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# Impact of dam-induced hydrological changes on riparian vegetation

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Hydrological disturbances are a key factor for the riparian vegetation, which is a highly dynamic ecosystem prone to external forcing. Random fluctuations of water stages drive in fact the alternation of periods of floods and exposure of the vegetated plots. During flooding, the plots are submerged and vegetation is damaged by burial, uprooting and anoxia, while during exposure periods vegetation grows according to the soil moisture content and the phreatic water table depth. The distribution of vegetation along the riparian transect is then directly connected to the stochasticity of river discharges.

River damming can have remarkable impacts on the hydrology of a river and, consequently, on the riparian vegetation. Several field studies show how the river regulation induced by artificial reservoirs can greatly modify the statistical moments and the autocorrelation of the discharge time series. The vegetation responds to these changes reducing its overall heterogeneity, declining - substituted by exotic species - and shifting its starting position nearer or far away from the channel center. These latter processes are known as narrowing and widening, respectively.

In our work we explore the effects of dam-induced hydrological changes on the narrowing/widening process and on the total biomass along the transect. To this aim we use an eco-hydrological stochastic model developed by *Camporeale and Ridolfi* [2006], which is able to give a realistic distribution of the biomass along the transect as a function of a few hydrologic, hydraulic and vegetation parameters. We apply the model to an exemplifying case, by investigating the vegetation response to a set of changes in mean discharge and coefficient of variation. The range of these changes is deduced from the analysis of field data in pre- and post-dam conditions.

Firstly, we analyze the narrowing/widening process. In particular, we analyze two percentage differences of the starting transversal position with respect to the pre-dam condition: in the first one the mean discharge is kept constant and the coefficient of variation is changed, in the second one the opposite is made. In the first case, we find non negligible values of the percentage differences – of the order of 10-40% - and we note that they depend on the ratio $T_g/T_d$, where $T_g$ and $T_d$ are the typical timescales of growth and decay of the vegetation, respectively. The values collapse on different non monotone curves, depending on the $T_g/T_d$ ratio. In general, when the coefficient of variation increases, there is a widening, while when it decreases there is a narrowing. The non monotony makes possible the widening even in some situations with decreasing coefficient of variation.

In the second case, i.e. maintaining constant the coefficient of variation and changing the mean discharge, the obtained values are again non negligible - up to 15% - and collapse on a nonlinear curve, for each $T_g/T_d$ ratio. The decrease in the mean discharge always brings to a narrowing. Finally, we note that the sum of the two percentage differences just explained gives a good approximation of the overall narrowing/widening consequent to a change of both the mean discharge and the coefficient of variation.

Similar analyses are made for the total biomass along the transect and its temporal variability, and also for these variables we find nonlinear curves and great changes, of the order of 100-1000%. In conclusion, we propose a method to assess the impact of river regulation on the riparian vegetation and we quantify some of the changes promoted by a reservoir on the vegetation, highlighting how great they can be.

Camporeale, C., Ridolfi, L., 2006. Riparian vegetation distribution induced by river flow variability: a stochastic approach. Water Resour. Res. 42.