Assessing the impact of global changes on the surface water resources of Southwestern Nigeria

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Abstract

Understanding the relative impact of land use, land cover and climate change (LULCC) on basin runoff is necessary in assessing basin water stress. This assessment requires long-term observed rainfall time series and land-use/land-cover (LULC) spatial data. However, there are challenges with the availability of spatio-temporal data, particularly limited range of available historical hydro-meteorological measurements. In order to assess the likely water stress, the study used long-term (1961–2007) rainfall data to drive the Pitman monthly rainfall-runoff model to assess changes to the water resources of three selected basins in Nigeria—Asa, Ogun, and Owena. Three CGCMs—CSIRO Mark3.5, MIROC3.2-medres and UKMO-HadCM3 dynamically downscaled to a 60 km by 60 km grid using the Conformal-Cubic Atmospheric Model (C-CAM)—are used to simulate impacts of future climate changes on water resources. These three models were found suitable for simulating rainfall-runoff based on the insignificant differences of models' mean with mean of observed rainfall and temperature for pre-2010 data compared to other downscaled C-CAM models (GFDL-CM2.0, GFDL-CM2.1, and ECHAM5/MPI-Ocean model). The model results show increases in the runoff coefficient with decreases in forest cover between 1981 and 2007 with average runoff coefficients of 5.3%, 12.0% and 6.4% for Asa, Ogun and Owena basins respectively. Based on CSIRO, MIROC, and UKMO predicted annual reduction in rainfall trend, the future scenarios revealed a low runoff coefficient for the three basins—Asa (CSIRO 6.0%, MIROC 6.0%, and UKMO 5.9%), Ogun (CSIRO14.6%, MIROC 14.6%, and UKMO 14.4%), and Owena (CSIRO 8.5%, MIROC 8.7%, and UKMO 8.9%). In all scenarios Asa basin has lower runoff coefficient when compared to Ogun and Owena basins, indicating that future water stress in Asa basin would be much higher.