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Interactive comment on "Erosion-induced massive organic carbon burial and carbon emission in the Yellow River basin, China" *by* L. Ran et al.

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Dear reviewers, We thank you very much for your comments on our manuscript.

A quantification of sediment and C fluxes for the Chinese Loess plateau is a significant contribution to the literature. The authors make a good case that sediment fluxes in this river system are large, relative to other basins. There are still very few studies that attempt to quantify the magnitudes of the component sediment and C fluxes. However, the main conclusion of the study is not fully supported by the data:

Firstly, the conceptual framework (Eq. 3) only considers one single atmospheric C flux between the soil system and the atmosphere, i.e., Dc (decomposed OC). The decomposed OC is derived from the difference between the OC in the mobilized sediments

and that in various sediment sinks along the sediment trajectory (Eq. 5). However, soil erosion not only affects the cycling of the OC in mobilized sediments but that SOC dynamics of eroding or depositional environments of the whole basin have been changed due to the lateral SOC fluxes by soil erosion. For instance, it was found that removal of SOC by erosion at the eroding environment causes dynamic replacement of in situ SOC resulting in C fluxes from the atmosphere to the soil system, i.e., a C sink (e.g., Harden et al., 1999;Billings et al., 2010). Therefore, a budget that only takes into account the C dynamics of the mobilized sediments while neglecting the effects of soil erosion on the soil system of the whole basin is only a partial assessment of the role of soil erosion as a C source or sink. The conclusion of the study that erosion on the Chinese Loess Plateau represents a C source then simply reflects the omission of a sink term in their analysis. Several examples of frameworks to assess both the sink/source behavior of eroding basins are available in literature (e.g., Stallard, 1998;Berhe et al., 2007).

"Response: Our study has already taken into account the OC replacement at the eroding sites and the OC dynamics at the depositional lowlands. We agree that soil erosion affects not only the cycling of OC in the mobilized sediments, but also the OC dynamics at the eroding and the depositional sites. At the eroding sites, removal of the topsoils that have higher SOC contents relative to the subsoils would be partly replenished by enhanced carbon stabilization. This has been validated in European and North American watersheds that have humid climate and relatively weak soil erosion (e.g., Van Oost et al., 2007. Science, 318, 626-629; Berhe et al., 2007. Bioscience, 57, 337-346; Harden et al., 1999. Global Biogeochemical Cycles, 13, 885-901).

For the Yellow River with extremely strong soil erosion (>3000 t/km2/yr), arid climate (annual precipitation 300-500 mm only on the Loess Plateau, in the middle Yellow River basin), and serious land degradation, SOC replacement is quite low. Feng et al. (2013. Scientific Report, 3, 2846; doi: 10.1038/srep02846) investigated the ecosystem carbon storage dynamics on the Loess Plateau and discovered its ecosystem had been a C source until 2000 when widespread vegetation restoration programs (e.g., the Grain-for-Green Project) were launched. They found that the annual net ecosystem productivity (NEP) was -0.011 Gt in 2000 and it increased only in recent years. With stronger soil erosion and less vegetation cover before 2000, it is believed that the NEP had been much lower than that in 2000. Therefore, it can be concluded that the OC replacement at the eroding sites over the 61 yr was very weak. Limit of water availability is another important reason for the low ecosystem productivity. Similar to the OC replacement at the eroding sites, OC increment in the depositional lowlands resulting from ecosystem production is also limited during the period.

Although we cannot suppose that the SOC is in a steady state with time, due to the unavailability of SOC data for every year, we assume the used SOC map represents the average SOC replacement dynamics over the period because the soil survey was conducted largely in the 1980s (in the middle of the study period from 1950 to 2010). The SOC of the topsoils used in this study has already been at least partially replaced following previous erosion events. We have more clearly clarified these confusing statements in the conceptual framework description and the result and discussion sections in the revised version."

Secondly, while the authors acknowledge the limitations of their data, the assessment of the uncertainties is rather arbitrary. This study could benefit from a formal analysis of the uncertainties associated with the estimates of the component fluxes and the assertion of a 20% source. This should include all components of Eq. 3 and account for the propagation of errors.

In summary, this paper presents an excellent synthesis of the component fluxes on the Loess Plateau using a broad range of sources and approaches, but a careful reconsideration of their conceptual framework is needed. References: Berhe, A. A., Harte, J., Harden, J. W., and Torn, M. S.: The significance of the erosioninduced terrestrial carbon sink, Bioscience, 57, 337-346, 2007. Billings, S. A., Buddemeier, R. W., Richter, D. D., Van Oost, K., and Bohling, G.: A simple method for esti-mating the influence

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"Response: In this study, we analyzed the uncertainties of OC transport from two aspects. One is the uncertainties deriving from the sediment fluxes in the sediment budget (Eq.1). The other is the uncertainties in the OC contents and fluxes in all the components within the OC budget (Eq.3). Because the decomposed OC is determined through the budgetary calculations and there are uncertainties with each component, we have accounted for the propagation of error for the decomposition component by treating the errors on the individual components as being statistically independent (although not entirely true). A similar uncertainty assessment method was also used by Smith et al. (2001. Global Biogeochemical Cycles, 15, 697-707). We have included these statements and added references to justify in the revised version."

Interactive comment on Biogeosciences Discuss., 10, 13491, 2013.