SunRise : Smart Urban Networks for Resilient Infrastructure & Sustainable Ecosystems Smart City Demonstrator

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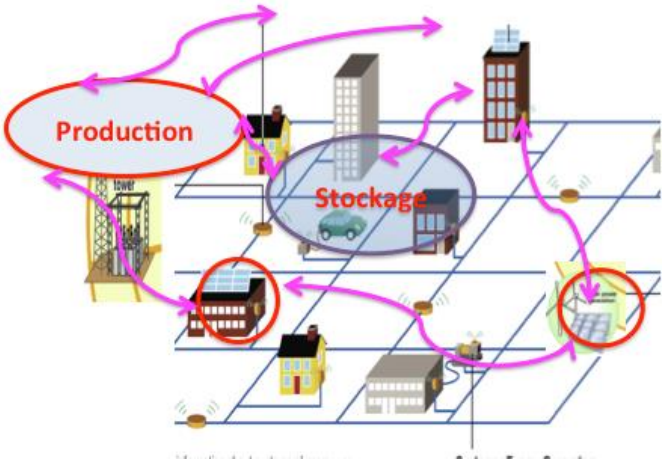
(University Lille1/Polytech'Lille)

Bruno Nguyen,

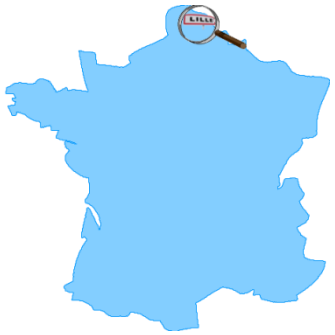
President, W-SMART



70 km Urban Network:

- Water (drinking and sewage)
- District heating
- Gas
- Electrical
- Public lighting

Scientific City Campus



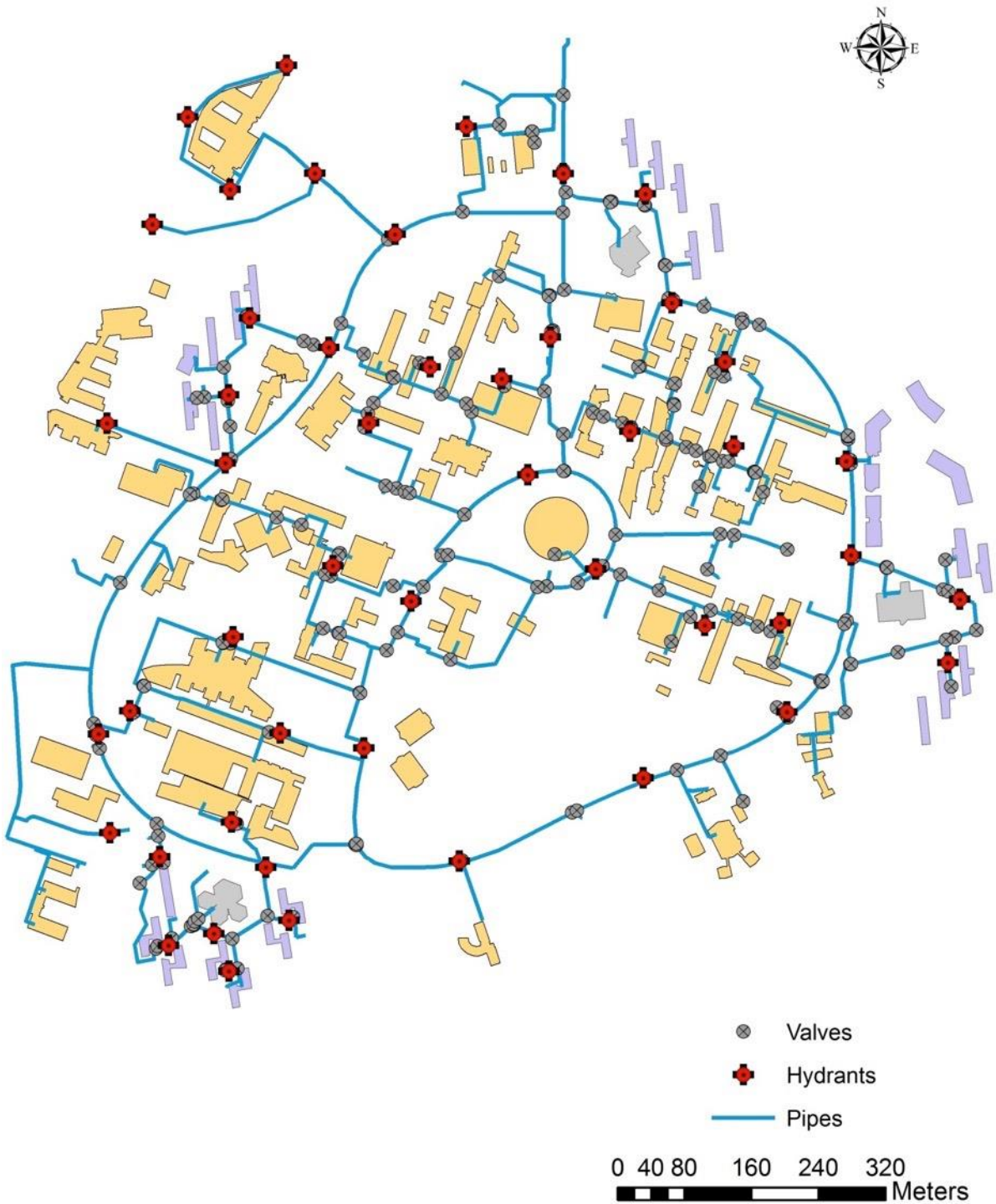
Small town:

- 110 Hectares
- 23 000 users
- 70 km of Urban Network
- 300 000 m^2 of constructions

SWN:

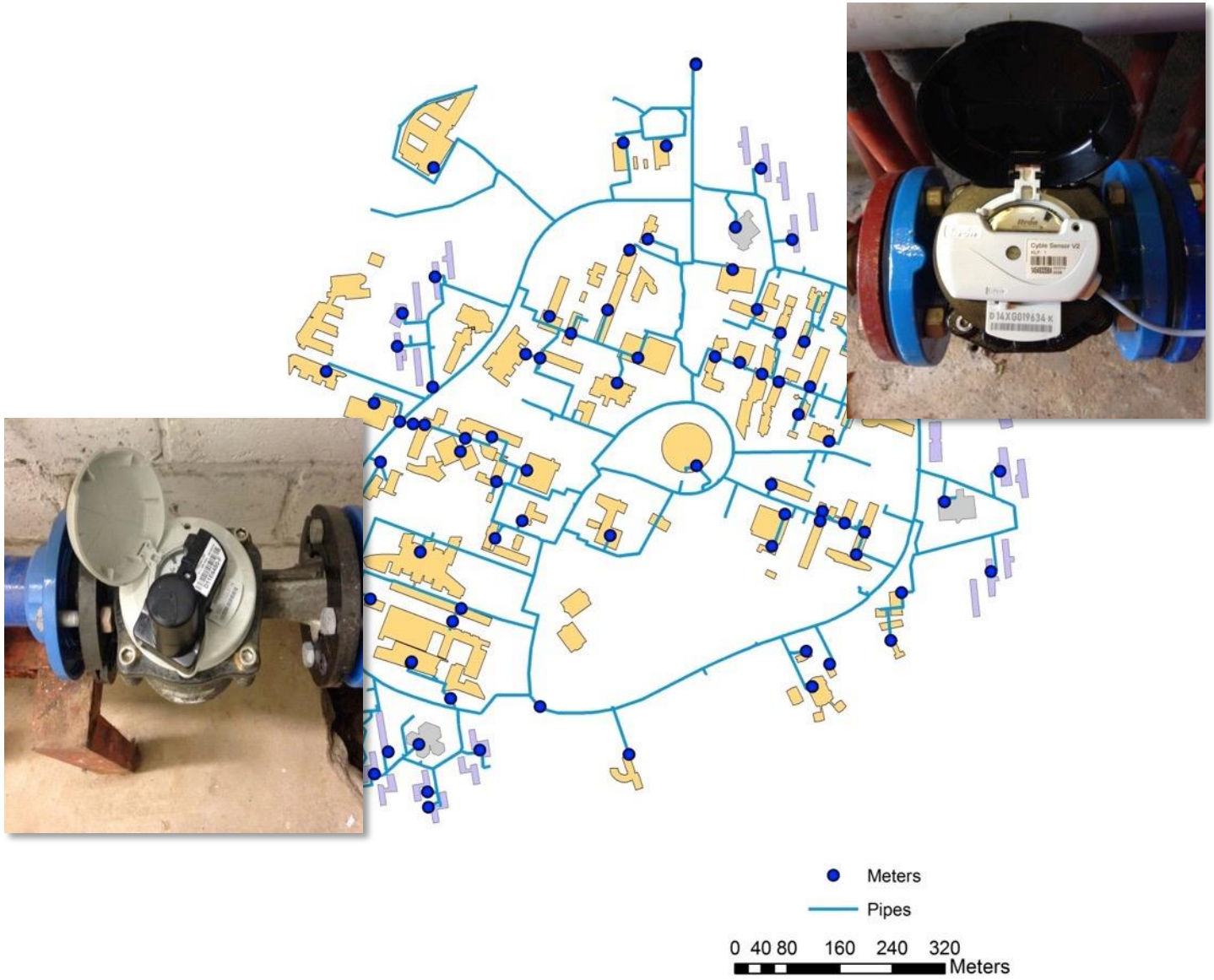
- VITENS
- EAU DE PARIS
- EAUX DU NORD
- KWR
- Université de Lille
- CEA-List
- CALMWATER

- 15 Kms of networks
- 49 hydrants
- 250 valves



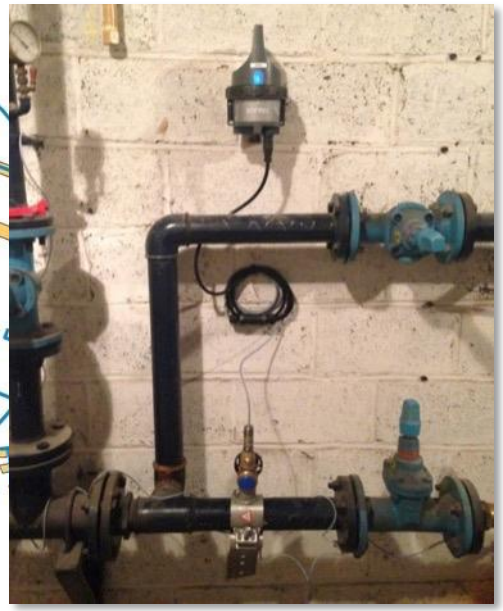
Monitoring :

