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Interactive comment on “Quantification of DOC concentrations in relation with soil properties of soils in tundra and taiga of Northern European Russia” by M. R. Oosterwoud et al.

Anonymous Referee #2

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General comment This paper provides data about DOC and its C composition in fractions (FA and HY), and some general properties of tundra and taiga soils distributing along a topographic sequence. Using these data, authors discussed DOC dynamics in relation to sorption processes onto sesquioxides in soil profiles and to changes in soil properties along with topography. Some discussions appear to be reasonable from the data referring previously published papers, but some are difficult to understand. Mainly authors try to explain the vertical distribution of DOC in soil profiles by sorption process of DOC to sesquioxides. However sorptive control for DOC distribution in the conclusion seems to be just speculation from DOC distribution because there was no evaluation about sorption potentials in soils and there was no clear relationship

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between DOC and sesquioxides as sorbents. Some physical data such as specific surface area, clay content and particle size distribution would be possibly supportive to explain the sorptive control for DOC but nothing was provided. pH should also be taken into account for organic matter adsorption onto sesquioxides because of variable charges on the mineral surface depending on pH. I think that results were poor for the discussion of adsorption process of DOC in these soils. Downward DOC movement along with the topography from A to E site is also explained by “the adsorptive properties of active layer soils”. However production and properties of DOC in the surface organic horizons should be different among experimental sites because of “distinctive differences in vegetation and morphology” (P3199 L21-22). This difference in vegetation could relate to organic matter properties, leading to difference in DOC production and properties. Only the adsorption process is not enough to explain the fate of DOC from soils to the stream along with topography. The relationship between DOC and EOC presented in mg/l is not clear. How did authors calculate it in Table 3? From the comparison between both parameters, authors drew one conclusion that the “80 – 90In consequences, I think that this paper, especially the discussion, should be reconstructed based on the actual data and whole contents should also be revised logically.

Specific comment Abstract L23-26 This sentence is not necessary because it seems just author’s impression.

P 3192 L1, DOC adsorption by crystallized clay minerals also occurs. . .

P 3193 L23: Rhizon samplers can collect soil solutions by suction. Was it effective in a organic horizon with dominance of gas phase?

P 3194 L13: Shaking rotation of 9 rpm is very slow being almost impossible to shaking. Is it correct?

P3194 L14: Degassing of carbonate during filtration under vacuum can raise pH? It didn’t influence pH measurement? Didn’t use subsample solution?

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P3194 L19: Was determination of total organic carbons not affected by contamination of carbonates in the deeper horizons with high pH in the E position of tundra region?

P 3194 L20 How much concentration of BaCl₂ was used for extraction of cations? P

3195 L7 To the remaining solution after treatment with DAX-8 resin. . .

P 3195 3.1 This section should be in the Materials and Methods section because of no experimental data in this description. Soils showing in Table 1 were not suitably named. Below 10 cm of the thickness of organic horizons in C and E profile in taiga and A profile of tundra soils is not fit to the histic horizon in the WRB system. The “Folic” in C, D, E profiles in tundra is also miss-matching to Cambisols. A thick peaty horizon existed only at the B plot locating not in lower region but in upper region in tundra area.

P 3197 L6-7 The sesquioxides of Al₂O₃ and Fe₂O₃ are not always much amount in the bottom horizons. Some are peaked at the middle horizon. P 3197 L10-11 Normally a B horizon contains larger content of secondary minerals as compared to the upper A horizon. However larger content of oxides in A horizon than C horizon is usual.

P 3198 L8-12 Cation bridges are proposed for the retention of DOC to minerals. Can you present any data for the proof? Decayed plant materials could largely contribute to DOC production under such hydromorphic conditions over 100 How did authors take into account such over saturated water over 100

P 3198 L22 Why “sharpest” is in comparison of two items.

P 3199 L6 Authors found the significant (?) relationship between CT and CEC. Despite of this correlation, why did authors say that “finer clay fractions contribute more to CEC without data of particle size distribution of soils? P 3199 L10-11 pH as well as weathering stages is also one of the control for base cation content. P 3199 L13-17 Can authors provide Base, Ca, Fe, and Al saturation in CEC?

P 3200 L20-21 Authors concluded that the reason why low concentration of DOC at tundra mineral soils was the adsorptive advantage of tundra soils with relatively larger

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content of the amorphous oxides despite of no significant relationship between DOC and oxide contents. Adsorptive capacity, specific surface area without covering organic matter, particle size distribution can be related to low retention of high concentration of DOC produced in the upper horizons of taiga soils. Such physical properties should be also taken into account.

P 3200 L23-24 There was a significant correlation between CT and DOC in Figure 6. It means that total C content and its quality seems to be a strong control for DOC production. Sorptive control was not dependent on sesquioxides but on total carbons. This means that DOC can in-situ produced in each horizons.

P 3201 L16-18 Is this correlation the positive linear regression? If this was the first linear regression, HY fraction occupied proportionally in DOC. It means that little change of the DOC composition with depth, giving contradiction of the discussion about HY degradation during the decomposition process.

P 3201 L20-21 Is the fact that the higher rate of HY fraction than FA in DOC just for tundra or taiga or both? Here how did FA compounds change into HY? Authors mentioned in the preceding sentence that substantial degradation of HY makes FA dominant.

P 3202 L6 Why was “the most” (the superlative) here?

P 3202 L23-24 Is this sentence the description for the stream in taiga? The area occupied by the peaty horizon (tundra B) can release low concentration of DOC. Not all histic horizons (which authors named) can contribute to high DOC output. P 3203 L4 Al and Fe in taiga didn't have negative but a positive correlation in Fig. 8.

P 3203 L12 Table 3

P 3203 L12-14 Which data can show the good relationship between DOC in soil solutions in Gleysols and in stream water?

P 3204 L10-12 and L23-25 In upper part, organic rich soils contribute to larger rate of

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FA in stream DOC, while the soil adjacent to the stream (is that E position?) seems to be responsible for DOC in the stream. Both are contradictory.

P 3205 L 7-9 EOC is also originated from soil organic carbon. Actually, EOC is correlated to CT (L23). Why did authors expect the EOC increase depending on soil depth? The rate of EOC in CT is depending on depth probably due to organic matter quality.

P 3206 L3-4 Please show calculation for conversion from mg/kg to mg/l in EOC.

P 3206 L9 Why did authors conclude high SOC turnover in taiga soils? Which data could support it?

P 3206 L26 Lower EOC in the soil nearby the stream was explained strong adsorption of EOC onto minerals. The expected EOC is actually not the EOC because the carbon was not extracted. It's just soil organic carbon strongly adsorbed onto minerals. Furthermore authors can't say degree of strength just with the data of amorphous oxide content.

P 3207 L7-9 Please clearly explains the calculation.

P 3208 4 Conclusion Most of descriptions were highly speculative. It can be revised after reevaluation the data taking into account these comments. P 3208 L7 Deeper active layer after regression of permafrost could be oxic and amorphous sesquioxides can be crystallized, leading to less adsorptive capacity. Authors also explained this in comparison between taiga and tundra mineral soils.

Table 1 Reconsider Histic and Follic horizon. Table 2 How did pH determined? With water or with neutral salt solution? Which type of description adopted for the soil survey? Fig. 1 It isn't informative to explain the soil organic matter. Fig. 7 This caption is not clear.

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