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Interactive Comment

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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We are very pleased to receive the interactive comments published on April 25th 2013 by an Anonymous Referee. These comments mainly concerned the methods used for statistical analysis (comment 1, 2 and 3) and the scale of research (comment 4) that are very important in hydrologic analysis. We respond to these comments below.

1. In several instances in the manuscript, the results of the statistical analysis are indicated without units (For instance, '(t, t_{max} and t_{min}, respectively) all increased significantly during the research period. The changing rates of t, t_{max} and t_{min} were 0.038, 0.019 and 0.046, respectively') .

- Thank you very much for your comment. You are right. We will add the units wherever needed in the new version.

Though this would be normally interpreted as an oversight, the authors do compare the magnitude of the long term trends in the different variables, although they are not directly comparable. For instance, in the conclusions they state 'The annual runoff, sediment concentration and sediment load all have significant trends of linear decline in the last 60 yrs (Fig. 2). The runoff decreases faster, with a rate of slope of 1.32, than sediment load (0.71), and therefore the decreasing rate of sediment concentration (induced from ratio of sediment load to runoff) was very big (2.34).' The sentence is really meaning less because the regression slope for runoff has completely different units than the trend in sediment load. If runoff had been measured in G m^3 instead of M m^3, the trend would have been numerically much smaller. This indicates, in my opinion, that the authors have applied the statistical analysis as a sort of black box method, and did not take much care in its interpretation.

- Our main aim with this analysis was to detect trends of runoff and sediment load over time. We thank you for reminding us that the slope of the regression equation does not allow direct comparison between the different variables. We will adapt the manuscript accordingly, and will also add the units of the variables. In addition, we will add information on the degree of change expressed as a percentage.

2. My second major concern is the use of mass curves to display the data. The mass curve is approximately a sort of accumulated deviations (from the long term mean) over time. But when the authors refer to the mass curve, they translate them for the reader in terms of actual deviations from the long term mean, without really using the mass curves themselves. One example can be found here '10 Over the whole study period, the mass curves of t, t_{max} and t_{min} showed similar changes by declining first and then rising; the changing points of t and t_{min} were at 1988 and t_{max} in 1996. This indicates that mean annual t and t_{min} before 1988 were smaller than the mean for the whole period, but that after 1988 they were higher than the mean of whole process.' Why do not describe the data in terms of the observed deviations directly? The stages

defined by the mass curves can be much more easily identified in the deviations from the mean directly, than in in the accumulated deviations. The mass curves represent an integration of the process, but then the authors had to resort to discuss the time derivative of the mass curves, i.e. the original series.

- It is true that the mass curves provide information on the cumulative deviation from the long term mean. This means that if the mass curve is rising, the deviation is increasing, while if the mass curve is falling, the deviation is decreasing. This makes it easier to identify the changing points at which there is a change in the trend. This is more difficult to accomplish with the observed data directly, although we agree that this could be done. However, the observed original series changed so fast (Fig. 2) that it is more difficult to abstract the stages directly. Hence, we use mass curves mainly as a tool to more easily identify the different stages. The mass curve of accumulated anomalies allows us to use simple (if admittedly arbitrary) rules to define stages and the changing points between them. We set the rule of "If the continuous change lasts more than 3 yrs, it was treated as the same stage" to reduce the noise, which allowed us to identify a few relative long term stages rather than many short stages.

- We used the normalized values of anomalies which does not only show the same relative change of mass curves generated from the original data, but which also allows for easier comparison because data series of anomalies starts and ends at 0, and because it is without units.

3. To better identify the anthropogenic influence, the authors define paired years in which precipitation and temperature were similar, but that displays different values of the sediment transport. The definition of similar years is also weird: years with values of precipitation and temperature with less that 1% difference. For precipitation this would make sense, but not for temperature, because the 1% threshold depends on the units of temperature that one is using, and these units are arbitrary. A researcher using degrees Fahrenheit or Kelvin would find different similar years. Actually, using Kelvin, most years would fall within the 1% threshold.

- We set thresholds of annual precipitation and temperature to select paired years with similar weather conditions because runoff generation and soil erosion (and sediment load) are impacted by integrated factors and we should simplify the discussion by comparing years that were similar from a meteorological point of view.

- It is true that the value of the threshold represents a different degree of similarity based on the units that are used. However, the value itself is arbitrary too, and could also be changed. The thresholds in the manuscript can be set according to aims of research and the criteria are changeable. If we set a stricter criterion, there will be less paired years to compare, but the years that would be selected would be more similar. Hence, the main issue here is not the threshold value or the units, but to pragmatically select a threshold that results in a sufficient number of paired years that are still similar enough to allow some useful comparison between them.

- We agree, though, that we should have added the units. We will add the units after temperature and precipitation.

Of course, the results of the analysis cannot depend on an arbitrary choice of units. A more proper way to define similarly in this context would be to choose years that deviate less than a certain threshold of the long term standard deviation. This definition is units-independent.

- Although we agree with this remark in principle, we would like to point out that in practice the use of actual measured values is easier, and that besides the threshold is arbitrary anyway since not only the units but also the threshold value is arbitrary. This is not a problem as the threshold is only a tool in selecting an appropriate number of years that are similar from a meteorological point of view; the threshold is not an aim in itself.

- Nevertheless, we will try out the use of a units-independent threshold to see if this improves the identification of paired years.

4. The final conclusion, namely those anthropogenic factors must play a role because methodologically similar years display different sediment transports, may be correct, but I found it very weakly substantiated. As the authors wrote, a mean value of temperature and in particular of precipitation, may hide huge difference in the distribution of daily or weekly values, which may strongly influence runoff and sediment load, at least in theory. Flash flood caused by heavy rain during a few days is a clear example. Thus, there can be many more meteorological factors than can explain these differences without necessarily invoking the anthropogenic contribution. Probably, the causes put forward by the authors contain a portion of truth, and they sound reasonable. But the analysis should go deeper to really pin-point those factors.

- Yes. The great storm events are the most important influencing forces of runoff generation, soil erosion on the slopes and sediment load of river. The monthly data must indeed hide huge differences of rainfall events. Generally, the more detailed the data, the more accurate the analysis that can be performed. However, data availability is a problem, especially at the scale of the whole river basin. In our research basin, the weather and hydrological stations are not dense enough to draw a very fine picture. Besides, for larger areas the analysis is complicated by the fact that rainfall is not only very unevenly distributed over time, but also over space. The time series of runoff, sediment load and sediment concentration provide information on the integrated response at the level of the whole Yan river basin. To analyze conditions at catchment scale using these data, we therefore need to simplify the analysis by looking at average rainfall rather than at high resolution rainfall data. In future work we hope to apply more physically based methods that would allow the use of more detailed data (as far as these are available, e.g. event, daily or weekly data), and we intend to compare these results with the results of the statistical methods that we have applied in the current manuscript.

- Scale and scale problems beset the research all the time. Based on our experience, the proper scale of influencing factors should be decided according to variability of these factors and their response, e.g. the single storm event would be better for analysis at the plot or slope scale, but the single storm events perhaps cannot be used for the scale of basin because their unevenness both in depth and intensity and/or geographic distribution when we use the statistical models.

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