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The role of river hydrology on Salix shoot and root survival statistics on the alluvial sediment of a restored river corridor

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In river restoration projects there is considerable interest in understanding the morphodynamics of river reaches in relation to the characteristics of vegetation that may colonize the bare alluvial sediment, and locally stabilize it by root anchoring. Vegetation interacts with river hydrology on multiple time scales, but such interactions are at present still poorly understood.
In this contribution, we discuss both the above and below ground biomass growth dynamics of 1188 Salix cuttings (individual and group survival rate, growth of the longest shoots and number of branches and morphological root analysis) in relation to local river hydrodynamics.
Cuttings were organized in square plots of different size and planted in spring 2009 on a gravel island of the restored river section of River Thur (Niederneunforn, Canton Thurgau, Switzerland). Cuttings in the plots were monitored regularly, from the beginning of the campaign (March) until the end of the growing season (October). We obtained a detailed and quite unique set of data, which includes, among others, root characteristic statistics obtained from image and high-resolution scanner analysis of carefully uprooted samples.
Beyond describing the survival rate dynamics in relation to river hydrology, we show the nature and strength of correlations between island topography, cutting growth statistics and local reach morphodynamics (see also Pasquale et. al.3, session HS 3.1). In particular, by comparing empirical histograms of the vertical root distribution vs. those of the saturated water surface in the sediment, we show that main tropic responses are oxytropism, hydrotropism and thigmotropism. Moreover, by numerical modelling of the local hydrodynamics, we can also identify the spatial distribution of preferential locations of oxytropism and hydrotropism. As far as factors causing mortality are concerned, we also show that erosion by flood is responsible for influencing the spatial and temporal distribution of the survived cuttings within the plots. We then discuss the implications of oxytropism and hydrotropism in the context of resistance to erosion, mainly as an additional nonlinear factor crucial to the root mechanical anchoring in the sediment. Eventually, our experiments provide evidence of some fundamental ecohydrological dynamics influencing the establishment and possibly the ultimate vegetation pattern formation on alluvial sediment.