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# Morphological evolution of near-critical flows: numerical solutions.

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The flood regime of many rivers is characterized by intense morphological modifications. For mountains streams, during floods, flow is often near-critical condition (Fr $\rightarrow$ 1), a situation in which the celerity of bed and surface waves are of the same order so that the bed interacts strongly with the water surface. The evolution of the bed can be computed by means of synchronous solutions of the St. Venant-Exner model. Under these conditions the mathematical form (conservative, primitive) of the hyperbolic system of the governing equations becomes crucial. In fact, adopting a primitive form leads to an incorrect computation of both shock waves (bores) strength and speed which results in a loss of mass. A quasi-conservative formulation of the governing equations is proposed to overcome this problem. Numerical solutions are then obtained using a quasi-conservative formulation of the well-known MacCormack method. To test the proposed formulation, the model is first applied to idealized benchmark problems. The bed and flow dynamics in a natural river (Vara river in northern Italy) is also studied and the numerical results are compared with the experimental observations obtained on a physical model.