

# 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.

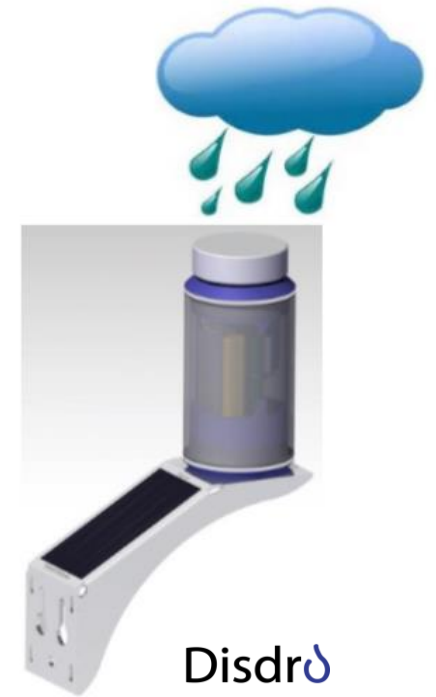
# Low-cost RAIN sensors

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)

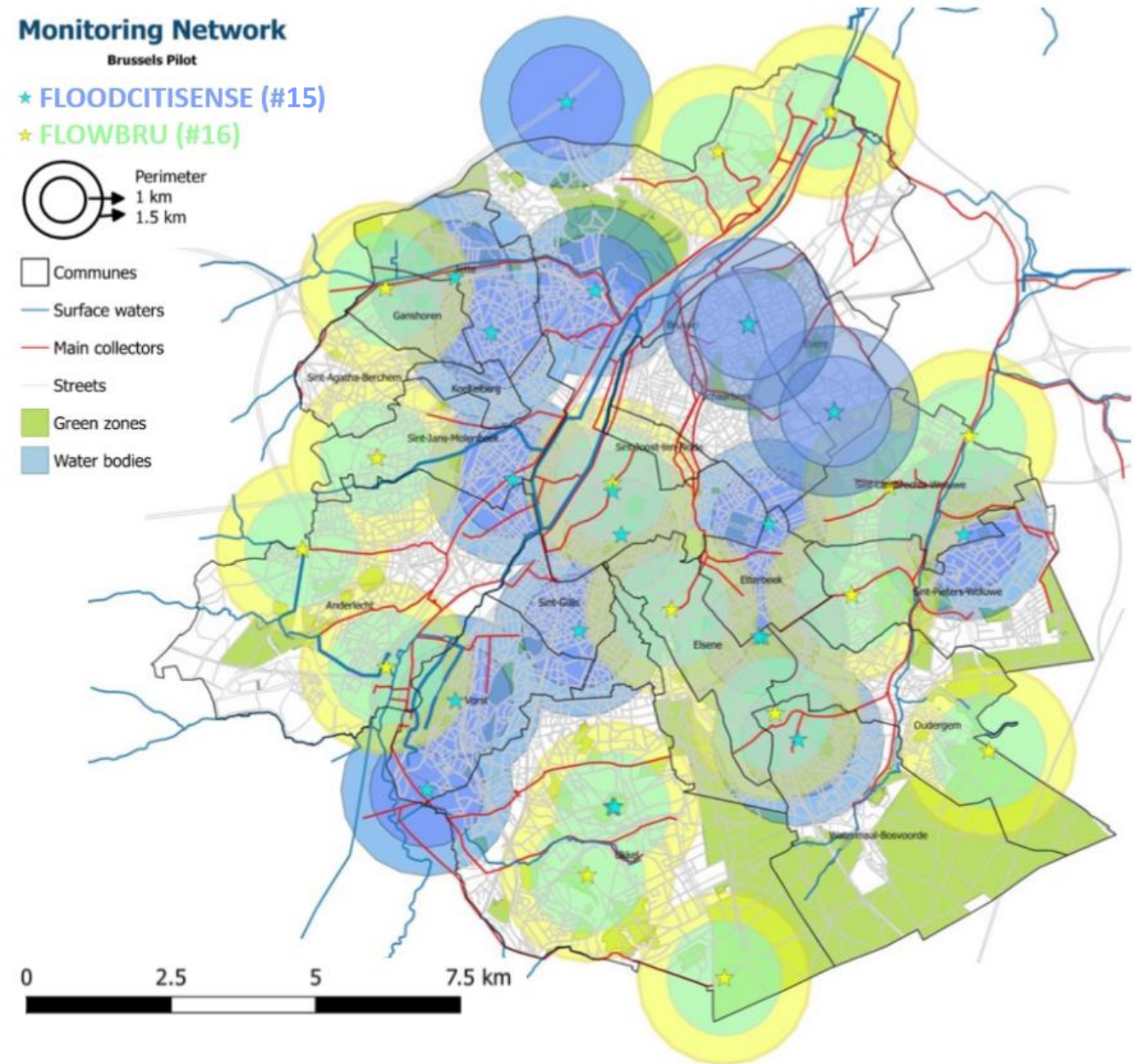
Open data via our [Web](#) and [Mobile App](#)



