Wang, Yu-Chi; Guo, Wen-Dar; Shih, Dong-Sin; Chen, Cheng-Hsin; Yang, Tsun-Hua

The Establishment of Rapid Evaluating System for Surficial Inundations

THE ESTABLISHMENT OF RAPID EVALUATING SYSTEM FOR SURFICIAL INUNDATIONS

Yu-Chi Wang[1], Wen-Dar Guo[2], Dong-Sin Shih[3], Cheng-Hsin Chen[4] and Tsun-Hua Yang[5]

Typhoon and inundation issues in Taiwan have become increasingly important because the storm water sewer and regional drainage systems of metropolises are frequently unable to meet the requirements of the existing and future metropolitan development. T Therefore, when typhoons or torrential rains arrive, severe inundations occur if the rainfall intensity exceeds the design capacity of the storm sewer system. For example, the torrential rain accompanying Typhoon Kalmaegi in 2008 caused widespread damage in the coastal towns of Pingtung County. In 2010, Typhoon Fanapi and Typhoon Megi brought surprising rainfall to Kaohsiung and Yilan, which also caused serious urban inundation disasters. In 2011, Typhoon Nanmadol reached southern Taiwan and caused heavy inundation in the regions surrounding Pingtung County and Kaohsiung City. Clearly, Taiwan encounters increasingly damaging typhoons each year. The protection offered by existing flood prevention engineering is limited. To reduce effectively the overall damage from typhoons, torrential rain, and floods, appropriate non-structural mitigation methods must be adopted in addition to currently available engineering solutions. The most viable and effective methods among the many non-structural solutions may the disaster warning systems. The losses caused by flooding can be reduced if the areas at risk of flooding can be predicted and warnings can be issued to prompt disaster prevention and allow response units and residents to prepare before disasters occur.

Hence, based on the results of ensemble quantitative precipitation forecasts (QPF) designed by the Taiwan Typhoon and Flood Research Institute (TTFRI), a system that effectively evaluates inundation and provides warnings for townships throughout Taiwan is developed in this study . First, the corresponding data are collected: the rain gauge stations, the GIS shape files, the typhoon inundation events and the designed capacity of storm sewer system. Then, the evaluation method based on the criteria of sewer system capacity (CSC) is proposed. The main concept of the CSC method is to multiply the discharge of storm sewer system by three factors to classify four levels of inundation probability (high, medium, low, and no inundation).

To verify the evaluation performance of the proposed system, Typhoon Megi and Typhoon Nanmadol are tested in this study. Four verification indices, Bias Score (BS), Probability of Detection (POD), False Alarm Ratio (FAR) and Threat Score (TS) are used to evaluate the prediction accuracy. The verification results of Typhoon Megi are shown in Table 1 and Figure 1.

[1] Associate Researcher, Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, Taichung City, 40763, Taiwan (yuchi@ttfri.narl.org.tw)
[2] Associate Researcher, Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, Taipei City, 10093, Taiwan (wdguo@ttfri.narl.org.tw)
[3]Associate Researcher, Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, Taichung City, 40763, Taiwan (dsshih@ttfri.narl.org.tw)
[4]Assistant Researcher, Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, Taichung City, 40763, Taiwan (mas@ttfri.narl.org.tw)
[5] Associate Researcher, Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, Taichung City, 40763, Taiwan (tshyang@ttfri.narl.org.tw)

The results indicate that, on the basis of the analysis of actual inundation records from the typhoon event, it is concluded that the proposed inundation evaluation system combining the QPF with sewer system capacity is capable of identifying inundation areas and offers valuable information for flooding early warning during typhoon.

Table 1 Verification results by four different evaluation indexes for Typhoon Megi.

Index	Using observed precipitation data	Using QPF data
BS	2.714	3.286
POD	1.000	0.857
FAR	0.632	0.739
TS	0.368	0.250

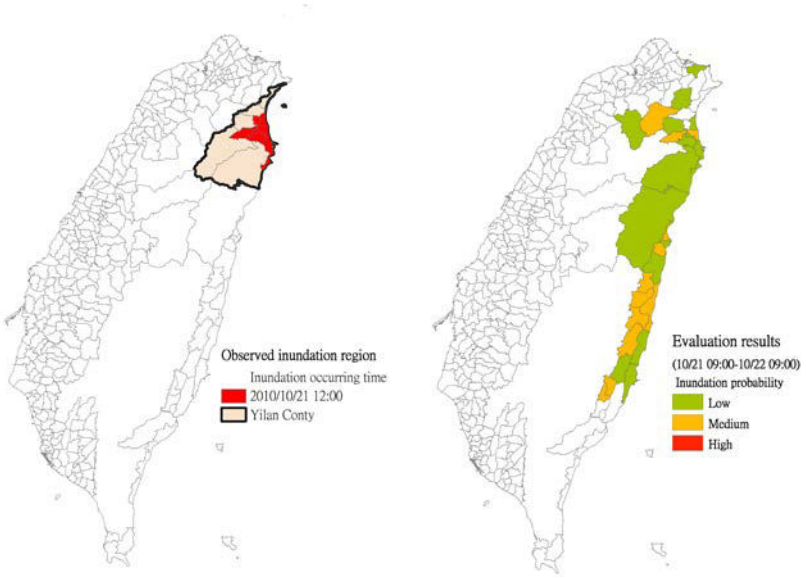

Figure 1 (a) Observed inundation map and (b) Evaluation results for Typhoon Megi.