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Interactive comment on "High-resolution digital mapping of soil organic carbon in permafrost terrain using machine-learning: A case study in a sub-Arctic peatland environment" *by* Matthias B. Siewert

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Anonymous Referee #4

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Author present comparison of four digital soil mapping techniques in predicting high-resolution (2x2m) SOC stocks of sub-Arctic peatland terrain. Study reports that Random forest performed better in comparison to other three techniques used and land cover types derived from a high resolution remote sensing data was the most impor-

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Discussion paper

tant predictor of SOC stock variability. Author also report that most of the SOC of study area is relatively new carbon ($\sim$ 2000 years old). Author report interesting findings and the outcome should be of interest to a wide readership of Biogeosciences. However, the current manuscript can be improved in multiple different ways as suggested below:

Thank you for your review.

- The sentence structure at multiple places is awkward so a careful editing is required.

My apologies. The manuscript will be revised throughout with a focus on readability.

- Its not clear to me how 2x2m spatial resolution for SOC stock was defined? Author seem to have a

variety of environmental datasets with spatial resolution ranging from 1 m to 20 m.

The spatial resolution of 2x2m was chosen as a compromise between the available input variables, output quality, the benefit of higher resolution and processing time. However, as several reviewers have highlighted interest in the exploration of different resolutions, I suggest to add estimates for 1m, 2m, 10m, 30m, 100m, 1000m. This has been tested and should yield meaningful results. It will however mean a throughout revision of the manuscript.

- I don't agree with the term internal validation used in this manuscript. Using model training dataset as a model validation is not correct. It provides an incorrect metric of map accuracy. For validation, you have to either use the split sample in the beginning (like you did for 20% data) or it has to be take one out approach (cross validation; using remaining samples to predict at the data point by taking out that data point from the model calibration data).

The internal validation will be removed from the article.

- Its not clear to me how land cover data was treated in different models used, were all the land cover types were equally important predictors of SOC? or it was only a subset of all the land cover types? Please provide results.

The land cover types were treated as equally important predictors. This will be emphasized in the revised discussion.

- I will like to see a section on uncertainty in this manuscript. Either calculate the uncertainty or provide a discussion of potential sources of uncertainty involved this study.

A discussion of sources of error is provided on page 13 L 18-33 (original manuscript). The section will update to point out uncertainty and be given a separate heading to make it easier accessible for the reader.

- The manuscript will benefit if authors can provide reasoning to the observed results. For e.g., why the environmental predictors changed with depths, why certain environmental controllers were significant predictor at certain depth and not other.

The revised version will contain a more in depth discussion of these topics.

-How the multicollinearity and non-linear relationships were handled?

Multicollinearity was tested using a cross-table of the predicting variables. In the revised version, highly correlated predictive variables will be excluded. Non-linear relationships can be handled by the chosen models. See the discussion in section 5.1.

- Fig. 5 need to be replaced, please remove pseudo sampling points from the plots,

provide the number of samples used for model validation. Provide separate plots for 4 mapping techniques

using validation samples only. Add R2, RMSE, and CCC values in each plots.

I see the need to replace Figure 5. However, if the figure is replaced according to the suggestion of the reviewer (excluding training and pseudo sampling points) it would mean that it will only be based on 10 validation points per model. This due to the low amount of sample points to start with. Using the full dataset (excluding pseudo sampling points) will provide much more information to the reader than just ten points. The R2 and RMSE can in this case be derived from cross-validation (one out approach) as suggested by the reviewer earlier on.

- Table 1: Please remove metrices calculated using model calibration datasets, and after adding these values in plots suggested earlier, you will not need this table. In results section, please describe what readers should learn from these map accuracy measures.

Table 1 has been removed. The information will be added in Fig. 5. Detail was added in the result section to describe what the reader should learn from the measures in terms of accuracy and precision.

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