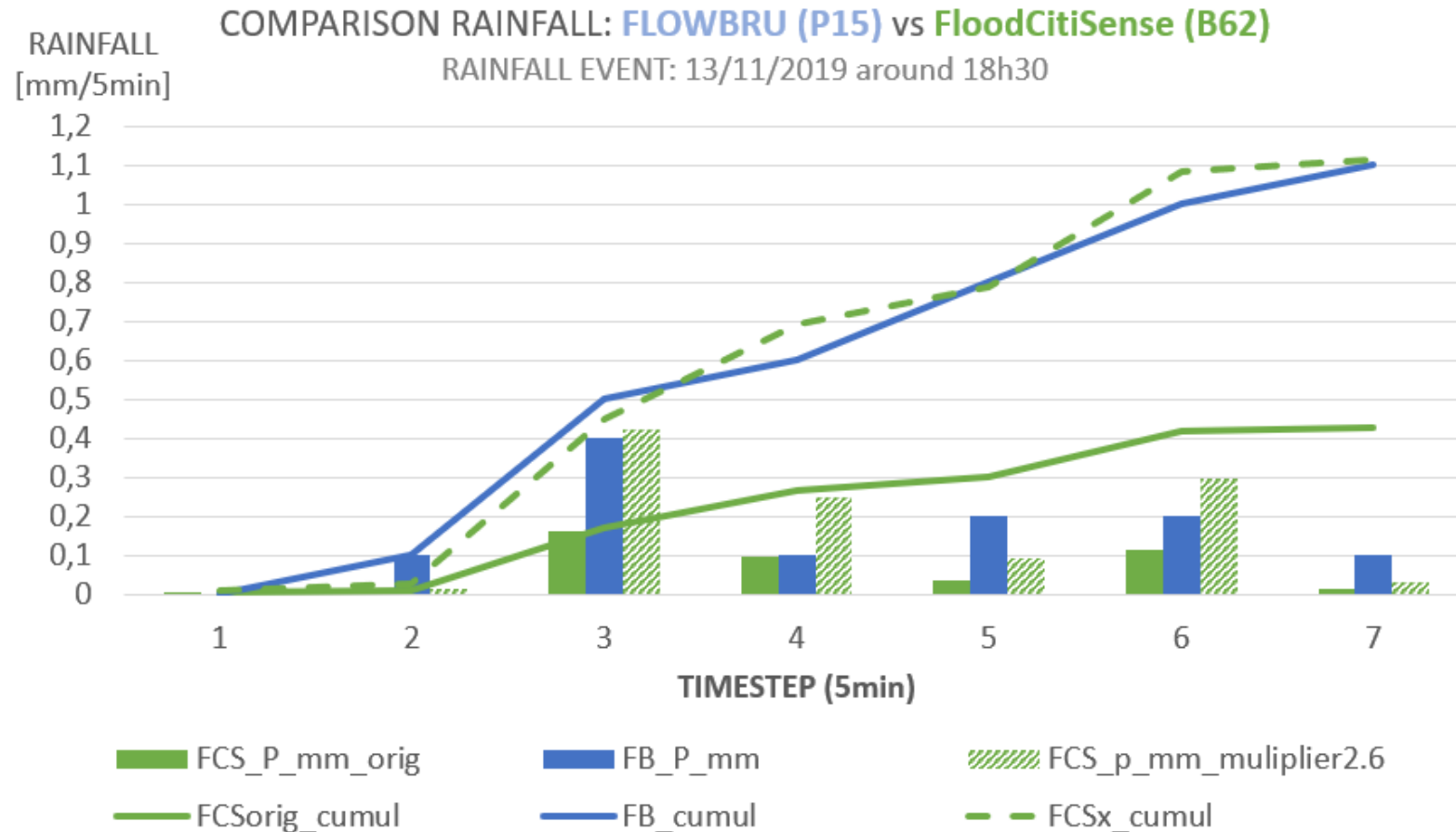
# Brussels Pilot

**15 low-cost sensors** were installed with help of citizens, aiming at filling the “gaps” of the existing professional rain gauge network [Flowbru.be](http://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

ACCOUSTIC  
RAIN GAUGE

BATTERY  
(4V)