90 Automatic Meter Readings (AMRs)



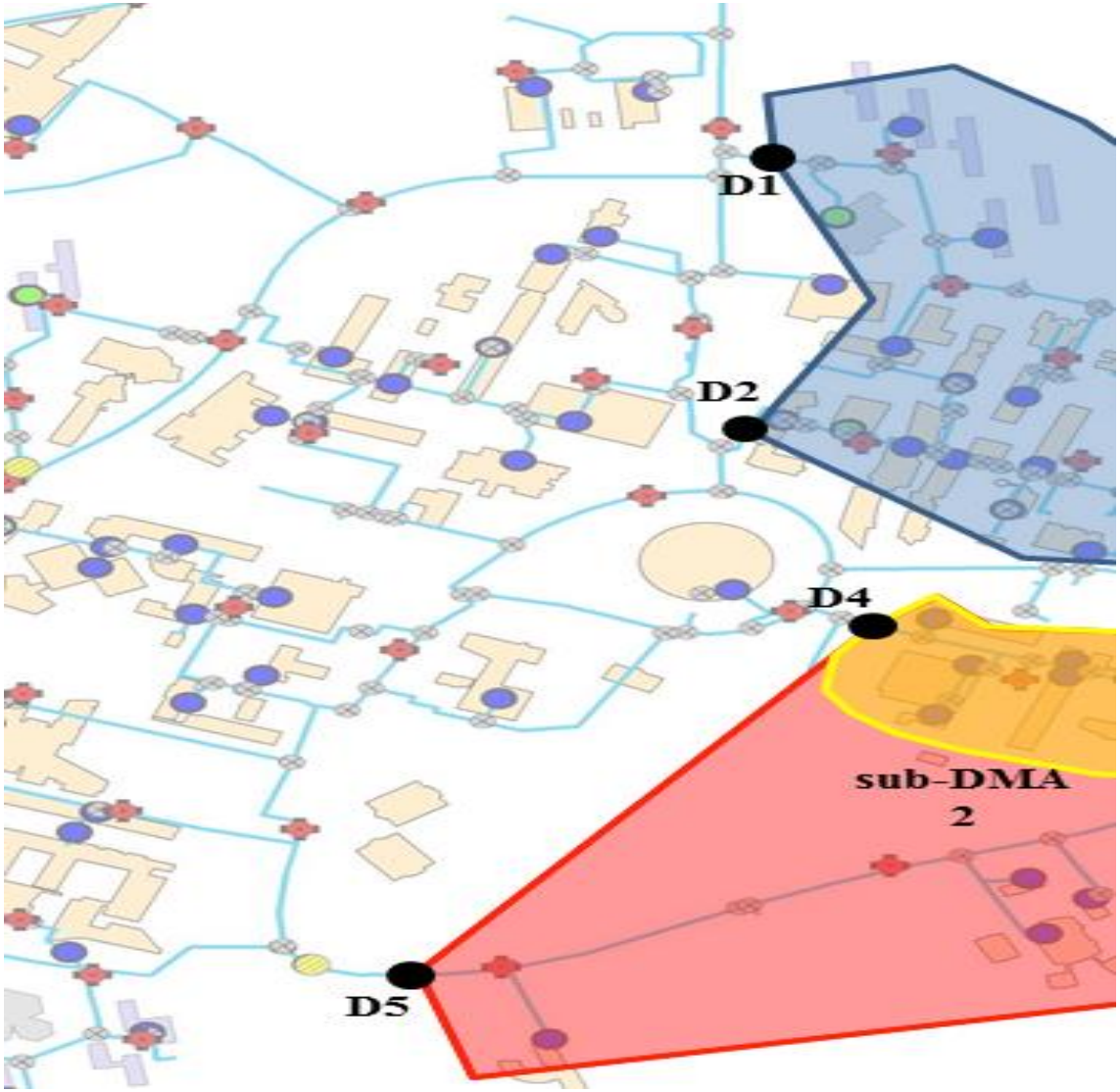
Monitoring :

5 Pressure sensors

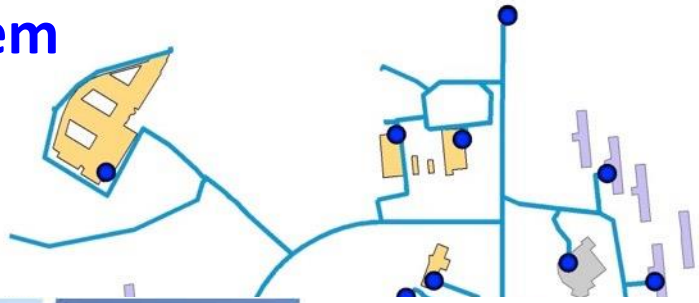


Monitoring

District metered areas (DMA) (under construction)

