



Tools-and-cover effects in transiently responding mountain rivers: hallmarks and consequences

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Knickzones that propagate upstream are a very common consequence of changes in environmental boundary conditions in mountain rivers, in particular in response to increases in rock uplift rate or sudden drops in downstream base level. This first-order behaviour can be simulated by a wide variety of fluvial erosion theories, including the whole family that we might describe as “stream-power-like”. However, we argue here that second order details in the form of the propagating knickzone – in particular, its steepness and the channel concavity that can be measured downstream of the knick – provide diagnostic hallmarks of the influence of strongly nonlinear sediment flux effects (also known as “tools and cover effects”) on river incision rates. We illustrate that these hallmarks can be found in a wide range of steep mountain rivers undergoing transient responses to changing boundary conditions, and infer that nonlinear sediment flux effects in rivers may be the rule, not the exception. We investigate the effects that such sediment-flux effects have on our ability to read past baselevel forcing from modern river profiles, highlighting the efficacy (or otherwise) of various approaches.