



Presentation of the Morée-Sausset / Kodak case study

A. Gires, I. Tchiguirinskaia, D. Schertzer, A. Giangola-Murzyn

In collaboration with DEA 93 (N. Stantic, F. Chaumeau, V. Lanier)

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Rain gauges

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X-band radar

Sewer flow

Models and input data

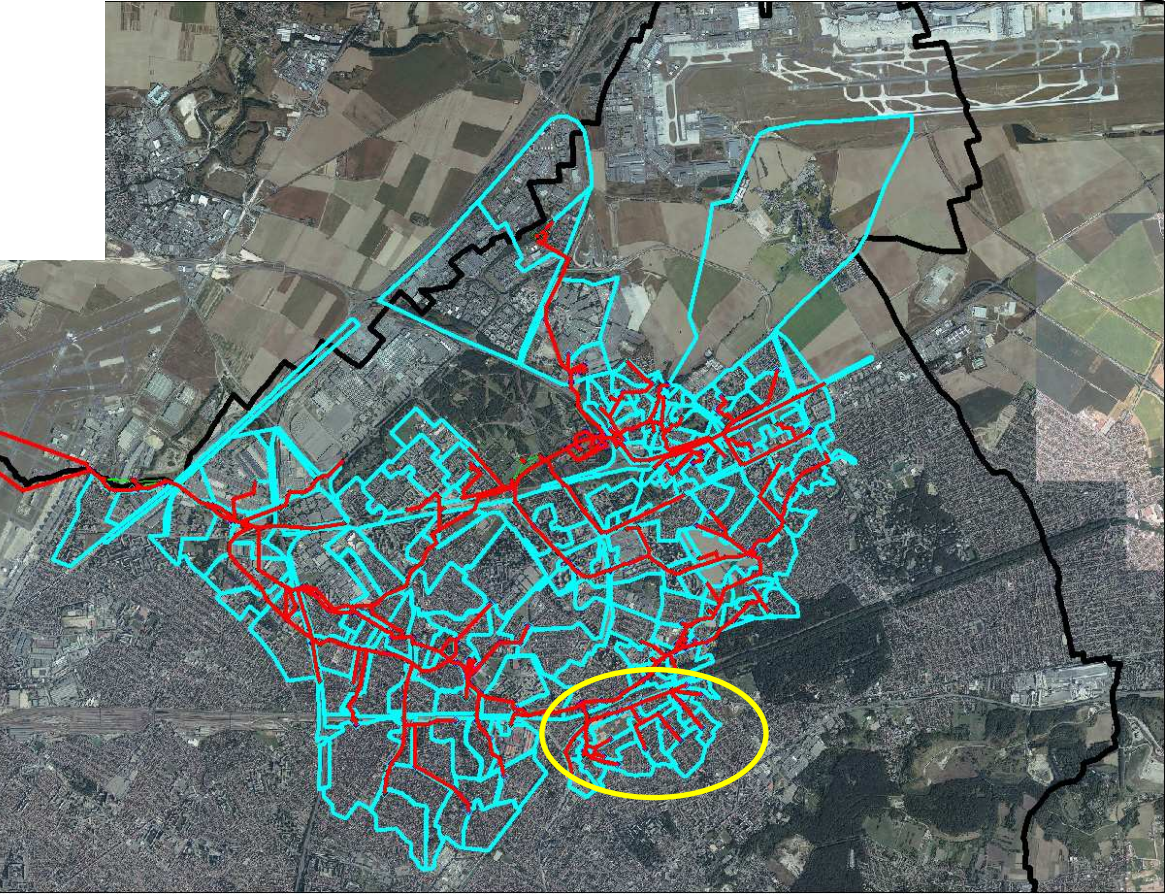
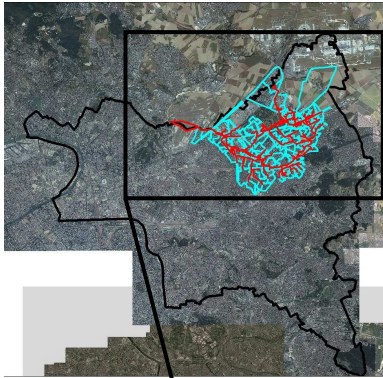
Models description


Spatial data


Drainage system


Morée-Sausset catchment


- 3 400 ha predominantly urban area
- Rather flat
- Average coefficient of imperviousness ~50%.




 Sub-catchment

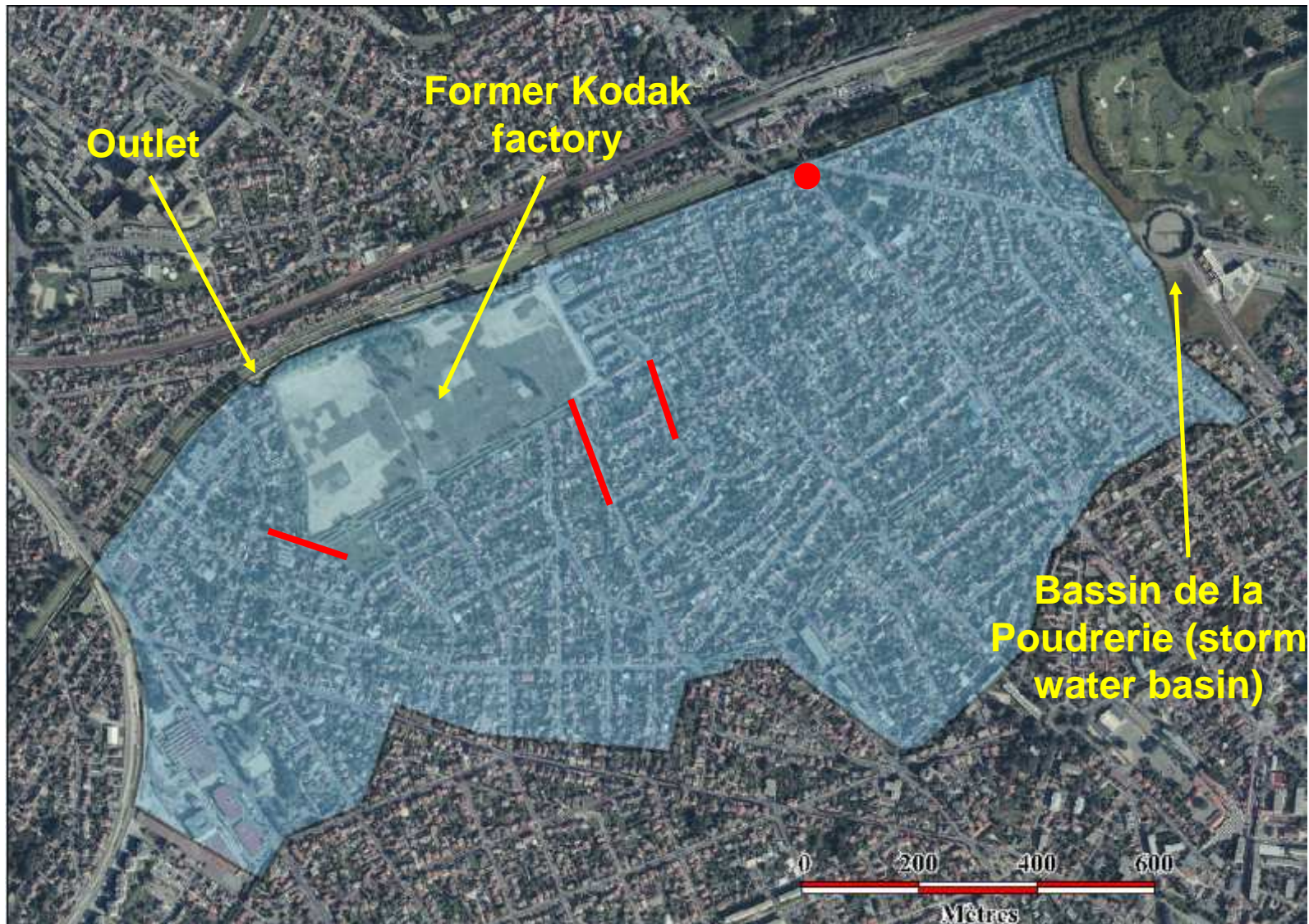
 Sewer system

 Limit of Seine-Saint-Denis

 N

 2 km

Kodak catchment

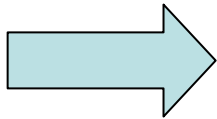


- 1.44 km²
- Project to build a storm water storage basin

Pluvial flooding and weak points

The Morée-Sausset area (as well as the whole Seine-Saint-Denis County) is prone to pluvial flooding for mainly three reasons:

