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The impact of flood variables on riparian vegetation

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The riparian vegetation of Alpine rivers often grows in temporally dynamic riverine environments which are characterized by pronounced meteorological and hydrological fluctuations and high resource competition. Within these relatively rough conditions, riparian vegetation fulfils essential ecosystem functions such as water retention, biomass production and habitat to endangered species. The identification of relevant flood attributes impacting riparian vegetation is crucial for a better understanding of the vegetation dynamics in the riverine ecosystem. Hence, in this contribution we aim to quantify the ecological effects of flood attributes on riparian vegetation and to analyze the spatial coherence of flood-vegetation interaction patterns.

We analyzed a 500 m long and 300-400 m wide study reach located on the Maggia River in southern Switzerland. Altogether five floods between 2008 and 2011 with return periods ranging from 1.4 to 20.1 years were studied. To assess the significance of the flood attributes, we compared post-flood to pre-flood vegetation vigour to flood intensity. Pre- and post-flood vegetation vigour was represented by the Normalized Difference Vegetation Index (NDVI) which was computed from images recorded by high resolution ground-based cameras. Flood intensity was expressed in space in the study reach by six flood attributes (inundation duration, maximum depth, maximum and total velocity, maximum and total shear stress) which were simulated by the 2D hydrodynamic model BASEMENT (VAW, ETH Zurich). We considered three floodplain units separately (main bar, secondary bar, transitional zone). Based on our results, pre-flood vegetation vigour largely determined vegetation reaction to the less intense floods (R = 0.59-0.96). However for larger floods with a strong erosive effect, its contribution was significantly lower (R = 0.59-0.68). Using multivariate regression analysis we show that pre-flood vegetation vigour and maximum velocity proved to be the most significant variables impacting vegetation response. Generally, maximal flood attributes had more significant impacts than integrated attributes over the flood duration. Additional explanatory variables in the model should account for vegetation heterogeneity, groundwater conditions and different effects of lateral and surface erosion.