Innovative, multi-disciplinary sensing of rainfall and flood response in urban environments

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Abstract

On 28 July, a cloudburst hit Amsterdam, pouring 90 mm of rainfall over the city with intense rainfall peaks of up to 150 mm/h (Amsterdam Rainproof, 2014). Sewer and drainage systems were unable to cope with this amount of water and flooding occurred at many locations. This example illustrates the disruptive effects that intense storms can have on urban societies, the economy and infrastructure.

Extreme rainfall is expected to occur more often in the future as a result of climate change. To be able to react to this, urban water managers need to accurately know vulnerable spots in the city, as well as the potential impact to society. Currently, detailed information about rainfall intensities in cities, and effects of intense storm events on urban societies is lacking. Collection of these detailed data would require the installation of a highly granular network of weather stations, making preparation of cities around the globe for extreme weather costly. Moreover, as demonstrated by Sips et al. (2013), the costs associated with sensing infrastructure may cause abandoning the implementation thereof.

In this study, we will present first results of an “Urban Weather Sensing Lab” that is created in the city of Amsterdam to provide high resolution, real-time, directly accessible information on rainfall and urban water/drainage system conditions. In this Lab, innovative sensing techniques will be utilised, based on routinely collected data and existing infrastructure, including rainfall estimation from microwave links (Overeem et al., 2011), low-cost acoustic rainfall sensors and low-cost sensors in the drainage system. These will be combined with Social Sensing; information provided by citizens in an active way through smartphone apps and in a passive way by information retrieval from social media posts (Twitter, Flickr etc.) (Gaitan et al., 2014). Sensor information will be integrated, visualised and made accessible to citizens to help raise citizen awareness of urban water management challenges and promote resilience by providing information on how citizens can contribute in addressing these. Moreover, citizens and businesses can benefit from reliable weather information in planning their social and commercial activities.

In an initial deployment in the city of Amsterdam, we aim to derive 2 main results: (1) results from social sensing experiments using a prototype smartphone app; (2) results from high resolution hydrodynamic modelling fuelled by the input from Innovative sensing.

Citizens will be actively involved in collecting rainfall and other weather information using a smartphone app (figure 1). The smartphone app can be used to collect weather information through opportunistic as well through participatory or request-driven social sensing. Experiments will be conducted in Amsterdam, where citizens will first autonomously use the app to collect data. In a next step, users will be requested by the app to measure the weather at a certain moment. This will eventually allow water managers and emergency services to collect information from critical locations where information is lacking, in real-time. Results of the first app experiments, to be conducted in summer 2015, will be presented.
Fig 1: Interface of Social Weather smartphone app, used to collect data on rainfall and other weather-related parameters

High resolution data collected will be entered into 3Di, a new versatile water management instrument capable of detailed, extremely fast hydraulic computations (www.3Di.nu). The collected high density datasets will for the first time enable testing of the high resolution capabilities of the modelling software and validate outcomes of the simulations. Results of simulations using rainfall derived from microwave links will be presented.

References
