On the relevance of sewer monitoring for water quality impact assessment

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10e Journée d'échanges régionale
L'autosurveillance des réseaux d'assainissement,

Lyon, 9th April 2015

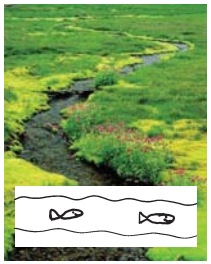
Est-ce que les dans les rivières se soucient des rejets pluviaux urbains ?

Et si oui, comment pouvons-nous savoir ce qui les met en colère?

Bottom Line

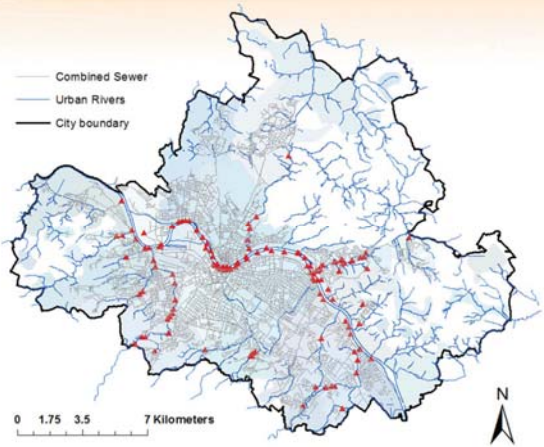
Questions:

- How to mitigate impacts on water quality?
- **How** can we identify effective and cost-efficient solutions?

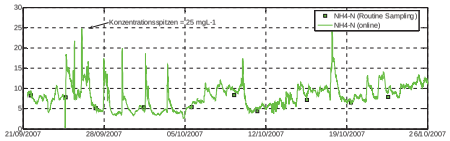


Focus

1. spatial differentiation of urban drainage impacts

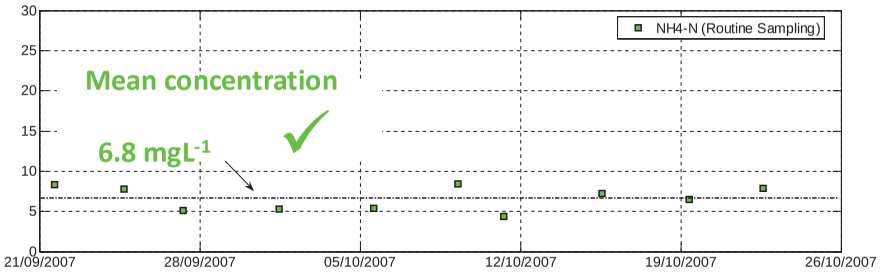


2. Varying temporal scales, i.e. variability of process dynamics



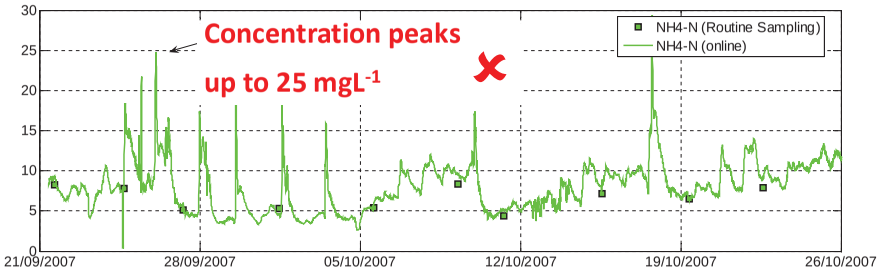
Water quality (grab) sampling (á 1 week)

River Water Quality NH_4-N [mgL^{-1}]



Online water quality monitoring (5‘)

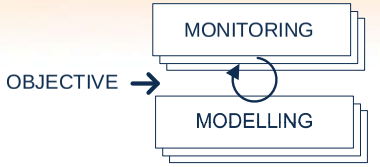
River Water Quality NH_4-N [mgL^{-1}]



→ dynamics?

How can we *efficiently* identify combined sewer overflows ?

