Hydrol. Earth Syst. Sci. Discuss., 8, C3751–C3753, 2011
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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrological responses to climate change conditioned by historic alterations of land-use and water-use" *by* J. Jarsjö et al.

Anonymous Referee #1

Received and published: 1 September 2011

Summary:

This paper evaluates the change in actual evapotranspiration over the Aral Sea drainage basin and the possible resulting river discharge depletion. Changes due to climate change are compared to the impact of a future irrigation and non-irrigation scenario. For the climate change assessment 20 GCMs of the AR4 assessment report are used and the discrepancies and resulting uncertainties are discussed. In addition changes and ensemble uncertainties between the AR4 and TAR models are evaluated and results show that the uncertainties between GCMs have decreased over time.

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Interactive Discussion
Discussion Paper

Changes are assessed both by applying change factors to observed precipitation and temperature (CRU data) and by direct forcing of the hydrological model with GCM data.

General comments:

The introduction clearly states the relevance of this study and seeing the dramatic decrease in discharge in the basin this case study certainly is of interest to HESS. Yet, the study follows in a long row of hydro-climatic impact assessments and, although the others already made a thorough attempt to give an extended uncertainty analysis, I would like to see this analysis extended with the following points before the paper can be published in HESS:

- From the manuscript it is unclear how the authors consider the seasonality of changes in precipitation, temperature, runoff and discharge and the possible biases in seasonality of temperature and precipitation calculated by GCMs. The timing of precipitation and evaporation maxima and their coincidence will also have a major impact on resulting river discharge. Were the GCM projections applied on a monthly time-scale to the CRU precipitation and temperature? The authors should consider this change in timing and seasonality and its impact as well.

- Page 7600, section 2: In this section a description of the basin is given. According to this section river flow is only depleted by irrigation. Is there any other water use (drinking water, industrial, domestic) in the basin. And if so, what percentage of total water use is covered by irrigation?

- Page 7602, section 3.1,line 10: ET is calculated with the Turc equation. Given the relevance of ET for this study, please give the equation and the motivation for using this equation. The references to work of Shibuo et al. 2007 and Asokan et al 2010, do already give enough information on the impact of the uncertainties in ET equations.

- Page 7602, section 3.1, line 8: “network-routed sum of locally created average precipitation surplus”. What routing technique is applied? Is a routing scheme included?

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Is there a realistic delay in river flow, which is certainly of relevance in a basin of this size. Is open water evaporation from the river considered? And would this impact the results of the study?

- Page 7603, section 3.2, line 27: "Results for the future period are then based on adding the GCM change projections". Please clarify how this was done. Were the changes projected on an annual or monthly base? Were the changes projected for each GCM individually and were the resulting ET, R and Q results averaged or were the GCM average P an T projections used?

- Page 7604, section 3.2, line 5: Unclear, see comment above, ET change for each GCM individually or ensemble average ET change?

- Page 7605, section 4, line 5: The authors state that the GCMs projected quite different changes in P. Did they consider the fact that averaging opposite changes will result in a relatively modest ensemble average change projection in ET, Q and R?

- Page 7607, section 4, line 8: The authors discuss a non-linear R response over time. Is this non-linear response really related to changes over time or is this response caused by the use of observational data for the historic period and use of GCM data for the future period? The authors do state that the non-linear response can already be derived from the observed data. Yet, I would like to see this analysis extended with the derivation and comparison of R changes derived from both GCM and observational data over a similar historic period (Fig. 3).

- The authors consider a non-irrigation scenario. Is this a realistic scenario in the ASDB? Are there possibilities for less intensive irrigation? Please mention this in the discussion / results section.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 7595, 2011.