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# Implementation of natural vegetation into 3D hydrodynamic models for flow and sediment transport

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3D hydrodynamic numerical models that are based on the Reynolds-averaged Navier-Stokes (RANS) equations are increasingly used to calculate flow and sediment transport on the river reach scale. They allow us to study the effect of vegetation on the currents and sediment processes in the water during mean flow or flood events.
For the RANS modelling approach, vegetation is usually implemented on a canopy scale, using spatially-averaged resistance values for the vegetated region of the computational domain. The form and friction drag of vegetation is typically parameterized by a quadratic drag law. In most of the existing approaches for the inclusion of vegetation, vegetation has to be parameterized in terms of stiff cylinders with given stem diameter, stem density, vegetation height and drag coefficient. This is difficult to apply when it comes to naturally structured and flexible vegetation as it is found in river environments and described in the available botanical and biotope maps.

Therefore we have developed a new flow resistance approach for 3D numerical models that is based on methods from porous media flow which were adapted for the vegetation-typical low porosities. It uses plant-community typical parameters like biomass, leaf area index (LAI) and vegetation structure. Based on vertical and spatial profiles of these parameters for aquatic and floodplain vegetation types, the plant properties are linked to the hydraulic resistance in a way that allows its implementation into 3D numerical models. The method gives good results for some first applications with emergent vegetation. It has to be further developed and tested.