

EnISSA

Enhanced In Situ Soil Analysis

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- 1. Introduction
 - 1. General
 - 2. MIP
- 2. Objective EnISSA
- 3. EnISSA MIP
- 4. Results
 - 1. Case studies
 - 2. EnISSA <-> traditional approach
- 5. Conclusions

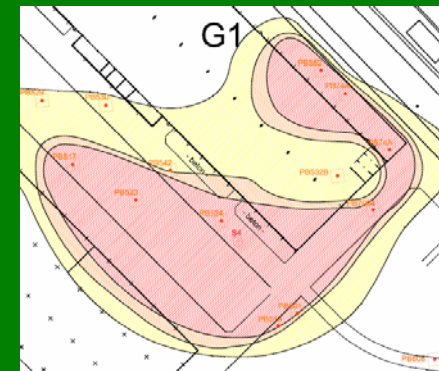
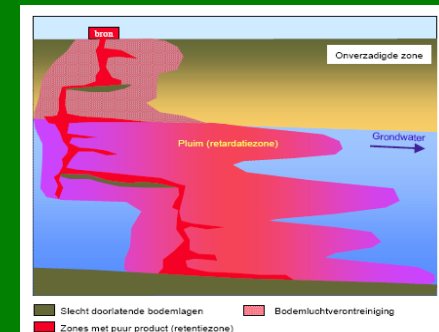




Introduction



- classic sampling strategies (groundwater wells)
- ↓
- + low detection level
 - + broad analysis spectrum
 - Decision making: Time inefficient
 - Large contaminated area: large information gaps





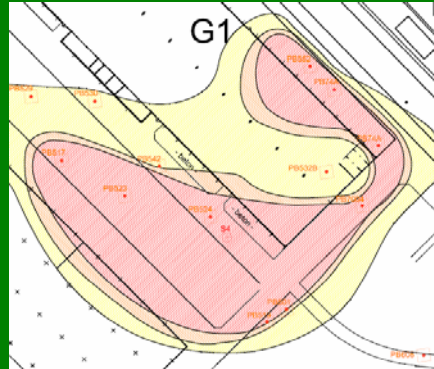
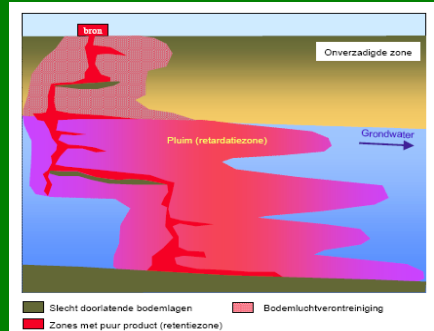
Introduction



classic ↔ Current "On Site" soil investigation (MIP, ROST, ...)

↓

- + information in the field
- + detailed soil profiles
- information quality not equal to classic sampling
 - Detection limit > clean up values
 - Sum detectors (indistinct)

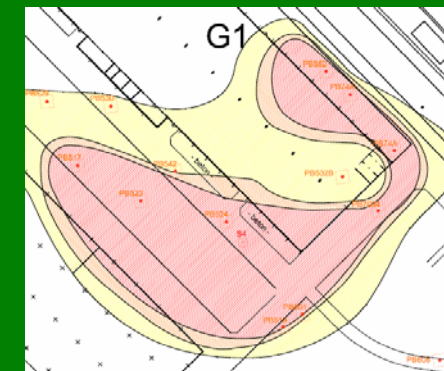
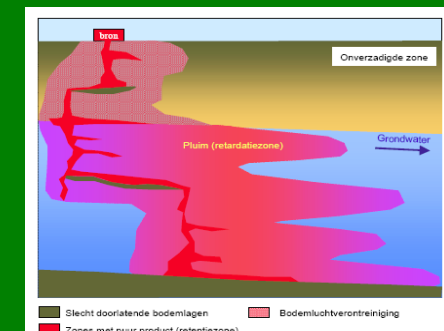




Introduction

Combining best of both worlds by using both screening methods and traditional sampling

- + low detection level
- + broad analysis spectrum
- + information in the field
- + detailed soil profiles





