"W- SMART"

Water Security Management Academy for Research & Technology

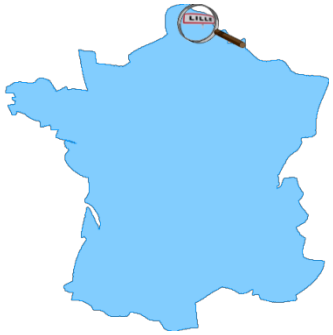
Industry–University Collaborative Research & Development Center

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

Scientific City Campus
Prof. Ilan Juran & Prof. Isam Shahrour



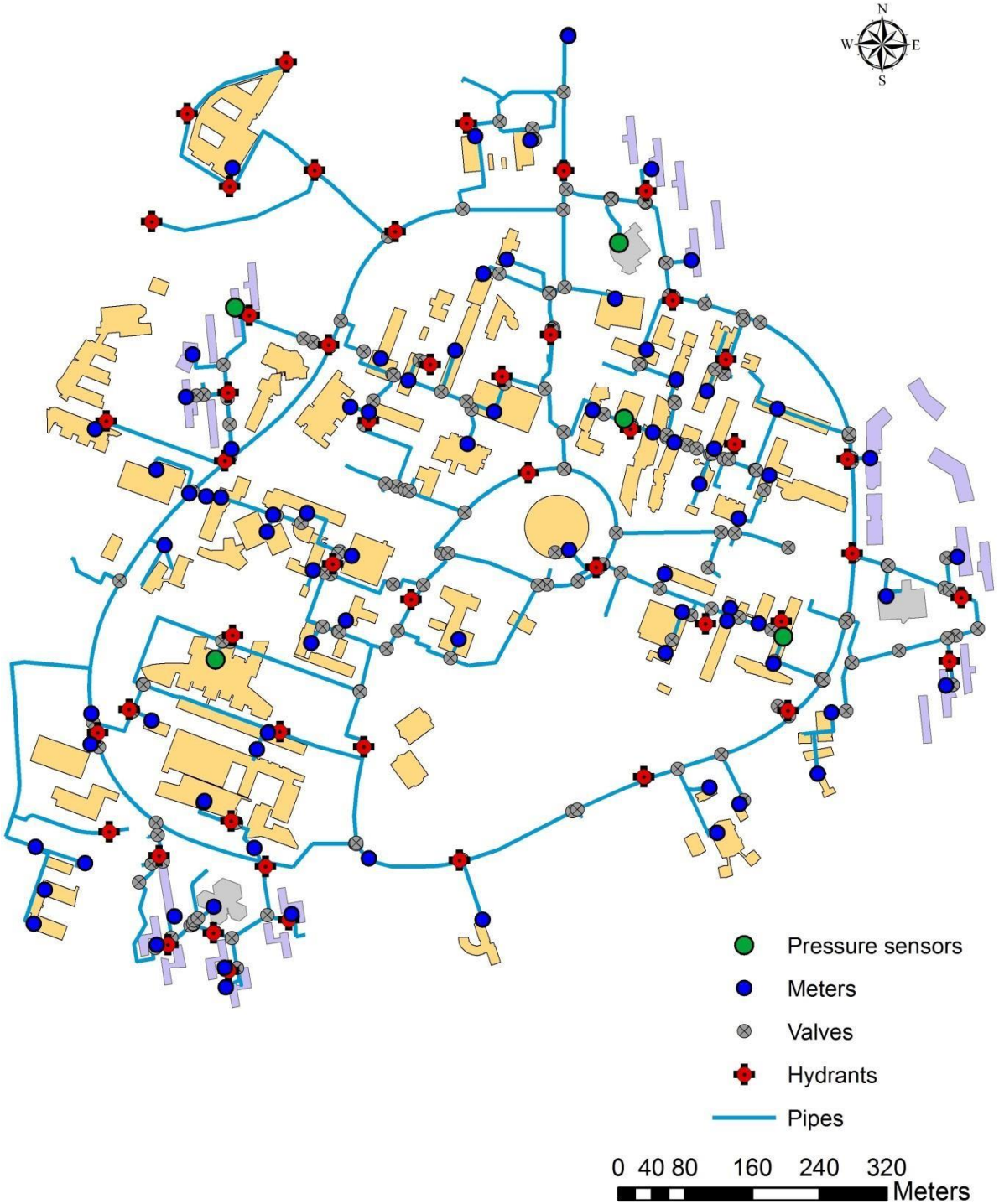
Small town:

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

SWN:

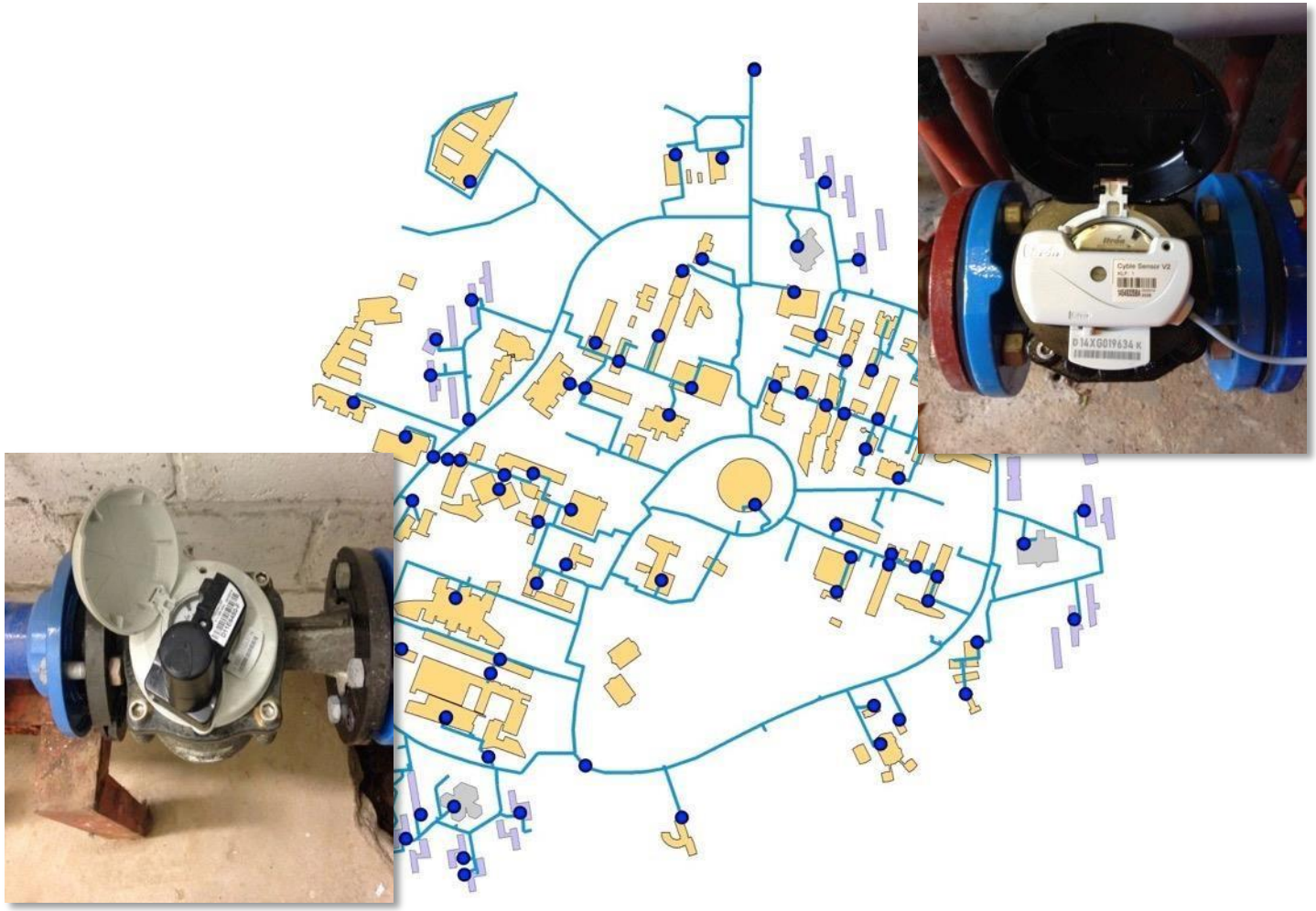
- VITENS
- EAU DE PARIS
- SUEZ / EAUX DU NORD
- KWR
- Université de Lille
- CEA-List
- CALMWATER