- The topography is rather flat
- The area has experienced a rapid urbanization over the last decades:
 - increase of impervious area
 - decrease of the natural storm water storage area,
 - increase of the runoff velocities
- Former river have been channelled and covered, which reduced there capacity, and the river bed has been urbanised



As a consequence of these two effects some downstream links (some of them former rivers) have become undersized with regards to current constraints and suffer regular overloading and generate occasional flooding.

Pluvial flooding and weak points

Former rivers : channelled and covered

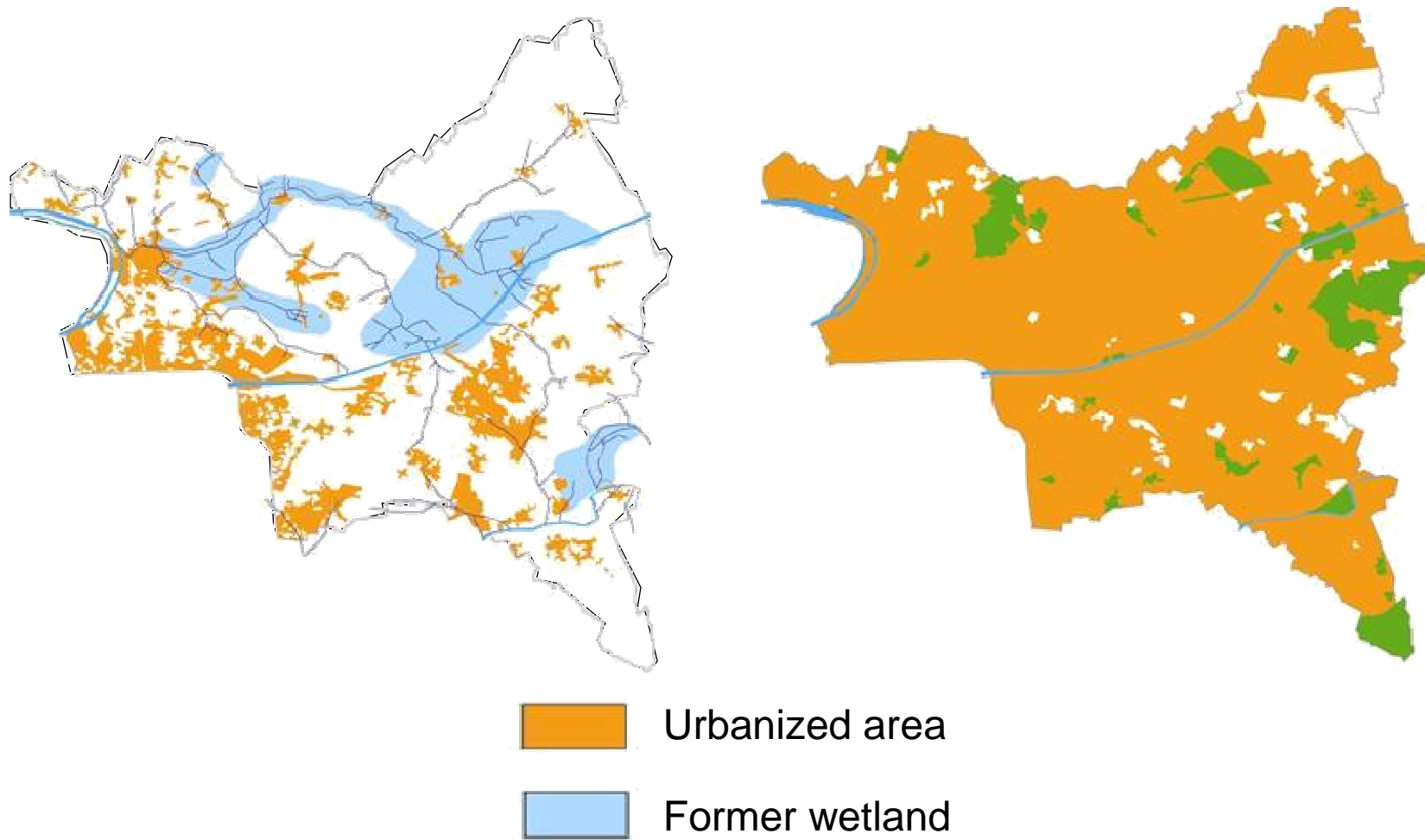


Illustration with “La Morée”

Pictures in Aulnay, between Mare aux Poutres and Gérard Philippe

Pluvial flooding and weak points

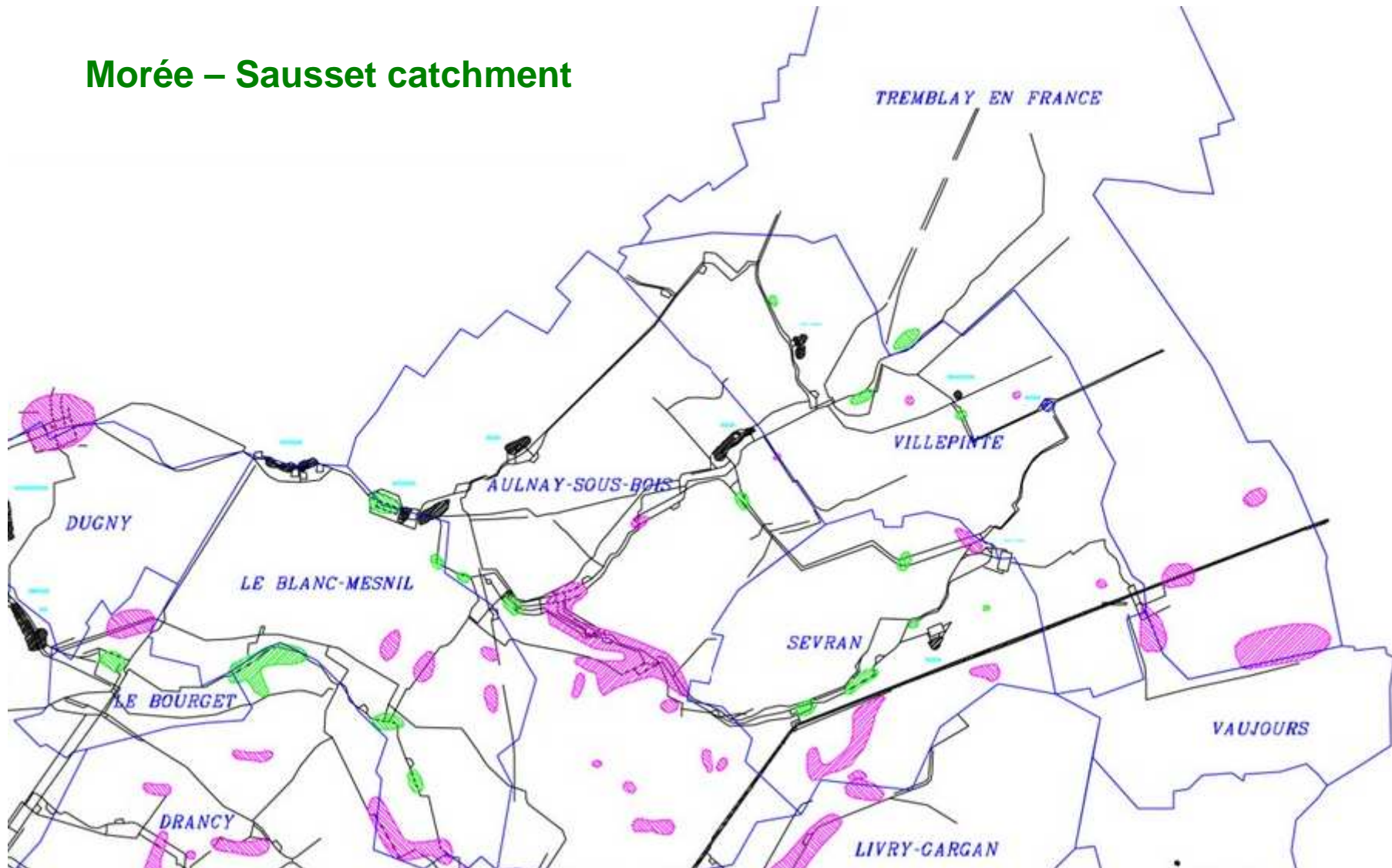
Evolution of urbanized area during the 20th century



