Analysis of the deviations from the "average" curve of sediment transport vs water flow

Michael Nones (1), Giampaolo Di Silvio (1), and Mauro Bisiacco (2)

(1) Hydraulic, Maritime, Environmental and Geotechnical Engineering Department, University of Padua, Padua, Italy (michael.nones@unipd.it), (2) Department of Information Engineering, University of Padua, Padua, Italy

Recent studies about analytical solutions of the 1-D morphodynamic model (Fasolato et al., 2009) have shown that any river reach maintains an equilibrium configuration (namely a stationary morphological situation) under the hypothesis that the boundaries of the river reach are in equilibrium as far as solid and liquid inputs are concerned. This hypothesis means that the bottom profile of the river and the grainsize composition of the bed should, in principle, remain constant in time, provided that sediments and water entering the reach are related by an equilibrium relation (transport formula).

Obviously, this condition is not always satisfied, especially in the mountain rivers, as the formation mechanisms of water and sediment inputs are quite different and seasonally delayed. These initial perturbations give place to important deviations from the "average" curve of sediment transport vs water flow, namely from the curve calculated in equilibrium conditions.

This study presents a general approach that can be used to explain and possibly predict these deviations. The approach is based on the deterministic analytical solution of the harmonic river (Fasolato et al., 2009), combined with a recursive model of ARMA type, with unknown parameters, which can be estimated by minimizing a suitable mean square error, in order to obtain the best ARMA model from two different points of view: its performances both in fitting the available (measured) data and in providing a prediction algorithm for the future evolutions. The recursive model for a synthetic river reach will provide the instantaneous sediment discharge as a function of the instantaneous water flow (namely equilibrium conditions) and the water flow measured at one or more previous time (non-equilibrium conditions).

This model is calibrated against a relatively small dataset of measurements about an important Italian water course: the Adige River, which flows from the Alps to the Adriatic Sea south of Venice. The analysis is limited to two gauge stations: Trento (typical mountain river reach) and Boara Pisani (typical lowland river reach).