- 15 Kms of networks
- 49 hydrants
- 250 valves
- 90 AMRs
- 5 Pressure sensors

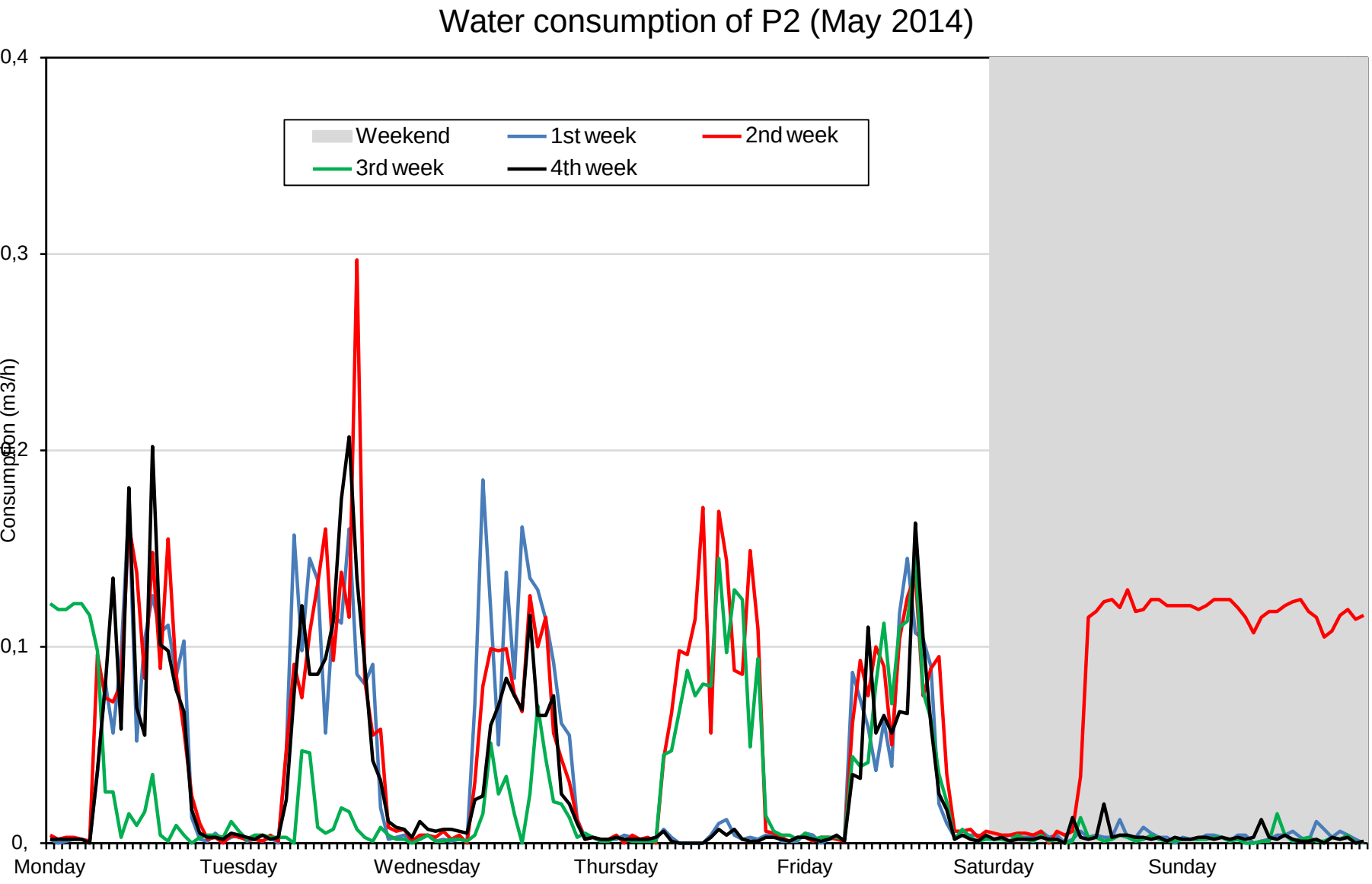


Monitoring :

90 Automatic Meter Readings (AMRs)

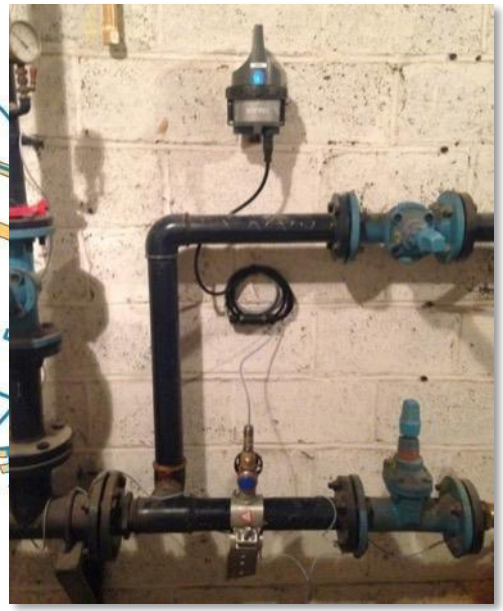


Example of AMR reading



Monitoring :

5 Pressure sensors



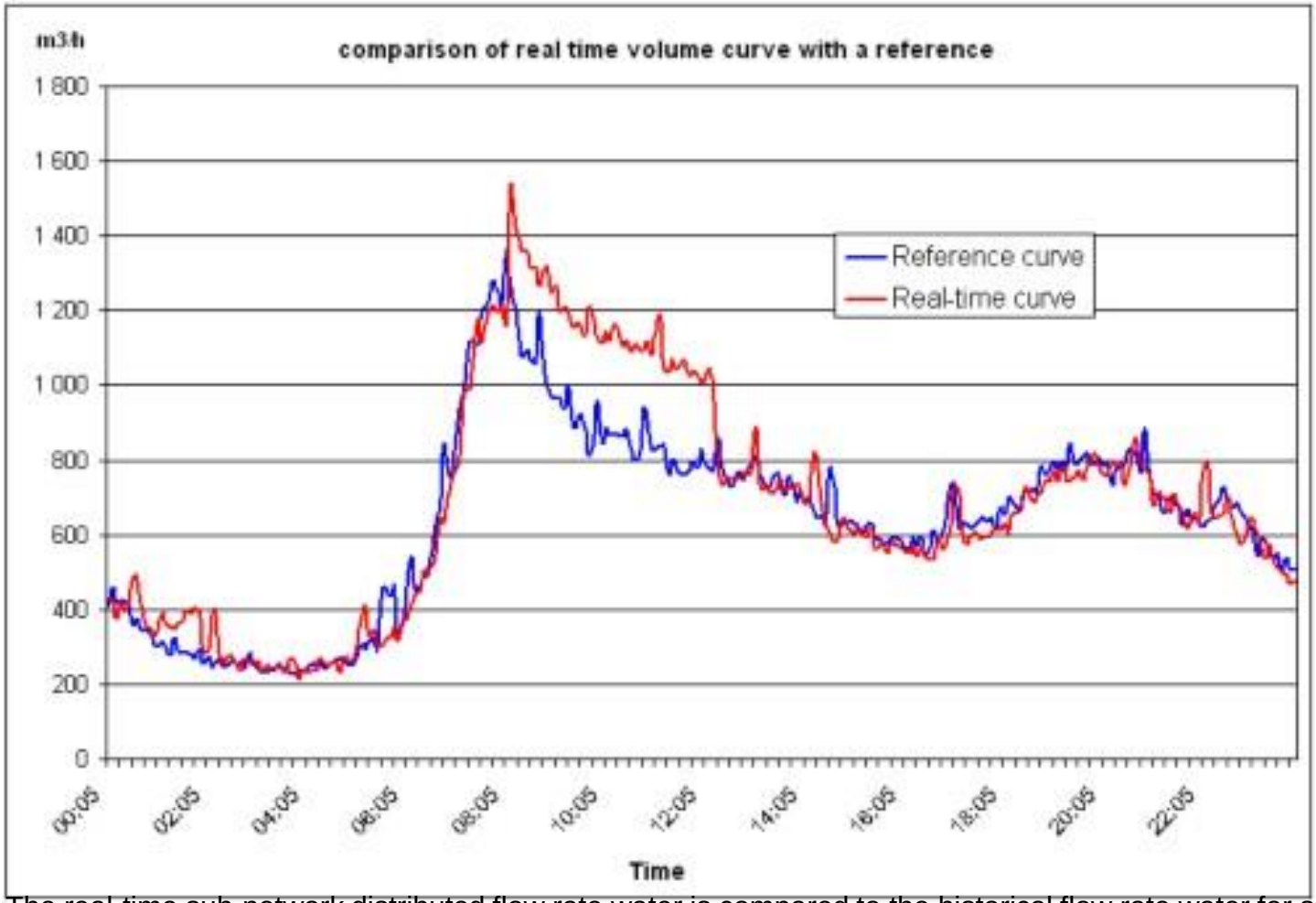
INCOM - Early leak Detection

Intelligent Network Control & On-site Monitoring

PhD Students

Elias Farah - University of Lille (2015)
Wilmer Cantos – NYU Tandon School of Engineering

