Probabilistic urban inundation nowcasting

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Abstract

A probabilistic model has been set up and evaluated for the nowcasting (short-term forecasting) of urban inundations. It consists of the following components:

- A rainfall nowcasting model based on the Short Term Ensemble Prediction System (STEPS), originally co-developed by the UK Met Office and Australian Bureau of Meteorology, but further customised for urban applications in Belgium (denoted STEPS-BE). It provides high-resolution (1 km / 5 min) rainfall nowcast ensembles with a 2-hour lead time.
- A hydraulic model that consists of the 1D sewer network and an innovative 'nested' 2D surface model to model 2D urban surface inundations at high resolution. The surface components are categorised into three groups and each group is modelled using triangular meshes at different resolutions; these include streets (3.75 – 15 m^2), high flood hazard areas (12.5 – 50 m^2) and low flood hazard areas (75 – 300 m^2).
- Functions describing urban flood damage and social consequences in relation to inundation depth. These functions were empirically derived based on questionnaires to people in the region that were recently affected by sewer floods.
- Statistical post-processing methods in order to produce probabilistic urban flood risk maps: spatial maps representing the probability of flooding.

The method has been implemented and tested for the villages Oostakker and Sint-Amandsberg, which are part of the larger city of Gent, Belgium. After each of the different above-mentioned components were evaluated, they were combined and tested for five recent historical flood events. The rainfall nowcasting, hydraulic sewer and 2D inundation modelling and socio-economical flood risk results each could be partly evaluated: the rainfall nowcasting results based on radar data and two rain gauges; the hydraulic sewer model results based on water level and discharge data at pumping stations; the 2D inundation modelling results based on limited data on some recent flood locations and inundation depths; the results for the socio-economical flood consequences of the most extreme events based on claims in the database of the national disaster agency. Different methods for visualisation of the probabilistic inundation results are proposed and tested.

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