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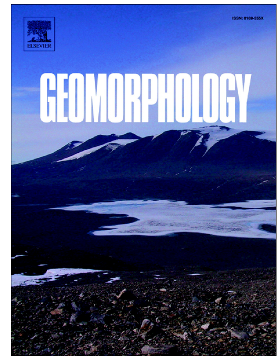

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Simulating bank erosion over an extended natural sinuous river reach using a universal slope stability algorithm coupled with a morphodynamic model

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Abstract

Meandering river channels are often associated with cohesive banks. Yet only a few river modelling packages include geotechnical and plant effects. Existing packages are solely compatible with single-threaded channels, require a specific mesh structure, derive lateral migration rates from hydraulic properties, determine stability based on friction angle, rely on nonphysical assumptions to describe cutoffs, or exclude floodplain processes and vegetation. In this paper, we evaluate the accuracy of a new geotechnical module that was developed and coupled with Telemac-Mascaret to address these limitations. Innovatively, the newly developed module relies on a fully configurable, universal genetic algorithm with tournament selection that permits it (1) to assess geotechnical stability along potentially unstable slope profiles intersecting liquid-solid boundaries, and (2) to predict the shape and extent of slump blocks while considering mechanical plant effects, bank hydrology, and the hydrostatic pressure caused by flow. The profiles of unstable banks are altered while ensuring mass conservation. Importantly, the new stability module is independent of mesh structure and can operate efficiently along multithreaded channels, cutoffs, and islands. Data collected along a 1.5-km-long reach of the semialluvial Medway Creek, Canada, over a period of 3.5 years are used to evaluate the capacity of the coupled model to accurately predict bank retreat in meandering river channels and to evaluate the extent to which the new model can