Pluvial flooding and weak points

Areas that have suffered regular pluvial flooding

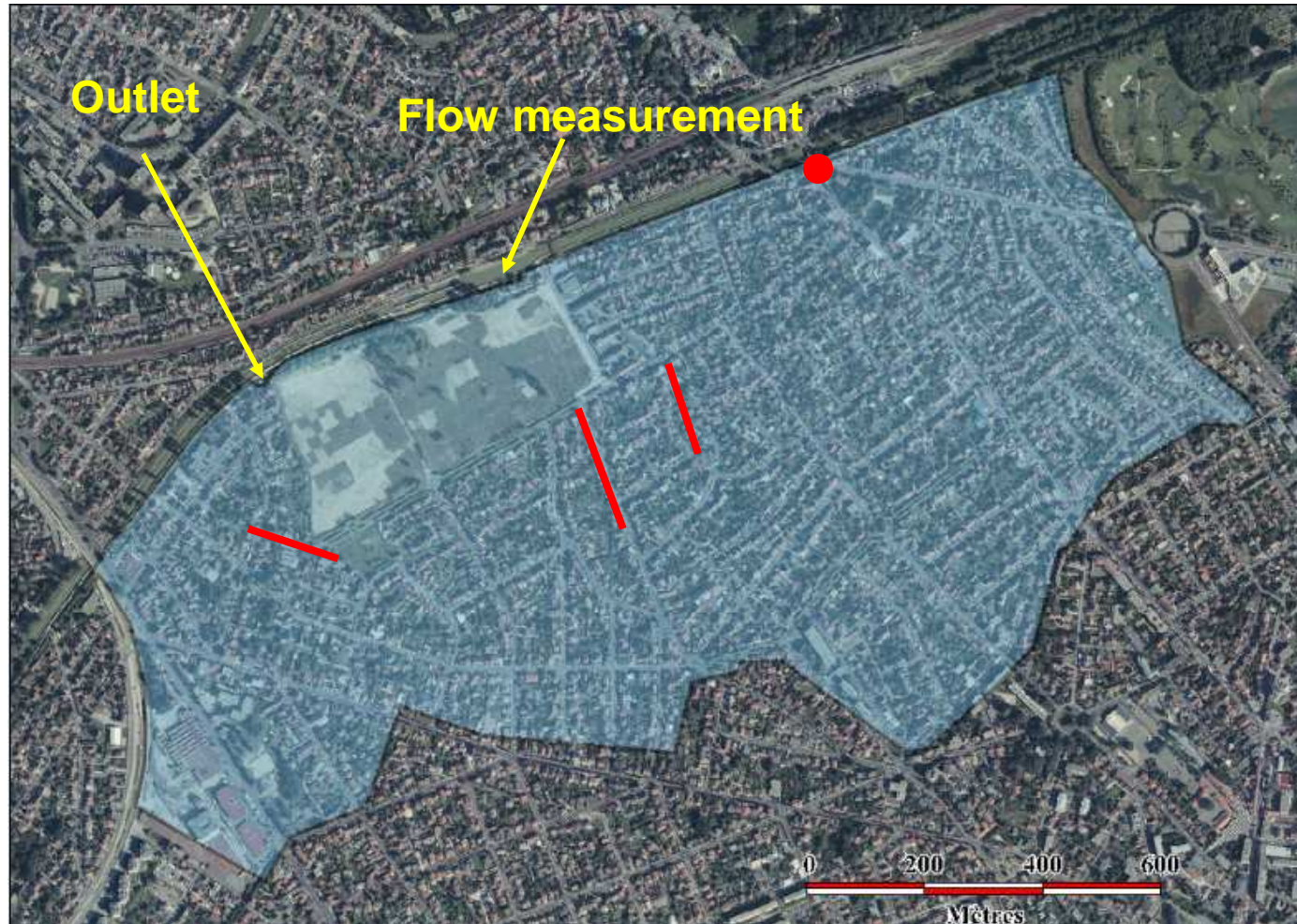
Morée – Sausset catchment



Pluvial flooding and weak points

Areas that have suffered regular pluvial flooding

Morée – Sausset catchment



Pluvial flooding and weak points

Example of flooded street in flat area



Livry-Gargan - rue Danton 23-08-2007

The water coming from this area is routed to the “Bassin de Poudrerie”.

Current solutions

Optimal use of storm water storm water storage basins.

