Citizen Rain Gauge Networks for Urban Rainfall Monitoring

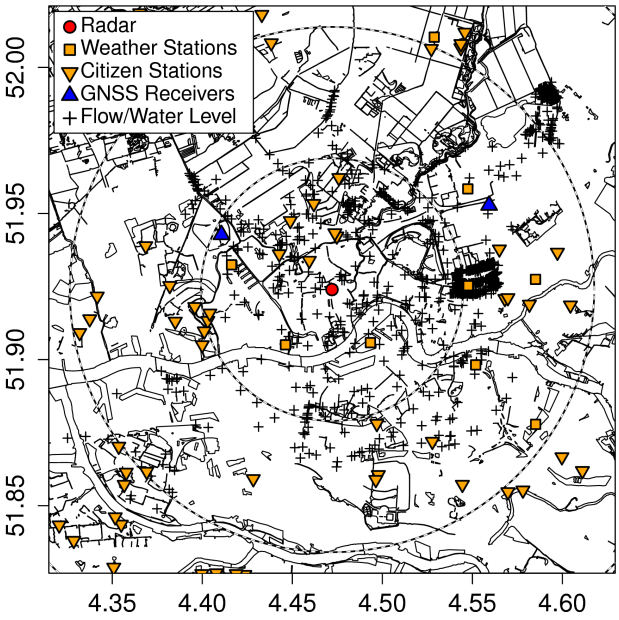
Motivation:
Almost 15% of the Netherlands consist of urban areas. Paved surfaces such as roofs or streets significantly increase runoff during heavy rain, leading to higher risks of flooding. Knowledge about the spatial distribution of rainfall over cities is key to improving urban flood forecasting systems and helping cities become more resilient to hydro-climatic risks. Unfortunately, getting accurate rainfall measurements in cities often proves difficult. Professional weather stations are few and most of them are located in rural areas. Radar and satellites offer interesting alternatives, but their resolution is often too low for urban flood forecasting.

Citizen Rain Gauge Networks:
Recently, a growing number of citizens have started sharing data from their personal weather stations through webplatforms like WOW or weather underground. These so-called citizen rain gauge networks offer new and exciting possibilities for measuring rainfall in urban areas. In 2017, the Dept. of Geoscience and Remote Sensing started gathering data from hundreds of citizen rain gauge networks around Rotterdam within the framework of project MUFFIN (Multiscale Urban Flood Forecasting).

Advantages and Limitations:
Citizen rain gauge networks are much denser (especially in cities) than their professional counterparts. Unfortunately, data quality and representativeness tend to be lower.

Data Processing and Quality Control:
Successful use of personal weather station data mainly depends on the design of robust processing and quality control schemes capable of removing bad data prior to analysis. Little research has been done on this topic and more rigorous quantitative evaluations and assessments are necessary.

Personal weather stations such as the Netatmo cost less than 300 EUR and are very popular among weather enthusiasts. But improper mounting and maintenance lowers the quality and representativitivity of the measurements.



Map of sensors deployed within 10 km from the city centre of Rotterdam. In addition to the radar, there are about 50 citizen rain gauges and 10 professional weather stations. More information about the MUFFIN campaign can be found at www.muffin-project.eu.

Objectives:
The main goal of this thesis will be to investigate the usefulness of citizen weather networks for urban rainfall estimation. This includes: (1) the development of novel quality control tools, (2) design of robust spatial and temporal interpolation techniques and (3) validation against independent professional weather stations and radar. Special attention will be given to the city of Rotterdam, where 50 citizen and 10 professional stations are available. Additional data for comparison will be provided by an X-band polarimetric radar overlooking the city. The focus will be on heavy summer-time rainfall events, with strong spatial and temporal variability.

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