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Online Library HESS
- Recent Final Revised Papers
- Volumes and Issues
- Special Issues
- Library Search
- Title and Author Search

Online Library HESSD
Alerts & RSS Feeds
General Information
Submission
Review
Production
Subscription
Comment on a Paper

Volumes and Issues | Contents of Issue 5

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Impacts of climate change on Blue Nile flows using bias-corrected GCM scenarios

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Abstract. This study analyses the output of 17 general circulation models (GCMs) included in the 4th IPCC assessment report. Downscaled precipitation and potential (reference crop) evapotranspiration (PET) scenarios for the 2081–2098 period were constructed for the upper Blue Nile basin. These were used to drive a fine-scale hydrological model of the Nile Basin to assess their impacts on the flows of the upper Blue Nile at Diem, which accounts for about 60% of the mean annual discharge of the Nile at Dongola. There is no consensus among the GCMs on the direction of precipitation change. Changes in total annual precipitation range between −15% to +14% but more models report reductions (10) than those reporting increases (7). Several models (6) report small changes within 5%. The ensemble mean of all models shows almost no change in the annual total rainfall. All models predict the temperature to increase between 2 °C and 5 °C and consequently PET to increase by 2–14%. Changes to the water balance are assessed using the Budyko framework. The basin is shown to belong to a moisture constrained regime. However, during the wet season the basin is largely energy constrained. For no change in rainfall, increasing PET thus leads to a reduced wet season runoff coefficient. The ensemble mean runoff coefficient (about 20% for baseline simulations) is reduced by about 3.5%. Assuming no change or moderate changes in rainfall, the simulations presented here indicate that the water balance of the upper Blue Nile basin may become more moisture constrained in the future.

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