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Interactive comment on "Carbon dynamics in boreal peat-lands of the Yenisey region, Western Siberia" *by* E. D. Schulze et al.

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Received and published: 2 October 2015 This study uses 14C measurements of peat in combination with extensive plant residue analyses to describe organic matter accumulation dynamics in a Siberian peatland. This is a very comprehensive and useful dataset. However, I recommend that the authors consider clarifying several aspects of the manuscript, especially detailing for a non-specialized audience the rationale for the method used to fractionate peat for 14C analysis, as well as clarifying the terminology employed, which is potentially confusing with respect to the definition of DOC.

Following your suggestion (see below) we will clarify the definition of DOC (<0.45um, but, as far as we know, there is no general agreement).

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Overall, the study would benefit from posing clear motivating questions up-front as to why the authors would expect accumulation rates and ages to differ in this region as opposed to other previously-studied Siberian peatlands. Presumably, a main question of interest is whether infiltration of younger DOC to deep peat layers confounds interpretations of when peat initially began to develop in the region, and by proxy at other boreal sites. However, this question does not explicitly emerge until well into the Discussion.

The motivation of this study was not to solve the genesis of peat in Siberia, but to providing data for atmospheric measurements at the tall tower of Zotto. Only AFTER we completed this survey, we realized that the region has a specific history of peat development. I do not find it appropriate to give ad-posterior reasons for a study. This is why we put this into the discussion. Due to the long fen stage, the average peat accumulation is lower than in other areas where bogs shifted into a Sphagnum stage in early Holocene. We think that this is a major point of discussion.

Highlighting this point might increase the accessibility and relevance of the paper to a broader audience. For example, you could add text at the top of 11282 where you propose that these published 14C dates may underestimate the time period when peat began developing in the region.

I hesitate to add text, because I do not want to attack older literature on this topic. The reader must draw his own conclusions. The difference between DOC and POC-age has been described earlier, and this work has been cited.

A distinct aspect of the paper is the use of a base separation on a restricted particle size fraction to isolate samples for 14C analysis. More discussion of the rationale and justification for employing this method should be included. I infer that the reason for doing so was to remove younger DOC to get at the ages of initial peat deposits. Thanks for this comment. This is exactly the rational, which we stated. We will revisit the wording.

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However, comparisons with other published papers at the regional scale are then complicated two-fold. First, only 14C ages for the >36 and <63 um fraction are presented, thus excluding larger and smaller particles.

We must apologize for an error, and we are grateful that the referee points at this. Our DOC-fractionation was 2 steps, a centrifugation (2889 g, 30 Minutes) and a filtration (glass filter). Thus, the particle size is < 1,6 and NOT <36 um.

Secondly, a base extraction would not only remove DOC in the peat matrix derived from other sources, but also in-situ decomposition products that were adsorbed to the particulate matrix. Thus, this appears to be a good method for isolating oldest peat to assess the time of vegetation establishment, but cannot be used to infer "peat age" per se, which is a conceptually different measurement. Thus, comparisons with other studies are analogous to an "apples to oranges" comparison. It would be very useful to know the fractional contribution of the >36 and <63 um fraction to the bulk peat as a whole. Is this the dominant size fraction, and why was it chosen? Why not just conduct a base extraction on the bulk peat?

We did not use any chemicals for extraction (bases), but only gravity and mesh size. We measured the 14C-age in the >63um fraction. It was not significantly different from our POC. The main reason to discard the >63um fraction was that it contained inorganic sand (dust deposits?). We measured the bulk samples in an initial trial. In most cases the bulk measurement is between DOC and POC, but there are also younger values. We have to few data-points and cannot provide a general relation between bulk and our POC.

Finally, I would argue against describing the supernatant solution of a base extraction as "dissolved organic carbon." This generates confusion with the traditional definition of DOC as carbon that is soluble under ambient environmental conditions. Rather, your supernatant yielded "base-soluble organic carbon" and should be described as such so the casual reader does not take the data out of context with how the term is usually

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used.

