



The October 1787 Ebro flood: the biggest flood event of NE Iberian Peninsula in the last 500 years

Josep Carles Balasch Solanes¹, **Josep Barriendos**², Mariano Barriendos³, Jordi Tuset⁴, and David Pino⁵

¹ETSEAFIV University of Lleida, Chemistry, Physics and Environmental and Soil Sciences, Lleida, Spain

(josepcarles.balasch@udl.cat)

²CREAF Ecological and Forestry Applications Research Center. Universitat Autònoma de Barcelona. Bellaterra (Barcelona), Spain (josep.barriendos@gmail.com)

³IDAEA Instituto de Diagnóstico Ambiental y Estudios del Agua (CSIC) – Barcelona, Spain (barriendos@telefonica.net)

⁴RIUS Fluvial Dynamics Research Group, University of Lleida. Lleida, Spain (jotume@gmail.com)

⁵Department of Physics, Universitat Politècnica de Catalunya-BarcelonaTech. Castelldefels (Barcelona), Spain (david.pino@upc.edu)

The reconstruction of past flood episodes is of vital importance in the study of river dynamics for assessing the impact of climatic and environmental changes, and evaluating the risk of these disasters on current populations. The main objective of this study is to present a multidisciplinary analysis of the catastrophic flood episode that occurred in the Ebro River basin (85,000 km²) on 8th-9th October 1787.

The methodology includes an extensive research from documentary sources of the damaged locations. By using this data, maps of the extent of the affected area and the temporal evolution of the event have been reconstructed. Then, utilizing the maximum water height (3 flood marks), numerical simulations of hydraulic and hydrological reconstructions have been carried out to obtain the peak flows and the amount of precipitation. The meteorological reconstruction utilizes daily barometric information collected at that time from different observatories in Western Europe to plot surface pressure maps to estimate wind direction and the location of the cyclonic centers.

The results show that this is the most serious episode that has occurred in the northeast of the Iberian Peninsula the last 500 years. There were more than 500 fatalities in the Lower Ebro area, numerous homes and structures were destroyed and the regional economy was damaged for several decades. The affected area was mainly the eastern Ebro basin (with 31 documented points), but it also extended to small areas of coastal basins of the Llobregat and Júcar Rivers (9 affected points). After about 10-12 consecutive days of rain caused by two active low-pressure centers combined with an influx of moist air from the Mediterranean Sea, some of the largest peak flows that the Ebro River has experienced since the beginning of the 16th century occurred. These flows reach to 12,900 m³·s⁻¹ of the Ebro River in Tortosa (mean flow: 428 m³·s⁻¹), 4,500 m³·s⁻¹ of the Ebro in Zaragoza (mean flow: 231 m³·s⁻¹), 4,500 m³·s⁻¹ of the Segre River in Lleida (mean flow: 80 m³·s⁻¹) and about 2,500 m³·s⁻¹ of the Cinca River in Fraga (mean flow: 78 m³·s⁻¹). According

to historical accounts, the origin of the flood is purely pluvial without contributions of snow melting in the Pyrenees.

The specific peak flow of the Ebro in Tortosa ($0.15 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{km}^{-2}$) exceed the flows of any large European river of the same basin size (Po, Danube, Rhine, Rhône). Therefore, we are facing an event of extreme magnitude that is essential to study and to explain fluvial variability and risk analysis.