ESSDD

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comment

Interactive comment on "A new dataset of soil Carbon and Nitrogen stocks and profiles from an instrumented Greenlandic fen designed to evaluate land-surface models" *by* Xavier Morel et al.

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Thank you very much for your review and your constructive comments on this manuscript. I hope that the explanation given below, and the changes to the manuscript, will provide an adequate response. Referee comments are indicated as "RC" and author responses as "AR".

RC : The manuscript presents a data set of soil C and N contents from a Greenlandic fen site, which is a setting for long-term gas flux measurements of methane and car-

bon dioxide. In principle, these kind of data are valuable for C modeling community. However, I am not sure if this rather small dataset is sufficient for publication in ESSD, and have to leave it for editorial judgement.

AR : Thank you for noting that these data are valuable for C modeling community. We, the 1st, 3rd and last authors are Earth System modelers and we needed these data to be able to develop and test our biogeochemical model that will be used in IPCC type simulations. We believe it will be used by similar modeling groups around the world. Of course we let the editor decide whether this paper fits ESSD's scope.

RC : In any case, in the current stage, the reasoning related to the value and rarity of the current dataset is not fully convincing. Also, the manuscript text is not of very good quality, with respect to both logical structure and correct use of scientific English. I do not think the manuscript is ready for publishing yet, and significant improvements are needed in order to reach publishable quality.

AR : This was also mentionned by other reviewers. We improved the logical structure by restructuring the methods, results and discussion sections. Concerning the correct use of scientific English, the manuscript was corrected and when approved for scientific content, it will go through a professional langage editor.

We hope these improvements and and our answer to the reviewers' major comments below will convince the reviewer the revised manuscript reached publishable quality.

RC : *** Major Comments :

RATIONALE AND CONTEXT OF THE STUDY - The rationale and discussion are written on a very general, even shallow level, and does not include the two aspects of the data I find most interesting: 1) that it is a report of a Greenlandic fen particularly, and 2) most importantly, that the data include also N stocks alongside the C stocks.

AR : We don't believe our rationale and discussion were written on a shallow level but we indeed did not did not stress the importance of data on a Greenlandic fen and on N

stocks. We added a paragraph in the introduction about wetlands, peatlands and fens in Greenland, and added N contents in Tables and 2 subsections on N content. Thank you for bringing this up.

RC : 1) Greenlandic fens are typically small and shallow (and often young?), and distinct by their characteristics from many other northern peatlands. Instead of the clearly incomplete summary of C stock estimates from northern flux sites presented in Table 1, the authors should provide a good summary of soil C & N sites across Greenland, and present also the results of the Nuuk site in the context of other Greenlandic data. According to my understanding, there is not whole lot of such data available, so summarizing the previous data from Greenland would be a good way to "sell" this data set, and facilitate its meaningful use. The introduction section would also greatly benefit of a summary of Greenlandic fens in general – how abundant they are, how they can be characterized, what are the main gaps in knowledge.

AR : There is indeed very little data available on peatlands in general from Greenland, let alone on fens. Barthelmes et al, 2015 present an overview of the knowledge on greenlandic peatlands in general in the context of the Ramsar Convention on Wetlands and the National Inventory Submission for Denmark (NIS Denmark) to the Climate Convention UNFCCC. They point out that very little is actually known. Peatlands in general are found along the coast, in the South-West, with a few occurrences in the coastal strip of N-W and N-E Greenland. Most peat occurrences are shallow (thickness < 30cm) but may reach 1.5m in select locations. They found only a dozen published in-situ measurements of peatlands among which only 2 deal with C, the other being focused on archeology or paleoecology. To our knowledge, the only comprehensive study of fens covering all Greenland is that by Karami et al, 2018 who estimate fens extent using remote sensing data. Their study give only area, there is no estimate on C or N. This is now mentioned in the introduction and is indeed a good way to Âń sell Âż this data. Thank you.

RC : 2) While C stocks in northern soils have been studied extensively, N stocks in

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northern soils have gained much less attention, e.g. there is no proper estimate (but a clear need) for a N stock estimate for northern permafrost soils. With this in view, I find it a little odd that the authors have decided to give so little emphasis on their N data in this report. Nitrogen is mentioned in the title and presented as figures, but close to nothing is said about nitrogen in abstract, introduction, results text or conclusion. Nitrogen is a limiting factor for plant growth and microbial activities in northern soils, and this has been acknowledged recently by many modeling studies that deal with the C and N interactions in soils. E.g., Kicklighter et al. (2019) & Luan et al. (2019) and give some insights to this topic. Also, there are reports of increased N2O release from northern soils with permafrost thaw, (Elberling et al. 2010, Voigt et al. 2017), also emphasizing the importance of such soil N and C/N ratio data.

