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Biogeosciences Discussions

Interactive comment on "Spatial and seasonal variability of heterotrophic and autotrophic soil respiration in a winter wheat stand" *by* N. Prolingheuer et al.

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General Notes:

The manuscript entitled "Spatial and seasonal variability of heterotrophic and autotrophic soil respiration in a winter wheat stand" by Prolingheuer et al. describes fluxes of soil respiration (Rs), with measured or calculated components, and an emphasis on temporal and spatial variability as is well described in the title. The paper is well written, with good spelling and mostly clear and appropriate grammar and phrasing. The objectives and methods are well described and cited. Citation in general is good.

The scientific significance of the work is limited but valid. The overall conclusion that

autotrophic root respiration (Ra) is more variable in space and time compared to heterotrophic respiration (Rh) and thus drives the variability of Rs, is expected from the nature of soils and plants, where plant mass changes in time and has a defined spatial pattern. However, information on the specific ecosystem under study, including the relative contribution of fluxes and their variability, remains valuable. As described below, however, the analysis has some flaws, limiting the validity of the results. In addition, the spatial relations and ranges described within and between fluxes are not supported by additional explanatory data (e.g. root biomass, gradients in soil properties, etc).

Problems that should be addressed are:

Contribution of fluxes. Differences in moisture between treatments (deep and shallow collars) are mentioned, a result of water uptake by roots in normal conditions. Also, there is a significant relation shown between moisture and Rh. Consequently, the contribution of Rh to Rs expected for this field should be calculated only after Rh is corrected to the moisture level measured under "normal" soils conditions, using whatever moisture function is more suitable.

Temperature and moisture effects. The correlation of various explanatory variables with each other and the limited number of sampling dates, as mentioned in the paper (p 9149, l 25-28), result in difficulties when modelling or interpreting the models. It is thus misleading to suggest the results can be evidence of a lower or higher sensitivity to temperature as done for the low Q10 observed (p 9150 l 20-23); i.e. there is a high probability that a confounding effect with moisture is lowering the Q10. The use of AIC is useful as far as the explanatory variables or mechanisms are unclear. The suggestion that temperature is not needed to explain Rh (p 9151 l 6-9) is only a result of the limited conditions for this site and period. There is little mention of the limitations of this modelling exercise for any generalization. The modelling exercise does not relate well with the variability analysis and conveys only limited information.

Flux calculation and variability. The main problem in the paper lies in the calculation

of the variance in Ra, and dependence on Rs. To explain the issue I'll define some values: RH = measured heterotrophic respiration in 50 cm collar RH' = not-measured heterotrophic respiration in 7 cm collar RA = not-measured autotrophic respiration in 7 cm collar RS = RH' + RA (measured) Ra = estimated autotrophic respiration = RS – RH Ra is thus RA plus the difference RH'-RH. If RH is higher than RH', Ra will be lower than RA and vice-versa. Ra thus includes the variance associated with RA plus the variance associated with RH-RH', i.e. the small scale variability of heterotrophic respiration. Not only does Ra have an added variability, but this variability is not independent of RS: both Ra and RS are modified by (RH'-RH). To give an extreme example, if RA had 0 variance and only RH and RH' showed small-scale (not large-scale) variability then Ra and not RH would still correlate best with RS. Thus a correlation analysis is not valid if the small scale variability if RH is significant(which is likely the case). A more correct analysis could be done by using a 3rd independent collar to measure RS and determine the small scale relation between RS with Ra and RS with RH. The added variability on Ra compared to RA, however, would still exist. Determining the small scale variability if RH with independent collars would also be useful.

In section 3.3: - When relating the variance or CV of fluxes it is valid to look at the temporal, or seasonal contribution of Ra to Rs, because the mean of RH-RH' for each day should be 0. However, the spatial relations are influenced by this unknown variable, as described above.

In section 3.4: - Spatial gradients in RH'-RH, influencing the variance in Ra, may produce spatial autocorrelations in Ra. i.e. in areas with smaller variance in RH, Ra will vary less and will seem to be spatially correlated. - The average spacing in the study (4.61 m) is too large to detect autocorrelations at smaller scales where they may be expected reflecting root patterns. - The ranges of correlations given of up to 20 m are likely a result of soil and terrain differences proper to the site. But this is not explained. A generalization of the results to other sites is thus not possible. In section 4 Conclusions: as a consequence of the above, several conclusions are not valid, including: -

The high spatial variability in Ra - Attributing the variability of Ra to root development (this was not measured) - Spatial correlations and dependence of Rs on Ra

Conclusions: Although the quality of the work is good in some respects, the issues above as well as the limited use of many the conclusions are a problem. In addition I believe the study should avoid over-interpreting results or generalizing from this specific case. I believe the manuscript needs a major revision and simplification to show the most clear and robust results and conclusions. Most important is to consider the problem of non-independent measurements and added variance in estimations of Ra.

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