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Interactive comment on "Modeling soil organic carbon dynamics and its driving factors in global main cereal cropping systems" *by* Guocheng Wang et al.

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Reviewer #2: This study simulated the spatiotemporal soil C dynamics across the global main cereal cropping systems using the RothC model and databases of soil and climate. The impacts of C input management, and soil and climatic variables on SOC changes were also analyzed. With the right reframing of the questions and additional detail, the study may become more novel and useful for the community. I think the study warrants publication in ACP after minor revision.

Authors' Response: We greatly thank the reviewer for their thoughtful comments and understanding of our work.

Detailed comments: 1. There is a focus on three crop residue retention rates (i.e., 30%, 60% and 90%) throughout the manuscript, yet the reason or context for this is not provided.

Authors' Response: As mentioned above, we have provided more information and clarified this in the revised MS: "The crop residue that is retained in the system after harvest can benefit the sequestration of soil carbon in the croplands. The amount of above-ground residue that is retained in the system, however, shows vast spatial disparity and uncertainty across the global croplands. In developing regions such as Asia and Africa, it has been suggested that only approximately 30% of the crop residues are retained in the soils after harvest (Jiang et al., 2012;Baudron et al., 2014). In developed regions such as Europe and North America, however, the crop residue retention rate can reach over 60% (Scarlat et al., 2010;Lokupitiya et al., 2012). Furthermore, in Australia, it has been reported that 100% of the crop residue was retained across 72–100% of the cropping area of the country from 2010 to 2014 (National Inventory Report, 2013, 2015). However, this information is based on rough estimations and/or statistical data. To the best of our knowledge, detailed information on the residue retention rates over a meaningfully large scale of both time and space across different countries and continents is still lacking. Consequently, a scenario modeling approach was adopted to assess the dynamics of SOC as determined by various potential management practices on crop residues. We specified three crop residue retention rates in the present study, i.e., 30%, 60% and 90%." These three scenarios represent the residue retention rates typically adopted in developing regions with relatively poorly managed systems (30%), developed regions with better managed systems (60%), and the areas with well-managed agricultural conservation systems (90%).

2. I suggest authors compare the present results with other modeling studies for SOC changes at the global scale.

Authors' Response: We have further compared the global cropland soil C sequestration rates quantified in this study to the estimations of Lal (2004). The efficiency of the conversion of C input to SOC (i.e., ratio of SOC change to C input) estimated in the present study was compared to that of Campbell et al. (2000) in the revised MS. We found that our modeled results are comparable and fall within the ranges of their estimations.

3. The modeled SOC density would be more valuable if the present results are compared with the observed SOC density in the five continents.

Authors' Response: In this study, we adopted the HWSD soil dataset (can be referred to as the observed SOC density) as one of the model's driving inputs, and our goal was to simulate the soil carbon changes under changing environmental and management conditions during the last half century. As such, the modeled SOC density in the final year is highly dependent on the initial SOC density (HWSD soil dataset, also as the model's soil input data) and the modeled SOC changes. Comparing the soil C changes to the initial SOC density (observed SOC density) is meaningful and useful to extrapolate the regulating effects of soil conditions on SOC dynamics. We assessed the impacts of initial SOC density on the modeled SOC changes in the present study (Fig. 4 and Fig. 5), and found that under otherwise similar conditions, the soil would lose more C with a higher initial SOC density, and vice versa.

4. If a correction coefficient for RothC model be used to model SOC density in rice paddy, the results would be more reliable. I suggest authors discuss this issue by integrating corrected SOC density in rice paddy.

Authors' Response: We have discussed this issue in the revised MS: "Second, the RothC model was developed to simulate the soil organic matter turnover in upland soils (Jenkinson et al., 1990), and it generally performs well in the global wheat systems with non-waterlogged soils (Wang et al., 2016). In the paddy soils, particularly during the rice-growing seasons, the soil C decomposition rate might be reduced when subjected to anaerobic conditions. For example, Shirato and Yokozawa (2005) used the RothC model to simulate the C changes in Japanese paddy soils and suggested

that the model's performance can be improved by modifying the SOC decomposition rates during the rice growing-season. As such, the default parameters adopted in the present study may bias the simulations of the SOC changes across the rice systems are that mainly distributed in the Southeast Asia. In the present study, we adopted the model's default parameters rather than the modified factors from Shirato and Yokozawa (2005) mainly because the rice-growing areas in Japan constitute approximately 1% of the world's total (FAOSTAT, 2017), and the associated climatic and edaphic conditions differ significantly from the other rice systems. We highlight the need to robustly calibrate the model's soil C decomposition rates against the long-term experimental data across the rice paddy soils to represent the different patterns in climate, soil and management conditions of the Southeast Asia in the future."

5. Change "cropland soil organic carbon" to "soil organic carbon in cropland".

Authors' Response: Modified accordingly.

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Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2017-430/acp-2017-430-AC2-supplement.pdf

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