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A lumped modeling of river - riparian vegetation interactions with flow variability

S. Tealdi, C. Camporeale, and L. Ridolfi
Politecnico di Torino, DITIC, Italy (stefano.tealdi@polito.it)

Flow variability has a great impact on the river morphology and riparian vegetation dynamics. The most common anthropic cause is the dam construction, which often reduces both the discharge regime and sediment transport, thus producing a narrowing and degradation of the river bed. Furthermore, since riparian vegetation is closely connected to discharge stochasticity, it can experience remarkable changes after the construction of artificial reservoirs. A number of field studies have shown the consequences of river regulation on both river morphology and riparian vegetation, which often exhibits significant decreases and shifts along the transect.
Riparian vegetation and river morphology are closely linked. Vegetation provides additional resistance to the soil by the root system, and increases the bank slope. Furthermore ,the aggradation/degradation of river bed modifies the probability density function of river water levels, on which the riparian vegetation depends. Therefore, river cross-section and riparian vegetation dynamics are mutually dependent.
In this study we propose a simple lumped bio-morphodynamic model that describes the interplay between fluvial cross-section and vegetation dynamics, and the effects of changes in discharge and sediment transport induced by external factors. The model provides the temporal dynamics of the river width and bed elevation. These dynamics turn out to be non-trivial and can exhibit non-monotonic behavior, with aggradations/ degradations, and narrowing/widening phenomena. In this study, we compare the results with and without vegetation, and we quantitatively investigate how vegetation influences river morphodynamics.
The model has been tested on real rivers using data obtained from field studies. The agreement between the outcomes and the measured field data is satisfactory.