

Complementing urban rainfall/flood monitoring using low-cost *citizen observatories: first result and challenges*

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Problem statement

If aiming at an **EARLY WARNING SERVICE** for **PLUVIAL FLOODING** in cities, near real-time **MONITORING of RAINFALL INTENSITY** is a core element.

Pluvial floods are typical the result of intense rainfall, triggering a fast hydrological response in cities. During summer convective rainfall events can be very localized.



Within the **FloodCitiSense** project we are exploring the **potential of low-cost citizen observatories** for **high-density monitoring** of intense rainfall and pluvial flooding in three pilot cities: Brussels, Rotterdam and Birmingham.

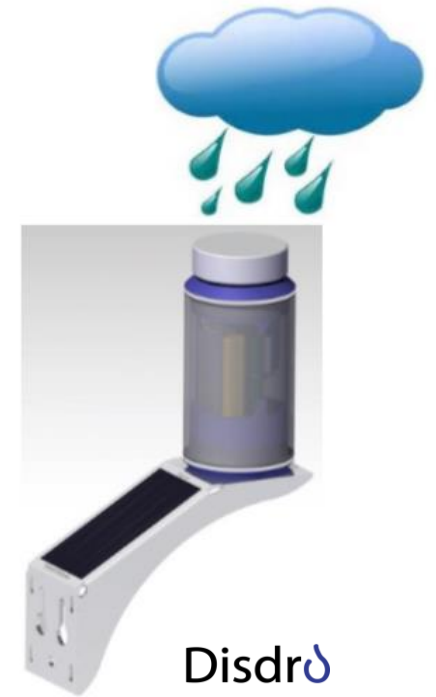
Low-cost RAIN sensors

Second generation sensor

- **Acoustic** precipitation gauge
- **Battery** alimented by efficient solar panel
- Data transmission via **LoRa** technology

Sensors components provided by Disdrometrics and assembled during **Citizen Science workshops** in Brussels, Rotterdam and Birmingham (# 50 participants)

