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Interactive comment on "A multi-isotope model for simulating soil organic carbon cycling on an eroding landscape (WATEM_C v1.0)" *by* Zhengang Wang and Kristof Van Oost

Anonymous Referee #1

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General comments Dear Editors and Authors, This article contributes with a modelling tool (WATEM_C v1.0) for the soil erosion model WATEM, to simulate soil organic carbon cycling in a dynamically eroding landscape. The manuscript is overall fairly well-structured and provides interesting content and results from a novel modelling tool built on integrating soil erosion (WATEM) with SOC models. The use of C isotopes aims to demonstrate that the model can identify sites of erosion and deposition with regards to SOC isotopic enrichment. The text however needs corrections regarding language and grammar. There is also a lack of detail regarding any/the study site used in the model iterations. I recommend major revisions, results- and topic-wise this article would be suitable for publication in Geoscientific Model Development. Below I discuss Specific

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and Technical detailed comments and suggested changes.

Specific comments This manuscript provides interesting findings and brings forward a flexible tool that will be useful in research areas covering topics of carbon research and soil erosion. There are some issues that need to be addressed: 1. There are many grammatical and spelling errors in the manuscript, mainly in section 1 Introduction, 3 Results and 4 Discussion. The text is sometimes unclear on what it intends to formulate. I have provided some suggestions in Technical comments. 2. There is a lack of detail regarding any study site that is used to demonstrate the model results. Was this site an actual plot or a computed site? There is a mention of "Belgium" on row 294 in 4 Discussion, but it is not clear how it is related to the findings of this manuscript. If you do have a study site, it should be mentioned, together with basic input parameters, so that other researchers can repeat the simulations. 3. In the introduction, there is a mention of soil erosion and deposition models taking the effect of grain size into consideration, is there any such consideration in your model outside of the scope of the RUSLE components which are inputted into the WATEM model? 4. A suggestion is also to expand the discussion regarding replacement of SOC in eroding areas – for this study did you consider litterfall and vegetation input? For instance, is the vegetation cover heterogeneous in your study area, if so are there any patterns in SOC enrichment that could be connected to vegetation?

Technical comments 1. Consider italicizing the coefficients that are used in the expressions, also in the text for better reading flow. 2. Figures and text make inconsistent use of n-dash and minus signs, suggest streamline for consistency. 3. Row 23: remove "the" in "SOC is the largest organic C pool on the land" 4. Row 25: remove "is" in "atmosphere CO2 sensitive is" 5. Row 37-38: in "During the erosion events, soil aggregates are broken by raindrop and overland flow, which can enhance the SOC decomposition", rewrite to clarify and remove unnecessary "the"s. 6. Row 39-40: "Soil minerals move upwards from below due to soil truncation are added SOC by inputs from plants" – this sentence needs to be rewritten to clarify its meaning, e.g. does

soil truncation force minerals towards the soil surface? And is the SOC added from other sources? 7. Row 41: “SOC deposited in the depositional settings is buried to depth and well preserved”, rewrite to clarify 8. Row 43: “SOC tocks”, change to stocks 9. Row 43: “It was found that”, should more likely be “It has been found” 10. Row 45-47: “Soil redistribution could lead to difference of SOC stability between eroding and depositional areas. Berhe et al. (2008) found that SOC decomposes faster in the eroding areas compared to depositional areas through signatures of radioactive C isotope.” These sentences need to be corrected for grammar, and in the last sentence it needs to be clarified that by using radioactive C isotopes it has been found that SOC decomposes at faster rates. Here I also suggest that you write out 14C. 11. Row 49-50: “Radioactive C isotope gives information on the SOC turnover time, and it is a useful tool to investigate long-term SOC cycling (Trumbore, 2009).” Rewrite so that it is grammatically correct. 12. Row 51: “SOC redistribution was found to have an effect”, replace was found with “has been found”. 13. Row 55-56: a). “Some models separate sediments into different sizes, and these models are suitable for simulations the size selectivity in erosion and deposition” – clarify e.g. by using “into different grain size”. Grammar correction: “are suitable for simulating” 14. Row 59-61: “These models were further added processes of 137Cs deposition, decay and redistribution associated with soil particles, so that they can be calibrated using observed 137Cs data (Van Oost et al., 2003). “ Here, I think you should give a clear example, to demonstrate why this is relevant. 15. Row 64-65: “Because the SOC is a complex of different components, it is often represented by various pools with respect to C input and decomposition rates in models such as Century” – capitalize and add “CENTURY”, remove “the” from “Because the SOC”. 16. Row 69-70:” For example, 14C signatures of SOC has been used to constrain parameters of a multiple-pool SOC model using Bayesian method” - check grammar. 17. Row 72-73: Can you give any examples? 18. Row 73-74: Clarify what “at the profile scale” is. Replace “was investigated” with “has been investigated”. Also, “they” is not pre-defined, so either introduce the authors of the study you refer to before using “they”, or rewrite the sentence into a more generic form 19. Row 75-78:

