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## ***Interactive comment on “Changes in soil organic carbon storage predicted by Earth system models during the 21st century” by K. E. O. Todd-Brown et al.***

### **Anonymous Referee #3**

Received and published: 11 January 2014

This manuscript presents a comparison of model predictions of soil organic carbon changes from different Earth system models participating in the CIMP5 inter-comparison project. This analysis is an important contribution to the literature, surveying the state of the art in terms of model predictions and highlighting important aspects for model improvement. I found the manuscript well written and suitable for publication. Only some minor technical changes are suggested below.

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## Technical comments

- The introduction section presents a good overview of our current understanding of possible effects of climate change on soil carbon stocks. However, I feel it still needs to introduce better the manuscript and the analyses presented. For example, I think it'd be helpful for the reader if you explain better what is CIMP5 and why it is important to compare the output from these different models? Why do we need to compare the numerical output and not the implementation of the models themselves? What is new and different in this manuscript in comparison to the analysis previously presented in Todd-Brown et al. (2013)? What is RCP8.5 and why is it relevant to compare the model output from this scenario? I feel the introduction should give a little more weight to the context and motivation of the analysis.
- There is a simple issue about terminology on page 18978. You use the terms temperature and moisture sensitivity to describe the functions of temperature and moisture that modify the decomposition rate. I think the correct term here is 'dependence' and not 'sensitivity'. Sensitivity is better understood as the derivative of the function with respect to either temperature or moisture, while dependence is the function itself. Many people treat these two terms equally, but there have been some attempts to homogenize terminology in this respect. See Sierra (2012) for a discussion on the topic.
- Tables 1 and 2. Can you give a measure of variation across models? I think it'd be good to see either the standard deviation or the range accompanying the multi-model mean in the last column.
- A recent paper also analyzing model output from CIMP5 found an important contribution of turnover times on the variability of predictions across models (Friend et al. 2013). Although these authors only looked at vegetation carbon, I think it

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places a good reference framework for discussion in this manuscript. Maybe you could discuss this study as well.

## References

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- C. Sierra. Temperature sensitivity of organic matter decomposition in the Arrhenius equation: some theoretical considerations. *Biogeochemistry*, 108(1):1–15, 2012.
- K. E. O. Todd-Brown, J. T. Randerson, W. M. Post, F. M. Hoffman, C. Tarnocai, E. A. G. Schuur, and S. D. Allison. Causes of variation in soil carbon simulations from CMIP5 earth system models and comparison with observations. *Biogeosciences*, 10(3):1717–1736, 2013.

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