Calibration of a hydrological model in the Sió River catchment (NE Iberian Peninsula)

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Introduction

Two considerable flash floods occurred in November 2015 and November 2016 in the Sió River basin (509 km^2), a small tributary of the Segre River, within the Ebro River basin in NE Iberian Peninsula (Figure 1). The 2015 flood killed four elderly people while sleeping in the basement of a nursing home built within the flood plain in the town of Agramunt and caused important economic losses across the entire catchment.

Objective

The calibration of a hydrological model for the Sió River to serve as a flood early warning system.

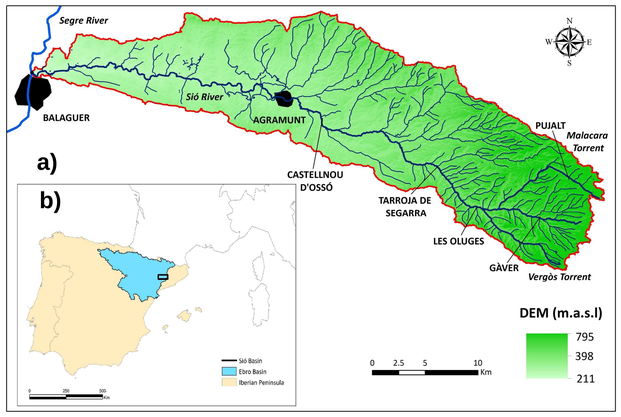

Figure 1. Sió River basin (a) and its location within the Ebro River basin (b)

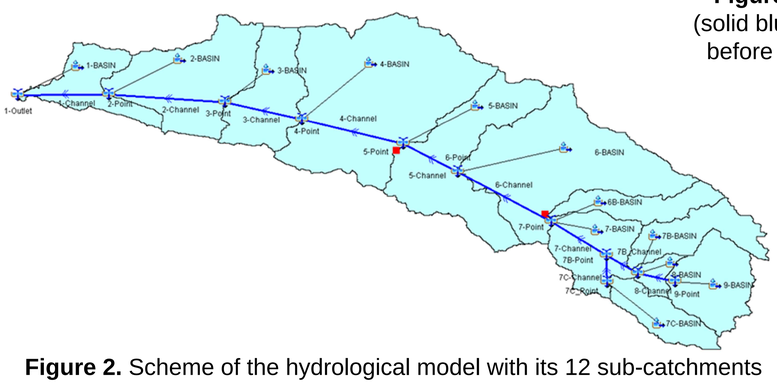

Figure 2. Scheme of the hydrological model with its 12 sub-catchments

Methods

The Sió River hydrological model consisted of 12 sub-catchments (Figure 2). The software used was HEC-HMS v.4.2. and the chosen runoff transformation model was Curve Number with Type 2 soil moisture condition. Rain data with a 15-minute resolution came from four rain gauges (Figure 3).

Water stage data of 2016 flood from two Smarty Planet radar sensors installed by Arantec at Castellnou d'Ossó and Tarroja de Segarra were used to calibrate this model. The modelled period was from 23/Nov/2016 16:00 to 24/Nov/2016 23:00 with one-minute intervals.

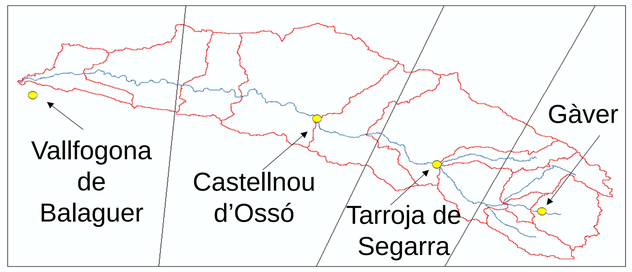

Figure 3. The four rain gauges used and their Thiessen polygons

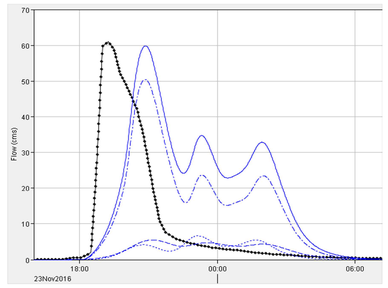

Figure 4. Measured (black line) and modelled (solid blue line) hydrographs at Tarroja de Segarra

