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Assessment of structural sediment connectivity within catchments: insights from graph theory

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To understand the sedimentary signal delivered at catchment outlets, many authors now refer to the concept of connectivity. In this framework, the sedimentary signal is seen as an emergent organization of local filiations and interactions. The challenge is then to open black boxes that remain within a sediment cascade, that requires both accurate geomorphic investigations in the field (reconstruction of sequences of geomorphic evolution, description of sediment pathways) but also the development of tools dedicated to sediment cascades modelling. More precisely the development of tools dedicated to the study of connectivity in geomorphology is still in progress, even if the graph theory offers promising perspectives. In this presentation, graph theory is applied to abstract the network structure of sediment cascades, keeping only nodes (sediment sources, sediment stores, outlet) and links (linkage by a transportation agent), represented as vertices and edges. From the description of the assemblages of sedimentary flows, we provide three main indices to explore how small-scale processes may result in significant broad-scale geomorphic patterns. First, we assess the potential contribution of each node to the sediment delivery at the outlet. Second, we measure the influence of each node regarding how this node is accessible from both sediment sources and outlet. Third, we calculate a connectivity index to reveal whether the potential contribution of a node is lower or higher than expected from its location within the network. These indices are calculated in the case of a virtual sediment cascade, but are also applied to a catchment located in southern french alps. We demonstrate that these indices are robust, and may lead to simulations. In the present case, we try to predict how a sediment cascade may be impacted by an edge disruption or by a reconnection.