Sub-grid and 3-D Modeling for Better Flood Management

"On the Integration of Rainfall, Free Surface Flow, and Ground Water with Detailed DEMS for Flooding Management"

A Talk by Prof. Guus S. Stelling

Emeritus Professor of DELFT University of Technology;
Senior Scientist, Stelling Hydraulics

August 25, 3 – 4 p.m.

Refreshments start at 2:30 p.m.

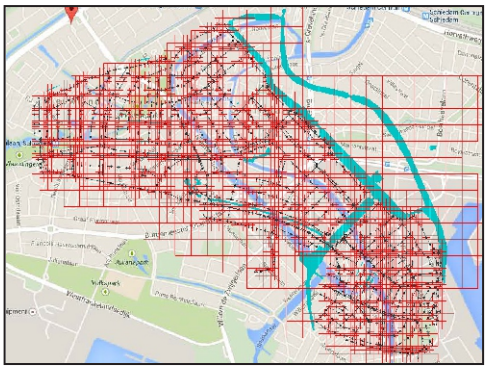
McHugh Auditorium, Watermen's Hall
Virginia Institute of Marine Science
1375 Greate Road, Gloucester Point, VA 23062

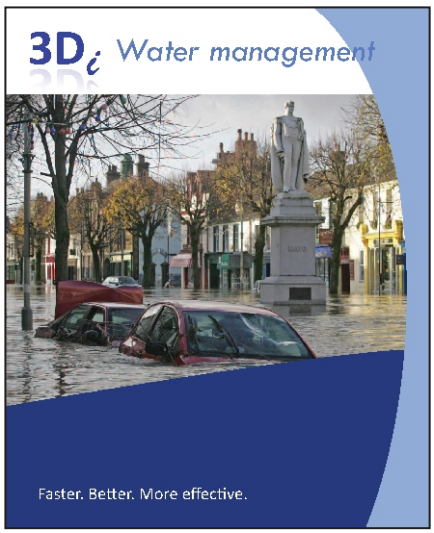
This talk will be about modelling heavy rainstorms, drainage, ponding, flooding, infiltration and exfiltration of groundwater. <u>Sponsored by the Commonwealth Center for Recurrent Flooding Resiliency.</u>

For practical applications two aspects are important: (i) the bathymetry and (ii) the flow

(I): Due to advanced remote sensing techniques very detailed DEM's (digital elevation models) are nowadays available. For instance of the Netherlands height data is publicly available with a grid spacing of 0.5 m. Often there are more data points than can be handled by a numerical flooding simulation of a large area. The sub-grid method, (Casulli, 2009), however allows the use of very detailed bathymetric data without the need for flow variables at every pixel. In urban areas not only the surface area is important but also the underground systems for sewage, drainage and even public transportation may be relevant for accurate flooding simulations. In rural areas the infiltration capacity of the soil plays a role as well. In our contribution we will show how the bathymetry is an integrated whole of the surface, the subsurface and underground network systems.

(ii): To simulate surface flows due to dam breaks, or other causes such as rain storms and storm surges, two types play an important role: rapidly varied flow and overland flow. Rapidly varied flows, such as bores and hydraulic jumps, are dominated by conservation laws. Overland flow is dominated by friction. In our contribution we will describe what kind of additions (Stelling, 2012) to the sub-grid method are required to get accurate results for both flow types. In the subsurface there is groundwater flow and pipe flow. For ground water we use a simple Dupuit assumption. Pipe flow may be pressurized. Non-linearities due to for instance the transition from free surface flow to pressurized flow are solved by the Nested-Newton Method, (Casulli and Stelling, 2013). We also show how the interaction between surface water and groundwater, such as infiltration and exfiltration or seepage, is modelled.





VIMS | William & Mary
Virginia Institute of Marine Science
Old Dominion University
William & Mary
Chartered 1693