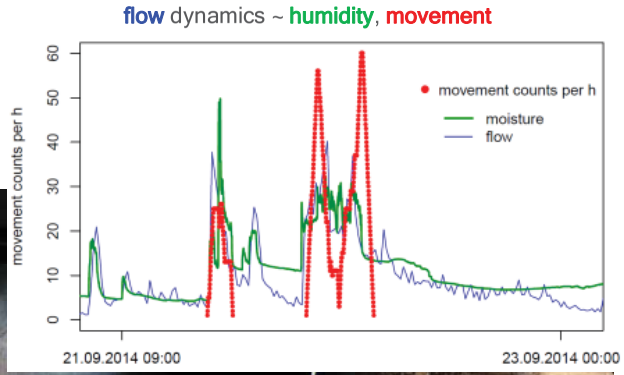
→ Methods



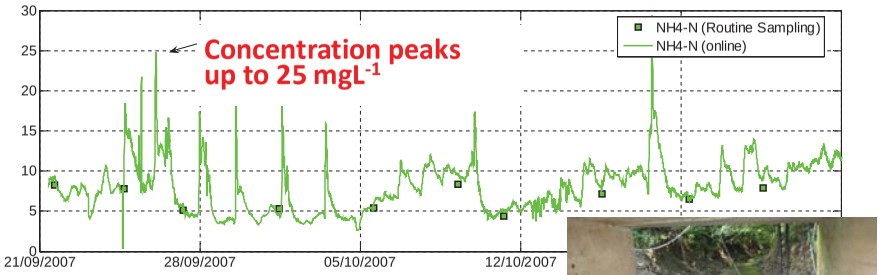
		Method	Data requirements: rain	hydr	qual	infra-structure	Information gain: CSO ident	CSO vol	CSO load	spatial relev.	RW impact	'useful-ness'	'effort'
monitoring	in-sewer	level monitoring (POLENI)				(x)	x	(x)		(x)		3	2
		flow/velocity monitoring					x	x	x			2	3
		pollution monitoring (load)					x	x	x			2	4
		'binary observations' (0/I)					x	(x)		x		1	2
	indirect	correlation with rain charact.	x	x			(x)			(x)		1	2
		RW quality monitoring	(x)				(x)	(x)	(x)		x	3	4
	ecology	sampling macro-invertebrates									x	3	4
modelling	hydraulics	hydrology ('grey-box model')	x	x		(x)	x			(x)		2	3
		hydrodynamics	x	x		x	x			x		3	4
	quality	pollution load ('grey-box')	x	x	x	(x)	x	x	(x)			2	4
		integrated water quality model	x	x	x	x	x	x	x	x		3	5

Inspired by: Sonnenberg et al. – 12th ICUD (2011)

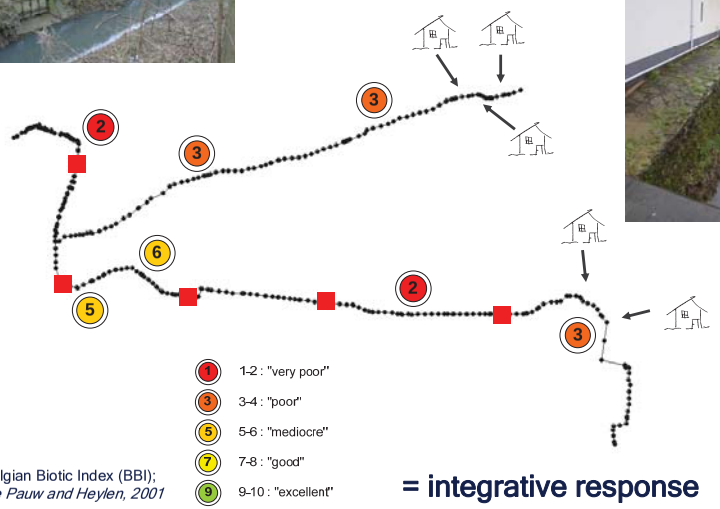
CSO detection using low-cost (‚binary‘) sensors



River Water Quality NH_4-N [mgL^{-1}]



