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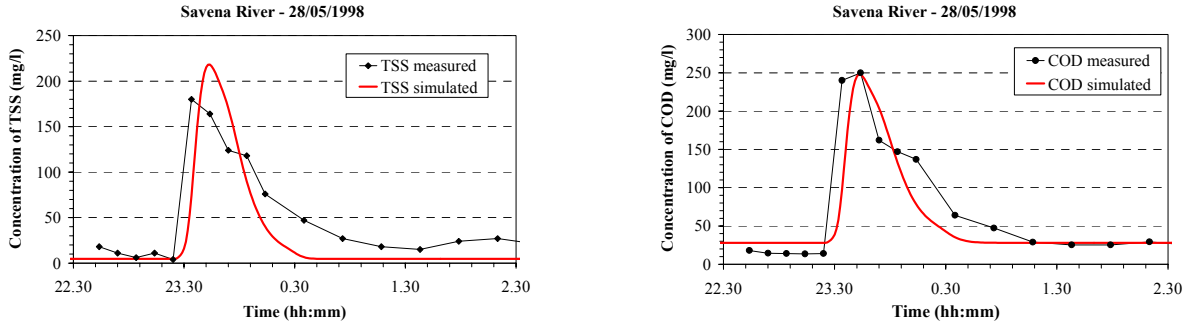
This work describes a mathematical model for the integrated simulation of the urban drainage system and the receiving water body during rainfall events.
The developed model, UPSIM (Maglionico, 1998), is a simplified conceptual model that schematised the sewer networks in several sub-catchments and the river in several stretch, each one simulated with linear canals and reservoirs.
For the sewer network, starting from the data recorded by the rain gauges, the model evaluates the net rainfall considering the hydrological losses on the catchment; the flow entering in the network through the gully pots is evaluated considering the catchment as a linear reservoir. The network is assumed to be another linear reservoir and therefore the total outflow is evaluated.
The quality module, starting from the antecedent dry weather period of each event, evaluates the pollutant mass stored on the catchment, the wash off and the transport into the network by the rainfall event.
The outputs of the sewer model are flow and concentrations in the outflow of every single overflow. These data are the input of the river model.
The model has been calibrated on an experimental catchment in Bologna (Italy) (Artina et al., 1999) where have been collected quantity and quality data on the sewer network (a part, of about 450 ha, of the sewer network of Bologna) and in the receiving body (Savena River) during rainfall periods. For pollutants propagation into the river has been adopted a reservoir scheme where the peak reduction of the wave occurs in a reservoir, characterised by a constant k (which is function of the stretch length and the water velocity). On the basis of the collected data during the Time of Travel survey in the Savena River (Artina et al., 1999) the following equation was proposed: $k = 4.2 \cdot \sqrt{L/U}$ where k is expressed in seconds, L is the length of the schematised stretch in metres, and U is the average velocity of the flow in *m/s* in the schematised stretch.



Comparison between simulated and measured TSS and COD in the Savena river (about 300 meters downstream the overflow) on May 28th, 1998.

It has been shown that a simplified model of the river is sufficient to evaluate the effect of discharge spilled from overflows of the sewer network during rainfall period into the receiving water bodies. Particularly considering the fact that the phenomenon is of limited duration and that therefore the deterioration or chemical reaction of the substance are negligible.
However, it has also been shown that to define the hydraulic characteristics of the river, and to correctly calibrate the model, a knowledge of the travel time is necessary.
It is important to remark that the only way to establish criteria for improving the water quality conditions of the river (for example according to the UPM criteria) and to study engineering solutions would be to set-up an integrated simulation of the whole system: sewer network and receiving water body and that a simplified model (with a reduced number of parameters and more quickly respect a detailed physical based model) can be very useful to assessment different scenarios.

References

Artina S., G. Bardasi, F. Borea, C. Franco, M. Maglionico, A. Paoletti, U. Sanfilippo, Water quality modelling in ephemeral streams receiving urban overflows. The pilot study in Bologna. *Proc. 8th ICUD*, Sydney, 1999.
Maglionico M. Indagine sperimentale e simulazione numerica degli aspetti qualitativi dei deflussi nelle reti di drenaggio urbano, *Ph.D. Thesis, Università di Bologna*, In Italian, 1998.