Geophysical Research Abstracts
Vol. 15, EGU2013-7022, 2013
EGU General Assembly 2013

Effects of vegetation on sediment transport rate in an erodible channel bed

Aronne Armanini (1), Valentina Cavedon (2), and Maurizio Righetti (3)

(1) Department of Civil, Environmental and Mechanic Engineering, University of Trento, Italy (aronne.armanini@ing.unitn.it), (2) Department of Civil, Environmental and Mechanic Engineering, University of Trento, Italy (valentina.cavedon@ing.unitn.it), (3) Department of Civil, Environmental and Mechanic Engineering, University of Trento, Italy (maurizio.righetti@ing.unitn.it)

Since few decades we have modified our attitude respect to the role of vegetation in rivers. The use of vegetation has been recognized as a fundamental element for the environmental quality of water streams. On the other hand, the presence of vegetation exerts a non-marginal influence not only on the hydrodynamic, but also on the morphology. It is increasingly urgent to set up new reliable conceptual and operational tools, capable of predicting the interaction between water, vegetation and sediments.
In the paper we present a new stochastic model theoretically based, termed “ballistic approach”, for the evaluation of sediment transport rate in a stream with and without vegetation. The model considers the average ranges of the particles in motion and their statistical distribution. The discharge is obtained by the integration of the distribution of ranges of the particles jump multiplied by the average particles velocity. The formula is compared with some of the most famous empirical formulas for the evaluation of sediment transport rate in unvegetated riverbeds and with a large number of experimental data in literature and obtained in a laboratory channel.
The model is then extended for considering the effect of rigid and emergent vegetation on the sediment transport rate, based on the idea that the presence of vegetation affects both the range of the particles jump and the velocities of the particles. The formula related with the presence of vegetation is calibrated by means a large number of experimental data, obtained in a mobile bed laboratory channel fed by water and sediments. Vegetation was modeled by means cylindrical emergent elements in different size and arrangements, that reproduced different densities of vegetation. The different data are obtained for different flow conditions (water and sediment discharges) chosen a priori. Besides, in the same campaign of experiments, we have considered the effect of the vegetation on the bed, putting in evidence the typical bed forms produced by the stems and their interaction with the natural bed forms (dunes).
We chose to change the arrangement of the cylinders and the vegetation densities for two reasons. First of all, to put in evidence the dependence of the density of the vegetation on the transport rate and on the flow conditions. The second reason, to highlight the effects of different plant distributions and densities on bed forms and, consequently, on flow resistance and sediment transport.
The results have shown a good agreement between theory and experiments.