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Modelling of vegetation-driven morphodynamics in braided rivers.

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River planform results from the complex interaction between flow, sediment transport and vegetation, and can evolve following a change in these controls. The braided planform of New Zealand's Lower Waitaki River, for instance, is endangered by the action of artificially-introduced alien vegetation, which spread across the braidplain following the reduction in magnitude of floods by hydropower dam construction. This vegetation, by encouraging flow concentration into the main channel, would likely promote a shift towards a single-thread morphology if it was not artificially removed within a central fairway.

The purpose of this work is to study the evolution of braided rivers such as the Waitaki under different management scenarios through two-dimensional numerical modelling. The construction of a suitable model represents a task in itself, since a modelling framework coupling all the relevant processes is not yet readily available. Our starting point is the physics-based GIAMT2D numerical model, which solves two-dimensional flow and bedload transport in wet/dry domains, and recently modified by the inclusion of a rule-based bank erosion model. We have further developed this model by adding a vegetation module, which accounts in a simplified manner for time-evolving biomass density, adjusting local flow roughness, critical shear stress for sediment transport, and bank erodibility accordingly. Our goal is to use the model to study decadal-scale evolution of a reach on the Waitaki River and predict planform characteristics under different vegetation management scenarios.

Here we present the results of a preliminary application of the model to reproduce the morphodynamic evolution of a braided channel in a set of flume experiments that used alfalfa as vegetation. The experiments began with a braided morphology that spontaneoulsy formed at constant flow over a bed of bare uniform sand. The planform transitioned towards single-thread when this discharge was repeatedly cycled with periods of low flow and vegetation growth.