

Interactive comment on “Assessing the peatland hummock-hollow classification framework using high-resolution elevation models: Implications for appropriate complexity ecosystem modelling” by Paul A. Moore et al.

L. Kutzbach (Referee)

lars.kutzbach@uni-hamburg.de

Received and published: 27 May 2019

The manuscript of Moore et al. presents a very interesting and comprehensive analysis of the microtopographic structure of boreal non-patterned bogs. The paper scrutinizes the binary hummock-or-hollow classification approach, which is often followed in sampling design or modeling of biogeochemical and ecophysiological peatland processes.

The authors applied a well-designed combination of elaborate field data acquisition methods, targeted statistical analyses and appropriate process modeling. I am par-

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ticularly pleased about the creative and thorough usage of various spatial statistical methods for analyzing the heterogeneity of peatland microtopography (e.g., Gaussian mixture models, Fourier transform power spectra of microtopographic variability along transects, slope and aspect analysis for microtopographic features, fractal dimension of plots). I also like the approach of simulating water content and net primary productivity in dependence of microtopography properties as an approach to demonstrate the relevance of thorough microtopography characterization for quantification of energy and matter fluxes. The authors show that non-consideration of the full continuum of microtopographical variability can lead to serious biases in spatial averages of net primary productivity due to negligence of microforms that are intermediate between hummocks and hollows. Even more pronounced bias would be expected for, e.g., methane emissions, which are controlled by water level depth below the moss surface in a highly nonlinear way.

Thus, the presented study is of high scientific relevance and originality. However, I think that the quality of the manuscript needs to be improved. In the following, I provide lists of (1.) general comments, (2.) specific comments, and (3.) technical comments. I recommend the manuscript for publication after major revisions.

General comments

(1) The experimental design of the study needs to be better explained. It is now too difficult for the reader to find out which method was applied where. That the many analyses were conducted at various peatland sites, needs to be more clearly stated already in the introduction. Furthermore, I think that a figure explaining the study design by including maps of different scale (e.g., northern hemisphere with location of all investigated peatlands, Nobel peatland with location of random plots in detail), would help. It would be also helpful if information on site and/or spatial scale would be added to all of the figure captions.

(2) The approach for modeling water content and potential NPP needs to be better

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described (L. 224-240). What is the basis for the parameterizations for water content for the different microforms? Please provide references. Is NPP considered as a CO₂ flux or a carbon flux? Without specifying this, the modelled NPP values cannot be checked for plausibility. However, such a plausibility check would be necessary. Please compare your modelling results with empirical data on NPP of bog microforms.

Specific comments

L. 50: I do not like this often used comparison because it is like comparing apples with oranges: The carbon pool of peatlands is estimated over their mean peat depth (can be more than 15 m), whereas carbon pools of soils are estimated for specific reference soil depths (e.g. 1 m, 3 m). Hence, do peatlands contain one third of the upper meter of global soils or of the upper 3 m or how many meters? Furthermore, soils store not only organic carbon but also inorganic carbon!

L. 69: I would think that the area covered by a hummock can be also quite larger than 1 m².

L. 96: I suggest adding the reference: Cresto Aleina F., Runkle B. R. K., Kleinen T., Kutzbach L., Schneider J., Brovkin V. (2015): Modeling micro-topographic controls on boreal peatland hydrology and methane fluxes. *Biogeosciences* 12: 5689-5704.

L. 112-113: Sentence not clear to me; please rewrite! I do not understand how you want to “explore DEM-derived properties” “using multi-site plot-scale sampling”.

L. 137: Write more specific: What kind of “individuals”? Have these been scientists, students, or farmers neighboring the peatland?

L. 157: Unit of resolution?

L. 234: According to SI system, do not mix units and quantities. Better “WC is the ratio of the mass of water and the mass of the non-water components of the soil (Unit: g g⁻¹).”

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L237: Specify the variable x. Probably, x equals WC, correct?

L 238: Better: "...represents percentage of maximum NPP"

L. 836: It is confusing to use the two terms "net photosynthesis" and "NPP" as y-axis titles of different diagrams in the same figure, respectively. Do you use the terms as synonyms? In my view, integration of net photosynthesis over time at the canopy scale leads to NPP; thus "net photosynthesis" and "NPP" would be closely related but not synonymous.

Technical comments

L. 29: Correct "examine"

L. 31: Correct: "northern"

L. 38: Correct: "positions"

L. 50 Correct "one third"

L. 107: Hyphenate: "plot-scale"

L. 121: Hyphenate "transect-based"

L. 145: I suggest writing: "0.1 m x 0.1 m x 0.1 m (same for similar expressions throughout the manuscript)

L. 179: Comma before "and" (beginning of independent sentence)

L. 186: Number the equations.

L. 208: better "selected" instead of "decided"

L. 239: "mo" is not a standard abbreviation for a SI unit. Please define this somewhere before using it.

L. 296: I would move the F statistics in parentheses to the end of the sentence.

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L. 311: Infelicitous usage of statistical terminology: In my view, a result can be either significant or non-significant, give a specific error probability. It cannot be strongly or weakly significant.

L. 374: Hyphenate: “under-samples”

L. 380: Better a full stop instead of a comma after “conditions”

L. 465: Comma before “which”

L. 507: Hyphenate “water table-dependent”

L. 516: Comma before “where”

L. 532: Comma before “where”

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-20>, 2019.

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