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Reply on RC1

Fang Yu et al.

Author 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-AC1, 2022

Dear reviewer,

Thanks for the comments. In response, we will make several changes according to the suggestions and criticisms□Our point-by-point response to the reviewers' comments is given below. In most points we agree with the reviewer but not for all. Our point to point responds are in italic type.

1) The vertical distribution of soil organic carbon (SOC) in forest ecosystems has two meanings: one is vertical distribution along elevation and the other is vertical distribution in a profile. In order to avoid ambiguity, I suggested that the author emphasize vertical distribution on profile in the title and article (L1, 8...)

This will be addressesd.

2) L26-32 talks about the influence of vertical factors on soil organic carbon. Vertical factors here refer to the influence of altitude rather than the vertical depth of the profile studied in this paper. Should be deleted!

We are confused here, since L26-32 didn't mention any point relating to the influence of altitude...

3) L76-80 mentioned that the vertical transport of SOC is mainly in the form of DOC leaching, so why not take DOC as the research index in this paper?

The main hypothesis of the study is that the vertical transport of the percolating water (mainly in the form of DOC) redistributes SOC. DOC could be transformed in other forms and such as taken up by microbes, which we don't think is a stable and good indicator.

4) The full names of the six stand types of L100 should appear before giving abbreviations.

This will be addressed.

5) L115 there were only two replicates for each forest at the standard standscale, which was not enough for field experiments.

There were 3 replicates for each subsite. Here P1 and P2 are two subsites locating in one forest but with different sampling slopes. We should've mentioned the number of replicates here. We apologize for the confusion.

6) L124-125 soil samples were only screened through 10 mesh (1.7mm), while the standard method for determining SOC needed soils been through 100 mesh (0.15mm).

This is a typo, it was screened through 100 mesh. We apologize for the careless.

7) L130-137 This paper only selected the data of 5 published articles for fitting analysis, which could not constitute a reasonable meta-analysis.

One of the dataset referenced from Jobbágy and Jackson (2000) are averaged values from 3 global databases of soil profile in temperate forest soils (National Soil Characterization Database produced by the U.S. Department of Agriculture, World Inventory of Soil Emission Potential Database, and the Canadian Forest Service) which cover 60 samples for the temperate deciduous forest, and 123 for the temperate evergreen forest across the world.

8) L207-212 Here, spatial variability, environmental factors and other unrelated topics are discussed.

The purpose of this paragraph is to demonstrate that the surface SOC strongly correlates to environmental factors in our sampling sites, and that the vertical distribution of SOC on profile is constrained by the transport of water and it is decoupled with the environmental factors. But we do agree with the reviewer, this paragraph can be shortened into 1-2 sentences.

9) L215-216 There is no need to emphasis the dominant species in stands.

This will be addressed.

10) The goodness of fit of curves in the results of L219-220 is not high, and the tolerance range in Table 3 is very wide, so almost indicators of the forest soils reduced along the profile depth can appear this curve, such as fine root biomass and microbial biomass, which are not distributed according to the principle of percolation theory. Therefore, the method of this paper is not appropriate.

The results mentioned in L219-230 covers results from different regions of the world, including 3 global dataset with 60 samples from the temperate deciduous forest, and 123 from the temperate evergreen forest, and 3 sites in China and 1 in Germany. The deviations are 20%, 4.5%, 4%, 7.6% and 9.7%. There is no range mentioned in Table 3.We think what the reviewer meant here is the range in Figure 3. L174-179 explained how we determined the boundary. And Figure 5 demonstrates the agreement of prediction and the averaged values from Figure 3 in each layer of soil. There are many indicators in forest soils that accumulate more in the surface and show curving trend as soil goes deeper, but the exponents of the curving can be various. However, here we demonstrate that the exponent of the SOC trend agrees with the proposed value from percolation theory, which is -1.149.

11) 226-227 The shallow soil was more disturbed by the external environment, while the SOC in the deep soil was mainly from the roots. The influence range of litter was generally considered to be in the Leaching - deposition (B) layer. The deeper soil has more adsorption sites, so the vertical transport of DOC in the soil is also affected by soil adsorption.

We agree with the reviewer's point. The hypothesis of the study is that the downword movement of water, with DOC as the solute, redistributes SOC on soil profile. root is a source of carbon input, there are studies show that the SOC profile is deeper than root profile, and that the downward transport of DOC along the soil profile is the potential driver of the redistribution of carbon in the soil. Previous studies have shown that percolation theory can describe the chemical weathering rate becasue the reaction rate is limited by solute transport , which means that reaction is in equilibrium along the track, and the reaction rate is porpotional to solute velocity. Similar to chemical weathering, adsorption and desorption can be limited by solute transport as well if the solute travels too slow. However, here the reviewer pointed a good point which we should dig deeper to see the adsorption and desorption has the same situation as chemical weathering in the subsurface.