

Responses to anonymous referee #2

General comments

Sorry for my late review. I have now arranged to finish my review on this MS by Chang et al., which simulated soil carbon dynamics under different management scenarios in alpine grasslands on the Tibetan Plateau. As mentioned by these authors, a large proportion of grassland area on the plateau had experienced more or less degradation due to intensive grazing activity. Due to this point, it is of great significance to explore how soil carbon pool responds to grassland degradation and restoration. The manuscript is well written, and I only have some minor comments which should be considered during the revision.

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

(1) The authors used Haibei's biomass data to calibrate Century model, and then predicted SOC dynamics in Zeku County. What kind of uncertainties will be produced due to the long distance between Haibei and Zeku?

<Reply> Although long term observations provide the ultimate validation of ecosystem process models, long term records are rarely available, making current calibration and validation of models in Zeku County impossible. By contrast, Haibei Station represents the key ecosystem type- alpine meadow on the Tibetan Plateau, and details of its climate, elevation, soils, N deposition, and seasonal plant primary

productivity are available. We took advantage of this unique opportunity to parameterize the Century model at Haibei Station, and then performed ‘space for time’ substitutions to validate the adjusted model in Zeku County using our observed SOC values. Although Zeku county is about 200 km distant from the Haibei Station, highly similarity between these sites were for climate, vegetation type, soil type and grazing history, etc. This sufficiently similarities ensure that the Century model adjusted at Haibei station can be applied in Zeku county, and the attendant uncertainty with model extrapolation would be minimal. This model extrapolation from site-calibration to regional validation or projection was also widely used in other published papers and was proved to be successful (Feng et al., 2011; Tan et al., 2010; Zhang et al., 2007; Zhuang et al., 2010).

Feng, X. and Zhao, Y.: Grazing intensity monitoring in Northern China steppe: Integrating CENTURY model and MODIS data, *Ecological Indicators*, 11, 175-182, 2011.

Tan, K., Ciais, P., Piao, S., Wu, X., Tang, Y., Vuichard, N., Liang, S., and Fang, J.: Application of the ORCHIDEE global vegetation model to evaluate biomass and soil carbon stocks of Qinghai-Tibetan grasslands, *Global biogeochemical cycles*, 24, GB1013, 2010.

Zhang, Y. Q., Tang, Y. H., Jiang, J., and Yang, Y. H.: Characterizing the dynamics of soil organic carbon in grasslands on the Qinghai-Tibetan Plateau, *Science in China Series D-Earth Sciences*, 50, 113-120, 2007.

Zhuang, Q., He, J., Lu, Y., Ji, L., Xiao, J., and Luo, T.: Carbon dynamics of terrestrial ecosystems on the Tibetan Plateau during the 20th century: an analysis with a process-based biogeochemical model, *Global Ecology and Biogeography*, 19, 649-662, 2010.

(2) I think the authors should at least cite some related references or acknowledge the related scientists when using data from Haibei Research Station since these long-term measurements are not performed by these authors.

<Reply> Yes, we added ‘We would like to thank the National Field Observation

Station of Haibei Alpine Meadow Ecosystem Research Station, Northwest Institute of Plateau Biology, Chinese Academy of Science, for providing vegetation and climate data' in the Acknowledgements section.

(3) Actually, the RMSE in Fig.2 was pretty large, even larger than the average SOC density among different sampling sites, indicating large uncertainties involved in model simulation. The authors should clearly acknowledge this point in the revised MS.

<Reply> Yes, we clearly stated this point in 'Model calibration and validation' section as 'Century model produced a relatively high error with in simulating Zeku County conditions, with light, moderate, heavy and extreme degradation RMSE of 10.04, 12.01, 11.20 and 12.01%, respectively (Fig. 2)' (line 234-236).

(4) There are some clerical errors throughout the manuscript, please carefully check them before final acceptance.

<Reply> We checked the manuscript carefully, and also invited an native English speaker (Dr. A. Wilkes) to check the MS.