Original Article | Published: 26 May 2020

Suitability of averaged outputs from multiple rainfall-runoff models for hydrological extremes: a case of River Kafu catchment in East Africa

C. Onyutha ✉, C. J. Amollo, J. Nyende & A. Nakagiri

International Journal of Energy and Water Resources (2020) | Cite this article

Abstract

In this study, seven rainfall-runoff models were applied to model daily River Kafu flows from 1952 to 1981. Among others, models from the rainfall-runoff library of the eWater toolkit were applied. Optimal parameters of each model were obtained based on an automatic calibration strategy. Averaging in terms of simple arithmetic mean, hereinafter taken as the multi-model ensemble (MME), was performed to independently and identically distributed events separately extracted from the outputs of the individual models. How well the MME captured variation and frequency of observed hydrological extremes was assessed. Models performed better for high flows than low flows. Absolute model average biases on quantiles with return periods from 1 to 30 years were over the ranges 5.5–83.6% and 11.6–57.7% for high flows and low flows, respectively. It is envisaged that making model structures flexible and performing calibration with objective functions constrained to extreme events can enhance simultaneous capturing of high flows and low flows. The amount of variance in annual maxima series that could be explained by the multi-model ensemble was 73.4% and ranged from 35.1 to 82.5% for the individual models. This made the multi-model ensemble better than outputs from six of the seven models. For the annual minima flows, the multi-model ensemble yielded the smallest root mean squared error but the third largest coefficient of determination. Notably, the suitability of the multi-model ensemble in capturing the hydrological extremes depends on the selected goodness-of-fit measure, approach for combination of model outputs, number of models considered and length of data used.

Sections Figures References

Abstract