DRAIN Project: An Integrated Urban Drainage Model in QGIS with IBER-SWMM

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Introduction

Urban flooding has been a worldwide catastrophic disaster due to increased urbanization, reduced infiltration capacity and climate change. With exceptional higher intense rainfall occurring in short intervals of time, cities experience pluvial and flash floods. This has led to the deterioration of the drainage systems demanding a proper study of the behavior of the water in the drainage network combined with the stormwater runoff. A combined model of IBER and SWMM has been proposed to understand the Combined Sewer Overflows (CSO) in the network system. The DRAIN Project (Digital RAIN) is a research project which comprises of developing an integrated urban drainage model capable of modelling surface stormwater (2D) with hydraulic modeling through conduits and channels (1D). By combining the calculation methodology of IBER with SWMM, a tool has been structured to operate utilizing the advantages of both powerful tools on a GIS interface.

Methodology

A QGIS plugin for the 1D/2D modeling is available named "DRAIN", which creates a GeoPackage format spatial database when started. This database is designed to support both SWMM and IBER models while offering improved user experience. The GIS layers are linked via foreign keys to ensure reliable data management, supported by functions and triggers. For a 1D/2D simulation, input data includes SWMM elements such as junctions, spillways, outfalls and IBER-specific layers such as DEM, surface layer etc. which can be imported via an INP file and GIS techniques respectively. The plugin enables the user to seamlessly conduct simulations by integrating both IBER and SWMM based on the prepared GIS data and an automatically generated mesh. The mesh is developed using the Frontal-Delaunay algorithm incorporated in the plugin itself.

Results and discussion

The model results are presented into two sections: surface results and drainage network results. Users have the flexibility to customize the output and open them from both IBER and SWMM interface. This allows the user to consult the entire set of calculated results. The plugin allows the users to effectively visualize the hydraulic results (depth and velocity) with desired timestep and their corresponding maximum value as shown in figure below:

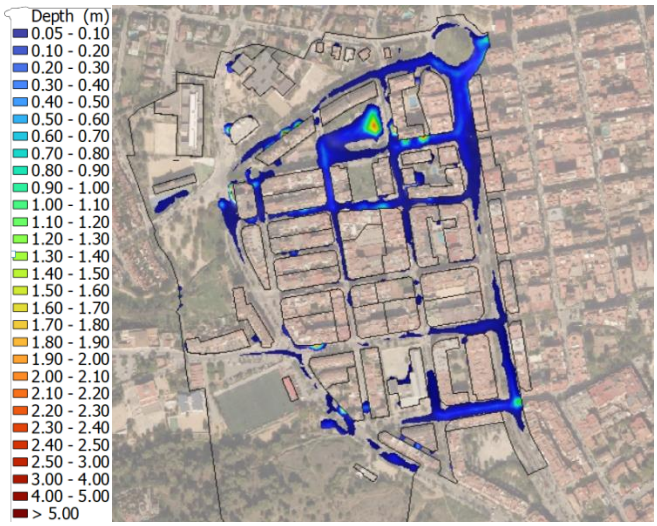

Figure 1 Maximum depth map corresponding to return period of T= 10 years.

Conclusion

This abstract outline the integration of the high-resolution dual drainage IBER-SWMM within the QGIS interface via an open-source plugin. This tools offers a comprehensive solution for modeling drainage water dynamics from both stormwater runoff and sewer network.

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