t test taking the daily means as replicates. The description of Statistical analysis has been made in the section of Materials and Methods.

25.Comment: Page 3295, Line 22) If you already present equations for all the other key calculations, it makes sense to explicitly describe your formula for calculating SVI. Presumably you needed some estimate of stem diameter both at the tree base and under the branches, did you use some taper function to derive these from DBH? What was the rationale for not including branch area, do other cited studies include branch area in their standlevel stem respiration estimates? This seems potentially important for interpreting differences among studies.

Response: We have added the equation for calculating stem volume to the section of Calculations (Page 3295). We used taper function to estimate stem volume in which only basal area of breast-height and under-branch height (height from the ground to crown base) were needed. Stem and branch respiration were two parts of woody tissue respiration. Generally stem respiration did not include branch respiration. In the future branch respiration may be studied in detail.

26.Comment: Page 3296, Line 1) Show the allometric equation here. This is a potentially useful/interesting piece of data.

Response: The allometric equation has been added to the section of calculations (Page 3296).

27.Comment: Page 3296, Line 3) Because you present no description of statistical analysis i assume that none was done, is this right?

Response: We think reviewer was asking us about the content in Line 13, Page 3296.

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The statistical analysis of the differences in environmental factors between the two seasons was not made. The conclusion was made based on the diurnal variation pattern. Especially in the diurnal variation pattern of the revised manuscript, the differences in soil moisture or air temperature were distinct between the two seasons.

28.Comment: Page 3296, Line 18) Replace “Jarivs” with “Jarvis”.

Response: “Jarivs” has been corrected to “Jarvis”.

29.Comment: Page 3296, Lines 14-16) This looks mistaken, like you got the results the wrong way around. The 4a (stem surface area) plot doesn’t look significant, whereas 4b (stem volume).

Response: The relationship between stem respiration and diameter was analyzed by correlation analysis in SPSS, and it surely showed that stem respiration per surface area was correlated with DBH ( $P < 0.05$ ). The linear equation and  $R^2$  have been added to Fig.5 in the revised manuscript.

30.Comment: Page 3296, Line 20) This doesn’t quite make sense, plus distinctive is misspelt. I suggest you change to “As shown in Fig 5,Es presented a distinctive daily”.

Response: Stem respiration had a variation on the daily scale and showed “S” pattern which was similar with  $T_s$ . So “Es presented a distinctive daily” has been changed to “both  $E_s$  and  $T_s$  presented a daily dynamic”.

31.Comment: Page 3296, Lines 21-22) Coefficient is misspelt. Differences in SE don’t necessarily indicate a difference in coefficient of variation (CV). If you want to make this point, why don’t you just calculate CV directly (mean/standard deviation).

Response: The spelling error of coefficient has been corrected. The analysis of CV was made instead of SE, in order to indicate the small difference in stem temperature among the individual trees compared with stem respiration.

32.Comment: Page 3296, Line 24) December is misspelt. These easy mistakes

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shouldn't make it into a submitted manuscript. I'll ignore further mistakes like this, get the text checked thoroughly.

Response: The misspelling has been checked thoroughly and corrected.

33.Comment: Page 3296, Line 24) How much value is there in standardizing stem respiration to a specific temperature, given the very low  $r^2$  between stem respiration and temperature ( $< 0.043$ )?

Response: As we responded to comment 25, the daily means of stem respiration were analyzed instead of E23 by t test. The analysis of E23 was removed.

34.Comment: Page 3297, Line 7) What does the sample size of 3 come from. You say that stem temperature was recorded on 6-8 trees (page 3293, line 27).

Response: Q10 was calculated based on data of all sample trees. The difference in Q10 between the two seasons was analyzed by t test taking the daily means as replicates.

35.Comment: Page 3297, Line 11) Remove "The"

Response: "the" has been removed.

36.Comment: Page 3299, Line 18) This sentence doesn't make clear sense. This paragraph in general has lots of grammar errors.

Response: "However, some studies had showed the variation of stem respiration with height" has been change to "However, some studies showed stem respiration varied with height". This paragraph has been shortened. "that the younger locations of the stem had higher respiration rates than the older locations" has been removed. "Stockfors (2000) predicted the whole-tree respiration by measuring stem temperature at different heights. Araki et al. (2010) found the vertical variation in daily stem CO<sub>2</sub> efflux of Chamaecyparis obtusa tree was more evident in the growing season than in the dormant season" has also been remove because they are not involved in our discussion

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such as the vertical variation between the seasons. “The higher respiration rates in the upper-canopy leaves were attributed to the higher maintenance respiration for the more photosynthetic activity (Turnbull et al., 2003; Whitehead et al., 2004). The rate of stem photosynthesis was higher due to the higher irradiance at the upper of stems than at the lower (Cerasoli et al., 2009), also resulting in the higher requirements for maintenance respiration. Such explanation indirectly well interpreted our findings.” has been removed because stem photosynthesis could be negligible due to the dense canopy.

37.Comment: Page 3299, Line 28) Well, as long as there is a linear relationship between temperature and respiration, which there might not be (though i agree it's very unlikely). So, the certainty in this sentence seems unwarranted.