**CONSIDERABLE ABSOLUTE DIFFERENCES BETWEEN MEASURED RAINFALL INTENSITIES !!!**

# Preliminary results : global performance

## FloodCitiSense vs Flowbru

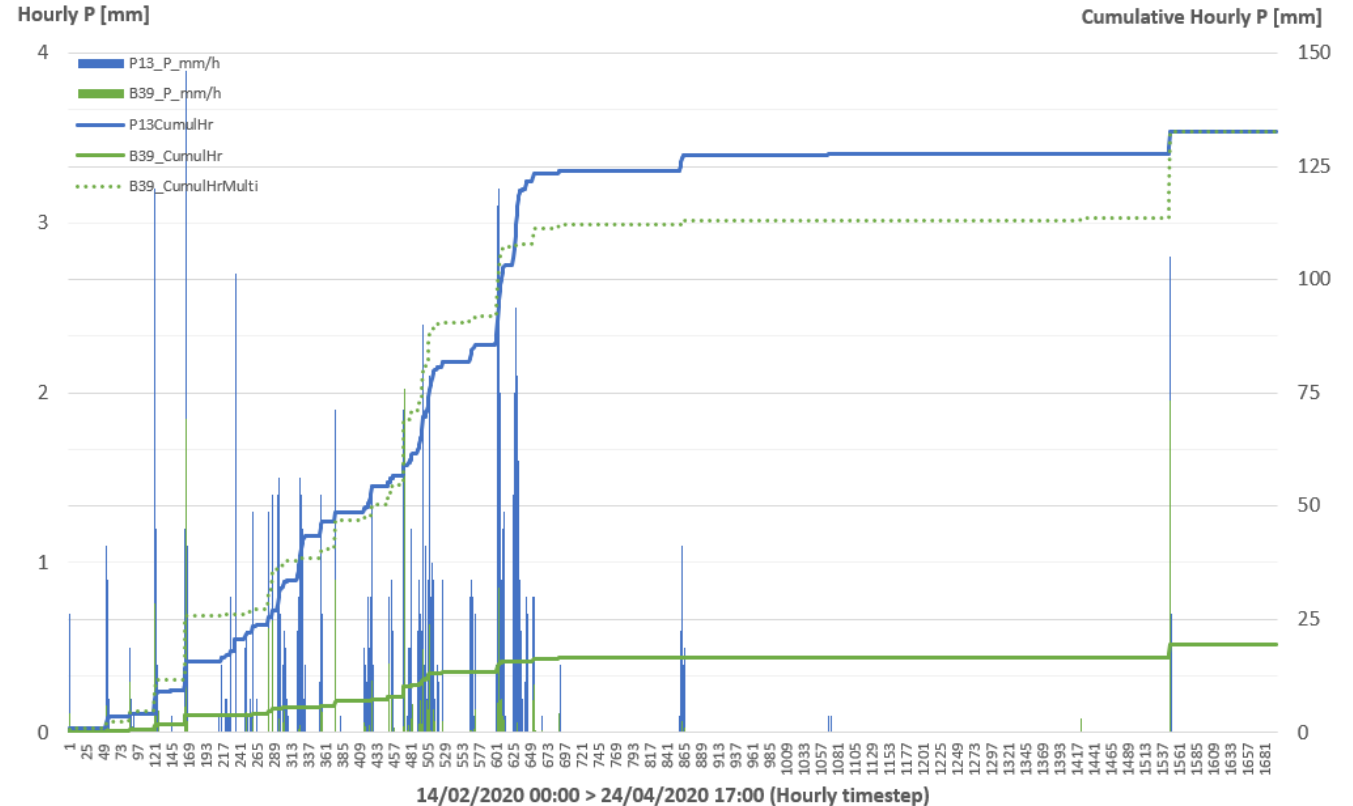
### COMPARISON OF HOURLY RAINFALL RATES

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

### PACKAGES RECEIVAL RATE

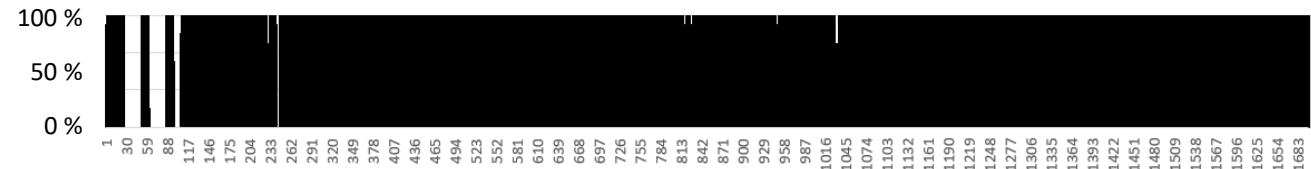
- Overall rate: 95%
- White color indicates loss of packages (=data loss)

