Urban stormwater modelling with MOHID

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Abstract
MOHID is a platform that includes a set of numerical models to simulate the water cycle in an integrated approach. It is an open source project that has been developed and applied to a wide range of studies since 1985. To increase its applicability for urban storm water modelling, the main module of the platform MOHID Land is now integrated with SWMM model via OpenMI. This poster evaluates the performance of MOHID in urban storm water modelling, by comparing results of the test cases presented by S. Néelz and G. Pender (2013) and of a real case study with InfoWorks ICM vs. 5.5. Moreover, it is discussed the advantage of covering the entire water cycle in MOHID platform, making it applicable for a wide range of cases.

Keywords
1D2D, urban drainage, urban stormwater, modelling, MOHID

BACKGROUND AND RELEVANCE

MOHID is a platform that includes a set of numerical models to simulate the water cycle in an integrated approach (Surface Water Bodies, Watersheds and Groundwater). It is an open source project maintained by MARETEC[1] since 1985, and is now supported by Hidromod and Action Modulers companies.

The main modules of MOHID are: MOHID Water and MOHID Land. MOHID Water is focused in 3D free surface flows and has been applied to marine and surface water bodies' studies. MOHID Land is a fully distributed hydrological model composed by three core modules: 1D river network, 2D overland flow and 3D groundwater flow (Figure 1). Each of these modules can be run as alone or be combined with the others, making MOHID Land applicable to a wide range of cases, from large catchments to small irrigation plots.

MOHID Studio is a package developed by Action Modulers that supports pre- and post-processing data for MOHID platform with a friendly graphical user interface and extends the applicability of MOHID with the integration of OpenMI interface (Braunschweig et al., 2012). This integration includes now the coupling of MOHID Land with SWMM model (Rossman, 2010) to perform 1D2D urban stormwater modelling. This coupling enables the application of a full dynamic wave model based on MOHID Land, which solves the full 2D shallow water equations with an explicit numerical scheme based on a finite-volumes spatial discretisation on a regular grid and fractional

[1] Research Centre for Marine, Environment and Technology (http://www.maretec.org/)

time-steps, and on SWMM, which solves the dynamic wave equations with a 1D explicit dynamic engine.

There have been several studies that compare different modelling packages for urban stormwater modelling (e.g. Zoppou (2001) presents a review of the available software on the late 90's and more recent comparisons focused on 2D overland models performance are presented by Hunter et al. (2008) and S. Néelz and G. Pender (2013)). This poster introduces a comparison of MOHID Land 2D results with S. Néelz and G. Pender (2013) data, and evaluates MOHID Studio against InfoWorks ICM vs. 5.5 with a 1D2D real case study. The presented results are relevant to demonstrate the ability of MOHID to perform 2D and 1D2D hydraulic modelling simulations, opening the range of application of this transversal platform to urban storm water modelling.

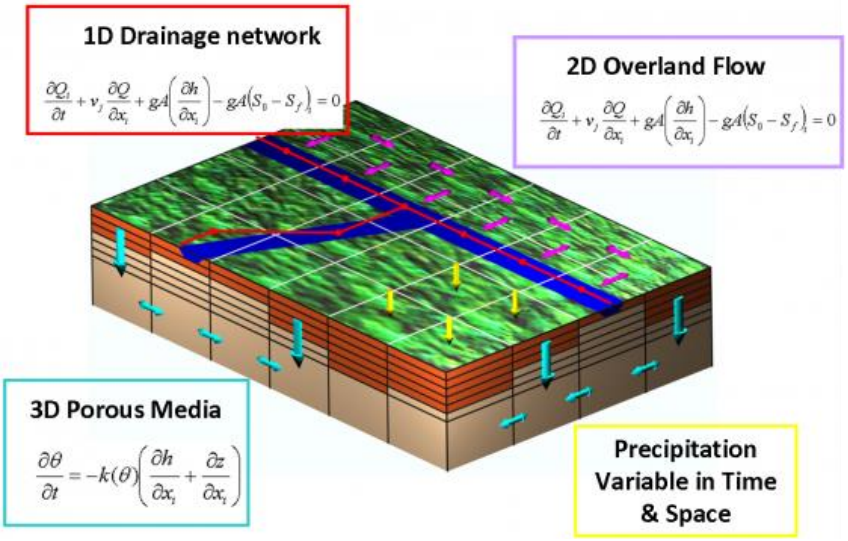


Figure 1. MOHID Land structure (from: MOHID wiki, 2014)

