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On rating curve variability in presence of movable bed and unsteady flow. Applications to Tuscan rivers.

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In common engineering practice, rating curves are obtained from direct stage-discharge measurements or, more often, from stage measurements coupled with flow simulations.
The present work mainly focuses on the latter technique, where stage-measuring gauges are usually installed on bridges with flow conditions likely to be influenced by local geometry constraints. In such cases, backwater flow and flow transition to supercritical state may occur, influencing sediment transport capacity and triggering more intense changes in river morphology.
The unsteadiness of the flow hydrograph may play an important role too, according to the velocity of its rising and falling limbs.
Nevertheless, the simulations conducted to build a rating curve are often carried out with steady flow and fixed bed conditions where the afore-mentioned effects are not taken into account at all.
Numerical simulations with mobile bed and different unsteady flow conditions have been conducted on some real case studies in the rivers of Tuscany (Italy), in order to assess how rating curves change with respect to the "standard" one (that is, the classical steady flow rating curve).
A 1D finite volume numerical model (REMo, River Evolution Modeler) has been employed for the simulations. The model solves the 1D Shallow Water equations coupled with the sediments continuity equation in composite channels, where the overbanks are treated with fixed bed conditions while the main channel can either aggrade or be scoured. The model employs an explicit scheme with 2nd order accuracy in both space and time: this allows the correct handling of moderately stiff source terms via a local corrector step. Such capability is very important for the applications of the present work as it allows the modelling of abrupt contractions and jumps in bed bottom elevations which often occur near bridges.
The outcomes of the simulations are critically analyzed in order to provide a first insight on the conditions inducing significant changes between the two types of rating curves.