Persistent control of vertical bed dynamics by active faults in unconfined gravel-bed rivers

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# ABSTRACT

Fluvial control by tectonic processes has been explored at millennial and orogen scales and more recently at annual and reach scales associated with fault rupture. Fluviotectonic dynamics operating between these time-scales are relatively unexplored. I use a time-series of six surveys of thirty monumented cross-sections, collected over twenty-two years, to evaluate change in bed material storage (bed change) in an unconfined gravel bed river within an active New Zealand forearc basin. The 16-kilometre study reach crosses four active oblique strike-slip faults and several folds. We analyse metrics of bed change and relate spatial patterns to surface deformation interpreted from a 1 m LiDAR-derived elevation model. Incremental changes between surveys at the same station are noisy as are net bed changes through time with neither metric revealing clear patterns. By contrast, patterns of total bed change accumulated over the time-series reveals spatial coherence with intersecting geologic structures Relatively little total bed change occurs at cross-sections located close to uplifted axes and greater total bed change is generally observed at cross-sections downstream of such intersections and/or coinciding with back-tilting. We conclude that bed change compartmentalisation by active geologic structures along an unconfined alluvial river is detectable, spatially coherent, and persistent during an interseismic period. We also propose an updated model of profile deformation and evolution to account for tectonic back-tilt.