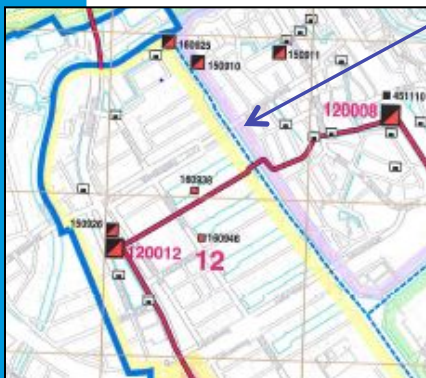
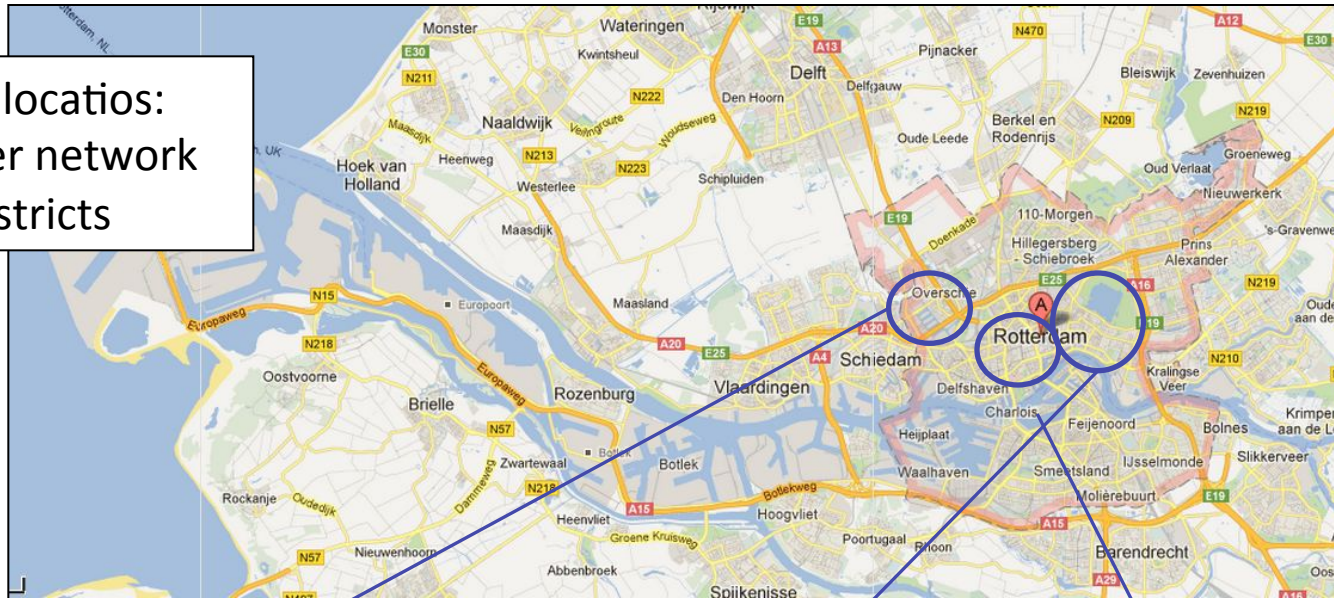


Pilot location description: **ROTTERDAM**

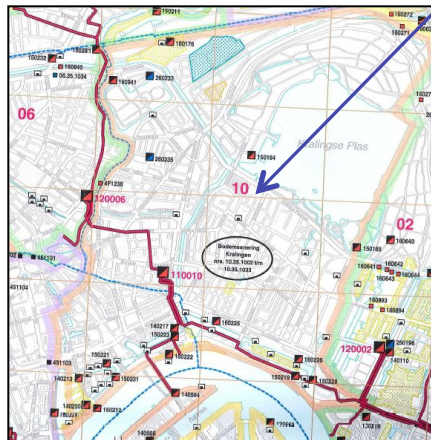
- Location and environmental settings
- Urban pluvial flood risk problems and management objectives
- Characteristics of the drainage and monitoring systems.



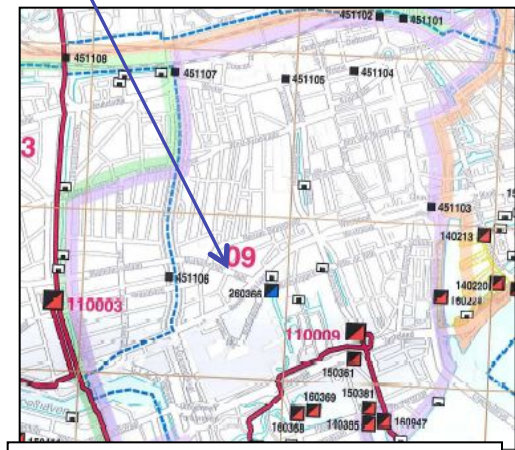
Pilot locations:
3 sewer network districts



District 12. Spaanse Polder: 1,9 Km²



District 10. Kralingen-Crooswijk: 8 Km²



District 9. Centrum: 3,7 Km²

D 10-Kralingen: located in the Eastern part of the city of Rotterdam, at about 1 Km from the City Centre.

