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A fine-resolution dynamic urban flood mapping method using graph theory

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Aiming at producing time and spatial variant flood predictions of urban flooding due to heavy rainfall, a new flood mapping method is developed, using graph theory. In the proposed method, geographical layout of the sewer network is represented by a directional graph where nodes and edges represent manholes and pipes, with direction indicating the gravitational flow direction, resembling the real urban flooding conditions. The sewer network's dynamic response towards rainfall is modeled by a collection of semi-distributed conceptual models, while heterogeneous behavior of sewer interactions (i.e. backwater effect) is modelled using the outcomes of a frequent subgraph analysis of historical flooding records. A logistic regression model is employed eventually for qualitative prediction of future flooding at each manhole location. The proposed methodology captures both location and time specific flooding information of the future, and could be easily visualized in the form of a dynamic flooding map. In addition, the data-driven nature of the modelling method has the advantage of easy implementation and computing efficiency. Testing is done for a suburban catchment in the city of Gent, Belgium. The results are evaluated for both spatially variated rainfall from rain gauges and radar rainfall estimates.