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Modelling and managing runoff processes in urban and peri-urban watersheds

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This communication presents a physically based and spatially distributed numerical model that simulates the quantity of runoff and the quantity of rainwater infiltrated into unsaturated soil layers from any temporally-spatially varied rainfall event at any point of the peri-urban watersheds.

Our numerical model simulates water flow in the entire land based phase of the hydrological cycle from rainfall to river flow, via various flow processes such as, overland flow, infiltration into different unsaturated soil layers, evapotranspiration from vegetation, groundwater flow and drainage into pipes via road gulley. Fully dynamic exchange of water between all major hydrological components is included in the model (e.g. surface water, soil water and groundwater).

It is a fully distributed numerical model. The spatial and temporal variation of meteorological, hydrological, geological and hydrogeological data across the model area is described in gridded form for the input as well as the output from the model. Moreover, to evaluate the necessary precipitation inputs for given durations and a given return period to our model, we use a multifractal frequency analysis. This method has the advantage to rely on a few robust exponents that are physically meaningful and can be evaluated on discontinuous and/or low frequency samples. Thus, the study peri-urban watershed will be represented in more detail than the traditional lumped approach where hydrologic parameters are averaged over the urban subbasin.

Using GIS, we visualise the resulting runoff processes together with the evolution of water table levels and the water quantity entering the sewer system via road gulley for the two case studies: a county contiguous to Paris (France) and in the Panola Area (USA).