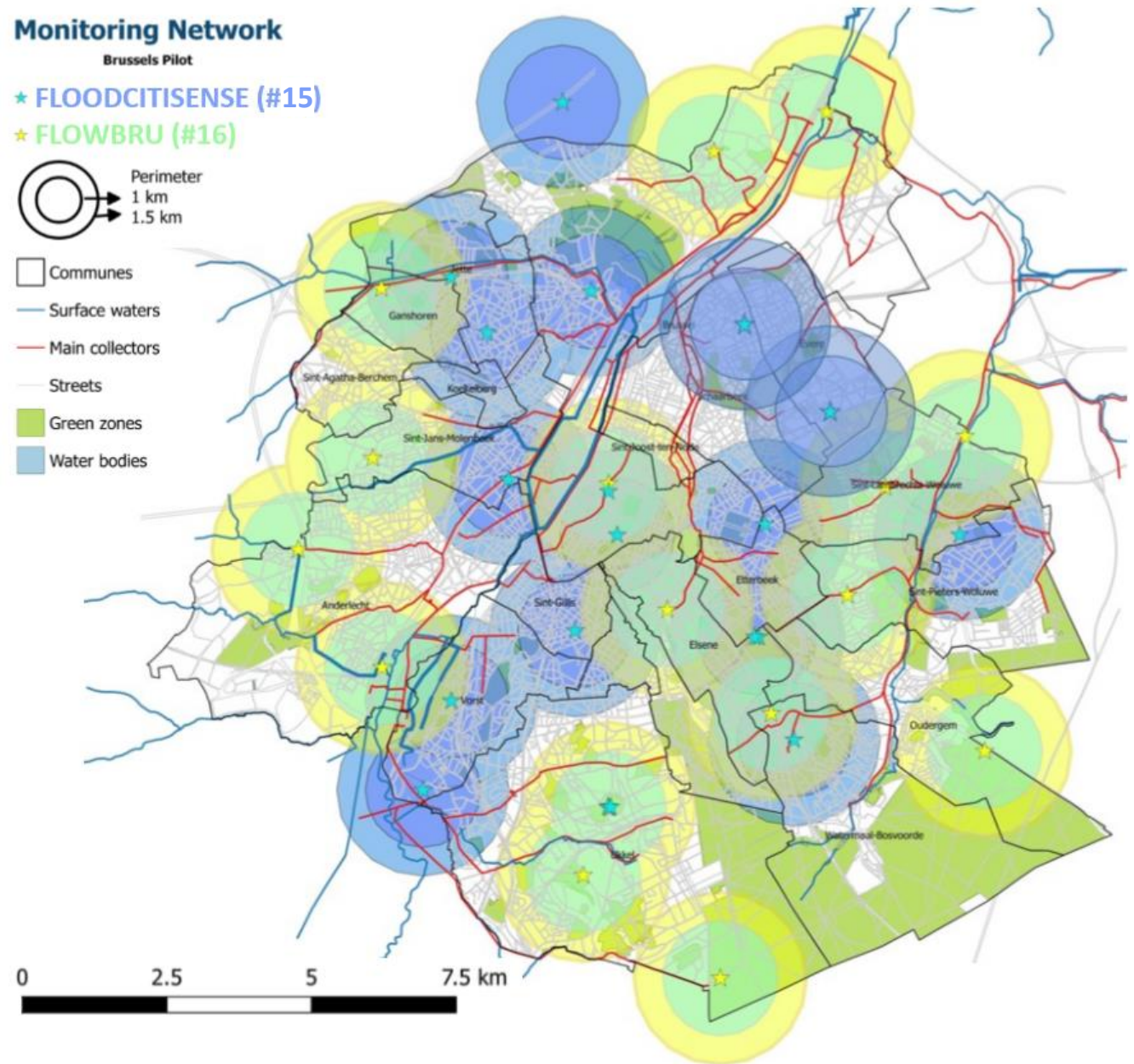
Open data via our [Web](#) and [Mobile App](#)



