Geophysical Research Abstracts
Vol. 20, EGU2018-15595, 2018
EGU General Assembly 2018

Sediment connectivity in the Piave River basin: effects of reservoirs and water diversion

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Sediment is usually considered to move from sources to sinks across a river basin through pathways defined by the drainage network of the basin. The sediment connectivity can be defined as the map representing the mass of sediment moving from one reach to another along a pathway of the river network. Quantifying the fluxes through these pathways at the scale of interest for human interventions is complex for a series of reasons: the low accuracy of sediment transport formulas, the uncertainties in sediment inputs, and the required simplifications regarding the flow conditions. However, estimating the sediment connectivity at basin scale is crucial for planning and management or river basin resources. Recent conceptual and modelling frameworks adopt a network based approach and a series of simplifications regarding the flow conditions and the relationship between discharge and sediment flux. Moreover they usually adopt a classical scaling of hydrological and geomorphological properties of the river reaches on the drainage area. Many Alpine river basins are characterized by the presence of reservoirs, often connected through pipelines, forming a second network and impose internal conditions, altering the "natural" hydrologic regime, therefore in most cases hampering this classical scaling. Moreover, the effects of this secondary internal network on the sediment connectivity are difficult to estimate because the managing rules and actual water withdrawals are rarely available. This study focuses on the Piave River basin, in North-East Italy. Around 80% of the annual discharge of the Piave River is diverted from the natural river bed, making it one of the most exploited rivers in Europe. In this basin there are indeed 25 major hydropower plants and 12 large reservoirs, with a total storage capacity of 156 Mm3. On top of the well-known effects of dams on sediment connectivity, the reduced transport capacity in the reaches affected by water diversion can increase the spatial extent of these impacts. In this research we apply the conceptual framework developed by Czuba and Foufoula (2014) to the Piave River network and compare the long term geomorphic changes resulting in two different settings: a hypothetic "natural" network obtained removing any impounding structure from an available DEM of the area and the actual present condition, affected by blockage of sediment and water abstractions due to reservoirs and the pipeline network connecting them. The results highlight the importance of infrastructures' planning and management for proper water and sediment resources' exploitation.