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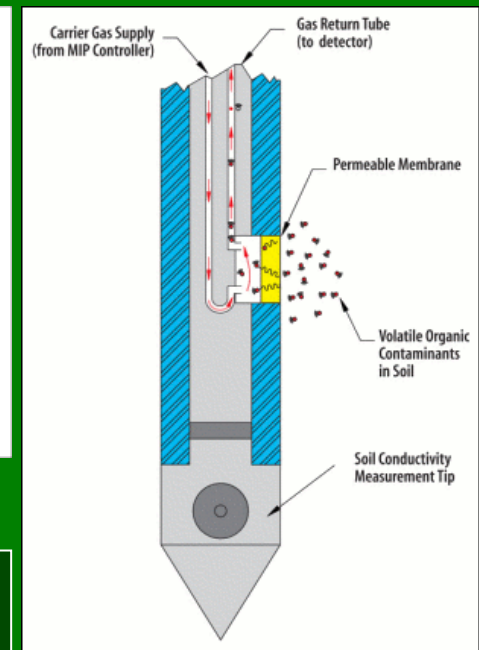
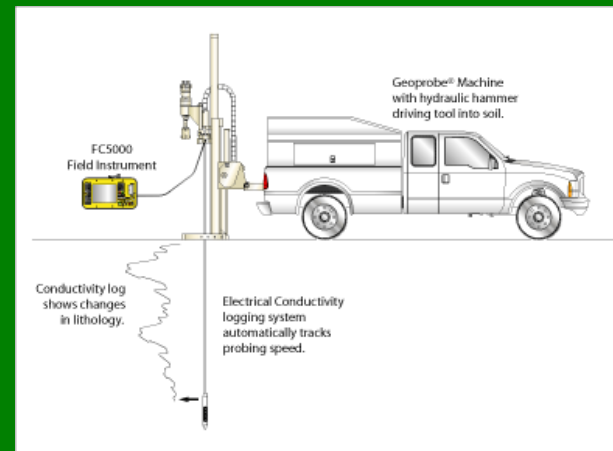
5. Conclusions





Membrane Interface Probe (MIP)

- Direct push
- Local heating of soil
- Hydrophobic semi permeable membrane
- Inert carrier gas & transport to detector



Sensitivity & detection limit → determined by detector



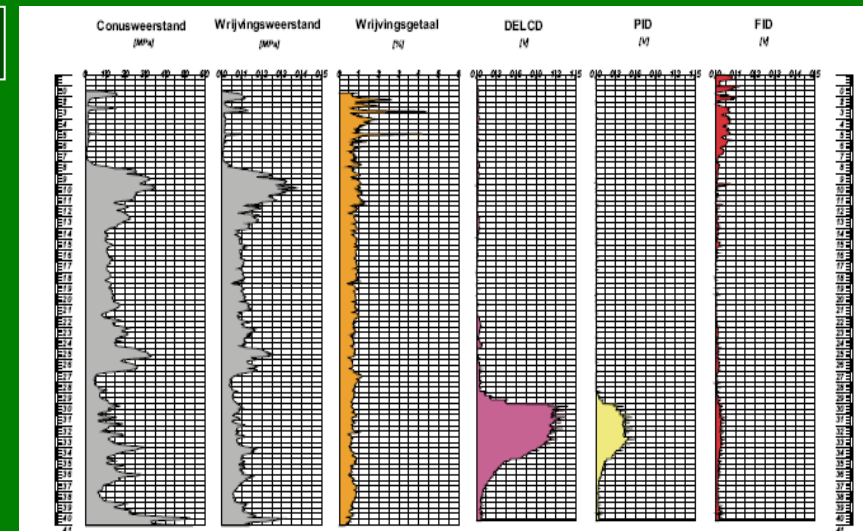


Membrane Interface Probe (MIP)

Conventional Membrane interface probe (MIP)

Combination of three detectors:

- Dry electrolytic detector (DELCD)
- Photo ionisation detector (PID)
- Flame ionisation detector (FID)



→ Summation-detectors: no information on individual contaminants: pollutant cocktails!

→ detection limit: * 3000 - 5000 $\mu\text{g/l}$ >>> typical groundwater clean-up values : $\mu\text{g/l}$

* optimal conditions + detector modifications: 200-500 $\mu\text{g/l}$



delineation of plume impossible/difficult!!