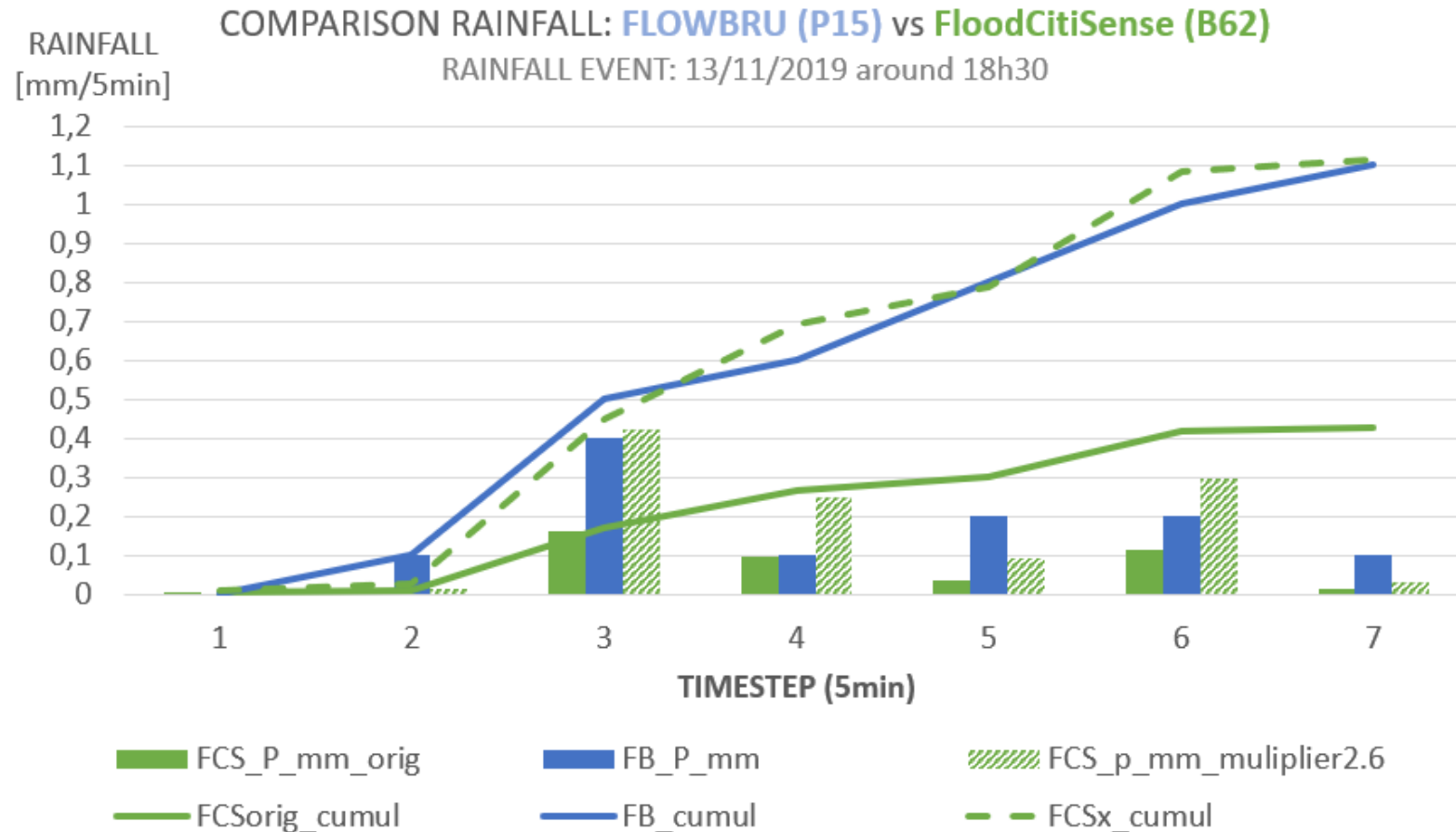
Brussels Pilot

15 low-cost sensors were installed with help of citizens, aiming at filling the “gaps” of the existing professional rain gauge network Flowbru.be (16)

A **better spatial coverage** was **achieved** via the low-cost rain sensors (blue on map) complementing the professional rain gauges (yellow/green)



Preliminary results: event



FLOWBRU
 HIGH-ACCURACY
 WEIGHING
 RAIN GAUGE
 POWER GRID
 (230V)



FloodCitiSense
 LOW-COST
 ACOUSTIC
 RAIN GAUGE
 BATTERY
 (4V)



CONSIDERABLE ABSOLUTE DIFFERENCES BETWEEN MEASURED RAINFALL INTENSITIES !!!

