

# XXIX CONFERENCE OF THE DANUBIAN COUNTRIES ON HYDROLOGICAL FORECASTING AND HYDROLOGICAL BASES OF WATER MANAGEMENT

## Comparison of one- and two-dimensional models for flood mapping in urban environments

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### INTRODUCTION

Floods are natural phenomena as a result of a combination of natural, geological and anthropogenic factors. Every year, floods cause loss of life, economic losses, adverse effects on the environment and cultural heritage all over the world. Floods are complex processes that have to be properly analyzed in order to know the exact spatial and temporal changes during a flood as well as the causes of these changes.

### CASE STUDY

In this study, a 2D hydraulic model using HEC-RAS software for river flow and floodplains modeling was applied on part of the town of Smolyan, where the Biala River flows into the Cherna River (Fig.1). This paper presents a comparative analysis of the performance of 1D and 2D modelling of floods in an urban area with respect to the generation of inundation for flood events with 20, 100 and 1000 - year return periods.



Fig.1 Location of the study area (part of the town of Smolyan, Bulgaria)

### METHODOLOGY

The simulations for the annual maximum water discharges with return periods - 20, 100, and 1000 years were performed. Detailed terrain data for mesh generation in the 2D model was provided by Drone. The computational mesh for terrain representation has a cell size of 2.5 / 2.5 m. The upstream boundary conditions were performed by synthetic hydrographs calculated using the Socolovsky method. For the downstream boundary condition, normal depth was assumed. Land use data and aerial photographs from Drone were analysed in order to get reasonable Manning's n values.

