

Estimating Water Balance at Beterou Watershed, Benin Using Soil and Water Assessment Tool (SWAT) Model

Authors : Ella Sèdé Maforikan

Abstract : Sustained water management requires quantitative information and the knowledge of spatiotemporal dynamics of hydrological system within the basin. This can be achieved through the research. Several studies have investigated both surface water and groundwater in Beterou catchment. However, there are few published papers on the application of the SWAT modeling in Beterou catchment. The objective of this study was to evaluate the performance of SWAT to simulate the water balance within the watershed. The inputs data consist of digital elevation model, land use maps, soil map, climatic data and discharge records. The model was calibrated and validated using the Sequential Uncertainty Fitting (SUF2) approach. The calibrated started from 1989 to 2006 with four years warming up period (1985-1988); and validation was from 2007 to 2020. The goodness of the model was assessed using five indices, i.e., Nash-Sutcliffe efficiency (NSE), the ratio of the root means square error to the standard deviation of measured data (RSR), percent bias (PBIAS), the coefficient of determination (R^2), and Kling Gupta efficiency (KGE). Results showed that SWAT model successfully simulated river flow in Beterou catchment with $NSE = 0.79$, $R^2 = 0.80$ and $KGE = 0.83$ for the calibration process against validation process that provides $NSE = 0.78$, $R^2 = 0.78$ and $KGE = 0.85$ using site-based streamflow data. The relative error (PBIAS) ranges from -12.2% to 3.1%. The parameters runoff curve number (CN2), Moist Bulk Density (SOL_BD), Base Flow Alpha Factor (ALPHA_BF), and the available water capacity of the soil layer (SOL_AWC) were the most sensitive parameter. The study provides further research with uncertainty analysis and recommendations for model improvement and provision of an efficient means to improve rainfall and discharges measurement data.

Keywords : watershed, water balance, SWAT modeling, Beterou

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