Preliminary results : global performance

FloodCitiSense vs Flowbru

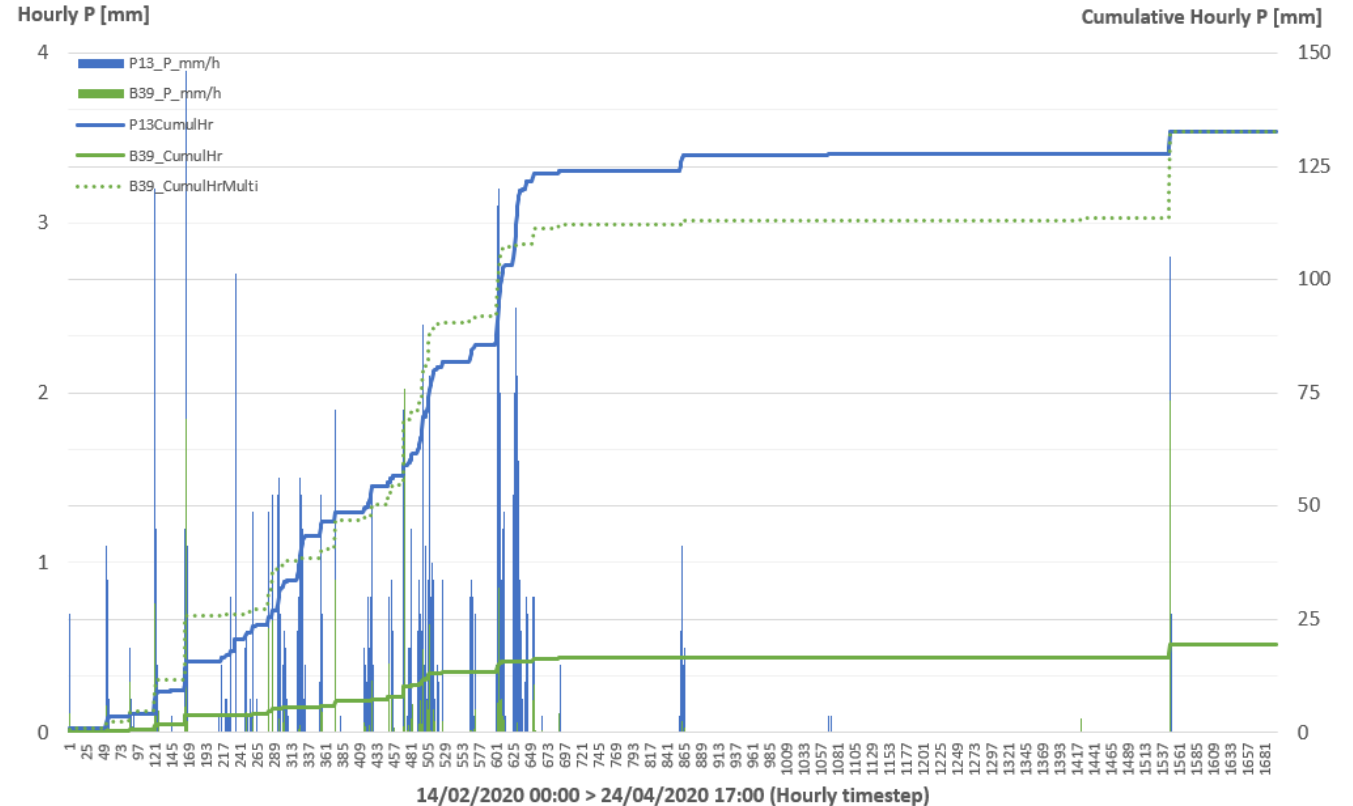
COMPARISON OF HOURLY RAINFALL RATES

- Cumulative curves show relatively high correlation (0.72) between 2 timeseries
- Clear underestimation of absolute rainfall rates

PACKAGES RECEIVAL RATE

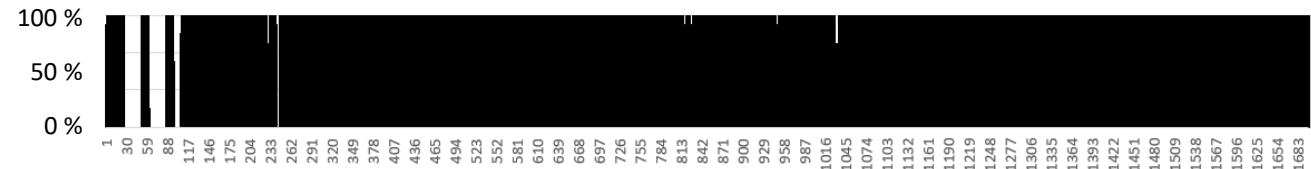
- Overall rate: 95%
- White color indicates loss of packages (=data loss)

COMPARISON HOURLY P: B39 (low-cost) vs P13 (Flowbru)



