Response to Reviewers' Comments

Anonymous Referee #2

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Despite previous reports on China's carbon budget, large uncertainties still remain about how the unique LULC change in China has contributed to the carbon balance. The authors intended to evaluate the influence of climate and LULC change on carbon cycle of China's ecosystems in the last two decades. The topic is interesting, but I have reservations regarding the publication of the manuscript.

Comment 1: The primary concern of the reviewer is whether the CEVSA model robustly simulates carbon fluxes of China's ecosystems. Model outputs are much dependent on model design and parameter choices, and thus it is essential to evaluate reliability and accuracy of model outputs. However, the authors do not establish the accuracy of their model for their task. Moreover, when doing the model spin-up, the authors assumed average climate condition between 1971 and 1990 as the climate condition when carbon cycle of the ecosystems reaches equilibrium. This assumption is unreliable as warming in this period has probably already driven the carbon cycle deviated from equilibrium status.

Ans: Before we used the CEVSA model for simulation, the CEVSA model had been well calibrated and validated by our colleague, Dr.Gu, who is the inventor of the CEVSA model. Please see Gao, et al. (2008) and Gu et al. (2006) below.

Gao, Z.Q. and J.Y. Liu (2008), Simulation study of China net primary production, *Chinese Science Bulletin, 53(3)*, 434-443.

Gu, F.X. and M.K.Cao (2006), A comparison between simulated and measured CO2 and water flux in a sub-tropical coniferous forest, *Science in China, 49 (SuppII)*, 241-251.

With a similar driving condition, one of the first author's colleagues, Dr.Tao, had validated the CEVSA model with in-situ observations at different stations in China (Qian Yanzhou, Changbai shan and Yucheng in Chinese Terrestrial Ecosystem Flux Research Network (http://www.chinaflux.org/en/index/index.asp)). Since the focus of this article is to investigate the differential impacts of climate and land use/land cover changes on the carbon cycle in China (1981 - 2000), these model validation results were therefore not emphasized within our discussion in this article. Some validation results can be seen as follows for reference (Figure 2).

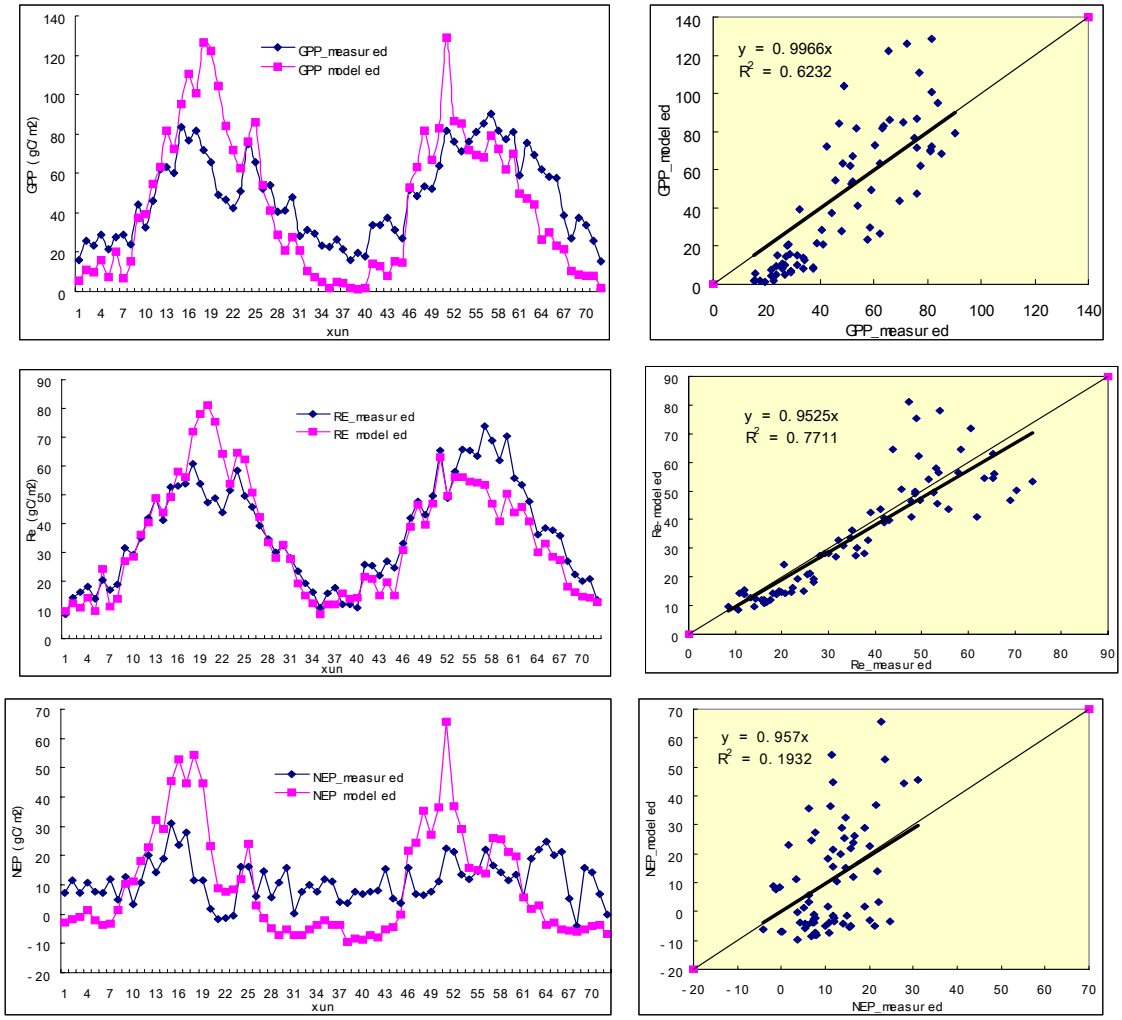

Figure 2. The comparisons between simulated and observed values of GPP, Re, and NEP in coniferous forest ecosystem of Qianyanzhou station.