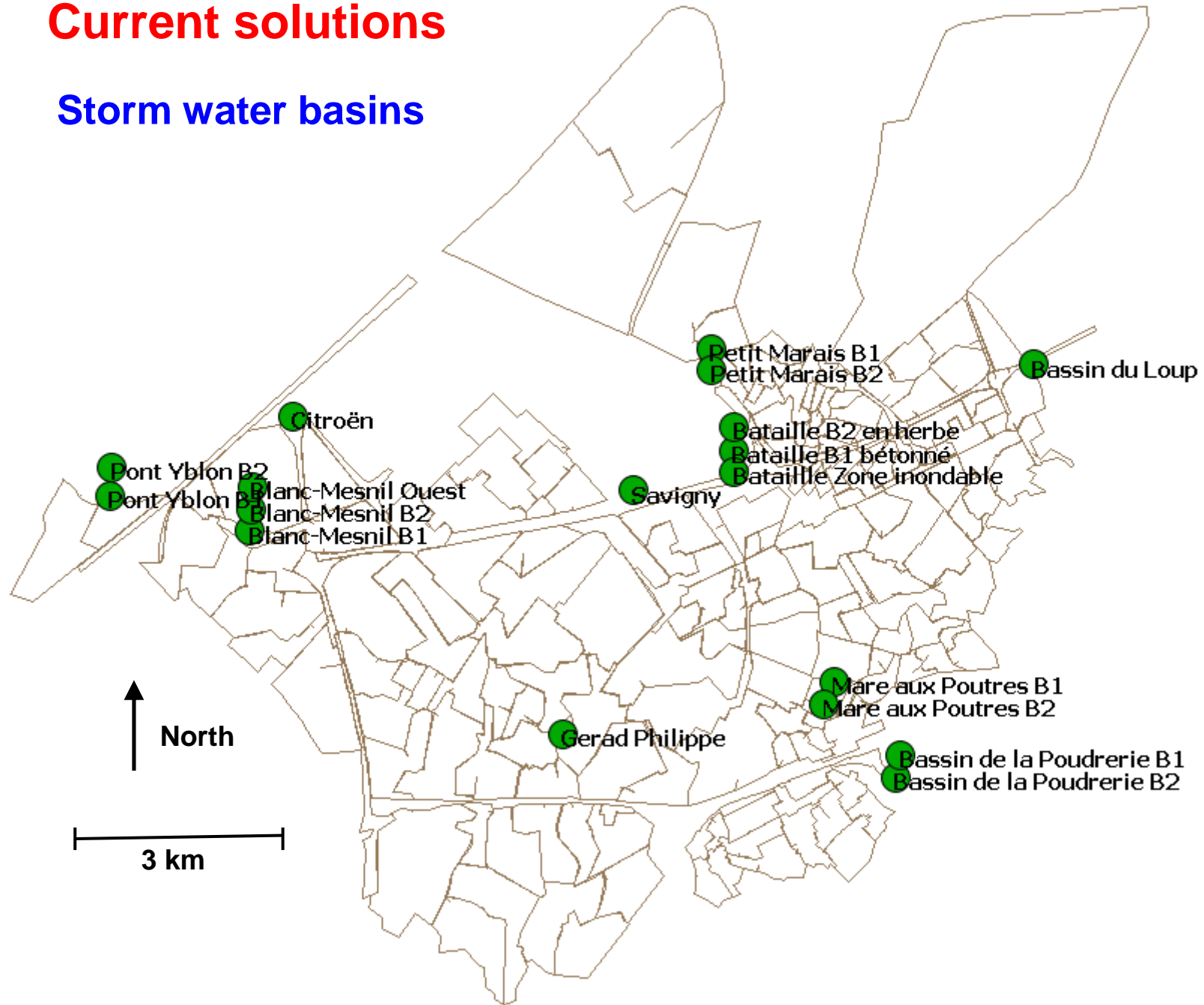
- 18 such basins over the Morée-Sausset catchment (see below) of total size 577 000m³. Some of them are underground and other open air.
- The real time control relies on the implementation of one out of 27 pre-defined scenarios. A scenario is selected according to the observed water level at strategic point in the network and rainfall radar estimates and nowcasts (mainly expected intensity and direction of next storm). Hydrological models are not currently used in real time.



