Validation of an online water quality monitoring methodology for sewers of mid-size cities

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T. Maruéjouls, C. Aaron, J. Alferes,
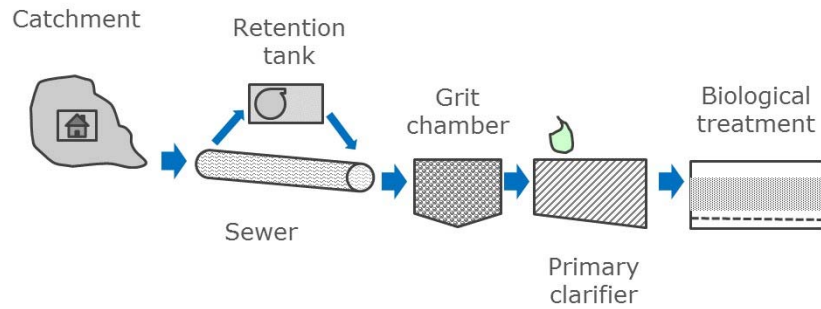Q .Plana, S. Tik and P. A. Vanrolleghem

23rd EJSW: Monitoring Urban Drainage Systems,
Chichillianne, France, May 19th 2017

suez
le lyre

UNIVERSITÉ
LAVAL

Location case study
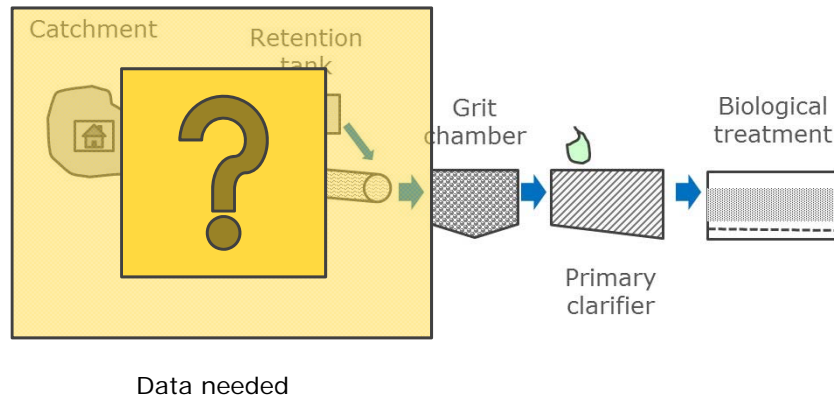
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Motivation

- Aim:
  - Integrated water quality model
  - Focusing on particulate matter
  - "Real" case study
- Challenge:
  - Water quality data

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Data availability… is not equally distributed

Data needed

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Measurement campaigns

- Iterative approach
  - Increase reliability and efficiency of follow-up campaigns
  - Allows for changing experimental set-up

- Measurement campaigns:
  - Small-scale initial campaign at inlet of WWTP
    - September 2016
  - Two follow-up full scale campaigns
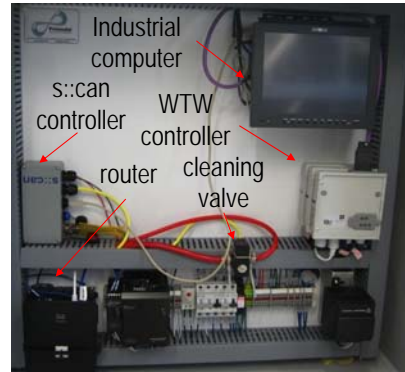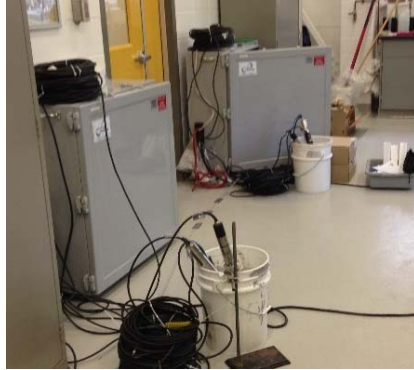   - Spring / summer 2017
    - Spring / summer 2018

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Validation of water quality monitoring methodology

- Available equipment and methodology:
  - Automated monitoring stations and sensors
  - Maintenance protocol for online measurements (inlet WWTP)
    - Alferes et al. (2014)
    - Plana (2015)
  - Data treatment (univariate time series analysis)
    - Alferes et al. (2014)

- But:
  - New case study
  - New environmental conditions

- Validation of online water quality monitoring methodology?