Leakage detection with virtuals sensors



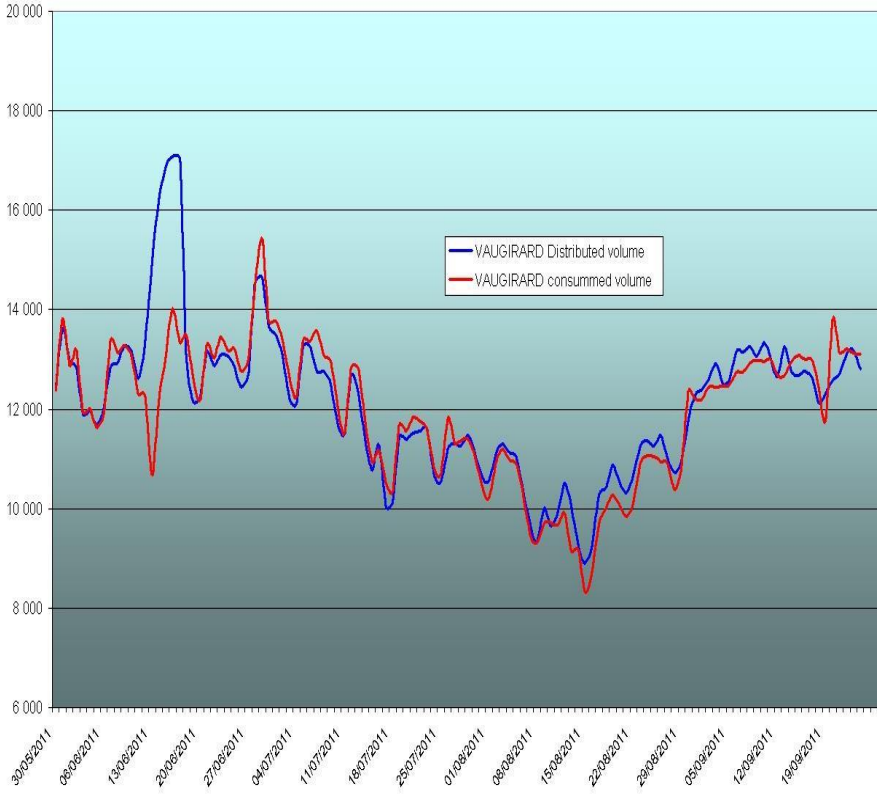
INCOM

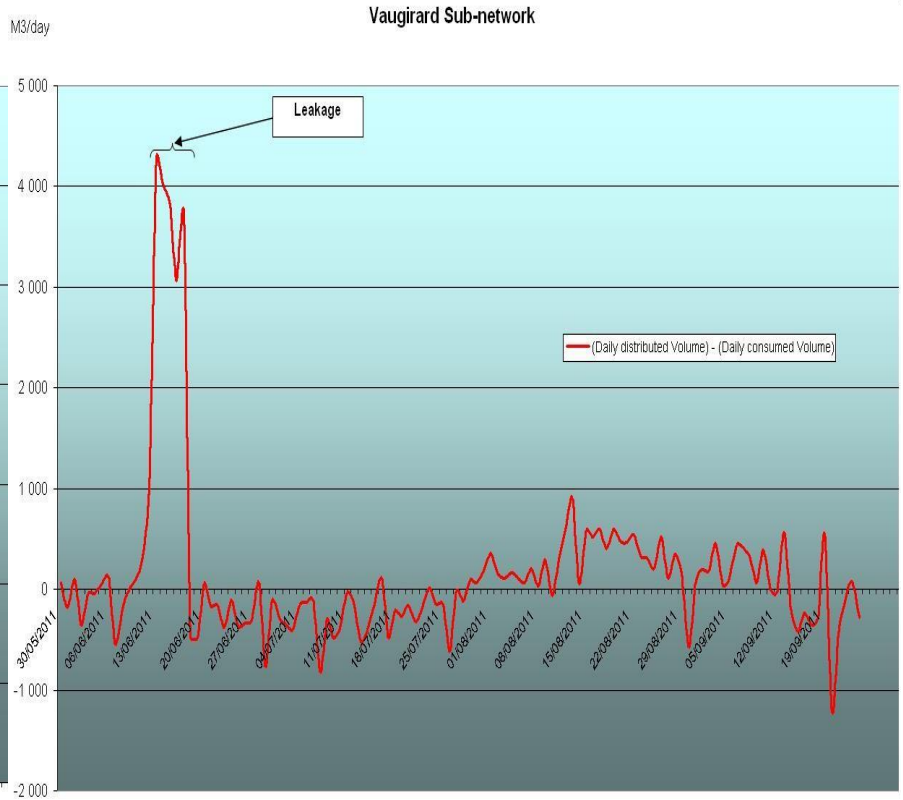
The real-time sub-network distributed flow rate water is compared to the historical flow rate water for similar period

A low and high threshold alarm system detects 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

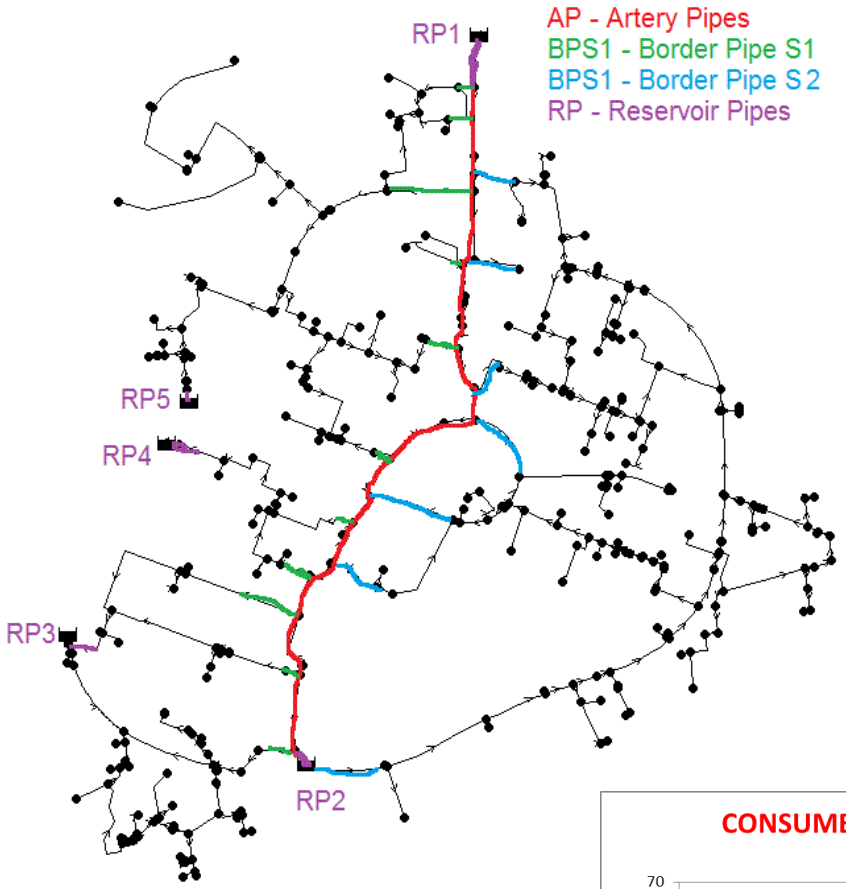




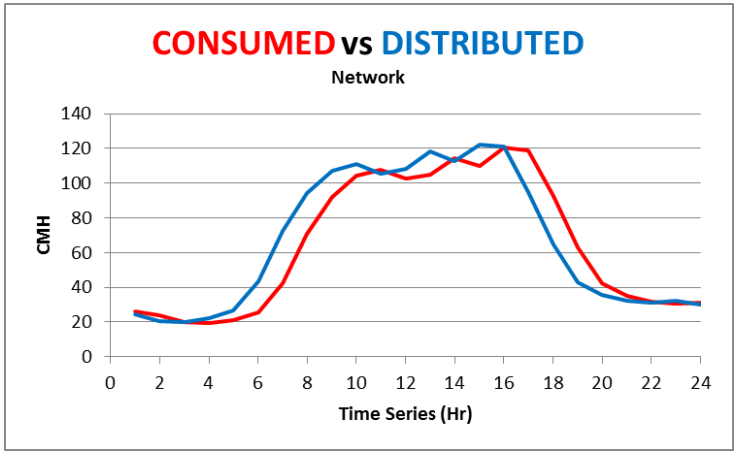
Comparison between Daily water distributed volume trend and Daily water consumption volume trend in the same sub network.

Daily water losses calculated trend in a sub network.