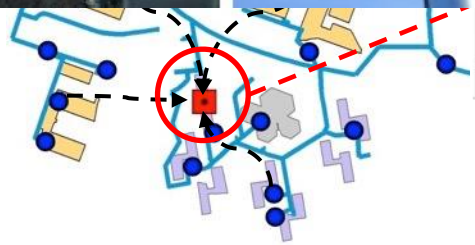


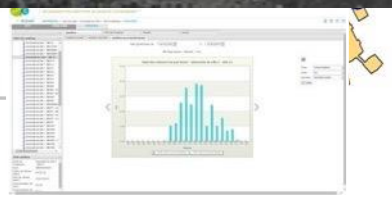
Data collection system



VHF 169 MHz

GPRS





Receivers

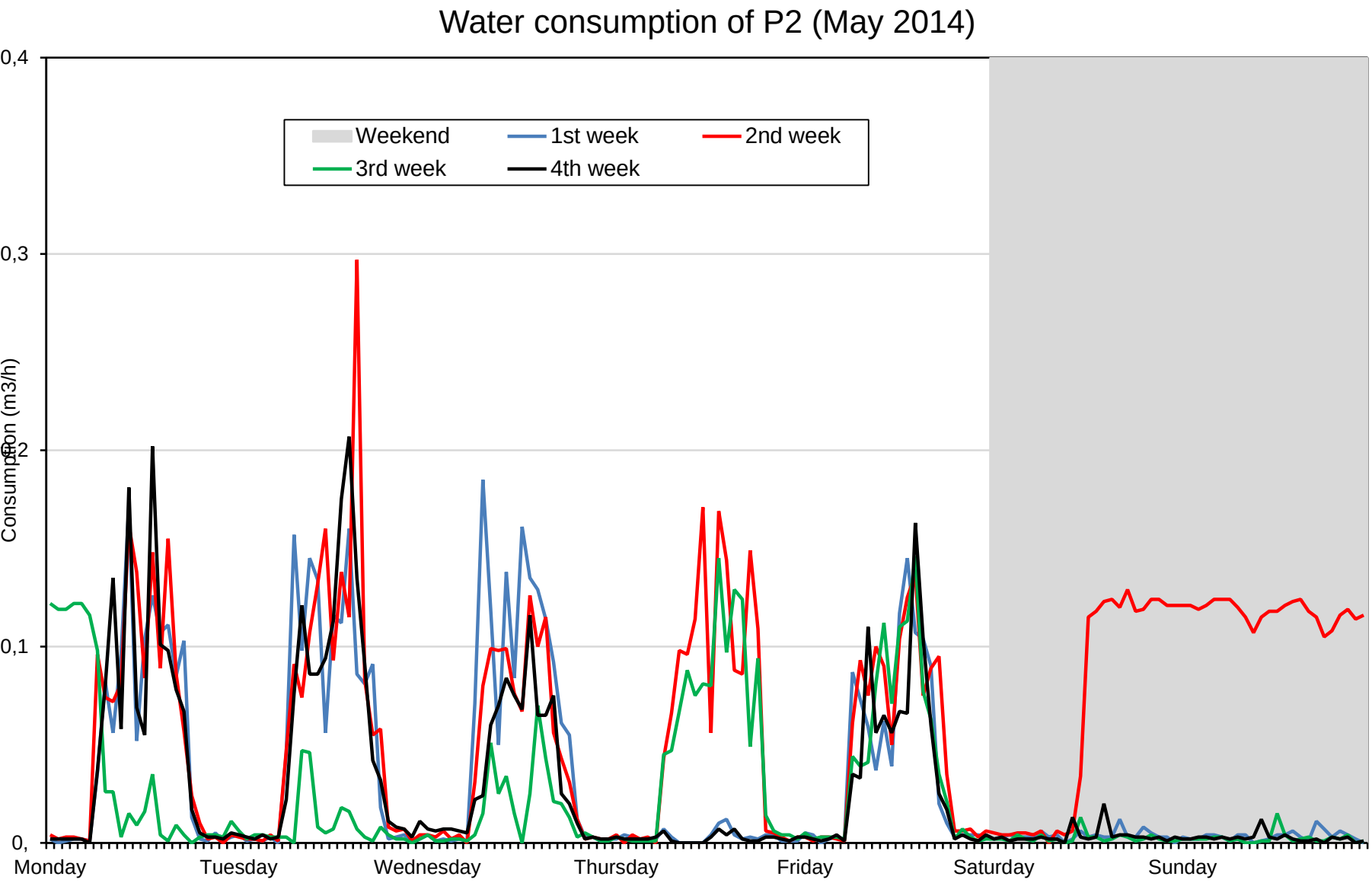
Meters

Pipes

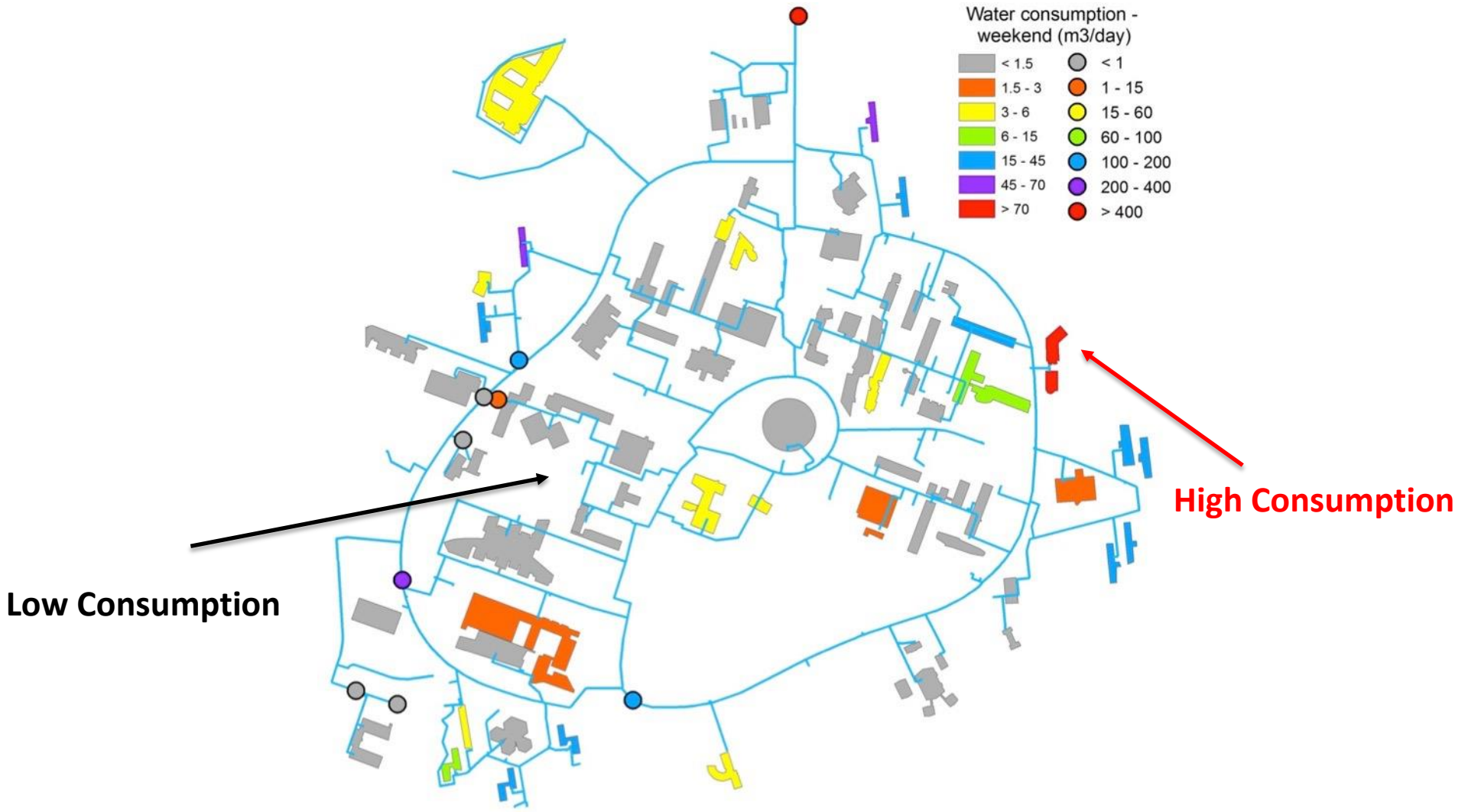
0 40 80 160 240 320

Meters

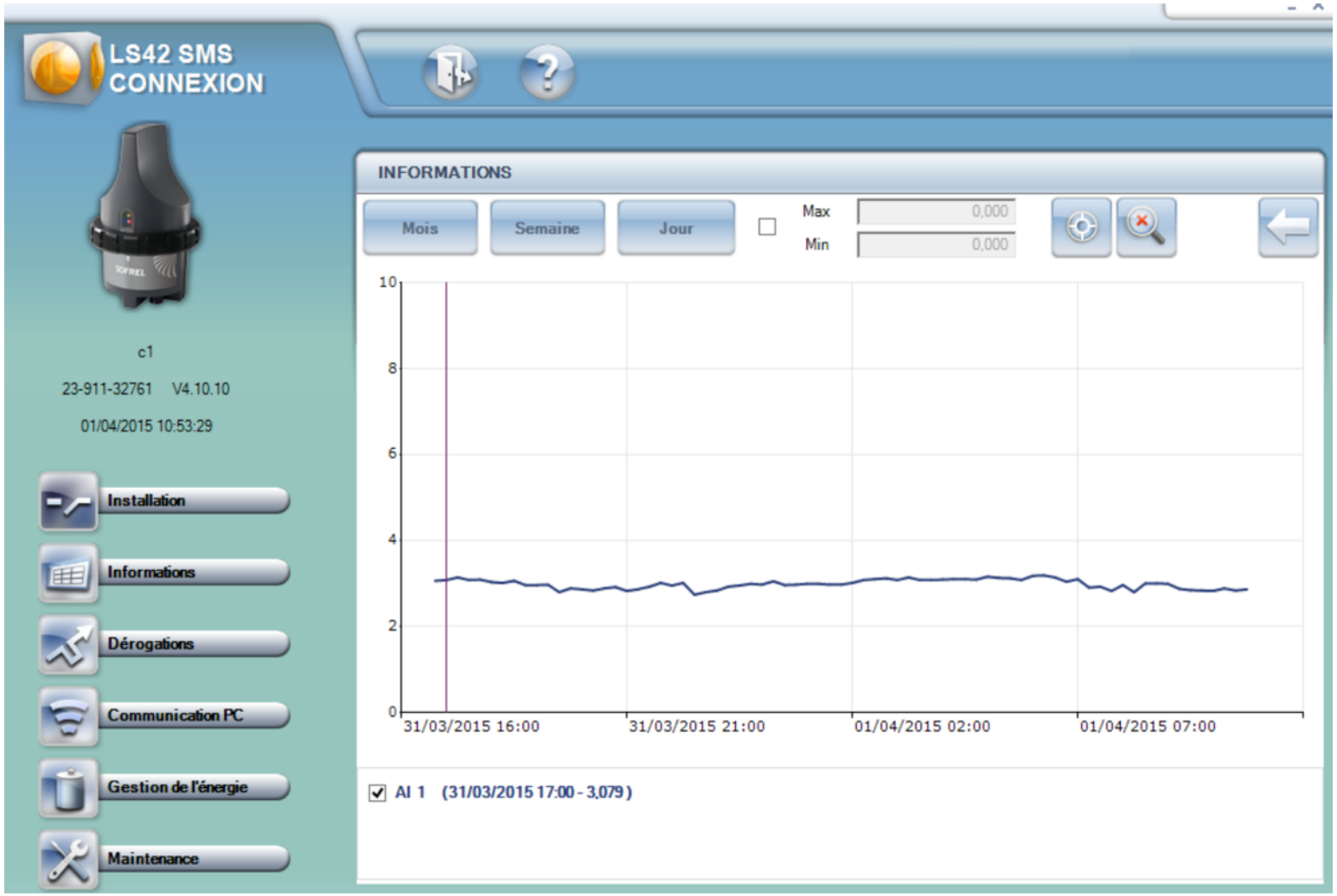
Example of AMR reading



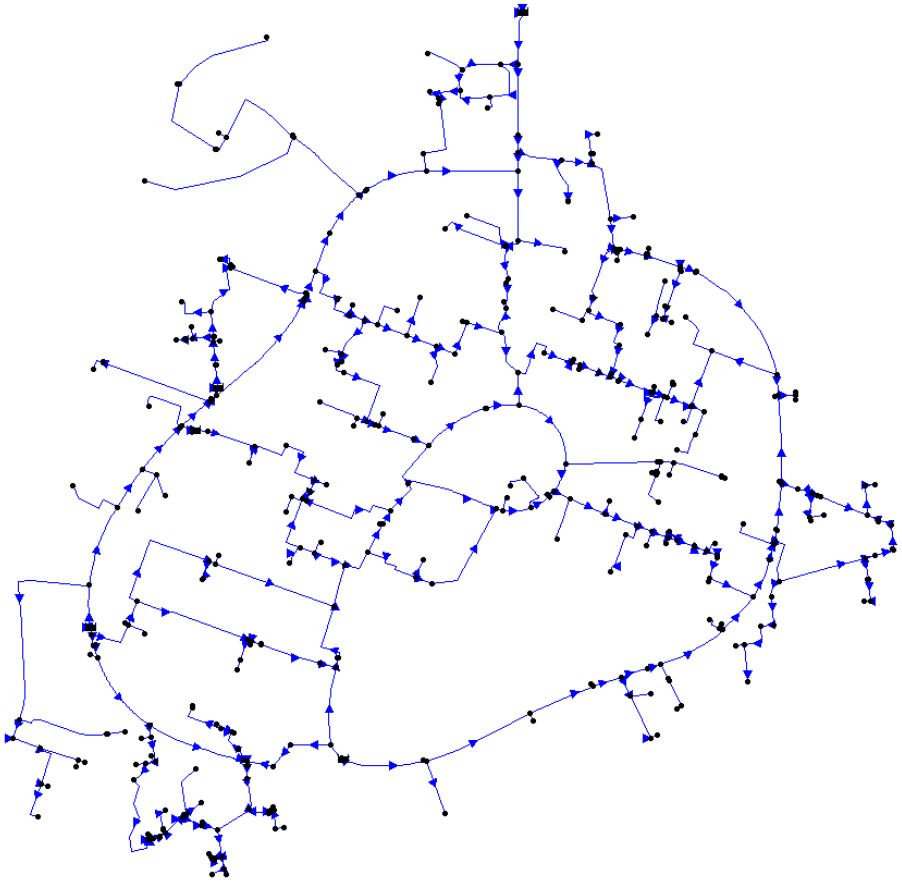
Water Consumption in the Campus (week-end)

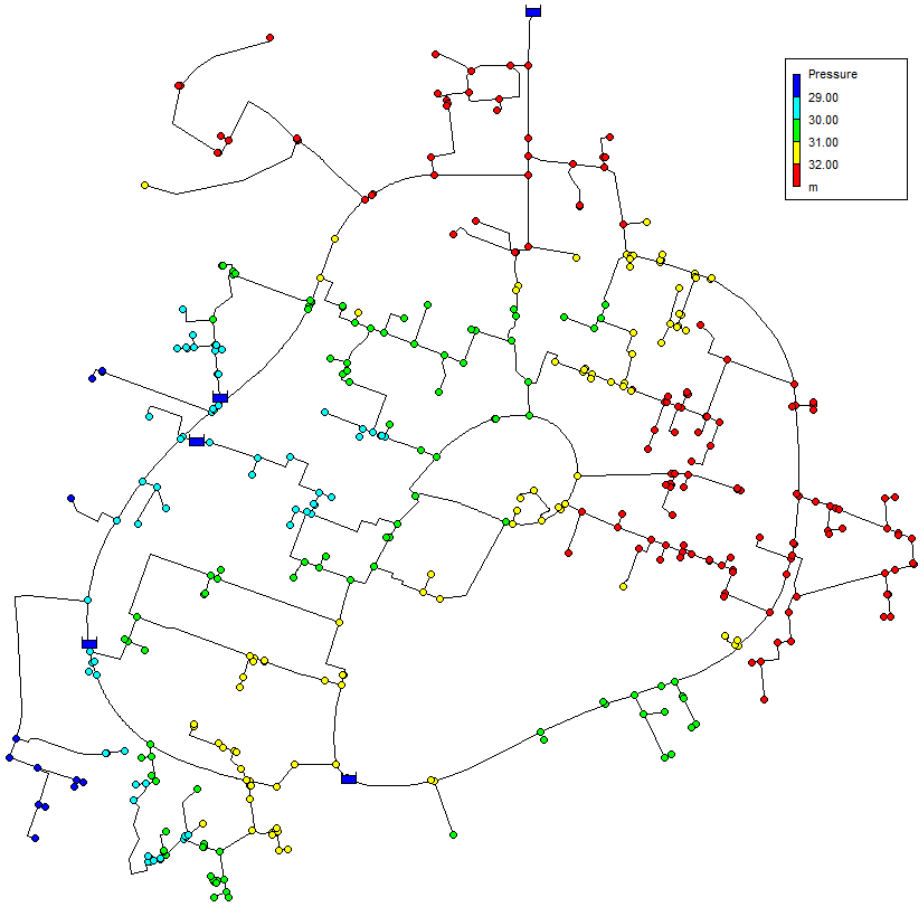


Example of pressure variation



Hydraulic Modeling (EPANET)





"W- SMART"

Water Security Management Academy for Research & Technology

–University Industry Collaborative Research & Development Center

University Lille-1 – W-SMART – KWR Research Institute – CEA LIST Institute

Bio-SMART sponsored by EDP, SEN, VITENS

Bio-Safety Monitoring & pro-Active Real-time conTrol

INCOM sponsored by EDP, SEN

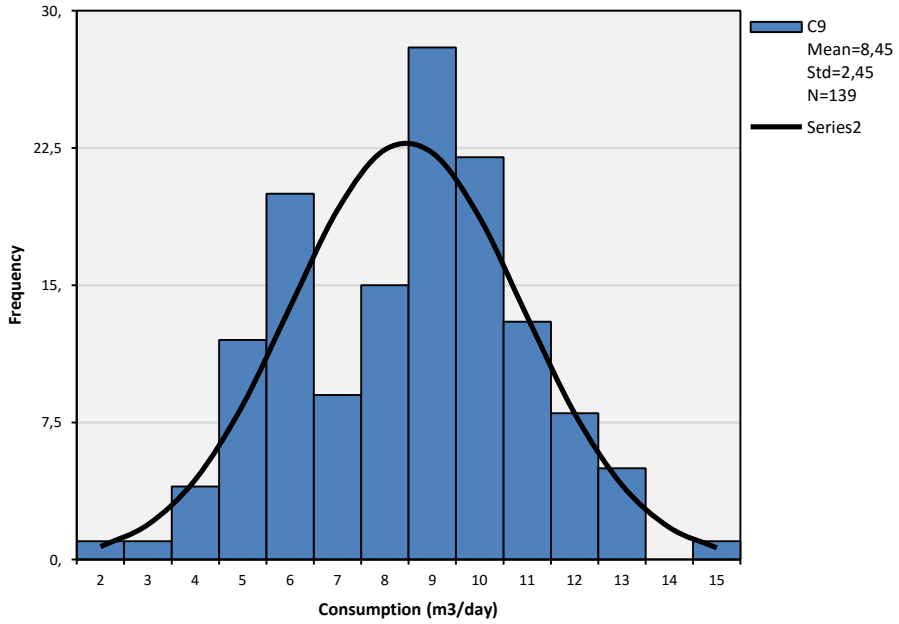
Intelligent Network Control & On-site Monitoring

SmartWater4Europe sponsored by EU-FP7

Smart Water Network Demonstrator Project - VITENS

Leak detection methods

- Analysis of the minimum night flow (MNF) measured
- District metered areas (DMA)
- Statistical analysis of historical data