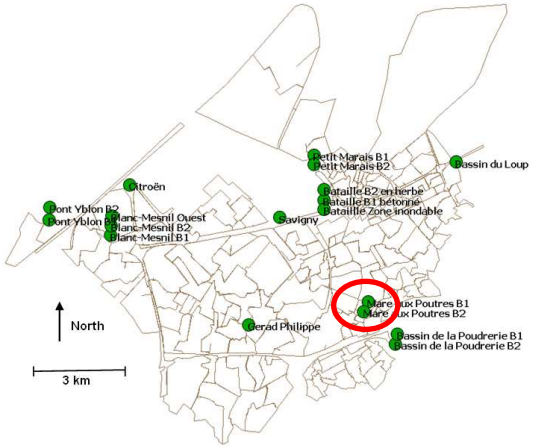
DEA operating room

Current solutions

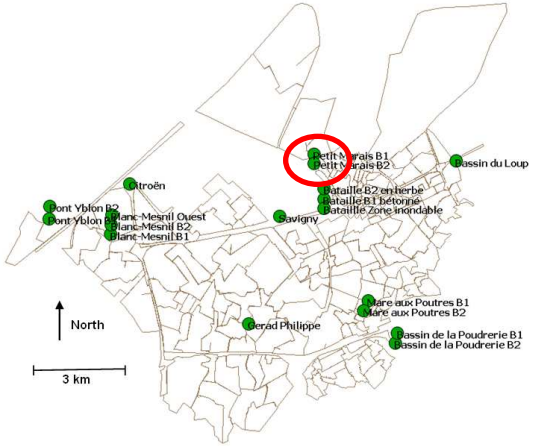
Storm water basins



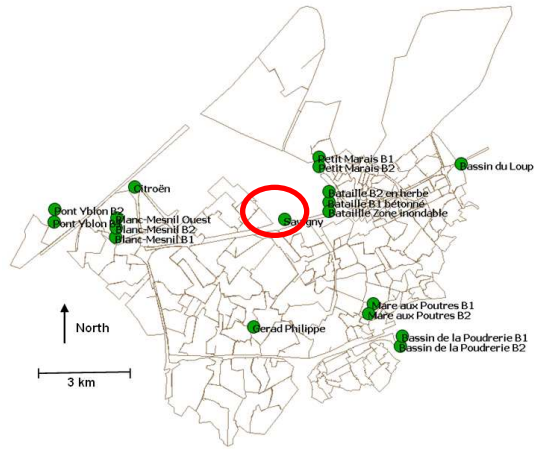
Mare aux Poutres



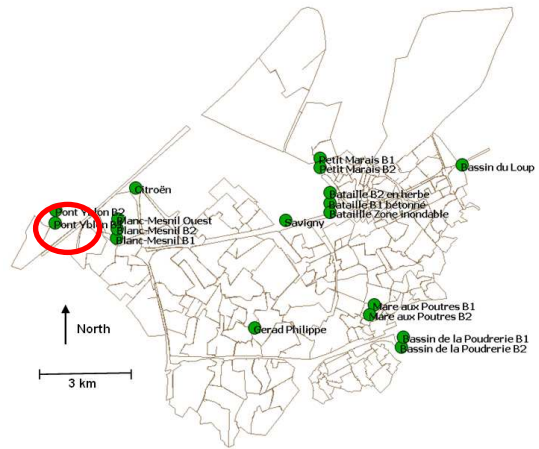
Petit Marais



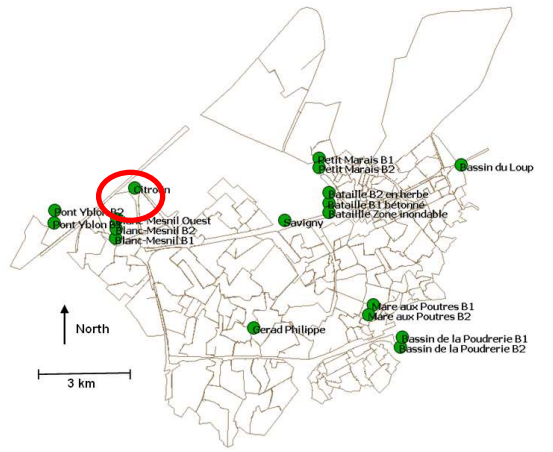
Savigny



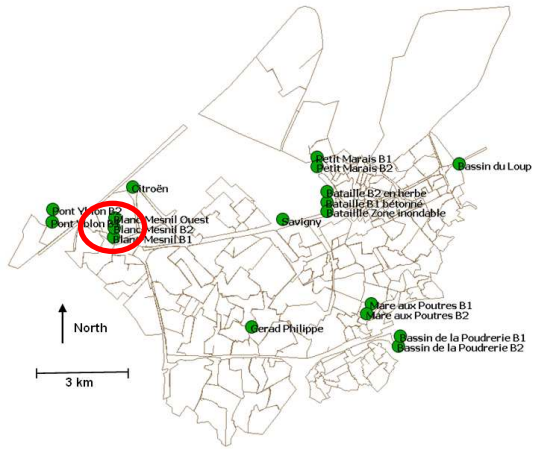
Pont Yblon



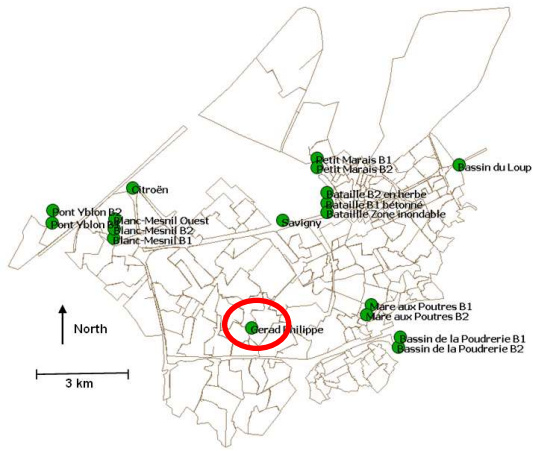
Citroën



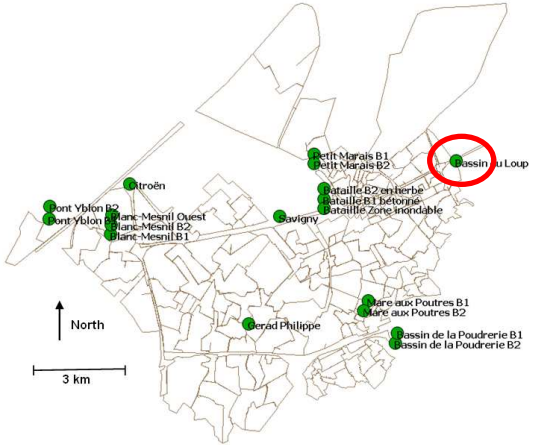
Blanc Mesnil



