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Coupled 1-D sewer and street networks and 2-D flooding model to rapidly evaluate surface inundation

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Flash floods have occurred frequently in the urban areas around the world and cause the infrastructure and people living to expose continuously in the high risk level of pluvial flooding. According to historical surveys, the major reasons of severe surface inundations in the urban areas can be attributed to heavy rainfall in the short time and/or drainage system failure. In order to obtain real-time flood forecasting with high accuracy and less uncertainty, an appropriate system for predicting floods is necessary. For the reason, this study coupled 1-D sewer and street networks and 2-D flooding model as an operational modelling system for rapidly evaluating surface inundation. The proposed system is constructed by three significant components: (1) all the rainfall-runoff of a sub-catchment collected via gullies is simulated by the RUNOFF module of the Storm Water Management Model (SWMM); (2) and directly drained to the 1-D sewer and street networks via manholes as inflow discharges to conduct flow routing by using the EXTRAN module of SWMM; (3) after the 1-D simulations, the surcharges from manholes are considered as point sources in 2-D overland flow simulations that are executed by the WASH123D model. It can thus be used for urban flood modelling that reflects the rainfall-runoff processes, and the dynamic flow interactions between the storm sewer system and the ground surface in urban areas.
In the present study, we adopted the Huwei Science and Technology Park, located in the south-western part of Taiwan, as the demonstration area because of its high industrial values. The region has an area about 1 km2 with approximately 1 km in both length and width. It is as isolated urban drainage area in which there is a complete sewer system that collects the runoff and drains to the detention pond. Based on the simulated results, the proposed modelling system was found that the simulated floods fit to the survey records because the physical rainfall-runoff phenomena in urban environment were better reflected.

Keywords: SWMM, WASH123D, surface inundation, real-time.