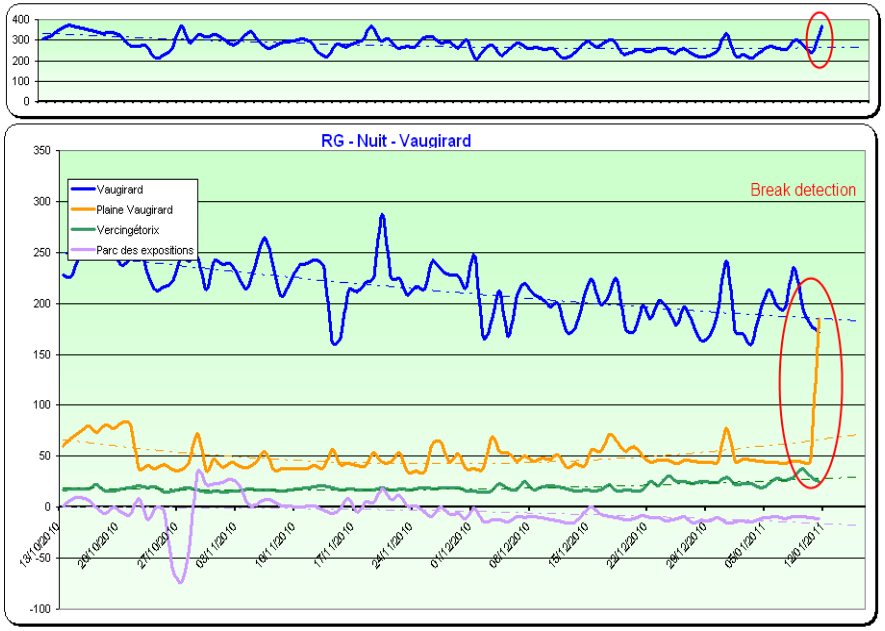
Leakage Detection

Leakage detection with increasing average night flow and daily distributed volume

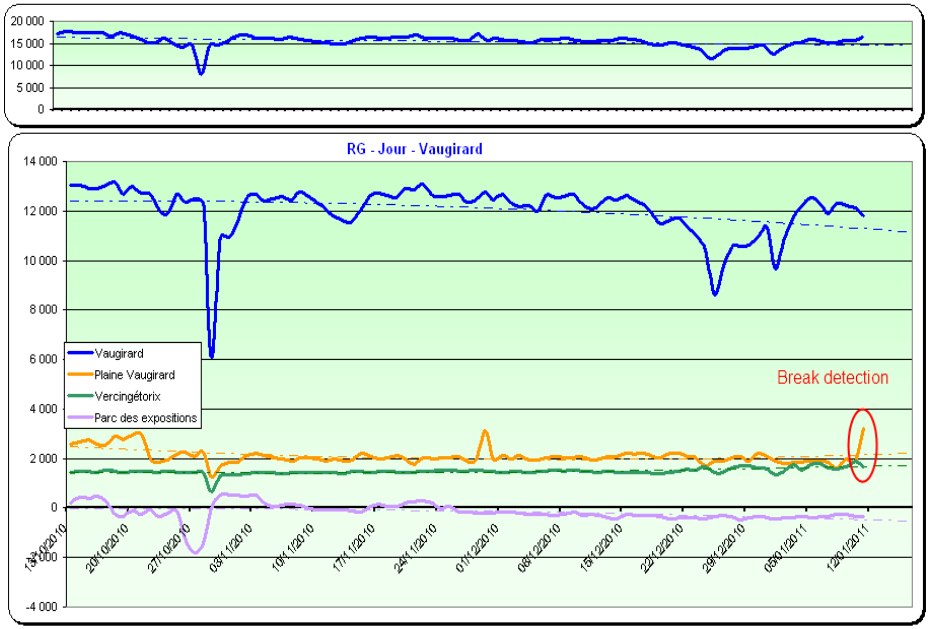
Most of leakage detection are detected with the average night flow and confirmed with the daily distributed volume.

Rising detection has to be correlated with operation events (it can be due to filling swimming pool for example).

Average night flow

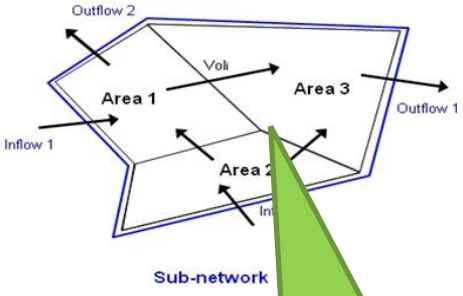


Daily distributed volume



Limitation: Mirror Effect

Majority **errors** in analysis of the distribution data for leak detection are due to a **default in the human identification** of the **mirror effect**.



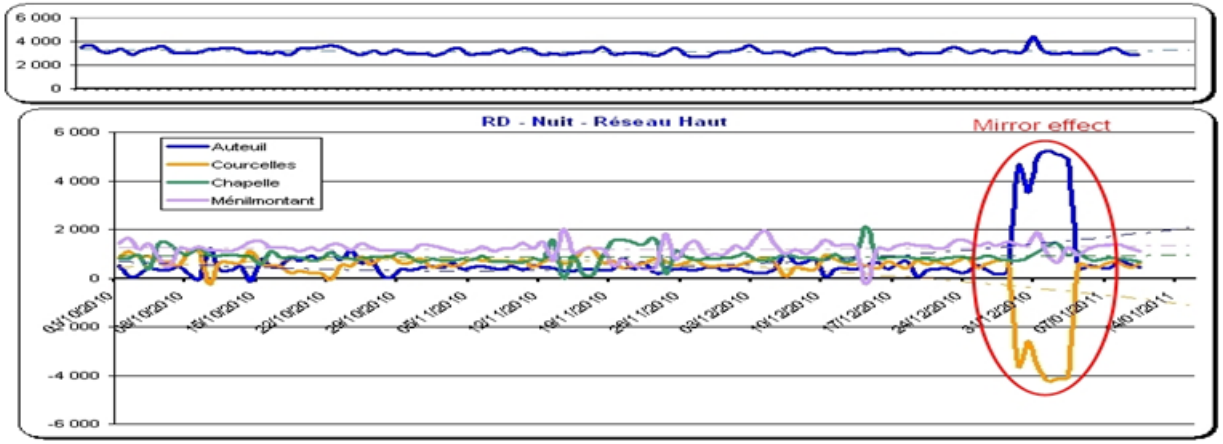
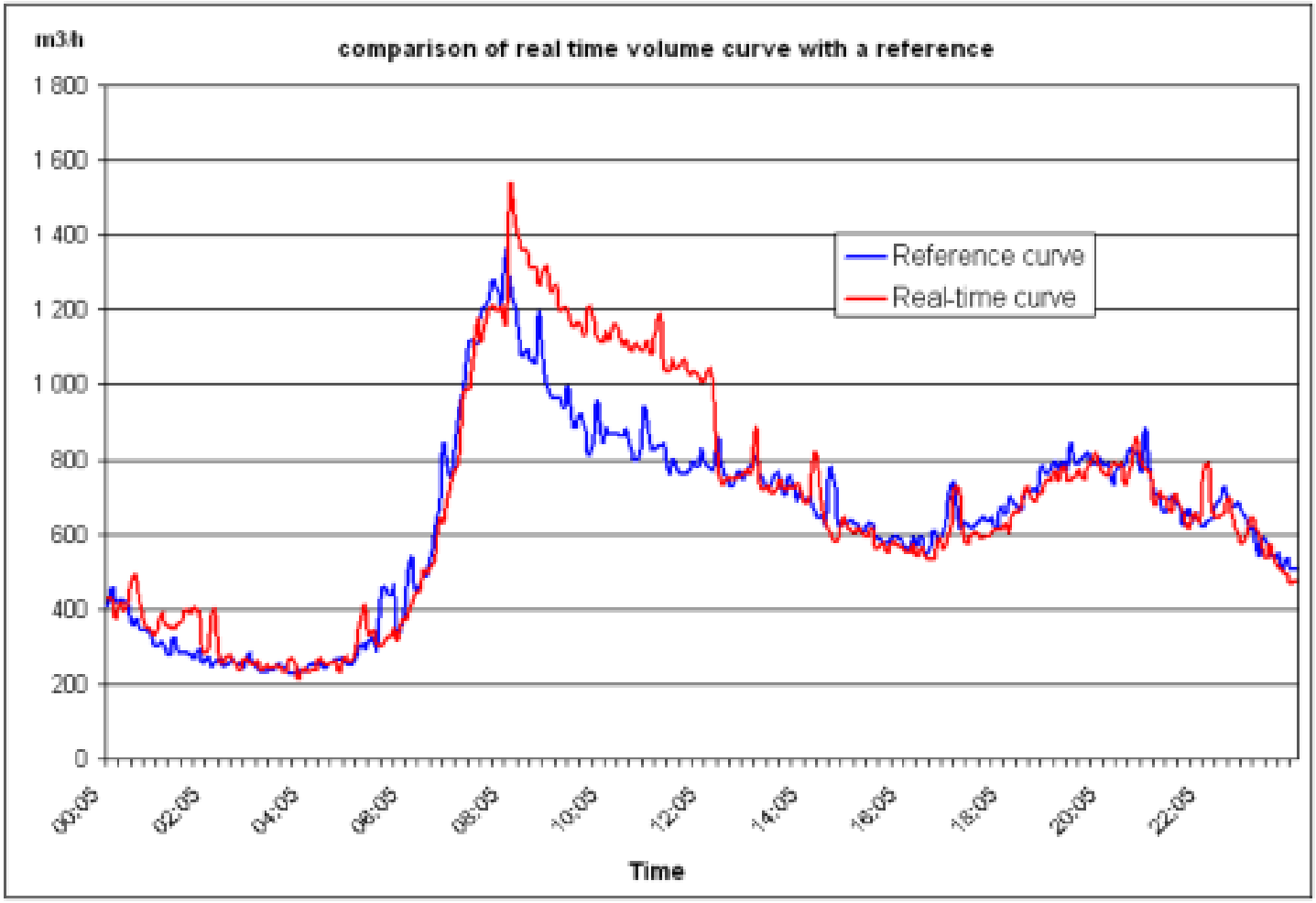


Figure 16: Mirror effect of an area flow-meter default.

Deficient flow-meter between **two areas (volume transferred not measure) therefore** "**mirror effect**" while the sub network curve of distributed water is not affected.