What we know… insufficient ecological status

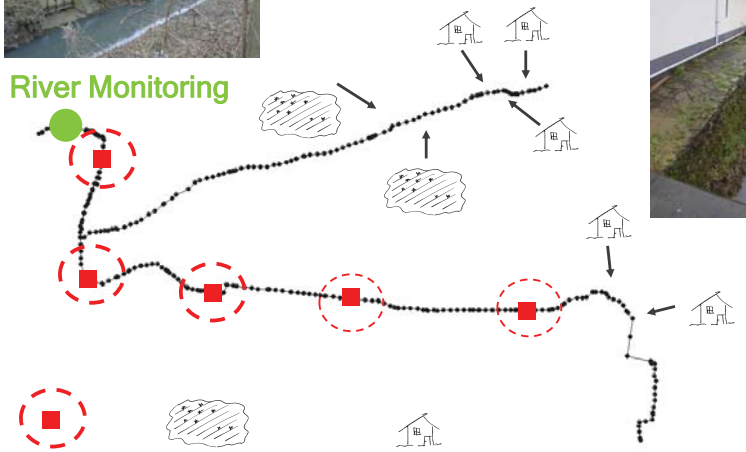


Belgian Biotic Index (BBI);
De Pauw and Heylen, 2001

= integrative response

What we know… various pressures

River Monitoring



CSO's *Diffuse sources (?)* *Direct dischargers*

Blumensaat et al. (2013), Water Science and Technology 67(2) | Dirxcks, et al. (2011), Water Science and Technology 63(5)

What we don't know…

- **Cause-effect-relations?**
- **Relevance of identified 'pressures'?**
  - Pollution dynamics?
  - Influence of sewer overflows?
  - Other influencing factors …?
- **Effects of mitigation measures?**

→ Combined approach:
online WQ monitoring || process modelling

Integrated water quality model

Urban Drainage (SE)

conservative pollutant transport
(4states: Q, iCOD, rCOD, NH_4-N)

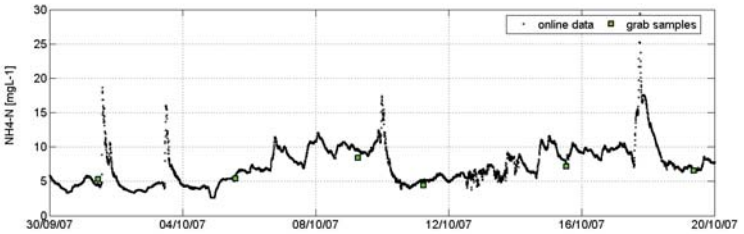
Catchment Hydrology (HYD)

4states:
Q, iCOD, rCOD, NH_4-N

River Network (RW)

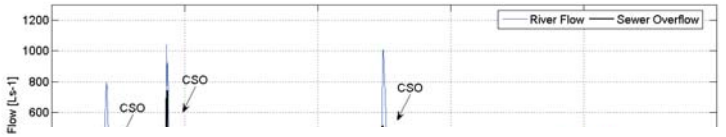
pollutant conversion
(T_{var})

Integrated water quality: monitoring vs. modelling



Calibration results: sewage flow and quality

River water quality: monitoring vs. modelling



<u>Cause:</u> hydraulic stress
(and *not* the pollution from the CSO)

<u>Effect:</u> remobilisation of river sediments
-> NH_4-N release

How can we *efficiently* identify combined sewer overflows ?

→ Methods

		Method	Data requirements				Information gain					'useful-ness'	'effort'
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		flow/velocity monitoring					x	x				4	3
		pollution monitoring (load)					x	x	x			4	4
		'binary observations' (0/I)					x	??		x		3	1
	indirect	correlation with rain charact.	x	x			(x)			(x)		1	2
		RW quality monitoring	(x)				(x)	(x)	(x)		x	3	4
	ecology	sampling macro-invertebrates									x	3	2
modelling	hydraulics	hydrology ('grey-box model')	x	x		(x)	x	x		(x)		2	2
		hydrodynamics	x	x		x	x	x		x		3	3
	quality	pollution load ('grey-box')	x	x	x	(x)	x	x	x	(x)		3	4
		integrated water quality model	x	x	x	x	x	x	x	x	x	5	5

Key Conclusions

1. **Sewer** (online) **monitoring** is … laborious, costly, sometimes frustrating…
   → but: **essential** to understand process dynamics
2. The lack of information is not a reason to discard the idea of modelling… → but **adequate reference data are essential** to substantiate modelling results, and to so increase trustworthiness.
3. **Integrated numerical modelling** clearly **makes sense**! BUT: sensitivity analyses and the use of high resolution reference data should become integral parts of the modelling exercise.
4. **There is no standard, cookbook-like routine** that helps in solving future problems! Diverse methods needs to be combined in accordance to experience and resources.
5. **Engineers** need to **extend** their technical **expertise towards** a better **ecological understanding**. The 'missing link' (emission – ecology) remains a research & awareness challenge!