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Prediction of future climate change for the Blue Nile, using a nested Regional Climate Model

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Although the Nile River Basin is rich in natural resources, it faces many challenges. Rainfall is highly variable across the region, on both seasonal and inter-annual scales. This variability makes the region vulnerable to droughts and floods. Many development projects involving Nile waters are currently underway, or being studied. These projects will lead to land-use patterns changes and water distribution and availability. It is thus important to assess the effects of a) these projects and b) evolving water resource management and policies, on regional hydrological processes.
This paper seeks to establish a basis for evaluation of such impacts within the Blue Nile River sub-basin, using the RegCM3 Regional Climate Model to simulate interactions between the land surface and climatic processes. We first present results from application of this RCM model nested with downscaled outputs obtained from the ECHAM5/MPI-OM1 transient simulations for the 20th Century. We then investigate changes associated with mid-21st century emissions forcing of the SRES A1B scenario. The results obtained from the climate model are then fed as inputs to the Nile Forecast System (NFS), a hydrologic distributed rainfall runoff model of the Nile Basin, The interaction between climatic and hydrological processes on the land surface has been fully coupled. Rainfall patterns and evaporation rates have been generated using RegCM3, and the resulting runoff and Blue Nile streamflow patterns have been simulated using the NFS.
This paper compares the results obtained from the RegCM3 climate model with observational datasets for precipitation and temperature from the Climate Research Unit (UK) and the NASA Goddard Space Flight Center GPCP (USA) for 1985-2000. The validity of the streamflow predictions from the NFS is assessed using historical gauge records. Finally, we present results from modeling of the A1B emissions scenario of the IPCC for the years 2034-2055. Our results indicate that future changes in rainfall may vary over different areas of the Upper Blue Nile catchment in Ethiopia. Our results suggest that there may be good reasons for developing climate models with finer spatial resolution than the more commonly used GCMs.