

Interactive comment on “Using the UKCP09 probabilistic scenarios to model the amplified impact of climate change on river basin sediment yield” by T. J. Coulthard et al.

Anonymous Referee #2

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Review of Using the UKCP09 probabilistic scenarios to model the amplified impact of climate change on river basin sediment yield, by Coulthard et al.

This paper discusses the potential changes to sediment yield in a small river basin caused by climate change. It is a very important topic, and the method employed is according to the authors novel, which would merit publication in HESS. First of all, I would like to state that the paper is nicely written, and the introduction is excellent, it puts the paper in context. However, I have some remarks on the experiment setup as well as the interpretation of the results. I therefore recommend that the paper undergoes a

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major revision and is then resubmitted.

Scientific content The first major remark is the use of the UKCP09 generated series. I understand that a sample of the climate runs has to be made because of limitations to computational time, and I agree that the sample selection is reasonable. However, it is not clear to me how the precipitation series were put together for a specific run. The authors mention that 5 tiles were used that overlapped the area. Was the driving data then the average rainfall from these 5 tiles? As I understand, the weather generator is a stochastic tool, which means that the grid points are uncorrelated in space and time. This makes them not useful for creating realistic catchment averages of rainfall, and therefore also not useful in hydrological studies. Moreover, how do the points overlay the catchment? And how is the overlying 25 km grid, from which the change factors are calculated, related to the 5 km grid and the catchment? These points are not clear to me, and the effect they may have on the rainfall and runoff needs to be clarified.

The second major remark is the use of the baseline runs. As I understand, the baseline runs were not run with any influence from the climate model, purely by the weather generator? This is good, but it does not tell you anything of the influence of the climate model over the same period. To create a control run, with which you compare against future scenario run, you would have to run simulations driven by the three scenarios over the period 1961-1990. As I understand, this information is not available from UKCP09 weather generator. This makes future scenarios very difficult to assess, since you are not comparing like with like. This is obvious from Figure 4 and table 1, where there is a larger difference between the baseline (which I would interpret as a proxy for observed values) and the scenarios (both in terms of mean and percentiles) than between the time periods of the scenarios themselves. Without any information about how the scenario-driven weather generator behaves over the control period, it is impossible to quantify the bias in the climate models. I understand that this is not possible to address fully within the study, but if it is not addressed, the results are not valid.

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The third remark is on the treatment of extremes. Firstly, climate models were not constructed to give information on extreme events, rather on changes in the mean climate (where they are more robust), so any assessment of changes to extremes has to be taken with great care. The authors have addressed this in table 2 where the 5 and 95% percentiles are used as the lower and upper limits. However, in Fig 6, the high scenario indicates values of daily rainfall of almost 300 mm which results in maximum runoff almost 500 m³/s, which seems physically unrealistic, even under a changed climate. In figure 5, the different aspects of the high scenario are discussed, and the impact on the peaks around 700000 m³ are discussed, and this is a reasonable result, however, the impacts on the very high yields are very questionable given the extreme values of precipitation and runoff.

The paper sets out to assess the a probabilistic framework of climate impact on sediment flow, but it lacks an uncertainty estimation from the different sources of the chain. It is a complex system, and the authors mention the sources of uncertainty, but there is no attempt to estimate the contribution of each source to the final uncertainty.

Presentation The introduction is very well written and gives an excellent introduction to the subject and where this study fits in with the literature. However, there is no connection with the previous literature in the discussion. I would suggest a comparison with previous work to show the benefit and advances. The results from the sediment yield is presented and discussed before the rainfall and runoff, and I would suggest to do it the other way around. Sections 2, 3 and 4 are related to descriptions of methods and study area and could be put in one chapter with sub headings.

Figures Figure 2b is described as histogram, but it is a frequency-intensity diagram

Figure 3 is very difficult to interpret because of all the experiments. The information is nicely presented in figure 4, so I would suggest deleting figure 3, or present a few cases as examples

Figure 5. The black dots sometimes shadow the grey dots. I would suggest using

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different symbols to be able to show both .

Figure 8 is not very clear to me, as well as the discussion, and this needs more explanation.

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