High resolution modelling of urban catchments

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High heterogeneity of urban catchments requires to represent the variability of precipitation over the large range of involved space-time scales; that is neither provided by raingauge networks, nor the classical 1km2 radar products. An effort has been made in recent years to develop and integrate high-resolution weather radars into urban areas, and in parallel to adapt hydrological models to better simulate the heterogeneity of urban environments and the high variability of rainfall.

The case study used in this paper is a 2.15km2 urban catchment, located at the southeast of Paris region. The local authority in charge of the pluvial water management uses up to now C band radar data (1km2, 5min) for forecasting purposes and a semi-distributed hydrological model for modelling needs. A new dual polarization X band high-resolution (1ha, 2.5 min) radar has been installed in the Paris region in the framework of INTERREG RainGain project and work has been initiated to adapt hydrological models to this high resolution data and also to investigate how the detailed information can be used to improve urban water management. In this work we propose to perform high resolution modeling for urban catchment using a distributed model, the aim is to study the sensitivity of the hydrological response to both rainfall and model resolution.

The model used is Multi-Hydro, which is a fully distributed and physically based model developed at the Ecole des Ponts ParisTech. It is an interacting core between open source software packages, each of them representing a portion of the water cycle in urban environment, the spatial resolution up to 1m is chosen by the user and it is easily changeable. 10 X band high-resolution rainfall events are used, the data was spatially aggregated 6 times to 1km2 resolution and temporally 3 times to 10min. For each event, 28 spatio-temporal combinations were then simulated using MultiHydro model at different resolutions (10m, 5m and 2m).

First results shows that MultiHydro has a high sensitivity to the change in rainfall measurement scale, which increases further when increasing the model resolution. The study pointed also to the fact that high-resolution modeling is still a big challenge, and efforts have to be made to deal with the high computation times (from 30min at 10m to 24h at 2m to simulate 8h event).