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Channel evolution model of semiarid stream response to urban-induced hydromodification

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ABSTRACT

We present a novel channel evolution model (CEM) that qualitatively describes morphologic responses of semiarid channels to altered hydrologic and sediment regimes associated with urbanization (hydromodification). The CEM is based on southern California data from 83 detailed channel surveys, hundreds of synoptic surveys, and historical analyses of aerial photographs along 14 reaches. Channel evolution sometimes follows the well-known sequence described by Schumm et al. (Incised Channels: Morphology, Dynamics, and Control, Water Resources Publications, Littleton, Colorado, 1984) for incising, single-thread channels; however, departures from this sequence are common and include transitions of single thread to braided evolutionary endpoints, as opposed to a return to quasi-equilibrium single-thread planform. Thresholds and risk factors associated with observed channel response are also presented. In particular, distance to grade control and network position emerged as key controls on channel response trajectory. The CEM and quantitative extensions provide managers with a framework for understanding channel responses and rehabilitation alternatives, and may be transferable to other semiarid settings. It also offers insights regarding channel susceptibility to hydromodification, highlights key boundary conditions for high-risk channels, and underscores critical knowledge gaps in predicting the complex, discontinuous response trajectories that are highly prevalent in urbanized watersheds.