RESULTS AND DISCUSSION

S. Néelz and G. Pender (2013) defined eight standard benchmarking tests that were compared with analytical solutions, field data, physical model data and other model predictions of real or hypothetical flood events. To summarise the comparison with MOHID Land, Figure 2 presents results obtained for test 2, 8A and 8B. Test 2 assess the software's ability to handle disconnected water bodies, wetting and drying of floodplains, and to predict the inundation extent due to momentum flooding on a complex topography, with an emphasis on the final distribution of flood water rather than peak levels. Test 8A tests the package's capability to simulate shallow inundation originating from a point source and from rainfall applied directly to the model grid, at relatively high resolution. Test 8B make use of the 2D dataset used in Test 8B and add the 1D sewer network to tests the package's capability to simulate shallow inundation originating from a surcharging underground pipe. For more details about these models, please refer to S. Néelz and G. Pender (2013). The results presented by MOHID Land have a strong agreement with the most detailed models that consider the full 2D shallow water equations.

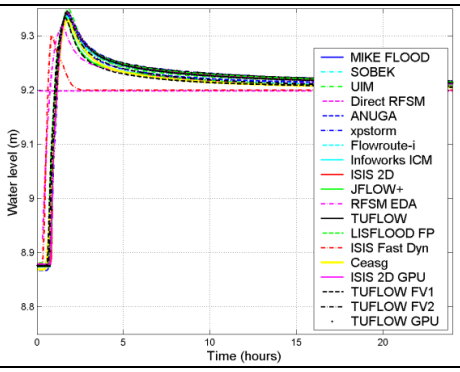
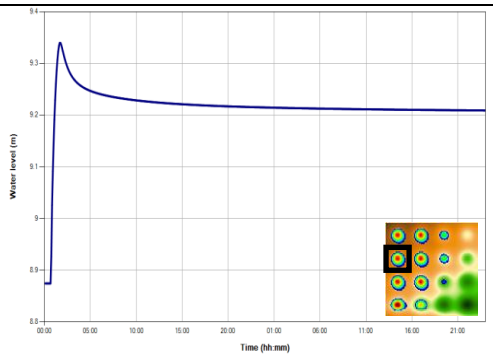
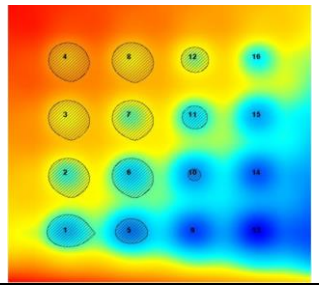
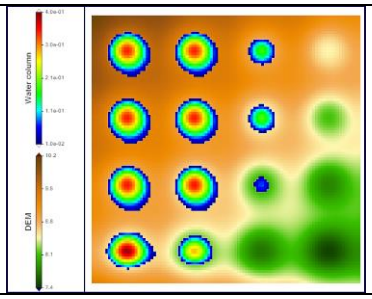
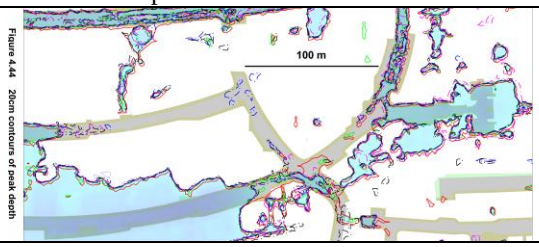
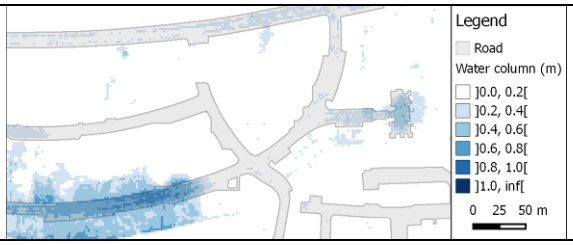
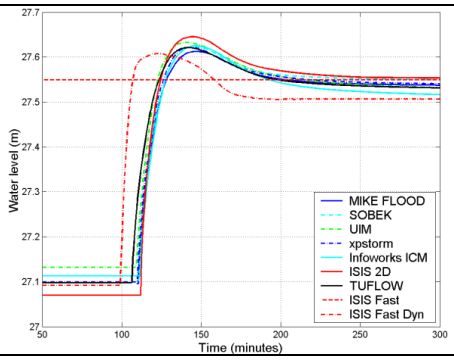
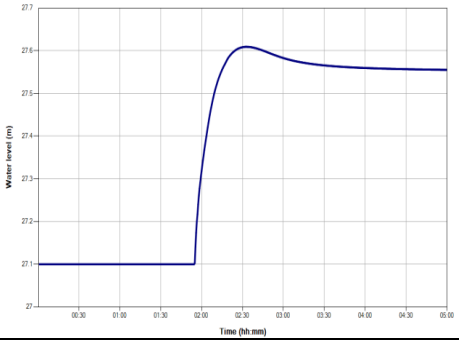
Results presented by S. Néelz and G. Pender (2013)	MOHID Studio results
Test 2 – Point 3:	
	
