COMPARATIVE STUDY OF FIFTY POTENTIAL EVAPOTRANSPERSION MODELS FOR URBAN AREA IN TROPICAL REGION

UMAR FARUK LAWAN

A project report submitted in partial fulfilment of the requirements for the award of the degree of Master of Engineering (Hydraulics and Hydrology)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

AUGUST 2015
Specially dedicated to my father, mother, brothers and sisters, I don’t have enough words to thank you, for your immense support, care, and love.
ACKNOWLEDGEMENT

In the name of Allah, the Most Beneficent, the Most Merciful. All praise and thanks be to the Almighty, the most Gracious the Merciful, beside which there is no other deity worthy of worship. The blessings of the Almighty be upon the Prophets from first to the last and all those noble men and women after them.

First, I will like to express my sincere gratitude and thanks to ALLAH. I am deeply thankful to my parents, brothers and sisters for their continuous support, love and prayers throughout my study.

I undoubtedly owe much to my Project Supervisor, Dr. Muhamad Askari for the guidance, constant motivation and invaluable knowledge given to me during my study.

Finally, it is difficult to mention everybody but I would like to thank Malam Gambo Haruna, Malam Muttaka Na’iya Ibrahim, Dr. Mahdi Lawan Yakub, Ibrahim Hassan, Abdulrazaq Salauddin, Mahmud Murtala Farouq, umar Musa and all my friends and colleagues who have provided assistance at various occasions generously with their knowledge and expertise in preparing this thesis. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them. I am deeply grateful to all my family members.
ABSTRACT

Evaluation of potential evapotranspiration (PET) models against Penman Monteith FAO-56 has become more popular in developing countries. However, it requires complete weather variables data. To overcome this problem, we evaluated a number of PET models which were classified into fourteen-Temperature based models; twelve-Mass transfer based models; twenty one-Radiation based models and three-Combination based models against 20 years-observed pan evaporation data from Subang Jaya meteorological station. Julian day based mean imputation was used to fill the missing data. Tukey's outlier detection method was employed before estimating the PET. The performance of the models were evaluated with percentage of error (% error) in total values, % error in maximum values, % error in minimum values, % error in average values, root mean squared error (RMSE), and the paired t-test of the prediction accuracy. The results showed that Linacre, Meyer, Conchrane-Orcutt, and Kimberly Penman performed better than the other PET models among their categories. The present study also indicated that Kimberly Penman (combination based model) is decided as the best PET model. However, with considering the small difference of RMSE values and number of required weather variables, Conchrane-Orcutt (radiation based model) is recommended for future research and practical hydrological application.
ABSTRAK

Penilaian model potensi penyejatpeluhan (PET) menggunakan Penman Monteith FAO-56 semakin popular di negara-negara membangun. Walau bagaimanapun, model ini memerlukan data pembolehubah cuaca yang lengkap. Untuk mengatasi masalah ini, beberapa model PET yang telah diklasifikasikan kepada empat belas model berasaskan suhu, dua belas model berasaskan pemindahan jisim, dua puluh satu model berasaskan radiasi, dan tiga model berasaskan gabungan dinilai menggunakan data penyejatan pan bagi pemerhatian selama 20 tahun daripada stesen meteorologi Subang Jaya. Hari Julian berasaskan imputasi min telah digunakan untuk mengisi data yang hilang. Kaedah pengesanan titik terpencil Tukey digunakan sebelum menganggarkan PET. Prestasi model dinilai dengan peratusan ralat (% ralat) dalam jumlah nilai, % ralat dalam nilai maksimum, % ralat dalam nilai minimum, % ralat dalam nilai purata, ralat min punca kuasa dua (RMSE), dan ketepatan ramalan ujian t berpasangan. Keputusan menunjukkan prestasi Linacre, Meyer, Conchrane-Orcutt, dan Kimberly Penman adalah lebih baik berbanding dengan model PET lain dalam kategori masing-masing. Kajian ini juga memberikan Kimberly Penman (model berasaskan kombinasi) diputuskan sebagai model PET yang terbaik. Walau bagaimanapun, dengan mempertimbangkan perbezaan kecil nilai RMSE dan pembolehubah cuaca yang diperlukan, Conchrane-Orcutt (model berasaskan radiasi) disyorkan untuk penyelidikan masa depan dan aplikasi hidrologi praktikal.