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Interactive comment on "Scaling impacts on environmental controls and spatial heterogeneity of soil organic carbon stocks" *by* U. Mishra and W. J. Riley

Anonymous Referee #1

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This work builds on a previous study published by the authors in 2012 by investigating spatial scaling controls on soil carbon stock estimates. The authors use a suite of databases with spatial resolutions ranging from approximately 100m to 10km, including National Land Cover Database, USGS databases, and DEMs (convolved to 100m). The authors successively increased the spatial scale of environmental variables, using both observational data and geospatial approaches, to predict soil carbon stocks at different spatial scales. Their principal finding was that the strength of controls of environmental factors on soil carbon stocks generally decreased as spatial scale increased (which makes sense), with the effects of temperature exerting the strongest controls across scales. At finer scales, the controls of topographic attributes were more promi-

nent while at larger scales temperature and elevation were more significant. While these findings are perhaps not surprising, and are consistent with other reports, the implications are of broad significance with respect to interpretation of earth system models. The main take home message of this important work is that current modelling efforts operating at coarse spatial scales (> 100 km) are likely unable to utilize certain environmental data in estimating soil organic carbon stocks. The manuscript is generally well written, well researched, and clearly presented. I feel this should be appropriate for the readership of Biogeosciences and offer minor comments by line number, below.

1724, L3: If citing Jenny, it would be appropriate to also mention the significance of time as a soil forming factor. The authors mention this on page 1734, line 7, but it's worth mentioning here.

1725, L9: I think it would be helpful to succinctly state what the authors mean by "model benchmarking".

1727, L9: Would it be possible to provide a citation or reference for the UAF Northern Soils Research Program?

1729, L14: Perhaps this is described in detail in Mishra and Riley, 2012, but there are no descriptions of soil depths in this study. Could it be clarified that pedons described here are to 1m?

1732, L20-25: Could it be clarified how the relationship between scrub vegetation and SOC stocks changes (positive or negative relationship)?

1734, L20: Another good discussion of soil forming factors at multiple scales affecting SOC stocks: Torn MS, Swanston CW, Castanha C, Trumbore SE. 2009. Storage and Turnover of Organic Matter in Soil, in Biophysico-Chemical Processes Inolving Natural Nonliving Organic Matter in Environmental Systems; edited by Senesi N, Xing B, Huang PM. John Wiley and Sons, Jew Jersey, USA. pp. 219-272.