Leakage detection with virtuals sensors



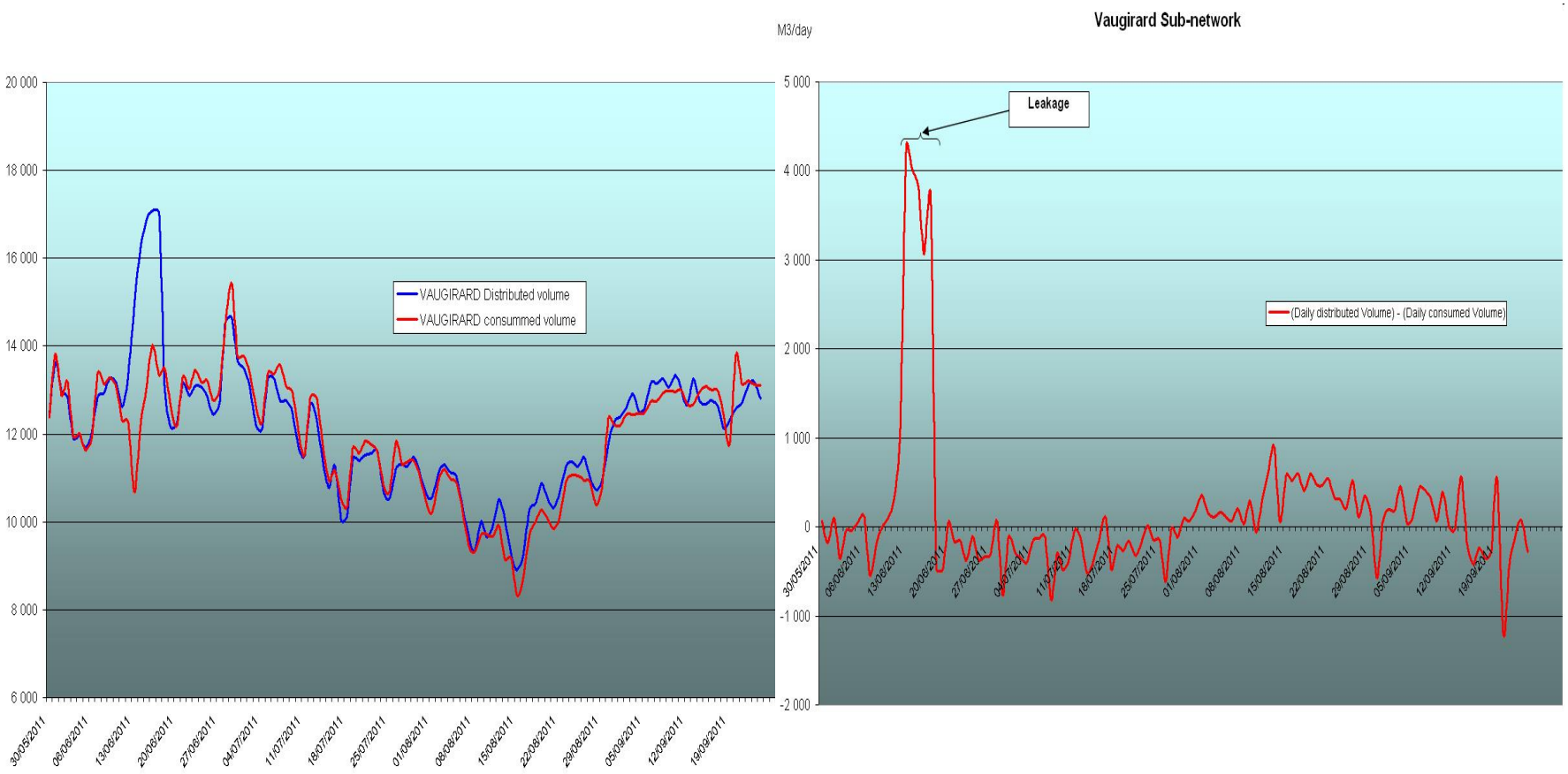
INCOM

The real-time sub-network distributed flow rate water is compared to the historical flow rate water for similar period

A low and high threshold alarm system detect abnormal evolution of the sub-network water distribution

F. Montiel, B. Nguyen – Eau de Paris - frank.montiel@eaudeparis.fr, bruno.nguyen@eaudeparis.fr

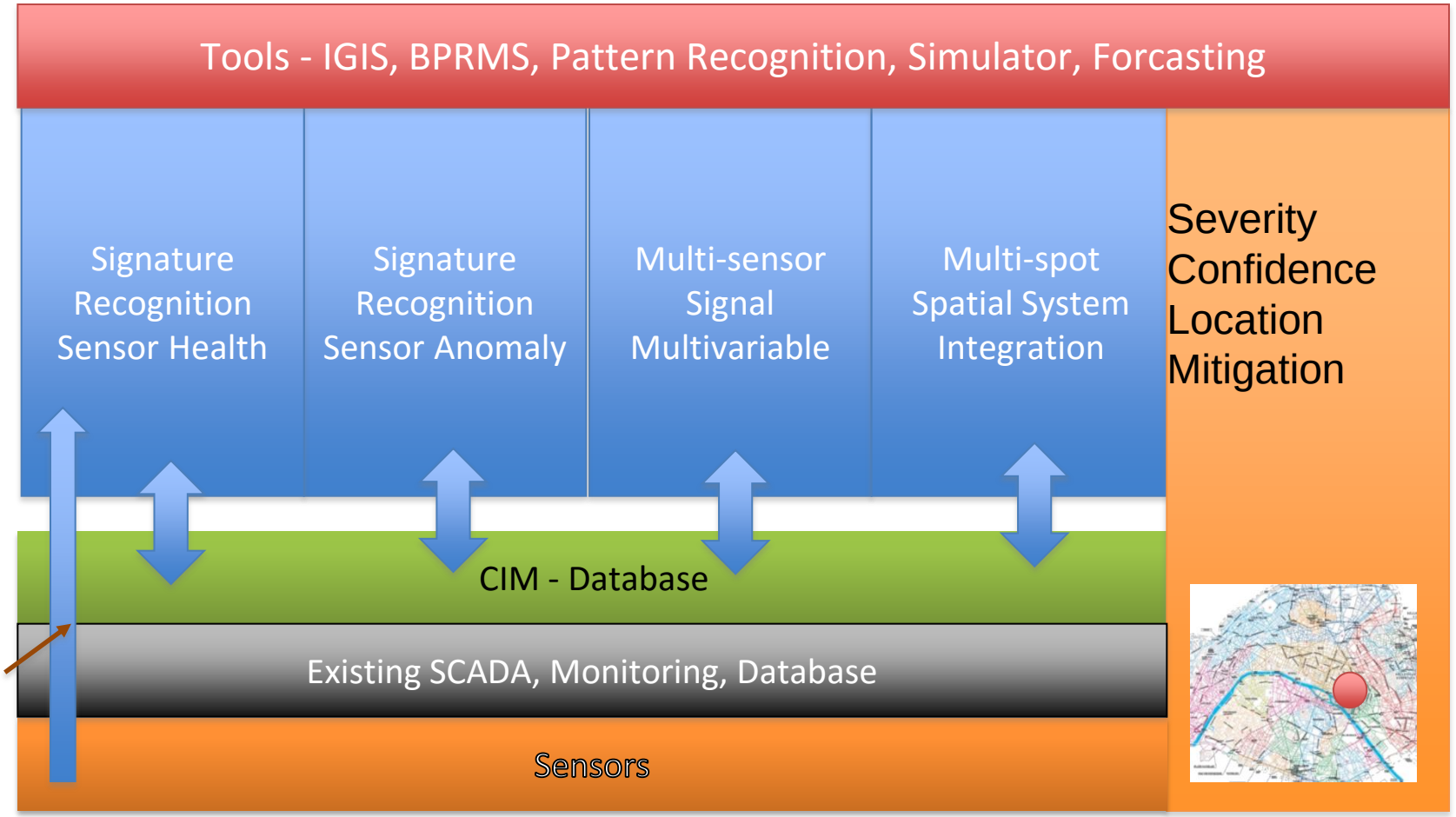
AMR-DMA Pipe leakage detection example



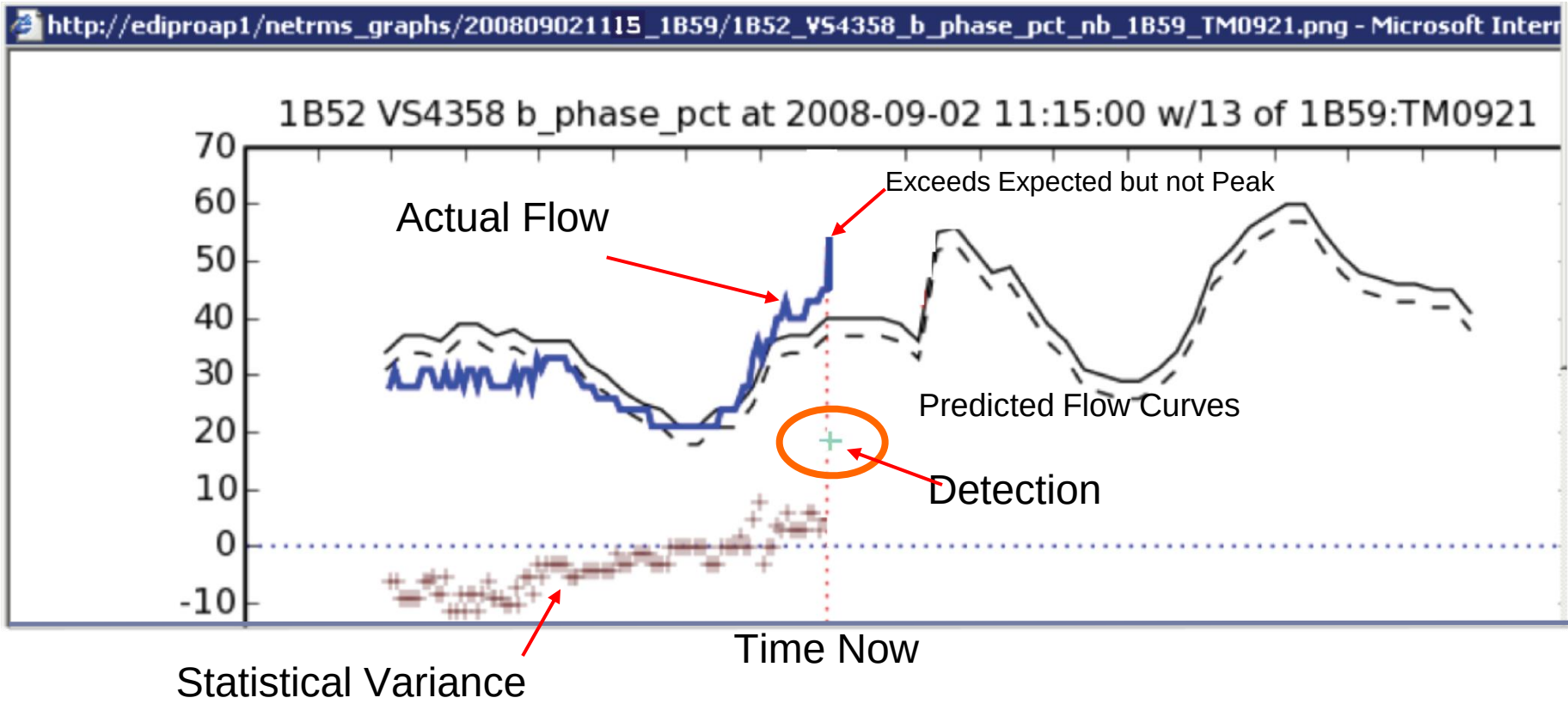
Comparison between Daily water distributed volume trend and Daily water consumption volume trend in the same sub network.

Daily water losses calculated trend in a sub network.

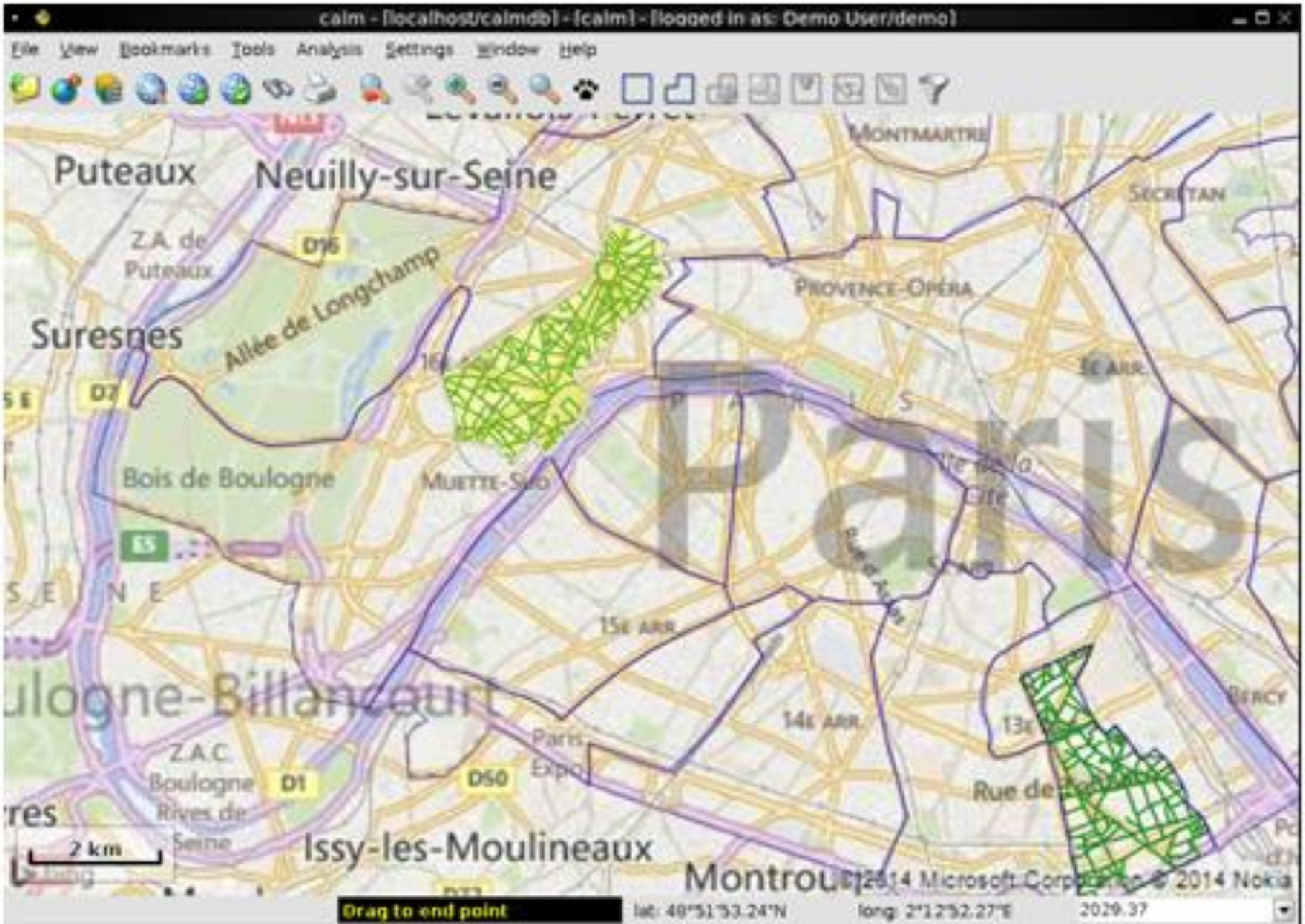
Command and Control System of Systems
C2SOS