PACKAGES RECEIVED - HOURLY

B39 - 14/02/2020 > 24/04/2020



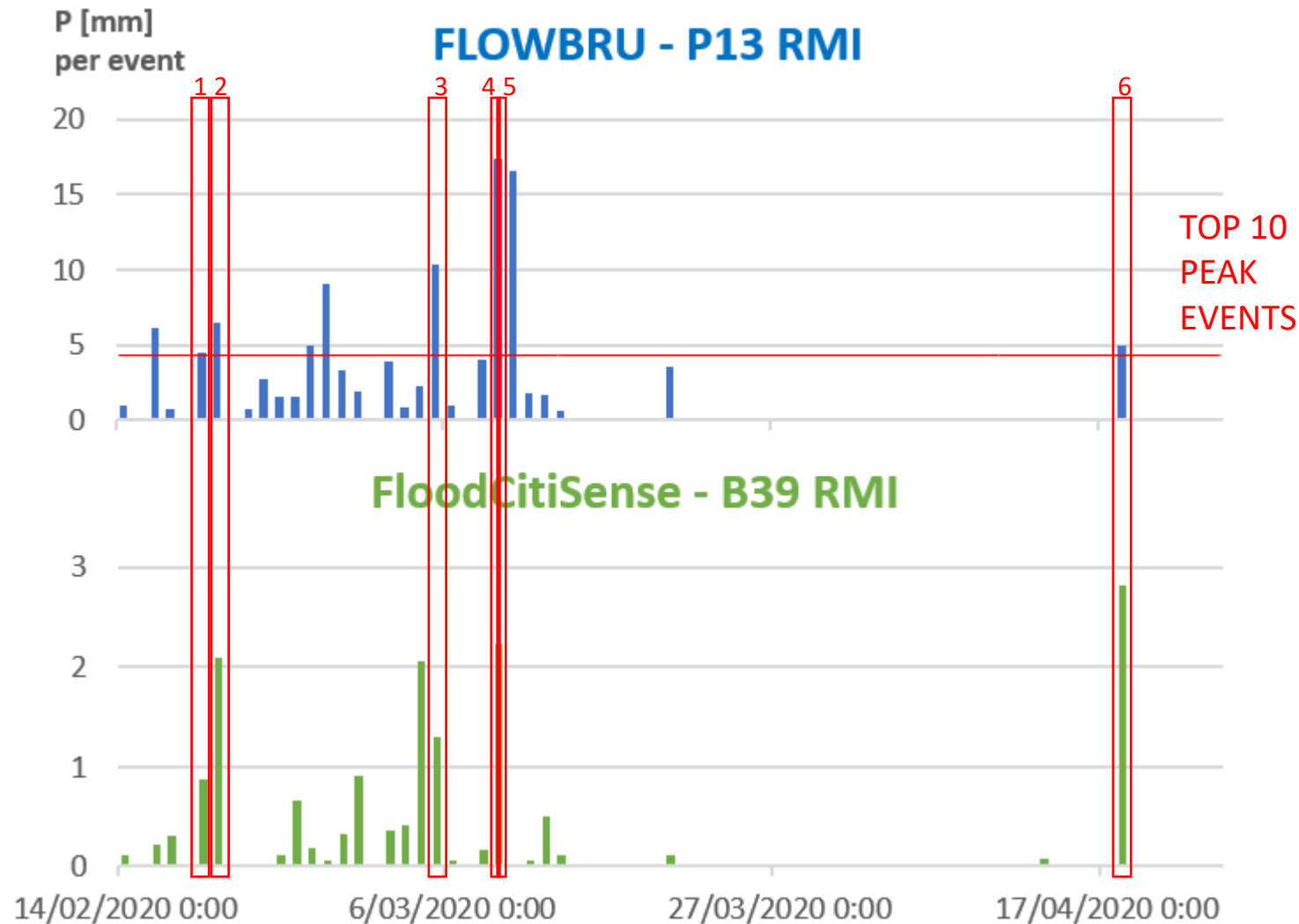
Preliminary results : peak rainfall

FloodCitiSense vs Flowbru

COMPARISON OF PEAK

RAINFALL EVENTS

- Peak rainfall of **TOP 10 events** is ranging from 4.4 up to 17.4 mm per hour (high-accuracy rain gauge of Flowbru at same site is used as reference)
- From the TOP 10 events **only 6** were **registered by low-cost** rainfall sensor (red boxes on graph)