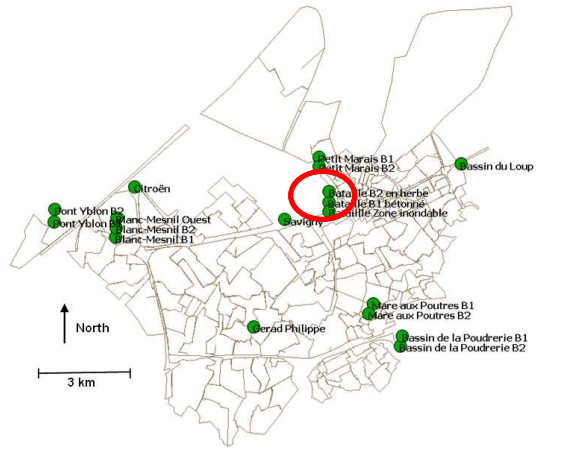
Gérard Philippe



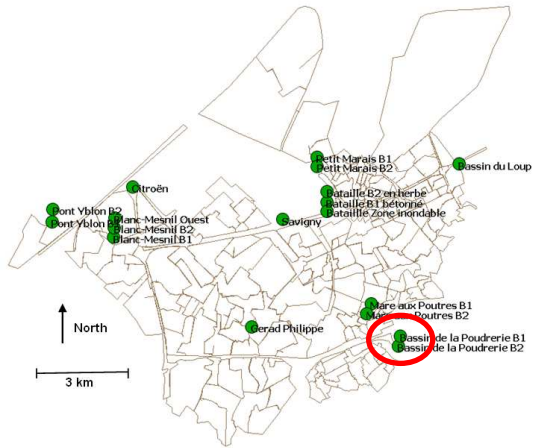
Le Loup



Bataille



Bassin de la Poudrerie

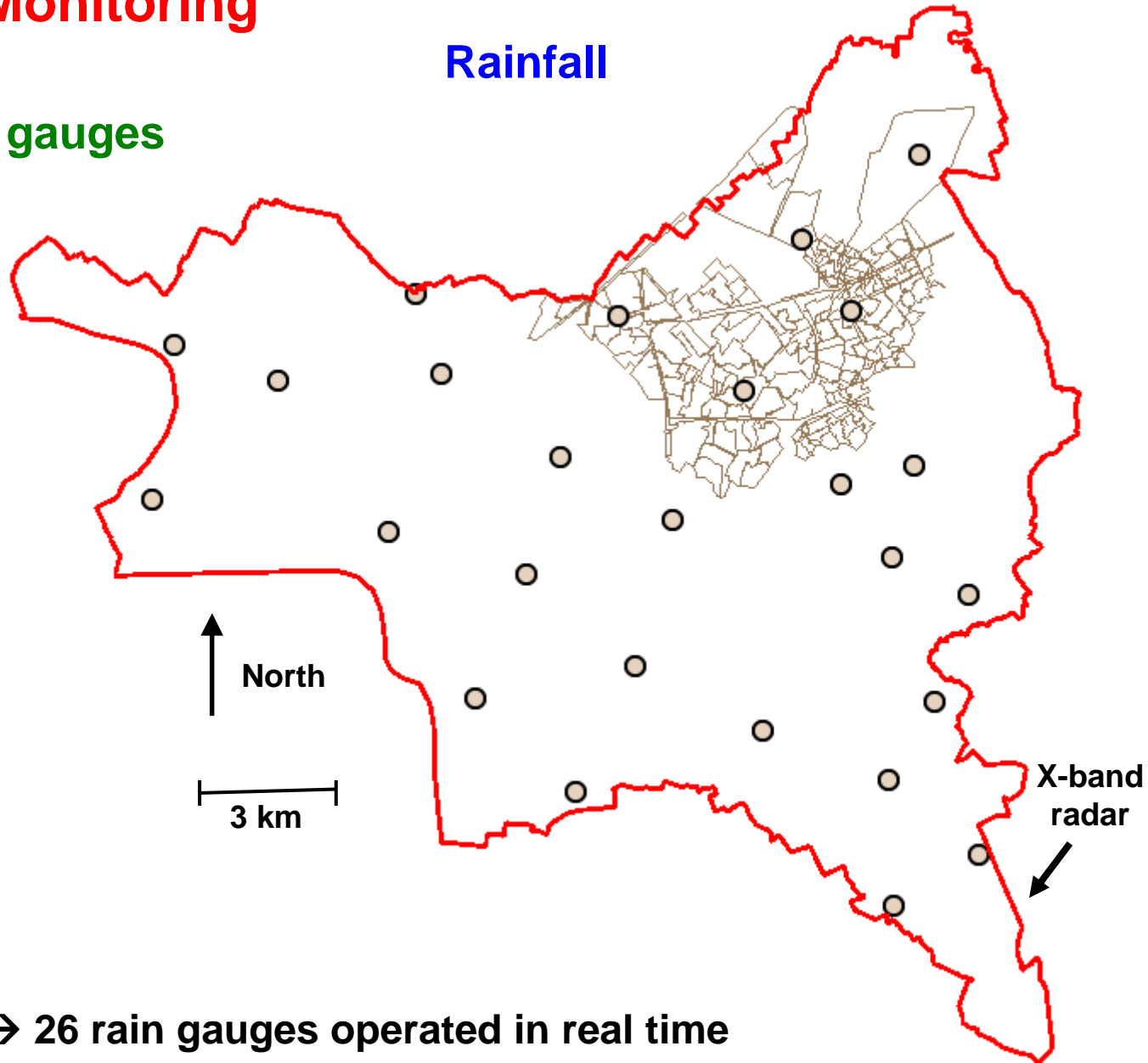


Event of 27 June 2001

Monitoring

Rainfall

Rain gauges



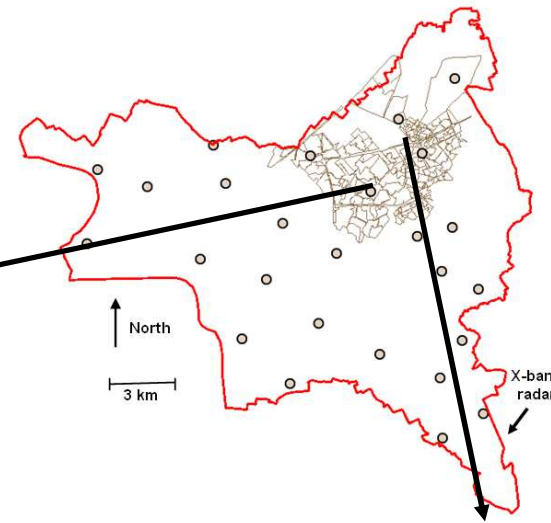
→ 26 rain gauges operated in real time

Monitoring

Rainfall

Rain gauges

Gérard Philippe



Petit Marais

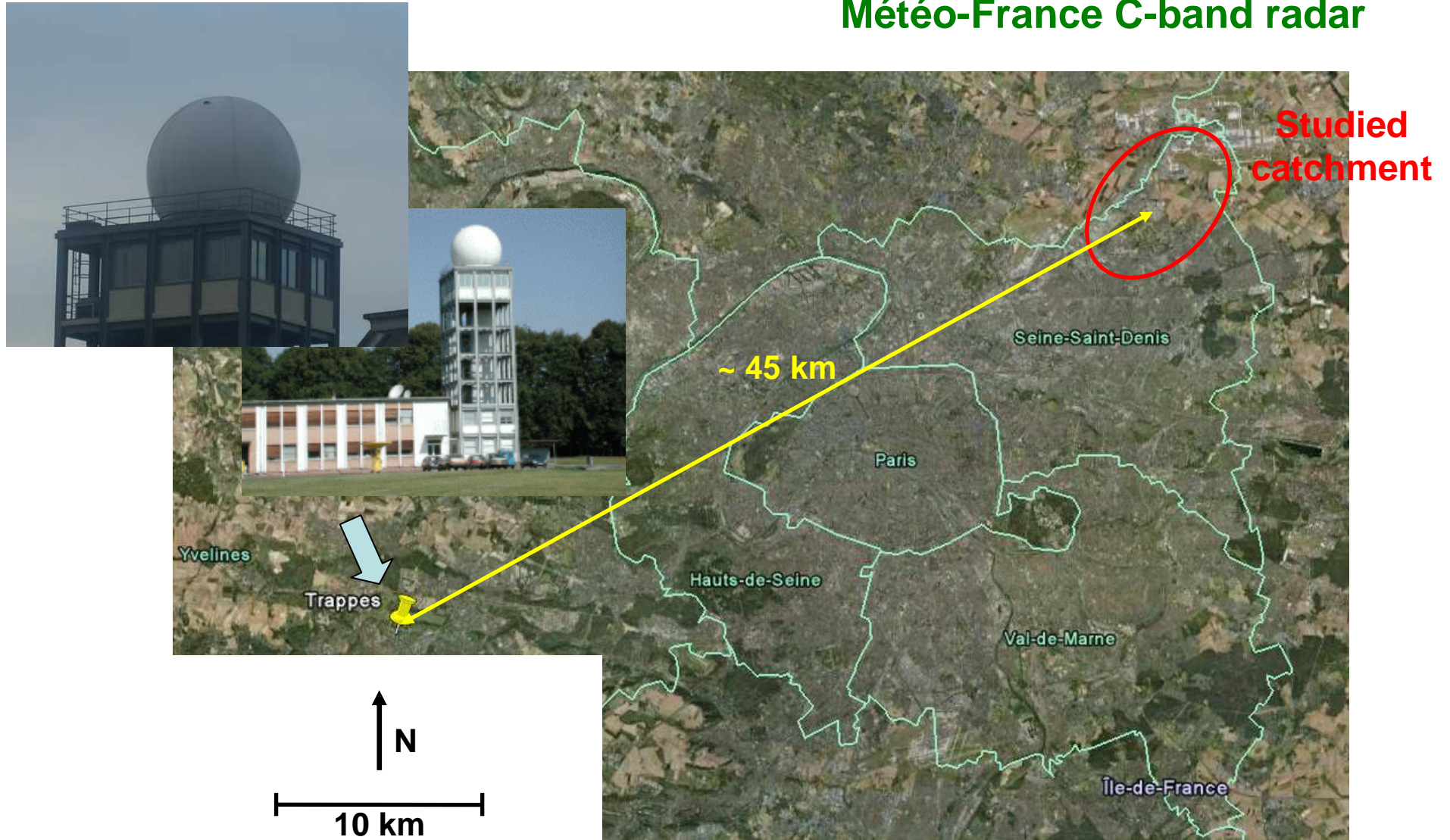


→ Two rain gauges are collocated at each location to ensure a backup.