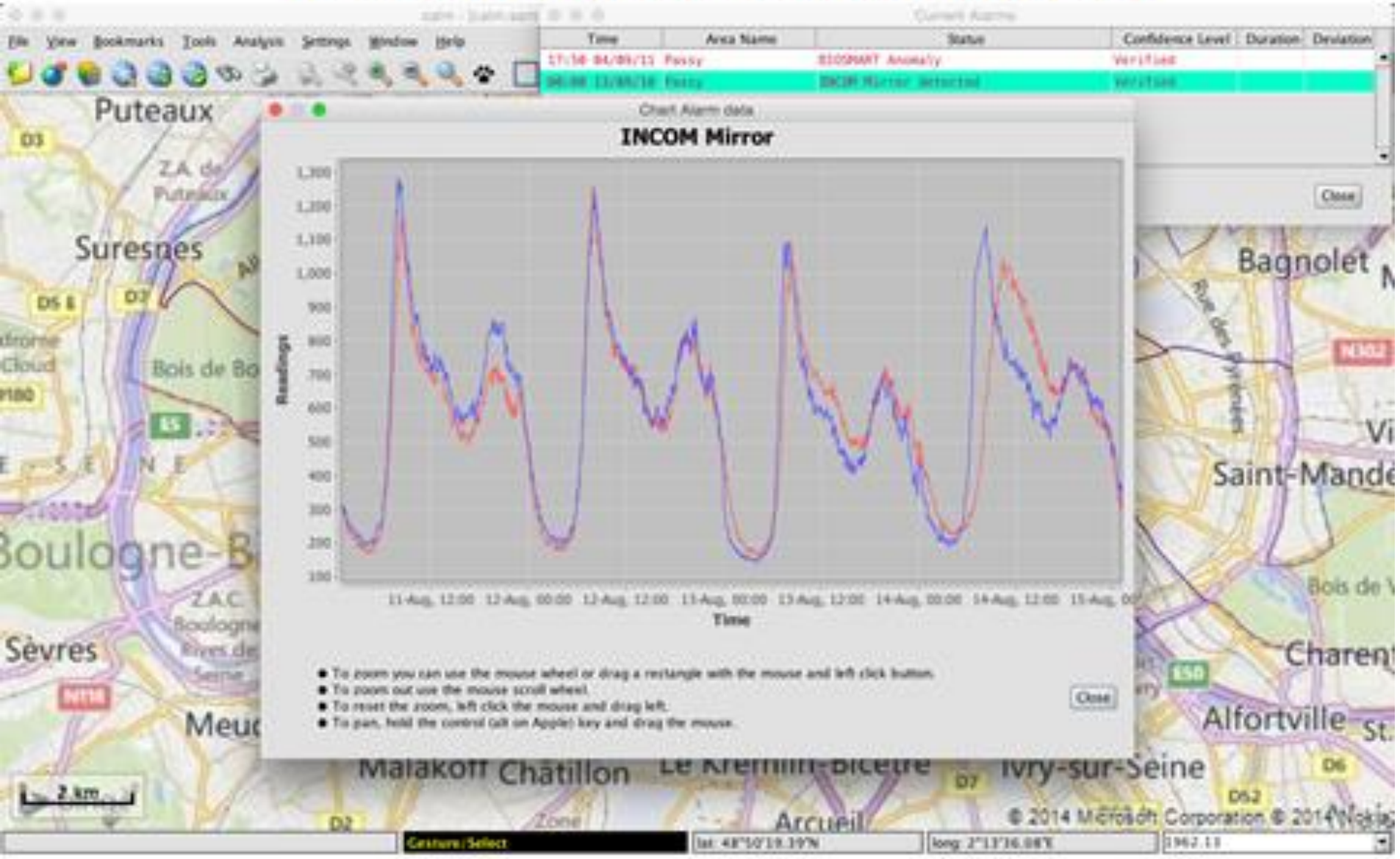
Anomaly Prediction - Flow



Using Actual EDP Data from two DMA to Demo-Simulate Leak Detection

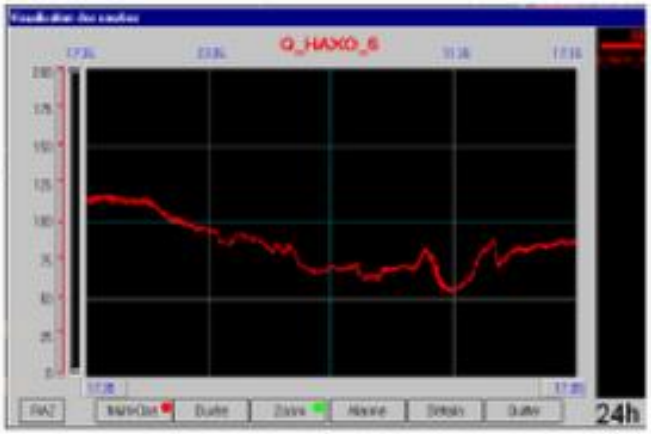


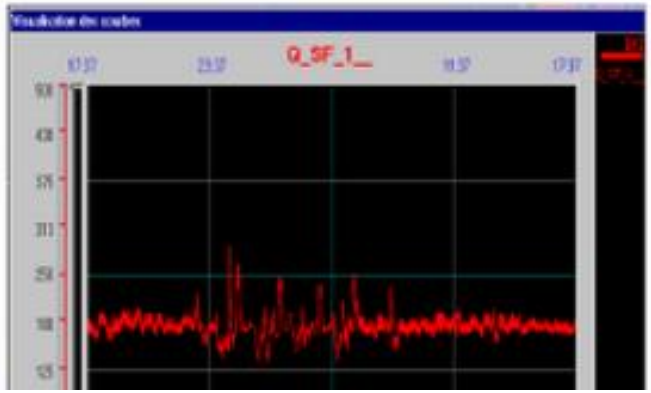
Visualization of data from Detected Anomaly



Water Quality Management

• Since 2004, 104 Chlorscans sensors have been operated online and in real time throughout Paris.





