



Application of passive sampling for monitoring pesticides and pharmaceuticals in groundwater

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Introduction: conventional monitoring

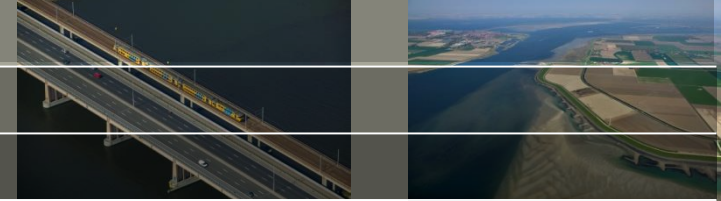
Conventional monitoring occurs by pumping groundwater
Easy and the sampled volume is well defined

However,

- Pumping can disturb groundwater zones
- It gives a “snap shot” concentration
- Due to peat and clay-layers, not sufficient ground water can be sampled
- The sampled volume is limited which often gives analytical results below limits of detection



Early warning



- Plant protection substances and pharmaceuticals (via manure) are applied at surface
- Can be transported to ground water
- Measuring low concentration is favorable.
- Effects of measures to protect ground water takes many years

Measuring low concentrations → unwanted compounds are earlier detected → measures can be taken in an earlier stage

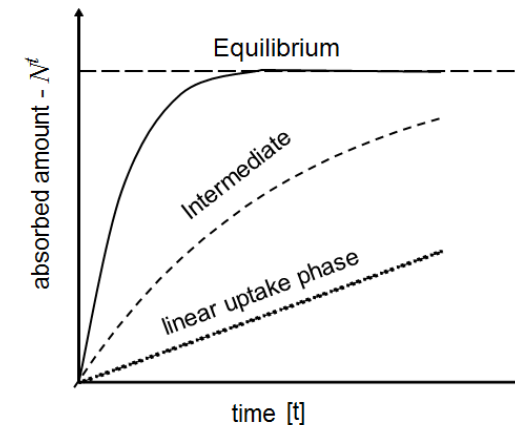


Alternative: passive sampling

- Use of a sampler existing of sorption material is placed in the well.
- Transport of compounds from water to sampler by diffusion

Benefit

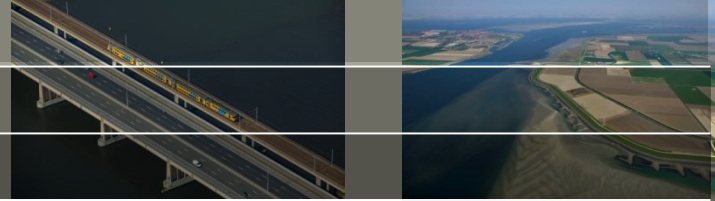
- Sampler can be deployed for a long time period (weeks/months)
→ Larger sampled volume → lower concentrations
- Average concentration over sampling period
- Different types of passive samplers
 - * Equilibrium samplers; like silicone rubber, LPDE, PBDS
 - * Adsorption samplers: like Cermic dosimeter, Empore disk



Disadvantage

Not for all samplers calculation of water concentrations is well defined

Application



Technique is used for monitoring e.g. volatile compounds like VOC's and BTEX in ground water at polluted sites, in several European countries, like France and Germany

However, lack of guidelines in a regulatory context limits the application

In routine monitoring of ground water for e.g. pesticides in ground it is not used, at least not in the Netherlands

For surface water monitoring passive sampling is already more frequently used in the Netherlands

Our study: Test passive sampling and monitoring pesticides and pharmaceuticals in Noord-Brabant

Aim:

- 1) To test application of passive sampling in ground wells to detect compounds in earlier stage
- 2) Monitor pesticides and pharmaceuticals

Sampling wells:

- Two locations of monitoring network
Province of Noord-Brabant
- Agricultural area
- Pesticides detected in the past
- Wells with filters on approx. 4 m-mv (shallow) and approx. 22 m-mv (deep)



