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Exploring increase of flood attenuation potential of reservoirs through simple gates operations.

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Along with other flood risk mitigation measures, artificial flood storage has been considered as a mean to control flood peaks in mountainous basins, particularly as part of the flood management practices. Classical studies attain the evaluation of the 'natural' flood attenuation potential driven by the portion of volume available above the spillway crest level. These studies allow to reconstruct modified flood frequency curves in sections downstream as modified by this unconditioned type of attenuation. Less understood is the possibility to quantify the additional attenuation potential of reservoirs deriving by simple and standardized gates operations. Unconditioned gates opening in advance with respect to the incoming flood are the typical operations considered in this work. The study has been carried out using a system of 63 artificial reservoirs located in the Northwestern part of Italy, for which a comprehensive set of hydrological and hydraulic data has been collected with the help of the Italian Dams Authority (Registro Italiano Dighe, RID). The main aim of the study is to select the most interesting cases in which gates operation is able to consistently improve flood attenuation, and provide an overview of the effect that these dams exercise on the flood frequency curves of the river sections downstream.

For what the 'natural' attenuation potential is concerned, an attenuation index named SFA (Synthetic Flood Attenuation) has been computed on all dams and subsequently used to modify the original frequency curve of the incoming floods. A recent regional statistical method for flood estimation has been used for this purpose. With the help of the same model and of additional information required to describe flood volumes, triangular and power-law synthetic flood hydrographs have been simulated. Gates operation is addressed to a preemptive drawdown, and is conceived as a fixed opening in defined conditions at the flood arrival. Consequently, the maximum outgoing peak discharge is computed by solving numerically the continuity equation. Standardized conditions of gate opening are referred to initially full reservoir and: i) a minimum reasonable lead time before the peak, equal to the basin lag time; ii) the crossing time of an incoming discharge threshold. Results are examined in terms of dependency on hydrograph shape and peak position, and allowed us to rank reservoirs according to their 'natural' and additional attenuation potential.