



Ain Shams University  
Faculty of Engineering  
Irrigation and Hydraulics Department

## **RAINFALL-RUNOFF SIMULATION USING DISTRIBUTED HYDROLOGIC MODEL IN SINAI**

Thesis submitted to Irrigation and Hydraulics Department  
Faculty of Engineering, Ain Shams University  
in Partial Fulfillment of the Requirements for the

**Degree of Master of Science in Civil Engineering**

By  
**Eng. Azza Ewis Ismail Gad**

(B.Sc. in Civil Engineering, Zagazig University)

Supervised by

**Prof. Dr. Ahmed Ali Ali Hassan**

Professor, irrigation and hydraulics Department, Faculty of  
Engineering, Ain Shams University

**Dr. Ashraf Mohamed El Mostafa**

Associate professor, Irrigation and Hydraulics Department, Faculty  
of Engineering, Ain Shams University

**Dr. Eman Ahmed Hassan**

Associate professor, Water Resources Research Institute (WRI),  
National Water Research Center (NWRC), Egypt

Cairo, Egypt  
2015

**AIN-SHAMS UNIVERSITY  
FACULTY OF ENGINEERING**

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By  
**Azza Ewis Ismail Gad**  
B.Sc. in Civil Engineering, Zagazig University

**EXAMINERS COMMITTEE**

**Name, Title & Affiliation**  
**Signature**

**Prof. Dr. Gamal Mohamed Kotb .....**  
Deputy Director of Water Resources  
Research Institute, National Water Research Center.

**Prof. Dr. Abdel kawi A. Khalif.....**  
Professor of Hydraulics, Irrigation and Hydraulics  
Department, Faculty of Engineering, Ain Shams  
University.

**Prof. Dr. Ahmed Ali Ali Hassan.....**  
Professor of Hydraulics, Irrigation and Hydraulics  
Department, Faculty of Engineering, Ain Shams  
University.

**Dr. Ashraf Mohamed El Mostafa.....**  
Associate professor, Irrigation and Hydraulics  
Department, Faculty of Engineering, Ain Shams  
University.

Date: 16-2-2015

## **STATEMENT**

This thesis is submitted to Ain-Shams University for the degree of Master 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<sup>2</sup> and it drains directly in the Gulf of Suez at Sudr town. Wadi El- Melha covers an area about 26 km<sup>2</sup> 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*

## ACKNOWLEDGEMENT

At the beginning and end, thanks to Allah

I would like to thank my supervisor Professor Dr. **Ahmed Ali**, Professor of Hydraulics, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, for his invaluable guidance and support.

I would like to express my special thanks to my supervisor Dr. **Ashraf El Mostafa**, Associate Professor of Hydraulics, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, for his generous support and helpful supervision during all the phases of this research.

I would like to express my special thanks to my supervisor Dr. **Eman Ahmed**, Associate professor, Water Resources Research Institute (WRRI), National Water Research Center (NWRC), for her generous support and helpful supervision during all the phases of this research.

I am deeply grateful to my husband **Eng. Emad Hussein** for his support and encouragement. I would sincerely like to thank my lovely children **Mohammed and Rodina**. Words of thanks also go to **my mother** for her continuous support and constant encouragement.

My thanks and gratitude goes to **Dr. Khaled Gaber**, Dr. **Khalil Tamam**, **WRRI**, **NWRC**, for their generous help and invaluable advice.

My thanks are also due to **my colleagues** at the **WRRI** for their friendship and encouragement.



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