

# The Importance of Particles and Continuous Monitoring in Urban Drainage Systems

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*Eawag Webinar on  
Acoustic Monitoring of Suspended Solids in Natural and Engineering Systems*  
Webinar, May 16 2023



## Content

- Importance of TSS as a pollution vector
- Traditional TSS measurements
- Turbidity as a TSS measurement surrogate
- Operational issues with turbidimeters
- Value of high-frequency TSS data
- Characteristics of a perfect TSS sensor

## **My initiation to TSS in urban drainage systems**

"Fonctionnement du traitement des eaux usées en cas de fortes variations de débit"  
Journée d'étude CB-IAWQ, Liège, 31.05.95

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### **Variabilité des charges solides en suspension à l'exutoire des réseaux de collecte**

Michel Verbanck

*Université Libre de Bruxelles, Laboratoire de Traitement des Eaux et Pollution*

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## **My initiation to TSS in urban drainage systems**

### *Wastewater treatment operations under high flow variations*

*Symposium Belgian Branche of IAWQ, May 31 1995*

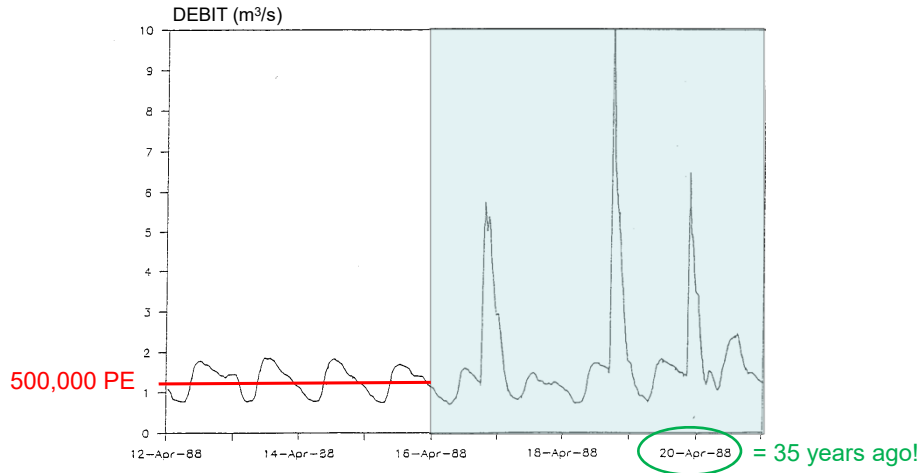
### *Variability of TSS loads at the outlet of the collection system*

Michel Verbanck

*Université Libre de Bruxelles, Laboratoire de Traitement des Eaux et Pollution*

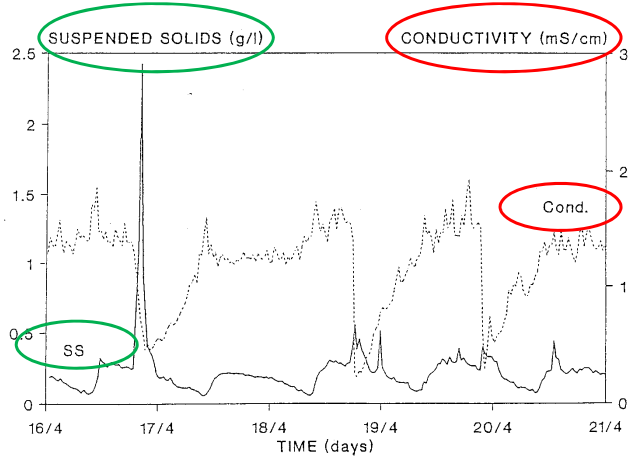
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## Brussels – Dissolved and particulate pollution



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## Brussels – Dissolved and particulate pollution



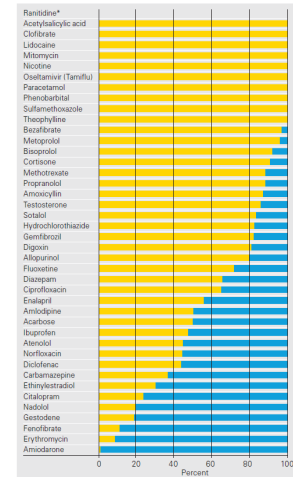
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## TSS in urban drainage systems

Vehicle transporting at least 50% of:

- Organic matter
  - Nitrogen & Phosphorus
  - Pathogens
  - Heavy metals
  - Hydrophobic micropollutants (PAH, pesticides, ...)
- 
- Inorganics (sand) abrasive to downstream equipment

