

Review of studies on hydrological modelling in Malaysia

ABSTRACT

Hydrological models are vital component and essential tools for water resources and environmental planning and management. In recent times, several studies have been conducted with a view of examining the compatibility of model results with streamflow measurements. Some modelers are of the view that even the use of complex modeling techniques does not give better assessment due to soil heterogeneity and climatic changes that plays vital roles in the behavior of streamflow. In Malaysia, several public domain hydrologic models that range from physically-based models, empirical models and conceptual models are in use. These include hydrologic modeling system (HEC-HMS), soil water assessment tool (SWAT), MIKE-SHE, artificial neural network (ANN). In view of this, a study was conducted to evaluate the hydrological models used in Malaysia, determine the coverage of the hydrological models in major river basins and to identify the methodologies used (specifically model performance and evaluation). The results of the review showed that 65% of the studies conducted used physical-based models, 37% used empirical models while 6% used conceptual models. Of the 65% of physical-based modelling studies, 60% utilized HEC-HMS an open source models, 20% used SWAT (public domain model), 9% used MIKE-SHE, MIKE 11 and MIKE 22, Infoworks RS occupied 7% while TREX and IFAS occupy 2% each. Thus, indicating preference for open access models in Malaysia. In the case of empirical models, 46% from the total of empirical researches in Malaysia used ANN, 13% used Logistic Regression (LR), while Fuzzy logic, Unit Hydrograph, Auto-regressive integrated moving average (ARIMA) model and support vector machine (SVM) contributed 8% each. Whereas the remaining proportion is occupied by Numerical weather prediction (NWP), land surface model (LSM), frequency ratio (FR), decision tree (DT) and weight of evidence (WoE). Majority of the hydrological modelling studies utilized one or more statistical measure of evaluating hydrological model performance (R, R², NSE, RMSE, MAE, etc.) except in some few cases where no specific method was stated. Of the 70 papers reviewed in this study, 16 did not specify the type of model evaluation criteria they used in evaluating their studies, 17 utilized only one method while 37 used two or more methods. NSE with 27% was found to be the most widely used method of evaluating model performance; R and RMSE came second with a percentage use 24% each. R² (20%) was recorded as the third most widely used model evaluation criteria in Malaysia, MAE came fourth with 16% while PBIAS is the least with 11%. The findings of this work will serve as a guide to modelers in identifying the type of hydrological model they need to apply to a particular catchment for a particular problem. It will equally help water resources managers and policy makers in providing them with executive summary of hydrological studies and where more input is needed to achieve sustainable development.

Keyword: Hydrologic models; Review; Malaysia; GIS; HEC-HMS; SWAT