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Uncertainty analysis in urban flooding performance evaluation

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System performance quantification and the evaluation of the related quality of service is very complex due to the numerous different factors that may affect the system behaviour. Many definitions have been proposed to explain the concept of performance for an hydraulic system and many methodologies have been carried out in order to quantify performance in the most objective and general way (Hashimoto, 1982; La Loggia & Mazzola, 1989; Coelho, 1997). This aim is usually pursued by the definition of Performance Indicators (PIs) that have the task of synthetically represent the behaviour of the system. Specifically, in urban drainage, this kind of approach aims to analyse the systems performance identifying the most critical elements of a sewer system with respect to specific system variables such as, for instance, water levels, surcharge frequency, flooding volumes, etc. (Cardoso et al., 1999; Oliveri et al., 2004). For each PI a suitable penalty curve is defined in order to evaluate, for each element of the sewer network and for each system variable, the associated performance. The system performance is assimilated to the level of service, varying between a "void service" and an "optimum service" condition, and the curve is built in penalising the behaviour far from "optimum service" conditions. The performance of the whole system is calculated via global functions that extend the element-level performance rating across the network, so obtaining global network values. In the described procedure, however, some uncertainty arises due to both the user-defined shape of the penalty curves and the weights assigned to each network element in global function. Thus, performance analysis results are affected by operator experience. This statement has the major consequence of making performance analysis subjective and, consequently, only useful for comparison between different scenarios applied to the same system. Aim of the presented study is the statistical analysis of sewer system performance

with specific reference to urban flooding. The theoretical framework for the study has been given by the GLUE (Generalised Likelihood Uncertainty Estimation) methodology (Beven and Binley, 1992). In order to analyse the uncertainty due to subjective selection of penalty curves and weighting function, several of them have been used for the performance analysis of a complex urban drainage system. The analysis has been made on statistical basis, i.e. performing long term simulation and fitting performance values with probability distributions, obtaining frequency-performance relationships. The results of the analysis allowed for some considerations for improving the robustness of the PI method and for increasing the user confidence in the method results. The analysis has been applied to the real case study of the "Centro Storico" catchment in Palermo (Italy). The catchment is about 2.5 km2, with about 88% of impervious areas, mainly roofs and roads. The whole catchment has been divided into 262 subcatcments, and the model runs under the hypothesis that each subcatchment is connected to a single inlet manhole. Simulations have been carried out using statistical independent historical rainfall events (Lei and Schilling, 1996) recorded during 1994-2002 at the Palermo - Parco d'Orléans meteorological station located into the analysed area.

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