I recommend revising the manuscript fully with these issues in view.

AR : We agree that the first version of the manuscript did not cover enough the nitrogen data. We updated results table 3 and 4 by adding nitrogen stocks plots by plots. Two subsections on nitrogen stocks and vertically integrated nitrogen densities have been added in the Results sections. We also added a paragraph in the introduction using directly some of the reviewer's sentences. Thank you again.

RC : TOTAL C AND N STOCKS - The total C and N stocks on kg C m-2 basis are a key results of this study, since they are the usual outcome of soil C inventories and can be very intuitively associated to gas fluxes that are also expressed on square meter basis. Despite this, they are not reported as a part of the public dataset, not reported in the abstract, and not sufficiently compared with similar ecosystem types. Although the depth of the sampled soil profiles was quite variable (as stated on page 9, lines 1-15), the authors could e.g. report the C stocks in the peat profile to make them comparable with each other, and then based on the few mineral soil measurements in this data and relevant literature estimate how much this might underestimate the total C stock down to 1 m.

AR : Total C and N stocks have been included in the abstract.

In order to properly estimate the total C stock down to 1 meter, the need of soil carbon data below the organic-mineral interface (OMI) is indeed crucial. However, due to the difficulties of collecting samples below the OMI, there are only 5 samples in our data that were taken below this interface, i.e in the mineral part of the soil. These are the deepest samples of the plots T1-0, T1-5, T1-15,T1-20 and T2-80 (Fig.6). The average value of soil carbon content over these 5 samples is 29.2 kgC.m-2. But extrapolating total C stock down to 1 m for every profile using only 5 samples does not seem statistically significant. Moreover, these samples were taken below the OMI and might not properly characterize the mineral part of the soil. Using this value to fill the missing data down to 1m seems quite brutal, and will probably overestimate resulting C stocks . Although we can reasonably assume that below the OMI the carbon and nitrogen profiles decrease with depth, we do not know anything about it : is this decrease linear ? If so, what is the mean slope ? These informations are crucial for a proper estimate, but are missing. That is why we think a proper estimation of total C stock down to 1 m is out of the scope of this paper.

RC : QUALITY OF THE REPORT TEXT – The language and structure of the report needs still some work to reach publishable quality. The manuscript would benefit from a proper language check, since it has quite a lot of wordings and expressions that are not typical for good English scientific writing (e.g., P1 L16: northern latitudes wetlands instead of northern latitude wetlands, P3 L1: modelisation instead of modeling, P3 L30: datations instead of datings, P4 L10: the use of verb doted, P5 L2: the use of verb extinction).

AR : We believe we corrected all the typos and errors.

RC : Also, the text should be checked for logical structure, now the method part includes results (P4 starting from L26), and the results section starts with text (P7 L1-18) that should be partly moved to methods, and partly discarded: Instead of describing

the contents of each figure and table specifically, it would be much better to refer to tables and figures in parenthesis after sentences describing the results in question. The results section is referenced also there is a separate discussion section – why not combining these to one?

AR : Methods and results sections were rewritten according to these remarks, and discussion section was merged into the results.

RC : The text should also summarize better the dataset to facilitate the reader to get a good overview: e.g., describing the length of transects, depth of sampled profiles and total amount of samples in the abstract would be critical for such a dataset description, and the flux and auxiliary data available from the site should be much better described in order to make it attractive for modelers (P4 L1 ->): which gas fluxes are measured, for how many years, which seasons, which other parameters are available (meteodata, energy fluxes, water fluxes, LAI, plant biomass etc.). All in all, the text needs much more time and thought to make it easily readable and logical, and a good complementation for the datasets it describes.

AR : Abstract and introduction were rewritten according to these remarks. They now clearly state and summarize the dataset (measured variables, length of transects, horizontal and vertical resolution and total amount of samples).

As asked by another reviewer, a paragraph on CO_2 and CH_4 fluxes has been added in section 2, as well as other anciliary data.