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Sensitivity of urban storm models to rainfall spatio-temporal variability investigated using two different modelling approaches

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Nowadays, there is a growing interest on small-scale rainfall information, provided by weather radars, to be used in urban water management and decision-making. In parallel there is a growing interest devoted to the development of hydrological models following notably the increase of computation capabilities and the availability of high-resolution GIS information needed for such model's implementation. However, various scientific questions do exist about the real need for high resolution rainfall data for modeling applications, and improvements that should be implemented on urban storm models in order to increase their ability to integrate the detailed knowledge about the rainfall structure.

The purpose of this work is to investigate the real needs for small scale rainfall information for modeling applications. Several modeling investigations were conducted to analyze the sensitivity of urban storm models to rainfall variability and to quantify the gain in terms of performance related to the knowledge of the small-scale rainfall structures. Most of these former researches, remain inconclusive about the advantage of such detailed rainfall information for modeling applications. Furthermore, most of these works involve only conceptually based models, originally designed for input of a uniform rainfall over sub-catchment or even catchment scales. In this paper investigations are performed using two hydrological models involving two different modeling approaches: the first model is Multi-Hydro which is a fully distributed and physically based model developed at Ecole des Ponts ParisTech, the second one is CANOE which is semi-distributed and conceptual based. Both models were implemented at different resolutions to assess the effect of scale on their ability to take into account small scale rainfall variability. High resolution rainfall data (250 m pixel size, 3.41 min) used in this work is coming from the ENPC X-band radar installed at Ecole des Ponts ParisTech in Paris region.

Results coming out from this work demonstrate how difficult is to evaluate hydrological models' needs in terms of rainfall resolution, but it highlights the fact that both hydrological models exhibit a sensitivity to small scale rainfall variability. Their sensitivity depends on the modeling approach involved, on their spatial resolution and on the characteristics of storm events. The fully-distributed model seems to be more sensitive to the spatio-temporal variability of rainfall observed below the 1 km radar grid. However, the improvement of semi-distributed model resolution by considering smaller sub-catchments increases the model ability to integrate the small-scale rainfall variability. It highlights the need to have a model resolution tailored to the available rainfall data.