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Integration of a timeseries of remote sensing derived sub-pixel impervious maps into hydrological rainfall-runoff modelling

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Hydrological models are indispensable to describe and study hydrological conditions in catchments. In case of fully distributed hydrological models there is a need for spatially distributed input data, which is often difficult and/or expensive to collect. Remote sensing potentially offers a relatively easy and cheap way of collecting spatially distributed information of the earth surface. Within the framework of the MAMUD project (Measuring and Modelling Urban Dynamics) one of the aims is to integrate remote sensing data into the hydrological modelling process. The fully distributed, grid based, rainfall-runoff model WetSpa is used and adapted for flexible input from remote sensing derived model parameters. The adapted model is applied on the River Tolka, an urban catchment, located in the greater Dublin area (Ireland).

In strongly urbanised catchments the imperviousness of some land-cover types is of large influence on the amount and intensity of the surface runoff. Rather than using static land use maps, with subjectively defined average imperviousness for each class, direct measures of imperviousness are integrated into the WetSpa model. Proportions of imperviousness are estimated by means of a sub-pixel classification technique: using a high-resolution Quickbird image a timeseries of 4 sub-pixel imperviousness maps is derived from Landsat imagery (1988, 1994, 1997 and 2001). This time-series is integrated into the rainfall-runoff modelling for the period 1985-2005. The modelling results are compared to the original results, i.e. simulation using static land use classes. The simulation with sub-pixel imperviousness yields a considerable difference in peak discharges, confirming its status as key factor in describing the hydrological dynamics in urban catchments.

Next to the integration of sub-pixel imperviousness maps it is shown that further integration of remote sensing information, such as vegetation index based parameterization and evapotranspiration estimates, will result in a more accurate estimation of the runoff.

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