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Interactive comment on "Runoff and sediment load of the Yan River, China: changes over the last 60 yr" *by* F. Wang et al.

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Firstly, we'd like to thank Professor Mike Kirby for carefully reading our manuscript for providing comments. The relationship between characteristics of the Yan River (runoff and sediment load) and their driving forces (climate change and human activities) are complex. We hope that this discussion, including our replies below, will contribute to shedding light on these relationships.

1 There is valuable data in this study, but the analysis does little to shed light on the processes that drive the observed trends. I see no value in the Mass curves of normalized anomalies (Figure 4). This analysis shows an upward bulge for any variable with a

decreasing trend and vice-versa, so that the curves add nothing to the trends already shown in figures 2 and 3, and provide a dubious basis for subdividing the period of record.

Fig. 2 is mainly to show the linear trends in river characteristics over the whole study period. The declines were all significant; but there were many points above or below the fitted lines. Sometimes this applies to a series of points in succession, which indicates that within the overall declining trend there are stages in which the observed values deviate from the trend. The mass curves of normalized anomalies make it easier to define these stages. It is true that the overall shape of these curves is always an upward bulge, but we used the curve to find variations that have duration of several years rather than to present the trend over the whole period (this is done in Figure 2). We do agree that subdividing of the whole period of record is, in essence, an arbitrary process, meaning that such subdivision could be done in various ways. However, by using figure 4 we apply a method that is based on the data in combination with some decision rules, rather than on expert judgement alone.

2 It is not always easy to marry the tables with the figures. For example figure 2 appears to show sediment load varying between c. 110 Mt y-1 to c. 500 Mt y-1 with an average of about 200 Mt y-1, whereas table 1 gives values of 1.3, 182.0 and 41.5 Mt y-1 respectively.

The data of sediment load in Fig. 2 and Table 1 are the same. Note that in Fig. 2 the sediment load is indicated by the diamonds, which are at the bottom of the chart.

3 As pointed out in the text and shown in Table 6, siltation, mainly behind check dams, accounts for a total of 2265 Mt, which is several years' mean river sediment load, whichever figure is taken. This issue is left largely unresolved (p1233) but seems to cast doubt on the consistency of the data.

We do not think that this casts doubt on the consistency of the data. However, it does demonstrate why it is difficult (if not impossible) to determine which part of the ob-

served trends is caused by climate change and which part by human activities. It is beyond doubt that human activities have a huge influence in the catchment, as demonstrated by e.g. the number of check dams and by the amount of sediment that was deposited behind them. However, what we cannot say is what the sediment load at the catchment outlet would have been if these structures had not been there. Some of the sediment that was now trapped behind check dams would have deposited elsewhere before reaching the outlet, while conversely, erosion downstream of the check dams might have increased because the deposition of sediment behind check dams resulted in lower sediment loads in the water, and thus a higher difference between transport capacity and actual sediment load. This might have resulted in erosion downstream of the check dams. The sediment load data at the outlet (Ganguyi Hydrological Station (GHS)) are the integrated result of everything that happens within the catchment, and are thus influenced by many factors including siltation of reservoirs, check dams, other soil and water conservation measures, land use change and climate change. The sediment delivery ratio (SDR) from the slopes is also changing all the time, and might also be a major cause of less sediment load at GHS. Therefore, we think that our data only allow us to draw the conclusion that both climate and human influence were important. This is not due to inconsistency in the data, but to the complexity of catchment response.

4 Since sediment load is very strongly driven by extreme events, it is difficult to read much into any analysis based on annual totals. What I would recommend is to analyse the daily (or even monthly) data which should underlie the annual data presented, trying to identify changes in the relationships between daily rainfall, daily runoff and daily sediment concentration (or load), which are more likely to show the impact of management, whether through land use change or through engineering structures.

We fully agree that extreme events cause strong soil erosion in the Loess Plateau. We have mentioned this in the manuscript too, although we have not expanded on it much. However, the rainfall pattern (seasonal distribution and times) has not changed

greatly in the research period, and thus cannot explain the trends that we observed. The occurrence of extreme events could, however, cause deviations from the trends for individual years. Hence, the occurrence of extreme events might be one of the main reasons for the seemingly random differences between years that remain after considering the overall trends as well as the differences between the different stages that we identified. The detailed impacts of rainfall events on soil erosion and sediment load are quite complex and highly localised and this complexity could not be captured by the approach taken in this manuscript. The current manuscript provides more an overview based on relatively simple methods. We agree that we cannot draw detailed conclusions from our analysis, and have therefore refrained from giving any percentages on the contribution of climate and human factors. We do take your point that an analysis of daily (monthly) data might enable us to draw firmer conclusions on the impact of management. This, however, requires a different approach than we have used in this manuscript.

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