Geophysical Research Abstracts
Vol. 18, EGU2016-8928, 2016
EGU General Assembly 2016

How does sediment affect the hydraulics of bedrock-alluvial rivers?

Rebecca Hodge (1), Trevor Hoey (2), George Maniatis (2,3), and Emilie Leprêtre (4)

(1) Department of Geography, Durham University, Durham, UK (rebecca.hodge@durham.ac.uk), (2) School of Geographical and Earth Sciences, University of Glasgow, Glasgow, UK, (3) School of Computing Science, Glasgow, University of Glasgow, UK, (4) Suez Environment and University of Montpellier, France

Relationships between flow, sediment transport and channel morphology are relatively well established in coarse-grained alluvial channels. Developing equivalent relationships for bedrock-alluvial channels is complicated by the two different components that comprise the channel morphology: bedrock and sediment. These two components usually have very different response times to hydraulic forcing, meaning that the bedrock morphology may be inherited from previous conditions. The influence of changing sediment cover on channel morphology and roughness will depend on the relative magnitudes of the sediment size and the spatial variations in bedrock elevation.

We report results from experiments in a 0.9m wide flume designed to quantify the interactions between flow and sediment patch morphology using two contrasting bedrock topographies. The first topography is a plane bed with sand-scale roughness, and the second is a 1:10 scale, 3D printed, model of a bedrock channel with spatially variable roughness (standard deviation of elevations = 12 mm in the flume). In all experiments, a sediment pulse was added to the flume (D_{50} between 7 and 15 mm) and sediment patches were allowed to stabilise under constant flow conditions. The flow was then incrementally increased in order to identify the discharges at which sediment patches and isolated grains were eroded.

In the plane bed experiments $\sim$20% sediment cover is sufficient to alter the channel hydraulics through the increased roughness of the bed; this impact is expressed as the increased discharge at which isolated grains are entrained. In the scaled bed experiments, partial sediment cover decreased local flow velocities on a relatively smooth area of the bed. At the scale of the entire channel, the bed morphology, and the hydraulics induced by it, was a primary control on sediment cover stability at lower sediment inputs. At higher inputs, where sediment infilled the local bed topography, patches were relatively more stable, suggesting an increased impact on the hydraulics and the role of grain-grain interactions. We draw together these experiments using a theoretical framework to express the impact of sediment cover on channel roughness and hence hydraulics.