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M&M: Automated monitoring stations (I)

- Vision by Rieger and Vanrolleghem (2008) features flexibility:
  - Compact set-up
  - Sensors used

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M&M: Automated monitoring stations (II)

Equipped with:
- pH sensor (WTW)
- Conductivity sensor (WTW)
- Turbidity sensor (WTW)

- Spectrometer (s::can):
  - Total chemical oxygen demand (CODtot)
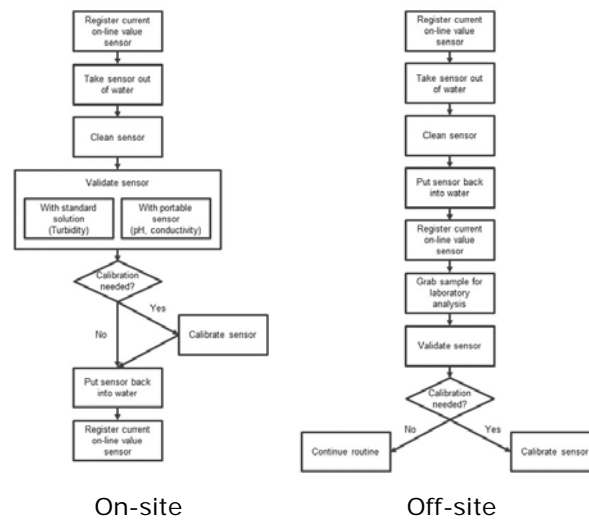 - Soluble COD (CODs)
  - Total suspended solids (TSS)

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M&M: Maintenance protocol

• Developed building on the work of Plana (2015)

• Based on the sensor's type of data quality validation:
  • On-site data
    • pH
    • Conductivity
    • Turbidity
  • Off-site
    • Spectrometer

M&M: Maintenance Protocol

On-site   Off-site

M&M: Maintenance schedule

• Proposed for the inlet of the WWTP (Plana, 2015)

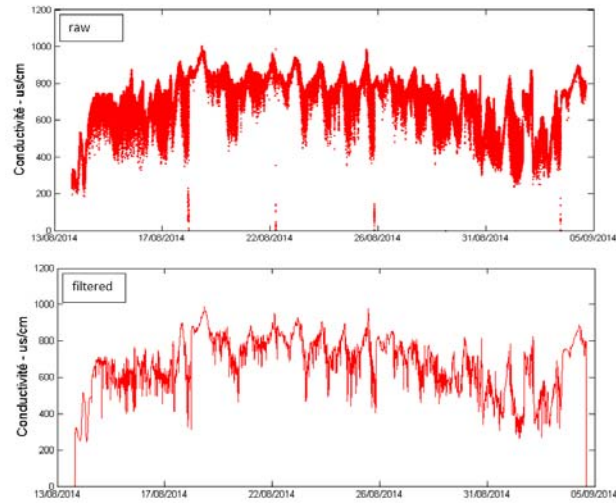| Sensor	Cleaning	Validation	Calibration
pH	Weekly	Weekly	Monthly
Conductivity	Weekly	Weekly	Monthly
Turbidity	Bi-weekly	Monthly	Yearly
Spectrometer	Weekly	Weekly	Local, bi-monthly

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M&M: Data treatment (I)

• Alferes et al. (2014)
• Univariate time series analysis
  • First step: outlier detection and data smoothing
  • Second step: fault detection (data validation)

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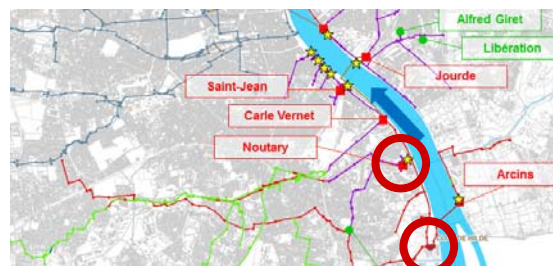
M&M: Data treatment (II)

Results Quebec,
Conductivity,
Outlet grit chamber

Current state of measurement campaign

• Started in mid-April

• First location operational
  • Inlet wastewater treatment plant (WWTP) "Clos de Hilde"
• Second location soon to be installed
  • Pumping chamber "Noutary"

