中華水土保持學報, 36(2): 133-144(2005)
Journal of Chinese Soil and Water Conservation, 36 (2)*:133-144* (2005)

線性水庫模式與無因次單位歷線模式之時間參數探討

李光敦[1]　許淑貞[2]　張進鑫[3]

摘　要　線性水庫模式與無因次單位歷線模式爲目前台灣地區，常用以進行降雨逕流模擬之水文模式。線性水庫模式中之 nK 參數，可藉由有效降雨組體圖與直接逕流歷線之第一階動差求得，其物理意義爲稽延時間值。而無因次單位歷線模式是利用水文紀錄資料，求取降雨組體圖重心至直接逕流總體積一半之時間點，而得稽延時間 T_{lag}。在實際工程應用上，T_{lag} 值常與集水區地文特性參數 $LL_{ca}\sqrt{S_c}$ 進行迴歸分析，以便將無因次單位歷線模式應用於無水文紀錄之地區。

本研究以面積大小介於 53 km² 至 343 km² 間之 10 個集水區爲例，分別針對線性水庫模式與無因次單位歷線模式中之時間參數進行探討。研究中發現，線性水庫模式中之 nK 值，並不適宜以有效降雨組體圖與直接逕流歷線之動差方式求得，而應以水文紀錄檢定方式推算 n 值與 K 值。而利用多場暴雨紀錄所得之無因次單位歷線模式的時間參數 T_{lag} 與集水區地文參數 $LL_{ca}\sqrt{S_c}$ 進行迴歸分析，發現此二參數之相關程度甚低。而由線性水庫模式之 nK 值與無因次單位歷線模式之 T_{lag} 值的比較可知，在同一集水區中，不同降雨場次所推算的時間參數有甚大變異，此結果顯示在採用線性水庫模式或是無因次單位歷線模式，並不適合利用水文紀錄所檢定之 nK 與 T_{lag} 的平均值，以代表該集水區水文特性。研究中爲瞭解 nK 值與 T_{lag} 值隨降雨事件之變異特性，採用運動波集流時間公式所推求之集流時間 T_c 與上述二時間參數值進行比較，並進行相關性分析。冀能藉由本文之分析結果，以提供工程師於採用線性水庫模式與無因次單位歷線模式時，正確選擇模式中時間參數之適當值，方能妥善模擬集水區之降雨逕流關係。

關鍵詞：線性水庫模式、無因次單位歷線模式、稽延時間、運動波集流時間。

Time Parameters Investigation of the Linear Reservoir Model and Dimensionless Unit Hydrograph Model

Kwan-Tun Lee[1]　Shu-Chen Hsu[2]　Chin-Hsin Chang[3]

ABSTRACT　The linear reservoir (LR) and dimensionless unit hydrograph (DUH) models are the hydrological models usually applied in Taiwan for rainfall-runoff simulation. The nK parameter in the LR model reflects the time lag of the watershed. It can be obtained through moment analysis of the storm hyetographs and the discharge hydrographs. The time lag parameter T_{lag} in the DUH model is defined as the time from the center of the storm hyetograph to the occurrence of the half of the total runoff

〔1〕國立台灣海洋大學河海工程學研究所教授(通訊作者)
Professor, Institute of River and Harbor Engineering, National Taiwan Ocean University, Keelung 202, Taiwan, R.O.C. (Corresponding Author)
E-mail: ktlee@mail.ntou.edu.tw
〔2〕國立台灣海洋大學河海工程學研究所碩士班研究生
Graduate Student, Institute of River and Harbor Engineering, National Taiwan Ocean University, Keelung 202, Taiwan, R.O.C.
〔3〕國立台灣海洋大學河海工程學研究所博士班研究生
Doctoral graduate student, Institute of River and Harbor Engineering, National Taiwan Ocean University, Keelung 202, Taiwan, R.O.C.

volume. The T_{lag} is then related to the watershed geomorphic factor $LL_{ca}/\sqrt{S_c}$ for further application in ungauged watersheds for the rainfall runoff simulation. Hydrologic and geomorphologic data from ten watersheds, whose sizes range from 53 km² to 343 km², were collected for the time parameter analysis in this study. The results showed that the nK parameter obtained by using the trial and error procedure is usually better than using the conventional moment method. Regression analysis showed that the correlation was poor for the parameters T_{lag} and $LL_{ca}/\sqrt{S_c}$ in the DUH model. The calibrated nK value and T_{lag} value for different storms in a watershed showed large variation. It can be concluded that the mean nK value and T_{lag} value for the LR model and the DUH model should be used with caution. In order to realize the change of the two time parameters for different storms, a kinematic-wave based time of concentration equation was used to estimate time of concentration T_c for different storms, and correlation analyses were then conducted to fully understand the relationship between these two time parameters and T_c. We hope that the analytical results from this study can provide a criterion for choosing an adequate time parameter to conduct the rainfall-runoff simulation.

Key Words: linear reservoir model, dimensionless unit hydrograph model, time lag, kinematic wave based time of concentration.