



## Scientific challenges for enhancing urban pluvial flood resilience

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Historically, flood risk management in Europe and around the world has mainly focused on fluvial and coastal flooding; however, recent events have revealed the imminent risk imposed by urban pluvial flooding (also known as surface water flooding) and therefore the need for improved management of flooding from all sources. According to the UK Government's Independent Review into the Summer 2007 Flood Events, about two thirds of flood damage in urban areas was caused by surface water flooding, a type of flooding for which no models, forecasts or warnings existed. Similar events have occurred around the world in recent years and the associated damage has been enormous. In addition, the extent, magnitude and frequency of urban pluvial flooding are likely to increase in the near future, given the increasing effects of climate change, the increased urbanisation and population growth. Following these events and facts, significant attention has been given to urban pluvial flooding in the last few years and major efforts have been made to effectively model, forecast and manage this type of flooding. Nevertheless, there are still significant scientific challenges which need to be addressed in order to properly deal with urban pluvial flooding and enhance the resilience to it. Most of these challenges are associated with the complexity of urban areas and with the small temporal and spatial scales at which urban pluvial flooding takes place (it happens quickly and is localised), which make it significantly different from other types of flooding (e.g. fluvial and coastal flooding).

Some of the main challenges to be addressed are the following:

- Need for high spatial and temporal resolution rainfall estimates and forecast: the rainfall events which generate pluvial flooding are often associated with thunderstorms of small spatial scale ( $\sim 10$  km), whose magnitude and spatial distribution are difficult to monitor and predict.
- Need for improved hydrological and hydraulic models: to accurately model urban pluvial flooding, it is necessary to realistically represent the urban fabric and all the phenomena that take place when this type of flooding occurs, especially the interaction between the sewer system and the urban surface. Physically based dual-drainage models have developed quickly in the last few years; however, there are still significant uncertainties in the existing models and a number of questions to be answered regarding their suitability for off-line as well as for real time applications.
- Need for urban pluvial flood records, which enable calibration and verification of models.
- Need for operational short-term urban pluvial flood forecasting systems and improved flood emergency management.
- Need for improved (water sensitive) urban planning.
- Need for participatory approaches and improved engagement of stakeholders in flood risk management.

As can be seen, there are many challenges of different nature which need to be addressed in order to enhance the resilience to urban pluvial flooding. An integrated, applied and multi disciplinary approach is required if this type of flooding is to be dealt with effectively and efficiently.