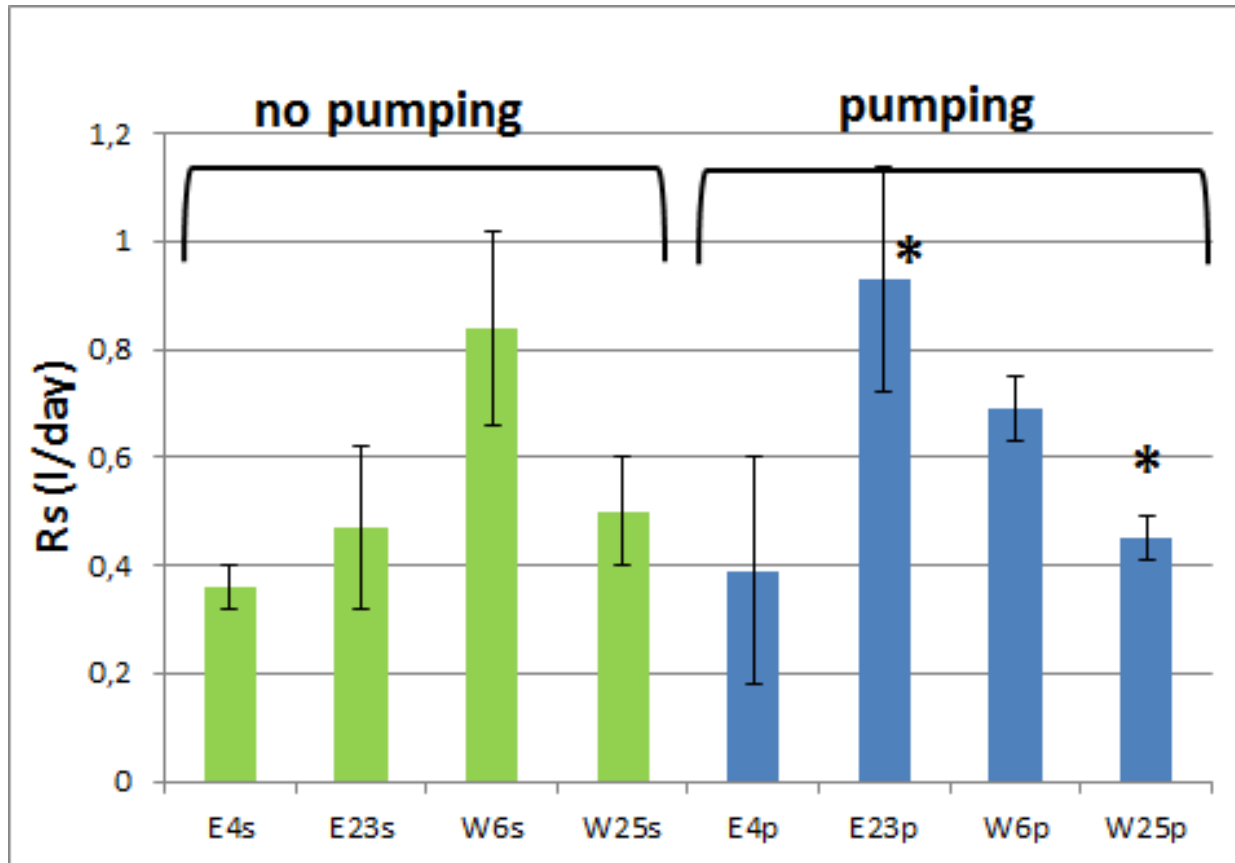
Field work

- Application of two type of samplers (silicone rubber and Empore disks)
- Comparison with conventional taken water samples
- Two sampling periods, one with and one without pumping ~ 7 L /day
- Deployment for 6 to 7 weeks
- Analysis of mainly hydrophilic pesticides and pharmaceuticals
- Silicone rubber used for estimation sampled volume