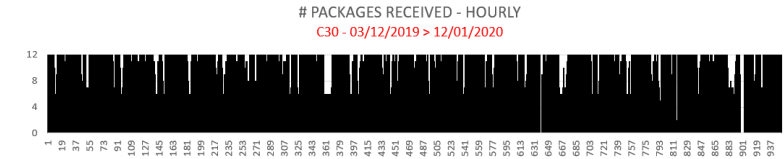


Challenges low-cost sensors

LoRa > using [Global Open LoRaWAN network](#)



- Theoretical ranges of gateway and sensors are much lower in urban context
- Problems: no connection, unstable connection = loss of packages, etc.
- Solution: Extra OWN gateways installed!
- Result > important **data gaps**!

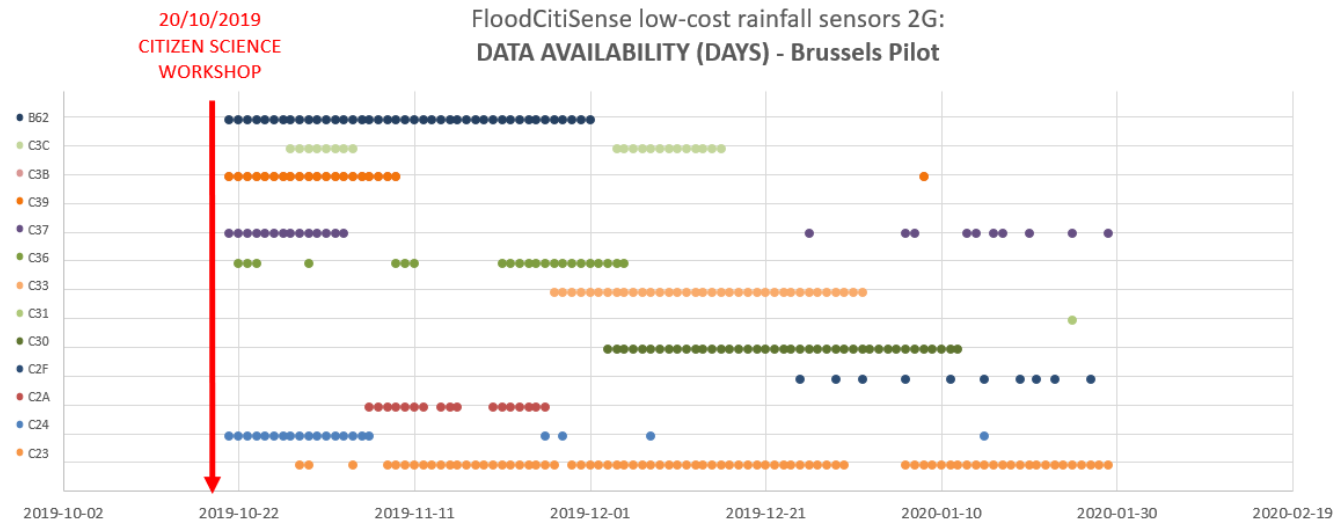


Batteries

- Major challenge during winter (low sun)
- Many sensors lost connection
- Revival of some sensors (7) in spring 😊

Absolute values of rainfall intensities

- Comparison with high-accuracy Flowbru sensors shows considerable differences in measured rainfall
- Working on calibration of conversion rate (*Disdrometrics*)



Conclusions

- In urban context installation of low-cost sensors is challenging: important to have S-SW orientation + limit obstruction by neighbouring objects
- Use of OWN gateways ensures stable connection for data transmission via LoRa = limits loss of packages!
- Preliminary results based on limited data:
 - Medium to High correlation with reference rainfall measurements
 - Clear underestimation of absolute values
 - Peak rainfall identification not reliable at the moment

OUTLOOK : EXTEND DATA ANALYSIS on MORE DATA!

