混合機器學習模式於淹水災害風險分析之研究

Flood hazard risk analysis using hybrid machine learning models

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摘　要

台灣位於西太平洋颱風路徑要衝，夏秋兩季常受到颱風侵襲，每年平均受到3至4場颱風侵襲，伴隨來的豐沛雨量，若颱風所帶來的大量雨水無法即時宣洩時，造成的淹水不僅阻礙交通，對於居民的生命財產亦造成巨大威脅。對於淹水預警及減災上，繪製出準確的淹水潛勢地圖是必要的。本研究提出以聚類型演算法結合機器學習建立淹水潛勢評估模式，其中包含兩個部分：第一部分，依據每個網格點的淹水影響因子以自組織映射(self-organizing map, SOM)進行網格點的分類，第二部分，每類網格點分別使用隨機森林(random forest, RF)建立淹水潛勢模式產生潛勢值。本研究提出模式應用於台灣宜蘭縣平地地區共十個鄉鎮，並證明提出模式的優勢。結果顯示，本研究提出之淹水潛勢評估模式可準確提供淹水潛勢地圖的能力。未來可根據本研究所發展之淹水潛勢評估模式，提供管理機關掌握淹水潛勢情況之參考，希望降低淹水之生命財產損失。

關鍵字: 淹水、淹水潛勢評估模式、機器學習法、自組織映射、隨機森林

Abstract

Taiwan is located on the path of typhoons that occur in the western Pacific Ocean, and it is frequently hit by three to four typhoons on average during summer and autumn every year. The abundant precipitation caused by typhoons can result in inundation if large amounts of rainwater cannot be drained in time. This, in turn, not only obstructs traffic but also poses a significant threat to the lives and properties of the residents. Concerning flood warning and disaster reduction, it is imperative to create accurate

flood susceptibility maps. In this study, a two-step flood susceptibility model based on the clustering algorithm combined with machine learning is proposed to yield the flood susceptibility map. The first step is to categorize grid points based on the flood impact factors using a self-organizing map (SOM). The second step uses the random forest (RF) to establish a flood susceptibility model for each category of grid points to generate their flood susceptibility values. The proposed model was applied to ten townships in the Lanyang Plain in Yilan County, Taiwan, to demonstrate its advantages. The results of this study show that the flood susceptibility model can accurately generate the flood susceptibility maps of the concerned areas. In conclusion, the flood susceptibility model developed in this study can be used as a reference for the competent authorities to evaluate inundation potential situations in order to reduce losses of life and property.

Key words: Flood, Flood susceptibility model, Machine learning, Self-organizing map, Random forest