

Interactive comment on “Rates and potentials of soil organic carbon sequestration in agricultural lands in Japan: an assessment using a process-based model and spatially-explicit land-use change inventories” by Y. Yagasaki and Y. Shirato

Anonymous Referee #1

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Review of MS BGD-10-18359-2013 by Yagasaki and Shirato

The authors evaluate the effect of current and future land use and management on soil organic carbon stocks in Japan using modeling, soil carbon monitoring, and various scenarios regarding land use and climate. To start with: The study has a very high information density and is partially difficult to follow because so many different factors and variables were studied. Despite extensive explanations the applied methods are

C7775

sometimes difficult to comprehend. On the other hand, the authors see many shortcomings in their work, particularly concerning inherent uncertainties in measurements, modeling, and scenarios. I suggest to split the current manuscript into two separate papers, one dealing with the comparison of SOC modeling and monitoring including the method of assigning virtual land use units to the perimeter, and the other one addressing scenarios and their effect on future SOC. In case the authors should decide to revise their paper, more detailed comments below may help to sharpen their work. I suggest copy-editing of the manuscript; many sentences are very difficult to follow and I found some orthographic errors, some examples are given below.

P 18360 | 21: Sentence starting with ‘scenario analysis’ is not clear.

P 18361 | 7. Which ‘system’ is referred to here?

L 10. What is an ‘acceptable level of validity’?

L 3 and p 18364 | 18ff. Terms net net, land based and activity based accounting must be explained.

P 183623 | 15 ff. Various sentences here are awkward and difficult to understand.

P 18363 | 25. As I understand this sentence Monte Carlo simulations were applied but I could not find the corresponding results in the text.

P 18365 | 10 ff. More detailed information on the decision tree and the assignment of the 9 land use types is needed. For example, it is not clear whether all of these land use types occur in every single grid cell.

L 25 ff. After reading these sentences it is still not clear how the spatially explicit future land use map was generated.

P 18366 | 12. Where do this three groups stem from? Above it is referred to 9 land use types.

P 18367 | 16. I wonder how the phosphate adsorption coefficient was used to tune the

C7776

decomposition rate of HUM in Andosols? Details are required here.

P 18368 paragraph 2.5 'Soil'. It must be clearly indicated whether all three soil datasets included the minimum information namely soil organic carbon concentration and soil bulk density. Was % carbon always measured with the same method? It is mentioned that gravel content was not considered due to poor data availability. I see this as a crucial factor; the authors acknowledge that this may become a source of error but without a proper error estimate I would argue that ignoring gravel is a major flaw.

P 18369, agricultural activity. Key to SOC modeling is a reliable estimate of below-ground carbon inputs to soil. How was this estimated? Later it is referred to Shirato et al. (2004) for two out of nine land use types but details are needed here. Table 1 provides some overview but from this it cannot be inferred how inputs were estimated and to what extent belowground inputs were considered at all.

L 16. MG was estimated according to the text; why is manure input for MG zero in Fig. 2 (year 1980)?

P 18376, paragraph 3.4. For future SOC the response of NPP to climate change is an important driver. How was this considered for the scenarios presented here?

P 18380, l 19 ff. After reading this sentence I wonder what the alternative explanation for SOC changes might be? Section 4.1. should be more clearly structured with putting the two main mechanisms and their importance in the beginning.

P 18381 l 7. 'archive' should read 'achieve' (?). The whole sentence is difficult to read.

L 22. What is the 'fiscal year' referring to, same as calendar year?

L 524-531. These sentences can be omitted.

P 18382 l 17. I doubt that with the current approach the robustness of the modeling can be evaluated. RothC is a very simple soil carbon model and it is not clear whether its minor response to different climate scenarios is just due to a poor sensitivity of the

C7777

model to climate variables in general. To factor our direct human influence probably needs a much more sophisticated model framework that also includes vegetation response to climate change as well as a more elaborated soil water submodel. Also the monthly time step in RothC, which attenuates short term extreme events, speaks against its use for distinguishing direct from indirect human induced influence on SOC.

L 27. It is unclear what the last sentence of the paragraph wants to tell. Maybe omit.

P 18383 l 25. Is 1.79 Tg CO₂ per year meant?

P 18384. I appreciate it as good scientific practice to always be self-critical with the work we are doing but after reading this paragraph I feel that the authors raise fundamental questions that do undermine their own approach. The same applies for the whole section on uncertainties. Uncertainties are not strictly quantified but discussed in a general way. For example, I wonder why on page 18385 l 17 the authors argue that a full assessment on the uncertainty of input estimates needs to be implemented but they failed to do so in their study. The reference to Koga et al. (2011) (for manure application) actually underpins how sensitive the conclusion from modeling studies is to parameter uncertainty.

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C7778