The role of spatial heterogeneity in exchange processes of river ecosystems

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I. Introduction

Despite the important influence of macrophytes (waterplants) on water flow, sedimentation processes and nutrient dynamics, they are overlooked for a long time in hydrologic and geomorphologic studies of lowland rivers. Macrophytes form an obstruction for the water flow which results in an increased flow resistance and thus water heights. Besides the temporal variation of these effects, due to the seasonal appearance of vegetation, also the spatial configuration of the macrophytes in the river plays an important part. The distribution of plants in the river is after all far from homogeneous (see Figure 1), in stead a patchy formation occurs, resulting in areas with higher stream velocities (between the patches) and areas with limited velocities (in the patches).

Figure 1. Patchy configuration of macrophytes in the river AA.

This flow heterogeneity has effect on sedimentation and erosion processes, etc. As such the river ecosystem is determined with cascade- and feedback effects, which are crucial for the understanding of the system.

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II. STRIVE model

In a common research project the Hydraulics Laboratory (UGent) and the Ecosystem Management research group (UA) investigated already several ecosystem processes (surface water flow, growth of vegetation, ground water flow,...) and its mutual interactions. The different processes are modeled and coupled within the STRIVE (STReam - RIVer - Ecosystem) package. Till now, only a 1D hydrodynamic description is used, which is unsatisfactory to study the cascade- and feedback effects due to the former discussed spatial heterogeneity.

III. Research Objectives

- Performing lab and field measurements to get more inside into the effect of vegetation patches on flow, topography and the mutual influence of vegetation patches on each other.
- Development of a 2D hydrodynamic module within the STRIVE model to account for the spatial variability observed in the field. Special attention will be paid to an appropriate representation of the roughness, preferably based on physical properties of the plants.
- Running of integrated simulations where different modules (vegetation, 2D flow module, solutes, sediments, nutrients) of STRIVE are coupled to get more insight in the cascade- and feedback processes of lowland river ecosystem, especially the effect of spatial variability.

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