See above. I think that our DOC is very close to the conventional DOC. To our knowledge there is no agreed standard filtering for DOC and in most studies the particle size is not even mentioned. Here we present the maximum particle size for our DOC. We agree, that changes in wording may help, but conventional DOC is usually also not obtained by sedimentation (which would take very long, and the sedimentation time is not defined), but by centrifugation and filtration. The main difference is, that we used glass fiber filter, because we needed a C-free filter. This is why we end with 1.6um.

Finally, I do not agree with the statement made in the abstract: "This peat is older than previously reported mainly due to separating particulate organic carbon (POC) from dissolved organic carbon (DOC), which was 1900 to 6500 yr younger than POC." Rather, the peat matrix may be older than previous reports of bulk peat ages, but we cannot make an apples-to-apples comparison here. Comparisons with other systems would need to be made on the same basis as the other measurements. The bulk peat 14C is an informative ecological measurement, and it would have been helpful to present this data, especially for comparison with the other studies. Thanks for this suggestion. We will change the wording in the text.

We made some initial bulk measurements, but these are not sufficient to provide a correction factor. Thus, we agree that such a correction factor would be helpful, but it is probably dependent on the water content. This would be a separate study which we cannot do with the material we have.

Specific comments Figure 3: Convention in soil figures is to have deeper depths on the bottom of the figure for ease of visual interpretation.

We know this, but we do not agree. Depth is not a dependent variable

Section 2.2 presumably reports data collected using methods described in section 3.2, so thus more properly belongs in the Results section.

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We thought that this way of presentation helps the reader.

Section 3.3: I am concerned about the bulk density measurements; a 3.5 cm diametercore is quite narrow and would presumably compress the sample. How was this accounted for?

For the top layers of Sphagnum we used an area based subsampling, as we describe in methods. For deeper layers that are water saturated, there is no compression.

Section 3.4: The methods for separating DOC are unclear to me.

We will add text to methods to clarify the DOC extraction (centrifuge+filter)

Section 4.3: as a point of clarity, citations comparing the present results to previously published data more properly belong in the Discussion, not the Results

We think that minor clarification can be made in the results. It helps the reader.

Page 11291, line 20: This paragraph belongs in the Results.

We think it helps the reader at this point

Page 11293: “Following Darcy’s law (Nobel, 1991) the flow of water through a saturatedsubstrate is determined only by the pressure difference between the peat surface and the drainage system and not by the hydraulic conductance” This statement appears incorrect, as Darcy’s law states that Q/A = -k dh/dl, so flow thus depends on hydraulic conductance, which should vary with bulk density and other peat properties.

Thanks for this comment. Under stationary conditions, which we may assume after thousands of years, the Darcy law simplifies to the Laplace equation where the hydraulic conductivity cancels. The flow through the system is then only dependent on height and the boundary conditions. We change the text

Figure 7 is not cited at all in the results, where this data should be presented. 11293, line 9: I am unclear how Figure 7 supports this statement, please explain.

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This was also criticized by another referee, and we will change the caption

11293, line 17 “The present hydrological balance of the growing season is close to nil” I am unclear what you mean that the Pine forest is never flooded during the growing season?

No, the pine forest is uphill and never flooded.

11295, line 7: Also presumably by diffusion and advection, given your subsequent statements.

Thanks, this will be changed

3.4 20: One does not “compare the 14C spectra of the AMS with the 14C standard.” Do you mean that you used _ 14C of the samples for calibration with Oxcal?

Thanks, yes, this is what I meant to say

4.1 20: Do you mean the ages of DOC and POC were related?

Yes, indeed I think that this is the case, but there is a time-offset

5.1 5: Difficult to compare your ages with other work given that you did not measure 14C on the entire soil volume.

Sorry, but 14C analyses are not sufficient to make this comparison

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Interactive comment on Biogeosciences Discuss., 12, 11279, 2015.