Results

- Results installation
  - Inlet WWTP "Clos de Hilde", Bordeaux

- Results maintenance
  - Inlet WWTP "Clos de Hilde", Bordeaux

- Results comparison different measurement locations
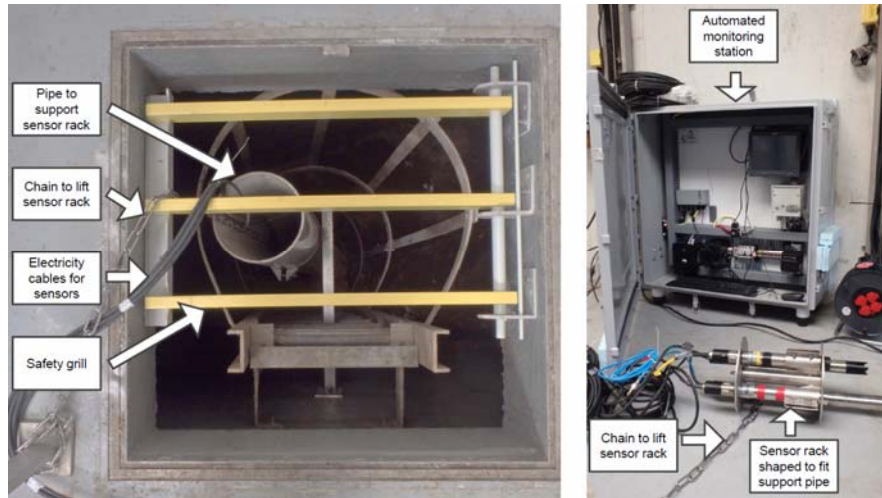 - Sewer and WWTP "East", Quebec City
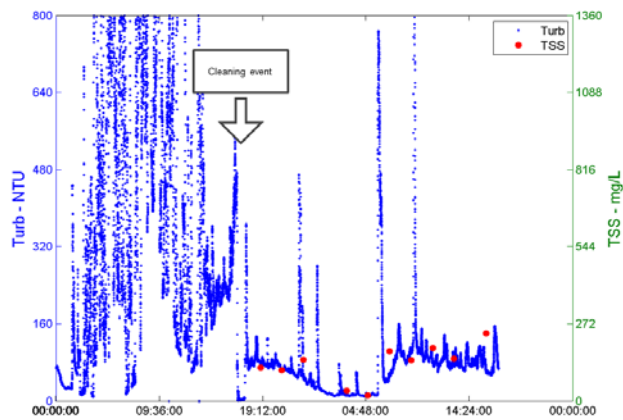
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Results Installation (I)

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Results Installation (II)

Results Maintenance (I)

Cleaning event visible
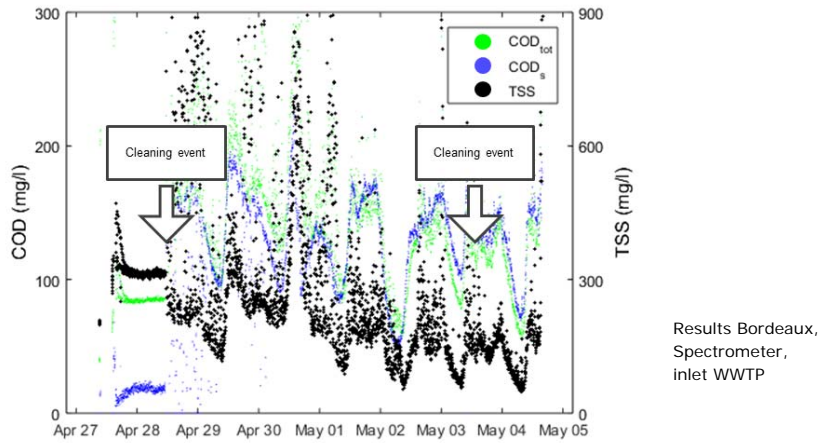-» all data before unusable

