探討以大氣壓力、風速及風向建立之線性方程式作為河川模擬之下游邊界適用性

Investigate the applicability of linear equations based on atmospheric pressure, wind speed and wind direction as downstream boundaries for river simulations

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摘　要

台灣的地理位置位於亞熱帶，多數降雨集中在梅雨季以及颱風季，又因台灣地形地勢關係山高河川短，颱風來臨時常在極短時間內發生大量的降雨，大量雨水導致河川中水位、流量暴增，常常造成嚴重的洪水災害，對生命財產造成重大的衝擊。若是能快速提供河川水位之預報資訊，不僅可以對降雨所造成的災害減少，也可以給決策者更多的參考資訊做到災害來臨前的應變。

河川水位模擬於過去的研究中在模擬時上游、下游邊界條件多直接以觀測水位做輸入，為了建立一個全預報的系統，本研究於河川水位模擬部分利用迪聖凡納(de Saint Venant)所推導之一維變量流方程式作為基礎，其中變量流模式之上、下游邊界分別利用線性水庫、潮位方程式所模擬之流量、潮位做輸入，最後將模擬結果與實測水位相互比較後確定此系統所整合之模式是否可作為洪水預報之用。

線性水庫之流量模擬係以研究區域淡水河上游之新海橋、中正橋、大直橋作為上游邊界並利用徐昇法取得三個上游邊界集水區之雨量配合 N、K 係數模擬而得，線性水庫模擬時所需之 N、K 係數為利用 ArcGIS 求得集水區之地文因子計算後而得，下游邊界暴潮潮位方程式則是利用近颱風中心之大氣壓力、風速及風向求得暴潮差，再加上天文潮後即可得颱風期間之暴潮潮位。

本研究結果可分為下列幾點:

1. 將此系統之模擬結果比較土地公鼻、台北橋、百齡橋三個水位測站之實測水位，發現模擬結果與實測水位誤差甚小，表示此系統之模式整合可作為洪水預報之用。
2. 本研究建立淡水河河口之暴潮線性方程式，使用三場歷史颱風暴潮資料進行檢定，其 R=0.874，具高度相關，顯示本研究建立之暴潮方程式是可應用於河川水位模擬之下游邊界。

關鍵詞：河系演算，暴潮偏差，淡水河，下游邊界

Abstract

Taiwan is a subtropical region, and most of the rainfall is concentrated in the plum rainy season and the typhoon season. Due to the terrain of Taiwan, high mountains, and short rivers, when typhoons come, there is often a lot of rainfall in a short period of time. A large amount of rain causes the water level and flow in the river to increase sharply, often causing serious flood inundation. Which inflicts disastrous loss of life and economy. If the forecast information of the river water level can be provided quickly, it can not only reduce the disaster caused by rainfall, but also give decision makers more reference information to respond to the disaster before it comes.

In previous studies, the upstream and downstream boundary conditions of river water level simulation were mostly directly input with the observed water level. To build a full forecast system. The river level simulation section uses a one-dimensional unsteady flow equation derived from de Saint Venant equations. Among them, the upstream and downstream boundaries of the unsteady flow model use the linear reservoir and the flow and tide level simulated by the tide level equation as input, the final simulation results are compared with the measured water level to determine whether the model integrated into the system can be used as a forecast.

The linear reservoir flow simulation takes Xinhai Bridge, Zhongzheng Bridge and Dazhi Bridge in the upper reaches of the Danshui River in the study area as the upstream boundaries, and the Thiessen method is used to obtain the rainfall of the three upstream boundary basins. And using the N and K coefficients, the analog values are obtained. The N and K coefficients required for the linear reservoir simulation are the terrestrial factor coefficients of the catchment calculated by ArcGIS. The storm surge equation of the downstream boundary uses the atmospheric pressure, wind speed and wind direction near the center of the typhoon to obtain the storm tide range, and after adding the astronomical tide, the storm surge during the typhoon can be obtained.

The results of this study can be divided into the following points:

1. Comparing the simulation results of this system with the measured water levels of the three water level measuring stations of Tutikungpi, Taipei Bridge and Bailing Bridge, it is found that the error between the simulation results and the measured water stages is good.
2. In this study, a linear equation of storm surge in the freshwater estuary was established and verified using the historical data of three typhoon storm surges. Its R=0.874, which is highly correlated, indicates that the storm surge equation established in this study can be applied to the downstream boundary of river water stages simulation.

Keywords: River routing, Storm surge, Tamsui River, Downstream boundary