Abstract

Hydrological models are essential for water resources planning, infrastructure development, and drought or flood risk management, yet their application in semiarid, data-scarce catchments remains challenging due to high spatial variability and limited observations. This study evaluated the performance of the HEC-HMS model for streamflow simulation in the Perkerra River catchment, Kenya. Model calibration was conducted using observed streamflow data from the Perkerra gauging station for the period January 2019 to December 2022, while validation was performed using data from January to December 2023. The validated and optimized model was subsequently applied to simulate streamflow at the Tigeri and Narosura stations within the catchment. Model performance was assessed using the Nash–Sutcliffe efficiency (NSE), root mean square error (RMSE), percent bias (PBIAS), RSR, and coefficient of determination (R2). NSE values 0.682 and 0.706 with low PBIAS values −4.45 and −1.80% during calibration and validation, respectively, indicated acceptable performance. Sensitivity analysis showed that baseflow parameters were the most influential, followed by impervious area, curve number, time of concentration, and storage coefficient. Overall, the results demonstrated that HEC-HMS could reliably simulate streamflow in the Perkerra catchment and had strong potential for application in poorly gauged semiarid basins, enabling drought preparedness.