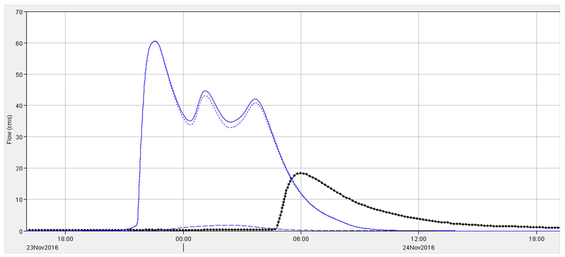

Figure 5. Measured (black line) and modelled (solid blue line) hydrographs at Castellnou d'Ossó before forcing infiltration into the alluvial aquifer

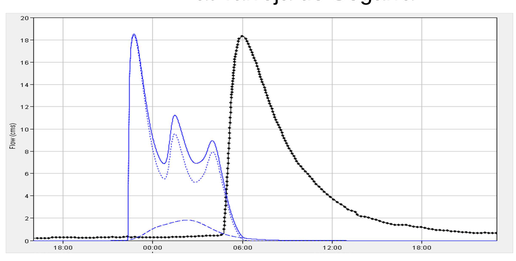

Figure 6. Measured (black line) and modelled (solid blue line) hydrographs at Castellnou d'Ossó after forcing infiltration into the alluvial aquifer

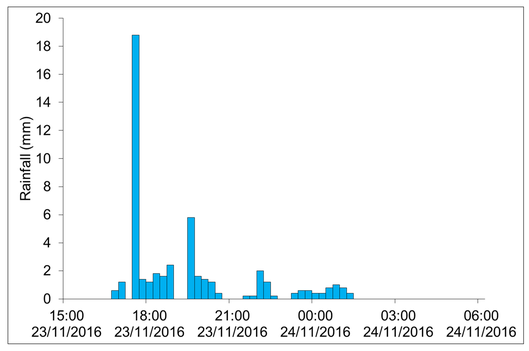

Figure 7. Hyetograph of November 2016 storm at Gàver gauge (headwaters; see Figure 3) with two secondary peaks

Figure 8. Aerial photo of Sió's flood plain the day after 2016 flash flood. Most of this water was ultimately infiltrated into the alluvial aquifer and alluvial plain

Results

In Tarroja de Segarra (Figure 4), the model correctly calculates peak flow value, but not its time of arrival (1h40' later) or runoff volume (84% higher).

In Castellnou d'Ossó (Figure 5), the model overestimated peak flow (330%) and runoff volume (340%). After forcing water infiltration into the alluvial aquifer (655 mm/h, or 0.182 mm/s), the model correctly estimated peak flow (Figure 6), but not its time of arrival (7h15' earlier) or runoff volume (70% higher). Besides, modelled hydrographs show secondary peaks that did not actually occur.

Discussion

Increased viscosity due to high sediment load (35 g/l in a post peak flow sample) may explain peak flow delay at Castellnou. Hyetograph's secondary peaks (Figure 7) may explain modelled hydrograph's secondary peaks. The reduced channel cross section (Figure 8) forces a wide alluvial plain flooding (Figure 9) that may explain runoff volume overestimation.

Aknowledgements

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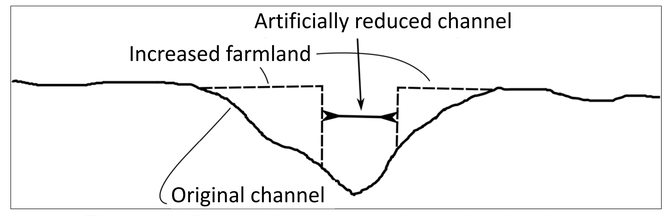

Figure 9. Channel's cross section reduction due to agricultural land occupation

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