% of pharmaceutical products in solution



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## Damage caused by TSS



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\*Hydro International (2013)

## TSS measurements



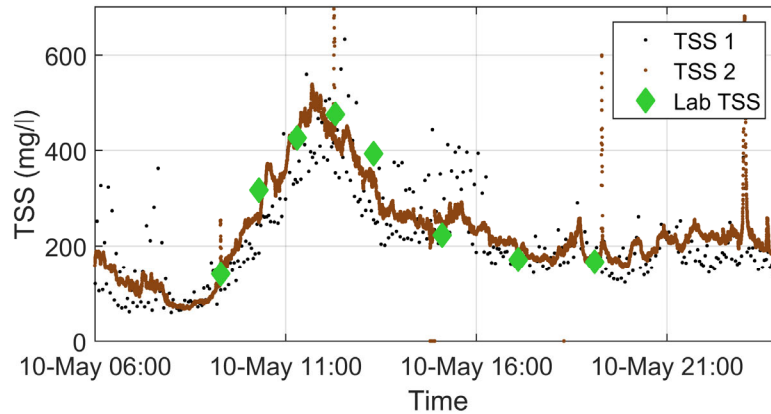
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## TSS measurements



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## TSS-turbidity relationship



Ledergerber, Bordeaux 2017

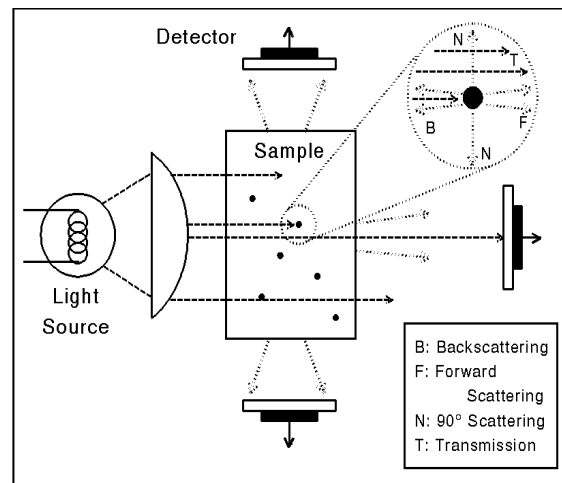
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## TSS measured through turbidity

Multiple measurement principles:

- Transmission
- Backscattering
- Forward scattering
- 90° scattering (nephelometry)

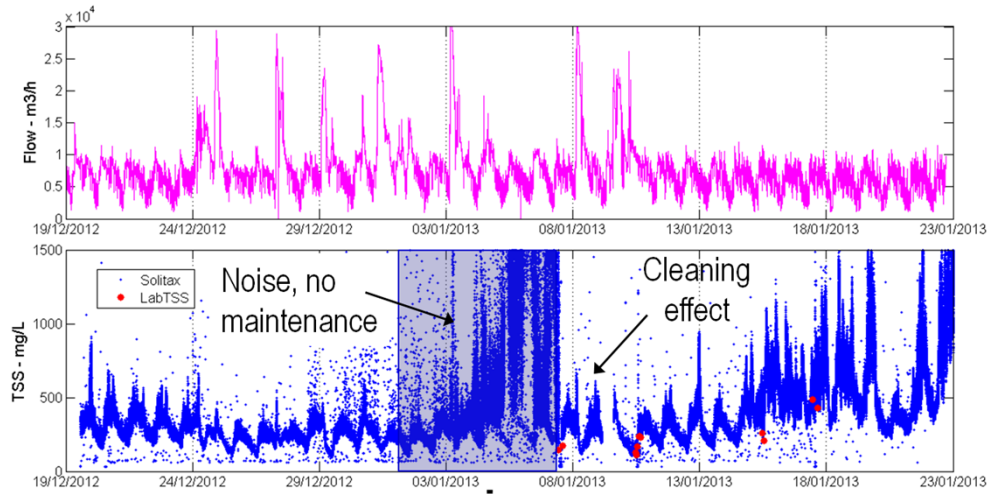


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## Operational issues with turbidity sensors

Weekly cleaning of turbidity sensor at Lynnetten raw sewage (DK)



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## Operational issues with turbidity sensors

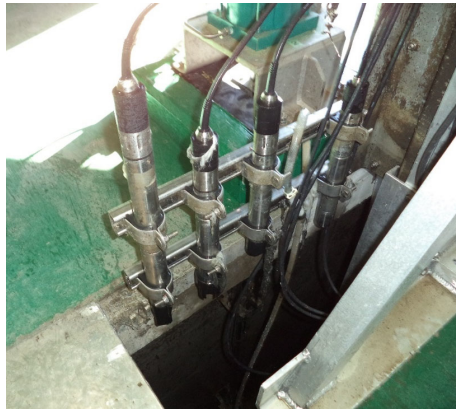
Weekly cleaning of turbidity sensor at Lynnetten raw sewage (DK)  
after New Year:



