Geophysical Research Abstracts
Vol. 14, EGU2012-2768, 2012
EGU General Assembly 2012

Flash floods reconstruction from historical data in the ungauged Ondara River basin at Tàrrega (NE Iberian Peninsula)

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In the last four centuries, the Ondara River has flash-flooded several times the town of Tàrrega (NE Iberian Peninsula), resulting in a great number of deaths and damages to buildings.

Indeed, since early 17th century, a minimum of seven major events have flooded the old-town streets –in some cases, up to the houses' second floor– in 1615, 1644, 1783, 1842, 1874, 1930 and 1989; the flood marks preserved in Tàrrega allowed the reconstruction of the peak flows, an information that can eventually be used to improve flood frequency analysis.

More in detail, each flash flood peak flow was reconstructed through the iterative application of a hydraulic model. The input data for each reconstruction were:

1. a digital terrain model of the river bed at the time of the flood
2. the stream, floodplain and urban areas roughness coefficients at the time of the flood
3. the channel slope (0.0045)
4. a tentative peak flow, to start the iterations
5. the actual maximum water height for each flood, given by the flood marks

As said above, the process was iterative: we tried different peak flows until the modelled maximum water height was less than 1 cm apart from the actual one, given by the flood marks.

The hydraulic model used was the unidimensional HEC-RAS 4.1 (USACE, 2010), applied with a gradually varied, steady, mixed flow along a 2700 m long reach divided in 53 cross sections. The Ondara River catchment at Tàrrega has an area of 150 km^2 and an average slope of 1.6 %; there are neither gauging records nor impoundments.

The reconstructed peak flows of the seven floods were: 790 $m^3 s^{-1}$, 1600 $m^3 s^{-1}$, 490 $m^3 s^{-1}$, 210 $m^3 s^{-1}$, 1190 $m^3 s^{-1}$, 280 $m^3 s^{-1}$, and 260 $m^3 s^{-1}$, respectively. The heaviest flood's specific peak flow (10.7 $m^3 s^{-1} km^{-2}$, occurred in 1644) ranked among the highest ever modelled or measured in similar-sized catchments in the Western Mediterranean region.

The diachronic modelling highlighted a change in the hydraulic behaviour of the reach: the flow became lower but faster since 1874, due to the deposition of a sediment layer.

A preliminary sensitivity analysis showed that the Manning's roughness coefficient contributed greatly to the uncertainty of the results, which was 4 % for great floods and 18 % for modest floods.