THE EFFECT OF ANTECEDENT MOISTURE CONDITION ON HEC-HMS MODEL PERFORMANCE: A CASE STUDY IN KELANI RIVER BASIN, SRI LANKA

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Degree of Master of Science

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Supervised by

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledging any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the supervisor: Date

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The Effect of Antecedent Moisture Condition on HEC-HMS Model Performance: A Case Study in Kelani River Basin, Sri Lanka

ABSTRACT

Among all observed natural hazards, water-related disasters are the most frequent and they pose major threats to people and while hindering socio-economic development. Flood forecasting is one the most challenging and difficult problems in hydrology. However, it is also one of the most important problems in hydrology due to its critical contribution in reducing economic damages and loss of life losses. In many regions of the world, flood forecasting is one among the few feasible options to manage floods. In Soil Conservation Service Curve Number (SCS-CN) method, Antecedent Moisture Condition (AMC) of the soil plays a very consequential role because the curve number varies according to the soil, land cover and soil moisture content, and that is considered while estimating runoff depth. Soil water represents only a minimal part of the water on our planet, but it is certainly one of the most imperative factors when it comes to flood forecasting since soil saturation directly affects runoff generation.

Kelani river basin was selected for the study because of the nature of the basin with respect to the vulnerability to floods and availability of data at finer resolution. Ten years of daily rainfall, streamflow and evaporation data from 2007 to 2017 water year were used for the study. Events separation was carried out using Minimum Inter-event Time (MIT) method. There are 38 selected events, out of which the first half events were used for model calibration and the second half events were used for model verification. The univariate gradient search method was applied to optimize the parameters by minimizing the Sum of Absolute Residual Error (SARE) objective function. Manual calibration was carried out using Nash-Sutcliffe model efficiency coefficient (NASH) as an objective function for comparison.

The average NASH value in model calibration and validation were 0.63 and 0.62 while the lowest Root Mean Square Error (RMSE) obtained in model calibration and validation were 1.31 and 2.82 respectively. The closer the model efficiency is to NASH value of 1, the more accurate the model is. The calibration data set performed better than the model verification data set as depicted by lower RMSE value. Random events were selected to incorporate different soil moisture conditions to check the model performances. It has been observed that the events that falls in Maha season performs better when AMC III is applied whereas the model performance neither improves nor deteriorate when the events falls in Yala season.

The present work reveals and confirms that while conducting event rainfall-runoff modelling for flood management using HEC-HMS, AMC should be considered in order to improve the model efficiency and performance. The study findings are applicable to other hydrologically similar basins in the same region or elsewhere and the findings from model sensitivity analysis are useful for fine tuning model performance and opting for better flood management strategies.

Keywords: Event based modelling, Inter-event time, Model sensitivity and efficiency

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