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Interactive comment on "Dissolved organic carbon (DOC) in Arctic ground ice" *by* M. Fritz et al.

Anonymous Referee #2

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Review of "Dissolved organic carbon (DOC) in Arctic ground ice" by Fritz et al.

Fritz and colleagues present the first study targeting DOC concentrations and stocks in circum-arctic ground ice, and correlate these findings with other parameters such as ion content and type of ground ice. I enjoyed reading the manuscript. It was well-written, well-organized and both the analytical and statistical methods seemed robust. Ice wedges and other ground ice play an important role in destabilization of thawing permafrost, but their relative importance in arctic carbon stocks nor their role in permafrost carbon release and carbon lability has hardly received any attention. I certainly recommend publication of this manuscript, after the (mostly minor) comments below have been incorporated/considered.

Main comments:

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Discussion Paper

1. The first of my main comment regards a combination of terminology and the overlooking of another pool of carbon in ground ice: particulate OC. As the authors describe, the Pleistocene ice wedges are yellowish-brown to grey in colour, clearly visible on the photos in Figure 2. My guess is that the ice also contains particulate matter and carbon, which is currently not assessed and neither mentioned, as the authors have not provided any information on the organic carbon that remained on the filters. I would find it very valuable if this information is included, and if not, at least that this pool is described as a component currently not addressed. Linked to this, the authors use POC to describe the OC pool in permafrost soils. In de "aquatic community", POC is often used to describe the particulate OC fraction in water. The current use of POC in the manuscript is confusing and in most permafrost literature not used like this. I suggest to use soil OC, or just OC, or soil OC (SOC) or something like this.

2. My second point concerns the availability of data. Can the data for DOC, water isotopes, ICP-OES etc. be presented in a supplementary table? Currently no individual sample info is available, and, for example, d18O and dD values are not included either.

Further comments:

p.78, L4: It's not clear what "Their" refers to.

p. 78, L19: Can something be "rapidly stored"? I suggest to rephrase into "rapidly frozen and stored".

p. 78, L22: "4172 km3" is a number with too many significant numbers given the estimates this has been calculated from. I suggest to replace with "4170" or even better "4200" (please also replace this at a few other occasions in the text).

p. 78, L22: See first, main comment: replace particulate OC with something else.

p. 79, L4: "degradation forms as thermokarst", you (also) mean alas deposits?

p. 79, L10: 100% volume? Isn't ice just ice? This is a bit confusing. Also, this paragraph lists many % numbers, some in weight, some in volume, can these be presented

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slightly more consistent?

p. 79, L13: I suggest to change "other sediments in Yedoma" with "other ice in Yedoma sediments", because this sentence is about the total ice content, right?

p. 79, L17-18: I think you can remove the definition of massive ice, it just adds to the confusion. p. 80, L24: "particulate OC", see the main comment above.

p. 80, L2: "DOC from permafrost is chemically labile", I think it would be more correct to write "DOC from yedoma sediment and yedoma ice wedges is chemically labile".

p. 80, L7: "that" should be removed.

p. 80, L25-26-27: Yes, this study measures DOC at the source, but only in ice wedges, not in the (total) permafrost. Maybe specify?

p. 81, L25: Only here you briefly define Yedoma. I think this should come a bit earlier in the manuscript.

p. 81, L16 and in many other places in the manuscript: please have a thorough look at your use of hyphens. In this sentence you correctly write "ground-ice conditions" with a hyphen between "ground" and "ice" because they together are an adjective to "conditions". At some other place (e.g. p.79, L5, 8, 14, 15, 25 and 28) you do not do this.

p. 82, L2: You use both "late glacial" but also "late Pleistocene" throughout the text. If they mean the same thing, I suggest to just stick to one of these.

p. 82, L14-15: You only included three surface water samples from thermokarst lakes. Compared to the rest of the pretty extensive dataset, I find this number a bit poor. There must be more data available in the literature.

p. 82, L18: I suggest to move "(purified water)" to directly behind "pre-cleaned".

