Impacts of small scale rainfall variability in urban areas: a case study with 2D/1D hydrological models in a multifractal framework

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ABSTRACT

In this paper the sensitivity to small scale unmeasured rainfall variability (i.e. scales smaller than 1km in space and 5 min in time, which are usually available with C-band radars) of a 2D/1D model with a 10 m resolution and a semi-distributed 1D model of the same 1.47 km^2 urban area is analyzed. The 2D/1D model is the open source numerical platform Multi-Hydro, which couples (open source) distributed models of involved hydrological/hydraulic processes and is currently being developed at Ecole des Ponts ParisTech. The methodology implemented to evaluate the uncertainties consists in generating an ensemble of realistic rainfall fields downscaled to a resolution of 12.3 m in space and 18.75 s in time with the help of a stochastic universal multifractal model. The corresponding ensemble of hydrographs is then simulated. It appears that the uncertainty is significant (for example the upper tail of the probability distribution of the peak flow distribution exhibits a power-law distribution) and that Multi-Hydro unveils much more uncertainty than the simpler 1D model. This points out a need to develop high resolution distributed modelling in urban areas.

KEYWORDS

Rainfall variability, 2D/1D modelling, multifractals, space-time downscaling