應用都市洪水即時預警模式進行滯蓄洪設施整合減災調適技術研究

Application of an Urban Real-Time Predicted Inundation Model to the Adaptation and Mitigation Technologies of Detention Pond

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摘要

都市積淹水之因素眾多且複雜，縱然有防洪設施之建設，但一旦雨量強度過大、下游潮位過高引發潮位上溯排水系統等，排水設施亦可能渲洩不及甚至溢流。滯蓄洪設施是近期都市減洪規劃中重要設施，然可能因啟動操作之時機影響其運作效能，進而衍生都市地區存在無法排除之有害逕流造成積淹水之問題。為避免逕流疊加造成更嚴重的局部地區淹水問題，需先分析在現有防洪設施基礎下，暴雨事件造成之都市區域地表逕流量，以進一步規劃減災調適之策略以容蓄洪水避免災害。

本研究以「極端降雨引致都市洪水即時預警模式與減災調適技術整合應用研究」之研究成果為基礎，測試演算民國 106 年尼莎暨海棠颱風、民國 107 年 0823 豪雨事件、民國 108 年 0813 豪雨事件等 3 場颱洪事件作為檢定與驗證案例。由模式演算結果與水位測站實測水位資料比較可知，民國 106 年尼莎暨海棠颱風安順橋測站第 60 小時即第 2 峰值之後模擬水位較實測水位低很多，水位趨勢與雨量一致，第 2 峰值與第 3 峰值間降雨有間歇，模式模擬排水較實測快。研究區域於民國 108 年 0813 豪雨期間模式演算結果與淹水站 13、15、28 及 57 之實測水深歷程相符，模式演算地面積淹 30 公分之到達時間亦與淹水感測器測得時間相近。

由民國 107 年 0823 豪雨事件演算結果之流量歷線與降雨歷程互相比較可知，流入淹水區域之流量歷線之形狀與降雨歷線較為相近，即直接反應降雨產生地表逕流；而流出淹水區域之流量歷線，因受地表逕流、窪蓄與滯洪池蓄洪之影響，先反應第 1 個較大的峰值後以一平緩多峰歷時 20 小時後才開始退水。於第 1 峰值後發生前開始抽水，抽水開始後滯洪池水位即開始下降，可知滯洪池於退水開始即進行抽水機操作，可有效迅速降低滯蓄洪水位，強化滯蓄洪設施功能。

為進一步分析滯蓄洪設施優化條件，以連續 2 場重現期 10 年豪雨事件(間隔 12 小時)，搭配在不同延時啟動抽水機，演算水深以分析滯蓄洪設設施操作減洪效果。以水深之平均降低值分析減洪效果，結果顯示啟動抽水機的時約在洪峰過後 4 小時，可以有

較佳的降低滯洪池水位的成效。初步分析仁德常淹水地區後，初擬可以研究區域內面積較大之校園綠地規劃增加約 4 萬立方公尺之滯蓄洪空間，並以 2 年重現期一日降雨事件模擬評估減洪效果，由校園水位變化可知，此一規劃於降雨歷程前 4-10 小時可發揮約 10cm-20cm 之減洪作用。進一步探討其周邊區域之水位變化，可發現水位歷線洪峰約可延遲 0.5 至 1 小時，可發揮約 5cm 之減洪作用。
關鍵詞：滯蓄洪設施、減災、調適、即時預警

Abstract

The causes of inundation in urban areas were numerous and complex. Even though there were flood mitigation facilities, once the rainfall intensity and the downstream tidal level were exceedingly high, the flood in drainage could not be drained in time or even overflow. Detention pond was an important flood mitigation facility in recent years. However, the detention efficiency might be affected by the timing of the operation. The harmful runoff that cannot be drained caused flooding in the urban areas. In order to avoid the problem of flooding in the local area caused by the superposition of runoff, it was necessary to analyze the surface runoff of the urban areas caused by the storm events on the basis of the current flood mitigation facilities.

The establishment of the PHD model was carried out to test the calculus of Typhoon Nesat in 2017, extremely heavy rainfall events 0823 in 2018 and 0813 in 2019 as a verification case. The water level between the simulated and measured results of the typhoon and rainfall events was compared. These results shows a good agreement in the peak value of water level, and the PHD model can reasonably calculate the runoff.

Analyze the optimal conditions of the detention facilities. Based on two consecutive 10-year heavy rain events (with an interval of 12 hours), and start pumping at different delays, calculate the water depth to analyze the flood reduction effect of the detention facilities. Analysis of the flood reduction effect based on the average reduction of water depth, the results show that when the pumping is started about 4 hours after the flood peak, the effect of lowering the water level of the detention pond can be better.

After preliminary analysis of the flooded area in Rende District, it is initially planned that the campus space in the area can be increased by about 40,000 m^3 of flood detention storage, and the flood mitigation will be evaluated by a 24-hr rainfall event simulation of the 2-year return period. The effect can be seen from the change of the campus water level. This plan can exert a flood mitigation effect of about 10cm-20cm 4-10 hours before the rainfall course. Further exploring the changes of the water level in the surrounding area, it can be found that the flood peak of the water level can be delayed by about 0.5 to 1 hour, and it can exert a flood mitigation effect of about 5 cm.
Keywords：detention pond, mitigation, adaptation, real-time prediction.