論　文　要　旨
Thesis Abstract

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※報告番号	甲第326号	氏　名 (Name)	CHITWATKULSIRI DETCHPHOL

主論文題名　（Title）
Development of a Real-Time Flood Forecasting System in a Tropical Urban Area: Application of Deep Learning Techniques with an Integrated Urban Flood Modelling

内容の要旨　（Abstract）
In urban areas of Thailand, especially in Bangkok, recent flash floods have caused severe damage and prompted a renewed focus on managing their impacts. The development of a real-time warning system could provide timely information to initiate flood management protocols, thereby reducing impacts. Therefore, we developed an innovative real-time flood forecasting system (RTFlood system) and applied it to the Ramkhamhaeng polder in Bangkok, which is particularly vulnerable to flash floods. The RTFlood system consists of two blocks of development. First, it consists of an urban flood model development, a rainfall forecasting model development, and a real-time flood forecasting system based on the physical hydraulic model (RTFlood-BPHM). This development consisted of preparing rainfall input data for subsequent use by a hydraulic model. This used radar rainfall data from the Bangkok Metropolitan Administration and developed forecasts using the TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting) rainfall model. This development also provided a real-time task management system that controlled all processes in the RTFlood-BPHM, i.e., input data preparation, hydraulic simulation timing, and post-processing of the output data for presentation. In addition, this provided a model simulation applying the input data to simulate flash floods. It used a dynamic, conceptual model (PCSWMM, Personal Computer version of the Stormwater Management Model) to represent the drainage systems of the target urban area and predict the inundation areas. The RTFlood-BPHM was applied to the Ramkhamhaeng polder to evaluate the system's accuracy for 116 recent flash floods. The result showed that 61.2% of the flash floods were successfully predicted with accuracy high enough for appropriate pre-warning. Moreover, it indicated that the RTFlood system alerted inundation potential 20 min earlier than separate flood modeling using radar and local rain stations individually. Second, the overall components of RTFlood-BPHM remain with further modification of a real-time flood forecasting system with an advanced machine learning model (RTFlood-AMLM). As of the RTFlood-AMLM development, the RFMP was assigned to process the flood map forecasting. The RTFlood-AMLM development is based on a generative adversarial network designed

for general-purpose image-to-image translation and roles as a flood map generator within a shorter computational time. The lead time of forecasting was extended up to an hour—the different scenarios of rainfall implemented through the RFMP. The result showed that RFMP provided a practical and high accuracy for flood prediction. The overall accuracy of 63.9% of the flash floods was successfully notified with great accuracy of the RTFlood-AMLM. The earlier alert made it possible to decide on explicit flood controls, including pump, canal gate operations, and residents in the area.

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