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Multi-Model CIMP5 projected impacts of increased greenhouse gases on the Niger basin and implications for hydropower production

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Climate change could potentially have large impacts on water availability in West Africa and the predictions are accrued with high uncertainties in this region. Countries in the Niger River basin (West Africa) plan the investment of $200 million in the installation of an additional 400MW of hydropower in the nearest future, adding to the existing 685MW. With the impacts of climate change in the basin already occurring, there is a need for comprehending the influence of future hydro-climatic changes on water resources and hydro-power generation in the basin.

This study uses a hydrological model to simulate river flow under present and future conditions and evaluates the impacts of potential changes on electricity production of the largest hydroelectric dam (Kainji) in the Niger Basin. The Kainji reservoir produces 25 per cent of the current energy needs of Nigeria and was subject to large fluctuations in energy production as a result of variable inflow and operational reasons.
Inflow into the reservoir was simulated using hydroclimatic data from a set of 7 regional climate models (RCM) with two emission scenarios from the CORDEX-Africa regional downscaling experiment, driven with CMIP5 data.
Based on observations of inflow, water level in the reservoir, and energy production we developed a simple hydroelectricity production model to simulate future energy production for the reservoir.
Results suggest increases in river flow for the majority of RCM data as a result of increases in precipitation in the headwaters of the basin around 2050 and slightly decreasing trends for low emission scenarios by the end of the century. Despite this consistent increase, shifts in timing of river flow can challenge the reliable production of energy. This analysis could help assess the planning of hydropower schemes in the basin for a sustainable production of hydroelectricity in the future.