Influence of uncertainty in flood hazard mapping downstream of dams using univariate and bivariate approaches for forcing hydrographs definition

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This study presents a methodology to derive flood hazard maps in flood prone areas downstream a dam taking into account uncertainties in the definition of forcing hydrographs.

In hydrology and hydraulics, several applications including dams and flood risk mapping require the selection of storm or hydrograph attributes with a predefined return period. Standard hydrological design approaches are mostly based on univariate frequency analysis methods. However, a multivariate analysis on flood variables is needed to design some hydraulic structures like dams, as the complexity of the routing process in a reservoir requires a representation of the full hydrograph.

Moreover, the risk related to a specific event can be over- or underestimated if only the univariate return period of either the peak or volume is analyzed. In addition, the return period should be defined in terms of risk of dam overtopping or downstream damages, instead of in terms of natural probability of occurrence of floods, to take into account the influence of reservoir and dam characteristics on the flood hydrograph routing process.

In this study, the role of a multivariate probability hydrological analysis on inundation and flood hazard maps downstream the dam is analyzed, highlighting the differences between univariate and bivariate approaches to derived design hydrographs. The methodology, here presented, has been applied to a study area located in Sicily.