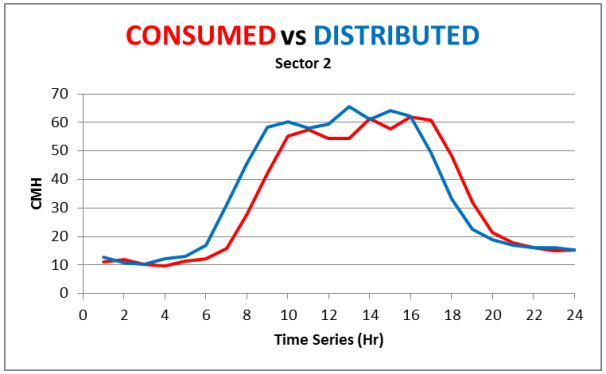
VDMAs

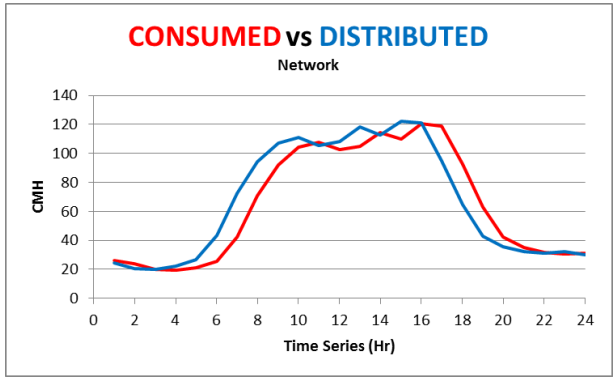


1 DMA



2 DMA

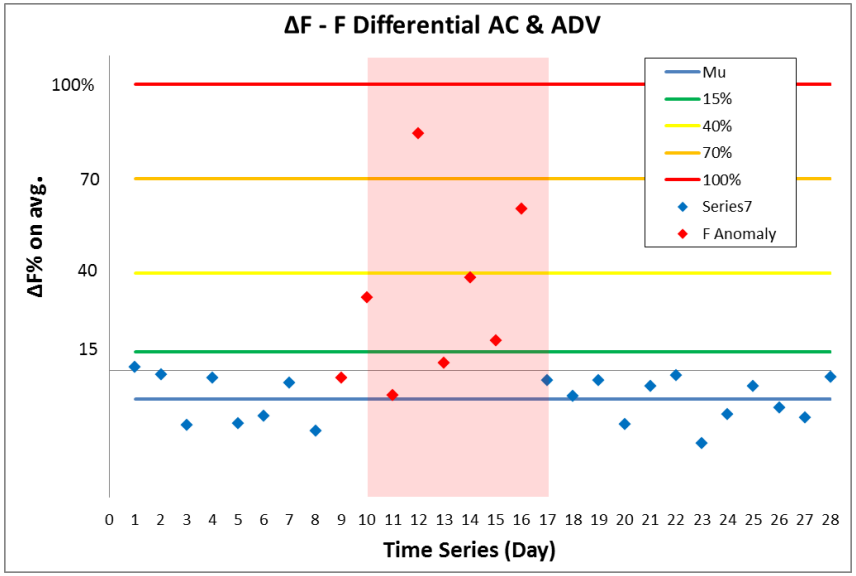




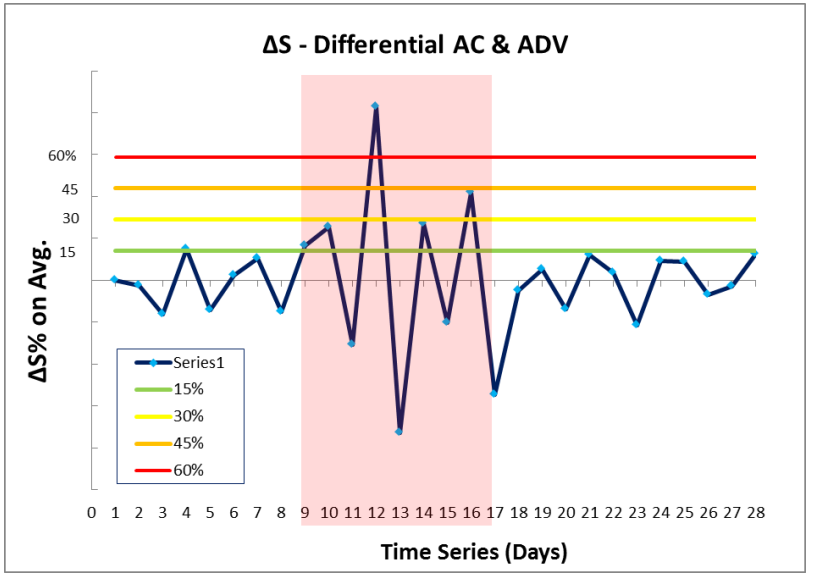
NetLeak: AC v ADV

Risk Indicator = Likelihood * Severity

Likelihood



Severity



Likelihood Matrix					
	Days				
ΔF% on avg.	1	2	3	4	>4
0-15%					
15-40%					
40-70%					
70-100%					
>100%					

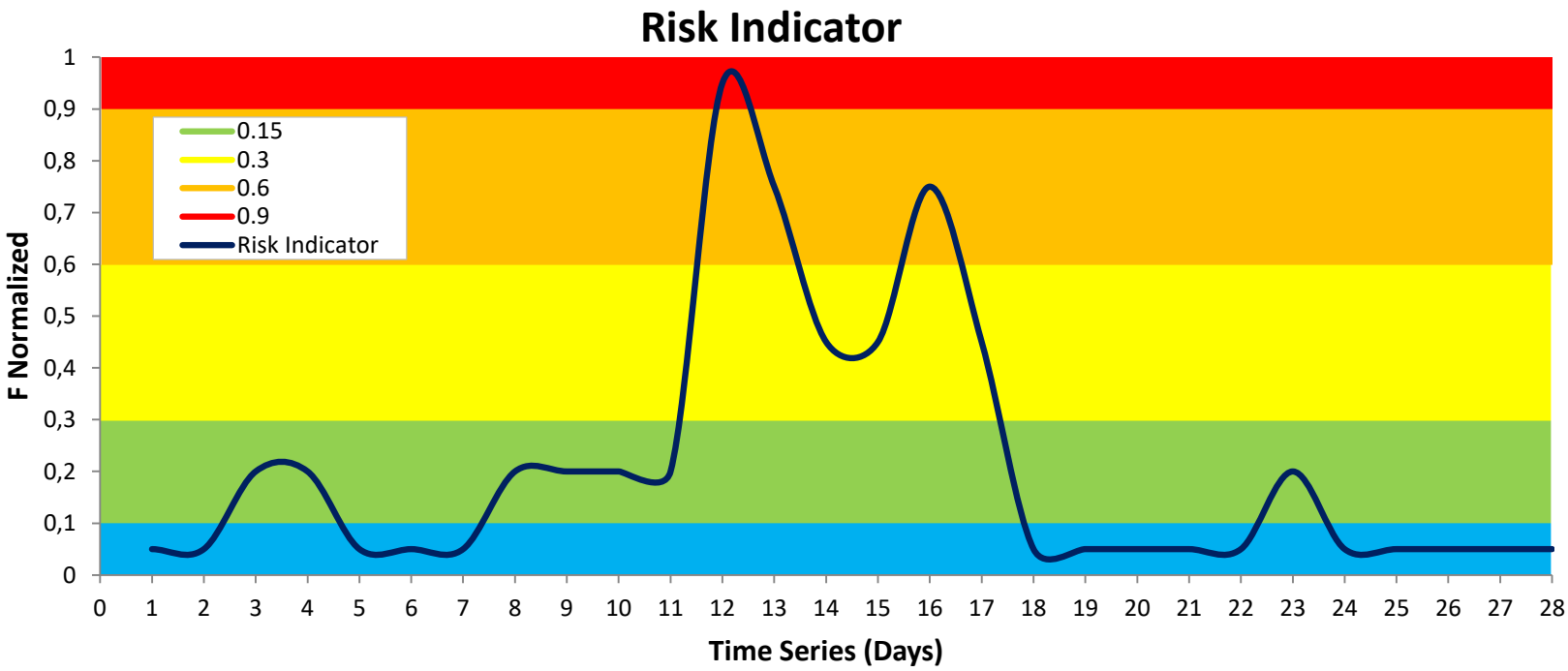
Likelihood Scale (0-100%)	
0-10%	Insignificant
10-30%	Low
30-60%	Moderate
60-90%	High Probability
>90%	Very High Probability

Severity Matrix					
	ΔF%				
ΔS%	0-15%	15-40%	40-70%	70-100%	>100%
0-15%					
15-30%					
30-45%					
45-60%					
>60%					