Results Quebec City,
turbidity,
inlet combined sewer
retention tank

Results Maintenance (II)
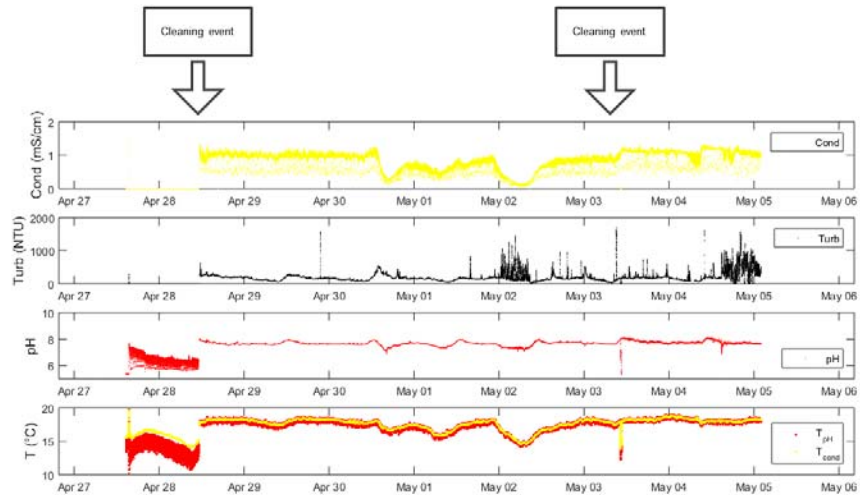
Keeping strict maintenance
   -» 2nd cleaning not visible

Results Bordeaux,
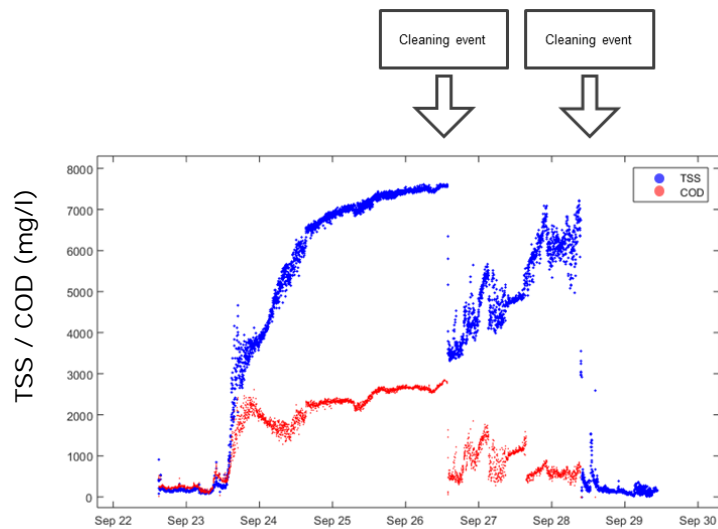Spectrometer,
inlet WWTP

Results Maintenance (III)

Results Bordeaux,
WTW sensors,
inlet WWTP

Results Maintenance (IV)

- First trial installation in September 2016
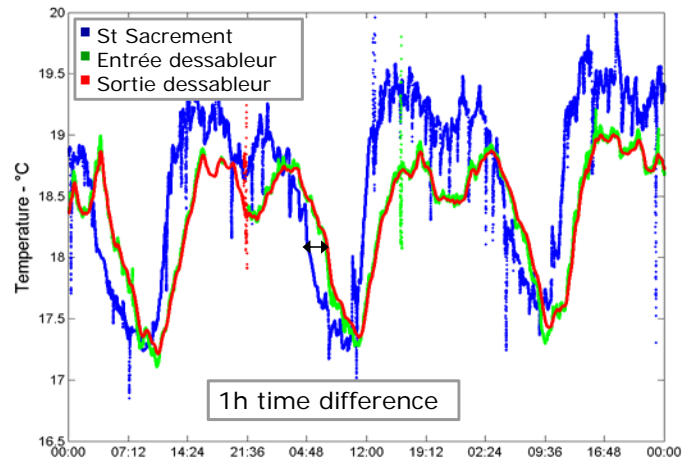- Strict maintenance schedule is not everything
  - Compressed air indispensable

Results Maintenance (V)

Cleaning event

Cleaning event

Results Bordeaux,
Spectrometer,
inlet WWTP

Results Comparison Sewer – Inlet WWTP

1h time difference

Results Quebec City,
Temperature   23

Conclusions and outlook

• Iterative approach
  • Strongly recommended

• Flexibility of automated monitoring stations
  • Small improvements for next generation
  • Validated

• Maintenance protocol and schedule for inlet WWTP
  • Small adjustments necessary
  • Validated

• Data validation and treatment
  • Still to be done

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