A sensitivity analysis using different spatial resolution terrain models and flood inundation models

George Papaioannou (1), Giuseppe T. Aronica (2), Athanasios Loukas (1), and Lampros Vasiliades (1)

(1) Department of Civil Engineering, University of Thessaly, Pedion Areos, 38334 Volos, Greece (gpapaioa@uth.gr), (2) Department of Civil Engineering, Computer Science, Building, Environmental Science, and Apllied Mathematics, University of Messina, Contrada Di Dio, 98166 Villaggio S. Agata - Messina, Italy

The impact of terrain spatial resolution and accuracy on the hydraulic flood modeling can pervade the water depth and the flood extent accuracy. Another significant factor that can affect the hydraulic flood modeling outputs is the selection of the hydrodynamic models (1D,2D,1D/2D). Human mortality, ravaged infrastructures and other damages can be derived by extreme flash flood events that can be prevailed in lowlands at suburban and urban areas. These incidents make the necessity of a detailed description of the terrain and the use of advanced hydraulic models essential for the accurate spatial distribution of the flooded areas. In this study, a sensitivity analysis undertaken using different spatial resolution of Digital Elevation Models (DEMs) and several hydraulic modeling approaches (1D, 2D, 1D/2D) including their effect on the results of river flow modeling and mapping of floodplain. Three digital terrain models (DTMs) were generated from the different elevation variation sources: Terrestrial Laser Scanning (TLS) point cloud data, classic land surveying and digitization of elevation contours from 1:5000 scale topographic maps. HEC-RAS and MIKE 11 are the 1-dimensional hydraulic models that are used. MLFP-2D (Aronica et al., 1998) and MIKE 21 are the 2-dimensional hydraulic models. The last case consist of the integration of MIKE 11/MIKE 21 where 1D-MIKE 11 and 2D-MIKE 21 hydraulic models are coupled through the MIKE FLOOD platform. The validation process of water depths and flood extent is achieved through historical flood records. Observed flood inundation areas in terms of simulated maximum water depth and flood extent were used for the validity of each application result. The methodology has been applied in the suburban section of Xerias river at Volos-Greece. Each dataset has been used to create a flood inundation map for different cross-section configurations using different hydraulic models. The comparison of resulting flood inundation maps indicates the sensitivity of floodplain modeling on spatial resolution of the DEMs accuracy and different hydraulic modeling approaches.