

## ***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 : This is a useful dataset from an understudied region very relevant for the future com- position of the atmosphere due to multiple climate change effect–feedback loops.

C1

The dataset is of sufficient quality and has been described in a suitable way.

AR : Thank you for your comment.

RC : The writing of the paper, however, is sloppy and would have greatly benefited from at least one of the co-authors having thoroughly read the manuscript before submission. I tried to make suggestions for improvement at more than 200 positions (see annotated ms). Also my specific comments can be found in the annotated ms, highlighted in yellow.

AR : Thank you for taking the time for suggesting many improvements in the joint document. All the minor typos and rewording suggestions have been taken into account, and we will not list them in this response. However, we answer your major specific comments here. Quoted parts design the sentences underlined by the reviewer, followed by its comments.

RC : page 1, l.10 : Here and throughout the manuscript: write unit as "kg C m-3" (space between kg and C, and no full stop between C and m-3).

AR : done

RC : page 2, l.6-7 : "During the Holocene, as peatland C sequestration is strongly correlated with atmospheric CO<sub>2</sub> concentration (Yu et al., 2011)." Sentence is incomplete. Check wording

AR : This sentence has been rewritten into : "During the Holocene, peatlands have been regulating the greenhouse gas (GHG) concentration by consistently sequestering carbon although at variable rates between the beginning and the end of the period (Yu et al., 2011)."

RC : page 2, l.11-12 : "Recent studies suggest that peatlands will remain a carbon sink in the future, although their response to global warming will switch from a negative to a positive feedback." How can the feedback of peatlands switch from negative to positive, if peatlands remain a carbon sink?

C2

AR : This sentence was indeed unclear and has been rewritten as : "Recent projections suggest that peatlands may remain a carbon sink in the future, although a weaker one."

RC : page 2, l.22 : "Changes in soil moisture are also known to alter the CH<sub>4</sub>/CO<sub>2</sub> ratio production." This last sentence appears a bit lost. This point should be a bit more elaborated.

AR : We reworded this sentence into: "Changes in soil moisture are also known to alter the CH<sub>4</sub>/CO<sub>2</sub> ratio production, as oxic and anoxic parts of the soil are strongly determined by soil water content and methanogenesis primarily occurs in anaerobic conditions and oxic decomposition in aerobic conditions."

RC : page 3, L.32 : "Datings of the sedimentary layer of Både So (Larsen et al., 2017) showed that the lake was under sea level until 8500 BP. Hence, the fen can not be older." How can that be? Until 8500 BP the sea level has risen tremendously since the last glacial maximum about 20,000 BP. So how could the lake have been BELOW sea level before 8500 BP?

AC : It is mainly due to the isostatic (or post-glacial) rebound. The weight of the ice cap sunked the crust. During the deglaciation, changes in ice mass distribution led to a raising of the Earth's crust. Thus, in every region where ice was present in large quantities, the coastline is determined by the sea level rise, but also by these crust movements. In regions such as Scandinavia, Greenland of North-Eastern America, both processes must be taken into account.

RC : page 4, l.2 : "water measurements" Which measurements are meant here exactly?

AR : We clarified this sentence : "There are no continuous water table level measurements devices, but some sporadic water table depth measurements are occasionally made throughout the year."

RC : page 5, l.5 : "extinction of the fen" Not the proper word here, but it was not clear

C3

what was supposed to be said here.

AR : was changed into "end of the fen"

RC : page 5, l.9-10 : "and the soil elevation as the mineral layer both rises" Check wording, meaning unclear.

AR : The whole sentence was reworded into : "The end of the transect matched with the boundary of the fen. Approaching this boundary, the soil elevation and the mineral layer both rose."

RC : page 5, l.12 : "we sampled its full length with a 10 meter distance between T2-0 and T2-80" Unclear what exactly that means: did you sample along a 10-m piece of the transect with higher horizontal resolution? If so, what was the modified horizontal distance within this 10-m sub-section of the transect? Or did I get it completely wrong?

AR : The original wording was indeed unclear and a bit awkward. We reworded this part into : "As the second transect fully lay in the peat deposit, soil samples were taken every 10 m for the whole transect, i.e. between the plots T2-0 and T2-80."

RC : "Hence, the temperature control of the samples may have not been optimal." What was the potential maximum temperature the samples were exposed to? Please estimate and state here.

AR : Another reviewer (#2) also asked more precision on controlling the samples potential decomposition. We omit to state that samples were sealed in hermetic plastic bags. The whole paragraph is rewritten as :

"Soil samples were individually stored in small sealed plastic bags just after extraction in order to limit oxygen exchanges and halt decomposition.

Ideally, soil samples should be stored at a 4°C temperature before being transferred to the lab. With no fridge on the site, we used an insulated cooler in order to control at best the samples' temperature. The maximum elapsed time between sample collection

C4

and their deposit at the laboratory was three days. Although the temperature control of the samples may not have been optimal, this short delay between sample collection and handling in the laboratory prevented any significant decomposition."

Concerning the potential maximal temperature the samples were exposed to, the mean temperature at mid-day encountered in the study zone during the campaign did not exceed 10°C, but the use of an insulated cooler probably ensured a lower samples temperature during the storage.

RC : page 7, l.4 : What is the difference between bulk density and density?

AR : In this sentence, density refer to the sample density. Bulk density is defined in equation (1)

RC : page 9, L.28 : "the lack of ash content data and isotopic measurements" Why were those measurements not performed?

AR : The main aim of this field campaign was to collect soil carbon data. We did not have the time to collect ash content data, nor the budget to perform isotopic measurement.

RC : Page 10, L.31- 32 "Finally, when using these data for land-surface model validation, it is preferable to only use the soil carbon data corresponding to the automatic chambers area, that is the profiles from plots T1 0 to T1 20." But this applies only to models that simulate the gas flux between land surface and atmosphere, but not to those models that calculate carbon stocks, right?

AR : Now that data for both soil carbon stocks/profiles and greenhouse gas fluxes are present for the fen, they can be used for validating models that simulate either gas flux between land surface and atmosphere (e.g. Morel et al, 2019 ; Kaiser et al., 2017) or soil carbon stocks and profiles (e.g. Guenet et al, 2017) or those who attempt joint modeling of both.

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C5

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C6