p. 83, L10: What other standards besides VSMOW did you use for your d18O and dD

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analysis? A standard that is sufficiently depleted such as SLAP should be included to be able to calibrate the ice wedge stable isotope composition that could reach values of e.g. -260 for dD.

p. 85, L13-14-15: This sentence is superfluous I think because it overlaps mostly with L3-4. Maybe expand L3-4 instead?

p. 86, L22: Maybe write "climate conditions of formation"?

p. 86, L22-25: This is interesting I think. Can you elaborate a bit on the reasons why you see this pattern?

p. 87, L4-5: Is there a simple way to explain what these percentages mean?

p. 87, L16: I think you should here instead of the McGuire paper refer to Holmes et al. 2012, which gives an updated estimate of pan-arctic DOC of 34 Tg/year (Holmes, R. M. et al. Seasonal and Annual Fluxes of Nutrients and Organic Matter from Large Rivers to the Arctic Ocean and Surrounding Seas. Estuaries and Coasts 35, 369-382, doi:10.1007/s12237-011-9386-6 (2012))

p. 88, L13: You've used WIV before, so I suggest to replace "wedge ice volumes" here with "WIV" to avoid confusion with volume of ice in square kilometers.

p. 88, L27-28: I suppose it makes sense that non-massive ice in soils is more DOC-rich, but it would not harm giving a brief explanation here why you think this is the case.

p. 89, L5-9: What is this calculation based upon? I suggest to clarify this or leave it out. Also, I do not understand the last sentence here.

p.89, L12: replace "on" with "in"

p. 89, L15: the term "mineralization" is a bit confusing as this word is also used as "degradation" sometimes. Maybe use "ion content" or "conductivity" or so instead?

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p. 89, L26: Only here you explain how ice wedges are formed. Would it be more appropriate to explain this earlier in the text? You only mention they are formed syngenetically but don't say anything more.

p. 90, L21-23: Is the sentence "Marine ion .... into coastal ones" really needed? I feel it mostly holds information that has already been stated elsewhere in this paragraph.

p. 91, L19-20 and before: I agree with the last sentence of this paragraph but I do not follow how this statement follows from the above sentences. I find it a bit confusing, and the point you are trying to make unclear. First of all, you say both ice wedge DOC and DOC in runoff of later and rivers are both biolabile (right?) but in between these two things you use "In contrast" (L17). Also, the sentence "One destination of the fresh, young and therefore most bioavailable ...". You mean the destination of vegetation debris before ending up in the ice wedge OC? And (L13): I think concentrations of DOC are also lower because all the vegetation debris and surface soils have already been actively flushed out by the spring flood when discharge and therefore, then, also DOC is high. All in all, I propose to reconsider the arguments that you use to arrive at the final sentence of this paragraph "The highlights ... of bioavailable DOC".

p. 91, L22: replace "particulate fraction" by something else.

p. 92, L21: "while" sounds strange, maybe use "with" or "during"?

p. 92, L22: "On the other hand" sounds incorrect here as this sentence adds up to the argument made by the previous sentence. Suggest to replace with "Also".

p. 92, L24: What are "forbs"?

p. 94, L1: Please replace "mineralization" with something else.

p. 94, bulletpoints: Just an idea, is it possible to arrange these conclusions parallel to the bulletpoints you list in the introduction? A parallel construction of objectives & conclusions would benefit the reader.

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p.94, L16: round up "4172 km3" to "4170" or "4200".

p. 95, L1-2: Maybe rephrase into " we propose that future studies shall strive to".

p. 95, bulletpoints: I think some of these points do not follow from the analyses/conclusions in this paper, and/or I find the points that are made a bit unclear. For example, why should DOC from coastal erosion be better quantified?

p. 95, L8: "what remains POC and what is going to become DOC", maybe just write "what fraction of soil OC will be leached as DOC".

Figure 3: capitalize holocene.

Interactive comment on The Cryosphere Discuss., 9, 77, 2015.