

# IMPROVED DISTRIBUTED RUNOFF MODELLING OF URBANISED CATCHMENTS BY INTEGRATION OF MULTI-RESOLUTION REMOTE SENSING

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## ABSTRACT

In urban catchments, surface runoff is the most important process determining the water quantity and quality. The runoff amount and intensity on catchment scale is strongly related to the impervious area cover, which is the predominant cover type in urbanized area. One of the main problems in urban hydrology is uncertainty in the degree of imperviousness. Moreover, the spatial distribution of the impervious surfaces seems to be important. This can only be taken effectively into account when a fully-distributed hydrological model is used. In this paper we investigate the assessment of imperviousness by a multi-resolution remote sensing technique and the consequences that this imperviousness estimation has on the uncertainty in peak discharges as determined by hydrological modeling. The GIS based distributed WetSpa model, which simulates peak discharges, hydrographs and the spatial distribution of runoff, infiltration and evapotranspiration with an hourly time step, was used for studying the influence of different imperviousness scenarios on runoff generation in the upper catchment of the Woluwe River. This catchment is part of the Scheldt River basin and is located in the south-eastern part of the Brussels agglomeration.

A multi-resolution approach is applied for mapping surface imperviousness in urbanized areas. The approach consists of two steps. In the first, a detailed land-cover map was produced from a high resolution (HR) Ikonos image that covers part of the Brussels metropolitan area. The output of the classification was improved with post-classification techniques. In the second step this enhanced HR classification of a relatively small area was then used to train a neural network based sub-pixel classification model that estimates impervious surface cover proportions within the pixels of a medium-resolution (MR) Landsat ETM+ image that covers the entire agglomeration of Brussels.

Based on both the HR and the MR map, runoff coefficient grid maps were calculated and used as input to a WetSpa rainfall-runoff model. Three alternative land-cover scenarios were tested: one in which a single impervious surface coefficient was defined for all urban classes, a second in which separate

coefficients were derived for different types of urban morphology and finally, a spatially fully distributed scenario was applied where each cell in the simulation model was assigned its own coefficient based on the HR and MR maps of imperviousness.

The study points to some interesting conclusions: it shows that estimates of imperviousness derived from satellite data may strongly differ from those made by experts for some urban classes, that the use of spatially distributed land-cover information obtained from satellite derived maps produces higher peak discharges, and little difference was observed between results obtained with detailed impervious surface maps derived from HR data and sub-pixel estimates derived from MR data. This proves that multi-resolution methods, which provide information on surface imperviousness for areas of large extent at relatively low cost, may be an interesting alternative for expensive HR mapping for rainfall-runoff modeling at catchment level. It is also concluded that the spatial distribution of impervious surfaces is very important, which shows the necessity of application of fully-distributed grid-based hydrological models for urban runoff simulation.