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Critical rainfall events for runoff pollution

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Abstract

Recent studies show that, in many climatic regions of the world, most of the pollutant mass discharged in receiving bodies by combined sewer overflows during a year are very often concentrated within a few dozen days, due especially to short and heavy rainfalls [Paoletti and Sanfilippo, 2004]. Therefore it looks very interesting to evaluate how the build-up and wash-off processes on the catchment surfaces influence runoff water quality.

The paper presents the concept of critical events from the point of view of runoff pollution, in terms of both concentration and mass flow in the runoff waters from the catchment surfaces in wet weather.

To this aim, the well-known SWMM models for build-up and wash-off are applied as modelling tool, considering the standard ranges for their parameters [Alley, 1981; Alley and Smith, 1981; Huber, 1986; Huber e Dickinson, 1988].

Long term simulations of two rainfall series, from two different climates (21 years for Milan in Italy and 33 year for Odense in Denmark, both with 5 minutes of timestep), reveal that while the pollutant mass on the catchment surface approaches to saturation after 5-30 days, rainfall intensities of just 5-10 mm/hours can cause the wash-off of most of this pollutant mass within 15-30 minutes.

In addition, some specific curves are drawn to represent the envelope of the resulting ratio between maximum mass flow and initial mass, that is the mass at event start.

So, it comes out that such critical events are quite frequent in a normal rainfall regime, with a return period of just few months or sometimes of even few weeks. Consequently, it is also possible to define specific synthetic events, suitable for testing the

effectiveness of feasible structural and non structural measures in practical problems.

Besides, the influence of the different characteristics of the two rainfall series of Milan and Odense on wash-off processes is analyzed. It turns out that the total mass washed off per year in Milan is almost twice the one in Odense, mainly because of the much higher values of the mean rainfall intensities, normally following dry weather periods of inter event time that are not very different (5.4 days for Milan and 7.5 days for Odense).

A further step of analysis consists in evaluating the reduction of the pollution loads due to a weekly cleaning of the catchment surfaces. The simulations show that with a reduction of 50% per each cleaning, the reduction is just about 15% for Milano and about 20% for Odense.

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