

Mahmoud S. Al-Khafaji

Building and Construction
Engineering Department,
University of Technology.
Baghdad, Iraq.
41100@uotechnology.edu.iq

Fouad H. Saeed

Ministry of Water
Resources
Baghdad, Iraq.
fouadhusseinsaeed@gmail.com

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Effect of DEM and Land Cover Resolutions on Simulated Runoff of Adhaim Watershed by SWAT Model

Abstract- Accurate estimation of surface runoff by using Soil and Water Assessment Tool (SWAT) model is highly depends on the accuracy of the Digital Elevation Model (DEM), Land Cove and Land Use (LC/LU), soil and weather data as input variables. The interactive and complementary effects of the DEM and LC/LU resolutions on the estimated runoff were not taken into consideration in previous studies. This research aims to study these effects on the accuracy of runoff estimation of Adhaim Watershed by using SWAT Model. Twenty surface runoff estimation SWAT models of Adhaim Watershed were implemented using five DEMs with spatial resolution of 30, 50, 90, 250 and 1000m in conjunction with four LC/LUs with spatial resolution of 30, 300, 500 and 1000 m. These models were calibrated and verified on daily time step with the adoption of maximizing Nash and Sutcliffe Efficiency (NS) as an objective function. The results of SWAT models show that specifying the watershed boundary and the total area is highly affected by the DEM resolution without considerable trend. Also, the estimated minimum altitude is inversely related to the DEM resolution, whereas the maximum altitude has a direct relationship. Furthermore, LC/LU resolution is highly affected the number and area of classes that can be distinguished in the LC/LU image. Although, the number of hydrologic response units (HRUs) depends on LC/LU resolution, it was found that this number increases with the increase in LC/LU resolution to a maximum number of HRUs and then it gradually decreases. Whereas, the HRUs has a direct relationship with the DEM resolution and the number of subbasins irregularly changed with the increase of DEM resolution. Results of runoff estimation by using SWAT models show that the estimated runoff is not directly or inversely related to the DEM and LC/LU resolutions. Moreover, the most accurate runoff was not estimated with the highest DEM and LC/LU resolutions, where it is obtained with DEM and LC/LU resolutions of 250 m and 1000 m respectively with NS of 0.74. Accordingly, it is recommended to use these resolutions for estimating the surface runoff of Adhaim Watershed. The relationship between the HRUs and estimated runoff is very complex therefore; more extensive studies are required to comprehend this relationship.

Keywords- Adhaim Watershed, DEM, surface runoff, SWAT model.

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