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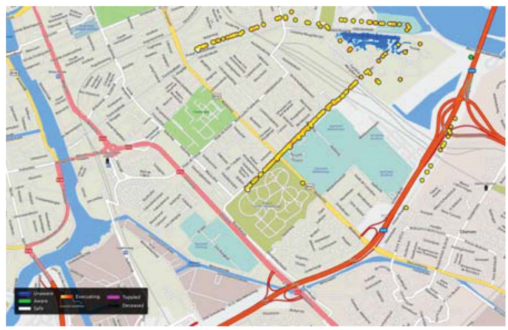
We present computational models for flood early warning systems developed within the *UrbanFlood* European Union project. The models are used for prediction of dike failures and for flood risk assessment. The *UrbanFlood* early warning system monitors sensor networks installed in flood defences (dikes and levees), detects sensor signal abnormalities through an artificial intelligence module, calculates dike failure probability, and simulates possible scenarios of breaching, flood propagation, and city evacuation. Additionally, a *Virtual Dike* computational module has been developed for advanced research into dike reliability and potential failure mechanisms. The *Virtual Dike* is also used for training the artificial intelligence module on signal parameters induced by dike instabilities. All the relevant information and simulation results are fed into an interactive decision support system that helps dike managers and city authorities to make informed decisions in case of flood emergency and in routine dike quality assessment. Some developments have been reported in http://dx.doi.org/10.1016/j.procs.2011.04.012 and http://dx.doi.org/10.1016/j.procs.2011.04.084.

In this paper, we introduce a modelling workflow that includes modules for dike reliability analysis, dike breaching, breach discharge calculation, flood simulation, and evacuation planning. We focus on two models recently introduced into the system: (1) the HR-Breach model predicting the growth of dike breach and (2) the Life Safety Model simulating city evacuation scenarios. Finally, we present simulation results and a comparison of different dike stability models.

One of the critical issues in modelling is validation. Full-scale *IJkDijk* failure experiments and trusted modelling tools are used to develop, calibrate and validate simplified models for operational decision support systems requiring real-time response and quick analysis of multiple scenarios in critical flood situations. To achieve this goal, a number of models that simulate dike reliability have been compared.



Simulation results in the UrbanFlood decision support system: dike breach, flood dynamics, and evacuation modeling for Science Park, Amsterdam.

Computational modules are invoked by workflow-based expert scenarios via the Common Information Space middleware. Compute-intensive models are run on a high-performance Cloud system of SARA supercomputing centre. This Cloud system provides dynamic resource allocation on demand, which is especially important in flood emergency situations.

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