Sönke Zaehle
Editor, Biogeosciences

Dear Dr. Zaehle,

Please find attached our further modified manuscript. We have modified the discussions section of the manuscript to address both issues you raised.

Sincerely,

Umakant Mishra
Environmental Science Division
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Editor's comments:

Comment -1: You state that your results could be useful for model benchmarking of ESMs, but I'm still not clear how? ESMs do not represent processes at the spatial scales you investigate, so how can these relationships be used evaluate models? A bit more detail of what you mean here would be helpful.

Response- We modified the text to add two important aspects to address your concerns in our further revised manuscript:

First, the climate modeling community needs more accurate assessment of SOC stocks at the scales that ESMs represent them. It is clear from our study that our ~10 km estimate of observed SOC stocks is very different than what can be inferred from a few point measurements. We therefore argue that our approach can be useful to improve coarse-resolution SOC estimates.

Second, ESMs are moving to much finer resolutions. For example, the US DOE ACME model (Bader et al., 2014) will soon represent ~10 km watersheds with subgrid heterogeneity of soils and vegetation. In the next 5-10 years, we believe ESM land models will function much closer to the resolution we identify in our paper as being representative of SOC landscape heterogeneity. As the model resolution becomes finer, datasets such as the one we describe in this paper will be critical for model benchmarking. As the ESMs become finer in scale, we think our results can be useful in; 1) inferring fine scale spatial heterogeneity of SOC stocks from coarse scale ESM results, and 2) predicting the change in environmental controls of SOC stocks across scales. We modified the text in discussion section to explain this further (P19L16-P20L2).

Comment -2: Reviewer two pointed out that because of the global focus of ESMs, it might be interesting to extend this work to a larger domain. While I can understand that this is impossible for the current study, I think this is an important caveat to note, because the major aim of ESMs would be to predict the difference in SOC between tropical, temperate and boreal ecosystems. If you wanted to use your results as a benchmark, then one would need to establish to which extent the observed SOC scaling relationships in an arctic/boreal are useful to understand the large-scale tropical to arctic difference in SOC.

Response- Thanks for this comment. We have addressed this remark in the limitation section of the manuscript (P20L7-10).

References:

Bader, D., Collins, W., Jacob, R., Jones, P., Rasch, P., Taylor, M., Thornton, P., and Williams, D.: Accelerated Climate Modeling for Energy (ACME) Project Strategy and Initial Implementation Plan; 2014. (Available online at http://climatemodeling.science.energy.gov).