

Time, space, and episodicity of physical disturbance in streams

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Abstract

Storm-driven episodes of gully erosion and landsliding produce large influxes of sediment to stream channels that have both immediate, often detrimental, impacts on aquatic communities and long-term consequences that are essential in the creation and maintenance of certain channel and riparian landforms. Together, these effects form an important component of river ecosystems. In this paper we describe issues involved in characterizing and predicting the frequency, magnitude, spatial extent, and synchrony of these sediment influxes. The processes that drive sediment fluxes exhibit spatial and temporal variability over a large range of scales. Disregard of this variability can have unanticipated consequences for efforts to quantify process rates, as we illustrate using landslide densities observed for a storm event in western Oregon. Multiple factors interact to create the temporal and spatial patterns of erosional and mass-wasting events that affect stream channels. Fires, in particular, enhance susceptibility to erosional and mass-wasting processes, and thus affect the timing and magnitude of sediment-mobilizing events. We use examples from west-central Idaho to show how fires, storms, and topography interact to create spatially distinct patches of intense erosional activity. We require quantitative descriptions of these controlling factors to make quantitative predictions of how differences or changes in topography, fire regime, and climate will affect the regime of sediment fluxes. The stochastic and heterogeneous nature of these factors leads us to quantify them in probabilistic terms. The effects of future fire and storm sequences are governed in part by the past sequence of events over time frames spanning centuries and spatial extents spanning entire river basins. Empirical characterization of past events poses a considerable challenge, given that our

observational record typically spans several decades at most. Numerical models that simulate multiple event sequences provide an alternative means for estimating the influence of antecedent conditions and for quantifying the role of different controlling factors.

Keywords: aquatic habitat, fire, landslides, erosion