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



# PACKAGES RECEIVED - HOURLY

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



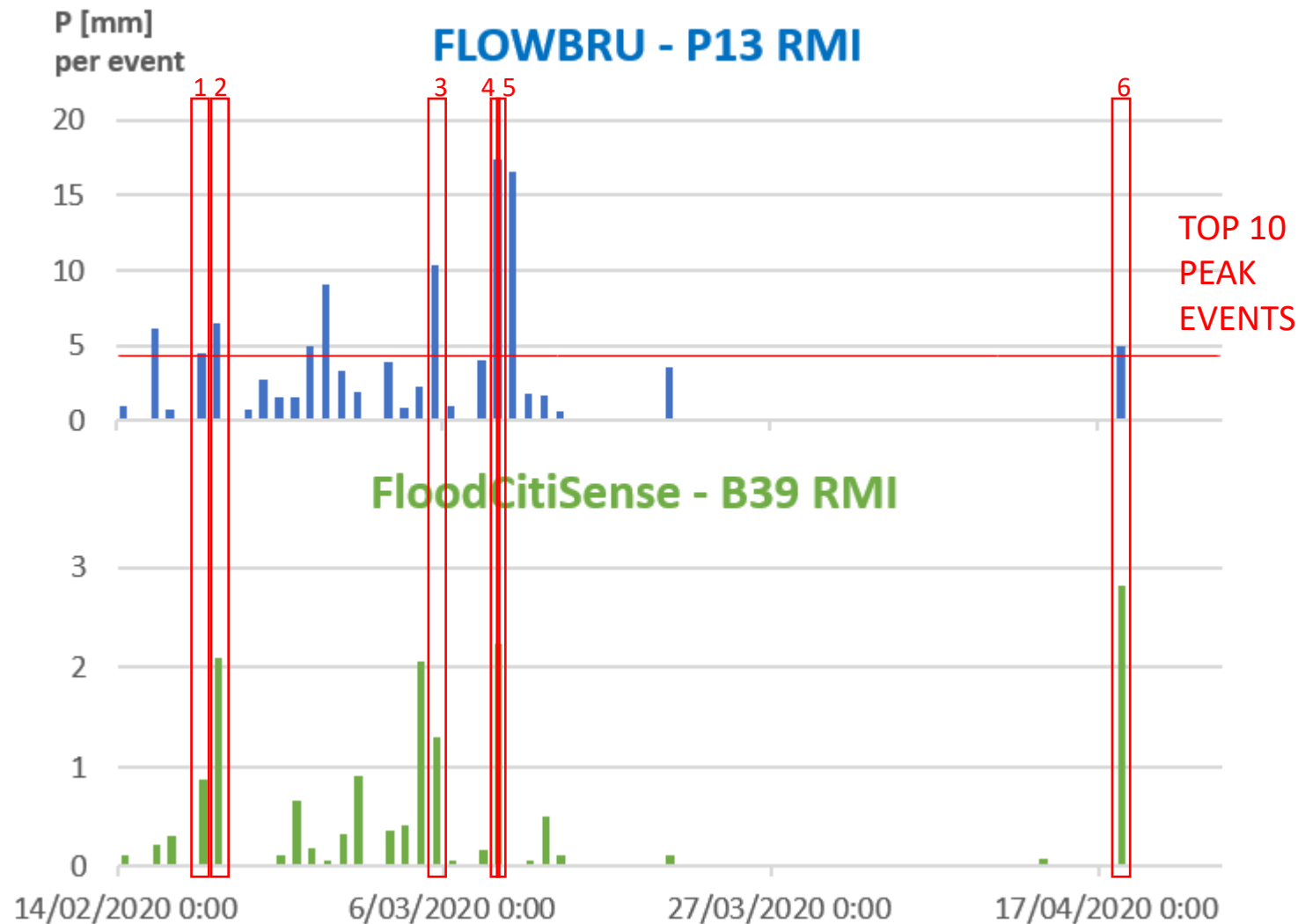
# Preliminary results : peak rainfall

## FloodCitiSense vs Flowbru

### COMPARISON OF PEAK

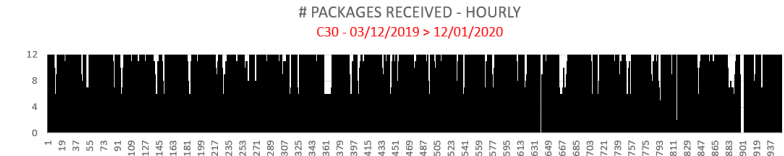
