**Biogeosciences
Discussions**

Interactive comment on "Distinct patterns in the diurnal and seasonal variability in four components of soil respiration in a temperate forest under free-air CO$_2$ enrichment" *by* L. Taneva and M. A. Gonzalez-Meler

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We appreciate the comments from referee#1 and for the opportunity to clarify some methodological aspects raised in his/her review. We will modify the manuscript to improve the methodological descriptions of isotope methods to minimize potential confusion. Specific comments follow:

"A prerequisite for such a partitioning is that the isotopic difference between end-members is relatively large. However, in the present paper differences in 13C signa-

tures is applied to separate soil respiration into four different sources, root/rhizosphere respiration (RR), litter decomposition (RL), and decomposition of two pools of root-free SOM (RSOM-young & RSOM-old). A litter exclusion treatment enabled the estimation of RL to RS. However, how the contribution from the remaining three sources is possible to separate with only one isotope is not clear to me."

As mentioned in the manuscript we took advantage of a long term (>9 years) isotope labeling of an intact ecosystem to separate components of soil respiration into the 4 components. The isotope difference between root- and soil-respired CO2 was 6 per mil or larger. This allowed for the separation of root-rhizosphere respiration (signal captured by the intact root incubation) from free bulk soil respiration. Soil respiration was further partitioned by separating oxidation of SOM being formed before the experiment started (1996; pre-treatment SOM) from the oxidation of SOM after the experiment started in 1996 (post-treatment SOM). The separation between these two pools is about 12 per mil. In both cases we are confident that the isotopic difference between each of the two pools is large to reduce the shortcomings brought up by the referee. Many studies have successfully attempted the partitioning of C oxidation pools isotopically with similar or even smaller spread in values of end-members. In addition, the broad ecosystem isotopic separation among end-members in our study also offers a unique opportunity to study the temporal dynamics of the oxidation of soil C pools in forests (e.g. pulse labeling), an elusive task in most systems, where C pools with slow turnover are often not quantified. Therefore we respectfully disagree with the referee as we believe a four pool separation is both feasible and unique in this system.

"To use a 1‰ difference in a sensitivity analysis, when a 95% confidence interval for the end-members is up to 4‰ (RR in the elevated plot), is not appropriate."

We think the sensitivity analysis shown is appropriate for the study and the questions we asked. A few points may need to be clarified though. All of our analyses were done per FACE ring (our replication unit; n=3) and the results from each of the rings were averaged. There was very little spatial variation within rings in the isotopic composition

of root- and free soil- respired CO2. Isotopically, there was more variation among rings than within rings and this may be due to multiple factors including microtopography, plantation density and others (these have been noted in some of the cited papers describing the site). The 95% confidence interval for each ring in RR was less than 0.8 per mil in all accounts and not near the 4 per mil value alluded by the referee. The sensitivity analysis was done by allowing the end-member to vary by 1 per mil from the measured value to account not only for potential spatial variability (small) but also to consider temporal variability in the isotopic composition of respired CO2 from these sources.

"I suggest the authors to make a complete rethinking of the model, the data treatment and the whole manuscript. Estimate the contribution from RL simply by calculating the difference in respiration rates between plots with and without litter. The respiration from old and young C can also be estimated from these two plots. Unfortunately, a further separation of the C sources is not possible with the data available."

In addition to measure RL as suggested by the referee we also measured RL using the isotopic partitioning models depicted in the manuscript and as a residual. All methods agreed on the estimation of RL validating the isotope partitioning model. We will make sure this is explicitly stated in a revised version of the manuscript.

"However, there might be some problems with this approach also. The assumption that there is no effect on stomatal conductance of the CO2-treatment is possibly wrong. The general view is that the effect of [CO2] is smaller in conifers than in some broadleaved (see Medlyn et al., 2001 New Phytologist 149: 247–264). But the effect on conifers is not always zero. "

We think this ours is a very safe statement as it is based on empirical data from the site and not assumed. Fortunately, photosynthetic responses of this ecosystem to elevated CO2 have been measured continuously and has shown that increases in CO2 from 380 to 560 ppm does not result in changes in ci/ca (e.g. Ellsworth, 1999; 2000; Maier

et al., 2008). A recent modeling study using linear and non-linear models and data from this site has also shown that ci/ca is fairly stable and that ca should increase 3-4 times over ambient levels to begin to affect ci-to-ca ratios on these pines under FACE conditions.

"In addition, there is a rather substantial understorey of broad leaved trees in the FACE plots at Duke, and the contribution to soil respiration from these may be of significance."

Pine productivity represents >90% of the overall productivity of this forest systems driving many of the variables affecting the rate of oxidation of soil C pools. Many studies from the site have corroborated the overwhelming influence of pines on belowground processes such as root dynamics and respiration (Hamilton et al., 2001; Matamala et al., 2003; Drake et al., 2011), or SOM dynamics (Bernhardt et al., 2006; Taneva et al., 2006; Jackson et al., 2009; Lichter et al., 2007). While the productivity of the understory is important and needs to be considered when closing C budgets we are fairly confident that the major drivers of belowground processes are accounted for in our analyses.

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