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Assessing historical sediment connectivity in a mesoscale catchment using multi-temporal aerial photographs

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Land uses changes interfere on sediment production and delivery in fluvial channel networks. The study of the evolution of sediment connectivity associated with different land use changes is prerequisite for a better understanding of sediment budgets and associated processes. Previous studies examined historical changes of sediment connectivity, but most are based on indices of sediment connectivity (IC) estimated by means of: (i) a single Digital Elevation Model (DEM), usually the most recent; and (ii) a weighting factor parameter, used in IC as a proxy of the impedance to sediment fluxes, that is assessed based on land use properties. However, some structural or geomorphological elements determined by both natural processes (e.g. rock falls) and human impacts (e.g. land uses changes) may have fundamental influences on connectivity, especially in a mountain areas typically affected by mass movements and strong land crop abandonment during the 20th century. Therefore, all these elements are able to modify landscape properties and, consequently, sediment connectivity.

Within this context, the objective of this work is to develop and apply a workflow to extract historical IC maps using different information that can be obtained from historical aerial photos. A prerequisite of the analysis is to reconstruct the land use and the landscape properties at the period in which the IC is estimated. The analysis consists of three interrelated steps: extraction of historical ortophotomaps and point clouds from historical photos (aerial photos from 1957 and 1977) in the Upper River Cinca (Southern Pyrenees), derivation of land use maps and topographic models for those periods, and assessment and comparison of historical sediment connectivity in contrasted sub-catchments exhibiting variable degrees of land use change. The study of changes on sediment connectivity through time may provide valuable information to understand some of the floodplain and channel adjustments that are observed in the majority of the fluvial systems experiencing massive land use changes in their headwaters during the middle of the 20th century.