

ABSTRACT

Based on detailed literature review of floods in Spain, two main conclusion can be drawn: i) the main factor that triggers off flood disasters has a socioeconomic background, which is due to the location of goods and services in flood prone zones, ii) flooding with large negative consequences are mainly concentrated in the Mediterranean areas, where besides the main cause, combine other factors related to hydroclimatic characteristics of these areas (e.g. convective storms of high intensity, small basins with steep slopes and wide alluvial valleys, shallow soils with permeable substrates), where flash floods are predominant. Nowadays, there is a vast amount of specific literature available on this topic that together with powerful computational tools facilitates the quantification of the risk. The concept of risk can be understood as the probability of occurrence of a flood event and its potential negative impacts. From this definition, flood risk management can be defined as a dynamic cyclical process of analysis, assessment and reduction on flood risk. Recent investigations carried out by the Research Group of Hydrological and Environmental Modelling at the UPV have showed important progress and contributions on this research area. On these grounds, it is possible to raise a suitable methodology for flood risk analysis, which would be supported with an integration of several techniques such as: stochastic models to generate synthetic convective storms, hydrological distributed modelling, two-dimensional hydraulic modeling, multivariate statistical analysis and estimation of direct, tangible flood damages. The results obtained with this variety of methods, which are spatially integrated with geographic information systems, would help us to quantify the flood risk and map it. Moreover, with this methodology it is possible to "analyze" the current flood risk as well as potential scenarios lead to the implementation of flood prevention strategies for flood risk reduction. On this hypothesis, the aim of this PhD thesis was to propose a methodology for flood risk analysis and reduction to be applied on a specific case study of a representative Mediterranean river system of meso-scale which has experienced flood damages: the "Rambla del Poyo" (Valencia). This methodology has been flexible both, in order to be adapted for the analysis of flood risk reduction through preventive measures such as "retention water in the landscape", and to allow an analysis of the effectiveness of this strategy.

Two sets of general conclusions have been found since the implementation of the research plan. First, regarding with the implemented methodology, there are the following conclusions: i) it has been shown to be effective in terms of data requirements, computational time and credibility of the results; ii) the use of stochastic modeling of convective storm coupled with hydrological distributed modeling has shown to have great potential in flood frequency estimation, mainly because of it has involved a physical analysis of the main hydrological processes in the catchment studied; iii) a hydrodynamic analysis using a coupled 1D/2D model of the case study, has proven to be a reliable tool for an extensive floodplain analysis, however, it has a limited usefulness due to computational and economic costs; iv) data on historical flood damages from field survey on the study area, has shown to be a reliable support to build depth-damage functions and their application to estimate direct, flood tangible damages and their integration for flood risk analysis. On the other hand, regarding with the analyzed measures of the "retention water in the

landscape", the following conclusions have been drawn: i) its effectiveness on flood peak reduction has been conditioned by several factors such as: spatio-temporal variability of storms, antecedent soil moisture conditions, flood magnitude, type of analyzed measure as a function of their effects on hydrological processes (generation or propagation of runoff) and their spatial distribution within the catchment; ii) generally speaking, it has been observed that the measure effectiveness on flood peak reduction, as retention water on slopes (afforestation) and retention water on channels (reservoirs), decreases with increasing flood magnitude; also, a greater increase in the catchment retention capacity and their relationship with its affected area, greater effectiveness has been observed iii) flood magnitude reductions on high-frequency events and ineffectiveness in low-frequency events, can result in significant flood risk reductions, i.e. this kind of measures would be more effective in terms of flood risk reduction. Alternatively to the measures of "retention water in the landscape" (which only affect flood hazard), an analysis of the introduction of preventive measures such as physical barriers on the houses doors (which affect flood susceptibility) has been shown to have a relative significance for flood risk reduction; iv) the effectiveness scrutiny on flood risk has provided a better analysis tool than the classical analysis on flood peak (i.e. flood hazard), because it was possible to quantify the degree of risk reduction of each one of the measures analyzed in the flood prone zone. This result may be useful in further evaluation of efficient alternatives in the flood risk management cycle, for example, for the flood risk assessment or for cost-benefit analysis. Finally, there have been some recommendations and future research lines, which have arisen from the requirements not covered in this PhD thesis.