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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 are thankful for the positive remarks from the reviewer, and for the detailed reading and useful suggestions. Below we respond to the more detailed comments.

Specific comments

1) Indeed, the effect of reservoirs and irrigation has two aspects. First, irrigation may affect the annual water budget, and secondly, the structures that capture the water (dams and reservoirs) may affect the annual cycle. We have now mentioned these two aspects in the introduction of the revised paper, where the objectives of the study are

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discussed.

2) We welcome the suggestions of these three references (Döll et al., 2002; De Rosnay et al., 2003; Haddeland et al., 2006), and we have mentioned these papers in the introduction. We now also come back to the findings reported in these papers in the discussion section of our revised paper.

3) We agree with the referee that the term “runoff” may be confusing in places where actually “river runoff” is meant. In the revised paper we have replaced the word “runoff” with “river runoff” in the appropriate places.

4) We agree that “reservoir filling” is not an appropriate term; we have replaced this by “irrigation during the monsoon”.

However, we do not agree with the referee that there is only very few irrigation from December to May, which may hold on average for the whole of the Indian subcontinent. However, for the Krishna basin area, widespread irrigation does occur during the post-monsoon season (December-May), in double-cropped irrigated areas fed by water from large reservoirs. This was observed during field visits and can be seen from independent observations using remote sensing of vegetation phenology (Biggs et al., in press) in these irrigated areas. Irrigation during this period would lead to return flows, and therefore to increased river runoff during the post-monsoon season, relative to the model simulation. We have added these arguments and these two studies in the revised paper.

Indeed, irrigation in the monsoon season could also lead to an increased base flows through increased soil runoff, and we have now mentioned this as well in our revised paper. We probably cannot solve the question what are the relative roles of irrigation and reservoir filling in river runoff decrease during the monsoon. For this we would need reservoir filling and operation data, but this could be an interesting topic for further research.

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5) Indeed, it may not be entirely clear what additional evaporation is meant here. What we mean by “additional evaporation” is indeed evaporation due to (additional) irrigation using water from the major reservoirs, including the evaporation from reservoirs and the field. We have mentioned this in the revised text in order to be clearer. The estimate of additional evaporation was obtained by computing the difference between adjusted and original annual river runoff, we will mention this as well in the text.

With regard to Equations 2 and 3, and the damping factor, these indeed replace physical processes that play a role in the changes in runoff. We have mentioned in the revised paper that the Equations 2 and 3 rather correct the output from the STREAM model (as described in Appendix A). To avoid confusion, we have now let river runoff be Q, both in Equations 2 and 3, and in Appendix A.

Technical correction

We agree and have removed drinking water in the revised text, as it is a negligible factor.

References

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