Simulation of runoff process within the humid foot-slope catchments of Mt. Kenya: an assessment of two infiltration approaches for rainfall-runoff modelling

Luke O. Olang

Department of Water and Environmental Engineering, School of Engineering and Technology, Kenyatta University, P. O. Box 43844 -00100, Nairobi, Kenya (E-mail: olanglk@yahoo.com)

ABSTRACT: The performance of the Diskin and Green-Ampt and the Nash cascade hydrologic models for runoff simulation were examined within the humid foot-slope sub-catchments of Mt Kenya. The major parameters of the models were treated as conceptual and derived with the help of the Schuffled Complex Evolution optimization algorithm due to their high degree of non-linearity and spatio-temporal variability. The relevant catchment based parameters were derived from spatial datasets with the help of GIS. A split-sampling procedure was used to apportion the selected observed rainfall-runoff events for calibration and validation purposes. For use in runoff generation and transformation, the models were combined into Nash-Cascade Green-Ampt and Nash-Cascade Diskin, and subsequently used to replicate the response of five upstream sub-catchments (6-26 km2) of the basin. Furthermore, a local regional analysis involving relating conceptual and physically based model parameters using transfer functions was also tested for the Nash-Cascade Diskin to enable extended use in the ungauged catchments of the same basin. From the results obtained, the Nash-Cascade Green-Ampt model generally produced better results for shorter runoff events predominant in the lower parts of the regions. The Nash-Cascade Diskin model provided better estimates for runoff events with longer durations. The model was also noted to be more dependable for higher intensity rainfall events. From the regional analysis, sufficiently reliable transfer functions were successfully developed. However, the regional efficiency was noted to diminish with the increasing number of conceptual parameters to be regionalized. Generally, both models demonstrated adequate dependability for use in extended hydrological predictions.
KEYWORDS: Mt. Kenya; humid zones; runoff simulation; hydrology; regionalization