Title:

Longitudinal variability of unit stream power and geomorphic response to floods with applications for river corridor management

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Abstract:

Morphodynamic response of channels and floodplains to flooding reflects interactions of erosive and resistive forces with sediment transport capacity and supply at multiple scales. Monotonic relationships between reach-scale (0.5 to 1 km) response to floods with independent variables such as flood unit stream power and channel confinement can be confounded by longitudinal variations in these variables at longer scales. In these cases, channel response depends on both local and upstream drivers. Using high resolution pre- and post-flood digital elevation models and a network of flood peak discharge estimates, we calculate reach-scale and segment scale (10 km) longitudinal variations in channel widening and sediment balance. We relate these responses to longitudinal variations of unit stream power and channel confinement for selected streams impacted by the 2013 Colorado Front Range regional flood event. These streams transition from steep and relatively confined in the canyons of the foothills to less steep and unconfined on the high plains. The channel widening response is more closely linked with reach-to-reach gradients in unit stream power: abrupt channel widening and braiding responses typically occurred within reaches where a large decrease in unit stream power occurred relative to the upstream reach. Sediment balance followed segment scale trends in unit stream power, exhibiting a net erosional trend within the foothills that switches to a net depositional trend within the transition to the plains. Predictive modeling of stream response to floods and fluvial hazards assessments that only consider absolute values of reach-scale stream power may under-estimate fluvial hazards in some settings by ignoring unit stream power gradients. We apply these findings to methods for mapping fluvial geomorphic hazard zones as well as riverine infrastructure management.