Response: Because the differences in stem respiration or stem temperature between the two heights were analyzed, if there is a linear relationship between temperature and respiration, the proportion of respiration between the two heights should be same with temperature. We have changed this sentence to “the variation in stem temperature could not totally explain why stem respiration doubled with height”.

38.Comment: Page 3300, Line 3-13) All these potential explanations are fine, but could they explain the amount of change you observe over a relatively small change in stem height. Is there any data in the literature you can find to support this?

Response: We agree with you. There was a relatively small change in stem height in our study. Because it was difficult to measure stem respiration at higher location. It is likely that we will focus on the vertical variation in the future, and then we will measure respiration and temperature at more locations of the stem. Although these potential explanations are reasonable according to the tree growth, in the literatures we have read, the difference in the wood structure of different heights has not been studied.

39.Comment: Page 3300, Line 7-10) This is about leaf respiration, is this relevant for interpreting your stem respiration results?

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Response: As stated in response 37, we have removed this sentence (Line 7-10 in Page 3300).

40.Comment: Page 3301, Line 6-7) This is quite a strong claim, do you have anything to support it?

Response: We want to express that the substrate supply plays an important role on autotrophic respiration. But this was not relevant to the following discussion. So we have removed that sentence ( Line 6-7 in Page 3301).

41.Comment: Page 3302, Line 7) This is not clear, perhaps change to “the lack of any clear rainfall seasonality. Woody”.

Response: “the unobvious wet/dry season dynamics” has been changed to “the lack of any clear rainfall seasonality”.

42.Comment: Page 3302, Line 13) Does that “pretty significant” mean significant, or almost significant, or what?

Response: “pretty significant” was expressed as “significant”. So it has been changed to “significant”.

43.Comment: Page 3302, Lines 17-19) Impressive. Why not show this data, how is this calculated differently to Figure 6?

Response: Based on all data both in July and December, the effect of mean temperature of all sample trees on mean stem respiration was estimated. Its statistical analysis description has been added to the section of Materials and Methods. In Fig.6, the effect temperature on stem respiration within the month was estimated based on the data of each sample tree.

44.Comment: Page 3302, Lines 7-8) Again, this is a nice possible explanation, you have zero evidence for this so this statement should be much more cautious.

Response: In the cited literature it indicated that there were differences in woody tissue

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respiration between the growing and non-growing seasons. In their studies they found woody tissue respiration varied with the season. That is what we want to express.

45.Comment: Page 3303, Line 24) It would be nice to have a conclusion here to synthesize your key findings and place them into a wider context. As it is, the text ends quite abruptly.

Response: In the end of Discussion, we have added a conclusion of synthesizing our key findings and suggesting some studies to be done in the future.

46.Comment: Table 2) How were these significances derived, what were your replicates and sample size? Did you make multiple replicate measurements from the same tree, or are you taking the separate trees as replicates? If the latter, you should just present means for all the trees rather than presenting the data for individual trees.

Response: Because there were great differences in stem respiration among the individuals, so we took the daily means of the individuals as replicates when the significances were derived.

47.Comment: Figure 2) Annotate this figure to describe the key elements of the equipment, for those of us not experienced with the method.

Response: The detailed description of the equipment has been added to Figure 2 in order to make reader understand how it works.

48.Comment: Figure 3) It would be easier to interpret, and would make your arguments about respiration seasonality clearer if you had the same measurement from different seasons on the same scale, so that the reader could immediately spot that December was colder and drier. If the data abnormality on 2nd August was caused by power failure why didn't levels return to normal afterwards? Also, the x-axis is wierd, why divide up by 20:00 and 04:00 or 19:00 and 03:00, and differently in the two panels?

Response: We have described the environmental factors with the same scale. The reason why soil moisture did not return to normal after the power failure is that the power

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failure was resulted from the heavy rain. So soil moisture increased after the power recovered. In order to make it understandable, we have used the data for continuous several days in the two seasons.

49.Comment: Figure 4) It would be useful to fit a regression line through these scatter-plots, and present the linear equation for the line and  $r^2$ .

Response: The linear equation and  $R^2$  have been established using the scatter diagram in Figure 5 of the revised manuscript as you suggested.

50.Comment: Figure 5) See first comment for figure 3.

Response: As we responded to comment 49, this Figure had been corrected as Figure 6 in the revised manuscript.

51.Comment: Figure 6) The rationale for fitting a single line to the group of data works if you expect all the individuals within the group to behave similarly. But here, particularly in December, it looks like there is one portion of the group with a very distinct pattern of response, with similar slope but much higher intercept. Is this a particular tree or something?

Response: There was great difference in stem respiration among the individuals. It might be different when the individuals are analyzed. However, we only want to know the general relationship between stem respiration and temperature in this forest. In the future, the difference in stem respiration and its response to environmental factors between the individuals may be analyzed.

52.Comment: Figure 7) See first comment for figure 3.

Response: As we responded to comment 49, this Figure has been corrected.

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Interactive comment on Biogeosciences Discuss., 9, 3289, 2012.

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