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Interactive comment on "Simulation of soil carbon dynamics in Australia under a framework that better connects spatially explicit data with ROTH C" *by* Juhwan Lee et al.

Anonymous Referee #2

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General comments

The authors developed soil C calculating system which connects spatial datasets on meteorology, soil, land use and land management with the RothC model. They calibrated the RothC and predicted changes in soil C for 100 years with different soil management scenarios. I think this work is within the scope of this journal and potentially many of audience of Journal would be interested in. This was my first impression after quick read of paper. But after careful reading, I found some severe problems. First, explanation of what the authors have done is not enough throughout the paper especially in "Materials and methods" section. Frequent disconnection in logic between

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sentences made me difficult to understand what the authors really have done. Development of calculation system is great achievement, but it was difficult to evaluate the validity of the many assumptions in developing the system and future simulation procedure. This might be partly because of English skill but I think not only due to that. Significant re-writing of manuscript with English check by native speaker will be needed for this manuscript.

Second, future projection of 100 years generally requires the use of climate change scenarios but there is no description on this. I understood that the future projection in this study was conducted by using current meteorological data. This is curious.

Third, the setting of the changing amount of C input in future projection is not realistic. I do not think six times higher organic matter input is realistic scenario. It is natural that increasing C input result in higher soil C qualitatively of course. Quantitative estimation by using realistic scenario (both future climate change and management scenario) with well-calibrated model will be valuable but this study is far from it at this moment.

Consequently, I have to evaluate this manuscript as rejection. I am happy if the following comments would be useful.

Specific comments and Technical corrections

L85-87: Please explain how you dealt with “BIO” pool of the original RothC, too, here. You mention other four pools but not BIO.

L96-97: The original RothC uses monthly precipitation and open pan evaporation to calculate soil moisture condition. Did you change this part by using AWC? If so, please explain.

L98: What kind of soil properties did you estimate by visible-near infrared spectra.

L101-105: You must explain more about land cover here including definitions of cropland, modified or native razing land and native environments (which appeared in Figure 2).

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L127-132: I did not understand this part.

L136: How did you relate evapotranspiration value with pan evaporation value? Explanation needed.

L150: Please show specific value of shoot to root ratio and show reference.

L151-155: Many assumptions here. Where did you get the value 1.25, for example? Please show references for each assumed value.

L157: How did you calculate 0.049?

L167: What does “each site” here mean? “73 sites” in L161? Or 4431 sites in L177? Explanation is not easily understandable.

L169-171: I think 100 years are too short to reach equilibrium. How did you set 100 years here?

L171-172: “from their initial values by a fraction of 1/100” is not clear explanation. From which value (minimum) to which value (maximum) for example? Please explain more in detail.

L182: Monthly variation?

L183-184: Why 10 Mg C ha-1 to exclude?

L184-185: This sentence should be in “Results”.

L188-19: 100-years of future prediction generally uses future climate change scenarios. Why the authors did not do so? Did you use just current meteorological condition for future 100 years?

L190-191: Is 6 times greater C inputs achievable? This is very large amount so you have to discuss if such amount of organic matter could be available in terms of resource availability.

L195: Why 11-year moving average? Explanation needed.

L198: 100 years is not enough to reach equilibrium in many cases. How did you judge if it reached equilibrium or not? Explanation needed.

L213-214: I could not read median value from this figure.

Figure 3: Some of characters of horizontal axis are overlapped and not visible.

Figure 4: Title of figure is not easily understandable.

L246-247: please show data to support this sentence.

Figure5: TOC in left panels should be ROC. TOC=POC+HOC+ROC. Is this correct? Definition of vulnerability should be explained in Figure caption, too, even it is in main text, so that figure can be self-understandable.

L257-258: Why changes in stock under grazing and cropping will be similar if climate and soil texture have a dominant effect? Not understandable. Explanation is not enough.

L259-260; 261-263: This should be due to the difference of DPM/RPM ratio. Please add discussion on this.

L270-271: This sentence is not needed. Should be deleted.

L286: I did not understand the relationship between this sentence and sentences before and after.

L297-298: This comparison does not make sense because the area of each land use is different.

L304-306: So why you did not use more complete dataset like Viscarra Rossel et al. (2014, 2019)?

L306-308: I could not understand why this concluding sentence appears here. It is disconnected from sentences in this paragraph.

L313: I do not think this is “plausible” as mentioned above.

L313-315: You must discuss the reason of these difference among land use.

L316-318: You must discuss or explain why soil C become more vulnerable when soil C increases. Sentence of L317-318 does not say anything.

L327-329: You must explain more why this C input level was plausible. Explanation is not enough.

L330: I could not imagine how to “manage it locally”. Explanation needed.

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