It includes a residential zone (Central and Southern part) where approximately **50.000 people live**, a small industrial area (Northern part) and a green area occupying the N-W part of the district, called Kralingse Bos. The Kralingse Plas is a 100 ha lake adjacent to the grassland. The southern border of the district is formed by one of the Maas river meanders.

The district area covers about 8Km², **40%** of which consists of **pervious areas** (grasslands, gardens, lake and canals), **60%** by **impervious areas** (linear infrastructures and buildings (10% industrial and 90% residential buildings)).

D 12-Spaansepolder: located in the Eastern part of the city of Rotterdam, at about 3 Km from the City Centre.

It is an industrial area, thus the majority of the area is paved (78%). There are a few green areas, mainly trees areas surrounding the water bodies or complementing linear infrastructures.

buildings	roads	other paved areas	green areas	water
59.3	46.5	69.1	17.8	30.8

D 9-Centrum: located in the middle of the city, this area includes the main railway station next to which the X-band radar is going to be placed.

It is a residential area with two main green areas: Het Park, on the Southern part, and Museumpark, in the middle of the district. As for District 10, the southern border of the district is formed by one of the Maas river meanders.

buildings	roads	other paved area	green areas	water
111.3	140.5	75.8	34.8	12.9

Urban pluvial flood risk problems and management objectives

- 1. Underground storage facilities** (e.g. Museumpark, 10000m³)



- 3. Further optimization of system operation:**

Rotterdam has a combined sewer system with 40 pumping stations that can be operated from a central control room.

- 4. Green roofs:** a durable solution for temporary water storage

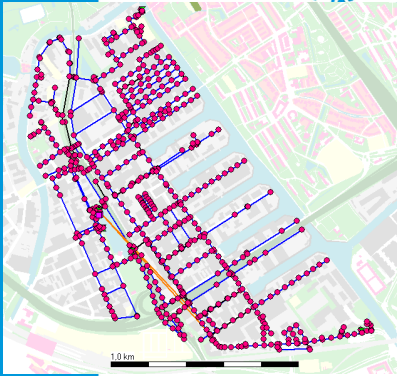


- 2. Water squares** (e.g. Belamyplein, Benthemplein, 17000m³)



12- SPAANSE POLDER

Pipe Total Length	Nodes	Nodes with Runoff	Pump stations	External weirs	Agverage slope
4243	638	638	2	7	0,002



10- KRALINGEN: The sewer system is connected to Maas river and to Boezen canal by two pumping systems that discharge water from the sewers into the water bodies, through two pressurized pipelines of 735 meters and 139 meters respectively.

The district is linked to a WWTP by a pressurized pipeline that discharges the water along 3,6 Km.

Pipe Total Length	Nodes	Nodes with Runoff	Pump stations	External weirs
160373	1598	2539	27	35



9-CENTRUM:

Pipe Total Length	Nodes	Nodes with Runoff	Pump stations	External weirs	Agverage slope
94386,7	3049	2832	2	11	0,009



