

Biogeosciences Discuss., author comment AC1
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Reply on RC1

Evgeny A. Zarov et al.

Author comment on "Vertical movement of dissolved organic carbon and carbon accumulation in West Siberian peatlands" by Evgeny A. Zarov et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-211-AC1>, 2021

Major comments:

1. First of all, English language of this paper is inappropriate for scientific publishing and especially in Biogeosciences. Paper should be completely revised to improve grammar and use of terminology.

The manuscript text was completely proofread by the native speaker experienced working with science texts.

The mentioned example has been corrected as well:

(Kraev et al., 2017) showed a possible path of methane displacement to deeper soil horizons due to the freezing of thick strata of epigenetic permafrost. The same mechanism potentially might be found for peatlands since high peat porosity is favorable for vertical water movement.

2. Figures and graphics in the paper must be sufficiently improved. Scales should be added in Figure 1. Figure 2 is a main result of this paper but it is very small, it is hard to read data from it. Cap should be much more informative, I suggest to place lines and dots description in the cap, add letters denoting what ecosystem type is presented by corresponding peat core.

The scale bars were added to the figure 1 (see attachment).

The figure 2 was changed to increase readability and clearness (peat stratigraphy changed to the shades, font and mark sizes increased)

3. Did you compare DOC concentration in a water sample after the extraction with in situ concentration of DOC in wetland pore water? Can extraction provide artificial fractionation? My concern is how we can extrapolate results of this paper to a real nature. Since you have any assumptions they should be stated explicitly and their applicability should be assessed somehow.

No, we did not. All samples was frozen and sent to the Max-Planck-Institut lab. The DOC fraction was obtained by centrifuging the sample at 2900 G for 30 minutes. Thus, the force to release the DOC from its matrix was larger than gravity under natural conditions.

We organize a field session (winter 2022) to collect number of peat cores to define the DOC concentration (summer 2022) along entire peat depth. Then we will be able to compare the DOC concentrations obtained by different ways, such as centrifuging, suction sampler and diffusive equilibration peeper. These results are planned to be published as a new article.

4. I think it is not correct to designate velocity calculated via equation 4 as a DOC vertical movement velocity. To calculate real DOC transport one needs to consider DOC diffusion, production and consumption rates in a peat profile. Via equation 4 effective (observed) vertical movement velocity is calculated and all mentioned mass balance terms for DOC are integrated in this velocity. This velocity does not correspond to the real process of DOC vertical migration, it explains only resulting value for all DOC-related processes.

We are fully agree with your comment. The v -value in the equation 4 was renamed to "apparent rate of DOC movement". It shows how fast the horizontal layer of DOC moves down over observed period regardless the physical processes beyond that, such as sorption/desorption, dissolution/sedimentation, microorganism consumption, changes in substrate porosity.

Thus it is not correct to compare your results with values from (Charman et al., 1999).

We mentioned (line 359) that Charman used a vertical hydraulic conductivity to estimate the DOC vertical movement. Nevertheless, we compared our results (obtained by DOC/POC ages discrepancy) to emphasize differences between these two approaches and that hydrology itself cannot explain the DOC downward movement.

5. Main focus of the paper is not clear for reader. In introduction section you state hypothesis on DOC-POC age differences. But most of the paper and discussion section is about peat history and stratigraphy. Paper title, Introduction and Results-Discussion should be consistent with each other. Please, declare that you have several certain goals and show their scientific importance in the Introduction. And consider them correspondingly in sections below.

The manuscript text has been significantly changed and restructured. Statements about peat stratigraphy and DOC/POC ages are added to the aim. Sections are consistent to each other.

Minor comments:

I 28 West Siberia is not a wetland, please fix this sentence. Also 50-70% sounds too much, wetland area estimated by Terentieva et al. 2016 is much less (about 30%).

The line was changed: West Siberia is the world's largest wetland where peatlands cover ~22 % (Sheng et al., 2004) of the entire area with the waterlogging of some local subregions to 50–75 % (Peregon, 2008).

I 108 Terms mesotrophic and oligotrophic are not international. Can you use terms "ombrotrophic" and "minerotrophic" instead? Otherwise these terms need definitions.

All terms were changed to the suggested.

I 126 In summer 2016 – what was an interval between sampling and AMS analysis? Can it alter results and what was done to avoid this bias?

The samples were extracted and immediately frozen in summer 2016, sent to the Max-Planck-Institute's lab (summer 2016) and stored there in frozen conditions until analysis (January 2018). Hence, we do not expect to see any bias occurred during the sample processing.

I 143 key samples data bank – what data bank, does it available somehow?

No, this is unpublished data bank. This sentence is added to the manuscript text.

I 164 I don't understand why both LOI and CC are used in this formula. As you said CC is determined in a dried sample and NOT in the ash. Please give any reference for this formula.

The next sentence added to the text:

This equation is used in correspond to the (Turunen et al., 2002) with adding LOI as a correction to convert the CAR to the ash-free organic matter values. In case of low ash content (i.e. LOI close to 1) this correction has almost no effect; but in case of high ash content (i.e. LOI is 0.5-0.7) it causes reducing of the CAR due to the fact that carbon is

accumulated only in organic matter but not in the mineral part.

Turunen, J., Tomppo, E., Tolonen, K., & Reinikainen, A. Estimating carbon accumulation rates of undrained mires in Finland—application to boreal and subarctic regions. *The Holocene*, 12(1), 69-80, 2002. <https://doi.org/10.1191/0959683602hl522rp>

I 173 How did you calculate cumulative CAR?

The next sentence added to the text:

CAR_{cumulative} has been calculated as a sum of CAR along a peat profile from the top to bottom.

I 175 This is a main equation for your paper. Is it presented for the first time? Where does it come from? References and details must be added here.

This equation is just a relation between the passed distance to the time of its movement. The next sentences added to the text:

The physical meaning of the equation 4 is how fast the horizontal layer of DOC moves down over observed period regardless the physical processes beyond that, such as sorption/desorption, dissolution/sedimentation, microorganism consumption, changes in substrate porosity.

I 176 You did not use d_{doc_i} in your equation but mention it in the description of terms, please fix it.

Changed.

I 349 What does it mean – "complete saturation of pore water by DOC"? Was it described somewhere that there is a complete saturation of water in DOC?

The next sentence added to the text:

Another possible reason is the complete saturation of pore water by DOC (i.e. the highest possible concentration in given conditions), whereby concentration systematically increases with depth and may prevent further active penetration.

I 375 References are needed.

Ref is added to the text.

I 394 Gas 14 C values – what does it mean, what gas?

The next sentence added to the text:

The mechanism of DOC downward movement is described in (Aravena et al., 1993; Charman et al., 1993, 1994, 1999; Chanton et al., 1995) showing that the gas (carbon dioxide and methane) ¹⁴C ages are significantly younger in DOC than the particulate peat.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2021-211/bg-2021-211-AC1-supplement.zip>