Computational Hydraulics and flood mitigation in Quebec, Canada

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Abstract

Statement of the Problem: After the 1996 Saguenay flood in Quebec, Canada, causing flooding and morphological damage to several rivers, the question of flood mitigation was raised to protect the population and the environment in case of future similar natural hazards occurrence. In fact, similar events took place such as Hurricane Katarina (2005, USA), the flooding of the Richelieu River (2011, Canada) or more recently the crisis at Oroville Dame causing the evacuation of nearly 200,000 people. Hence, it is of great importance to predict such events to be prepared and why not to reduce the impact of such events. Methodology & Theoretical Orientation: Computational hydraulics is put to contribution in order to mitigate flood events. To tackle difficult situations, a new software, UMHYSER-1D, is developed. UMHYSER-1D is a hydraulic and sediment transport model to simulate manmade channels and natural rivers, with fixed or loose boundaries, for single or interconnected channels. The unsteady flow is modeled using the 1D St-Venant equations, discretized using the NewC scheme, and for the unsteady sediment transport, the convection-diffusion equation is solved using a finite volume approach. Findings: Applied to the 1996 Saguenay flood, on the Ha! Ha! River, UMHYSER-1D captured the trends of erosion and deposition well even if the results do not fully agree with the collected data. Moreover, the results permitted forcing data verification and proved that some input cross-sections were not the right ones. For the case of Aux Sables River, UMHYSER-1D was of great help in the flood mitigation and environmental impact assessment studies. Conclusion & Significance: Computational hydraulics is proved to be a powerful tool in hydraulics engineering. Applied to flooding cases, not only water levels can be well predicted, but river morphology changes trend can be fairly well captured by UMHYSER-1D, a newly developed software.

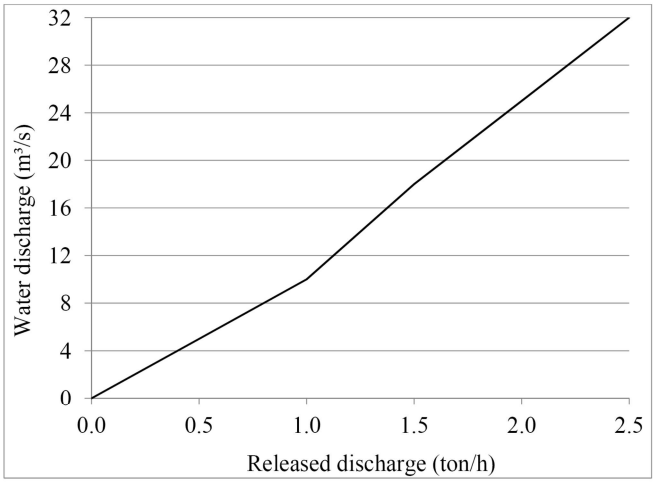


Figure 1: Maximum permitted sediment load released upstream corresponding to the water discharge of the Aux Sables River

Recent Publications

1. AlQasimi E, Mahdi T (2019) Flooding of the Saguenay region in 1996: Part 1-modeling River Ha! Ha! flooding. Natural Hazards, 96(1):1-15.
2. AlQasimi E, Pelletier P, Mahdi T (2019) Flooding of the Saguenay region in 1996. Part 2: Aux Sables River flood mitigation and environmental impact assessment. Natural Hazards, 96(1):17–32.
3. AlQasimi E, Mahdi T (2018) Unsteady Model for the Hydraulics of Sediments in Rivers. 26th Annual Conference of the CFD Society of Canada. June 10-12, 2018, University of Manitoba, in Winnipeg, Manitoba, Canada.
4. Brooks GR, Lawrence DE (2000) Geomorphic effects of flooding along reaches of selected rivers in the Saguenay Region, Quebec, July 1996. Geogr. Phys Quatern 54:281–299.
5. Huang J, Greimann B (2012) SRH-1D 3.0 User's Manual. Technical Report SRH-2013-11, US Bureau of Reclamation, Denver, USA.



Biography (150 word limit)

Tew-Fik Mahdi and Eman AlQasimi have their expertise in Computational Hydraulics, flood mitigation and environmental impact assessment. Their newly developed software based on the physics of water and sediment transport improve flood mitigation and environmental impact assessment in River engineering. UMHYSER-1D is the result of years of research and work on engineering challenging projects. The foundation is based on coupling sediment transport and flow equations with use of minimization theories to tackle the complicated issue of river widening. This new software can be applied to real test cases and used as a research tool to test new findings in fluvial computational hydraulics.

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Notes/Comments: