Geophysical Research Abstracts
Vol. 13, EGU2011-804, 2011
EGU General Assembly 2011

Quantifying the uncertainty on urban runoff associated to unmeasured small-scale rainfall variability: a comparison of two cases study

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In large urban areas such as the Paris and London one, storm water management is a challenge. Indeed because there is a significant proportion of impervious surface on large areas, great amounts of effective rainfall need to be handled. In this study, we use multifractal characterization of rainfall to quantify the uncertainty on sewer discharge forecasts associated to unmeasured small scale rainfall variability, i.e at a higher resolution than 1 km * 1 km * 5 min which is usually available with C-band radar networks.
Two urban areas are used as cases study and compared: a catchment in the county of Seine-Saint-Denis in the North of Paris, and the Cranbrook catchment in the North of London. Several types of rainfall events (frontal or convective) are analysed. Concerning the rainfall data, Nimrod mosaics of the Met Office is used for the London catchment. For Paris' we use the data from the C-band radar of Trappes, located in the East of Paris.
First an ensemble of realistic rainfall fields downscaled to a higher resolution is generated with the help of multifractal space-time cascades. The characteristic exponents used are the one estimated on the radar data. Second the corresponding ensemble of hydrographs is simulated by inputting each rainfall realization into a semi-distributed urban hydrological model. It appears that the uncertainty on the simulated peak flow is significant, reaching 40% for some rainfall events. Moreover the probability distribution of the extremes of both the rainfall and the peak flow exhibit a power-law falloff, indicting a high dispersion of the results. These results found on two independent models suggest that rainfall extremes play a key role in conditioning discharge extremes. The relationship between the characteristic exponents is discussed. In conclusion, we highlight the need to develop the use X-band radars in urban areas. Indeed such radars provide higher resolution data that would enable a better management of storm water.

The results were obtained within the framework of the project GARP-3C (program R2DS, région Iles-de-France), and as part of the Flood Risk Management Research Consortium (FRMRC2, SWP3).