

## **Recent advances on dendrogeomorphological research applied to flood hazard analysis in Spain**

*A. Díez-Herrero, J.M. Bodoque, J.A. Ballesteros-Cánovas, V. Ruiz-Villanueva, M. Génova, M. Stoffel, C. Guardiola-Albert, M.A. Eguibar, P. Mayer, J.M. Rubiales.*

Over the last forty years, applying dendrogeomorphology to palaeoflood analysis has improved estimates of the frequency and magnitude of past floods worldwide. This communication reviews the main results obtained by applying dendrogeomorphology to flood hazard research in several case studies in Spain. These dendrogeomorphological recent advances focused on the following topics: (1) anatomical analysis to understand the physiological response of trees to flood damage and improve sampling efficiency; (2) compiling robust flood chronologies in ungauged mountain streams, (3) determining flow depth and estimating flood discharge using two-dimensional hydraulic modelling, and comparing them with other palaeostage indicators; (4) calibrating hydraulic model parameters (i.e. Manning roughness); and (5) implementing stochastic-based, cost-benefit analysis to select optimal mitigation measures. Further developments will include new methods for better identification of the causes of specific types of flood damage to trees (e.g. tilted trees) or stable isotope analysis of tree rings to identify the climatic conditions associated with periods of increasing flood magnitude or frequency. Innovative results have been obtained from the application of these methodologies in different study sites in Spain, including ungauged basins in the Gredos Mountain Range and the Segovia province (Central Spain), and the Taburiente National Park (Canary Islands). The research projects Dendro-Avenidas (2008-2010) and MAS Dendro-Avenidas (2011-2014), both funded by the Spanish Ministry of Science and Innovation (nowdays Ministry of Economy and Competivity), and the project IDEA-GesPPNN (2011-2013, Spanish Bureau of National Parks; Ministry of Agriculture, Food and Environment) are exploring these novel research lines.