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## Operational issues with turbidity sensors

- Well-chosen turbidimeters, with proper installation and regular maintenance, keep providing good data

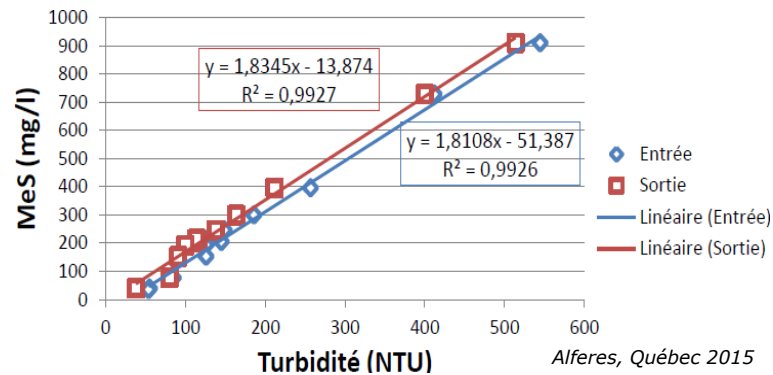


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## TSS – Turbidity relationship

- Wastewater-dependent
- Time-dependent
- Particle optical property-dependent

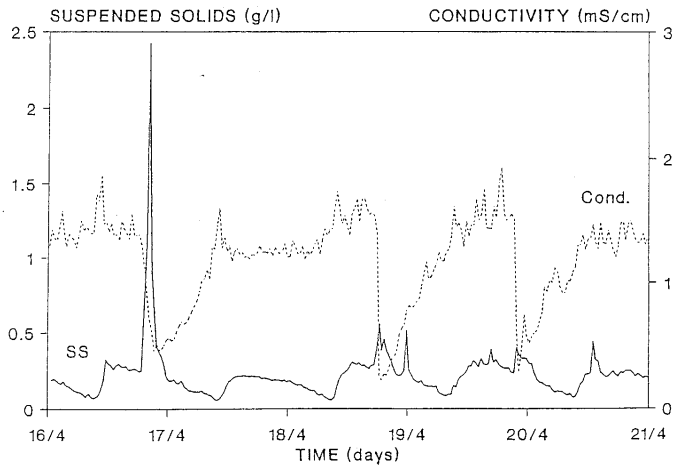


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## Value of high frequency TSS data

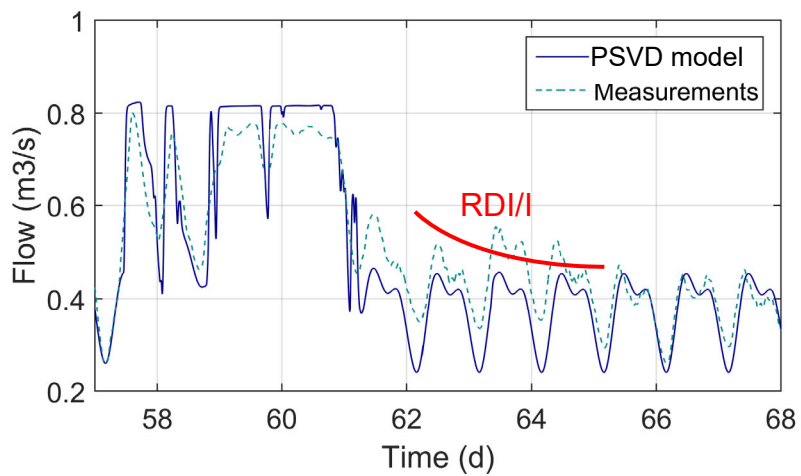


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## Value of high frequency TSS data