Severity Scale (1-5)
1
2
3
4
5

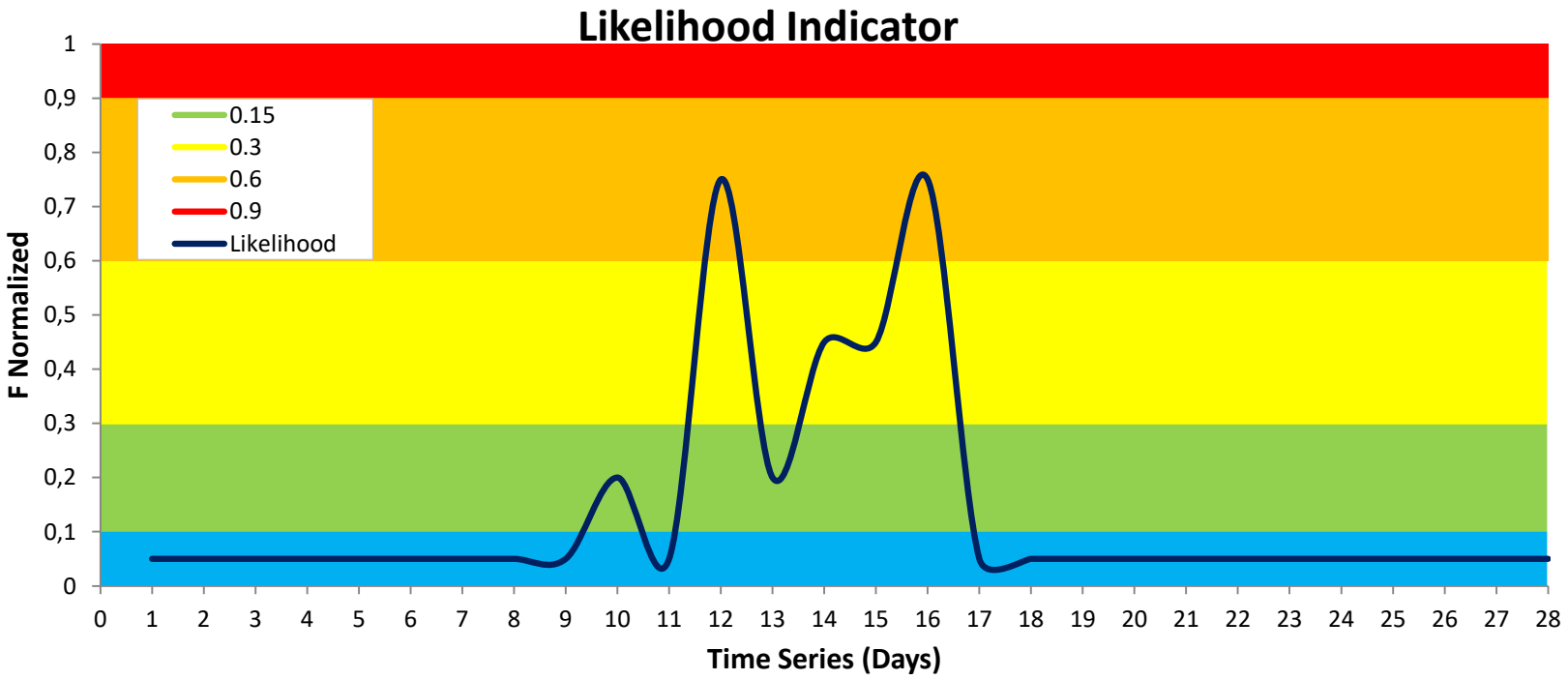
NetLeak: AC v ADV

Risk Indicator = Likelihood * Severity



NetLeak

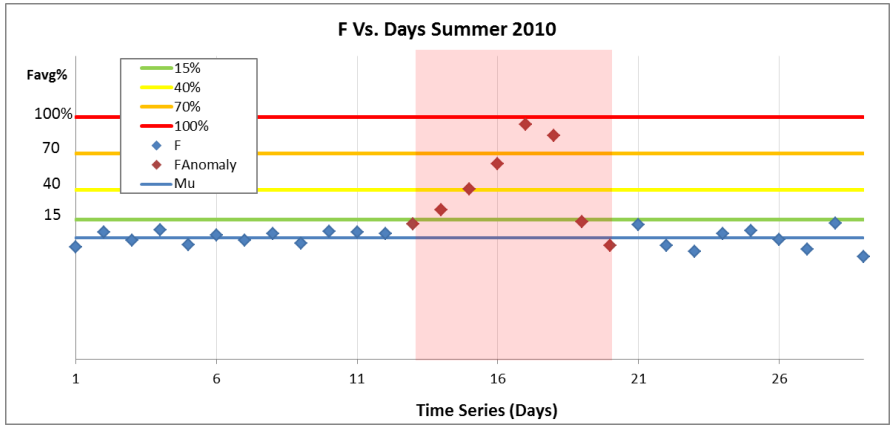
Risk Indicator = Likelihood * Severity



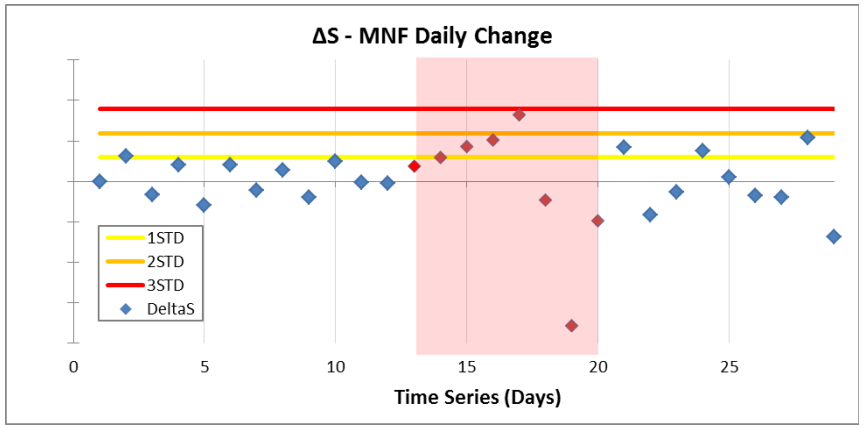
Progressive Leak

Risk Indicator = Likelihood * Severity

Likelihood



Severity



Likelihood Matrix					
	Days				
ΔF% on avg.	1	2	3	4	>4
0-15%					
15-40%					
40-70%					
70-100%					
>100%					

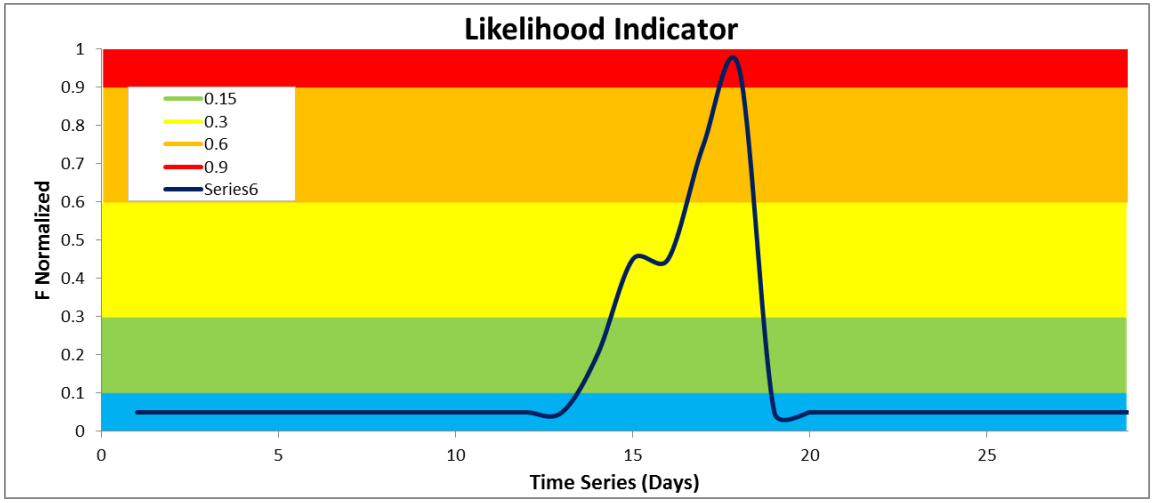
Likelihood Scale (0-100%)	
0-10%	Insignificant
10-30%	Low
30-60%	Moderate
60-90%	High Probability
>90%	Very High Probability

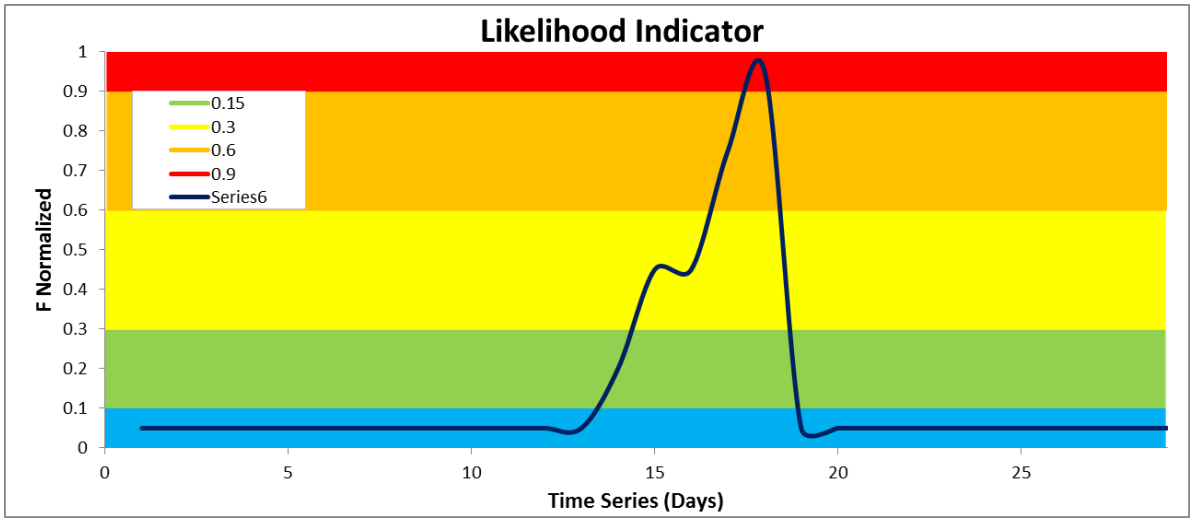
Severity Matrix					
	ΔF%				
ΔS%	0-15%	15-40%	40-70%	70-100%	>100%
0-15%					
15-30%					
30-45%					
45-60%					
>60%					

