

NORMAN workshop emerging subs, Amsterdam, 29-30 November 2012



SMART MONITORING OF THE WATER CYCLE



Ron van der Oost



Waternet

Surface and ground water



Waste water



Research & engineering



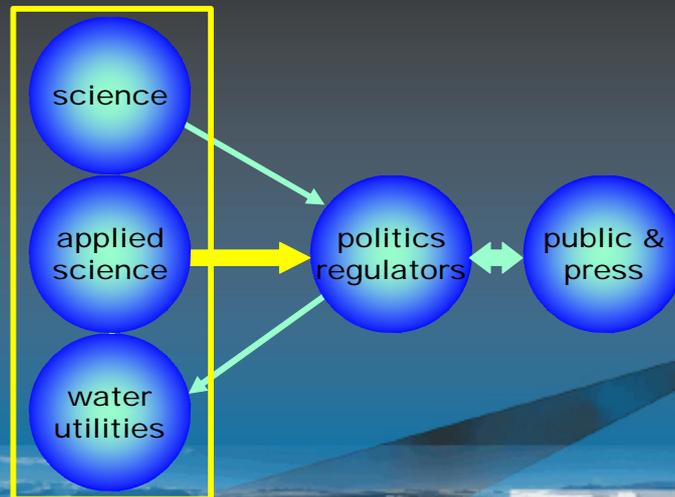
Waterproof & HWL labs

Drinking water



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Parties involved in water quality



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3

Outline

- **Monitoring of micropollutants in the water cycle**
- **Bioassays & passive sampling**
- **Design of a 'smart monitoring' strategy**

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4

Micropollutants in the water cycle

Behaviour and bioavailability ES
Effects on the ecosystem (biodiversity)



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WFD monitoring

guidelines

Chemical status:
33+ priority
pollutants

Ecological status:
5 groups
populations

Measures to improve the water quality have to be taken if
monitoring indicates no good chemical or ecological status!

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Monitoring substances or effects?



- **Substances:**
 - selected priority pollutants (e.g. 33 for EU WFD)
- **Effects:**
 - General toxicity: effects of total mixture of pollutants
 - Specific toxicity: effects of substances with a similar mechanism of toxic action; high sensitivity!
 - Unknown cause of effect (TIE/EDA needed)

More reliable risk assessment by use of toxic screening prior to relevant chemical analyses

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Monitoring substances or effects?

Toxicity:

- ☺ Limited amount of assays can give a cost-effective and reliable risk assessment
- ☹ Low substance specificity
- ☺ Bioavailability included
- ☺ Mixture toxicity included
- ☺ Metabolites included
- ☺ Unknown substances included
- ☹ Chronic exposure is difficult and expensive
- ☹ No accepted classification available
- ☹ Biomagnification not included
- ☺ No effects ☞ no worries

....
D. De Zwart (RIVM, Netherlands)

Chemistry:

- ☹ Search for a needle in a haystack: obligatory analysis of more than 200 substances in drinking water
- ☹ Many analyses are yet impossible (e.g. matrix effects)
- ☹ Not enough toxicity data available for risk assessment (ERA)
- ☹ No information on bioavailability
- ☹ No information on mixture toxicity
- ☹ Low concentrations ☞ still worries
- ☹ Surrogate security and accuracy

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Smart monitoring project



Alternatives for WFD monitoring:

- Integrated monitoring (chemistry, biology & toxicology)
- Time-integrated monitoring (passive sampling)
- Toxic *in vitro* screening to identify risks and 'hot spots'
- Risk analysis of most relevant micropollutants (TIE, EDA)
- Application of innovative techniques ('omics')

Goal: more information on water quality for less €\$!

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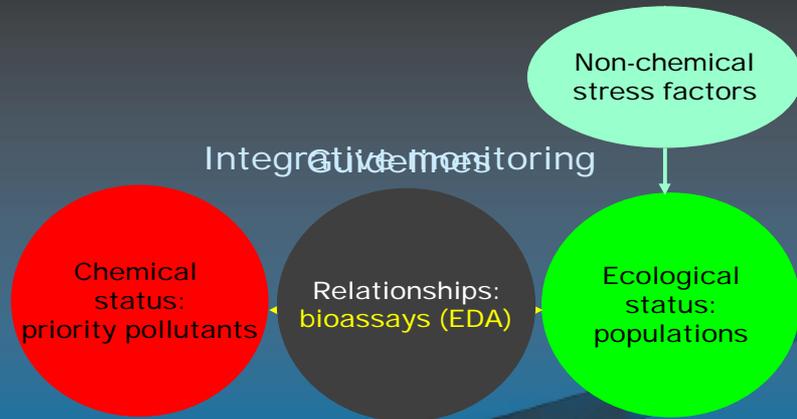
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10

