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Linking landscape morphological complexity and sediment connectivity

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Connectivity relates to the coupling of landforms (e.g. hillslopes and channels) and the transfer of water and sediment between them. The degree to which parts of a catchment are connected depends largely on the morphological complexity of the catchment's landscape. Landscapes can have very different and distinct morphologies, such as terraces, V-shaped valleys or broad floodplains. The objective of this study is to better understand and quantify the relation between landscape complexity and catchment connectivity. We hypothesize that connectivity decreases with increasing landscape morphological complexity. To quantify the connectivity-complexity relationship we use artificially created Digital Elevation Models (DEMs) with distinct morphologies as inputs in the landscape evolution model LAPSUS to simulate the sediment connectivity of each landscape. We then test our hypothesis also on six common real-world DEMs with widely different morphologies. Finally, we explore the effects of rainfall sequence on catchment response for both artificial and real catchments. Simulation results confirm the hypothesis and quantify the non-linear relation. Results from the exploration of sediment connectivity in response to sequences of rainfall events indicate that feedbacks between erosion and deposition are more important for certain landscape morphologies than for others: given regular rainfall input, a more constant sediment connectivity and erosion response may be expected from rolling or V-shaped catchments than from dissected or stepped landscapes. Insight in and awareness of different behaviour and response of different morphologies might be useful for landscape and ecosystem management, for instance for soil and water conservation methods and locations.