Monitoring

Rainfall

Météo-France C-band radar

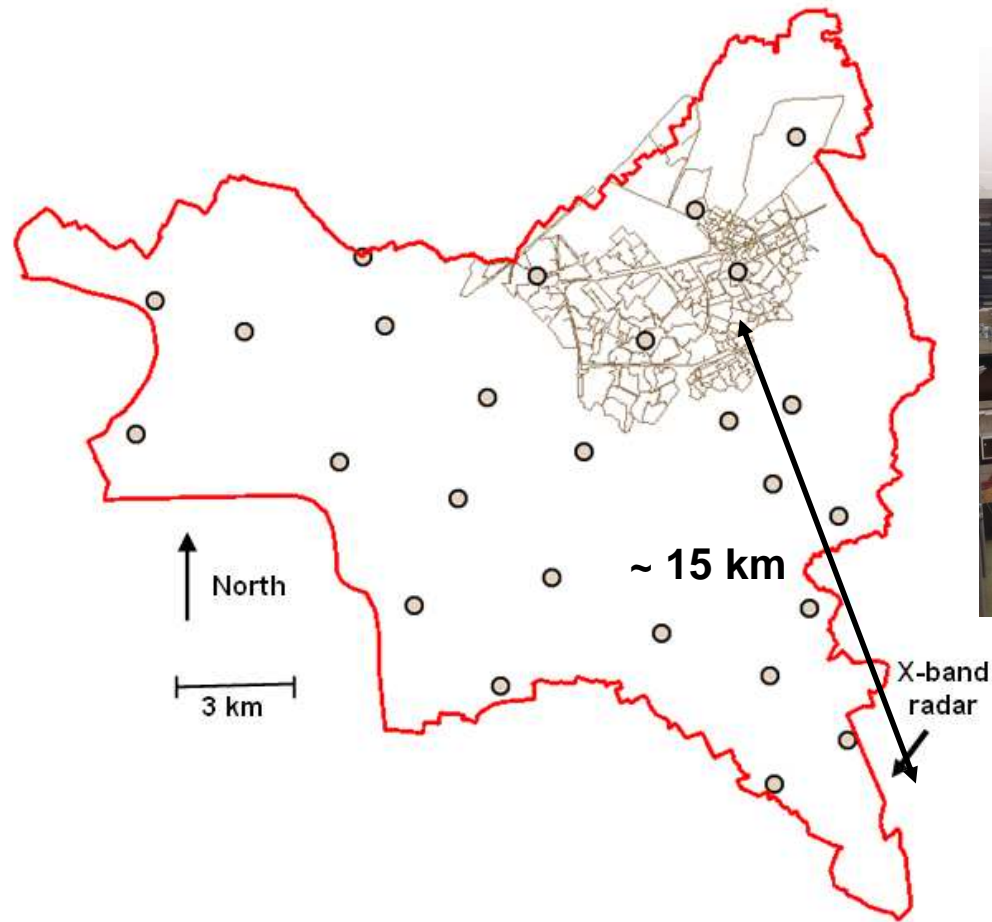


Resolution : 1 km x 1 km x 5 min

Monitoring

Rainfall

Dual-pol. X band radar



Resolution : 100 m x 100 m x 1 min

Monitoring

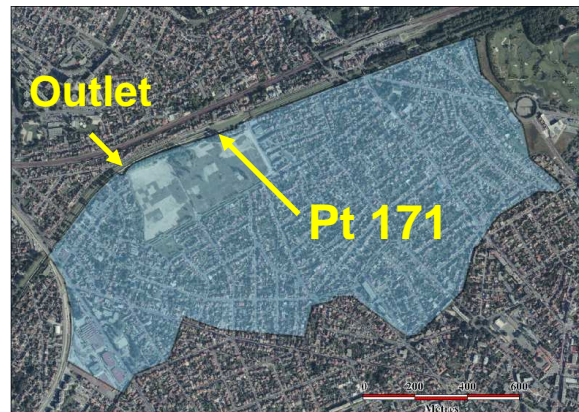
Sewer flow monitoring

Morée-Sausset catchment

At least one water level and velocity sensor before each storage basin

Kodak catchment

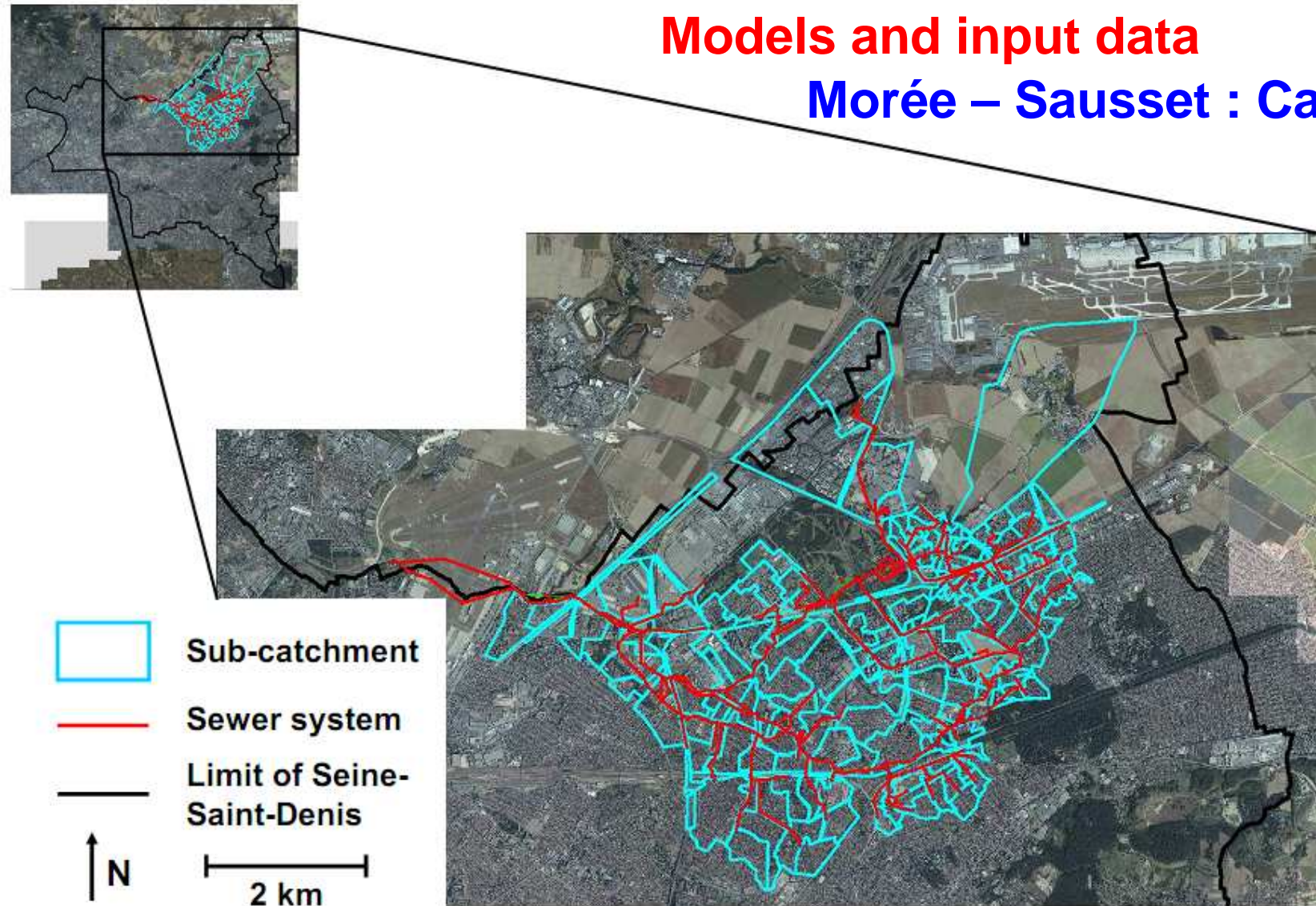
Level and velocity sensor measurement at Pt 171



Pt 171 is located in this pipe

Models and input data

Morée – Sausset : Canoe



- Modelled with Canoe (lumped model for each sub-catchment and Saint-Venant equations in the links)

- 3400 ha with 198 sub-catchments (avg 17 ha)
- 69 Km of links (avg slope 0.009 m/m)
- Total rainfall: 19 mm (North-West) → 9mm
- Rather flat area (mean link slope 0.009 m/m)