Alternatives for WFD monitoring

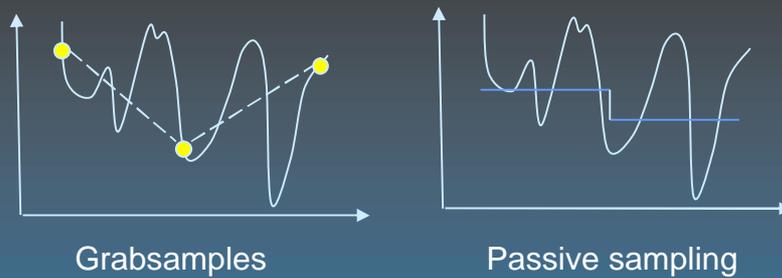


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Passive sampling: time integration



- Grabsamples are 'snapshots'
- PS is better for trends & time weighed average
- Lower sampling frequencies needed with PS

18/8 2011

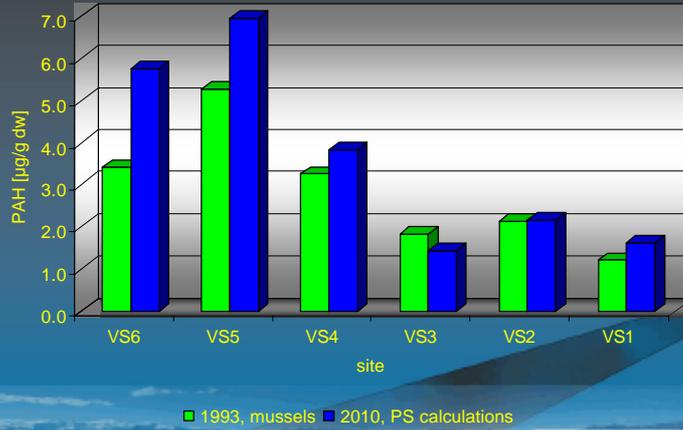
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Bioaccumulation vs. passive sampling

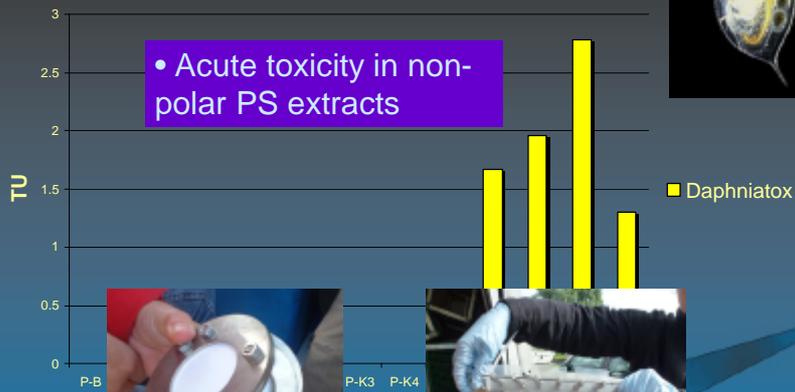
PAH bioaccumulation vs. Passive sampling



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Daphnids: acute toxicity



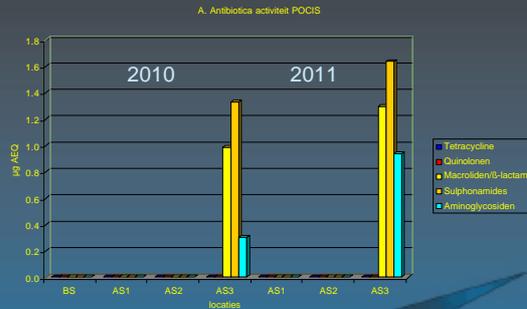
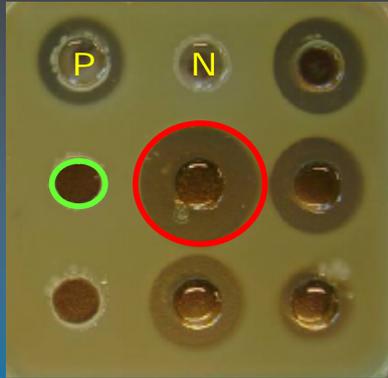
• Acute toxicity in non-polar PS extracts



