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Use of CORDEX to Evaluate Dam Operation Policies for the Hydroelectric Power Industry in East Africa

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The productivity of hydroelectric dams along the Nile River is determined by the level of Lake Victoria which is primarily dictated by the rainfall and temperature variability over the Lake Victoria Basin (LVB). The 'Agreed Curve' Policy-ACP water release rule (approximately 400 m3/s) has been applied to manage the outflow from Lake Victoria. It guarantees the amount of water that would naturally flow out of the lake, as a function of the lake level, if there were no dams. However, the declining level of Lake Victoria and population growth around the lake have resulted in chronic and debilitating load shedding and power outage for tens of millions of residential and industrial consumers in the region. A new hydrological release plan ("Constant Release" Curve Policy-CRCP) has been proposed and others are being considered to improve reliability of hydroelectric power supply for the consumers. The CRCP is a binary rule. More specifically, if the lake level (LL) satisfies the condition 10.64 < LL < 12.14 meters at the end of the year it is considered to be a Low Hydrology regime and the mean water release through the hydroelectric power plant turbines is set at 687 m3/s for the following year. On the other hand if LL > 12.14 meters at the end of the year it is designated as a High Hydrology scenario and the mean water release is set at 1247 m3/s for the following year. The CRCP operation rule is designed to result in water release targets that optimize the operation of the electric turbines while also stabilizing the water level of Lake Victoria.

The development of water release policies for the hydroelectric dams at Lake Victoria recently proposed do not take into account the projected climate change. In a recent study, Semazzi et al. (2012) used PRECIS modeled rainfall as input to a water balance model for Lake Victoria to estimate the corresponding lake levels and found that the proposed CRCP operational rule outperforms the ACP, which is currently being used, for the recent decades. They concluded that the performance of the CRCP operational rule is not as favorable for the future decades compared to the recent decades indicating that caution should be exercised in recommending it to replace the present ACP water release policy. The strategy described above was based on only one model and therefore is highly limited in estimating model uncertainty. In the present study, we have adopted a more comprehensive approach by using multiple CORDEX model rainfall data to estimate lake levels and confidence levels for the two release policies. This provides a better estimate of model uncertainty which should translate into improved actionable information for the planning of the hydroelectric industry along the White Nile River.