### RAINFALL EVENTS

- 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](#)



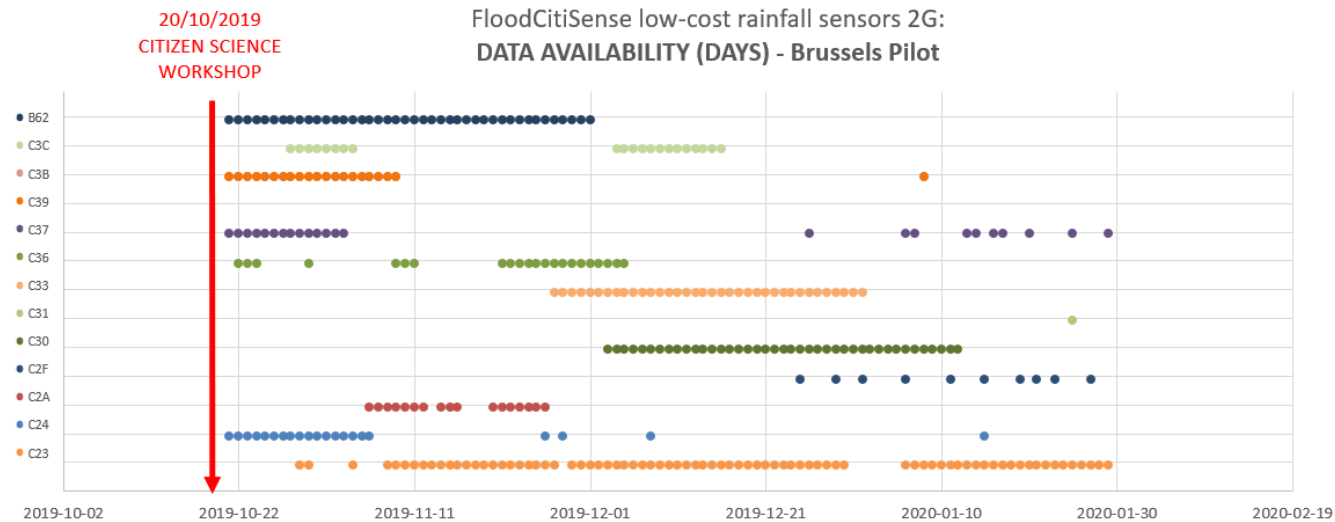
- Theoretical ranges of gateway and sensors are much lower in urban context
- Problems: no connection, unstable connection = loss of packages, etc.
- Solution: Extra OWN gateways installed!
- Result > important **data gaps**!

