Integration of spatially hydrological modelling on Bentong Catchment, Pahang, Peninsular Malaysia using distributed GIS-based rainfall runoff model

ABSTRACT

With the advance of GIS technology, hydrology model can simulated at catchment wide scale. The objective is to integrate National Resource Conservation Service (NRCS) Curve Number (CN) with kinematic wave and manning's equation using GIS to develop a simple GIS-based distributed model to simulate rainfall runoff in Bentong catchment. Model was built using Spatial Distributed Direct Hydrograph (SDDH) concept and applying the time area (TA) approach in presenting the predicted discharge hydrograph. The effective precipitation estimation was first calculated using the NRCS CN method. Then, the core maps that consists of digital elevation model (DEM), soil and land use map in grid. DEM was used to derive slope, flow direction and flow accumulation while soil and land use map used to derive roughness coefficient and CN. The overland velocity and channel velocity estimation derived from combination of kinematic wave theory with Manning's equation. To capture the time frame, the travel time map was divided into isochrones in order to generate the TA histogram and finally. The creation of SDDH using the TA histogram which will lead to the estimation of travel time for the catchment. Simulated hydrograph was plotted together with the observed discharge for comparison. Six storm events used for model performance evaluation using statistical measure such as Nash-Sutcliffe efficiency (NSE), percent bias (PBIAS) and coefficient of determination (R^2). SDDH model performed quite well as NSE gave result ranging from 0.55 to 0.68 with mean of 0.6. PBIAS indicate that the model slightly over predicted compared to observed hydrograph with result ranges from -46.71 (the most over predicted) to +4.83 (the most under predicted) with average of -20.73%. R^2 ranges between 0.55 to 0.82 with mean of 0.67. When comparing the time to peak, (tp), min, and peak discharge, (pd), m3 /s, results gave NSEtp 0.82, PBIAStp 0.65, R2 tp 0.32, NSEpd 0.95, PBIASpd 14.49 and R2 pd 0.98, respectively. Results indicate that the integrated distributed model is successfully applied to the catchment.

Keyword: Rainfall runoff; NRCS CN; GIS; Spatial distributed; Time area