International Journal of Climatology

Prediction of inflows into Lake Kariba using a combination of physical and empirical models

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Abstract:

Seasonal climate forecasts are operationally produced at various climate prediction centres around the world. However, these forecasts may not necessarily be appropriately integrated into application models in order to help with decision-making processes. This study investigates the use of a combination of physical and empirical models to predict seasonal inflows into Lake Kariba in southern Africa. Two predictions systems are considered. The first uses antecedent seasonal rainfall totals over the upper Zambezi catchment as predictor in a statistical model for estimating seasonal inflows into Lake Kariba. The second and more sophisticated method uses predicted low-level atmospheric circulation of a coupled ocean–atmosphere general circulation model (CGCM) downscaled to the inflows. Forecast verification results are presented for five run-on 3-month seasons; from September to June over an independent hindcast period of 14 years (1995/1996 to 2008/2009). Verification is conducted using the relative operating characteristic (ROC) and the reliability diagram. In addition to the presented verification statistics, the hindcasts are also evaluated in terms of their economic value as a usefulness indicator of forecast quality for bureaucrats and to the general public. The models in general perform best during the austral mid-summer season of DJF (seasonal onset of inflows) and the autumn season of MAM (main inflow season). Moreover, the prediction system that uses the output of the CGCM is superior to the simple statistical approach. An additional forecast of a recent flooding event (2010/2011), which lies outside of the 14-year verification window, is presented to demonstrate the forecast system's operational capability further during a season of high inflows that caused societal and infrastructure problems over the region.