Flow and morphology around trees installed in rivers: do we need a stem attached?

Ingo Schnauder ,

Institute of Hydraulic Engineering and Water Resources Management, TU Wien

Vienna, Austria

Koen Blanckaert

Institute of Hydraulic Engineering and Water Resources Management, TU Wien

Vienna, Austria

Anchoring entire trees to the river bed centrally in the cross-section is a recent approach for the use of large wood in river restoration. Tree installations provide flow diversity and initiate morphodynamics associated with scouring, wake deposition and grain size sorting. Trees are typically cropped prior to installation and only the root-bole disc and main stem remain – resulting in a 'T'-like shape when oriented with the root-bole facing upstream. Nevertheless, the presence of a stem is a unique feature in comparison with standard bluff and porous bodies and affects stability, flow and morphodynamics in different ways.

The aim of physical experiments at TU Wien was to quantify the effects of the tree stem and enhance our understanding of how flow and habitat diversity are modified. In a large 1:5 scale model with mobile bed of coarse sand, clear water scour conditions were established and different configurations with and without stem at different elevation above the bed were tested. Morphologic changes were measured with a bed-scanning LASER, flow measurements in vertical and horizontal profiles with Acoustic Doppler Velocimetry Profilers (ADVP) and surface flow patterns with particle tracking velocimetry (SPTV). The combined approach enabled to relate the three-dimensional scour and deposition patterns to the shear layer dynamics and wake flow characteristics.

Results show that the presence of a stem matters. Firstly structurally, because the stem enables trees to streamline thus keeping a stable position with the root-bole oriented perpendicularly to the flow, maximizing its frontally projected area and thus its hydraulic and morphologic impact. Secondly, the stem acts as a physical barrier separating the shear layers originating from both edges of the root-bole with implications for the wake turbulence and erosion / deposition patterns.