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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 #1: The spatiotemporal variation of cropland soil organic carbon (SOC) across the global main cereal cropping system were analyzed based on the result of soil C turnover model (RothC), and the relationship between SOC changes and C input management, edaphic and climatic variables were also investigated in this article. Though, the modeled SOC may have bias due to the defect of the RothC model and the lack of model inputs datasets, it was still a better way to understand the spatiotemporal distribution of the SOC and its variation in a certain extent. It is very interesting and useful for the carbon input management and investigating the soil C sequestration on

a global scale under the background of climate change. This paper is well presented, but the English of this paper need to be improved.

Authors' Response: We greatly appreciate the reviewer's comments and their understanding of our work. We have submitted our MS to American Journal Experts (http://www.aje.com/) for editing and improvement of the English language.

The following is the concerns: 1.It was confused by direct relationship between the net fluxes of carbon dioxide (CO2) and soil organic carbon (SOC). "The net fluxes of carbon dioxide (CO2) between the atmosphere and agricultural systems are mainly characterized by the changes in soil carbon stock, which. . ." in Page1 Line 10-12. CO2 flux mainly depends on the CO2 exchange between land surface and atmosphere by photosynthesis and respiration of the plant and decomposition of the microbe, but the variation of soil organic carbon was dominated by the carbon input. Detailed physical mechanism was suggested to be involved to link these two terms. And , the same question is also found in Page 2 Line 8-9, "a small variation in soil carbon stock can lead to substantial changes in atmospheric carbon dioxide (CO2) concentrations".

Authors' Response: Yes, we have modified the sentences to the following form to avoid any possible misunderstandings: "Changes in the soil organic carbon (SOC) stock are determined by the balance between the carbon input from organic materials and the output from soil C decomposition. The fate of SOC in cropland soils plays a significant role in both sustainable agricultural production and climate change mitigation." For the second point, we further clarified this in the revised MS: "On a global scale, the soil is the largest terrestrial carbon pool, and it stores approximately three times the quantity of C that is in the atmosphere. Consequently, a small variation in soil carbon stock can lead to substantial changes in atmospheric carbon dioxide (CO2) concentrations". This is a widely accepted view in the existing literature, please refer to Cleveland and Townsend (2006), Davidson and Janssens (2006), Luo et al. (2010), and West and Post (2002).

2.What does the abbreviation stand for? e.g. , GIS, WISE, SOTER, HWSD, . . .

Authors' Response: We have clarified these abbreviations in the revised MS. GIS: geographic information system; WISE: World Inventory of Soil Emission Potentials; SOTER: Soil Terrain Database; HWSD: Harmonized World Soil Database.

3.Why did the authors choose the 30%, 60% and 90% of the crop residue retention rates in this study?

Authors' Response: We have explained and clarified the use of these rates 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 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%).

4."enhancing the crop residue retention rate from 30% to 60% and 90% approximately induced a double and triple SOC sequestration rate, respectively (Fig. 1 and Fig. S3)" in Page 10 Line 20-21. It was difficulty to get the information of a double and triple SOC sequestration rate from these two Figures.

Authors' Response: We have clarified this in the revised MS: "On a global average, the total amount of C input to soils is 1.7, 2.7 and 3.7 Mg C ha-1 under the crop residue retention rates of 30%, 60% and 90%, respectively (Fig. S3). The corresponding annual rates of SOC changes under R30, R60 and R90 were 0.22, 0.45 and 0.69 Mg C ha-1 yr-1, respectively (Fig. 1), indicating approximately doubled and tripled SOC sequestration rates after enhancing the residue retention rate from 30% to 60% and 90%."

5. Because the air temperature and precipitation datasets are the input parameters, there should have some parameterization schemes to calculate the SOC based on the effect of temperature and precipitation in the RothC model. The derived SOC from the model has already included the information of climate change. How did you strip out this effect when attributing the variation of SOC under the background of climate change?

Authors' Response: The quantified dynamics of soil carbon are regulated by complex interactions between C input, climate conditions such as temperature and precipitation, and soil conditions such as initial soil C density and clay fraction. To assess the contribution of each controlling factor to soil C changes, we adopted the Spearman's rank correlation approach, using the cor.test function in the stats package in R. The sign of Spearman's rank correlation coefficient (rho), positive or negative, indicates the direction of the association between the independent and dependent variables. The absolute magnitude of rho, between 0 and 1, suggests the strength of the correlation between the two variables. We have specified this approach in the Methods section and presented the statistical analysis results in the Results section (and Fig. 4).

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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-AC1-supplement.pdf

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