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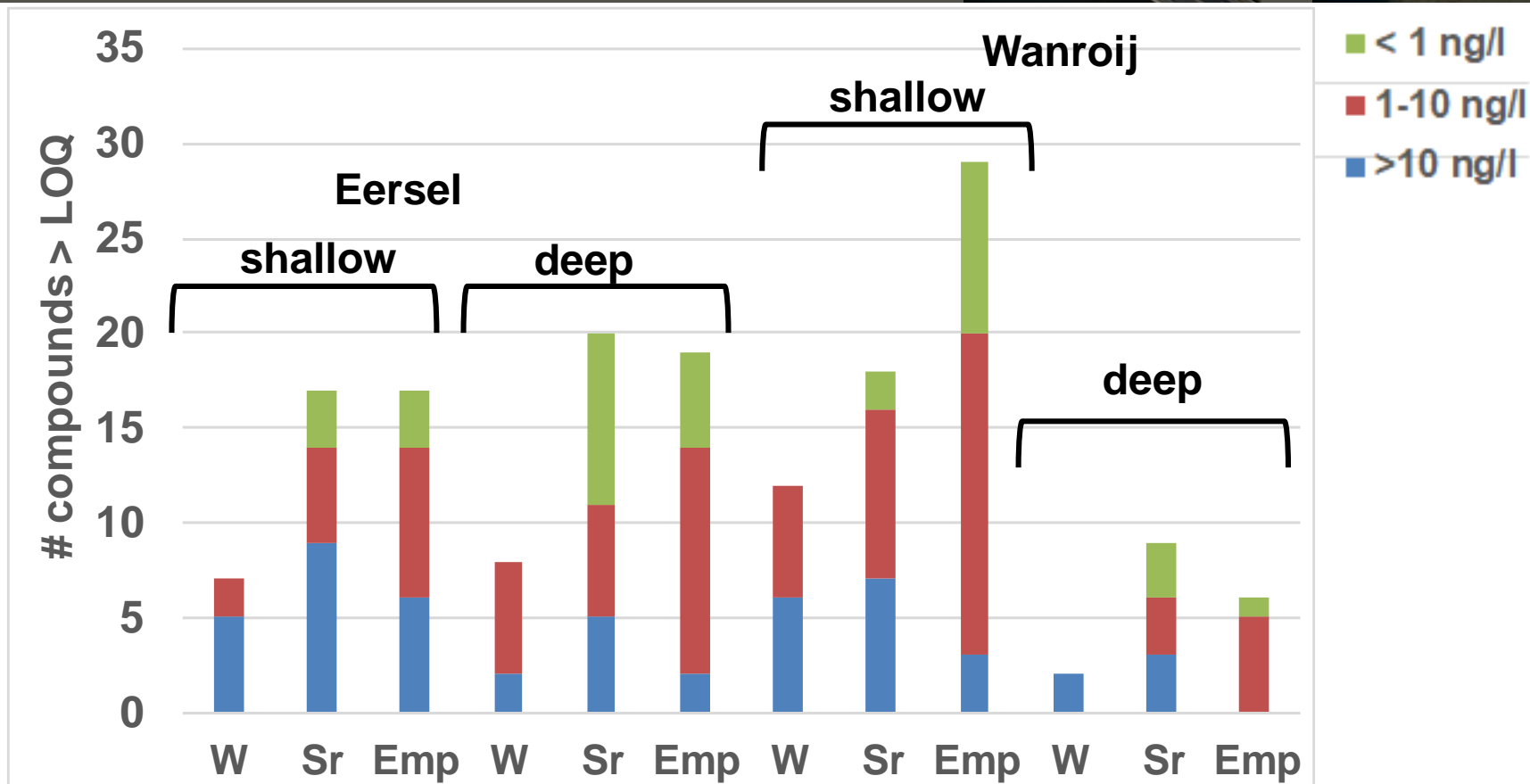
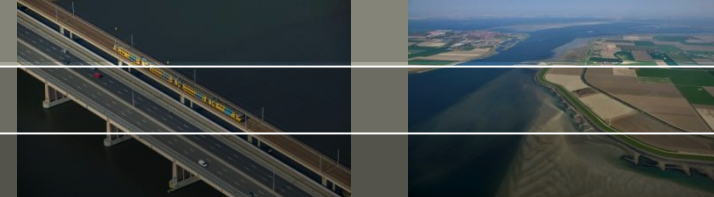
Results pumping



