

Answers to Anonymous Referee #2, Nan Lu, 24 SEP 2013

We thank the anonymous referee for his comments. In this reply we address the suggestions for revisions point by point.

Anonymous Referee #2

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General: The manuscript discussed a hot topic: soil organic carbon dynamics. The authors did an excellent job to use a chronosequence sampling method accompanied with a modeling approach to examine the temporal dynamics of SOC following afforestation of former arable land for 6 sites in the Loess Plateau. The results showed that SOC decreased in the first few years at the wetter sites but increased to levels higher than before afforestation after 25 to 30 yr. The accumulation rates of SOC were 1.58 to 6.22% yr⁻¹ in the upper 20 cm of soil. Plus, the simulations by the Yasso07 model reproduced the basic characteristics of measured SOC dynamics, suggesting that litter input and climatic factors were the major causes. The study got plenty of valuable data, including SOC by both direct measurement and modeling, the tree data and the biomasses of fine root and forest floor vegetation. The results are interesting and have been fully discussed in the manuscript. I think the study is innovative and worthy of publishing. However, the data were not shown in a proper way and there are still some aspects needing further discussion, so I think the manuscript need a major revision.

<Reply> Thanks for the general positive evaluation of our manuscript.

Comments:

1. In my opinion, SOC dynamic models should be validated by the data from at least one local long-term observation site (E.g. Lugato et al., 2010; Xu et al., 2011).

<Reply> This is a good point. It is ideal that the modeling results can be validated with data from long-term observation site. However, unfortunately, there is no such a site which monitors SOC dynamics in the study region. That's why we used the space-for-time sampling design to get the time sequence data. The data may have uncertainties as discussed in the paper, but that is the best dataset we can obtain at present.

I'm not sure about the modeling results since the absence of the details of the Yasso07 model in the present study. Considering SOC simulations by the Yasso07 model is a major part of the study, the model should be described in detail instead of just citing former researches. For instance, did the Yasso07 model need soil data as input? If so, soil data input to the model were obtained from the closest met-station or directly from soil sampling?

<Reply> More detailed information about the Yasso07 model were added in the paper. "It is assumed that (1) litter consist of four compound groups, including soluble in ethanol (E) or water (W), hydrolysable in acid (A), and neither soluble nor hydrolysable (N); (2) decomposition rate of the non-woody litter is determined by climate and EWAN composition; (3) decomposition of woody litter is determined by climate, EWAN composition as well as its physical size; (4) decomposition of the EWAN groups results in mass loss from the system, mass flows between the groups and formation of more stable humus (Karhu et al., 2011; Tuomi et al., 2011). The model input includes litter input (quantity and chemical quality of litter), climate (P, T and temperature

amplitude), and standard deviations (SD) of each variable. The model output includes SOC stock and change as well as the probability densities” (line 139-147). The model does not need soil data as input. In the discussion, the model performance was evaluated by using the residual analysis, i.e., correlation analysis of model residual with the soil property indicators, including clay content and C/N ratio etc.

2. The descriptive information of soil and biomass sampling, such as plantation age, should be listed in an extra table for a direct view.

<Reply> The descriptive information of plantation age, mean DBH, height of tree, SOC and fine root biomass samplings was listed in a new table and added in the revised paper.

Site ID	Plot ID	1	2	3	4	5	6	7	8
1	Age (yr)	5	6	8	8	15	26	28	30
	DBH (cm)	2	5.6	5.2	5	6.5	12	13.2	7.1
	Height (m)	2.5	7	5.9	7	7.5	12	15	7.5
	Sampling of SOC ^a	3	4	3	3	5	3	3	5
	Sampling of fine root ^a	4	4						4
2	Age (yr)	5	6	8	9	25	30	30	
	Mean DBH (cm)	5.3	5.2	5.6	5.8	9.2	14.3	13.8	
	Mean height (m)	6	6.5	8	8	12	13	13	
	Sampling of SOC ^a	3	3	7	3	3	5	3	
	Sampling of fine root ^a			5			4		
3	Age (yr)	3	8	9	13	15	30	30	30
	Mean DBH (cm)	2.4	6.1	4.2	11.7	13	11	16.1	13.5
	Mean height (m)	3	6.5	2.5	11	10	8	10	8
	Sampling of SOC ^a	5	4	3	3	6	5	3	3
	Sampling of fine root ^a	5	4			6	4		
4	Age (yr)	8	8	25	30				
	Mean DBH (cm)	5	7.8	10	15				
	Mean height (m)	3.5	7	6	7				
	Sampling of SOC ^a	3	4	5	4				
	Sampling of fine root ^a	4		5					
5	Age (yr)	5	9	9	25	30	30		
	Mean DBH (cm)	6.3	5	5.1	9	10.5	18		
	Mean height (m)	7	6.2	5.8	6.8	6.5	7		
	Sampling of SOC ^a	3	3	3	3	3	3		
	Sampling of fine root ^a								
6	Age (yr)	5	10	15	27				
	Mean DBH (cm)	3.2	6.7	8.2	14				
	Mean height (m)	3.4	6.9	8.2	10.4				
	Sampling of SOC ^a	3	3	3	3				
	Sampling of fine root ^a								

^a the number represents the sample size of each soil depth.

3. The author should check the data carefully. For instance, there is a plot locating between 10 and 20 years in Site 1 of Fig. 4, but missing in Fig. 5.

<Reply> Due to the limitations of time and labor, the fine root biomass of the plantations were not sampled for all of the plots. The text was modified for clarification. “Since the discontinuous age sequence of the plantations and the missing data for fine root biomass at some plots, we assumed that the litter biomass of each component and the total litter biomass changed linearly from 1980 to 2010 (Figs. 4 & 5). The annual litter biomass was estimated based on the linear regression equation for each site.” Line 161-164. This assumption could bring errors to the modeling results. We have been aware of this issue and have discussed it in the paper.

4. I am not sure that whether “the linear regressions are $R^2=0.96$ at $p < 0.05$ ” for all the sites in Fig. 5.

<Reply> We double checked the statistical results. The R^2 and p values were correct.

5. Litter input and climatic factors explained 88–96% of the variations in annual SOC changes at the soil depths of 0–20 cm. The ratio seems to be overestimated and the authors should make sure the data are reliable.

<Reply> We double checked the results and the numbers were correct. Climatic factors (including annual temperature and precipitation) and litter as well as their interactions explained 87.8-96.0% ($p<0.002$) variability of annual SOC changes. For a better clarification, a sentence was added in line 311-315: “Wherein, annual T and P contributed 25.7-66.6%. It is worthy to note that the climate was regulating the annual variability of litter productivity and decomposition simultaneously. The interactions between climatic factors and litter could contribute large fractions of variability in annual SOC changes. ”

6. Explanations should be stated that Why “Figures are not shown for sites 5 and 6” in Fig. 5 and “Data is not available for sites 5 and 6” in Fig. 8.

<Reply> We do not have fine root sampling at sites 5 and 6. The SOC samples of 80-100 cm of depth at sites 5 and 6 are also missing. It is clarified in the text notes.

7. Fig. 2, 4, 5, 6, 7 and 8 should be shown with legend instead of text in note.

<Reply> Thanks for this comment. We modified the figures by putting the legends in the figures directly and reducing the text in note.

8. Page 11193 (page 13), line 11 “The trend of carbon accumulation in the soil was the result from” should be “The trend of carbon accumulation in the soil resulted from”.

<Reply> Thanks. We changed the text accordingly.