- Model validation after a 2-day rain event in Bordeaux

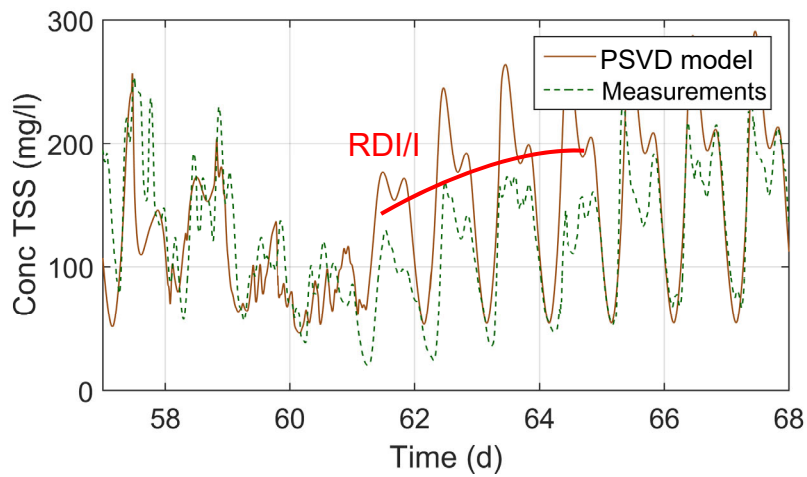


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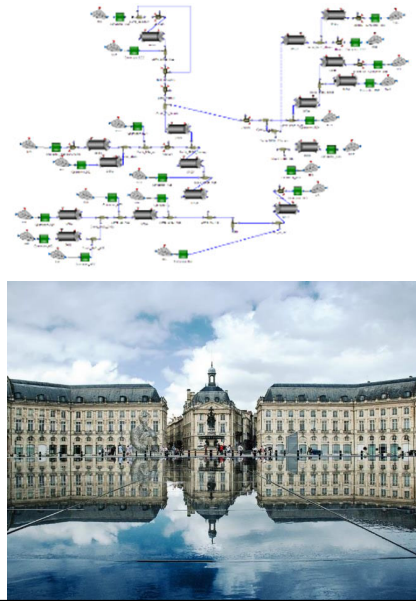


## Value of high frequency TSS data

- Model validation after a 2-day rain event in Bordeaux

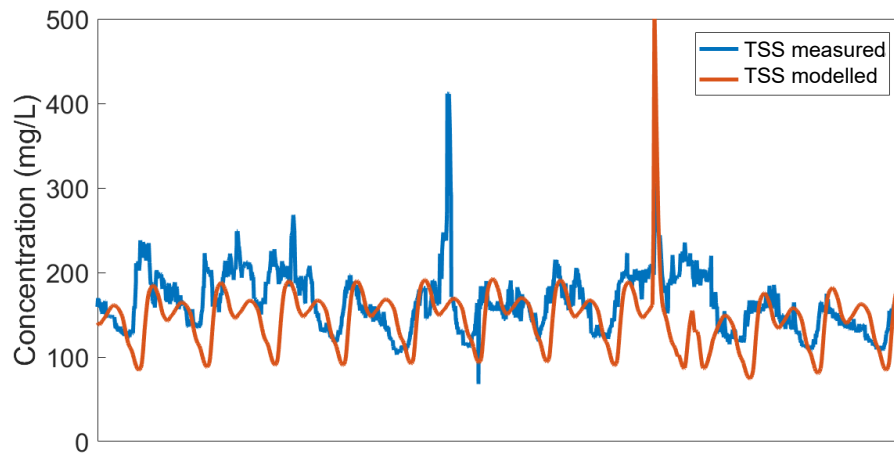


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## Value of high frequency TSS data

- Model validation for 11 days with 2 rain events in Québec



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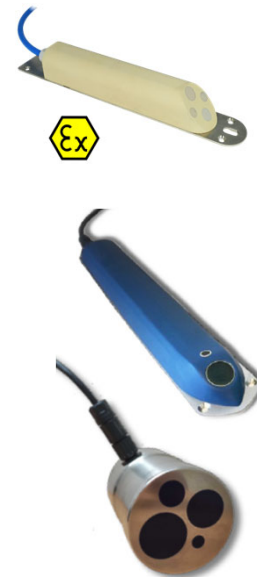
## Take home

- TSS carry over 50% of important pollution:
  - Organics
  - Nutrients
  - Pathogens
  - Micropollutants (heavy metals, hydrophobic PPCP)
  - Inorganics (sand)
- Dynamics are fast
- High-frequency monitoring & modelling is essential for urban pollution management
- Turbidity – TSS relationship exists and has been used a lot
- Problems remain with:
  - Installation
  - Maintenance
  - Stability of Turbidity-TSS relationship

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## The perfect TSS sensor should...

- [application] For real-time monitoring of particles in urban drainage/wastewater systems
- be easy to install (ATEX certification)
- **require virtually no maintenance**
- be easy to maintain (<10min /week)
- Fast, measurements within seconds
- spatially-resolved signal
- low-power consumption (operate over months)
- easy to calibrate (ideally: no calibration, factory-hardcoded)
- measure particle size distributions, different classes of material
- measure TSS<63um, separately measure « critical » particles
- ...



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