Proposal for improving discharge quantification in urban drainage

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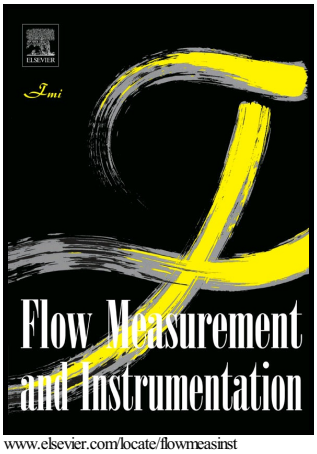

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Abstract:
The concepts of a permanent diagnosis and self-monitoring of sewer systems were introduced twenty years ago in France, and an increasing number of discharge measurement devices are being implemented in sewer networks. Selecting the locations for these devices is often difficult, since the efficiency of available sensors is heavily dependent on hydraulic conditions. In this paper, we propose considering the discharge transiting in a given geometric configuration for given hydraulic conditions as a reference. Three-dimensional modelling of the velocity field allows simulating the response of sensors in order to asses the associated errors and therefore reduce (or optimize?) the number of sensors with numerical calibration.
First the paper presents two technologies commonly used for discharge measurements in sewers. Then we explain the three-dimensional modelling. Finally the effect of a bend on the flow discharge measured is presented and discussed.

Keywords: discharge; uncertainties; CFD; flowmeters; sewer network

Introduction

With more than 90 % of the national population living in urban areas (INSEE, 2011), the anthropisation of the urban water cycle is prevalent in France. According to the data provided by IFEN (French Environment Institute) in 2004, 24.8 million flats and houses in France were connected to sewer systems whose total length was over 280,000 km. At the same time, it is known that pollutant loads discharged from urban water systems during a storm significantly contribute to water quality degradation (Mendiluce, 1972, Gromaire *et al.*, 2001 ; Chebbo and Gromaire, 2004 ; Mallin et al, 2007 ; Munoz et al, 2008 ; Reopanichkul et al, 2010; Gil et al, 2011). These figures reveal the economic significance of sewage operations and how managing sewer systems is a challenge. Without adequate management of those systems, the WFD (European Water Framework Directive) objective of achieving a healthy ecological status of water bodies may not be reached. To improve the operation of urban sewer systems, it is thus necessary to increase knowledge of their functioning, and in situ measurements will be carried out in order to evaluate, and then improve, the real functioning of these systems. Measurement networks are a vital tool for monitoring and operating with an increased interest in the case of continuous on line measurements.

The concept of permanent diagnosis and self-monitoring of sewer systems was introduced twenty years ago by the bylaw issued on 22 December 1994 by the French Ministry for Ecology, Sustainable Development and Energy. The bylaw issued on 22 June 2007 required that the discharges be measured at a characteristic point of the network. For managers and practitioners, general recommendations for preselecting these measurement points by taking into account various constraints can be found in the literature (Bertrand-Krajewski et al., 2000), (Joannis, 2001). However, many questions remain (Leclerc et Battaglia, 2001). A sewer system is a network of pipes running through an urbanized area designed to create a gravity flow from far upstream in the network to downstream at the treatment plant entrance. Moreover, a sewer network is a succession of singularities (e.g. junctions, drops and bends), so avoiding the effects of singularities is a nearly impossible task. The purpose of the present paper is to concentrate on the hydraulic conditions and more specifically the influence of singularities on flow rates measurements when measurement sites