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Influence of riparian vegetation distributions on the dispersion processes in rivers

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A subject of great interest is nowadays the study of the transport processes in wetlands. In this work we focus on the transport of substances that occurs in rivers surrounded with a vegetated floodplain. In this context, the evaluation of the longitudinal dispersion is a fundamental issue to be addressed to. In fact, although it plays an important role in the transport of chemicals, nutrients, wood debris, and seeds, few works have studied the effects of riparian vegetation on the dispersion coefficient in laterally non-uniform ecosystems. Within these environments, several field works have shown that the depth of the water table and flooding are fundamental mechanisms through which river hydrology controls riparian vegetation evolution. On the one side, riparian vegetation taps water and nutrients from the water table. On the other side, floods, with their destructive action, can affect the survival of riparian plants. The interplay between river hydrology and biological vegetation characteristics can therefore give rise to different biomass densities along a river transect. In turn, riparian vegetation is able to alter the flow field, turbulence structure, and, consequently, the longitudinal mixing. In particular, both the transversal depth-averaged velocity profile, and the transversal mixing - that play a key role in dispersion processes - are affected by the presence of vegetation. It follows that river hydrology, influencing the distribution of riparian vegetation, is potentially able to alter the longitudinal dispersion coefficient.

Here, a model to evaluate the transversal depth-averaged velocity in presence of emergent vegetation is proposed, in order to evaluate the significance of different vegetation densities on the value of the dispersion coefficient. In our work, some possible realistic riparian vegetation densities have been estimated adopting the stochastic model by

Camporeale and Ridolfi (2007). Then, the velocity profile is computed for different water depth by means of lateral distribution model, and the longitudinal dispersion is evaluated integrating its theoretical formulation. We have obtained theoretically and compared experimentally the dispersion coefficient in presence of vegetation and without vegetation. The effect of vegetation gives rise to remarkable differences, also of the order of 100-70%. Moreover, different behaviors have been highlighted when different biomass distributions, and varying water depth in the main channel are considered.