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Biogeosciences Discussions

Interactive comment on "Soil respiration at mean annual temperature predicts annual total across vegetation types and biomes" *by* M. Bahn et al.

M. Bahn et al.

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Ref #1: 'With this work, the authors demonstrate that annual soil respiration can be estimated by measuring soil respiration at mean annual temperature at sites which are not water limited. At seasonally arid sites, a correction factor based on the ratio between precipitation and potential evapotranspiration needs to be used. This work is, thus, extremely useful in that it proposes a feasible method to obtain reliable global estimates of soil respiration, and their space and annual variability. The approach is sound and the work well performed. Conclusions are well supported by the data.'

Reply: We appreciate that the referee acknowledges the potential of our approach.

Ref #1: 'However, despite the high scientific relevance and the good quality of the

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Interactive Discussion

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study, the ms is poorly structured and in many instances suffers from lack of clarity, to the point that it needs substantial rewriting. In fact, it is only in the Results and Discussion section that the study is presented in its logic order and the reader starts understanding the work performed. Both the Introduction and the Method sections are too short and, in particular for the latter, lack details and clarity. I suggest that the approach used (1. Tds, 2. Monte Carlo, 3. Test with the dataset) is first explained in the Introduction, and the same order is used to present the Methods. These should also be given in much more details.'

Reply: The text has been improved as suggested by Ref#1. The introduction has been extended to motivate and explain in more detail how the ms is structured:

(last paragraph of Introduction:) Here, we demonstrate that SR measured at mean annual temperature (SRMAT) may be a useful and meaningful predictor of SRannual. We do so by first outlining a theoretical framework, suggesting that SRMAT is in principle well suited for estimating SRannual at non water-limited sites within most of the globally occurring range of annual soil temperature variability and temperature sensitivity of SR (Q10). Secondly, we apply a Monte-Carlo analysis to test the hypothesized relationship between SRMAT and SRannual on a randomly generated dataset. Thirdly, we explore the relationship for existing databases of SR for 57 forests, plantations, savannas, shrublands and grasslands from boreal to tropical climates, including 71 site-years, and thus testing effects of cross-site versus intrasite (i.e. interannual) variability. Finally, we show that for seasonally dry ecosystems, where mean annual temperature occurs only in the wet season, SRannual can be estimated from wet season SRMAT and a correction factor based on the ratio of potential evapotranspiration to precipitation. Our finding indicates that it is sufficient to measure SRMAT for obtaining a highly constrained estimate of its annual total, which could help improving future assessments of the spatial distribution and interannual variation of soil CO2 emissions across ecosystems, landscapes and regions.

The methods section has been rearranged as suggested, and more details have been

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given.

Ref #1: 'Also, Results should be presented more extensively (see specific comments below).'

Reply: See specific reply below

Specific points: Ref #1: 'P04L17 _ Table 1: Number of sites and site-years. First of all there is an inconsistency between the 57 total sites presented in table 1 and the number of sites mentioned in the text (58). I suspect that the table lacks 1 tropical site. This needs to be checked and the mistake corrected.'

Reply: The reviewer is right! Originally 58 sites (including 8 tropical ones) were included, but for the final table and analysis it was decided that two rather than three age classes of Eucalyptus plantations would suffice, so to achieve a more balanced representation of tropical sites. The total number of sites and the number of tropical sites have been corrected to 57 and 7, respectively.

Ref #1: 'With regards to the site-years, data referring to this category are not clearly reported and they are firstly and only presented (as little triangles) in fig. 4. To which year do data in Table 1 refer to, for the sites where more years are available? I would suggest to report in Table 1 which are the sites where data for more than one year are available and give, for them, also the inter-annual variation of SR.'

Reply: This has been done in the revised ms.

Ref #1: 'P04L21: Here but also elsewhere in the text, the authors use the expression "season when mean annual temperature occurs". This, to me, makes no sense and I suggest rephrasing to something like "season when daily temperature is frequently close to the mean annual temperature value".'

Reply: This comment reflects a misunderstanding that calls for a more detailed explanation, which has also been added to the revised ms. As Ref#1 correctly points out, SRMAT needs to be measured when daily temperature is frequently close to the mean

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annual temperature value. However, at seasonally dry sites mean annual temperature need not occur during both the dry and the wet season. At some of the sites we included in our study, the dry season was particularly warm, causing soil temperatures to remain well above mean annual temperature throughout this part of the year, and being in the range of mean annual temperature only during the wet season. For this particular situation or cases when only wet season SRMAT is available, we suggest using the correction factor based on P/PET.

Ref #1: Methods: I suggest restructuring in: 2.1 Standard Deviation of global daily temperatures (in this paragraph the Q10 classes concept should also be clearly reported); 2.2. Monte Carlo Analysis; 2.3: Database. Each session should be presented with much more details than it currently is.

Reply: The methods section has been restructured as suggested, and further details have been added. The Q10 classes have been explained in the results section (cf. also reply further below)

Ref #1: P05L11: Add “for” before all sites. P05L13: Initialize Tsd P05L27: Initialize GPCC P06L20/

Reply: all done

Ref #1: Fig.1: The results in this figure should be presented in much more details. Data points do not seem to match with the theoretic lines given, but this is not reported at all. Also, the Q10 classes are very poorly explained throughout the ms, and need to be reported with clarity.

Reply: We agree that Fig. 1 deserves some more detailed explanation. Q10 values were grouped to classes in order to increase the clarity of the Figure and relate the observed values to the theoretical relationships. Thus, reported Q10 values of 1-2 should fall in between the lines depicted for Q10=1 and 2, a.s.o. As Ref # 1 points out, the correspondence between data points and theoretical lines is generally poor. At the

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same time it shows that all data fall in a range of Tsd where Q10 is expected to have a minor effect on mean SRannual/SRMAT. The results presented in Fig. 4 confirm that the relationship between SRMAT and SRannual is highly constrained across the range of Tsd and Q10 covered by our dataset. These further explanations have been added to the revised manuscript.

Ref #1: P08L9: I may be wrong, but to my understanding SRannual is lower than SRMAT only when the dry season is also warmer than the wet, and not simply out of the mean annual value. This, in fact, should not be the case if it was colder.

Reply: No, this is not the case. For seasonally dry sites, SRannual is overestimated from SRMAT measured only during the wet season, as its direct inference from SRMAT does not account for the fact that during the dry season SR may be substantially reduced due to water limitations. A clarifying statement has been added to the ms.

Interactive comment on Biogeosciences Discuss., 6, 11501, 2009.