**Hydrology and
Earth System
Sciences
Discussions**

Interactive
Comment

Interactive comment on "Impacts of climate change on Blue Nile flows using bias-corrected GCM scenarios" *by* M. E. Elshamy et al.

M. E. Elshamy et al.

The authors thank the referee for the constructive comments and for bringing the attention to the Budyko curve analysis. We would like to draw the attention of the referee that the climate of the upper Blue Nile basin is classified as highland climate (Shahin, 1985) as the average elevation of the region is above 1000m resulting is moderate temperatures throughout the year and average rainfall exceeding 1200 mm annually. However, the region shares some characteristics with semi-arid zones such as a relatively low runoff coefficient (about 20% for the whole sub-basin) and an annual evapotranspiration rate exceeding rainfall (PET/P ranges between 1.0-1.5). The bulk of the annual discharge is generated during the flood season where rainfall greatly exceeds evapotranspiration. Plotting annual discharge versus annual rainfall as suggested indicates that below 500mm of rainfall, runoff may not be generated.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Conducting the Budyko curve analysis and plotting some suggested alternative curves (Zhang's and Choudhury's) (Donohue et al., 2007), we found that the sensitivity results do not follow any of the curves and have a steeper slope in this region (it was not possible to submit the figure in this online comment). Simulation results for the baseline and the future do not follow any of the curves. This may be an effect of vegetation, a model deficiency, or simply because these curves are inherently simplified models, i.e. they are subject to deficiencies. We could fit a similar curve to the sensitivity results or the future ensemble results but we are not sure this would be more beneficial than the developed linear relationships between temperature, precipitation, and flow. The inverse distance gauge-based estimate of rainfall does not calculate residuals but interpolates rainfall from the gauges. The weight for a gauge is modified by its climatology using an exponential function of its distance (the further the gauge, the more the effect of the climatology). The details of the method is given in Elshamy (2006).

We agree with the reviewer that showing all the fluxes in the same unit would help appreciate their respective ratios to the main input (rainfall). This will be revised in the next version. We also agree that a flow diagram will help understand the procedure and connect the models with the used datasets. We tried to be brief in describing the downscaling scheme as it has been described in the referred paper. The spatial downscaling is achieved through the bias correction of distribution of the GCM grid-cell for each of the 20x20 km pixels falling within it as described in lines 21-24, page 1414. Increasing CRU-based PET by 10% was necessary to obtain good baseline results. Calibration of the hydrological model would not solve the problem because AET would never exceed PET during the wet season which was the reason for overestimating the flow which meant that PET was underestimated. This is supported by further research (in preparation) showing that CRU-based PET is underestimated compared to estimates derived from meteorological station data. We need not apply that to future scenarios because we calculate bias correction factors for PET based on the 10% inflated values, i.e. the factors will carry over the correction to the future.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Other specific comments will be handled in the revised version.

In the end, we would like to repeat our thanks to the reviewer for the constructive comments.

References

Donohue, R. J., Roderick, M. L., and McVicar, T. R.: On the importance of including vegetation dynamics in Budyko's hydrological model, Hydrol. Earth Syst. Sci., 11, 983-995, 2007.

Elshamy, M. E. A. M.: Improvement of the Hydrological Performance of Land Surface Parameterization: An Application to the Nile Basin, Doctor of Philosophy (PhD), Civil and Environmental Engineering, Imperial College, University of London, London, 2006.

Shahin, M.: Hydrology of the Nile Basin, Developments in water science ; 21, Elsevier, Amsterdam ; Oxford, 1985.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1407, 2008.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper