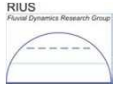


Error of the modelled peak flow of the hydraulically reconstructed 1907 flood of the Ebro River in Xerta (NE Iberian Peninsula)



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The Ebro River is one of the main rivers in the Iberian Peninsula. It drains into the Mediterranean Sea an area of 85,000 km² (Fig. 1). Its mean flow is 428 m³·s⁻¹ and the runoff coefficient is 25.8%.

Xerta (1250 inhabitants), located on an ample floodplain by a meander of the Ebro River opposite Tivenys (Fig. 2), possesses a flood scale containing nine major floods since 1617 (Fig. 3)

Our objective was to estimate the error of the reconstructed peak flow of the second highest of these floods, that of 21–23 October 1907.

The methodological procedure taken is summarised in Fig. 4. First, the peak flow was calculated with three methods: HEC-RAS model with steady flow (1D), Iber model (2D) and Manning's equation. Their results were, respectively: 11500, 12000 and 11500 m³·s⁻¹, which are coherent with the peak flows estimated by other authors in the nearby towns of Móra d'Ebre, Benifallet and Tortosa (Fig.1): 11200, 11500 and 12000 m³·s⁻¹.

Then, 14 sensitivity analyses were performed with six input variables of the HEC-RAS model (Table 1). The peak flow total error was calculated with a quadratic sum (Eq. 1) of the individual errors found with the sensitivity analysis. The sensitivity index was calculated with a ratio between output variation and input variation (Eq. 2)

$$\delta_{total} = \pm \sqrt{\sum_{x=1}^n [(\delta_x)^2]} \quad (\text{Eq. 1}) \quad I_x = \frac{F_1 - F_2}{\frac{F_{12}}{x_1 - x_2}} \quad (\text{Eq. 2})$$

Peak flow total error was found to be ±31-39%, depending on the water height error assumed (Table 2). Due to its high uncertainty, **Manning's was the input variable that contributed the most to the peak flow total error**. Future research should include more variables, such as sediment transport, or steady/unsteady flow.

Acknowledgements

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More info, soon, in:

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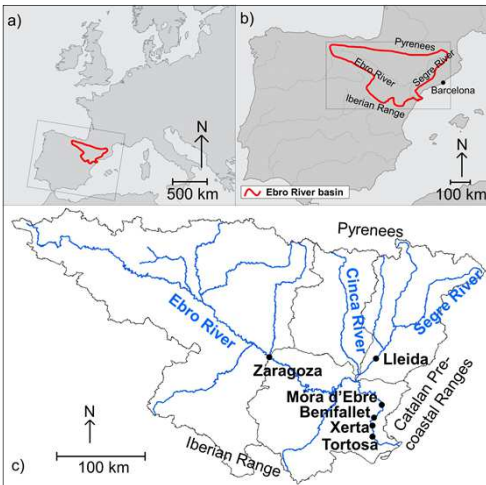


Figure 1. Location of the town of Xerta within the Ebro basin. Source: Own elaboration from a map Copyright © 2009 National Geographic Society, Washington, D.C.



Figure 2. The towns of Xerta and Tivenys. Adapted from an aerial photograph of June 2014 (ICGC, 2015).



Figure 3. Xerta's flood scale (Photos by Andreu Abellà)

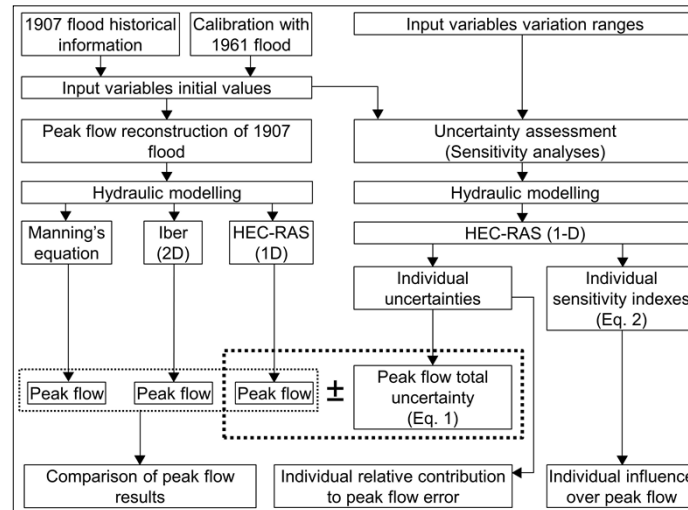


Figure 4. Overview of the methodological procedure

Table 1. Results of the 14 sensitivity analyses

Sensitivity analyses				Influence on the peak flow			
Number	Modified input variable	Initial value	Modification of the initial value	Resulting peak flow (m ³ ·s ⁻¹)	Absolute individual error (m ³ ·s ⁻¹)	Relative individual error (%)	Sensitivity index (I _x)
1	Water height	15.175 m a.s.l.	+10 cm	11750	±275	±2.4	+3.6
2			-10 cm	11200			
3			+30 cm	12325			
4			-30 cm	10650			
5			+100 cm	14430			
6			-100 cm	8825			
7	Manning's n	A different one for each cross section, according to soil uses	+30%	8925	±3500	±30.4	-1.0
8			-30%	15925			
9			Channel: 0.045 (+9%) Floodplain: 0.056 (+7%) Average: 0.055 (+8%)	10225			
10	Downstream boundary condition: normal height	0.905 m·km ⁻¹	+15%	11880	±455	±4.0	+0.3
11			-15%	10970			
12	Number of cross sections	45	22	14330	+2830	+25	+0.5
13	Flow paths direction	Straight	Meandering	11500	0	0	NA ^(a)
14	DEM resolution	5x5	25x25	11475	-25	-0.2	+0.01

^(a) NA: not applicable, because "straight" and "meandering" cannot be expressed in numbers.

Table 2. Peak flow total error

Water height uncertainty considered (cm)	Peak flow total absolute error (m ³ ·s ⁻¹)	Peak flow total relative error (%)	Relative contribution to the peak flow total error (%)			
			Water height	Manning's n	Downstream boundary condition	DEM resolution
±10	±3540	±31	6	82	11	<1
±30	±3627	±32	17	73	9	<1
±100	±4507	±39	41	52	7	<1



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