* (Sufficient) Pumping failed due to iron oxide formation

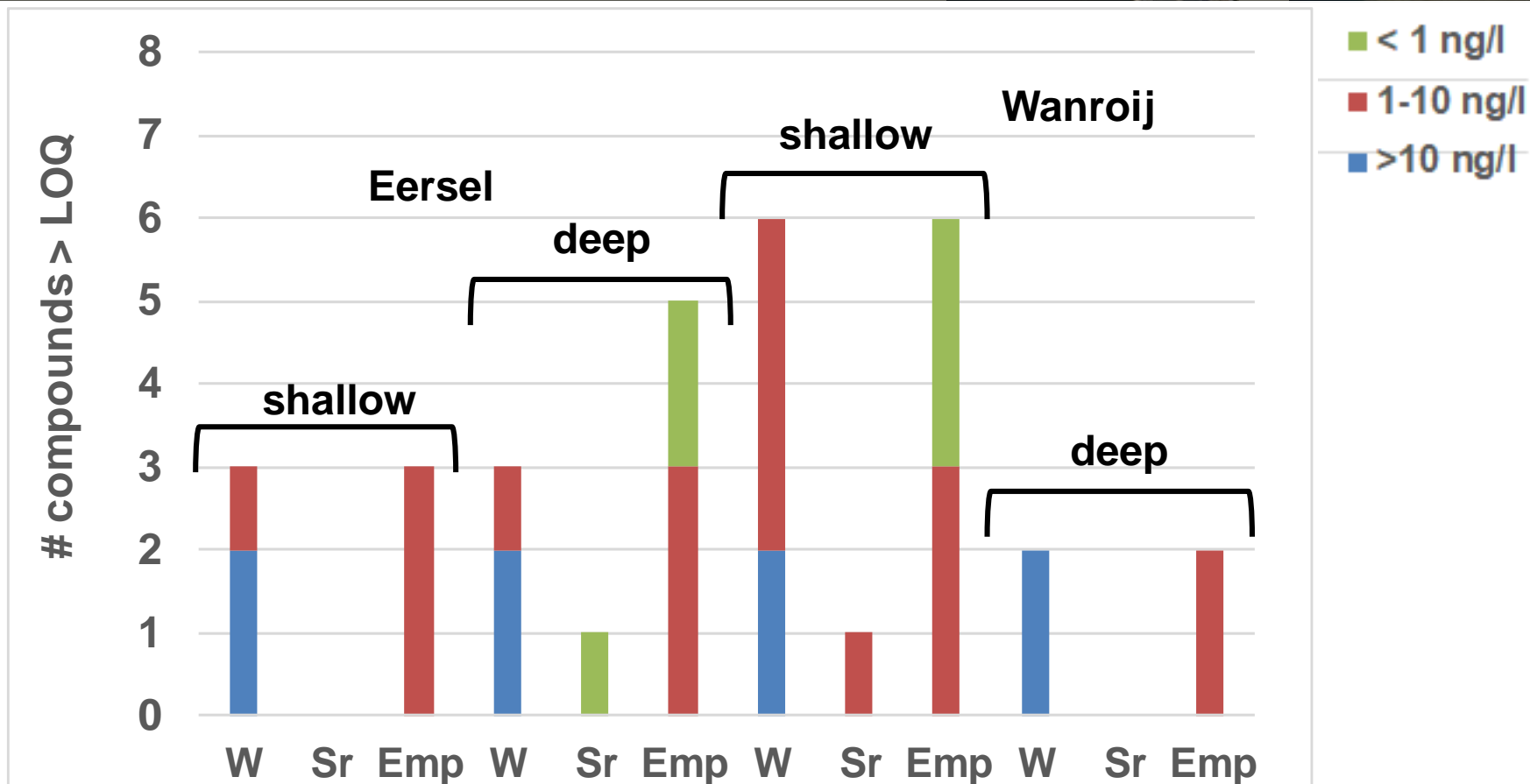
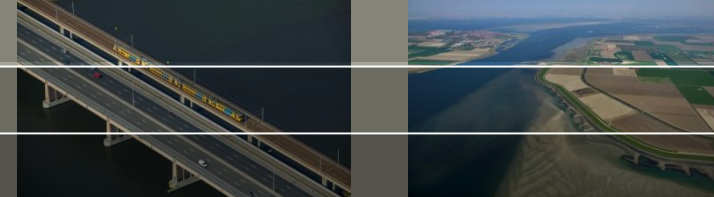
No large effect on sampling rate, but much trouble in the field

Results: pesticides



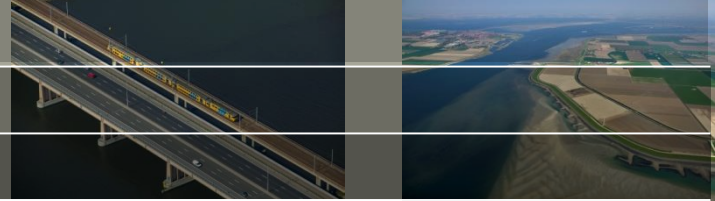
- Compounds found in conventional water samples also found on samplers → “usual suspects”
- More compounds detected by passive sampler than in water → many compound < 10 ng/l
- Many compounds on PS were never detected in the groundwater wells before

Results: pharmaceuticals



- Amount of compounds in water and Empore disks equal
- Empore disk performs better than SR → Pharmaceuticals are more hydrophilic
- Extraction of Empore disk was not optimal

Conclusions



- Added value in trend monitoring (“early warning”) because of detection in low concentrations
- Pesticides detected that were never seen before
- For “usual suspects” less added value
- With optimization extraction method pharmaceuticals can be better monitored
- Passive samplers can easily be installed and no pumping is needed
- Application of passive sampling give better insight in ground water quality → ready for application
- Further research needed for estimation sampled volume



Questions?

Beeld: Susan Rexwinkel

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11th of September 2019