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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "Sedimentation in the Three Gorges Dam and its impact on the sediment flux from the Changjiang (Yangtze River), China" *by* B. Q. Hu et al.

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The authors are grateful to the anonymous Referee #3 for his valuable comments, which substantially improved the quality and science of this paper.

1)First of all, the authors construct a linear regression for the post-TGD period based on data from a mere five-year period (2003-2007), which may not provide sufficient information to establish a robust relationship. It would add more insights if the authors could thoroughly discuss the validity and limitations of this approach. In addition, extreme values (outliers) usually dominate the formulation of the relationship. I noticed that the authors excluded extreme floods in 1954 and 1998 in Fig. 4b (p. 5204). In Fig. 2 (p. 5202), however, the extreme value (the cycle in the upper right corner of the figure; I guess it is from year 1998) was not excluded. I am wondering whether the corresponding linear equation presented in Fig. 2 would change significantly when this extreme value is taken out of the calculation. Furthermore, it is clear from Fig. 4b that the linear relationship for the period 1953-1968 is weak. Brief discussions on this point might help to convince the reader on why linear relationship is eventually applied between two stations for predicting purpose.

Author Response: Thank you for your comments! Yes, you are right. A discussion of the validity and limitations of the regression methods were added in Discussion of the revised manuscript. During the extreme floods years of 1954 and 1998, about 100 Mt of sediments were lost in the middle reaches through the river breaches and overbank flows (Yang et al., 2006). This situation also shown in Fig.4a in our manuscript, as indicated by high sediment loads at Yichang but low sediment loads at Datong in 1954 and 1998. Thus, the extreme years of 1954 and 1998 were excluded in the regression between Yichang and Datong (Yang et al., 2006). However, this situation did not happened for the upper reaches, as shown in Fig.2a of the revised manuscript. The sediment load at Yichang synchronously varied with the sediment from the four major tributaries. Thus, the data in 1998 should not be viewed as an extreme value for the upper reaches. Furthermore, the correlation between Yichang and Datong gradually became significant with periods (Fig. 4b in our original manuscript). As indicated by Yang et al. (2006), for the period of 1953–1968, before the impoundment of Danjiangkou Reservoir, the Hanjiang was the largest sediment contributor to the Changjiang below Yichang, and also a large amount (35%) of sediment coming from Yichang was deposited in the Dongting Lake during the period of 1953-1968 (Xu et al., 2007). Therefore, for 1953-1968, the correlation between Yichang and Datong was low. In contrast, after the mid-1980s, the Hanjiang had almost stopped supplying sediment to the mainstream (122 Mt/yr in 1953-1968 compared with 10 Mt/yr in 1986-2002). In the same period of 1986-2002, the sediment depleted in Dongting Lake also decreased to 47 Mt/yr, or 11% of that at Yichang. The correlation between Yichang and Datong in 1986-2002, therefore, became more significant (0.89) in 1986-2002. More detailed information can be found in Xu et al. (2007) and Yang et al. (2006). Brief discussion has been added in the Section 5.3 in the revised manuscript.

Xu, K. H., et al. (2007), Climatic and Anthropogenic Impacts on Water and Sediment Discharges from the Yangtze River (Changjiang), 1950-2005, in Large Rivers, edited by G. Avijit, pp. 609-626.

Yang, Z.S., et al. (2006), Dam impacts on the Changjiang (Yangtze) River sediment discharge to the sea: The past 55 years and after the Three Gorges Dam, Water Resour. Res., 42.

2)Second, according to the authors, "...sediment reduction from the Changjiang to the sea happened even earlier before the TGD. . ." (p. 5188) and "the reduction could be attributed to "the increased reforestation in the lower Jinshajiang basin. . ." (p. 5188). While reforestation in upper stream might be a sound argument, there is another fact which likely contributes to the reduction even though it is normally ignored in scientific studies. The fact is that, at the dam location, the main stream (about 900 m in width) of Changjiang was intercepted (by cofferdams) in late 1997 and the water was discharged through a man-made open channel (about 350m in width) beside the main stream until late 2002 when the open channel was intercepted as well. Considering the geographic location of the cofferdam (located in the turning point of a rough C-shape stream channel), it is possible that the cofferdam could trap part of the sediment within the period from late 1997 to late 2002. The trapping effect is evident from Fig. 4 (p. 5204) that the sediment load observed at Yichang station (downstream of the TGD) gradually decreased in four consecutive years 1999-2002 (extreme flood year 1998 excluded) after the main stream was intercepted.

Author Response: Thank you for your comments! This is an interesting comment, which was ignored in the previous studies. The construction of cofferdams certainly



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may trap part of the sediment load after 1997; however, the amounts of sediment trapped by cofferdams should not be large enough to explain the prior reduction of the Changjiang sediment flux (92 Mt/yr). The sediment load at Yichang synchronously varied with the sediment from the four major tributaries before the TGD operations in 2003 (Fig. 2a in the revised manuscript). This suggests that no systematic changes occurred in the regions between the four major tributaries and Yichang during the pre-TGD period. As shown in Fig.5 in the revised manuscript, the sediment load from Jinshajiang decreased from 280 Mt/yr in 1986-2000 to 166 Mt/yr in 2001-2007, this sharply sediment reduction should be the main cause for the prior sediment reduction of Changjiang sediment flux (92 Mt/yr in the case of no-TGD).

3)Third, two days ago (September 15, 2009), the TGD starts storing water with the goal of elevating the current water level (around 156 m) to the designed normal water level of the reservoir (175 m) in this coming October or November (depending on the amount of incoming water from the upstream). It is highly likely that the approximate 19 m rise in water level would lead to landslides and debris flows at various spatial scales. Both landslides and debris flows yield sediment to the reservoir, contributing to increase in sediment flux at the TGD. It might be helpful to address this point in the discussion to make the study more inclusive. However, I would leave the decision to the authors.

Author Response: Thank you for your comments! The discussion of landslides and debris flows had been added in the last paragraph of section 5.1.

4)Last, there are a couple of minor issues need to be clarified. The authors state that the TGD is "with 181 m in height" (p. 5182). To my knowledge, the height of the dam is 185m instead. In addition, the authors use "Changjiang Water Conservancy Committee (CWCC)" (p. 5182 and p. 5190) in the text. I am wondering whether it is referring to the "Changjiang Water Resources Commission (CWRC)" or not.

Author Response: the TGD is 181m in height, but with an elevation of 185m. The

“Changjiang Water Conservancy Committee (CWCC)” was changed to “Changjiang Water Resources Commission (CWRC)” in the revised manuscript.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 5177, 2009.