### RESULTS Comparison of HEC-RAS 1D and 2D model results

#### 1. Flooded area

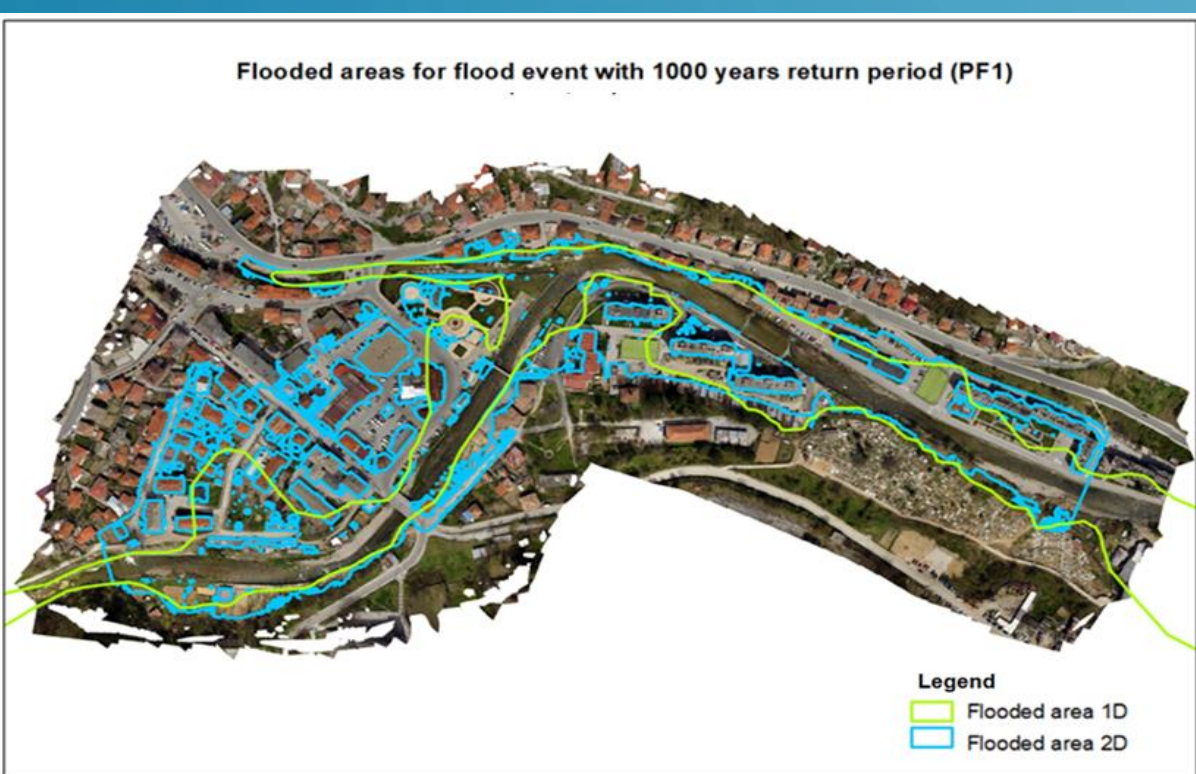


Fig.2 Flooded areas for flood event with 1000 years return period

#### 2. Water level

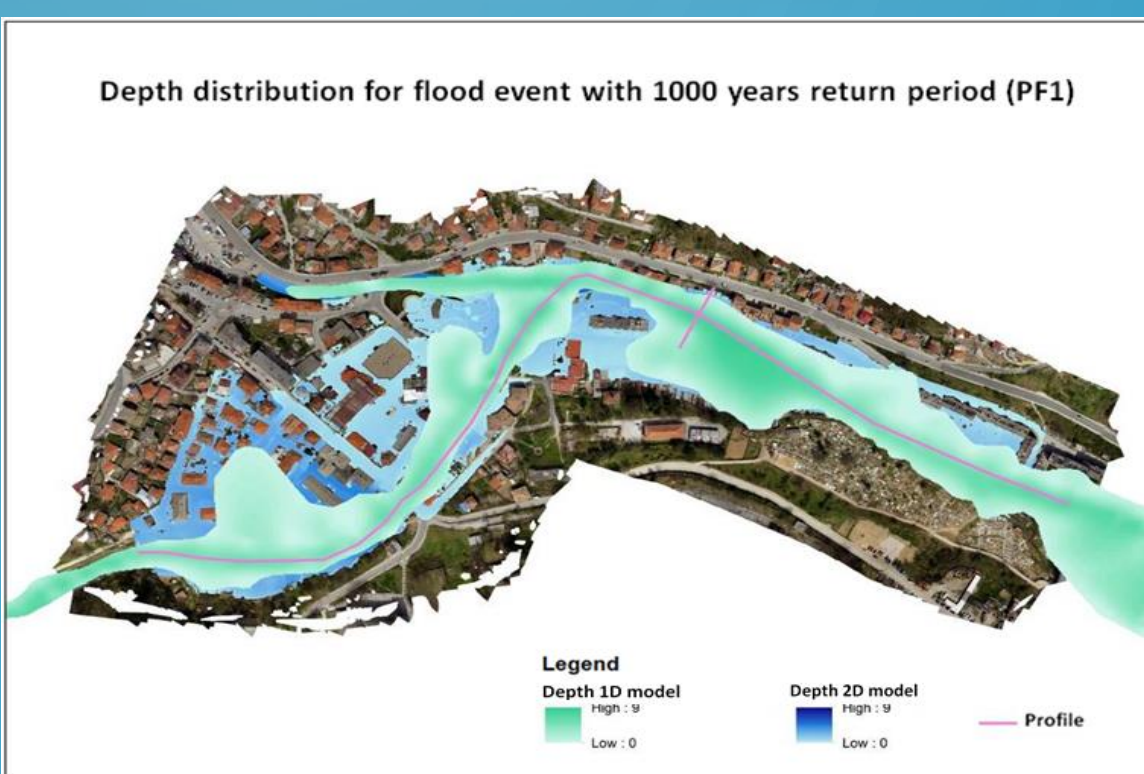


Fig. 3 Depths distribution for flood event with 1000 years return period

On Figure 4 is shown comparisons of the results of 1D and 2D models in cross-section and longitudinal profile. The differences in water levels in the longitudinal profile in the different scenarios are presented in Table 1.

