ETH zürich

Sediment Supply Control on River Widening Morphodynamics and Refugia Availability

Dynamic river widening is a restoration measure often implemented in channelized rivers. The goal is to reactive morphodynamic processes and increase habitat heterogeneity by removing bank protection and allowing channel widening. In this thesis, the morphodynamic activity of such widenings is linked to sediment supply, a fundamental fluvial process shaping riverscapes.

Mobile-bed laboratory experiments representing gravel-bed rivers of approximately one percent slope were combined with 2D hydrodynamic numerical modeling using BASEMENT to obtain widening topographies and the corresponding flow fields. The initial laboratory setup consisted of a straight channel with an adjacent floodplain on one side. After removing the fixed bank, this floodplain became available for lateral erosion and channel shifting. Seven experimental series were conducted, whereby the sediment supply relative to the channel's transport capacity was varied (100%, 80%, 60%, and 20%), and structural initiation measured were tested.

Sediment supply was found to be a key driver of lateral erosion and overall morphodynamic activity within the widening (Figure 1). Supply rates roughly balanced with the channel's transport capacity (100%, 80%) were shown to promote channel widening and continued sediment relocation. In contrast, sediment supply considerably lower than the channel's transport capacity (60%, 20%) maintained a stable single-thread channel disconnected from the floodplain. Increasing the sediment supply in a sediment-starved reach can reactivate morphodynamic processes but only after a transition period of several years to decades.

The hydro-morphological conditions resulting from different sediment supply levels were further linked to the availability of potential aquatic flood refugia. These are habitats that may function as temporary shelter for aquatic organisms during a flood by locally reducing its intensity. Morphodynamically active widenings were shown to offer more potential flood refugia than morphodynamically inactive widenings, thus increasing the resistance and resilience of the local aquatic community during floods.

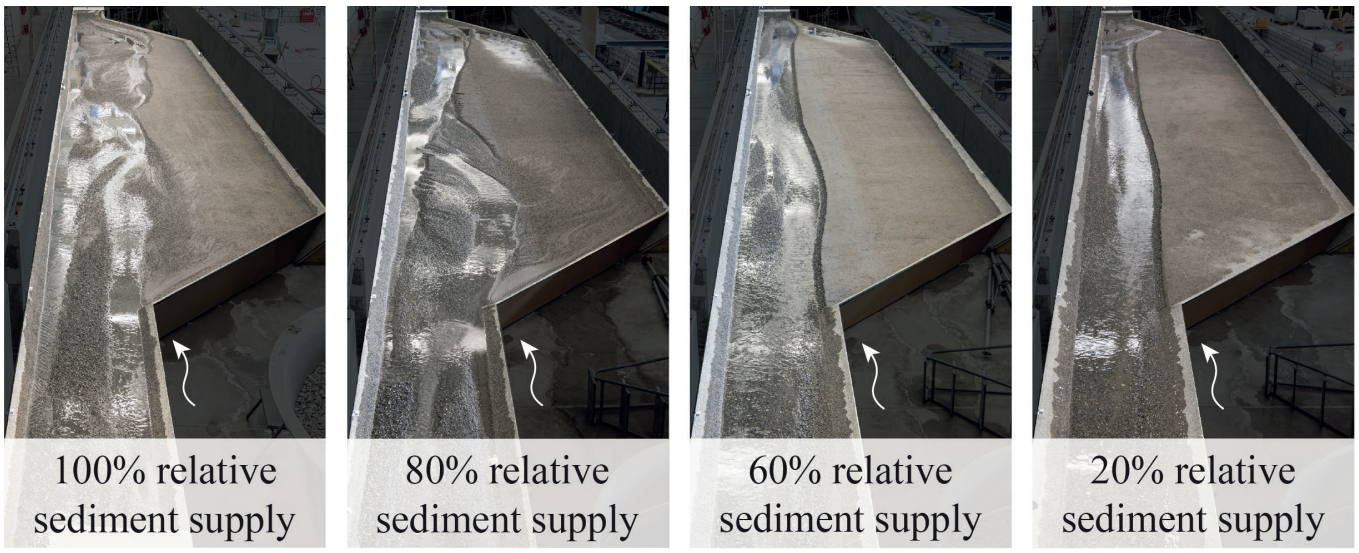

Figure 1: Widening topographies resulting from steady bed-forming discharge and variable sediment supply relative to the initial channel's transport capacity.

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