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Interactive comment on "Biological and physical influences on soil $^{14}CO_2$ seasonal dynamics in a temperate hardwood forest" *by* C. L. Phillips et al.

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Response to Reviewers

We appreciate the careful consideration the reviewers gave and their overall positive response. We incorporated all their suggestions, as described below.

Referee #1

Major Comments

1. The reviewer states: "[At] 10723L6 I don't understand why the 14C content of SOM is declining with depth due to decomposition. Are the authors implying that 14C is

preferentially decomposed? Maybe limit this statement to '[. . .] deplete in 14C due to radioactive decay, [. . .]'

We mean to state that SOM declines with depth because of the slowing rate of decomposition, i.e. deep soil is older. We have edited the statement accordingly.

2. With respect to variable expressions for ïĄĎ14CO2, the referee is absolutely right. We experimented with trying to express 14C in the simplest way possible, but the delta is important for clarity. We have edited all instances of 14CO2 to ïĄĎ14CO2.

3. Missing Data. The reviewer asked what the uncertainty is associated with using data from the next deeper well to gap-fill missing data from the shallowest well on two sampling dates. We compared the two approaches for days when both measurements were available (N=28) and found the gap-filling approach caused a small positive bias in estimated surface flux (mean difference =2.5, sd = 7.3, range = -15.0 to 15.0). We have added this information to the methods, and also added to the results the point that this gap-filling procedure may contribute to apparent seasonal variability in the 14C content of heterotrophic respiration.

4. Root incubations. Both reviewers commented that changes in the age of CO2 respired by roots could also contribute to the observed decline in 14C content in soil respiration through time, and that our study is limited by the fact that root respiration was measured at only one time point. Indeed, newly published results by Hopkins et al. since our original submission show a decline in 14C content of root respiration through the growing season. We have incorporated this information into the discussion.

We also revisited the Shuur and Trumbore 2006 paper and confirmed that they measured root respiration only one time (their second time point in Fig.1 from that paper is an estimated value. Also, the difference between the two points is about 10‰ which is small relative to conventional AMS errors of $\pm$5‰. Based on a pulse-labeling study in a temperate deciduous forest, Gaudinski et al (2009) concluded that "the effect of stored reserves on estimated ages of fine roots is unlikely to be large in most natural

abundance isotope studies". They also estimated a mean age of new root tissue of ∼ 0.4 years. Based on their findings, we had expected the range in 14C content of root respiration to be small relative to the range in microbial respiration. We have revised the conclusion to include roots as an additional source of variation in soil respiration 14C.

5. Partitioning recommendation. We created a new bullet point in 4.3 to explain in more detail the recommendation that early season soil respiration and atmospheric CO2 be employed as end-points for partitioning soil respiration isotopically into new and old carbon sources. We also included the findings from Hopkins et al. (2013) in this discussion.

6. Recommendations for capturing seasonal variability: We have revised and augmented this recommendation as suggested by the reviewer.

Minor comments 7. Regarding spaces before % and per mille symbols: the publisher should note that these spaces were added during the formatting process and do not exist in the submitted materials

8. 10722L The comma has been removed.

9. 10723L. "Radiocarbon" was replaced with 14C.

10. 10723L8. The publisher should note that this error does not occur in the originally submitted materials.

11. 10725L25. Author names have been added to species scientific names.

12. Mil is a common designation for plastic thickness in the U.S. (1 mil = 0.001 inch). It has been converted to mm thick.

13. 10728. Yes, above ground level. Change has been made.

14. 10733L15 Rtot has now been defined, and is used consistently in Figs. 3 and 6

15. 10736L2, clarified microbial respiration as CO2 from the trenched plot

16. 10737L21. Production of CO2 at depth is calculated in Eq.8 and is used in the denominator of Eq.9, so we have edited to Eqs. 8 and 9.

17. 110742L14, Edited "OM" abbreviation to organic matter

18. Table 1 Again, these spaces were added by the publisher. Other suggestions for the table have been incorporated.

19. Figure 1. We do think the sampling layout is sufficiently complex to warrant a schematic drawing, and defer to the editor to make the final call on this. We agree with the referee that it is important to have the same characters represent the soil plots in all the figures and have redrawn them accordingly.

20. Figure 5. We have added the panel letters a-c, and have redrawn the figures as suggested to show the average values for plots 1-3 vs plot 4.

21. Figure 6. We have relabeled the legend in figure 3 to Rtot and Rh, rather than Rs, to show that Rtot (surface flux from the intact plots) and Rh (surface flux from the trenched plot) are the same in Fig 3 and Fig 6.

22. Figure 10. We relabeled the y-axis to include the unit (cm).

Referee #2

1. We agree with the reviewer's comment that the lack of vertical trends in ïĄĎ14C of production suggests that most CO2 in this layer is root derived, and have added that statement in 3.3

2. We thank the reviewer for the useful citation (Ewing et al 2006) regarding release of old CO2 when ped structure is broken up. This citation makes a useful contribution to a discussion of the low 14CO2 observations, and has been referenced in 3.4. We must clarify, however, that we found only similar production gradients, not necessarily similar production rates in absolute terms. We did not try to compute the field and

lab respiration rates in common units because of the very different lengths of time, dimensions, and environmental conditions under which they were measured.

3. We added a discussion of root respiration (as described above).

4. We have added the missing reference for the Marin-Spiotta article.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/10/C5683/2013/bgd-10-C5683-2013-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 10, 10721, 2013.