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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.

Anonymous Referee #1

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GENERAL COMMENTS: Many previous studies have documented the large quantities of sediment transported from terrestrial landscapes into Asian Rivers, including the Yellow (Huanghe) River Basin (Millman and Meade, 1983, Ren and Shi, 1986, Millman et al., 1987, Jionxin, 2003, Weng et al. 2007). The objectives of this new study are to: 1) investigate the sediment and organic 'carbon' redistribution across the landscape in the Yellow River Basin, 2) investigate the amount of carbon decomposed during soil erosion and riverine transport during the period 1950 to 2010, and 3) determine the "fate" of eroded organic carbon by constructing a bulk sediment budget.

The authors assembled organic carbon, sediment transport, and deposition values from previously published literature sources into a basin-wide sediment and organic carbon budget. While I appreciate the significant amount of effort it took to assemble

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this manuscript, I question two main things: 1) whether this study provides enough new material and/or analysis to merit publication as a stand-alone manuscript, and 2) if the appropriate methods were used to meet the stated objectives. I describe these issues in more detail below, along with several other aspects of this paper that I find both challenging and confusing.

SPECIFIC COMMENTS: 1. Except for the derivation of a soil organic carbon term, the budget values were derived from previously published manuscripts or bulletins. This study does not provide a rigorous statistical uncertainty analysis of the derived "hill slope redistribution" or "organic carbon decomposition" estimates, which are the main results of the study.

2. The authors claim that the methods used in this study are better than previously modeled ones, because those have many uncertainties and assumptions associated with them. A bulk sediment budget approach also has many assumptions and uncertainties associated with it too, right? Sections 4, 5.1 and 5.2 of this manuscript describe some of them. Therefore, in the introduction, please give a better description about how the methods used in this study offer something new and improved about sediment and carbon cycling in the Yellow River basin.

3. The methods used in this study do not enable the authors to "determine the fate" of carbon, as this implies that carbon molecules will be tracked from source to sink, using some type of tracer methodology. Therefore, the authors should revise the way that they express their study objectives. One possibility is to state simply that they provide estimates of "carbon redistribution on the landscape" and "organic carbon decomposition".

4. Budgets are often presented with descriptions of key "sources" and "sinks" within the system, yet these terms are not used in the budget description in this manuscript. The authors need to clarify budget terminology and processes affecting source and sink strength. Additionally, some important terms of a sediment carbon budget may

BGD
10, C5867–C5871, 2013

be missing. What about carbon sequestration on the terrestrial landscape following erosion (Harden et al. 1999)? Nutrient additions in agricultural watersheds increase aquatic net primary productivity, so isn't there a possibility that greater carbon can be stored in the Yellow River Basin watershed because of this autochthonous carbon production and storage (Stallard, 1998)?

5. The authors claim (p. 13498, L7), "It is clear that Dc depends on the total eroded OC amount", yet the only evidence for this claim is the equation. It would help if there were literature citations supporting this method for deriving a carbon decomposition term.

6. Constructing a budget or a balance over a sixty year period must assume some steady state properties, meaning that the properties of the basin remain relatively unchanged over time. However, sedimentation rates rapidly decreased between 2000 and 2005 (Wang et al. 2007). The authors vaguely address this (page 13509, 27 -28), but it isn't clear what "we adopted the reconstructed soil erosion rates and then applied it to the study period" really means. Also, it isn't clear why the authors selected this extensive time period. Why not construct a budget for a shorter, more recent time?

7. One of the main findings of this study (p13515, L16 -17) is that 63% of the soil is deposited on land. I assume that the 63% is the sum of the following terms: 30% (dam trapping), 7.7% (slope redistribution), 4.5% (slope soil control), 7.8% (sediment diversion) and 13.3% (channel sedimentation). I would not consider trapping, sediment diversion as the result of water diversion, or channel sedimentation "land" deposits, since the deposition occurs in rivers. Once the proper terminology has been assigned, an interesting comparison study is Meade's (1990) paper which concluded that ninety percent of the sediment being eroded off the land surface of the conterminous United States is stored in river systems between the uplands and the ocean.

TECHNICAL CORRECTIONS In many cases, word choice and syntax could be improved. Here are some specific examples: p.13491, L4: Instead of "sedimentation" author should use "burial". p.13491, L6: Instead of "budgets" author should use "es-

BGD
10, C5867–C5871, 2013

timates". p.13491, L7: The "estimates" of various terms were "assembled" not "analyzed". p.13491, L10, Rephrase this sentence that begins, "Among the produced sediment, approximately 63% of it was deposited on land". An alternative could be, "Approximately 63% of the eroded sediment was deposited on land. . ." p. 13491, L19: "Although with several uncertainties to be better constrained", could be re-worded to read as, "Although several uncertainties need to be better constrained. . ."

p. 13493 L3-5 "With the estimated reservoir trapping (Ran et al., 2013c), this study was to investigate the sediment and organic redistribution". This statement is an important one, as it describes the goals of the study. However, the phrasing is awkward and vague for several reasons: a. Why is the introductory phrase of this thesis statement connected to the 2013c Ran et al. study? b. The word "carbon" is missing after organic. c. The author might consider the beginning the sentence, "The aim of this study was to". d. Is the author's aim to "estimate" not "investigate" the amount of carbon decomposed, right?

p. 13495, L6-7. No proper citation for the Yellow River Sediment Bulletins.

p. 13495 L15 How is the spatial variation of the soil map integrated into the SOC term in the equation?

p. 13496 L21 How is the uncertainty associated with the calculated terms, such as Rs, being addressed?

p. 13497 L20-21 Link the estimate of the Ec term to specific data sources.

p. 13498 Equation (4) Specify what C and S represent.

p. 13498, Equation (5) Connect each term of the equation to specific data sources.

p. 13504 L11-13 Explain more clearly how the variability in erosion intensity was connected with SOC.

p. 13504 L23 Why was an enrichment ratio of 1.1 used in this study?

BGD
10, C5867–C5871, 2013

p. 13505 L10-13 It is not clear to me how the authors “estimated” an OC content Æ§o from previous literature values.

p. 13506 L14-15 It is not clear how or why the sediments trapped by dams were weighted to produce a value of 0.65.

p. 13507 L28 Use specific years (for example, 2000 to 2010) instead of the phrase “modern times”.

Table 1. Heading. Are these “notes” or “literature sources”?

Table 2. Footnote. Why is sediment trapping estimated to the year 2005?

Table 3. Make two different columns, one giving the literature reference, and one giving the “notes” about how the estimates were made.

Figure 2. Use “conceptual diagram” instead of “sketch map”. Aren’t most basins eroding? How exactly does this diagram show the impact of human activity? This diagram illustrates CO2 emissions, but what about CO2 sequestration?

Figure 3. and Figure 4. Are these figures necessary? How do they relate to the stated study objectives?

Figure 5. There is a great amount of spatial variability in soil organic carbon within the Yellow River basin, but doesn’t all this variability get reduced to just one SOC term in the budget?

Figure 6. Consider presenting carbon yields (g m2 yr-1) or carbon fluxes (Tg yr-1) instead of two separate sediment and organic carbon terms in this figure.

Figure 8. Is this figure necessary?

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