**Biogeosciences
Discussions**

Interactive comment on "Soil respiration in a fire scar chronosequence of Canadian boreal jack pine forest" *by* D. R. Smith et al.

Anonymous Referee #2

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General comments

The authors present statistical analysis of soil respiration measurements in fire scars with different time since the last fire. Soil state variables temperature and water content were determined simultaneously as well as organic carbon content. Those co-variables were used to normalize and compute average soil respiration fluxes for the scars differing in their fire history.

The manuscript is not written in a precise or well-structured style. The introduction contains a lot of information, which is not really linked closely to this study. A clear goal or rationale is missing in the introduction. The results section contains information, which should have been given in the methods section. Parts of the discussion are simply repeating results. The discussion and the conclusions are rather weak. There

is a lot of redundancy in the mauscript and using such a lot of abbreviations makes it hard to read and undertand the text.

However, there are also major methodological concerns: (i) on the data handling in the pilot study (ii) on the method used to estimate the number of samples required (iii) on the handling of the soil water contents expressed as water filled pore space (iv) on how organic carbon content was used to normalise soil respiration (v) on not using collars for the first field campaign (vi) on using 3 samples for a two parameter model to link 'time since fire' to mean soil respiration All the methodological concerns are explained in detail in the 'specific comments'.

Specific comments

8726 9 and 13 This sounds contradictory: "was adjusted for ... and soil moisture" and on the other hand you state "... but no effect of Ms on Rs..." 8726 23-26 The last sentence of the abstract usually contains the most important conclusions. What is stated here is very general. The statement that more detailed measurements are required is rather trivial. Much stronger conclusions should be given here. 8728 11-23 This section should be skipped. There is no direct link to this study. 8729 17-19 This is a lot of references. I suggest to select the 2 or 3 most relevant. 8729 21 Only here a goal is mentioned. I suggest to give at least two precisely formulated goals, which you can refer to in the conclusions. 8729 27-29 Skip; this is weak. 8730 7 I suggest to skip figures 2 to 4. 8730 12-24 This is not really relevant, please shorten significantly 8731 23 skip "voltage" 8731 25 How many many measurements were averaged for water content? Or was the Theta probe only injected at one location for every collar? 8731 25-28 please replace with: "Measured soil water content (cm3/cm3) was normalised with the soil porosity (cm3/cm3) to determine effective saturation (water filled pore space)." 8732 9 You do not clip the grass to minimize autrophic respiration. You want to exclude effects of the carbon assimilation during the measurement. You intend to measure ecosystem soil respiration, why should you want to exlude autotrophic respiration close to the surface? 8732 10 This does not seem like a sound method to select

measurement locations. Especially against the background of knowing that there is a deterministic spatial pattern of respiration in forests, see Fang et al., 1998, Plant and Soil 205, 135-146. 8733 2 How much variability in Rs is lost due to the adjustment according to soil termperature? And is the number of samples required still representative? Because you already removed variability in Rs, which is actually apparent in the field measurements. You measure Rs not Rs adjusted for temperature. I do not think this is the most realistic estimate. 8733 8 This approach of Steele and Torrie is rather old-fashioned and very simple. In statistics there are more sophisticated and more reliable methods available like for example the Jacknife method, see Confalonieri et al., 2009, Field Crops Research 113(2), 125-130. 8734 5-6 Only ten collars per fire scar? According to table 2 you accept an error of almost 30%! 8734 19 This method of estimating effective saturation (called "volumetric pore moisture") is not appropriate. Using a constant porosity of 0.38, just because it is a sandy soil, is not adequate. There is a variability is porosity you have to account for. This is probably also the reason for the extremely weak correlation between respiration and effective saturation presented later on. This issue, however, could be solved: You can estimate the soil porosity in dependence of the soil bulk density Bd (g/cm3) you also measured using: Ps=1-Bd/2.65 where 2.65 g/cm3 is the density of the solid phase (quartz mineral). Since you also measured the organic carbon content Corg (g/g) you should also account for that by: Ps=1-Bd/(Corg*0.224+(1-Corg)*2.65) where 0.224 g/cm3 is the bulk density of organic matter (Rawls, 1983, Soil Science 135(2), 123-125). The effective saturation is then calculated according to Se=theta/Ps. Let me give an example: Assuming a soil bulk density of 1.5 g/cm3 and an organic carbon content of 0.05 g/g would yield a porosity of 0.4068. This has to be available for every location you would like to give Se. An alternative would simply be to use the volumetric water content directly, instead of Se. 8735 4 You have to give the units of the variables. Is Cs given in g/cm3? 8735 9 What is the unit of Rsc? Rs is given as g C/m2/s; Cs is g C/m3?; Then Rsc would be given in m/s. This makes no sense. 1/s would make sense, but then Cs must be given as g C/m2, which means you have to relate you organic carbon content to a certain soil

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depth!? This should be explained in detail. Is there a reference for this normalisation of Rs using Cs? 8735 16 please give R2 and RMSE of the fit. I wonder whether the RMSE is larger than the differences between the scars. 8735 22 Eq. 8 should be skipped, it is identical to Eq. 7 8736 1 Skip; Q10 and T0 are already given in 8735 16 8736 2-5 Now, the reader is completely confused. But Ms has no effect on Rs, see 8738 3! 8737 14 ok, but you only use 10 samples (see 8734 5), equivalent to ∼30% error (Table 2)! 8737 19 df could be omitted; giving N is sufficient 8737 20 here the Q10 of 2.21 is mentioned for the third time, please skip 8738 17-8739 17 This section is completely overloaded with abbreviations 8739 18-20 You fit a 2 parameter model to 2 degrees of freedom. From a statistical point of view this is disputable. From a scientific point of view I reject this analyses. There should be at least one more degree of freedom than parameters, not the same number. Particularly for that small numbers of N. Everything else is dubious. 8740 8-9 "where soil collars were not used"; this information should have been given in the methods section 8740 17-19 In that case your measuremant method of FC1 is not valid! You could not compare or pool it with data of FC2. The measurements during FC1 are inappropriate. 8742 I suggest to put that on context to required sample sizes for other ecosystems like, e.g. Confalonieri et al., 2009, Field Crops Research 113(2), 125-130 and Herbst et al., 2009, Vadose Zone Journal 8, 762-771 8742 25 "...a Q10 of 2" Now Q10 is 2.0??? 8744 "Rs is likely to be controlled primarily by Cs"; Please, show a plot of Rs against Cs and compute a coefficient of determination or corrrelation. And set this in relation to the correlation you detect between Rs vs. Ts and Rs vs Ms. 8744 9-13 skip; trivial and already mentioned 8743 15-8744 2 This needs to be discussed against the background of the measurement depth of Ts, see Graf et al, 2008, Biogeosciences 5, 1175-1188. Otherwise you could not compare Q10 of different experiments. 8744 12-15 skip; this is redundant 8746 2-8 What is much more often observed is the decrease of Rs with dry soil conditions. 8745 16-20 Then FC1 could not be compared to FC2, see above! 8746 1-3 If that is the reason for the increase in Rs in time after the fire it should be much more stressed in your manuscript. 8748 4 The number of replicates is clearly too small

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8750 2-8 This are not conclusions. This is just what was done. 8750 15-17 Even if you believe in that, you could not conclude that from this study. An R2 of 0.999 from three data is not convincing. 8750 18-20 skip, this is trivial 8749 19-8750 8 please skip the "Future research" section. This is not relevant in a conclusion section. 8770 Fig.6 You better give a figure with the Q01 fit.