Besides, the reviewer concerned about the use of equilibrium state in the model simulation. The equilibrium approach is deemed more suitable given that the transient state can have only fluctuations at a smaller scale. For example, on the paper written by Piao et al. (2009) (P.1014): they said "We processed the results of five global ecosystem models to quantify the effect of CO_2 and climate change on the carbon balance of China. These five models are the HyLand (HYL) model, the LPJ model, the ORCHIDEE model, Sheffield-DGVM and TRIFFID. Each model was initialized using a pre-industrial mean monthly climatology derived from the CRU data set and an atmospheric CO2 concentration of 296 ppm, until carbon pools reached steady-state equilibrium." Published by “Nature”. This statement manifests our assertion.

Piao, S.L., Fang , J.Y., et al. The carbon balance of terrestrial ecosystem in China. Nature , 458：1009-1014.（doi:10.1038/nature07944）.

Generally speaking, the simulation method being used by the five ecological models published in Piao et al. (2009) is the same with that of CEVSA model. As far as we know, most ecological process models have adopted the same aquarium approach and this is the way ecosystems function – always in a delicate balance no matter which fluctuation appears shortly as a transient state.

Comment 2: Second, the results reported by this MS are largely different from recent studies with state-of-art estimation. The annual net carbon change reported in this study is 0.017 Pg C/yr, which is one magnitude smaller than that by Piao et al. (2009) who estimated the carbon balance ranging from 0.19 Pg C/yr to 0.26 Pg C/yr using inventory and atmospheric inverse model. Such a huge difference should be noted and preferably be explained. Moreover, the authors suggested that their results were consistent with Fang et al. (2001), which is not the case. Fang et al. (2001) reported nation-wide carbon change of forest biomass (0.021 Pg C/yr), which does not include biomass C change in grassland, shrubland and soil C change under these ecosystems. Thus, the value reported by Fang et al. (2001) is only a portion of net ecosystem carbon change, but already larger than reported net ecosystem carbon change estimated by this study. Moreover, Fang et al. (2007) has improved the estimate of annual carbon sequestration rate of forest biomass to be 0.075 Pg C/yr during 1981-2000, which has a larger difference with value reported in this MS. The authors should carefully interpret previous reports and explain the differences between the estimation of this study and estimations of other previous studies.

Ans: We are not trying to use the CEVSA model to compete with other concurrent research ongoing in China or previous research to prove that which is right or which is wrong in the estimation of annual net carbon sink. Instead, this study is designed to answer one unique science question: would the LULC impact big enough to alter the trend of carbon cycle as compared to climate change? The CEVSA model that had been well calibrated and validated was applied and driven by high resolution LULC data retrieved from remote sensing and climate data collected from two ground-based meteorological stations. In particular, it allowed us to simulate carbon fluxes (net primary productivity (NPP), vegetation carbon (VEGC) storage, soil carbon (SOC) storage, heterotrophic respiration (HR), and net ecosystem productivity (NEP)) and carbon storage from 1981 to 2000 for differential analysis at the decadal scale. Our finding is that because the climate effect was much greater than that of changes of LULC, the total carbon storage in China actually increased by about 0.17 PgC within the 20 years.

It is known that the LULC data in 1980s didn't reflect the results of policy changes in these two decades and these changes mainly include the Six Large Afforestation Projects in China including 1) The Natural Forest Protection Program (1998–2008), 2) the Engineering Program for Returning Farmland to Forest initiated in 1997, 3) the Protection of Forest Program in the Yangtze River system and other key areas, 4) the Duststorm Source Control Project of Beijing and Tianjin (2003–2007), 5) the Wildlife and Natural Plant Species Protection and Reservation Project (2001–2010), and 6) the Fast Growing Timber Forest Bases Project in key areas initiated in 2002 (Liu et al., 2005a, 2005b). The objective of this study is thus to systematically assess the condition of LULC changes in between the 1980s and 1990s and reflects that difference onto the carbon cycle based on a common driving datasets of carbon fluxes and carbon storage in the literature for differential analysis. From these LUCC, we are able to evaluate the differential effect with potential to illuminating and answering one unique science question proposed here: would the LULC impact big enough to alter the trend of carbon cycle as compared to climate

change? Such an analysis led to answer one unique science question: "would the LULC impact big enough to alter the trend of carbon cycle as compared to climate change in the 1980s and 1990s in China?" As to which factors would be more accurate to estimate the overall annual net carbon sink than the others is really beyond the subject matter of this paper. For this reason, we have changed the title of this paper to "Assessing the Differential Impacts of Climate and Land Use/Land Cover Changes on the Carbon Cycle in the 1980s and 1990s in China" to clarify it.

Comment 3: Finally, the MS is not very well written in the sense of organization, as well as language.

Ans: We have edited this version again to improve the readership.