On-Line Water Quality Control at Eau De Paris

Online real-Time water quality systems

Intellisonde

S::can

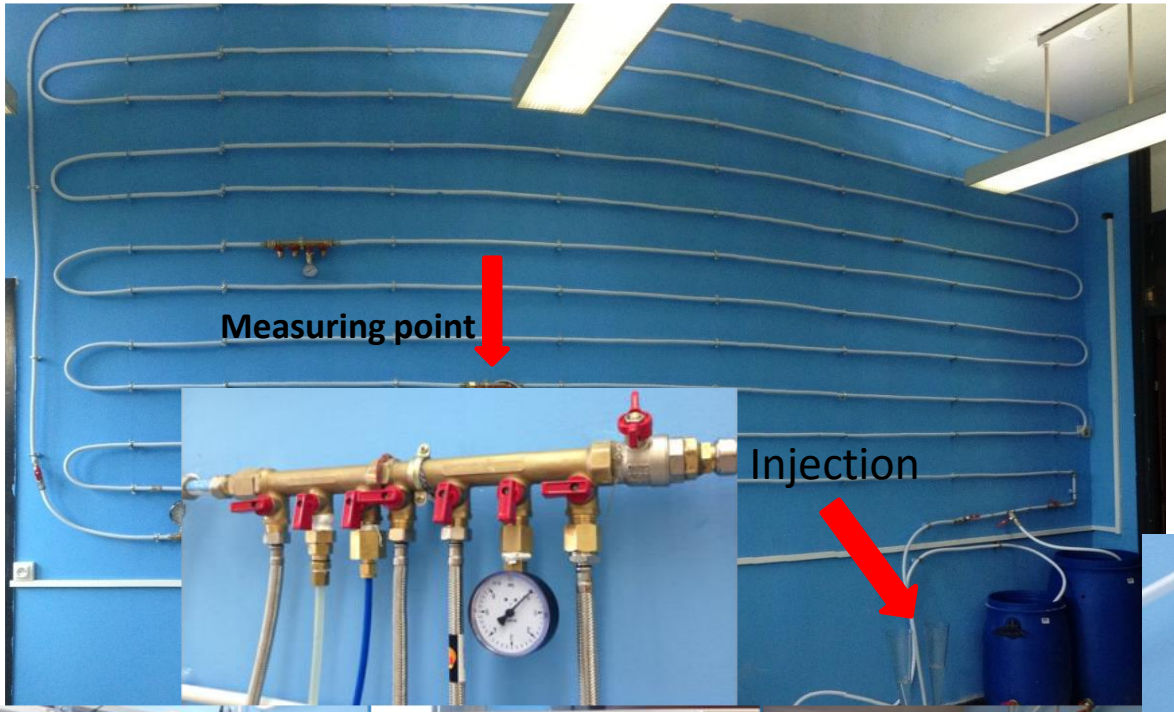
Optiqua

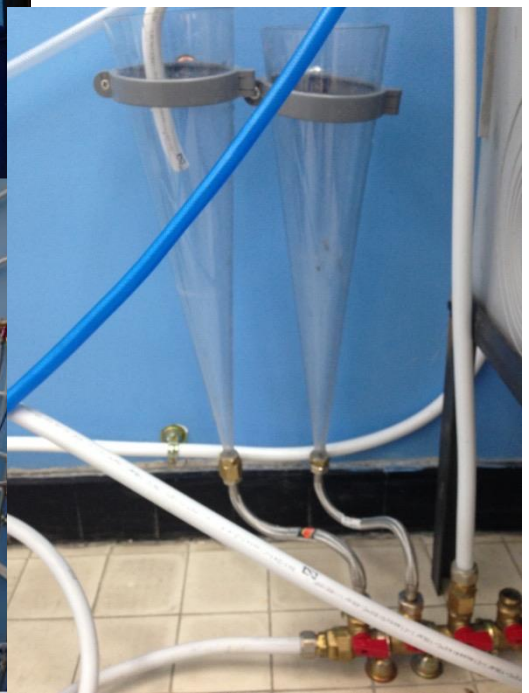
These sensors will be tested

Laboratory ➔ 61 m laboratory-scale distribution system

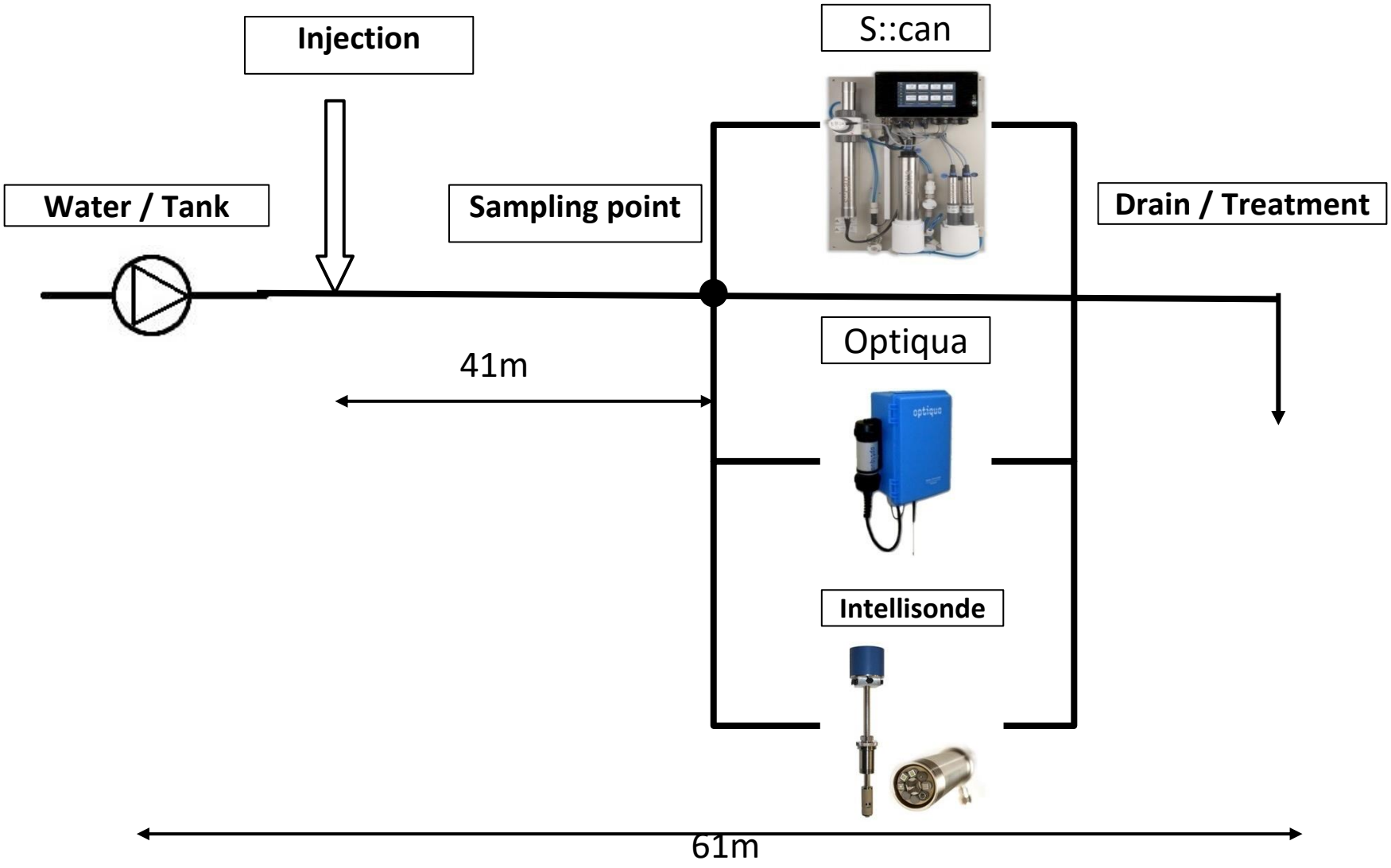
In field ➔ The choice of the site of city scientific of Lille 1

Laboratory pilot system

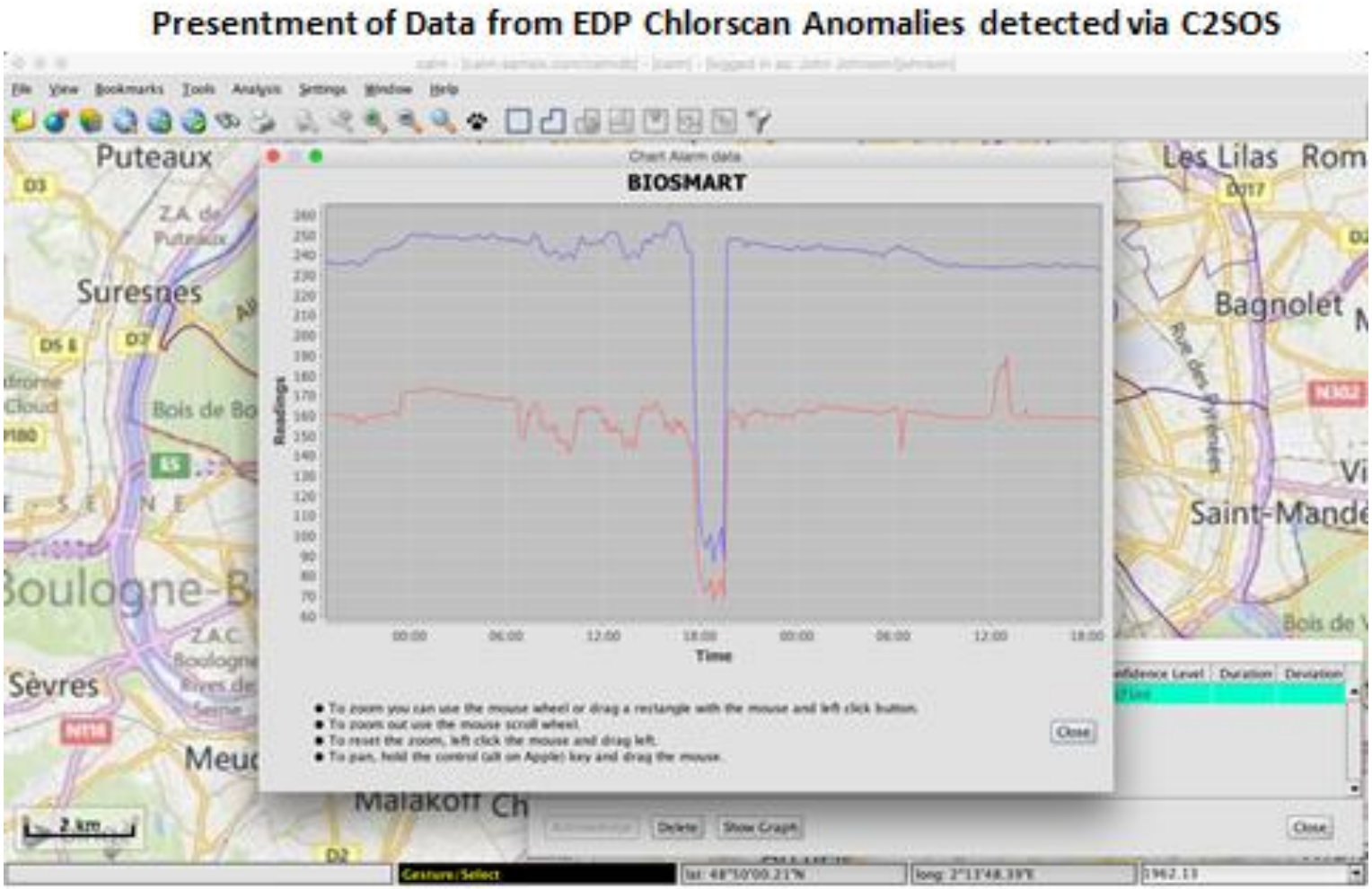




- ➔ Total length = 61 m
- ➔ 16 mm opaque double layer pipes
- ➔ Diameter = 16mm.

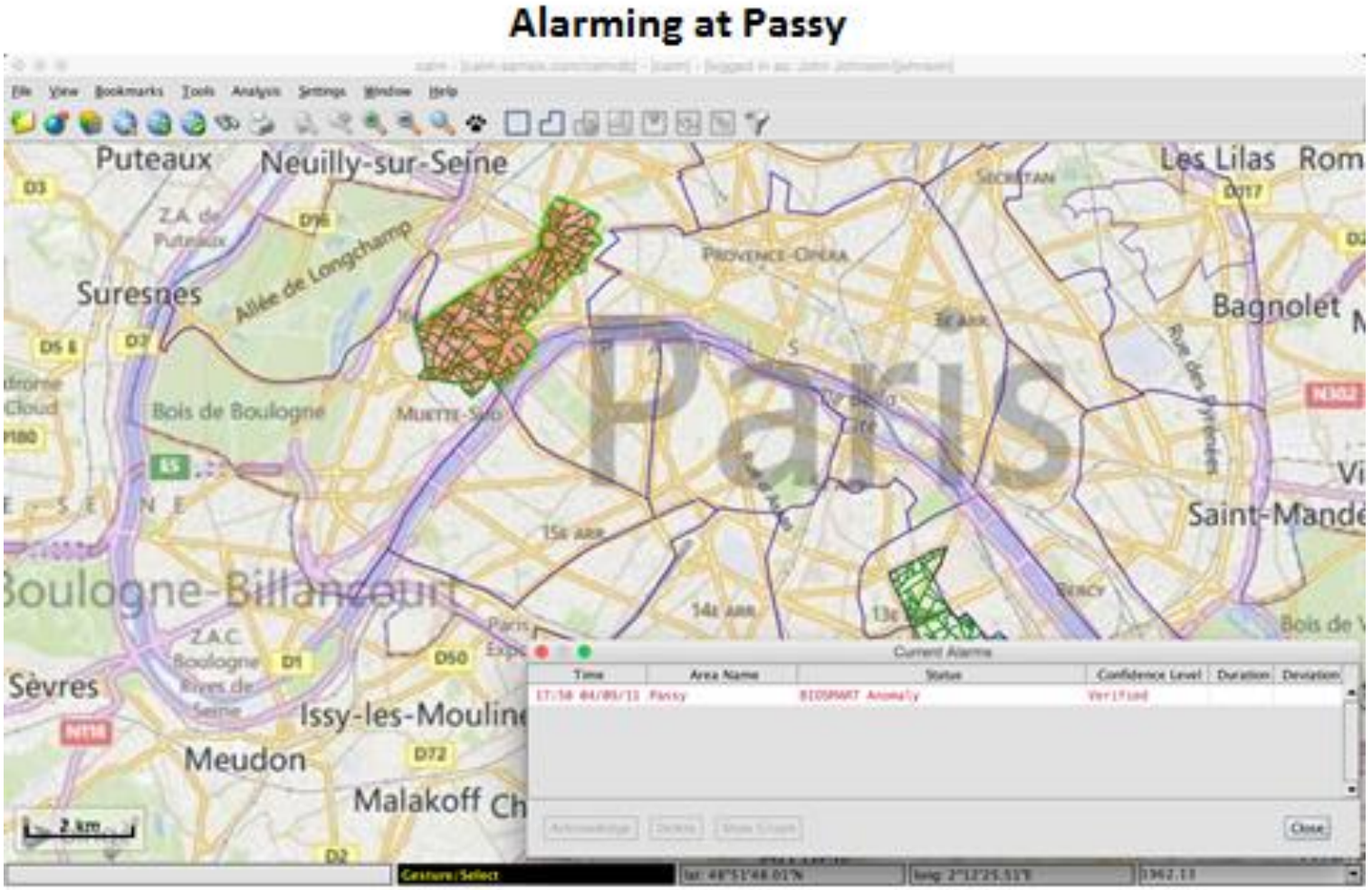

Injection
S::can
Water / Tank
Sampling point
Drain / Treatment
Optiqua
41m
Intellisonde
61m

