Hydrol. Earth Syst. Sci. Discuss., 7, C2805–C2810, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C2805/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Assessment of climate change impact on hydrological extremes in two source regions of the Nile River Basin" *by* M. T. Taye et al.

Anonymous Referee #3

Received and published: 11 October 2010

This paper is about the impacts of climate change on hydrology and hydrological extremes in two catchments in the Nile basin. Two conceptual hydrological models (VHM and NAM) are forced with a selection of 17 simulations from different GCMs and two SRES scenarios. Downscaling of GCM results is done using a frequency perturbation downscaling approach. The study combines existing models and methods to estimate variability and uncertainty in impacts of climate change on hydrology due to different causes: different regions, different hydrological models and different GCMs and SRES scenarios. The paper is reasonably written, moderately structured and within the scope of HESS. General comments, specific comments and some technical corrections are

given below.

General comments

- The structure of the paper can be improved at several points. First, the study area is described in the 'Introduction' section while it would be better to have a separate 'Study area and data' section (section 2). This section can then also include a description of the data (currently in 'Hydrological modelling' and 'Developing climate scenarios' sub-sections, page 5446 lines 6-16 and 22-25 respectively). Second, the structure of the 'Results and discussion' section needs to be improved. This section now starts with a description of the VHM model, that, although it is a result of the identification procedure employed, would be more suitable to include in the 'Hydrological modelling' sub-section. Furthermore, I would expect a sub-division into sub-sections more or less according to the different steps in this research and the different sources of uncertainty. For example: comparison observed data and GCM results, calibration and validation results of hydrological model, impacts using different GCMs and scenarios, impacts using different hydrological models and impacts for different climatic regions.
  - The description of the construction of climate change scenarios at the catchment scale is not very clear and complete. First, GCM simulations are selected according to their ability to simulate the current climate as represented by observations. How were the observations and GCM results compared? For which area and at which spatial scale? Has the difference in spatial scale between observations (point scale) and GCM results (200-300 km) been taken into account (see e.g. Osborn and Hulme, 1997; Sivapalan and Blöschl, 1998; Booij, 2002)? The methodology is very briefly described with a reference to a 'similar' approach and should be described more extensively. Furthermore, at least a summary of the results should be presented (figures and/ or tables) and discussed. Second, the meth-

ods and results regarding the frequency perturbation downscaling approach are not very clearly described. For instance, which information from GCMs has been used to perturb the observed potential evapotranspiration? Has the difference in spatial scale between observations and GCM results been taken into account when perturbing potential evapotranspiration and rainfall time series? What is probabilistic in this method: both the wet day perturbation and the intensity perturbation? How realistic is the random removal or addition of wet days in a time series; for instance isn't there any temporal correlation?

Specific comments

Abstract

- p5442, l14-17: The description of the results is somewhat brief. Please try to be more complete and include the most important conclusions.

Introduction

- p5442, l20: Provide some examples of relevant impact studies worldwide.
- p5443, l10-11: Which results have been obtained for Lake Tana and Nyando catchments in these studies?
- p5443, l11-13: How were the changes in climatic inputs translated to changes in hydrological regimes in these studies/ which methods have been used?
- p5443, l15-16: Although not widely investigated, could you give some examples of hydrological climate impact studies where different hydrological models, resolutions or parameterisations have been used?

- p5443, l20-29: Please clearly indicate in the objective of the paper that besides 17 GCMs and two SRES scenarios, also two different hydrological models for two catchments are applied.
- p5444, l14-21: What is the relation between the monsoon-type climate of Lake Tana catchment and the ITCZ?
- p5444, l25-26: Please include the surface areas of the two catchments and some geographical information (e.g. elevation and land use distribution).

Materials and methods

- p5445, l9-25: The description of the VHM model is not very clear and needs some clarification. Although the structure will be identified based on time series analysis it would be helpful if some kind of flow diagram of the model is given (the same for the NAM model).
- p5446, l1: How subjective is the calibration of the NAM model? Would the calibrated parameter set be very different when another modeller had calibrated the NAM model? Shouldn't the same calibration method be used for both the VHM and NAM model?
- p5446, l4-5: Which goodness-of-fit statistics have been used in the calibration of VHM and NAM? Also goodness-of-fit statistics related to extreme flows?
- p5446, l8-10: Which method has been used to calculate the weighted averaged time series for rainfall and potential evapotranspiration?
- p5446, l10: Is "Allen et al., 1998" the original reference for the Penman-Monteith method?

- p5446, l22-25: This data description does not seem to be consistent with the data description in lines 6-16 on this page.

Results and discussion

- p5450, l8: How is the water balance discrepancy (WBD) defined?
- p5450, l15-17: In which way were the VHM model results given higher credibility; quantitatively or qualitatively?
- p5452, l1-5: This study could be introduced already in the 'Introduction' section.
- p5453, l1: Fig. 5 is not very clear. What is the change factor in Fig. 5?
- p5453, l9-12: Also Fig. 4 is not very clear and therefore it is very hard to derive the changes of high and low flows from this figure.

Conclusions

- p5454, l8-9: This conclusion seems to be doubtful. The performance of both models for Nyando catchment is much worse compared to the performance for Lake Tana catchment, at least in terms of NS efficiency. Please discuss the reasons for this large difference in performance. And what are the results for the validation period?

Technical corrections

- p5442, l19-20: "an increase in greenhouse gases" instead of "greenhouse gases"
- p5443, l1: "Yates and Strzepek 1996" instead of "Yates and Strzeperk 1996"

- p5446, l27-28: "Anderson et al., 2006" is not in the reference list
- p5448, l21: Introduce Fig. 1 already in the 'Study area' paragraph

References

- Booij, M.J. (2002) Extreme daily precipitation in Western Europe with climate change at appropriate spatial scales. International Journal of Climatology, 22, 69-85.
- Osborn, T.J. and Hulme, M. (1997) Development of a relationship between station and grid-box rainday frequencies for climate model evaluation. Journal of Climate, 10, 1885-1908.
- Sivapalan, M. and Blöschl, G. (1998) Transformation of point rainfall to areal rainfall: Intensity-duration-frequency curves. Journal of Hydrology, 204, 150-167.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 5441, 2010.