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Flood simulation and loss estimate subject to land use/cover changes based on coupled 1D-2D analysis and neural networks

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Flood-induced losses have escalated since the mid-1950s, highly associated with the development of the major cities in Taiwan. Land use/cover changes (LUCC, e.g., urbanization) can perturb spatiotemporal patterns of heavy rains and surface runoffs thereby complicating the estimate of flood losses. In this study, we aim at leveraging a sophisticated, coupled 1D-2D flood simulation in order to provide the most accurate inundation scenarios for loss estimate, in conjunction with the use of a loss prediction scheme based on neural networks (NNs). We focus on a region in Central Taiwan that includes the Dajia and Wu Rivers and Taichung City. We first configure the HEC-RAS model (Version 5.0.6) in the study region, and then validate the model using the rainfall and discharge data of Typhoon Soulik, 24-hour design storm of 450 mm, and reported inundation and potential maps. Secondly, we investigate the impact of LUCC on flood simulation using two different land use conditions in 1995 and 2007, obtaining from the National Land Surveying and Mapping Center. The validated flood model is then run through all the flood events from 2007 to 2015 to generate a sequence of inundation maps that are further incorporated in the loss prediction model via training the prescribed damage functions and NNs. The sensitivity of flood loss estimate to antecedent land surface conditions and 1D-2D resolutions and accuracy will be discussed.

Keywords: hydraulic modeling, flooding, typhoon, catastrophe modeling, loss assessment