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Biogeosciences Discussions

Interactive comment on "Soil warming in a cool-temperate mixed forest with peat soil enhanced heterotrophic and basal respiration rates but $\vec{Q}_{10}$ remained unchanged" *by* M. Aguilos et al.

Anonymous Referee #1

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Aguilos et al. present an interesting study in which peat soils were exposed to higher temperatures in order to test how soil respiration, and particularly its heterotrophic and autotrophic fraction respond to warming. Their study confirms the few previous studies that suggested a sustained positive climate feedback from these soils in response to warming and can provide interesting information about the response of both heterotrophic and autotrophic soil respiration. 'Can', because I think the analysis needs revision to strengthen this part.

Although I like the experiment, I think that several points should be improved. First, the

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English is far from perfect, and therefore I suggest asking a native English speaker to correct it. Further, Materials and Methods are not entirely clear (see specific comments below) and, most importantly, I think the analysis of the results need to be improved by using a slightly different approach for the calculation of basal respiration rate and Q10. In the current study, the authors plotted the soil respiration data of the entire growing season (August-November 2007 or April-November 2008 and 2009) versus temperature to obtain 1 fit per year (i.e., 1 basal respiration rate and Q10 value per year). The key problem with this method is that seasonal variation in, for example, microbial community and root growth (the latter for control plots only of course) are also encompassed in the temperature response. As demonstrated by for example Curiel Yuste et al. (2004), seasonal changes in (amongst others) plant phenology can largely affect this apparent temperature sensitivity (which is thus rather a compilation of temperature effects, phenological effects, etc.). As a consequence, the temperature sensitivities obtained from such calculations are useless when one is interested in, for example, interannual variability of the temperature response of soil respiration (a topic discussed in the current manuscript) which would be strongly affected by confounding factors such as plant phenology. Moreover, it is not appropriate for calculation of the temperature sensitivity of Ra via comparison of trenched versus control plots (as made in the current manuscript). The primary reason for the latter is that the seasonal Q10 of the control plots encompasses changes in root growth. This means that part of the difference in temperature response between trenched and untrenched plots is simply due to differences in belowground allocation of photosynthates and root growth that very likely covary with temperature on a seasonal scale. Hypothetically, it is even possible that Rroot did not respond to temperature at all, but that root biomass and root exudates covaried with temperature, inducing an apparent increase of Rroot on a seasonal scale. Much more information and discussion on this topic can be found in Curiel Yuste et al. (2004), Davidson and Janssens (2006) and Vicca et al. (2009). To deal with this problem, authors could analyze their data similar to Vicca et al. (2009), fitting regressions for shorter periods (e.g., one regression per day). Like that, a seasonal course of the basal rate and the Q10 are obtained. This approach has several advantages. Besides being a must to obtain trustworthy basal rates and Q10's for Ra in this case, the Q10 computed in this way does not depend on plant phenological responses that covary with temperature, which makes it much more meaningful for interannual comparisons. Moreover, this approach also allows detecting seasonal variation in basal respiration rate, Q10 and in the warming response of the basal respiration rate and Q10 (in this case, for both Rh and Ra).

Specific comments

Materials and methods: p. 6419: from the information given here, it is not entirely clear to me what the experimental site looks like. As I understood, part of the vegetation was harvested, but it remains unclear which species were present (at what density) and which species were dominant at the moment of measurements.

p. 6420: I wonder if trenches of 30 cm are actually sufficiently deep to assume that what is measured is Rh only. Can authors provide any indications for that? Was rooting depth measured?

p. 6421: The information about the measurement system is confusing. Because information about, for example, enclosure time or equilibration time is lacking, I had a look at the papers of Liang et al (2003, 2004) to which authors referred. These studies mentioned an equilibration time of ca. 20 minutes. Were chambers in the current experiment also closed for 20 minutes? Did that affect air (and soil) temperature? I also noticed that authors used a different equation for flux calculation than Liang et al (2003, 2004) did, but the reason for this different equation is not given. I suppose it has to do with the measurement of water vapor that is possible with the improved system. Please clarify.

p. 6423: Using equation 4, the basal rate at 0 °C is calculated. However, this temperature is the minimum of all measurement temperatures and is therefore not a good reference temperature to use for comparison of the basal rate. I suggest using a dif-

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ferent equation, which allows calculation of a basal rate at, for example, 15 °C (which is about the mean soil temperature during soil respiration measurements). The function that can be used is: Fc=Rr*Q10ˆ((Tc-Tr)/10), with Fc the measured soil respiration rate at time c, Rr the basal rate at reference temperature Tr (e.g., 15 °C), Q10 the temperature sensitivity and Tc the temperature at time c.

Discussion: I think the discussion needs a section on the methods used here. Trenching is not a perfect technique for partitioning of Rh and Ra. Kuzyakov (2006) demonstrated the pro's and contra's of different partitioning techniques, and highlighted the shortcomings of trenching experiments. It's important for readers who are not experienced with this partitioning to realize this. I'd like to see discussed how the disadvantages of this technique may affect (warming responses of) basal rates and Q10 of Rh and Ra.

p.6424: It seems more logic to discuss first differences in soil respiration across years, followed by basal rate and Q10 which provide more detailed information about observed differences (instead of the other way around as in the current version).

p.6427, l.11-16: I find it inappropriate to extrapolate results of the growing season to obtain annual estimates. Winter temperatures are outside the range of temperatures under study, plants are dormant during winter, and snow cover and freeze-thaw cycles can have important impact on soil respiration.

References used: Curiel Yuste et al 2004. Annual Q10 of soil respiration reflects plant phonological patterns as well as temperature sensitivity. Global Change Biology, 10, 161-169.

Davidson and Janssens 2006. Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. Nature, 440, 165-173.

Kuzyakov 2006. Sources of CO2 efflux from soil and review of partitioning methods. Soil Biology and Biochemistry, 38, 425-448.

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Vicca et al 2009. Temperature dependence of greenhouse gas emissions from three hydromorphic soils at different groundwater levels. Geobiology, 7, 465-476.

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