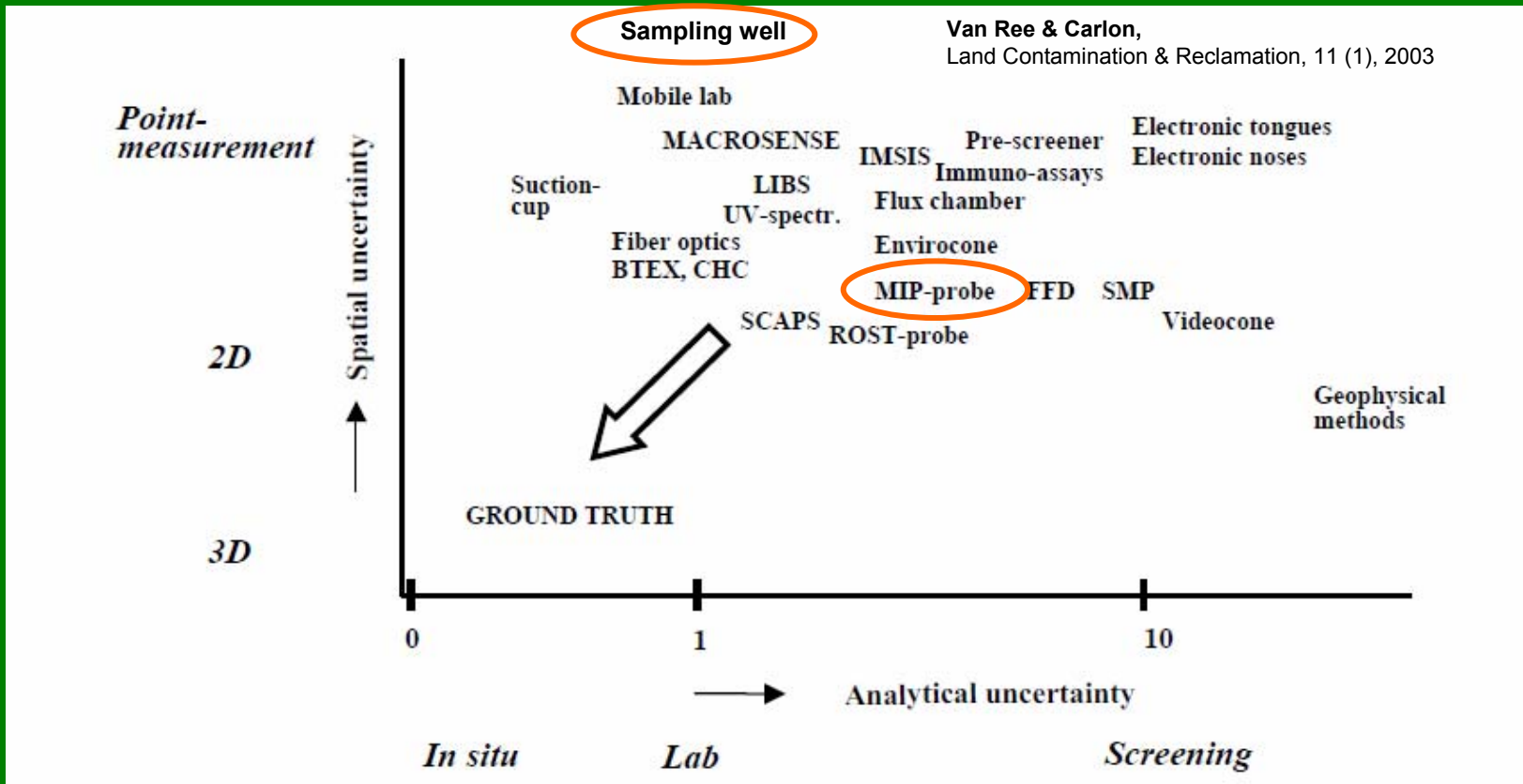


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Objective EnISSA



decrease **uncertainty** in conceptual site model by combining
“Best of both worlds” in one method.



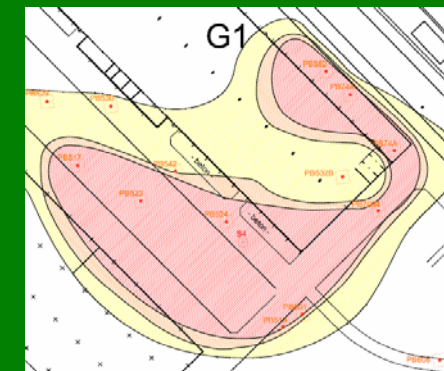
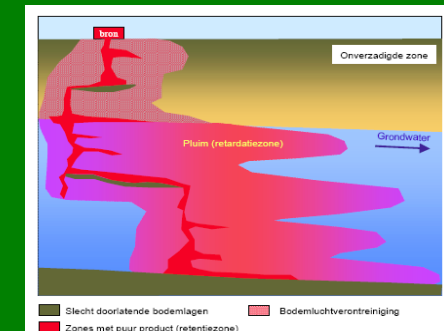


Introduction

Combining best of both worlds

- + low detection level
- + broad analysis spectrum
- + information in the field
- + detailed soil profiles

Development of a **fast** in situ technology with detection limits and selectivity comparable to classic sampling methods.





