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Balancing water and solute fluxes in unsaturated zones in urban areas

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Unsaturated zones in urban areas play a key element of the urban water cycle. They deliver groundwater recharge from several kinds of infiltration sources on the ground surface and in the subsurface. The major sources of infiltration in urban areas are infiltration of precipitation from permeable surface areas, rain water infiltration from rain water infiltration ponds, flood water infiltration from flood plain areas during flood events, waste water infiltration from septic tanks and leaks in the water supply pipe system as well as the sewer system. Associated with these water fluxes are different kinds of solute and partly colloid transport often in form of contamination loads.

The contaminant sources are manifold as well. Major pollution sources of importance are contaminated flood water infiltrating in flood plain areas, contaminated rain water runoff collected in ditches or rain water infiltration ponds, e.g. from roads, and waste water infiltrating directly from the users, mainly in developing countries, or from leaking sewers, mainly in industrialized countries. The quantification of these infiltration processes in urban areas is a large challenge due to the large variability in sediment hydraulic parameters, temporal variation of infiltration and contaminant behaviour. It is impossible to set-up a complex three-dimensional flow and transport model on the regional urban scale for such processes.

Therefore, within the EU-funded Joint Project AISUWRS (http://www.urbanwater.de) a methodology has been developed to simplify the process descriptions in an appropriate way, by representing the important quantities and their dependencies. All infiltration sources were considered separately. Further, they were classified by the hydraulic sediment properties and the infiltration conditions. Bayesian approaches have been used to obtain reliable parameter probability functions covering the parameter uncertainties by combining measured parameter values with literature data. Simpli-

fied transport modelling approaches based on analytical solutions has been developed to conduct Monte Carlo simulations to obtain probabilistic water and contaminant fluxes. GIS application enabled the management of spatial parameter distributions and regionalization of soil properties by classifying hydraulic properties as polygon attributes. So far, these approaches have been applied on urban scale for the infiltration from precipitation in neighbourhood structures and for infiltration from flood plains during flood events.