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Discussions

EGU

Interactive comment on "Dynamics of deep soil carbon – insights from ^{14}C time-series across a climatic gradient" *by* Tessa Sophia van der Voort et al.

Anonymous Referee #2

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This study aims at investigating the dynamics of carbon as a function of soil depth in five sites of the Swiss Alps. To reach this goal the authors realised 14C measurements on samples collected in late 90's and in 2014. Soils were sampled at different depths and a water extractable fraction was extracted. The authors derived C turnover rates from 14C data using a two-pool model. They identify a substantial fraction of fast-cycling C at depth and further investigate potential edaphic and climatic drivers of turnover.

The data gathered in this study are of great interest, but at this stage, the manuscript suffers from too severe limitations to be published.

In particular, the authors should decide what is precisely their objective: do they want

to provide insights on deep C cycling or to offer a new method to compute turn-over time using 14C data? I would suspect the readers of Biogeosciences to be really interested in the first option, as there are only a limited number of studies on this topic (as claimed in l 276 of the discussion). Nevertheless, the data on C turn-over along the soil profile are mainly presented as supplementary, while there is a strong focus on methodological aspects in the main text.

The discussion should also be improved. Too many repetitions of the results in 4.1.1 and 4.1.2; 4.1.3 repeats some facts of 4.1.2. 4.2: I could not find clear information in the materials and methods section about how the data supporting this section were collected. The introduction/rational should refer to the needs of information on petrogenic C. 4.3: you could condense your message as you expose the same arguments for bulk C and WEOC.

Some references to recent publications on deep C dynamics are lacking (i.e. He et al., 2016; Mathieu et al 2016; Balesdent et al 2018) while they could improve the discussion.

I finally encourage the authors to carefully examine the relevance - and the quality - of their illustrations (see some comments below). A better focus of both the text and illustrations would guarantee a better understanding of the message the authors could deliver from the very exceptional dataset they collected.

Some additional comments

Could you indicate what is "Rsample,t" in Eq 1 and 2. The model is based on the assumption that k1 is the turn-over of the WEOC pool. However, how do you justify that m1 is not the size of the WEOC pool (please provide the C content of the WEOC in your MS). ?

Clarify what do you mean by deep, and provide numerical value when you refer to depth in the text – currently you sometimes use it indifferently to refer to 30 cm or 80

cm, while the data strongly differ between both depths.

Some Figures and Tables are offered to the readers while they are not utilised in the text: remove them (one example is Fig 3 - PS the information on the back curve is missing in the legend)

I do not understand Figure 2. How do you compute turn-over time using one individual time point?

I suggest to remove Figure 5 as it is not precise – keep it for oral presentations - (what is vulnerable C?) and to provide Tables with exact numerical data in the main text.

Please provide the C content in for the samples measured for 14C. (Table 3 only show 3 different depths, while the data is available according to Fig 5)

You provide twice the particle size distribution (Tab 2 and 3).

Some of your interpretations rely on soil waterlogging while this information is not clearly available (when you first mention waterlogged soil line224, the reader has not idea of which sites are concerned). In addition, I would not conclude that waterlogging is a driver of turnover by looking at the non-averaged values in Table S5.

Why are the radiocarbon signatures of WEOC different between waterlogged and non-waterlogged soils in 3.1, while calculated turnover rates are not?

Change your title: your gradient is not only a climatic one but a geologic one as well, with strong implication on C cycling.

Figure 6: the colour code is not the same than in other figures.

I do not understand Table S1: how do you compute single resolved 14C data?

Fig S2: what stands at -20cm depth?

Table S5: figures are not aligned in the table what makes the reading a bit tricky. The caption is not in the same order than the columns. The title of the 5th column is not

clear (=> proportion of labile pool would be better)