Severity Scale (1-5)
1
2
3
4
5

Progressive Leak

Risk Indicator = Likelihood * Severity





Bio-SMART

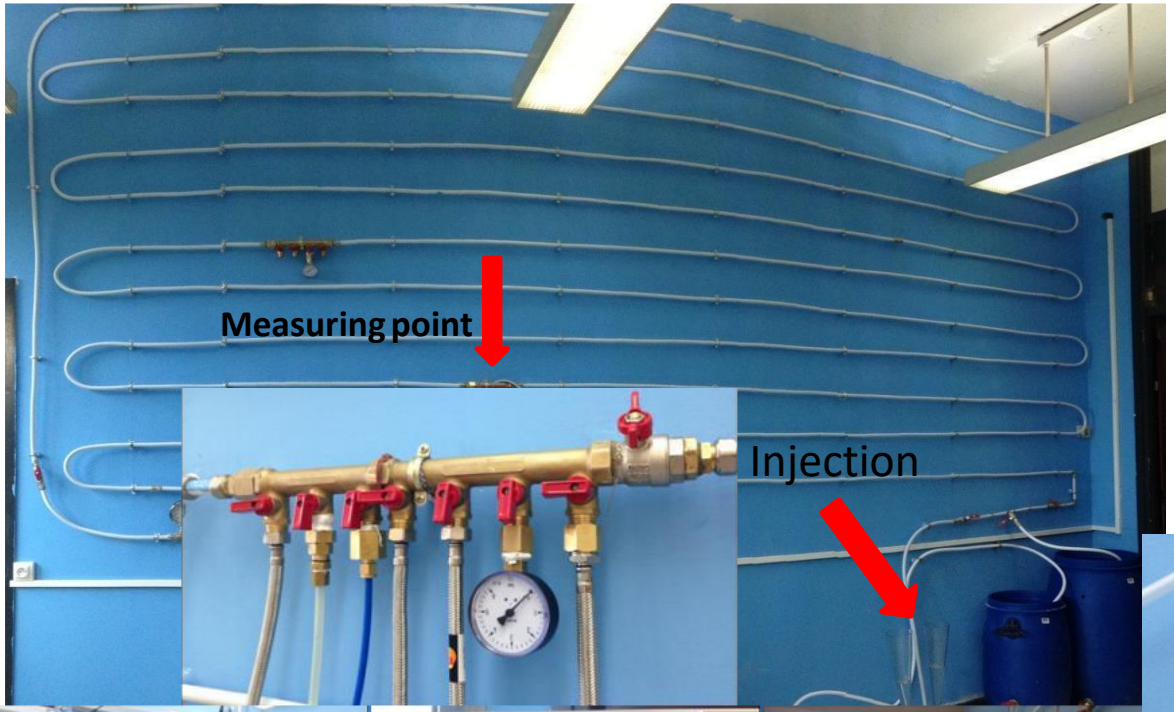
Bio-Safety Monitoring And Risk conTrol

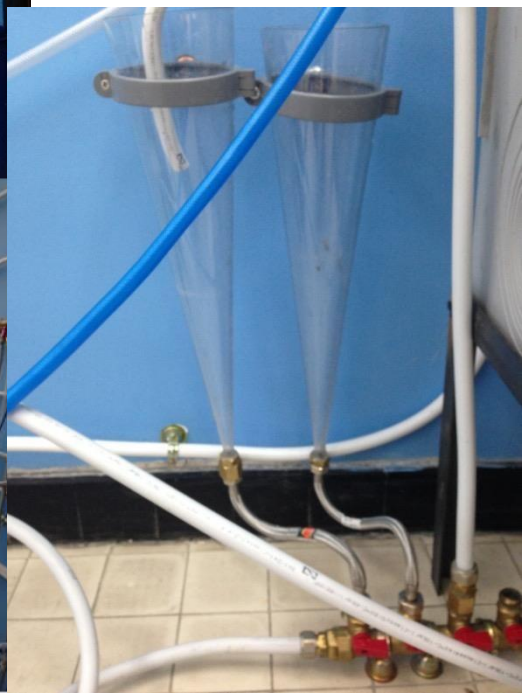
PhD Students

Amani Abdallah, University of Lille (2015)

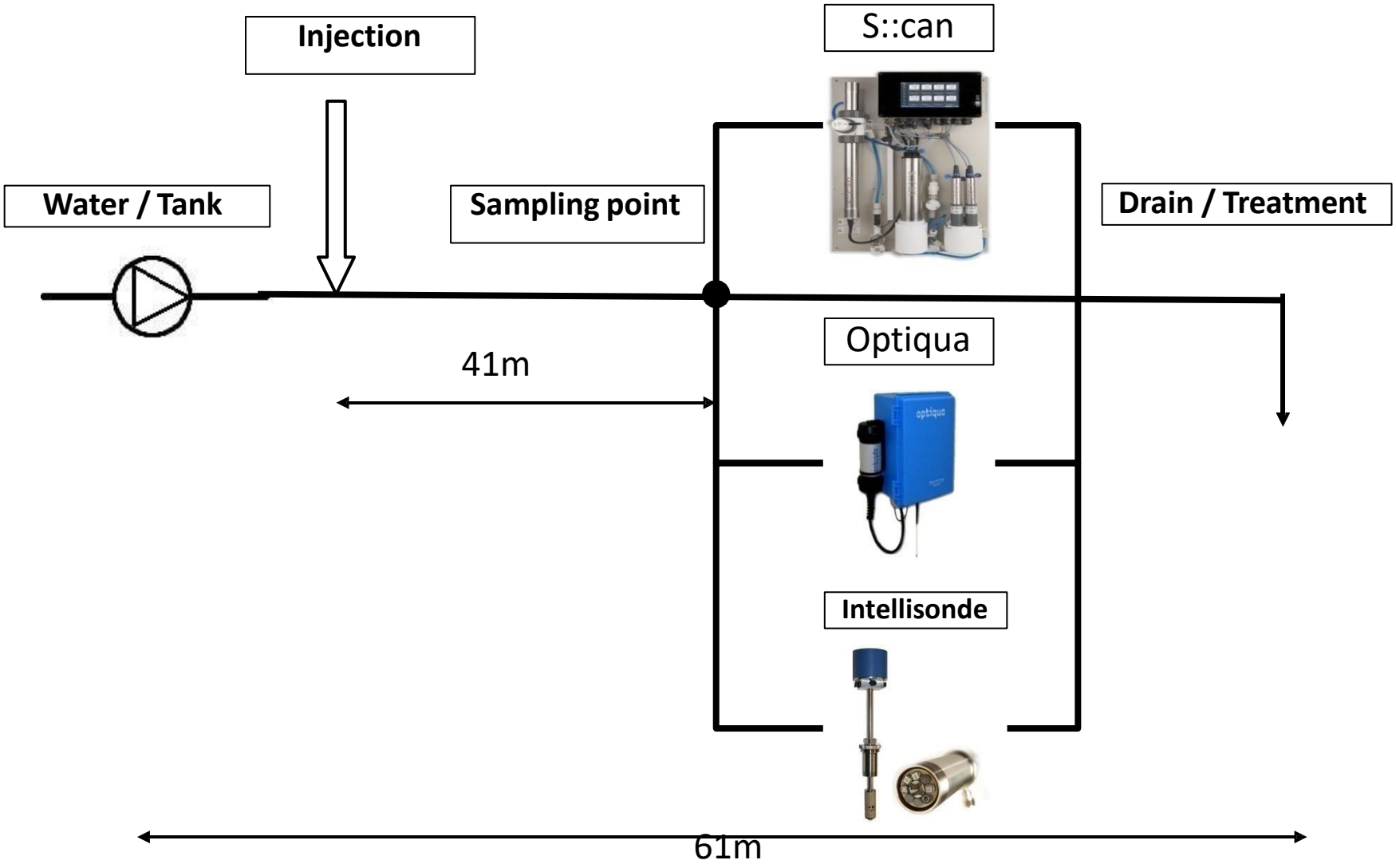
Silvia Tinelli, University of Pavia & NYU

Laboratory pilot system



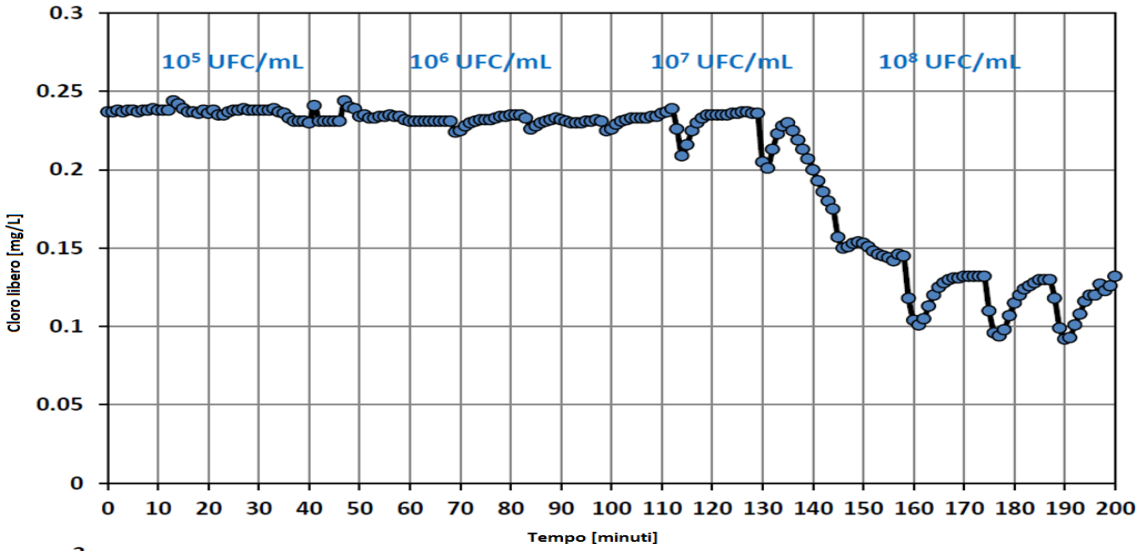


- ➔ Total length = 61 m
- ➔ 16 mm opaque double layer pipes
- ➔ Diameter = 16mm.