Models and input data

Kodak : Multi-Hydro

Surface module

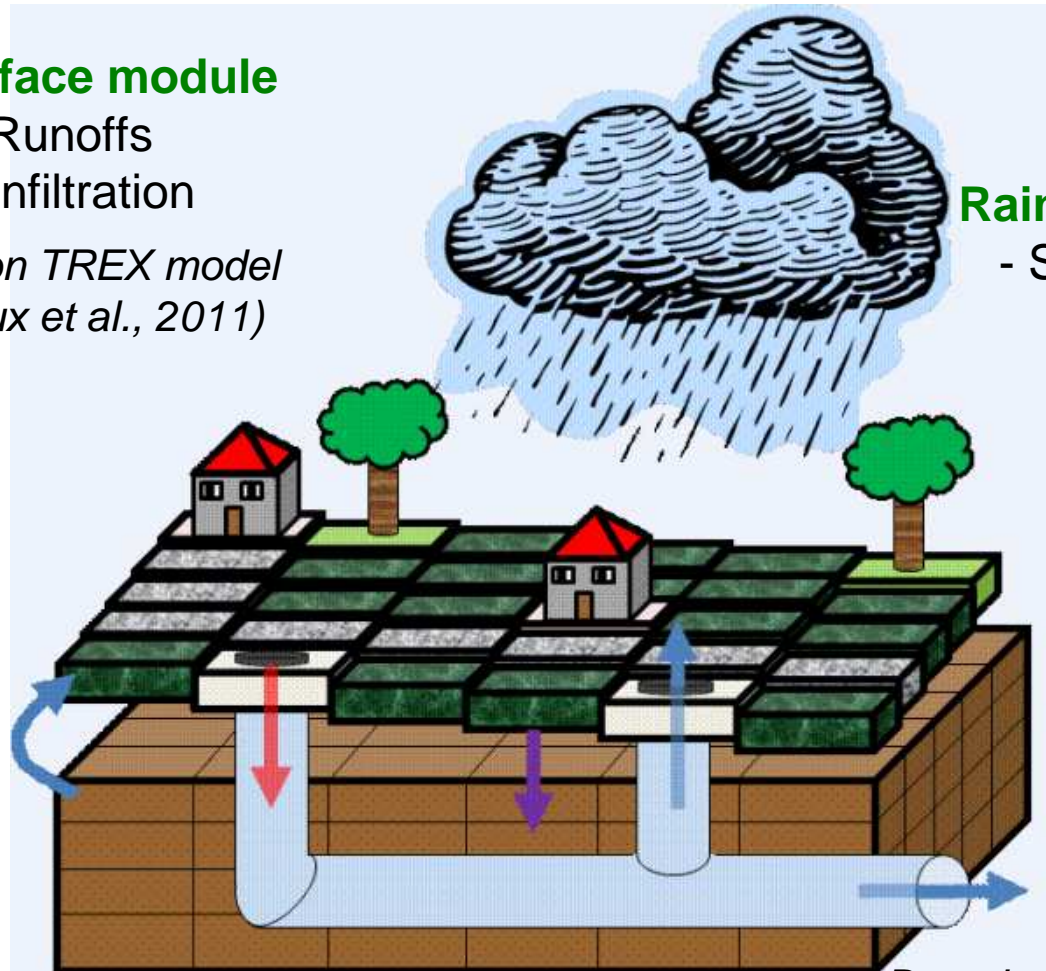
- Runoffs
- Infiltration

*Based on TREX model
(Velleux et al., 2011)*

Rainfall module

- Spatio-temporal rainfall

*Based on Multifractal cascades
(Schertzer and Lovejoy, 1987)*



Drainage module

- Sewer flow
(free surface, and loaded)
- Overflow

Based on SWMM model (Rossman, 2005)

Soil module

- Vertical flow in the non-saturated area
- Saturation during a rainfall event

Based on VS2DT model (Lapalla et al., 1987)

*For more details, meeting here next year for
Agathe Giangola-Murzyn's PhD defence !*

Models and input data

Spatial data

The spatial data inputted to the fully distributed and physically based Multi-Hydro model, which is used for the Kodak catchment, comes from the French National Institute of Geography:

- Land use cover: the spatial resolution is 50 cm x 50 cm
- Digital elevation model: the current spatial resolution is of 25 m x 25 m with a vertical precision of 1 m. An improved DEM with a spatial resolution of 1 m x 1 m with a vertical precision of 10 cm is currently being developed and will soon be available for this area

Models and input data

Spatial data



Models and input data

Drainage system

- **Separate sewer system**
- **Main sewer = former Morée and Sausset river (channelled and covered)**
- **18 storm water storage basins of total volume 577 000 m³.**
- **No weirs nor pumping stations (except for the emptying of the basins)**
- **Storm water is then routed to Seine River through the Garges-Epinay sewer.**

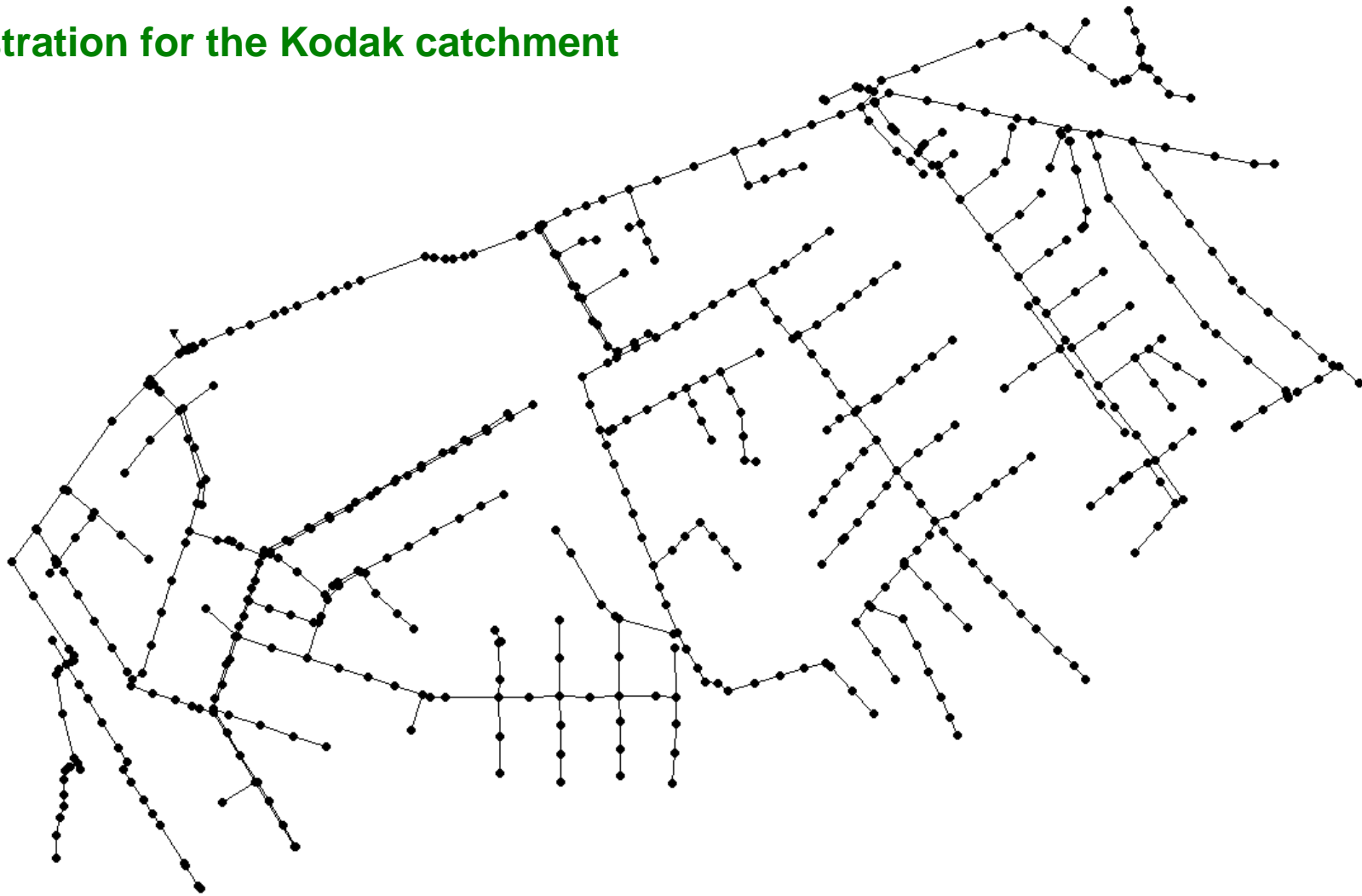
With Canoe, only the main sewer network the Morée-Sausset catchment (i.e. operated by the Seine-Saint-Denis County) is modelled. It consists of 69 km of pipes with an average slope of 0.009 m/m.

For the Kodak catchment, the whole sewer network is considered, leading to 560 conduits (of total length 18.4 km) collecting water from 510 manholes.

Models and input data

Drainage system

Illustration for the Kodak catchment



Spatial data

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Concerning the Canoe model, the area is divided in 198 sub-catchments which are considered as homogenous. Their size ranges from 0.9 to 92 ha, except for two of size 347 and 404 ha. The average size is 17 ha. The mean coefficient of imperviousness is 41%, with values ranging from 0 to 95%