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1D and 2D urban dam-break flood modelling in Istanbul, Turkey

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Urban flood events are increasing in frequency and severity as a consequence of several factors such as reduced infiltration capacities due to continued watershed development, increased construction in flood prone areas due to population growth, the possible amplification of rainfall intensity due to climate change, sea level rise which threatens coastal development, and poorly engineered flood control infrastructure (Gallegos et al., 2009). These factors will contribute to increased urban flood risk in the future, and as a result improved modelling of urban flooding according to different causative factor has been identified as a research priority (Gallegos et al., 2009; Ozdemir et al. 2013). The flooding disaster caused by dam failures is always a threat against lives and properties especially in urban environments. Therefore, the prediction of dynamics of dam-break flows plays a vital role in the forecast and evaluation of flooding disasters, and is of long-standing interest for researchers.

Flooding occurred on the Ayamama River (Istanbul-Turkey) due to high intensity rainfall and dam-breaching of Ata Pond in 9th September 2009. The settlements, industrial areas and transportation system on the floodplain of the Ayamama River were inundated. Therefore, 32 people were dead and millions of Euros economic loses were occurred. The aim of this study is 1 and 2-Dimensional flood modelling of the Ata Pond breaching using HEC-RAS and LISFLOOD-Roe models and comparison of the model results using the real flood extent. The HEC-RAS model solves the full 1-D Saint Venant equations for unsteady open channel flow whereas LISFLOOD-Roe is the 2-D shallow water model which calculates the flow according to the complete Saint Venant formulation (Villanueva and Wright, 2006; Neal et al., 2011). The model consists a shock capturing Godunov-type scheme based on the Roe Riemann solver (Roe, 1981). 3 m high resolution Digital Surface Model (DSM), natural characteristics of the pond and its breaching such as depth, wide, length, volume and breaching shape and daily total rainfall data were used in the models. The simulated flooding in the both models were compared with the real flood extent which gathered from photos taken after the flood event, high satellite images acquired after 20 days from the flood event, and field works.

The results show that LISFLOOD-Roe hydraulic model gives more than 80% fit to the extent of real flood event. Also both modelling results show that the embankment breaching of the Ata Pond directly affected the flood magnitude and intensity on the area. This study reveals that modelling of the probable flooding in urban areas is necessary and very important in urban planning.

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