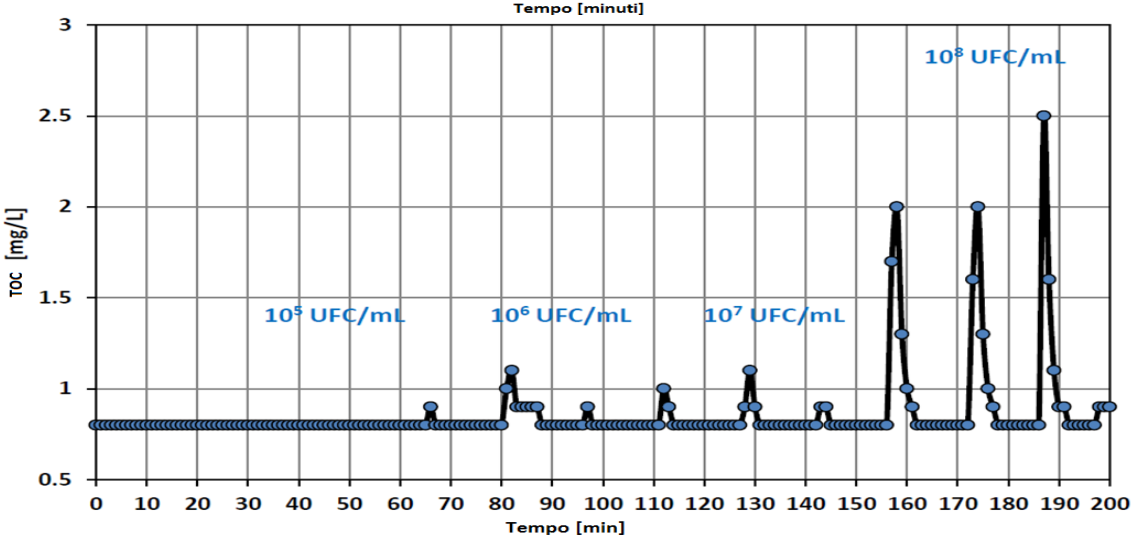

Injection
S::can
Water / Tank
Sampling point
Drain / Treatment
41m
Optiqua
Intellisonde
61m

Lille Demo Site – E. Coli Injections (1)

Variations of the water physical /chemical parameters following injections of E. Coli



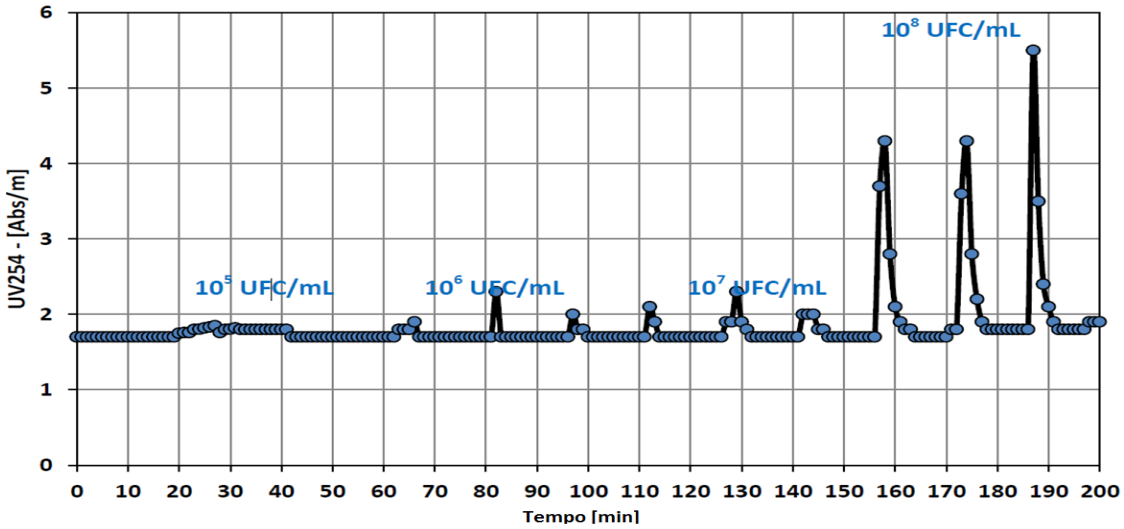
Variation of **Free Chlorine**



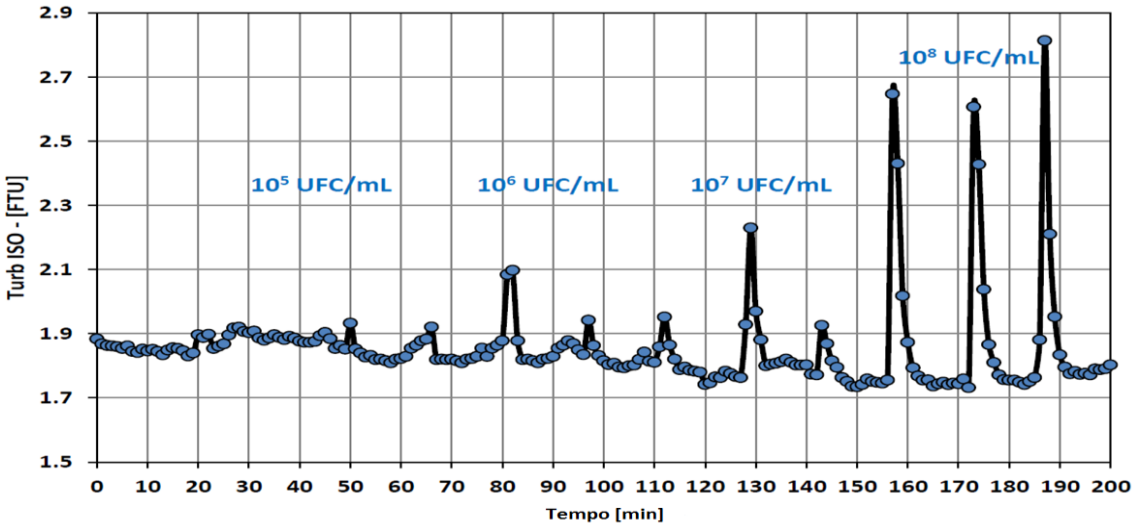
Variation of **TOC**

Lille Demo Site – E. Coli Injections (2)

Variations of the water physical /chemical parameters following injections of E. Coli



Variation of **UV254**



Variation of **Turbidity**

Numerical Experimentation

numerical simulations

EPANET

- Hydraulic Test
- Quality Model

EPANET-MSX

- Multi-species analysis
- Chemical Model

TEVA-SPOT

- Definition of cont. scenario
- Statistical method for the sensor location

Epanet:

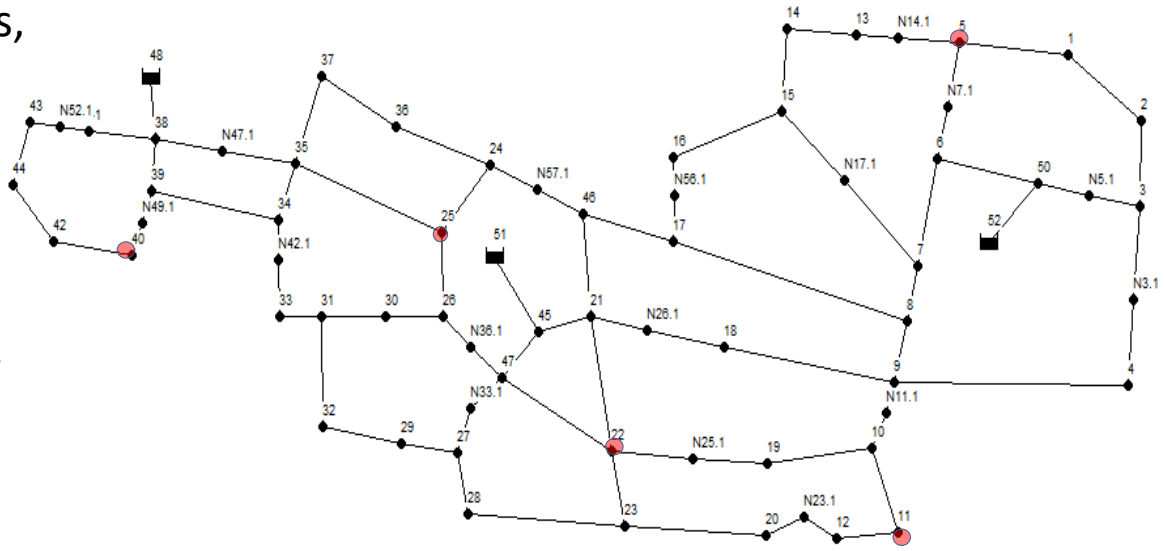
Simulations for different durations, masses and starting times

