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Capturing flow-vegetation interactions with an optical imaging technique

The functionality of river ecosystems is a complex phenomenon, strongly depending on the interactions between flow field characteristics, vegetation growth and the transport of sediments. These interactions are coined to be scale-dependent, leading to spatial and temporal pattern formation. Presently, modelling efforts are undertaken to describe the self-organisation of vegetation patterns in rivers streams. However, for the development of a (horizontal) two-dimensional model, the understanding of the controlling spatial plant-flow interactions is very important. In particular, two-dimensional data with high spatial and temporal resolution are necessary.

Conventional measuring techniques commonly provide high temporal resolution, however, the spatial extent is often limited to the amount of equipment. Here, we present an innovative low-cost measuring technique, which provides high spatial resolution data of different stream characteristics based on optical considerations. The technique make use of an off-the-shelve digital camera and a pile to which the camera is mounted. With this method, we aim to capture (1) the occurrence of macrophytes, (2) the flow field characteristics and (3) the sediment suspension properties of the river.

In particular, a technique is developed to derive the location and properties (emergent, submerged, floating, density, biomass) of vegetation in a river. The method is based on stitched pictures of a significant stretch of the river. Using large-scale particle velocimetry, also the spatially heterogeneous flow field characteristics are derived. Combining the in-situ measurements of the flow field with the vegetation presence provides insight in the feedback-processes between vegetation and the flow field. Finally, sediment concentrations are aimed to be obtained by linking the colour spectrum of the river with suspended sediment concentration through a thorough calibration process.

In this presentation, the focus will be on the methodology to obtain the flow velocity field accompanied by a discussion on the obtained accuracy and advantages and disadvantages of the optical imaging technique.

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