



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



SAFAA MAHMOUD



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شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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SAFAA MAHMOUD



Ain Shams University
Faculty of Engineering
Irrigation & Hydraulics Department

A MULTI-COMPONENT MODEL FOR LONG-TERM RIVER FLOW FORECASTING

A thesis submitted in partial fulfillment of the requirements of the degree
of

Master of Science in Civil Engineering
(Irrigation and Hydraulics)

by

EATEMAD AHMED HASSAN MOHAMMED KESHTA

Bachelor of Science in Civil Engineering
Faculty of Engineering - Matariya Branch, Helwan University, 2014

Supervised by

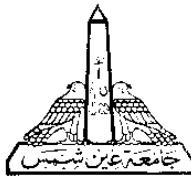
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**CAIRO - EGYPT
2020**



Ain Shams University
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11th March, 2020

STATEMENT

This thesis is submitted as a partial fulfillment of Master of Science in Civil Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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I would like to dedicate this work to my father, my mother, my brothers, my grandfather, my uncle, and my cousin.

A Multi-Component Model for Long-Term River Flow Forecasting

Abstract

The principle of seasonal forecast is to predict a range of most likely occurred values during the next season extending, probably, up to a year ahead. Seasonal flow forecast information could help in the decision-making process for water resources management.

A response-based hydrologic model was developed by this research for long-term rainfall-runoff simulations over the river basins. The model overcomes the typical difficulties in estimating infiltration and evapotranspiration parameters using a modified version of the Soil Conservation Service curve number SCS-CN method. In addition, the model simulates the surface and groundwater hydrograph components using the response unit-hydrograph approach instead of using a linear reservoir routing approach for routing surface and groundwater to the basin outlet. The model is less sensitive to groundwater infiltration parameters since groundwater is actually controlled by the surface component and not the opposite. For that reason, the model is called the SCHydro model (Surface Controlled Hydrologic model). The Model was calibrated and validated over the upper Blue Nile basin using observed flow data at Diem station for the period (1990-2009) and (2010-2017) respectively. Three statistical criteria were used; Nash-Sutcliffe Efficiency (NSE), Percent Bias (Bias%) and Root Mean Squared Error to observation Standard Deviation Ratio (RSR), for the comparison. The results show that the developed model can simulate the long-term behavior of the upper Blue Nile basin due to its very good performance according to the values

of NSE, Bias%, and RSR; 0.83, 0.80%, and 0.42 respectively for calibration and 0.87, 5.33%, and 0.36 respectively for validation.

The seasonal rainfall forecast ensembles, from Community Climate System Model version 4 (CCSM4), were forced into SCHydro in order to provide forecasted flow over the upper Blue Nile basin at Diem station. The seasonal rainfall forecast were bias corrected using the linear correction method. Three lead-times (LT3, LT6, and the whole season (May-November)) were analyzed and assessed using the NSE, Bias%, and RSR showing the acceptable performance. However, there is an obvious bias in the forecasted flow especially at LT3. In general, the results showed that the bias corrected seasonal rainfall forecast is capable to provide a good idea about the whole flood season at the beginning of the rainy season over the basin. Further, the seasonal forecasted flow relatively captured the observed flow at Diem station in the flood years more than in the dry years.

Key words: hydrologic model, long-term simulation, river flow, flow forecast, SCS-CN, Blue Nile basin, seasonal forecast, Global Climate Model (GCM), CCSM4