Biogeosciences Discuss.,
doi:10.5194/bg-2016-11-RC1, 2016

Biogeosciences Discussions

Interactive comment on "Which are important soil parameters influencing the spatial heterogeneity of ^{14}C in soil organic matter?" *by* S. John et al.

Anonymous Referee #1

Received and published: 8 March 2016

Review of MS Which are important soil parameters influencing the spatial heterogeneity of 14C in soil organic matter? by John et al.

The authors analyzed the 14C content of organic carbon in bulk soil and soil fractions at different distances from a beech tree. They discuss possible driving factors for the measured variability. This is an interesting and relevant topic, and the presented data deserve publication. However,

1) The study is rather descriptive and misses a sound statistical analysis. The approach makes it difficult to identify driving factors for 14C variability because many explanatory variables are cross-related. For example, soil depth, pMC, root biomass and silt/clay content correlate significantly with each other, hence, assignment of unique factors to pMC variability is hampered. Authors should consider using a general linear model for

their analysis.

2) It is not clear why authors explicitly excluded A-horizons from their study.

3) Without any estimate of C input from aboveground and belowground litter, i.e., without adding a dynamic component to the study, the explanation of 14C distributions remains vague.

Further, grammar and syntax are partially poor and I recommend copy-editing of the text.

Detailed comments

Title: The title should reflect that only one single gradient at different distances from a beech tree was studied. Hence, at least the word 'forest' should appear in the title.

Line 38. Why does sentence begin with 'however'?

Line 58. The description of parameters influencing the soil's 14C content is not well structured. The 14SOC content is in principal determined by i) input rates, ii) turnover or loss rates, iii) radioactive decay, and iv) changes in atmospheric 14CO2, i.e., changes in 14C of the input material over time. Soil or vegetation or climate properties modulate some of these principal factors. Authors are requested to put their list of factors into a logical order following these drivers.

Line 64.Is heterogeneity of SOM age meant?

Line 65 and later. Input from roots is called root litter, from living roots rhizodeposition. This is not in contrast to being 'fresh'.

Line 72 .There are studies on spatial variability of 14C in soils, e.g. Leifeld and Mayer (2015), Budge et al. (2011); Schoning et al. (2013). Results in these publications revealed also different patterns as compared to the current study.

Line 75-82. Again, the argumentation is not stringent. All listed factors just reflect a

change in SOM turnover rates, albeit caused by different mechanisms.

Line 84 and elsewhere. Authors are requested to explain what 'apparent 14C age' and, later 'apparent MRT' refers to.

Line 99. I suggest adding 'of a forest soil' behind 'subsoils'.

Line 183 ff. It is not clear why soils were treated with 0.5 % HCl before AMS. This removes part of SOM of a particular but unknown signature. If amount and signature of the dissolved C is not the same for all samples, the resulting 14Csample may lead to biased conclusions.

Line 336. Strictly spoken, the root biomass does not tell very much about the input from roots because root turnover and rhizodeposition may change with depth. Also the correlation between % SOC and root biomass must not be conclusive. Higher SOC in topsoils is, at least partially, resulting from aboveground litter input, and this explains much of the typically found difference in the mass-depth slope between depth and % SOC on the one hand and depth and root biomass on the other (see e.g. Jackson et al. (1996); Jobbagy and Jackson (2000).

Line 354. This conclusion is difficult to draw without consideration of carbon input rates. Chapter 4.2. I think the attempt to explain 14C by microbial biomass parameters is highly misleading. The measured microbial biomass reflects the current situation and its turnover time is in the range of months whereas 14SOC integrates processes that took place over centuries and millennia. The authors implicitly assume that the Cmik distribution in their profiles is representative for much longer timescales, which they do not know.

Line 366. Authors may also consider that DOC ages during its journey through the soil column; this may increase its 14C age substantially.

Line 385. Sentence unclear.

Line 437-444. I would argue that, in addition, the smaller topsoil variability in 14C

reflects the important role of aboveground litter inputs, which may be similar among the three sites.

Line 456. This is in some contradiction to line 383.

Line 461. OC input has not been estimated in this study, which is a major shortcoming. Hence, authors should not refer to input as a driving force for 14SOC unless they do a proper input estimate.

References

Budge, K., Leifeld, J., Hiltbrunner, E., and Fuhrer, J. (2011). Alpine grassland soils contain large proportion of labile carbon but indicate long turnover times. Biogeosciences 8, 1911-1923.

Jackson, R. B., Canadell, J., Ehleringer, J. R., Mooney, H. A., Sala, O. E., and Schulze, E. D. (1996). A Global Analysis of Root Distributions for Terrestrial Biomes. Oecologia 108, 389-411.

Jobbagy, E. G., and Jackson, R. B. (2000). The Vertical Distribution of Soil Organic Carbon and Its Relation to Climate and Vegetation. Ecological Applications 10, 423-436.

Leifeld, J., and Mayer, J. (2015). 14C in cropland soil of a long-term field trial – experimental variability and implications for estimating carbon turnover. SOIL 1, 537-542.

Schoning, I., Gruneberg, E., Sierra, C. A., Hessenmoller, D., Schrumpf, M., Weisser, W. W., and Schulze, E. D. (2013). Causes of variation in mineral soil C content and turnover in differently managed beech dominated forests. Plant and Soil 370, 625-639.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-11, 2016.