Ain Shams University
Faculty of Engineering
Irrigation and Hydraulics Department

RAINFALL-RUNOFF SIMULATION USING DISTRIBUTED HYDROLOGIC MODEL IN SINAI

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FACULTY OF ENGINEERING

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STATEMENT

This thesis is submitted to Ain-Shams University for the degree of Mater of Science in civil engineering.

The work included in this thesis was carried out by the author in the Irrigation and Hydraulics Department Faculty of Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification to any other university or institute.

Date :

Signature:

Name : Azza Ewis Ismail

To

My Mother

My Husband Emad

My lovely Children

Mohammed and Rodina

RAINFALL-RUNOFF SIMULATION USING DISTRIBUTED HYDROLOGIC MODEL IN SINAI

BY

AZZA EWIS ISMAIL GAD

Abstract

Rainfall-runoff process is complex and non-linear, so estimating rainfall-runoff is an important process for flood estimation. In cases where the historical flow records are not available, it becomes necessary to use another tool such as hydrologic models that incorporates watershed characteristics to predict flow rates and the volume of runoff for the watershed. The distributed model (Gridded Surface-Subsurface Hydrologic Analysis, GSSHA) is used in this research to simulate rainfall-runoff process in wadi El- Melha.

Wadi El- Melha is a sub-basin of Wadi Sudr chosen as a study area to apply the hydrologic model and carry out this research. WadiSudr is one of south-west Sinai wadis and covers a total area of about 600 km^2 and it drains directly in the Gulf of Suez at Sudr town. Wadi El- Melha covers an area about 26 km^2 from wadi Sudr and its main stream length is about 5.5 km.

GSSHA is a fully distributed-parameter, process-based hydrologic model that uses finite difference and finite

volume methods to simulate different hydrologic processes such as rainfall distribution and interception, overland water retention, infiltration, evapotranspiration, two-dimensional overland flow, one dimensional channel routing, and different methods for modeling the soil moisture profile in the unsaturated zone. The Green and Ampt method (GA) was used to simulate infiltration losses into the unsaturated zone. The watershed topographic and hydrologic properties are represented using 90 mx90 m Cartesian grids for wadi El-Melha. Channel dimensions were specified in the model based on field surveys using Global Positioning System (GPS). The rainfall data was collected and compiled from the available rain gauges in the study catchment. Overland hydraulic properties and soil hydraulic parameters were varied according to spatial combined classifications of soil type and land use maps. Field measurements of soil types and infiltration parameters were used to initially assign model parameters. The parameters were further adjusted through model calibration against available runoff measurements at the catchment outlet.GSSHA model is applied to 5 real storms. These storms are measured during the period from 1992 to 2013. The output hydrograph of the model were compared to the observed flow hydrograph and both visual and statistical comparison between simulated hydrograph and observed hydrograph .Sensitivity analyses were performed to evaluate the impact of model parameters on the simulated hydrographs.

The results of GSSHA model in this study show that the hydrological distribute model is suitable for arid region. It has the ability to predict watershed runoff hydrograph very close to the observed one.

Also, the results show that the channel roughness had significant impact on both the peak flow rate and the time to peak. On the other hand, overland roughness, hydraulic conductivity, and channel hydraulic conductivity had significant impact only on the peak flow rate. Finally, porosity, capillary head and initial moisture content had insignificant impact on either peak flow rate or time to peak.

Keywords*: Wadi EL-Melha, GSSHA Model, Sensitivity Analysis, Green&Ampt*

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