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Feedbacks and coevolution of alluvial channel morphology, flow distribution and vegetation.

Jose Fernando Rodriguez
School of Engineering, University of Newcastle, Callaghan, NSW, Australia

The three-dimensional flow distribution of alluvial streams is affected by the channel form as a result of stream curvature, stream width changes and in-stream topographic steering. In-stream vegetation also affects flow distribution in a similar way, either reinforcing or attenuating geometric forcing. But as these systems are the result of co-evolution, flow patterns in turn affect sediment transport fluxes, erosion and deposition which may eventually modify some aspects of the topography and vegetative cover. In addition, sediment sorting can be a powerful reinforcing agent in many situations. We present in this contribution different studies in which we cover a variety of situations where the interplay between flow mechanisms is different. We analyse the effects of different levels of curvature, width changes and bedform and vegetation steering on sediment transport and sorting and the resulting in-stream topographic changes. We identify three-dimensional flow patterns that are stage dependent. We also analyse self-maintenance feedbacks of the flow-related features under different flow conditions. We present cases of straight reaches, meandering reaches, reaches with pools and riffles, and reaches with riparian vegetation within a common framework. We cover both gravel-bed and sand-bed streams. Our approach combines laboratory experiments, field data and numerical simulations.