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RIKILT WATER-SCAN: antibiotics effect



- Different types of antibiotics activity in polar wwtp extracts

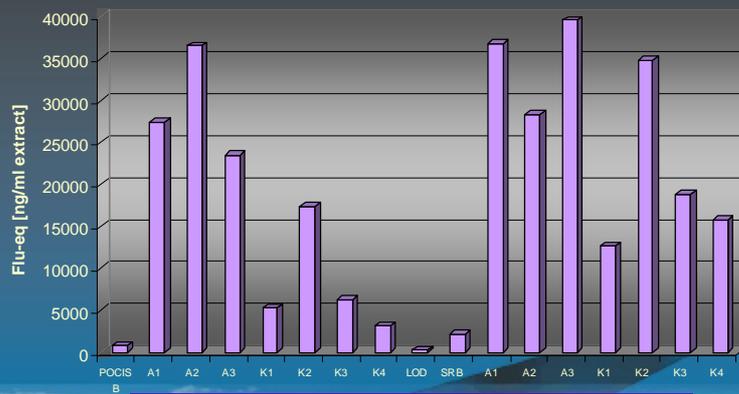
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Reporter gene assays: Anti AR-CALUX

anti-AR CALUX POCIS & SR



- Strong anti-androgenic activity in both polar and non-polar PS extracts

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17

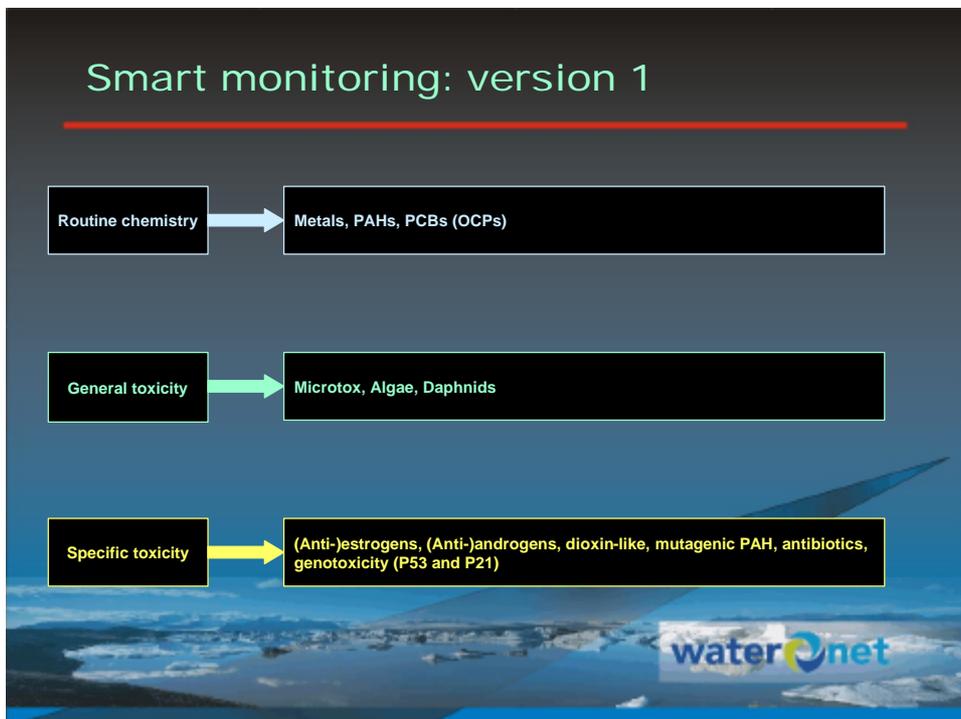
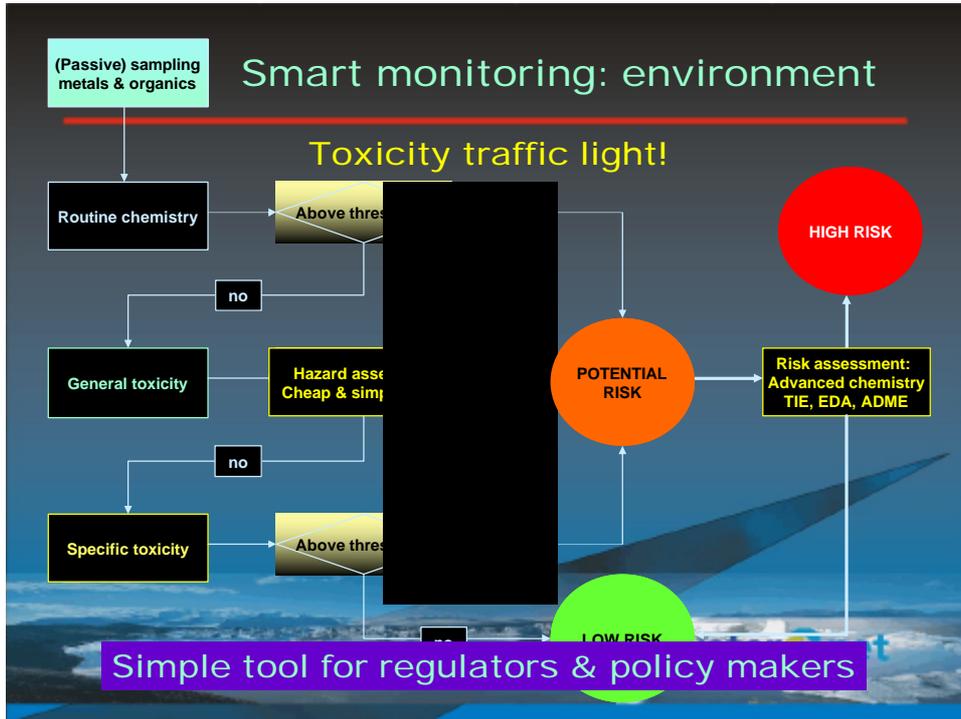
Vision on future monitoring

