Geophysical Research Abstracts
Vol. 17, EGU2015-7162-1, 2015
EGU General Assembly 2015
© Author(s) 2015. CC Attribution 3.0 License.

Nested 1D-2D approach for urban surface flood modeling

Damian Murla and Patrick Willems

KU Leuven, Civil Engineering, Hydraulics Laboratory, Leuven, Belgium (Damian.MurlaTuyls@bwk.kuleuven.be; Patrick.Willems@bwk.kuleuven.be)

Floods in urban areas as a consequence of sewer capacity exceedance receive increased attention because of trends in urbanization (increased population density and impermeability of the surface) and climate change. Despite the strong recent developments in numerical modeling of water systems, urban surface flood modeling is still a major challenge. Whereas very advanced and accurate flood modeling systems are in place and operation by many river authorities in support of flood management along rivers, this is not yet the case in urban water management. Reasons include the small scale of the urban inundation processes, the need to have very high resolution topographical information available, and the huge computational demands.

Urban drainage related inundation modeling requires a 1D full hydrodynamic model of the sewer network to be coupled with a 2D surface flood model. To reduce the computational times, 0D (flood cones), 1D/quasi-2D surface flood modeling approaches have been developed and applied in some case studies. In this research, a nested 1D/2D hydraulic model has been developed for an urban catchment at the city of Gent (Belgium), linking the underground sewer (minor system) with the overland surface (major system). For the overland surface flood modelling, comparison was made of 0D, 1D/quasi-2D and full 2D approaches. The approaches are advanced by considering nested 1D-2D approaches, including infiltration in the green city areas, and allowing the effects of surface storm water storage to be simulated. An optimal nested combination of three different mesh resolutions was identified; based on a compromise between precision and simulation time for further real-time flood forecasting, warning and control applications. Main streets as mesh zones together with buildings as void regions constitute one of these mesh resolution (3.75m2 – 15m2); they have been included since they channel most of the flood water from the manholes and they improve the accuracy of interactions within the 1D sewer network. Other areas that recorded flooding outside the main streets have been also included with the second mesh resolution for an accurate determination of flood maps (12.5m2 – 50m2). Permeable areas have been identified and used as infiltration zones using the Horton infiltration model. A mesh sensitivity analysis has been performed for the low flood risk areas for a proper model optimization. As outcome of that analysis, the third mesh resolution has been chosen (75m2 – 300m2). Performance tests have been applied for several synthetic design storms as well as historical storm events displaying satisfactory results upon comparing the flood mapping outcomes produced by the different approaches. Accounting for the infiltration in the green city spaces reduces the flood extents in the range 39% - 68%, while the average reduction in flood volume equals 86%.

Acknowledgement: Funding for this research was provided by the Interreg IVB NWE programme (project RainGain) and the Belgian Science Policy Office (project PLURISK). The high resolution topographical information data were obtained from the geographical information service AGIV; the original full hydrodynamic sewer network model from the service company Farys, and the InfoWorks licence from Innovyze.