Display of Data from EDP Chlorscan Anomalies detected via C2SOS



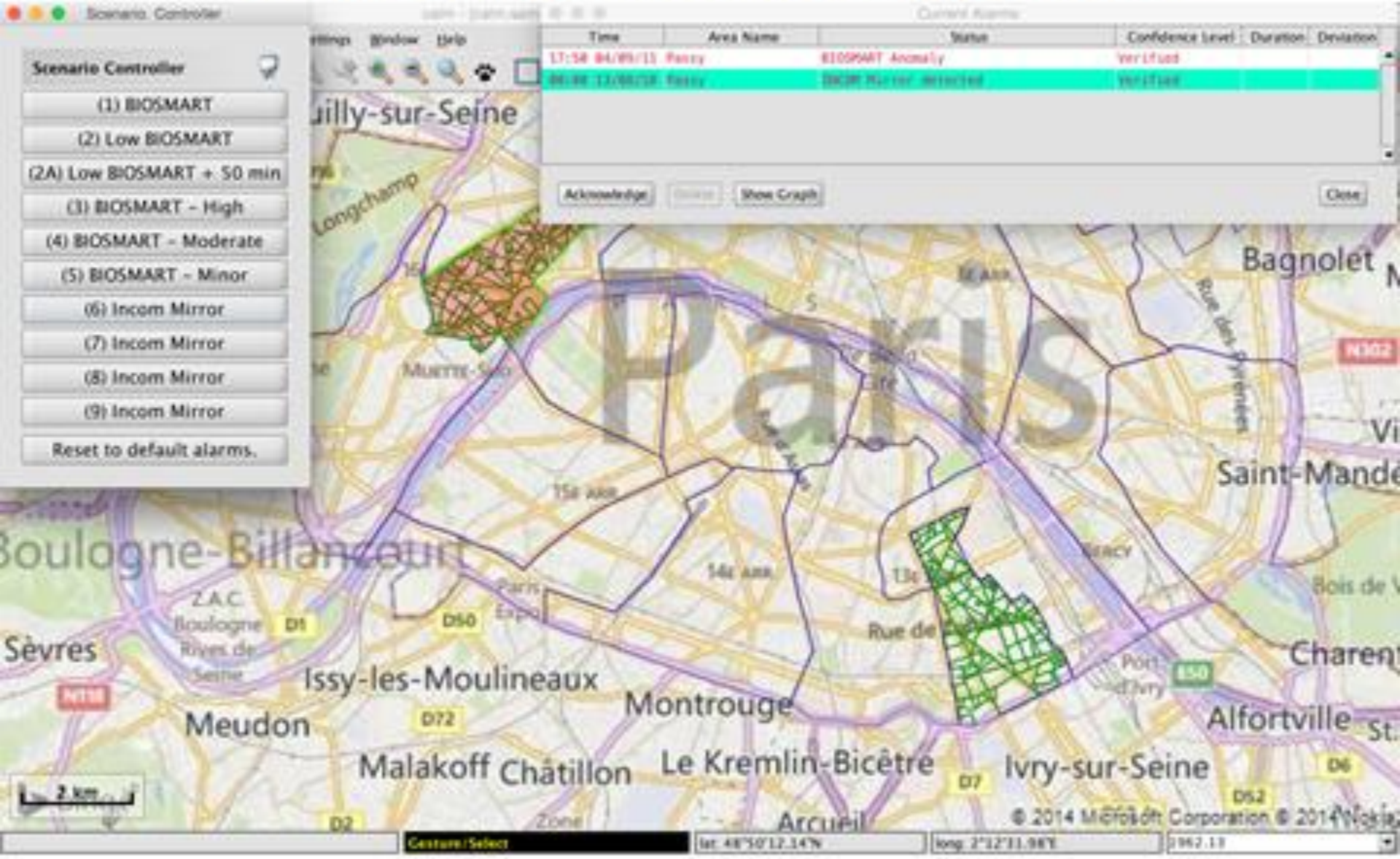
Source: Bio-SMART & INCOM Projects – M17 Project Meeting Minutes

Alarming at Passy

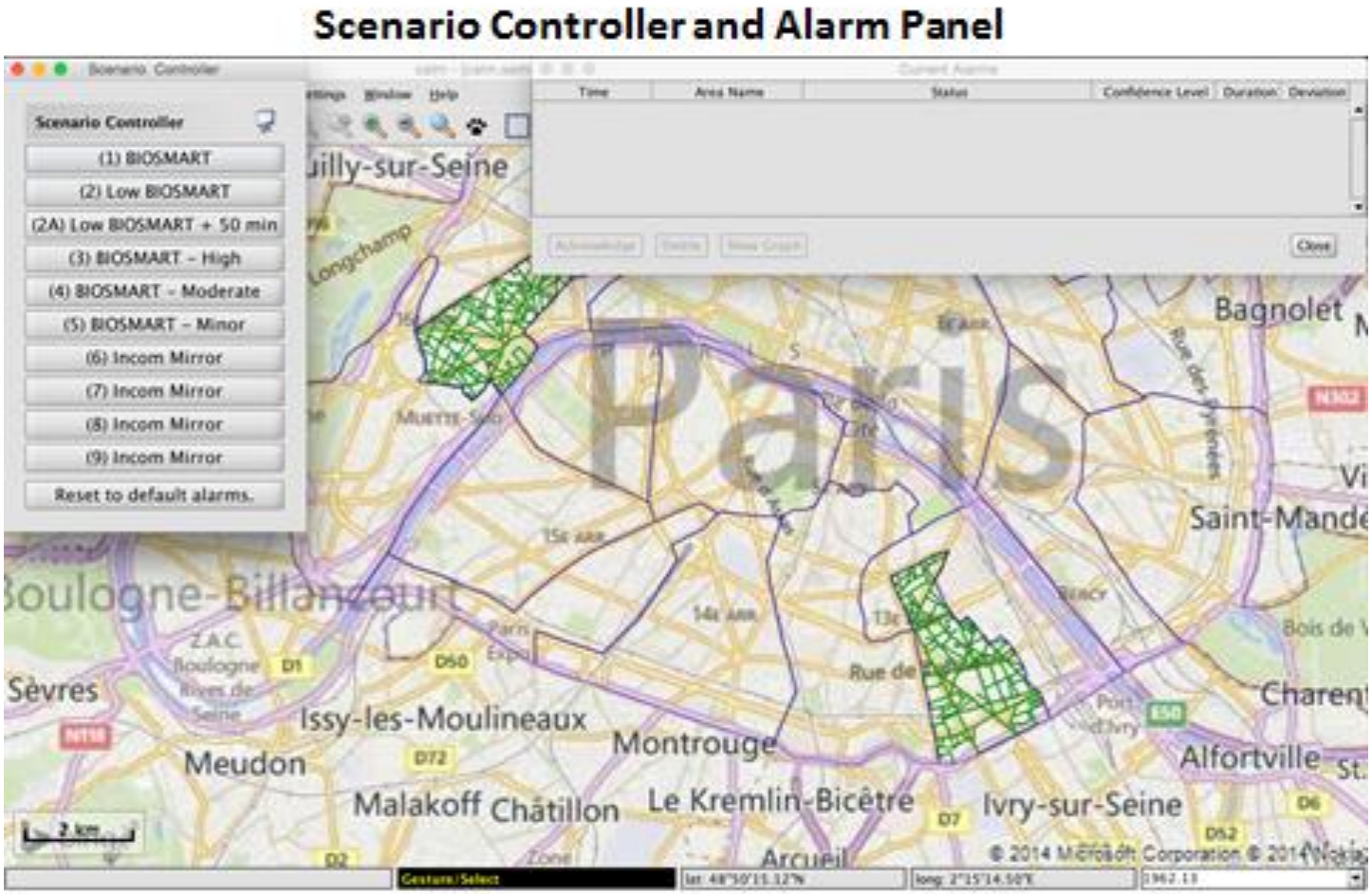


Source: Bio-SMART & INCOM Projects – M17 Project Meeting Minutes

Alarm Panel to Demonstrate Anomaly Detection



Scenario Controller and Alarm Panel



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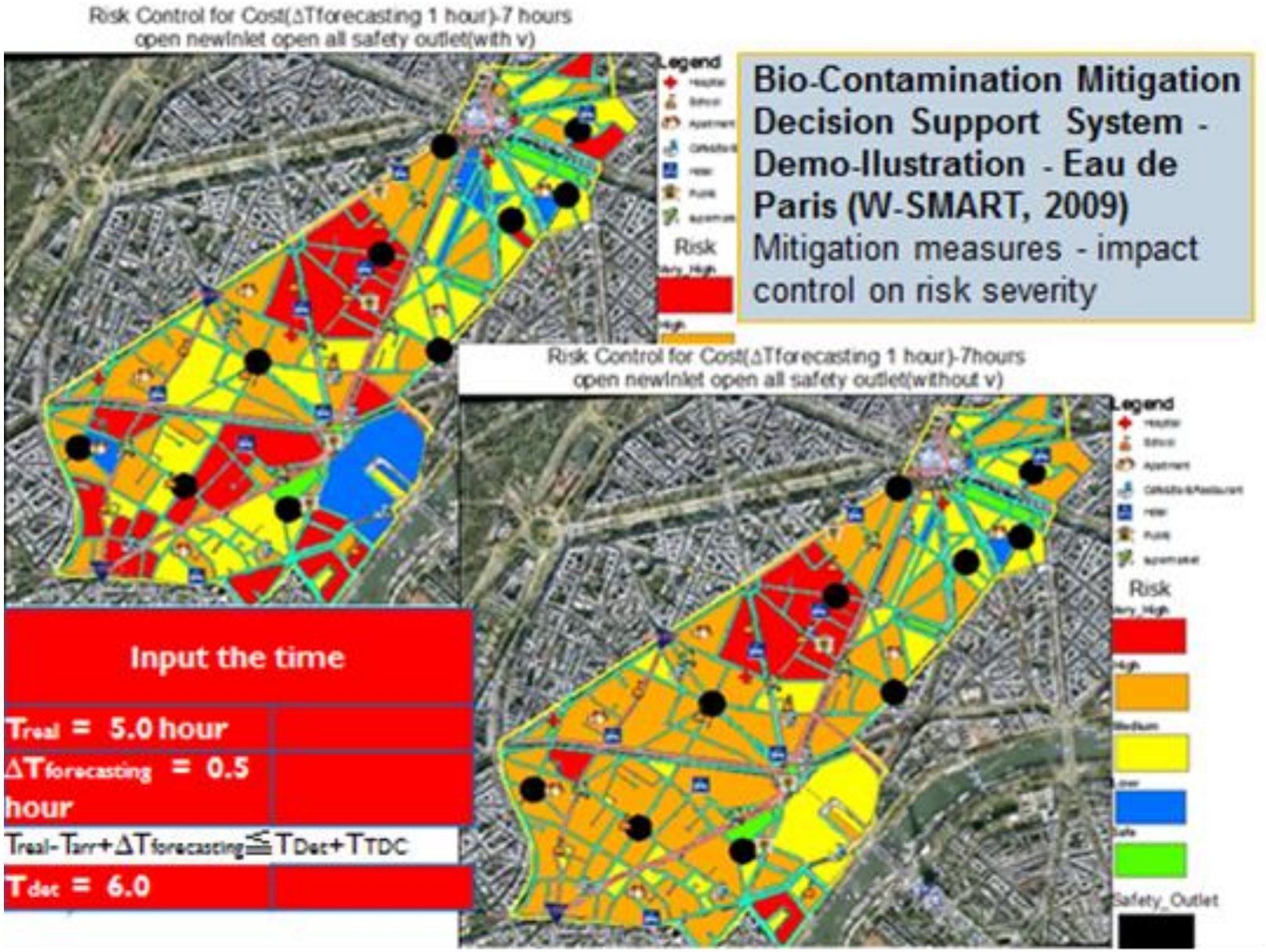
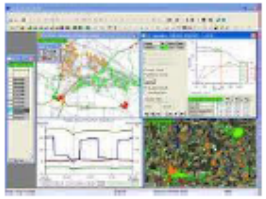


Bio-Contamination Mitigation Decision Support System Demo-Illustration (W-SMART, 2009)

Integrated Response Management
Decision Support System



Smart Threat Simulator
- Propagation & Impact

Smart Mitigation Module
- Mitigation options

Smart Event Recognition

Smart monitor systems

Rapid
mitigation

Smart deployment strategy
Based on:
- vulnerability
- impact
- mitigation options

CBRN attack
on drinking water
distribution network

THANK YOU FOR YOUR ATTENTION