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How does channel pattern generate unsteady bedload transport?

Trevor Hoey[1], **Richard Williams**[2], Laura Quick[2,3], Richard Boothroyd[4], Pamela Tolentino[2,5], and Carlos Primo David[5]

[1]Civil and Environmental Engineering, Brunel University of London, United Kingdom (trevor.hoey@brunel.ac.uk)
[2]Geographical and Earth Sciences, University of Glasgow, Glasgow, United Kingdom (richard.williams@glasgow.ac.uk; laura.quick@glasgow.ac.uk; Pammie.Tolentino@glasgow.ac.uk)
[3]University of Edinburgh, Edinburgh, United Kingdom
[4]Geography and Planning, University of Liverpool, Liverpool, United Kingdom (richard.boothroyd@liverpool.ac.uk)
[5]University of the Philippines Diliman, Quezon City, The Philippines (cp.david@yahoo.com)

Unsteady bedload transport, whereby temporal variations in transport rate occur under constant total discharge and sediment supply, can be generated from interactions between hydraulics, sediment sorting, bedforms and reach-scale morphological variability. At larger scales, the relation between temporal and spatial variability in bedload transport has not been explicitly resolved largely due to the difficulty in obtaining coincident data over large areas and for long time periods. We hypothesise that spatial variability in bedload transport is a function of river pattern, and explore the implications of our results for temporal bedload variability. We combined bathymetric and LiDAR surveys to generate a high-resolution DEM of a 33km reach of the Bislak River, the Philippines. This DEM was then used for two-dimensional hydraulic modelling to predict distributions of flow and shear stress across the entire reach. The reach consists of four contiguous sub-reaches with different (meandering, wandering, braided, and deltaic) channel patterns. Probability distributions of shear stress and predicted bedload transport rates within each sub-reach reveal significant differences between the four channel patterns. From these results, we assess how different channel patterns generate distinct bedload signatures that can be propagated to predict synthetic time series of bedload transport. The properties of these time series are compared with empirical data on the scales of unsteady bedload transport. Improved understanding of bedload transport variability has implications for quantitative definitions of channel pattern, interpretations of alluvial deposits and assessments of channel response to anthropogenic modification.