The XXXVIII International School of Hydraulics, 21-24 May 2019, Łąck, Poland

Flow-vegetation interactions: Advances in incorporating natural plant features in hydraulic analyses

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ABSTRACT

Vegetation imposes a critical control on the flow of water and transport of substances in riverine and coastal systems. In fluvial environments, it is well established that natural and maintained vegetation has important interconnections with channel flow resistance and morphological development as well as water quality. Similarly, coastal vegetation largely affects wave and sediment processes. Consequently, this topic area has received significant research attention in the recent years resulting in a rapid increase in the number of scientific publications (Fig. 1).

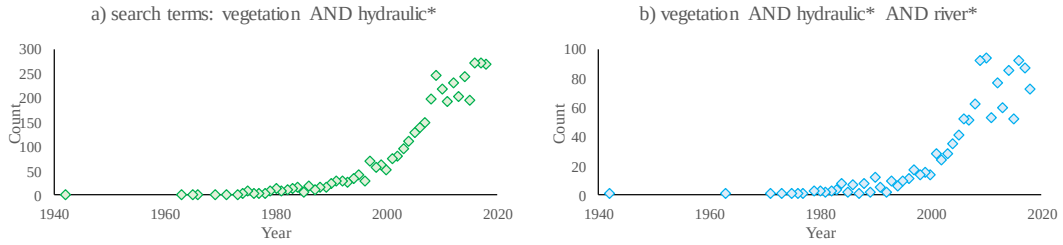

Fig. 1. Number of publications per year in the Scopus database with the title or abstract or keywords including the search terms a) vegetation AND hydraulic*; b) vegetation AND hydraulic* AND river*, with the asterisk denoting a wildcard.

Recent research has brought significant insight into descriptions and modelling of flow-vegetation interactions, but due to the spatial and temporal complexity of natural conditions, many questions remain to be resolved. The purpose of this presentation is to review developments on the physically and biologically solid descriptions of riparian and aquatic vegetation in both physical and numerical modelling applications. Particular emphasis is placed on how to address the effects of reconfiguration (bending and streamlining) of natural riparian/floodplain vegetation and the vertical structure of plant canopies. Scales to be covered range from point/laboratory scale to river reach / remote sensing, with a view on both practical and academic applications.

From an experimental research point of view, a major constraint presently is that well-controlled laboratory investigations are possible with only small plants or parts of larger plants due to the size restrictions of typical flumes. This limitation in experimental conditions can be expected to hinder investigations into complex flow processes occurring in the nature. As the research on flow-vegetation interactions progresses to sediment and nutrient processes, these shortcomings may form as a bottleneck. Therefore prototype scale experiments in outdoor flume environment are expected to allow e.g. a more suitable representation of the vertical structure of vegetation, with natural bottom topography and features including herbaceous understory and litter layer. Latest experiences from such experiments with notes on expected trade-offs between accuracy, controllability, and laboriousness are discussed.