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EnISSA MIP



EnISSA MIP: MIP with dedicated GC-MS detection combined with proprietary contaminant sampling technology

Target method:

Analysis time ~ 1 min → 400 data points per day // up to 12 compounds

Screening method:

Analysis time ~ 4 min : ~54 compounds can be detected





EnISSA MIP

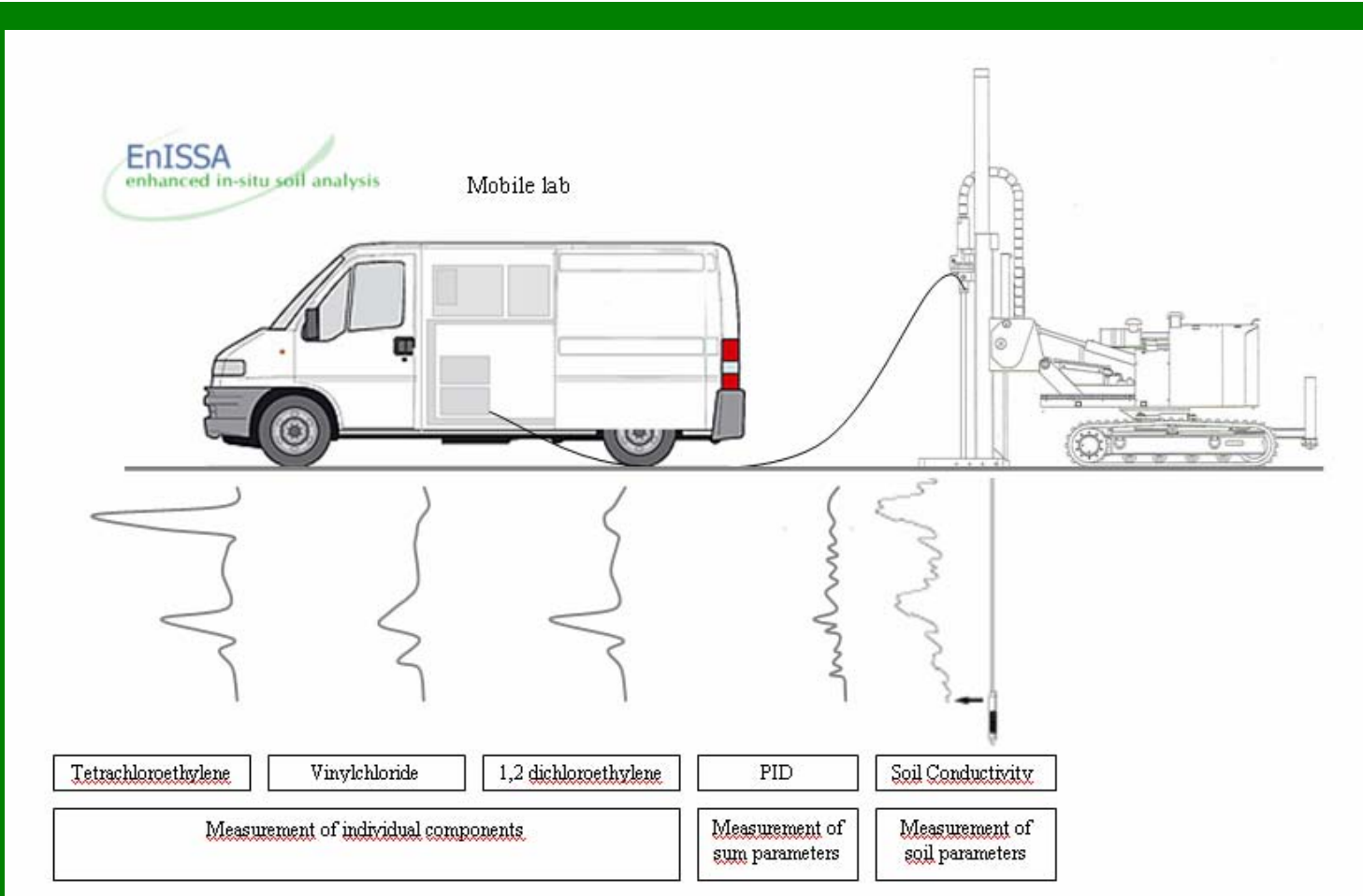
EnISSA MIP: MIP with dedicated GC-MS detection combined with proprietary contaminant sampling technology

