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Application of distributed GIS-based modeling for studying surface runoff processes in urban wetland

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The Woluwe is a small river of 15 km length that drains an area of 9400 hectares in the Belgian part of the Scheldt basin. It is a typical lowland river with only 30 m altitude difference, 1-3 m wide and 5-50 cm deep. The central part of the Woluwe River flows partially through several park and pond systems of the Brussels agglomeration. The Woluwe catchment contains of sources of drinking water in the Sonian Forest, wetlands in seepage zones and 21 ponds with different functions (hydrological system, fish-stock, recreational fishing, boat recreation, ornamental parks, forest ponds, wetland and nature value). In urban catchments the surface runoff is one of most important processes, which determines the water quantity and quality. Given that, an analysis of potential differences in the runoff generation, influenced by landuse changes in catchment could provide information on the potential future hydrological state of the urban wetlands. Similarly, an evaluation of the runoff partitions from different land use with special emphasis on impervious areas could show the possible source of water pollution in urban wetlands.

A modeling approach supported by remote sensed and field observed data was used for studying this relationship in the Woluwe catchment. Remote sensed data, including CASI-ATM sensor hyperspectral imagery provide a detailed view of the heterogeneous character of this urban valley. Biological monitoring of the river and ponds system provides detailed information on the quality status of the hydrological network. Groundwater modeling with MODFLOW shows locations of shallow groundwater conditions and seepage zones in the valley and at pond locations. Surface hydrological modeling was performed with the raster based WetSpa (Water and Energy Transfer between Soil, Plant and Atmosphere) model (Wang et al., 1996; De Smedt et al., 2000; Liu et al., 2002). WetSpa is especially suitable for flood prediction on hourly time scale. The model conceptualizes a basin hydrological system being composed of atmosphere, canopy, root zone, transmission zone, and saturation zone layers. The watershed is discretized into a number of grid cells, for which the water and energy balance are maintained. The cell is viewed as a hydrological homogeneous unit, which has the same elevation, same type of land cover and vegetation. The hydrological processes and the water budget computations are carried out for each cell. A mixture of physical and empirical relationships is used to describe the hydrological processes in the model. The model predicts flow hydrographs, which can be defined for any numbers and locations in the channel network, and can simulate the spatial distribution of catchment hydrological characteristics. Simulations for the Woluwe catchment for the period of

1980-1993 for an hourly time step and spatial resolution of 50 m grid cell were performed. Results show good agreement with the measured hydrograph at the basin outlet. Measurement and modeling approaches contribute to a further understanding of these complex urban wetlands and will help in analyzing threats and chances for sustaining this environment.