## 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!

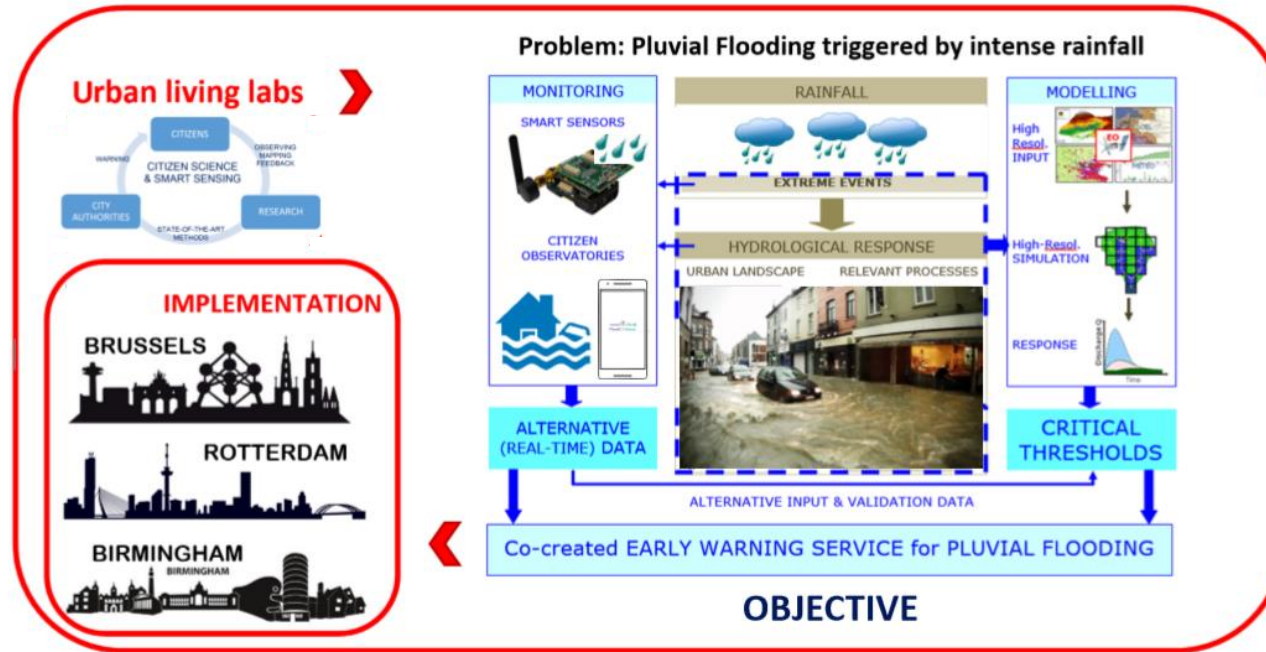


# FloodCitiSense

## PROJECT

### FloodCitiSense

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



CITIZENS  
“victims” > “actors”

CONSORTIUM



Contact: [info@floodcitisense.eu](mailto:info@floodcitisense.eu)

Website: [floodcitisense.eu](http://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](mailto:evenhoven@disdrometrics.com)

