Improvements in fluvial modelling to support the assessment and restoration of river reaches with eroded banks

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Amongst the fluvial models used to examine hydraulics and sediment transport in river channels, most ignore floodplain elements. In comparison, bank retreat and channel planform predictions for an environment with a cohesive soils require the consideration of mass movements, and ideally, of riparian vegetation effects. In this context, a simple morphodynamics model can provide insights into the evolution of a fluvial system, but is unlikely to provide accurate quantitative predictions. In addition, omitting to connect floodplain to fluvial processes can pose security hazards to the community while inflating maintenance costs. Using two contrasted river sites, the semi-alluvial Medway Creek (Ontario) and the alluvial St-François River (Quebec), and a newly developed morphodynamic-geotechnical model, we present a framework that can be used to model the co-evolution of a river channel and vegetated floodplain, and that can be applied to any type of alluvial channel. The model uses physics-based soil mechanics principles and a set of efficient spatial analysis algorithms to investigate long river reaches (up to several kilometers in length). Our results show that the coupled model predicts well the location and extent of bank retreat while providing reliable flow and transport predictions once calibrated. The main limitation of such an approach is the amount of data and effort required to adjust model parameters. In particular, financial and time constraints may not allow multiple topographic surveys to be acquired at a field site for any given investigation. Nevertheless, the potential for applied stream restoration remains high. The use of numerical modelling allows to evaluate different scenarios prior to implementation, and to estimate the width of a river corridor in an equilibrium state, i.e., with reduced risk associated with flooding and channel mobility.

Biography

Passionate about rivers and computer algorithms, Yannick Rousseau is an environmental modeller and model developer. He is a PhD candidate in the department of Geography, Planning and Environment at Concordia University, under the co-supervision of Dr. Pascale Biron and Dr. Marco Van de Wiel. His interests lie in the interaction between floodplain and river channel processes. In particular, he spent years examining the contribution of geotechnical processes to river bank retreat using physics-based and statistical modelling approaches. As a consultant in hydrogeomorphology at J.-F. Sabourin and Associates, he makes use of his abilities in modelling, spatial analysis and computer science to investigate practical questions related to hydrology, hydraulics and morphodynamics.