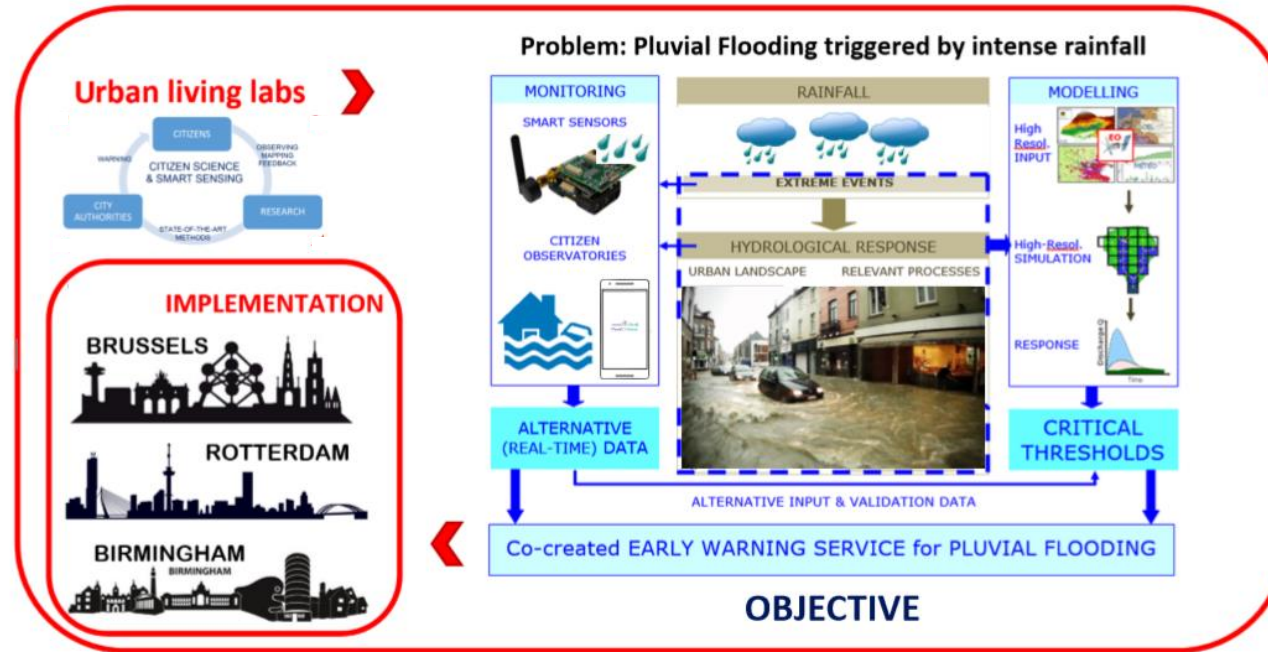


FloodCitiSense

PROJECT

FloodCitiSense

Early warning service for urban pluvial floods for and by citizens and city authorities



CITIZENS
“victims” > “actors”

CONSORTIUM



Contact: info@floodcitisense.eu

Website: floodcitisense.eu





FloodCitiSense in YOUR CITY as well?

Contribute by:



TESTING the **REPORTING** app in your city

REPORTING RAIN & IMPACTS

1. Download & install **FloodCitiSense** App @ Playstore/Appstore
2. Fill **App feedback form** while you are testing



TESTING the **LOW-COST RAINSENSOR**

Interested? Contact us!
evenhoven@disdrometrics.com

