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Pollutant transport uncertainty in pluvial flood surface water of urban catchments

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In case of heavy pluvial rain events in urban areas the available drainage system could be insufficient at peak flows (Sunkpho, 2011). Consequently, rainwater in the pipe network is likely to spill out through manholes, causing inundation. The presence of hazardous contaminants in the pipe drainage system, for example due to an accident with dangerous substances, represents a potential risk to humans especially when the contaminated drainage water reaches the surface. For the prediction of transport paths and risk mitigation, a real-time forecasting model of contaminants in the drainage system is required, which needs small computation cost for quick calculation and sufficient warning time. A particle based pollutant transport model based on precalculated velocity fields in an urban catchment can be used to forecast transport paths and contamination area of a single point source pollution. As the velocity field on the surface and in the pipe system is very dynamic in such scenarios, the riskmaps are sensitive to time and location of the spill event (Sämann, 2018). With an ensemble of velocity fields, chosen with a nearest neighbor criteria of the rainfall characteristics, the pollution affected area can be approximated if the real velocity field has not yet been calculated during the forecast process.

In this study, the influence of pollution spreading to time and space variability of single spill injection on a dynamic flow field is presented. A particle-based random walk method is used to calculate transport paths and spatial distribution of contaminants within a pipe network and on the surface of an urban catchment. The HYSTEM-EXTRAN (itwh, 2015) model is used to provide precalculated dynamic velocity fields. A variation of the dynamic velocity field has an impact on the pollutant spreading. Uncertainty of time, location and duration of a pollutant spill event needs to be compensated by using an ensemble of transport model runs. Prediction times are in the range of a few minutes. The model is used in an early warning system for real-time flood forecast and induced water contamination in urban areas (https://www.pluvialfloods.uni-hannover.de/pluvialfloods.html?&no_cache=1&L=1).

Literature

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