SOIL Discuss., referee comment RC2
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Comment on soil-2021-84

Anonymous Referee #2

Referee comment on "Prediction of the vertical scaling of soil organic carbon in temperate forest soils using percolation theory" by Fang Yu et al., SOIL Discuss., https://doi.org/10.5194/soil-2021-84-RC2, 2022

GENERAL COMMENTS

The manuscript deals with an important topic to highlight the role of soil in the global C budget. As a matter of fact, the soil organic carbon (SOC) in forest ecosystems could suppose 704 Pg C, up to the 43% of the total SOC stock, which is considered the largest pool of the terrestrial C (Lal, 2005). The mathematical background It's suitable and well explained, the results are properly presented and consistent with the hypothesis and the conclusions.

However, my main concern is related with the true scientific scope of this work. Beyond the metadata, the dataset for an original research paper is rather poor (60 composite samples with only a standard analytical routinely procedure –potassium dichromate oxidation-). In my opinion, it would be much more relevant to advance the knowledge of the distribution at depths > 1 meter, since there are evidences this could represent a significant additional stock and it's poor described in forests. Did the authors consider take samples deeper in the soil? Moreover, I have some troubles with the hypothesis put forward by the authors of the leaching of C as the main driver of C vertical pattern (see specific comments).

SPECIFIC COMMENTS

Introduction

L48: "coarse"

L49: Please enter the citation of "Trumbore et al., 2006" in references.

L50: As far as I read, neither Gill nor Joslin study the total SOC in the subsurface layer of soil.

L53-57: I'm not as optimistic as the authors about the vital importance of C leaching as a potential driver for the redistribution of C in the soil. For example, Jobbagy and Jackson (2000, p. 433) consider the decrease of SOC turnover with depth a much more plausible explanation (in fact, they find an inverse trend between precipitation and SOC depth). I would recommend that the authors consider other possible explanations in the manuscript (see also comment to L221 – 224).

Material and Methods:

L81: Doesn't the percolation theory also depend on soil texture? The physical process of water infiltration is highly dependent on it (*eg.* hydraulic saturated conductivity).

L82. The study of Sheppard et al. does not seem refer to the transport of SOC in temperate forest. Please, modify the sentence or move the reference elsewhere.

Table 2: Please, indicate here the soil type (WRD or Soil Survey Staff classifications). This could be interesting to understand the vertical distribution of SOC.

Table 2: Are these temperature the annual average temperatures? I find these (< 5ºC) too much low for a broad-leaved deciduous forest. Please, indicate the Koppen climate classification.

L122: Why was the C horizon not sampled?

Results

Figure 1b: I think the point "TS-P1" is really CS-P1.

L163 – 169 and Figure 2: The effect of comparing a 12% slope (CS-P) vs. 17% (LX-P2)

does not seem very convincing… In my opinion, it is very difficult to assess the relative influence of both factors (slope and precipitation) on the SOC.

Table 4: It would be useful to show the mean SOC value for the first meter.

L195: "temperate"

Discussion and conclusions

L221 – 224. It is true that the empirical data fit well as predicted by the percolation theory. However, I'm not clear about the relationship between this theory (beyond its name, it is a statistical theory that can be applied to many non-hydraulic phenomena, as traffic jams!) and the soil infiltration process. Could it not be also explained by other "power-law" soil processes such as roots decomposition rate or microbial activity? (see, eg., the vertical distribution of Soil Microbial Biomass Carbon showed by Sun et al., 2020). In my opinion, it would be needed to provide some additional evidence linking percolation theory with the physical process of water infiltration in soils.

Cited reference:

Lal, R., 2005. Forest soils and carbon sequestration. Forest Ecology and Management 220, 242 – 258.

Sun, T., Wang, Y., Hui, D., Jing, X., Feng, W., 2020. Soil properties rather than climate and ecosystem type control the vertical variations of soil organic carbon, microbial carbon, and microbial quotient. Soil Biology and Biogeochemistry 148, 107905.