



Impacts of urbanization on the hazard, vulnerability and risk of pluvial disaster

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The design capacity of an urban drainage system is often smaller than that of a fluvial protection facility such as levee. Many metropolises located in lowlands suffer pluvial inundation disaster more than pluvial flood disaster. For improving mitigation strategies, flood risk assessment is an important tool of non-structure flood control measures, especially in the countries suffering tropical cyclones and monsoon with high frequency. Locating in the hot zone of typhoon tracks in the Western Pacific, Taiwan suffers three to five typhoons annually. As results of urbanization in Taiwan, heavy rainfalls cause inundation disaster rising with the increase of population and the demand of land development. The purpose of this study is to evaluate the impacts of urbanization on the hazard, vulnerability and risk of pluvial disaster.

This study applies the concept that risk is composed by hazard and vulnerability to assess the flood risk of human life. Two-dimensional overland-flow simulation is performed based on a design extreme rainfall event to calculate the score of pluvial hazard factors for human life, including flood depth, velocity and rising ratio. The score of pluvial vulnerability for human life is carried out according to the factors of resident and environment. The risk matrix is applied to show the risk by composing the inundation hazards and vulnerabilities. Additionally, flood simulations performed are concerned with different stages of drainage channel construction that indicates the progress of the pluvial disaster mitigation for evaluating the impacts of urbanization on inundation hazard. The changes of land use and density of population are concerned with the impacts of urbanization on inundation vulnerability.

The Tainan City, one of the earliest cities on Taiwan, is selected as the case study because serious flooding was induced by Typhoon Morakot in 2009. Typhoon Morakot carried intense rain moved from the east slowly as low as 4 km/hr while the southwest monsoon also entered this region at the same time. The combined effect of these was that in the mid-area between typhoon and southwest monsoon, a sharp air-pressure gradient was built which unpredictably brought about heavy rainfall for about 72 hours in the study area to produce a record-breaking rainfall of 625mm in 48 hours. Through the assessing the impacts of urbanization on pluvial inundation risk of the Tainan City in the Typhoon Morakot event, the results show that the inundation hazard is decreased and the vulnerability is increased due to urbanization. Finally, the pluvial inundation risk maps for human life can provide useful information for setting mitigation strategies of flood inundation.