

Interactive comment on “Temperature sensitivity of soil respiration is dependent on readily decomposable C substrate concentration” by A. A. Larionova et al.

A. A. Larionova et al.

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1. The authors should consult a recent paper for a theoretical back-up of their analysis (Ågren G, Wetterstedt JÅM. 2007. What determines the temperature response of soil organic matter decomposition? Soil Biology Biochemistry 39:1794-1798). I would suggest that the authors write the paper in a more general tone considering that the temperature response of soil respiration results from a combination of several temperature dependent factors, the specific aspect that some of these factors may counteract each other is important but should be given a less prominent role.

- Theoretical back-up has been added to the text of Introduction&; p.3 and Discussion section p. 9 in the revised version of our ms.

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2. The standard separation of results and discussion into separate sections is suggested.

- Done.

3. In the Methods sections the three approaches are given in one order but as results they come in the opposite order. The same order should be used throughout and I would suggest having them in the order eq (4), eq (3), and eq (2); the equations should then be renumbered.

- The order of the description of the three approaches and numbering of the equations have been changed according to the Reviewer's comment. Also, the structure of Results has been re-arranged properly.

Specific comments: 1 .Introduction, first paragraph. I think it is important to understand the difference between steady state temperature responses and transient effects. The Giardina and Ryan paper is a based on steady state assumptions whereas some of the others refer to transient responses, see also ?gren GI, Bosatta E. 2002. Reconciling differences in predictions of temperature response of soil organic matter. Soil Biology Biochemistry 34:129-132. The Eliasson et al paper does not "confirm the overestimation"; it demonstrates the effect of transient responses.

-The paragraph concerning transient and steady state responses has been added to the text of Discussion; section (p. 10).

2. Eq (1). There is a + -sign that should be removed.

- Corrected.

3. Eq (4) should be introduced already here in connection with the Sikora and McCoy paper.

- Eq(4) has been shifted to Introduction section; it is Eq.2 in the revised version of the ms, p. 4.

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4. I suggest deleting the parts about r- and K-selection and copiotrophic and oligotrophic components, as such aspects are not covered by this analysis. This applies also to other parts of the manuscript.

- Microbiological terms have been removed from the text of revised version of our ms, with the discussion focused mainly on the changes of kinetic parameters.

5. Section 2.1. The description of the respiration measurements must be more detailed. In particular, how were the initial measurements made, cf. Table 1. The parts with the growth conditions in Section 2.2 belong to Section 2.1.

- The appropriate detailed description of the respiration measurements has been added, the description of the growth conditions has been moved to Section 2.1.

6. Eq (2). There must be errors in this equation. $1 - kt$ in the exponents should be $-kt$?
- Eq(2) has been corrected.

7. Section 3.1, paragraph beginning "The changes in glucose ..." The canceling effect of temperature in V_{max} and K_s occurs whenever K_s is (much) larger than S_n . Section 3.1, paragraph beginning "If substrate concentration ..." It is only when $S_n \gg K_s$ that the half-saturation constant plays no role (see also previous comment).

- The paragraphs have been corrected (p. 9). Canceling takes place at low S_n ; however, the temperature dependence of S_n is the main factor controlling soil respiration if there is no substrate added.

8. Section 3.2, first paragraph. The reference to Liski et al must be treated with caution because it is based on some strange model assumptions (see Ågren et al. 2000. Temperature dependence of old soil organic matter. *Ambio* 29:55).

- The paper by Liski et al, 1999 was cited only to show the whole spectrum of opinions concerning temperature sensitivity of labile and recalcitrant SOM. We agree that some assumptions of J. Liski's model are doubtful.

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9. Should not v_u , Eq (3), and V_{max} , Eq (4), be equal? The v_u from Fig 2 does not appear to equal V_{max} in Table 1. Why? Is this an indication of methodological problems?

- Corrected. Indeed, V_{max} is equal to $v(0)$, i.e. the sum of V_c and V_u . There was the mistake in Fig.2: only the respiration of growing biomass ($V_c \cdot e^{\mu t}$) rather than the sum of $V_u + V_c \cdot e^{\mu t}$ at 12oC has been shown. We added V_u to the lower curves in the revised version.

10. Table 1. In this table S_n decreases more at 12 oC than at 22 oC. I can understand this as a result of depletion of the substrate corresponding to S_n and a decrease in the substrate corresponding to S_n with temperature.

- In the studies on apparent acclimation, substrate depletion assumes that available substrate is quickly exhausted by soil warming. Therefore, based on this concept, S_n should be lower at 22oC. To the contrast, we found lower S_n at 12oC, probably due to decreased activity of microorganisms producing hydrolytic enzymes by temperature decline.

11. However, in the arable soil S_n increases with time at 22 oC. This has to be explained. There is also the problem with the initial sample, where the measurements have not been described. And how reliable are the initial measurements given that soil preparation as done here introduces a strong temporary disturbance?

- We have added the description of measurements in the initial samples to Materials and Methods section, p.5. Since we should take into account both an actual concentration of substrate and the rate of its turnover, we have added the values of turnover time ($T_t = (K_s + S_n) / V_{max}$) to the Table 1. Low S_n at the beginning of incubation in arable soil is probably related to a rapid turnover of the easily decomposable substrate. At the same time, the question whether it reflects the real increased microbial activity in fresh soil samples, or it is associated with the disturbance at soil sampling, is still unanswered (see p.12-13). Parameters in the freshly sampled soil were measured as

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soon as possible in 1-2 hrs after sampling, i.e. in disturbed soil. In special experiment (unpublished data) maximal deviations of respiration in disturbed and undisturbed soil were observed at low concentrations of substrate added, i.e. S_n and K_s are more sensitive to soil disturbance than V_{max} .

12. The following is the correct spelling of names (some appear more than once): Ågren, Strömgren, Kätterer, Andrén, Mäkelä, Westman. - Corrected.

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