



CASCADE: a toolbox for network-scale sediment connectivity assessment

Marco Tangi (1), Rafael Schmitt (2), Simone Bizzi (1), and Andrea Castelletti (1)

(1) Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milan, Italy (marco.tangi@polimi.it),

(2) The Natural Capital Project and Woods Institute for the Environment, Stanford University, United States of America (rschmitt@stanford.edu)

Sediment connectivity is fundamental for the functioning of fluvial eco-systems. Human disturbances to natural sediment transport processes caused, e.g., by dam construction or deforestation, are hence potentially detrimental to river ecosystems and ecosystem services. However, the alteration of the natural sediment transport processes is often underestimated or ignored while planning human interventions around or on river systems, leading to unforeseen impacts on the whole river system and costs for the people depending on its resources.

Modelling sediment connectivity and reaction to anthropic alterations represent a necessity to increase the understanding of the river process, to estimate impacts and plan effective measures. Since river are deeply connected systems, models should adopt a whole-network perspective, which traditional sediment transport modelling techniques often fail to provide. CASCADE (CATCHment Sediment Connectivity And DELivery) (Schmitt et al., 2016) is a modelling framework that combines concepts of network modelling with empirical sediment transport formulas to provide spatially fully distributed information on sediment transport and, connectivity in large river networks.

CASCADE is a flexible modelling framework which takes advantage of increasing availability of geomorphic data and hydrologic data in large-basins or at global scales to describe sediment connectivity in data rich as well as data scarce environments.

In this work, we present the CASCADE toolbox, an open source toolbox containing the functions and scripts necessary to run CASCADE and to provide advanced function for interactive analysis of sediment connectivity. The toolbox is designed to provide an estimation of the basin-scale, cumulative altering effects on sediment transport and connectivity caused by different anthropic and natural influences. The toolbox allows for easy integration of dams or other barriers as well as for coupling models for increased hillslope sediment generation.

Moreover, the CASCADE toolbox contains different user customization options, like the possibility to change the transport formulas employed. With its effective and flexible data requirements, its computational efficiency and its customization options, CASCADE is designed for river basin management even in those contexts where sediment connectivity is so far not commonly considered and its impacts underestimated. Applications include optimization of dam portfolios for minimal sediment trapping, identify dominant sources of sediment for reservoir storage loss, or visualizing basin-scale sediment connectivity under different sediment management strategies.