ANALYSIS OF THE EFFECT OF LOSS AND BASEFLOW METHODS AND CATCHMENT SCALE ON PERFORMANCE OF HEC-HMS MODEL FOR KELANI RIVER BASIN, SRI LANKA

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Degree of Master of Science

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Thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Water Resources Engineering and Management

Supervised by

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June 2018

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement 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 acknowledgment is made in text.

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The above candidate has carried out research for the Master's thesis under my supervision.

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Dr. R. L. H. L. Rajapakse Date

Analysis of the Effect of Loss and Baseflow Methods and Catchment Scale on Performance of HEC-HMS Model for Kelani River Basin, Sri Lanka

ABSTRACT

Hydrological models have become an indispensable tool for efficient water resource management which requires proper estimation of runoff in basins and recognition of appropriate catchment scale. The HEC-HMS (Hydrologic Engineering Center's Hydraulic Modeling System) is a reliable and freely available model. Different loss and baseflow estimation methods available in HEC-HMS have their own pros and cons. Lumping of model parameters over a large area reduces the model performance. In order to find the best loss and baseflow methods for simulating rainfall runoff and to check the possibility of further improvement in model performance by moving toward distributed modeling, Glencorse watershed in Kelani river basin of Sri Lanka was selected as the project area.

Daily rainfall data from 2006/2007 to 2008/2009 and 2010/2011 to 2013/2014 for four rainfall stations in Glencorse watershed with daily stream flow data of Glencorse gauging station for the same duration were used for this study. Two different combinations of baseflow and loss methods for simulation of runoff were considered while Clark unit hydrograph method was used as transform model. In the First Option, the Deficit and Constant Method and Recession Method were used as loss and baseflow methods, respectively, while for the Second Option, the Soil Moisture Accounting (SMA) and Linear reservoir methods were used for continuous simulation. Glencorse watershed was divided into 3, 6, 9 and 16 sub divisions to assess the improvement in model performance by shifting toward distributed modelling. Manual calibration approach was used for with Mean Ratio of Absolute Error (MRAE) as the main objective function while another two statistical goodness of fit measures, Nash–Sutcliffe model efficiency coefficient (NASH) and percent error in volume were also checked as an additional observation.

Soil Moisture Accounting as loss model and linear reservoir model as baseflow model simulated runoff more efficiently as compared to the other combination. Evaluation showed value of MRAE and NASH for Option 1 were 0.38 and 0.67 for calibration and 0.40 and 0.42 for verification, respectively. Option 2 evaluation showed MRAE and NASH as 0.31 and 0.70 for calibration and 0.34 and 0.57during verification, respectively. Soil Moisture Accounting and Linear Reservoir method used for distributed model showed improvement in model performance up to 6 sub-divisions after which the model performance started declining. Selection of appropriate method among different methods available in HEC-HMS should be in accordance with overall objective of study as it plays an important role in accurate estimation of runoff. Moving toward distributed modelling improves model performance but high resolution data and machine power is required..

Keywords: hydrological modelling, water resource management, HEC-HMS software, loss and base flow methods

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