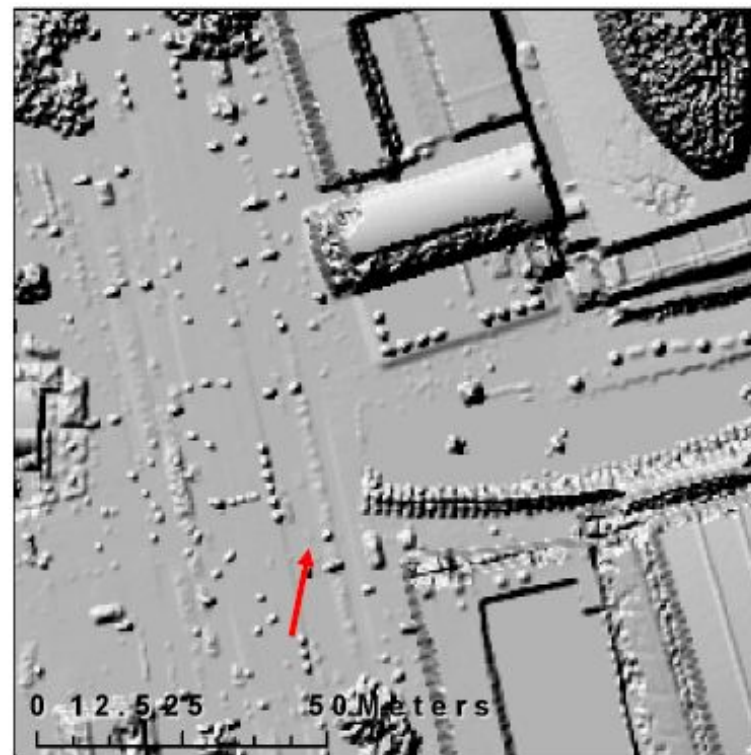
Digital Elevation Model

The Municipality provided a set of AHN-2 layers cropped to the administrative limits of the city. This **DEM** was produced using Light Detection and Ranging (LiDAR) of ground levels from an aerial platform.

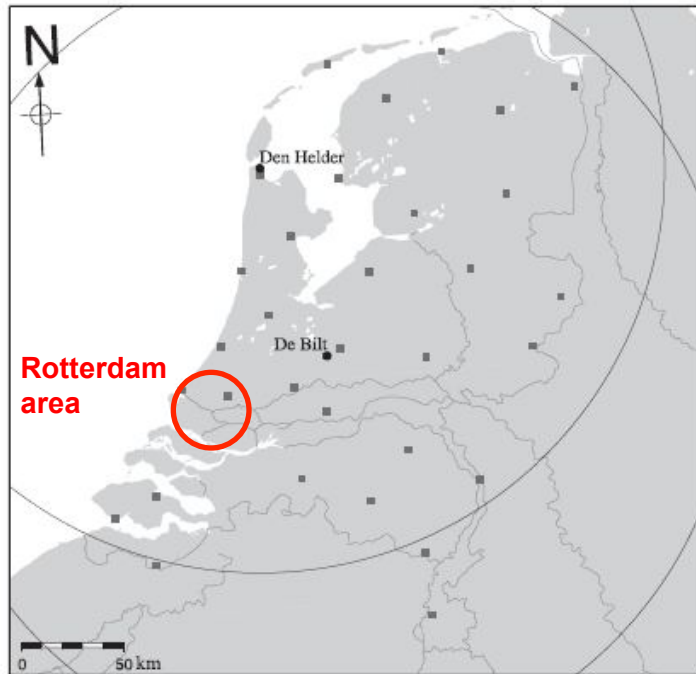
The DEM is characterized by

- a spatial resolution of $0.5\text{ m} \times 0.5\text{ m}$,
- a vertical precision of 5 cm,
- a systematic error of 5 cm, a random error of 5 cm,
- a minimum precision under two standard deviations of 15 cm. [1]

[1] Citizens' complaints, overland flow networks and vulnerability to pluvial Flooding (S. Gaitan et al., 2012)



1. C-Band radars: De Bilt and Den Helder (200 km range, operated by KNMI) [1]

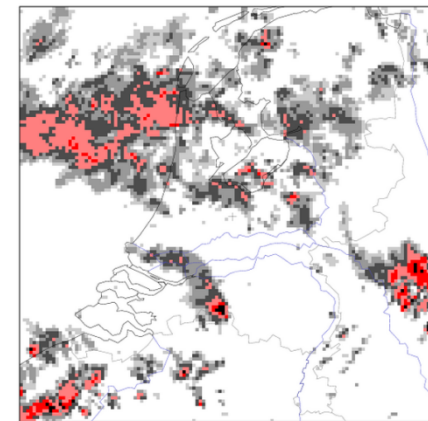


Specifications	C-band radar
Frequency	5.6 GHz
Polarization	horizontal
Spatial resolution	1 Km
Temporal resolution	5 min
Beamwidth	1°
Elevations	0.3°-25°

[1] Derivation of a 10-Year Radar-Based Climatology of Rainfall. A. Overeem et al. 2008



pCAPPI@0.8km, Aug. 8 1999, 16:34 UTC: Reflectivity



2. X-Band radar: Nationale Nederlanden building, next to Central Station.



Specifications	X-band radar
Frequency	9.475 GHz
Polarization	dual polarization
Spatial resolution	30 m
Temporal resolution	1 min
Beamwidth	1.8°
Elevations	0.5°

3. OVER THE WHOLE URBAN AREA:

- 8 fixed rain gauges from Municipality;
- 10-15 disdrometers from TUDelft;
- 2 KNMI raingauges (Airport and Hoek van Holland);
- At least 3 manual rain gauges from amateurs.





THANK YOU!

