EGU2020-573
https://doi.org/10.5194/egusphere-egu2020-573
EGU General Assembly 2020

Sediment dynamics across gravel-sand transitions: Implications for river stability and floodplain recycling

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The gravel-sand transition is observed along most rivers. It is characterized by an abrupt reduction in median bed grain size, from gravel- to sand-size sediment, and by a shift in sand transport mode from wash load-dominated to suspended bed material load. We document changes in channel stability, suspended sediment concentrations, flux and grain size across the gravel-sand transition of the Karnali River, Nepal. Upstream of the gravel-sand transition, gravel-bed channels are stable over hundred to thousand-year timescales. Downstream, floodplain sediment is reworked by lateral bank erosion, particularly during monsoon discharges. Suspended sediment concentration, grain size and flux reveal counterintuitive increases downstream of the gravel-sand transition. The results demonstrate a dramatic change in channel dynamics across the transition, from relatively fixed, steep gravel-bed rivers with infrequent avulsion to lower gradient, relatively mobile sand-bed channels. The increase in sediment concentrations and near-bed suspended grain size may be caused by enhanced channel mobility, which facilitates exchange between bed and bank materials. These results bring new constraints on channel stability at mountain fronts, and indicate that temporally and spatially limited sediment flux measurements downstream of gravel-sand transitions are more indicative of flow stage and floodplain recycling than of continental-scale sediment flux and denudation rate estimates.