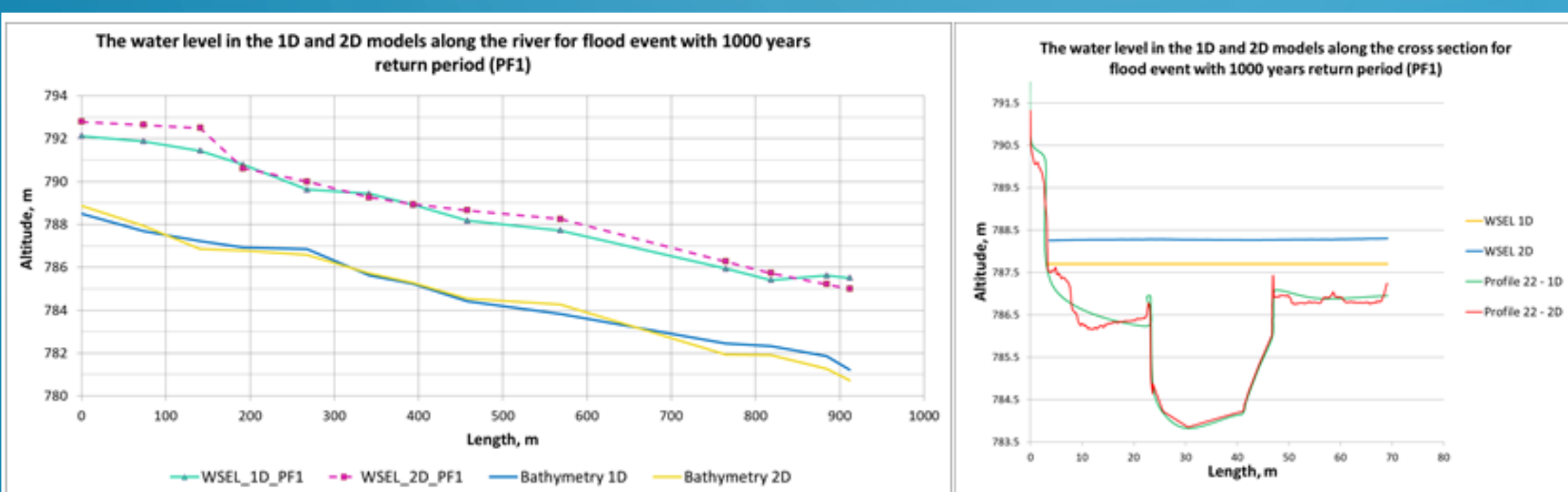


Fig. 4 Water level comparison 1D and 2D for flood event with 1000 years return period

Profile	WSEL 1D	WSEL 2D	Variation
32	792.13	792.789	0.659
31	791.88	792.641	0.761
30	791.44	792.498	1.058
28	790.78	790.608	-0.172
27	789.63	789.991	0.361
25	789.43	789.263	-0.167
24	788.92	788.935	0.015
23	788.18	788.653	0.473
22	787.723	788.25	0.527
21	785.94	786.268	0.328
20	785.41	785.723	0.313
19	785.62	785.213	-0.407
18	785.51	784.987	-0.523
Max variation			0.527

Tabl. 1 Differences in water levels

The results show that the differences vary from 1 cm to 67 cm and the larger differences are as a result of a more accurate description of the riverbed. An important difference in the results of the 1D and 2D modeling can be seen at the water level in the cross-sections. The result of the 1D model for a given cross-section has one value along the whole profile, while in the 2D model the result for the water level is different for each calculation point of the cross-section, the water level in a transverse profile is variable along its length.

### Conclusion

There is a similarity between the results of the two models in terms of the extent of the flooded areas. The 2D model takes into consideration variation in ground geometry because it computes all hydraulic properties at each mesh cell and computes the water surface elevation at each cell. While the 1D model just computes WSL at cross sections and between them uses the interpolation technique and does not take into consideration any changes in the characteristics of the river bed.