

## ***Interactive comment on “Quantifying Soil Carbon Accumulation in Alaskan Terrestrial Ecosystems during the Last 15,000 Years” by Sirui Wang et al.***

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Review of Wang et al. “Quantifying Soil Carbon Accumulation in Alaskan Terrestrial Ecosystems during the Last 15,000 Years”

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Summary

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Authors tested SOC simulations from the modified version of their Terrestrial Ecosystem Model (TEM) for peatlands (P-TEM) for Alaska region for time periods defined by climatic characteristics (solar radiation, temperature, and precipitation levels) and vegetation distribution during last 15 000 years. The model was applied for peatlands and

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non-peatlands (mineral soil forests). Simulated C distributions, NPP, and peat depths were presented for Alaska at fine scale spatial resolution (maps) and summarized for vegetation types. This can be an interesting study if presented carefully.

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General comments

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The advances of the model include hydrology, soil thermal, C and N dynamics modules. This looks promising however, the model code is not publicly available and need to be asked from authors. No software details were given. I'd like to see the code and run an example simulation in R to understand the model structure.

Description of NPP simulation by the model is missing. Description of Carbon and Nitrogen dynamics of CNDM module is also missing. Add descriptions for clarity. Results largely depended on the adopted distribution of vegetation types. Authors mentioned that distribution of vegetation types and their changes overdriven C accumulation over climate, but also noted that climate had probably driven distribution of vegetation types. Individual parameter values are not listed. It would be interesting to see the changes of key parameters between vegetation types in relation to their prevailing climate.

Description of observations of peat depths that were used for model validation is not sufficient. Some description is in section 2.5 but it is not clear and the points on the maps in Fig. 2 are barely visible. Describe clearly.

Structure of the paper is unclear. Reorder the ideas, avoid using repetitions.

Methods are presented in results. Results are presented in discussion. For example lines 369-370 in results describe how peat depth was calculated for the first time. Discussion Section 4.3 presents too many numbers without deeper insights on reason behind differences between other studies. At the end of discussion a scatterplot Fig. 14 between observed and modeled peat depths is presented for the 1st time. The Fig.

C2

14 shows that without exceptional agreement of 3 largest values the rest of the scatter is just a gunshot indicating poor performance of the model in most conditions. Authors avoid the explanation. Move results to result section. Present some values in Tables. In discussion interpret the results with a focus on the model and data input.

Interesting results as underestimation in uplands, lack of C loss simulation (Fig. 2), reasons behind vegetation controlling C storage, disagreement with observations, assumption that peatlands will remain C sink are brushed away. The agreement with other studies is OK but not enough for discussion. Describe reasons for agreement/disagreements, give insights on function/performance and reason why to use/trust your model. Although the authors claimed that the PTEM includes CN module, nothing can be learned from reading the paper how this or other modules affect the results. Given the SOC underestimation of uplands and large scatter with peatlands, and large-scale climate estimates, could accounting for differences in nutrient status or reevaluating response of C/N ratio be a key for improved estimation of spatial variability of SOC accumulation of P-TEM or TEM model?

Authors claim that recent climate is warmer and wetter in summers and therefore with future warmer-wetter climate peatland carbon sink will continue. Possibility of increased respiration and C loss due to droughts or warmer winters is not mentioned. For the conclusion on future C sink a simulations with climate scenarios would be useful.

The interesting results are damped by poor presentation. The manuscript read more as an early draft, rather than discussion paper ready for peer-review. Awkward English throughout makes it difficult to follow the main message and to review scientific merits. Manuscript was probably rejected elsewhere, as the references are not corresponding to the format required by Biogeosciences. In spite of interesting modeling approach, without careful language editing and major content corrections the manuscript cannot stand as a scientific paper in Biogeosciences and should be rejected. That would be a shame because otherwise it can be a useful paper for developing accurate models for

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peatland SOC accumulation.

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Specific comments:

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Increase Figs. 2, 3, 4 and their legends size by 50 or 100%

why are panels b, d, f in Fig. 3 scaled by zero? that makes differences to appear smaller increase legend in Fig. 5

increase Fig. 7 and 9, why fig. 9 it has 2 legend bars?

line 137 "observed water contents drive STM"?, did you mean observed temperatures?

lines 235-238 reformulate for clarity

line 293 correct value of C storage

lines 300-302, 309 reformulate for clarity

line 315 range of what?

lines 325 "spots were widely spread" reformulate, "SOC concentration" do you mean SOC storage?

line 326 reformulate "tundra was taking back area" or similar

line 361 Table 4 is not showing parameters

lines 375-377 reformulate for clarity

lines 420 – 460 reformulate for clarity

line 424 why if  $p < 0.05$  "some certain effects"?

line 428 "positive effect" of temperature? low temp slowed SOC accumulation, that's

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negative effect

line 437 delete “suggesting the warmest climate during HTM” it comes by definition of HTM

lines 443-448 does not make sense

line 452 what is “stored C in overall in the spatial scale”?

line 454 “negative accumulation rate” avoid writing nonsense

lines 485 – 545 reformulate whole section, move results into results, check for repetitions, highlight only most important trends and insights, shorten discussion if nothing much relevant to say

lines 508-519 OK

References – change into the corresponding format of Biogeosciences

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Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-284, 2016.