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Catchment-scale (dis)connectivity in sediment flux in the upper Hunter catchment, New South Wales, Australia

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Abstract

(Dis)connectivity within and between landscape compartments affects the extent and rate of transfer of energy and matter through catchments. Various landforms may impede sediment conveyance in a river system, whether laterally to the channel (termed buffers) or longitudinally along the channel itself (termed barriers). A generic approach to analysis of landscape (dis)connectivity using slope threshold analysis in GIS, tied to air photograph interpretation and field mapping of buffers and barriers, is tested in the upper Hunter catchment, Australia. Under simulated conditions, effective catchment area, which is a measure of the proportion of a catchment that has the potential to contribute sediment to the channel network, varies from 73% to just 3% of the total catchment area for differing subcatchments in the upper Hunter. This variability can be explained by the spatial distribution and assemblage of buffers and barriers in each subcatchment. Multiple forms of disconnectivity are evident in some subcatchments, such that when one buffer or barrier is breached, other features still impede sediment transfer within the system. The importance of the position of buffers and barriers within any given subcatchment is emphasised. Spatial variability in valley width exerts a critical control on catchment connectivity, with more efficient sediment conveyance in narrow valleys relative to wider valleys characterised by piedmonts, terraces, fans and extensive floodplains in which conveyance is impeded. This variability reflects the landscape history and geological setting of each subcatchment. The framework developed in this paper can be used to assess the impact of natural or human-induced buffers and barriers on catchment-scale sediment flux in any landscape setting, providing a physical template atop which other biogeochemical fluxes could be examined.

Keywords: Disconnectivity; Coupling; Sediment flux; Buffers; Barriers; Landscape history; GIS; Hunter catchment; Australia