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A discontinuous Galerkin finite element approximation for sediment transport and bed evolution

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The accurate representation of morphological processes and the ability to propagate changes in the riverbed over a wide range of space and time scales make the design and implementation of the appropriate numerical scheme very challenging. In particular, requirements of accuracy and stability for medium and long term simulations are difficult to meet. In this work, the derivation and implementation of a discontinuous Galerkin finite element approximation (DG) for sediment transport and bed evolution equations are presented. Numerical morphological models involve a coupling between a hydrodynamic flow solver which acts as a driving force and a bed evolution model which accounts for sediment flux and bathymetry changes. The numerical hydrodynamic model component of the system is provided by a well verified and validated shallow water DG solver (Tassi et al., 2007). The resulting numerical scheme is verified by comparing simulations versus analytical/semi analytical solutions; these include the evolution of an initially symmetric, isolated bedform; the formation and propagation of a step in a straight channel due to a sudden overload of sediment discharge; and the morphological evolution of an initially flat bed in a converging channel. Finally, the comparison against field data of a trench excavated in the main channel of the Parana river (Argentina) show how the model can be used to predict morphological changes in rivers.

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