EGU23-4867, updated on 23 Oct 2023
https://doi.org/10.5194/egusphere-egu23-4867
EGU General Assembly 2023

A probabilistic approach for planning the ordinary maintenance of existing torrent control structures: from first-level inspections to maintenance strategy

Alessio Cislaghi[1,2], Paola Morando[1], Emanuele Morlotti[1], and Gian Battista Bischetti[1,2]
[1]University of Milan, Department of Agricultural and Environmental Sciences, Milan, Italy (alessio.cislaghi@unimi.it)
[2]Centre of Applied Studies for the Sustainable Management and Protection of Mountain Areas (Ge.S.Di.Mont.), University of Milan, Edolo (Brescia), Italy

Check dams, submerged and ground sills, ground ramps, and bendway weirs are in-channel countermeasures built for mitigating flood and debris flow hazards. These torrent control structures have an own durability depending on structure type, material, design, construction, and maintenance, as well as on the physical pressures exerted on them. During the last half-century, while the natural degradation of the structures endangers their functionality, investments in ordinary maintenance have been significantly decreasing, worldwide. Thus, monitoring and planning an ordinary maintenance of existing structures should be a primary purpose for maintaining (or even improving) an adequate level of protection against natural hazards.

The present study proposes a framework for planning and promoting decision-making on the structure maintenance activities. The methodology consists in a procedure of first-level inspection based on three indicators (i.e., damage index, residual functionality, and active process index), followed by the application of a homogeneous Markov chain model on the collected field observations. The study has been conducted on three rivers in North Italy (Oglio, Pioverna, and Staffora) characterised by different hydrological-sediment transport regime, and level of artificiality.

The results of the first-level inspections, merged with a wide spectrum of other information (width, length, height, age of construction, materials, etc.), clearly show the actual status of the structures, whereas the Markov chain model provides different scenarios of physical structure degradation and decline of functionality, in function of time and levels of maintenance.

This framework is an interesting decision support tool for planning a long-term ordinary maintenance on torrent control structures, through a probabilistic assessment of structure failure, and a cost-effectiveness analysis of different maintenance activities. Moreover, this study represents a practical example of watershed management, starting from planning the first-level inspections of the existing torrent control structures until the assessment of the present and future vulnerability of the areas developed along the river channel network.