Master Thesis offer

Formation mechanisms of fine-sediment ribbons

Dr. Ing. Michele Trevisson

Prof. Dr. Olivier Eiff

Contact: michele.trevisson@kit.edu

Motivation

Sediment ribbons are longitudinal bedforms characterized by variations in the bed topography and/or bed roughness with flow-aligned ridges and troughs. They usually develop in rivers under sediment-supply-limited conditions as the result of lateral sediment sorting induced by the presence of secondary currents. Typical secondary-flow patterns developing over sediment ribbons are characterized by upflow over the ridges and downflow over the troughs. The topography of the sediment ribbons feeds back in turn on the intensity of the secondary currents resulting in an enhanced three-dimensional sediment transport and lateral momentum transfer. Even though sediment ribbons have a significant impact on transverse variations in sediment transport rates, their formation mechanism is still not well understood.
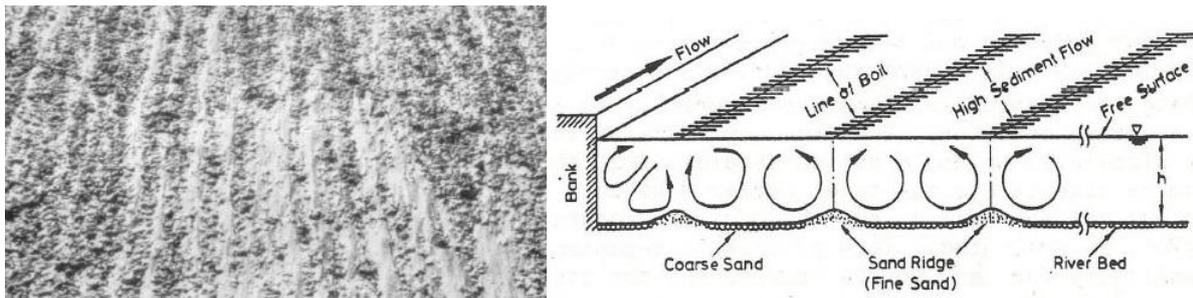
Figure 1: Fine-sediment ribbons (left) and secondary flow patterns developing over the ribbons (right).

Objectives

The aim of this project is to elucidate the hydrodynamic processes responsible for the formation of fine-sediment ribbons. The development of fine-sediment ribbons from an initially flat and uniform fine-sediment bed will be investigated in a laboratory flume by the means of simultaneous topographic and flow-field measurements. Different flow conditions close to the critical conditions of motion of the sediments will be analysed to clarify the influence of the shear stress and of the flow depth on the formation mechanism. A stereo photogrammetric technique will be applied to reconstruct the bed topographic and to measure sediment transport, while a stereo-PIV system will enable the reconstruction of the three-dimensional flow field in a transverse plane over the sediment ribbons. The study will focus in particular on the time-resolved analysis of the coherent structures responsible for the formation of secondary currents and thus, of the sediment ribbons.

Requirements

The candidate should have a good background and curiosity in fluid mechanics and turbulence. Programming skills in Matlab are required.