



The response of runoff generation to urban development: modelling and understanding

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The urbanisation process strongly changes natural catchment by increasing the impervious coverage and by creating a need for efficient drainage systems, resulting in a significant change of catchment hydrology from extreme floods to low flows. Thus, it is becoming important to quantify the impacts of urbanisation on runoff generation and to investigate the possibility of restoring pre-development flows in urban catchments for integrated urban stormwater management. Urban hydrological modelling emphasising on urbanisation effects has received substantial attention. However, the lack of good quality monitoring data in a same developing catchment limits model calibration for many of previous studies.

In this concern, this study aims to describe and better understand the effects of urbanisation on catchment hydrology through modelling of a series of scenarios in a developing urban catchment of Saunalahdenranta (SR). The catchment is located at Espoo, southern Finland and has an area of about 13.2 ha. The catchment was developed rapidly from a rural area to a residential area during 2001-2006. Hydrological data were measured in two minutes intervals during the development period, when the imperviousness of the catchment changed from 1.5% to 37%. Precipitation-runoff relationship is simulated using the Stormwater Management Model (SWMM) that is firstly parameterised, calibrated, and validated for the scenario of highly developed residential catchment in 2006. The hydrological impacts of spatial resolution and model parameters, such as the delineation of subcatchment, flow width as well as Manning's roughness are evaluated and discussed. The calibrated model is then used to investigate, how the hydrological response to urbanisation was changing in the scenarios for the previous years (2001-2005) with different levels of urban development (represented by impervious surfaces). The predictions for the several scenarios provide a quantification of the hydrological impacts of urban development. The peak value of runoff rate is increased but with a small temporal occurrence. The key phases of the construction activities from the point of view of their impacts on runoff generation are identified. Based on the modelling outputs, the mitigation against the adverse impacts will also be preliminary explored.