- Chemical analyses will always be needed, but they are most useful **if you know what you are looking for...**
- For an overall risk assessment the use of chemical analyses alone is insufficient, but a **combination of chemical and toxicological monitoring** is necessary, and may be less expensive!
- Comparable strategies for all **water cycle** compartments

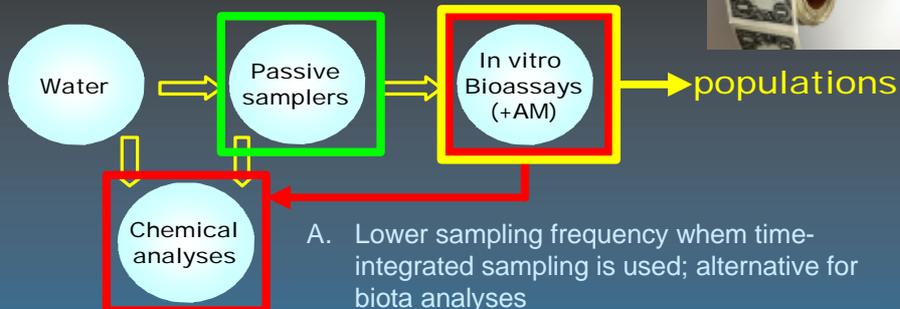
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18



Cost reductions on monitoring



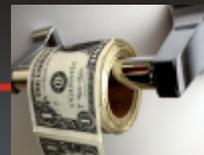
- Lower sampling frequency when time-integrated sampling is used; alternative for biota analyses
- Only advanced chemical analyses after responses in tox-screening
- Bioassay screening and innovative DNA testing to reduce costs for ecological testing

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21

Cost reductions on monitoring



- WFD chemical monitoring
 - 12x grabsamples (each month)
 - Chemical analyses of 33 priority pollutants
 - Costs around €40,000
- Smart monitoring, version 1
 - 4x passive sampling (each season)
 - Chemical analyses of metals/PAH/PCB/OCP
 - Toxicological analyses with 3 general & 9 specific bioassays
 - Costs around €10,000
 - Additional analyses **only at sites with potential risk!**

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Uncertainties?

- Bioassays
 - No (sensitive) response to all pollutants
- Passive sampling
 - Not all compounds accumulate in samplers
- Grab sampling
 - Snapshot; no information on bioavailability
- Chemical analyses of priority pollutants
 - No information on 99,000 other chemicals in water cycle...

Uncertainties of combination?

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What do we need...?

- Additional research on integrative monitoring (many projects)
- Further calibration of (polar) passive sampling (NIOZ, Deltares)
- Design of more 'simple' bioassays for effect measurement (BDS)
- Design of **trigger values** for classification of effects (DEMEAU)
- Design of **trigger values** for bioassay-PS combinations (SM)
- Design of less expensive EDA/TIE (HT-EDA, EDA Emerge)
- Develop simple tools for regulators/policy-makers (SM)

Paradigm shift: substances → risks!

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Thanks!



Research & Innovation Steering Group

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25