Hydrosedimentary connectivity in a disturbed forested catchment: toward a temporally dynamic index of connectivity

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Hydrosedimentary connectivity refers to the potential fluxes of water and sediment moving throughout a catchment. In forested catchments, these fluxes are altered by anthropogenic and natural disturbances. In this study, we modelled the interannual spatiotemporal evolution of hydrosedimentary connectivity influenced by forest cover change over the last four decades in the Mont-Louis catchment, a snow-dominated mountainous catchment in eastern Canada, which had 62\% of its total surface affected by forest disturbances (mainly logging, but also wildfires and diseases) between 1979 and 2017. Using a geomorphometric index of connectivity (IC) and a historical forest cover database, we produced one IC map per year that considered anthropogenic and natural disturbances affecting the forest cover of the studied catchment. To account for vegetation recovery, forest disturbances were weighted with local hydrological recovery rates. Over the four decades, the mean IC of the Mont-Louis catchment dramatically increased by 35\% in response to different types of disturbances. The spatial evolution of IC over the whole catchment and at the sub-catchment scale revealed that disturbance location has a strong influence on hydrosedimentary connectivity to the main channel. Our results also highlight the sharp contrast between IC computed from topography-based impedance to those computed from vegetation-based impedance. Forest disturbances appear to connect hillslopes with the hydrological network by producing pathways for sediment and water. The proposed reproducible framework might be used as a tool to assess and predict the potential impact of harvesting on rivers morphological dynamics and eventually preventing damage to fish habitat and sensitive river reaches.