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Pluvial flooding and efficiency of urban drainage

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Flooding events in urban areas occur quite frequently as a consequence of rain events of lower intensity than the design one, even in case of correct network dimensioning. Inlets are in those cases the critical nodes, and efficient drainage is only ensured when care is taken on their appropriate design and positioning within the drainage area. The lack of maintenance and overloads in the hydraulic system conducing street waters into the pipe network are often responsible for drainage failures. Hence, evaluation of flood risk in urban areas is made even more difficult if one considers that pluvial flooding are normally more frequent than floods occurring from natural water bodies and they may involve even small portions of the urban zones.

This contribution is focused on the analysis of a drainage system by employing a mixed approach made of some deterministic and stochastic components. The deterministic part is obtained by using an hydraulic model for the simulation of flood wave propagation over surface urban drainage structures, i.e. streets and pathways. The model involves a hyperbolic two-dimensional solution of the De Saint Venant equations that is obtained over a finite element representation of the spatial domain with an unstructured triangular network. The stochastic component is intended as the efficiency function controlling the inlets operation at various stages of the drainage process. In particular, a stochastic generation of inlet efficiency scenarios with varying their position in the drainage network is performed.

This methodological approach is addressed in this paper by testing the drainage efficiency of a selected study area in the town of Genoa. At this aim, in October-December 2009, a survey was carried out in order to investigate the operational conditions of the inlets throughout the study area. Based on the observed conditions the frequency distribution functions of inlet efficiency are determined according to the different sub-areas with specific anthropogenic characteristics. The analysis has been carried out by using as input various inlet efficiency scenarios based on the observed conditions with varying their position in the drainage network. The simulations are performed by using two real events and synthetic hyetographs derived (for three different return periods, namely 2, 5 and 10 years) from an analysis of rain data collected at the raingauge station of Genoa University.