Epanet MSX:

- Non-conservative hypothesis;
- Adsorption As^{+3}
- *E. Coli*
- *Pesticides/herbicides: chlorpyrifos (CP) and parathion (PA)*

Teva Spot:

- Optimal location of 5 sensors



Real Network proposed by Alperovits e Shamir (1977)

Results

Numerical simulations

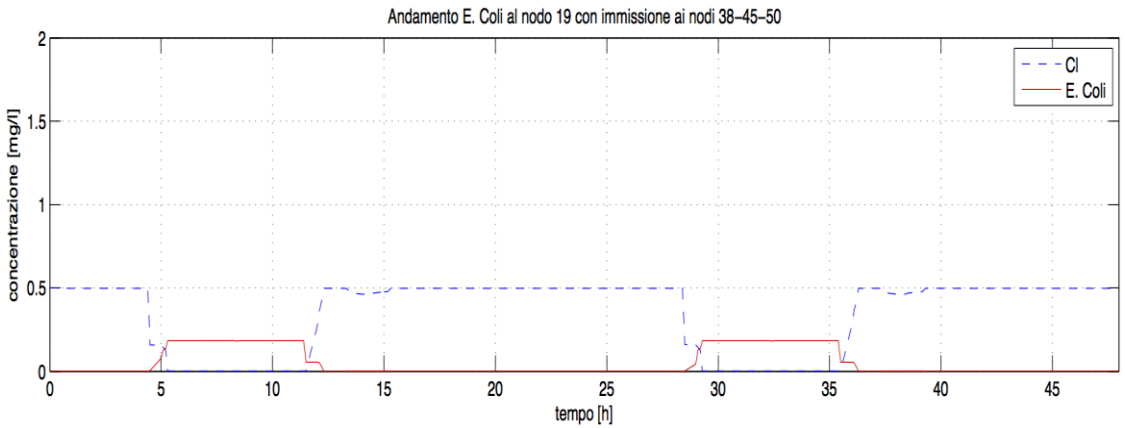
Epanet:

- The injection duration has no influence on the peak value of the pollutant in the network;
- The number and the location of contaminated nodes do not vary with the injected mass.

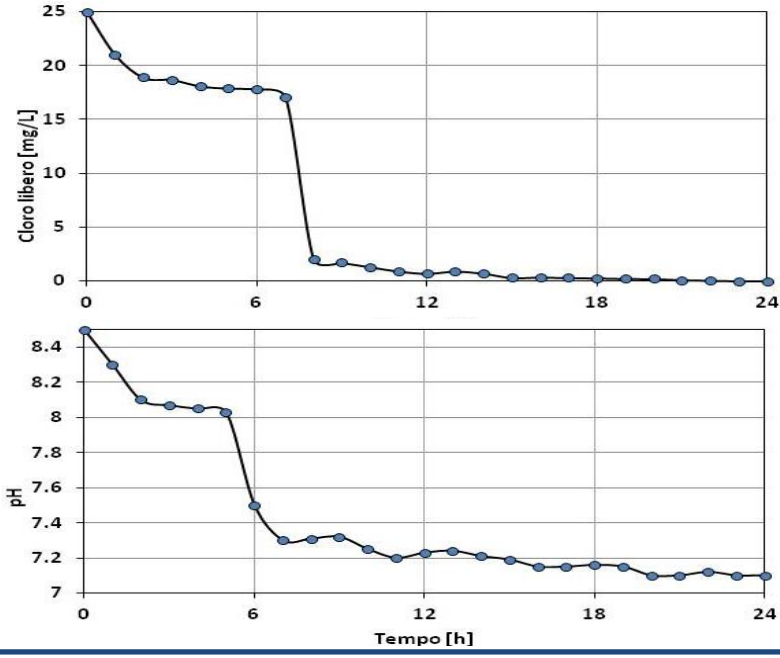
Epanet MSX:

- If E. Coli increases, the free chlorine decreases;
- With the injections of CP and PA the free chlorine drops to approximately zero

E. Coli Injections



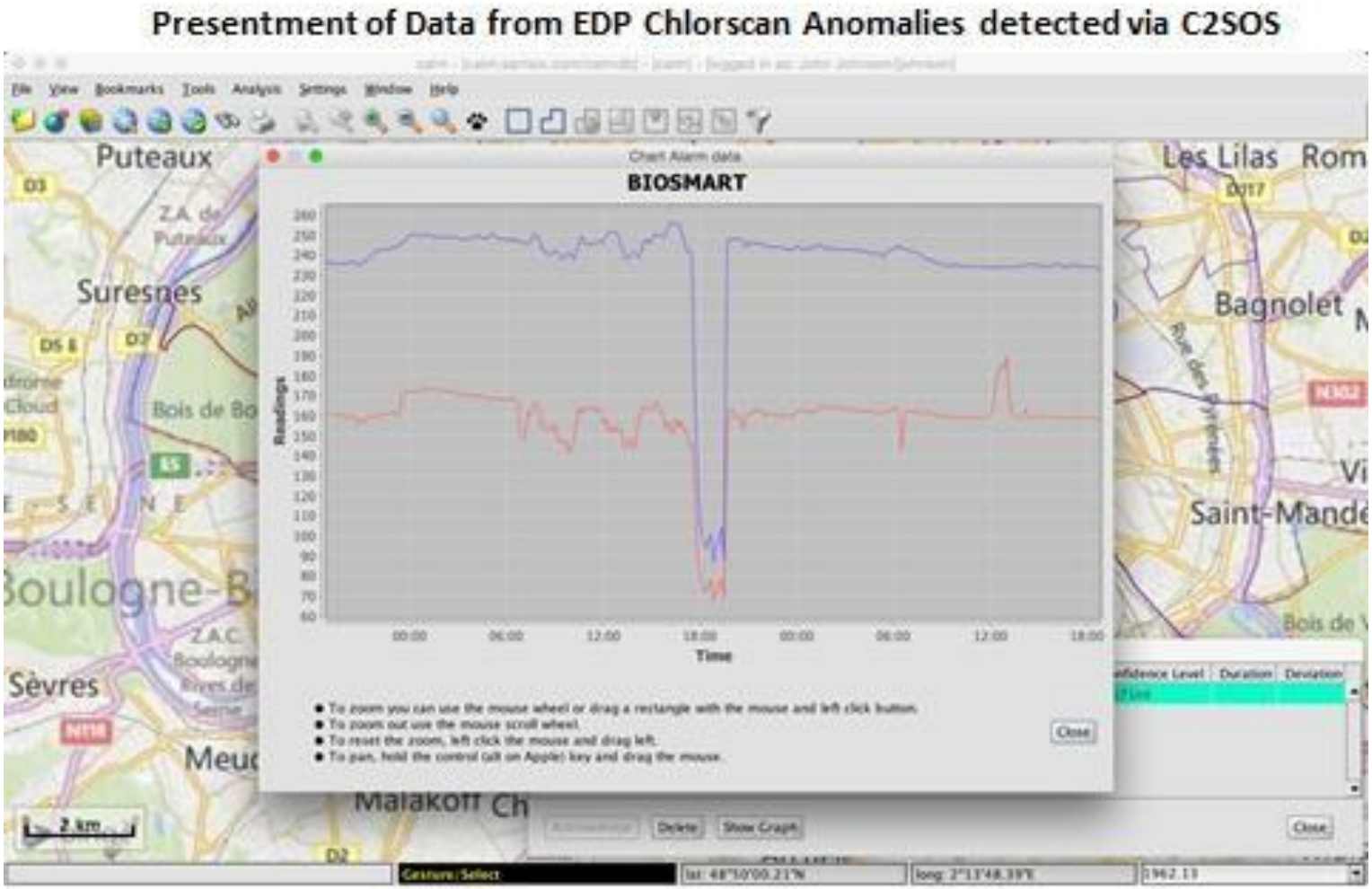
PA Injections



Teva Spot:

- Optimal location of sensors through statistical method

Display of Data from EDP Chlorscan Anomalies detected via C2SOS



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

Future development

Input:

Multi - Variables Analysis

Users' Requirements
Safety Standards

Public Health
Societal, Operational
Eco-Risk Financing

Output

- Multi-variables at a single/multiple point
- Multi-injections
- Non specific Chem. & Bio Anomalies
- Specific Anomalies Signature:
  - E. coli/E. faecalis
  - Pesticides and herbicides

Decision Support System

Risk Assessment Model

Likelihood Matrix					
	Days				
ΔF% on avg.	1	2	3	4	>4
0-15%					
15-40%					
40-70%					
70-100%					
>100%