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Hydrology and Earth System Sciences Discussions

Interactive comment on "Detecting the long-term impacts from climate variability and increasing water consumption on runoff in the Krishna river basin (India)" *by* L. M. Bouwer et al.

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General comments

We welcome the compliments of the reviewer on our paper. The paper is indeed not always overly clear on what is meant by impacts from climate variability (factor a) or (anthropogenic) climate change (factor b). In our revised draft we have more clearly defined the three factors mentioned by the referee. However, we have carefully chosen this division since our main objective is to differentiate between the effects of man-made hydrological developments and climate variability at the basin scale - climate variability including both natural and anthropogenic induced climate change. Furthermore, it is very difficult to separate natural climate variability from anthropogenic cli-

mate change at the regional or local level. Attempts have been made, for instance, to attribute regional temperature trends to either natural variability or greenhouse gas emissions forcing, see e.g. the study by Stott (2004). Such studies suggest that uncertainties of attribution of temperature changes increase with reduction in spatial scale. Changes in precipitation are even more difficult to attribute, according to a recent review (IDAG, 2005).

Therefore, to indicate the contribution of anthropogenic climate change relative to water consumption, as the referee suggests, is probably not possible at this scale. Such an indication is also not possible without the aid of general circulation models that could be used to estimate the local anthropogenic contribution to local climate change and climate variability. We however now address this difficulty in our revised paper and use the above elaboration and references.

Detailed comments

1) We agree, and have used the suggested replacement in the revised paper.

2) We agree, and we have now added “(1901-2000)” in the revised paper.

3) We agree; “natural” has been deleted.

4) We agree; and have replaced with “studies on water availability”.

5) We have replaced with “observed climate variability (natural and anthropogenic climate change) versus human water use on runoff variability at the river basin scale”.

6) We agree, and have replaced with “arises of how much water would have been”.

7) Indeed, the climate inputs into the model consist of temperature and precipitation. Other factors that may influence the water balance and in particular evaporation, such as radiation, wind speed and humidity, are not included in the model. We have now mentioned this in the revised paper.

8) Indeed, this comment applies to the period 1901-1915. Already during this period

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many (small) reservoirs are present in the basin. However, in order to avoid confusion, we have added a sentence explaining that we mean the small reservoirs, and not the larger ones constructed after 1947.

9) This sentence indeed only applies to the period 1901-1960; we have mentioned that in the revised draft.

10) There may indeed be reasons for this difference. It can be caused by the fact that the STREAM model is too sensitive to changes in precipitation. This can be a result from the fact that certain storage processes in the model (groundwater, and soil moisture) are not accurately represented. We have added these points in the revised text.

11) Yes, the continuity of the bias of 50% is just an assumption. We have now replaced the sentence as suggested.

12) We agree that this could be misleading, and have added "(as defined by the coefficient of variation)".

13) We agree, and have added the text "over the period 1991-2000".

14) We agree, and have added "observed", as suggested.

15) This is not particularly clear for the period 1951-1960; we have deleted this sentence.

16) We agree that this may be a rather obvious statement, however, we need to explain that the results are comparable.

17) We have now added the standard deviations of precipitation and runoff in the revised paper.

18) Same as 17.

19) We have now added "(squares)" in the caption of Fig. 1, as suggested.

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20) We have added an outline of the contour of the river basin in Fig. 5, as suggested.

References

Stott, P. A.: Attribution of regional-scale temperature changes to anthropogenic and natural causes, Geophys. Res. Lett., 30, 1728, 2004.

IDAG: Detecting and attributing external influences on the climate system: a review of recent advances, J. Climate, 18, 1291-1314, 2005.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1249, 2006.