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Modelling ephemeral channel evolution in the American South-west

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The complex interaction between vegetation growth, flow dynamics, sediment transport and channel morphology has received much recent attention, and has been investigated experimentally, numerically, and in the field at a number of scales. For example, vegetation growth may trap sediment, promote bar formation and encourage further vegetation establishment. In addition, the spatial and temporal distribution of vegetation is affected by the nature of flow inundation and channel planform change, with potential vegetation removal due to sediment scour during high flows or by burial during aggradation. These interactions are particularly complex in semi-arid ephemeral channels where rainfall is intermittent, and where sediment transport and vegetation growth depend on the spatial and temporal variability in water delivery.

Vertical and planform channel change has been observed throughout the American southwest following channel incision and arroyo formation at the turn of the 20^{th} century. Understanding the role of vegetation as a control on ephemeral channel form is important, both for interpreting the response of these fluvial systems to climatic changes over the Holocene, and also for predicting the likely impact of future climatic change. Whilst within-channel vegetation is known to represent an important control on channel aggradation in such environments, current understanding of the feedbacks

between vegetation growth, sediment transport and channel evolution in this setting remains incomplete.

Reduced-complexity models provide a means to develop such understanding. However, such models must be capable of incorporating the effects on channel morphology of controls that operate at both the reach scale (e.g. local channelisation and bar formation) and catchment scale (e.g. headcut retreat and floodwave propagation). Existing models tend to represent one or other scale of process controls, but not both. This paper presents a quasi two-dimensional reduced-complexity model that can be applied at the catchment scale, but which also accounts for local-scale variability in vegetation growth, sediment transport and channel change. Initial model-based investigations that focus on the relative importance of local-scale versus catchment-scale controls on channel form are presented, and evaluated in the context of historical channel evolution at the Walnut Gulch Experimental Watershed, Arizona.