Test 2 – final flooding extent:	
	
Test 8A – Floodplain:	
	
Test 8B – Point 1:	
	

Figure 2. Results for Test 2, 8A and 8B – comparison between MOHID Studio and models presented by S. Néelz and G. Pender (2013).

To complement the 1D2D analysis of Test 8B, a real case study is being setup in MOHID Studio and in InfoWorks ICM vs. 5.5. The chosen case study is the Zona Central catchment (Figure 3) in the downtown area of Coimbra, Portugal. It has an average slope of 24% and a total area of approximately 1.5 km^2, which is covered by a combined sewer system with 35 km long. The

rainfall in the area is being continuously monitoring with rain gauges and water depth sensors recorded data in two main location of the sewer network during 2011. The first results produced by MOHID Studio are in agreement with InfoWorks ICM vs. 5.5. The poster presents detailed results for real flood events in the catchment opening the varied range of application of MOHID to urban stormwater modelling.

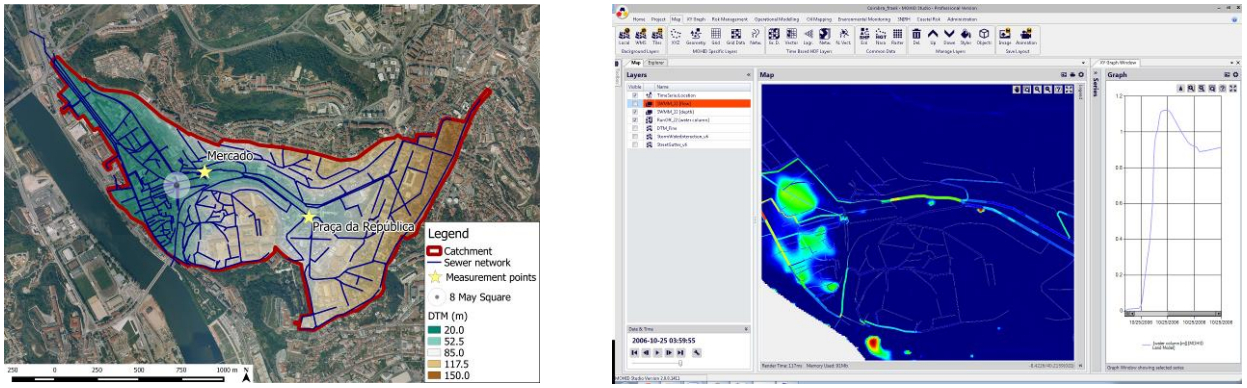


Figure 3. Dataset (left) and model implemented in MOHID Studio (right) of Zona Central catchment, Coimbra, Portugal.

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