It is not clear which study these findings are from, clarify 20. Row 82-83: Suggest rewriting this sentence to improve reading flow, would replace “are still lacking” with other expression 21. Row 84: Would use “modelling tool” rather than “model tool” 22. Row 85: perhaps use “eroding landscape” instead of “dynamic landscape” to clarify, or refer to erosion in some other way 23. Row 89: define “scenarios” with e.g. “erosion scenarios” or “erosion settings” to clarify 24. Row 106: space missing “(m).In” 25. Row 126: capitalize CENTURY model 26. Row 132: superscript missing in “ha-1” 27. Row 140: “We used discrimination ratio to”, add “a” to “used a discrimination” 28. Row 179: “At the meantime”, replace to “In the meantime” or change to other expression 29. Row 182-184: “For all the soil profiles, the component pools of each C isotopes of every layer are updated by homogeneously mixing the component materials every time step.” – check grammar 30. Row 188: missing space after “;” 31. Row 200: “137Cs originates from bomb experiments between 1950 and 1970.” Very simplified, it is worth clarifying that in the environment 137Cs concentrations are artificial fallout products from nuclear tests and reactor incidents, such as Chernobyl and Fukushima. 32. Row 200: “It falls to the Earth’s surface”, would use other expression 33. Row 203: “The model reads the values”, would remind the reader by clarifying which model 34. Row 211: “the model was develop using”, check grammar 35. Row 211: “complied”, do you mean “compiled”? 36. Row 276: “replacement of lost at the” lost SOC? 37. Row 280: replace “negelation” 38. Row 286: “from plant.” Check grammar 39. Row 288-290: “At the same depth, soil profile of low soil advection and diffusion rate contains more degraded SOC than profile of high soil advetion and diffusion rate, and therefore soil profile of low soil advection and diffusion rate has less negative δ13C values.” Check grammar, spelling and clarify the meaning of this sentence 40. Row 293-294: Check grammar and spelling 41. Row 303: Check spelling 42. Row 304-307: “Similar to δ13C profiles, erosion and deposition also have a truncation or burial effect of on the Δ14C profile and this results in the simulation that the eroding soil profiles have more negative Δ14C values compared to the stable soil profile while the profiles at the depositional sites have

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less negative Δ14C values than the stable soil profile (Figure 5c)." Check grammar and clarify the meaning 43. Row 318: "three-dimention" check spelling 44. Row 322: "This allows the model to be applied in various scenarios by setting relevant parameter values." Can you clarify which scenarios, e.g. different rates of erosion, different ranges of precipitation or change in vegetation? 45. Row 326: "The arrange", check expression/word 46. Row 330: "reprent", check spelling 47. Row n334: "a 3 pool" be consistent with using words vs. numbers, earlier it has been called a three-pool model 48. Row 339: "while depositional", check grammar "while the depositional" 49. Row 345-346: Check grammar 50. Row 349-350: The link to the code appears to be broken.

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2019-217/gmd-2019-217-RC1-supplement.pdf

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