Geophysical Research Abstracts
Vol. 16, EGU2014-12440, 2014
EGU General Assembly 2014

A 2D simulation model for urban flood management

Roland Price (1), Jonathan van der Wielen (2), Slavco Velickov (3), and Diogo Galvao (4)

(1) HydroLogic Research, Delft, Netherlands (rolandprice@ziggo.nl), (2) HydroLogic Research, Delft, Netherlands (Jonathan.vanderWielen@hydrologic.com), (3) HydroLogic Research, Delft, Netherlands (slavco.velickov@hydrologic.com), (4) HydroLogic Research, Delft, Netherlands (diogo.galvao@hydroresearch.com)

The European Floods Directive, which came into force on 26 November 2007, requires member states to assess all their water courses and coast lines for risk of flooding, to map flood extents and assets and humans at risk, and to take adequate and coordinated measures to reduce the flood risk in consultation with the public. Flood Risk Management Plans are to be in place by 2015.
There are a number of reasons for the promotion of this Directive, not least because there has been much urban and other infrastructural development in flood plains, which puts many at risk of flooding along with vital societal assets. In addition there is growing awareness that the changing climate appears to be inducing more frequent extremes of rainfall with a consequent increases in the frequency of flooding. Thirdly, the growing urban populations in Europe, and especially in the developing countries, means that more people are being put at risk from a greater frequency of urban flooding in particular.
There are urgent needs therefore to assess flood risk accurately and consistently, to reduce this risk where it is important to do so or where the benefit is greater than the damage cost, to improve flood forecasting and warning, to provide where necessary (and possible) flood insurance cover, and to involve all stakeholders in decision making affecting flood protection and flood risk management plans.
Key data for assessing risk are water levels achieved or forecasted during a flood.
Such levels should of course be monitored, but they also need to be predicted, whether for design or simulation. A 2D simulation model (PriceXD) solving the shallow water wave equations is presented specifically for determining flood risk, assessing flood defense schemes and generating flood forecasts and warnings. The simulation model is required to have a number of important properties:

-Solve the full shallow water wave equations using a range of possible solutions;
-Automatically adjust the time step and keep it as large as possible while maintaining the stability of the flow calculations;
-Operate on a square grid at any resolution while retaining at least some details of the ground topography of the basic grid, the storage, and the form roughness and conveyance of the ground surface;
-Account for the overall average ground slope for particular coarse cells;
-Have the facility to refine the grid locally;
-Have the facility to treat ponds or lakes as single, irregular cells;
-Permit prescribed inflows and arbitrary outflows across the boundaries of the model domain or internally, and sources and sinks at any interior cell;
-Simulate runoff for spatial rainfall while permitting infiltration;
-Use ground surface cover and soil type indices to determine surface roughness, interception and infiltration parameters;
-Present results at the basic cell level;
-Have the facility to begin a model run with monitored soil moisture data;
-Have the facility to hot-start a simulation using dumped data from a previous simulation;
-Operate with a graphics cards for parallel processing;
-Have the facility to link directly to the urban drainage simulation software such as SWMM through an Open Modelling Interface;
-Be linked to the Netherlands national rainfall database for continuous simulation of rainfall-runoff for particular polders and urban areas;
-Make the engine available as Open Source together with benchmark datasets;

PriceXD forms a key modelling component of an integrated urban water management system consisting of an on-line database and a number of complementary modelling systems for urban hydrology, groundwater, potable

water distribution, wastewater and stormwater drainage
(separate and combined sewerage), wastewater treatment, and surface channel networks. This will be a ’plug and play’ system. By linking the models together, confidence in the accuracy of the above-ground damage and construction costs is comparable to the below-ground costs. What is more, PriceXD can be used to examine additional physical phenomenon such as the interaction between flood flows and flows to and from inlets distributed along the pipes of the underground network, and to optimize the removal of blockages and improve asset management.

Finally, PriceXD is already an integral component on a number of operational projects and platforms, including the MyWater distributed platform and the HydroNET web portal, where it is already applied to realistic case studies on the Netherlands (namely the Rijnland area), facilitating the access to both the model execution and results, by abstracting most of the complexity out of the model setup and configuration.