

Republic of Iraq
Ministry of Higher Education and Scientific Research
University of Babylon
College of Engineering
Department of Civil Engineering



ANALYSIS OF RECORDS OF RAINFALL AND EVAPORATION IN BABYLON

A Thesis

Submitted to The College of Engineering
of The University of Babylon in Partial
Fulfillment of The Requirements
for The Degree of Master
of Science in Civil
Engineering

By

Mu'amer Hazim Ali Al-Ta'ee

(B. Sc. Civil Engineering)

Supervised By

Asst. Prof. Dr. Salah Tawfeek Ali Al-Baz'az

Asst. Prof. Dr. Omran Issa Mohammed

February 2009 A. D.

Sufar 1430 A. H.

بسم الله الرحمن الرحيم

{ وَمِنْ آيَاتِهِ أَنْتَ تَرَى الْأَرْضَ خَاشِعَةً فَإِذَا أَنْزَلْنَا عَلَيْهَا الْمَاءَ اهْتَزَّتْ وَرَبَّتْ إِنَّ الَّذِي

أَحْيَاهَا لَمُحْيِي الْمَوْتَى إِنَّهُ عَلَى كُلِّ شَيْءٍ قَدِيرٌ }

صدق الله العلي العظيم

(سورة فصلت- الآية ٣٩)

Dedication

- To my teacher who terminated his lifetime to be the lighted to my life way....
- To my family: My dear parents, my brothers, and my sisters
- To all people who love me and all that I love deeply

Acknowledgements

Praise be to **ALLAH** who enabled me to complete this work under his benediction.

Cordial thanks and deepest gratitude to my supervisor Asst. Prof. Dr. Salah Tawfeek Ali Al-Baz'az for his valuable guidance and his forceful encouragement throughout the preparation of this work.

I would like to express my sincere gratitude to my supervisor Asst. Prof. Dr. Omran Issa Mohammed for his guidance and kindness throughout this work.

I am indebted to the Iraqi Meteorological Organization in Baghdad for giving me the data that have been used in this research.

I am also grateful to Hilla Meteorological Station for unforgettable help in providing me with very useful meteorological information.

I would also like to express my thanks to the Directorate of Water Resources in Babylon.

Thanks are due to the staff members of Department of Architectural Engineering in Engineering College in Babylon University.

I also record my thanks to Mr. Zaid Abed Al-Ridah Abed and anyone helped me in this work.

Finally, sincere gratitude and appreciation to my family for their encouragement and support during the study.



Mu'amer Hazim Ali Al-Ta'ee

February 2009

Abstract

In this study three methods of analysis are applied to records of rainfall and evaporation from Hilla and other seven neighbouring meteorological observing stations. Firstly, Thiessen's polygons method is used to calculate monthly mean rainfall for Babylon Governorate, i.e. areal depth of rainfall for Babylon. The amounts of rainfall so obtained for November, December, January, and February are 15.159, 18.08, 22.719, and 15.339 mm/month respectively compared with 15.984, 17.623, 23.208, and 14.996 mm/month for the same months as recorded in Hilla. The same polygons are used to calculate monthly mean evaporation for this area, i.e. monthly mean evaporation for Babylon. The amounts of evaporation so obtained for Jun, July, and August are 266.912, 288.057, and 259.936 mm/month respectively compared with 235.425, 250.250, and 225.263 mm/month for the same months as recorded in Hilla.

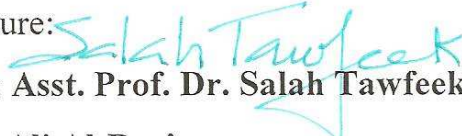
Secondly, the Penman method is modified using Hilla record of evaporation to calibrate the three equations that were used by Penman, i.e. incoming shortwave radiation equation, net longwave radiation equation, and wind function. Thus, new equations which are applicable to Hilla and are different from those originally suggested by Penman for England are presented so that computed evaporation is very close to the observed one. The sum of squared differences between computed and observed evaporation in Hilla for all months is 1.019 when using Penman's original method for evaporation in England and 0.27 when using our modified method. The sum of squared differences for all months in Hilla between computed evaporation by using Penman's original method for evaporation in England and computed evaporation by using our modified method is found equal to 0.721.

Thirdly, Box-Jenkins seasonal models are applied to Hilla records of monthly evaporation and monthly rainfall which consist of twenty nine years of records from 1978 to 2006. In building Box-Jenkins seasonal (SARIMA) model, the natural logarithm (\ln) is used to normalize data. Then, first order simple and

seasonal differencing is used. Autocorrelation function (ACF) and partial autocorrelation function (PACF) are used for model identification and the unconditional likelihood function is used to choose the best model corresponding to minimum sum of squares. Portmanteau lack of fit test is used as diagnostic checking. It is found that the first order seasonal integrated moving average (SIMA $(0, 1, 1) \times (0, 1, 1)_{12}$) model is the best model for both monthly evaporation and monthly rainfall. The estimated parameters of the model for monthly evaporation are 0.70 and 0.90 for both θ and Θ respectively and for monthly rainfall are 0.95 and 0.90 for both θ and Θ respectively. This model is used to forecast ten years of monthly evaporation and monthly rainfall for period 2007-2016.


Supervisors Certificate

We certify that the preparation of this thesis entitled “**Analysis of Records of Rainfall and Evaporation in Babylon**”, was prepared by “**Mu’amer Hazim Ali Al-Ta’ee**” under our supervision at Babylon University in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering in field of specialization is **Water Resources Engineering**.

Signature: 
Name: **Asst. Prof. Dr. Salah Tawfeek**
Ali Al-Baz’az

(supervisor)

Date: **22 / 3 / 2009**

Signature: 
Name: **Asst. Prof. Dr. Omran**
Issa Mohammed

(supervisor)

Date: **8 / 3 / 2009**

Examining Committee Certificate

We certify that we have read this thesis entitled “**Analysis of Records of Rainfall and Evaporation in Babylon**”, and as an examining committee, examined the student “**Mu’amer Hazim Ali Al-Ta’ee**” in its contents and what related to it, and that in our opinion it meets the standard of a thesis for the degree of Master of Science in Civil Engineering in field of specialization is **Water Resources Engineering**.

Signature:

Name: **Asst. Prof. Dr. Jawad Kadhim Abood**

(Member)

Date: 9 / 3 / 2009

Signature:

Name: **Asst. Prof. Kadhim Nief Kadhim Al-Ta’ee**

(Member)

Date: 8 / 3 / 2009

Signature:

Name: **Asst. Prof. Dr. Salah Tawfeek Ali Al-Baz’az**

(supervisor)

Date: 22 / 3 / 2009

Signature:

Name: **Asst. Prof. Dr. Omran Issa Mohammed**

(supervisor)

Date: 8 / 3 / 2009

Signature:

Name: **Asst. Prof. Dr. Kareem Radhi Ubaid Al-Murshidi**

(Chairman)

Date: 10 / 3 / 2009

Approval of Civil Engineering Department

Signature :

Name: **Prof. Dr. Ammar Yasir Ali**

Head of the Civil Engineering Department.

Date: 19 / 3 / 2009

Approval of Deanery of the College of Engineering.

Signature :

Name: **Asst. Prof. Dr. Salah Tawfeek Ali Al-Baz’az**

Dean of the College of Engineering.

Date: 22 / 3 / 2009