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Interactive comment on "Topography-based modelling reveals high spatial variability and seasonal emission patches in forest floor methane flux" *by* Elisa Vainio et al.

Elisa Vainio et al.

elisa.vainio@helsinki.fi

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We answer here shortly the main comments pointed out by the Referee #1. We will answer all the rest of the comments in detail later, as well as get back to the suggested modifications.

Referee #1 1. The modeling framework "Line 225: How many observations did you have for May-July and August-October? Did you have many measurements from one point in your model (e.g., early May measurement, late July measurement)? Can you be certain that the soil moisture measurements conducted within one study period (e.g. in early May and late July) can be directly compared and used in the same model,

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even though the soils tend to get drier during the summer? I think it's important that the measurements that you use for your response variable (i.e., soil moisture) are fully comparable with each other."

AC: There were around 6 measurements (median) from each sample point in both of the seasons. Our data is not temporally very comprehensive, and thus we opted to do two static periods. Still, we wanted to take into account that the soil does, in fact, get drier towards autumn. We assume that this two-seasons-strategy is good compromise with the data we have. We actually started the measurements in late May (line 132), so we missed the wettest period in the spring, and the most active measurement period was in June–August (line 135). However, we still ended up having approximately same amount of data for both seasons.

"225: Could you also describe why you decided to use soil moisture as a predictor of fluxes instead of using the different topographic indices directly? Also, did you consider creating a continuous vegetation type raster based on your vegetation classes and the gridded layers for the study domain? This could have been a useful predictor for CH4 fluxes as well."

AC: We opted to use this two-step modelling scheme because based on initial testing soil moisture was the most important explanatory variable for CH4 fluxes, and the other explanatory variables (i.e. topography indices) had only a marginal impact. Further, we assumed that the correlation between the CH4 flux and the topography indices was only due to the fact that they both correlated with moisture. Hence, the two-step modelling approach was likely less prone to spurious correlations between drivers and response variable. However, due to the referee comment below, we will re-evaluate our approach and consider modelling CH4 fluxes directly with the RF technique and using soil moisture as a driver in the model. We considered but did not create a continuous vegetation type raster, because there are many drivers affecting the vegetation, and we did not have data of all such drivers. There is no direct connection between e.g. vegetation and soil moisture (Fig. 4), nor with topography. A continuous vegetation

type raster would have probably required more thorough mapping of ground vegetation of the entire area.

"256: Why didn't you use the similar framework that you used for soil moisture to predict CH4 fluxes with soil moisture? You could have created a RF (or a GLM/GAM or some other) model with the measured soil moisture as a predictor, and then used that model to predict fluxes across the landscape using the predicted soil moisture. And this could have been repeated over the different bootstrapped soil moisture maps to get CH4 flux uncertainty map as well."

AC: Thank you for this comment, this sounds like a good alternative for the approach now used in the manuscript. We will re-evaluate our modelling approach and consider changing it to follow this referee suggestion.

"240: Could you add the response graphs (partial dependence plots) describing the relationship of these indices and soil moisture to the Appendix?"

AC: Yes, we can add these.

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