- Highly detailed profiles for individual compounds on ppb level:
 - comparable to conventional MIP-speed (30cm/min)
 - **each 30 cm individual pollutants on ppb level**
 - detailed measurement each 5 cm
 - 20 measured meters per day (400 data points)
- detailed profiles → reliable “on site” decisions → Dynamic sampling strategy





EnISSA MIP





EnISSA MIP



Field conditions may alter detection limit:

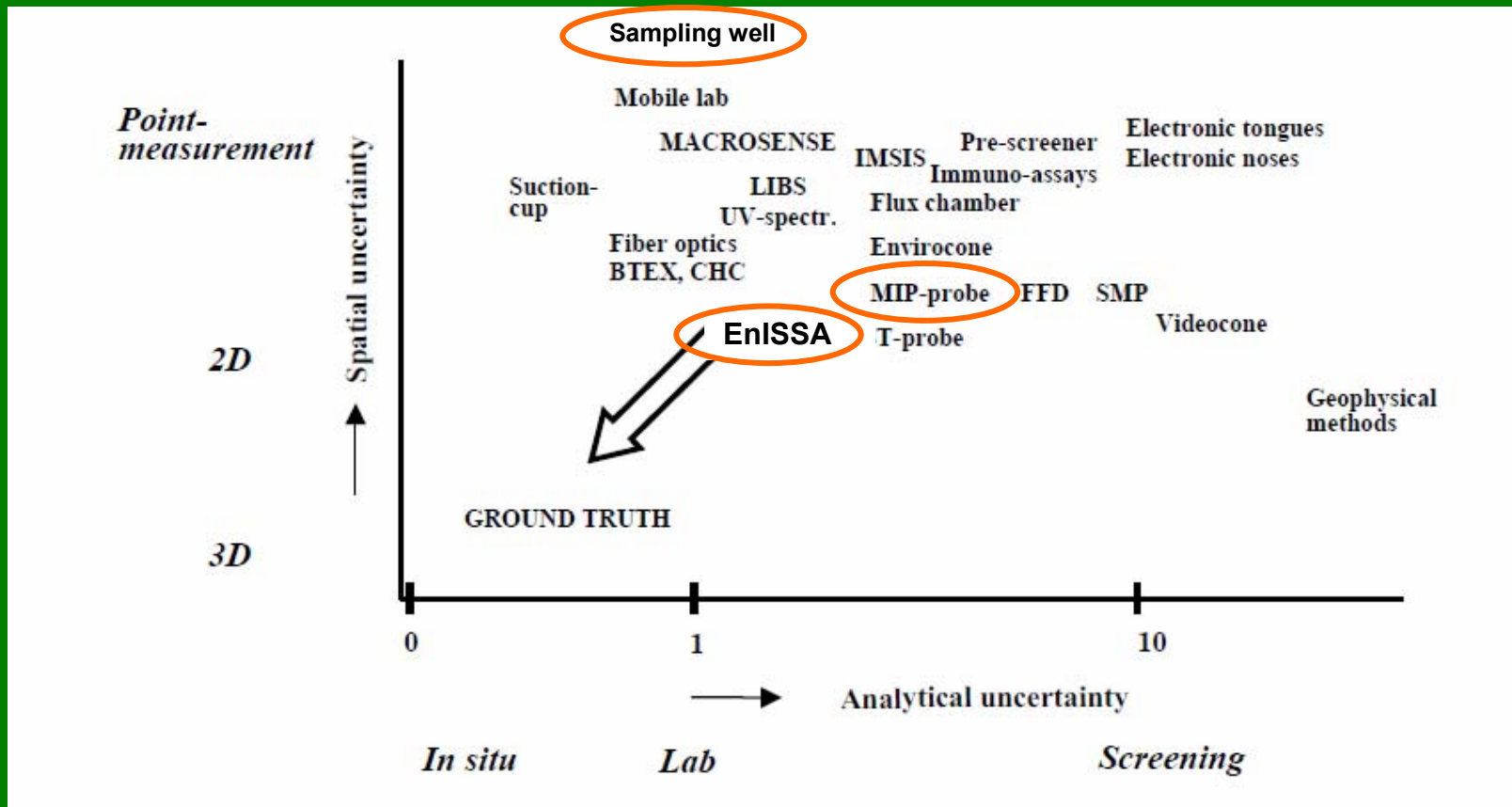
- ~~Interference with soil components (methane quenching)~~
- ~~detector response depends on which compound is measured~~
-> EnISSA measurement of individual compounds!
- Soil matrix properties:
 Different matrices may increase or decrease response
- Membrane temperature
- Membrane wear

EnISSA MIP: semi-quantitative measurement of individual compounds





Membrane Interface Probe (MIP)





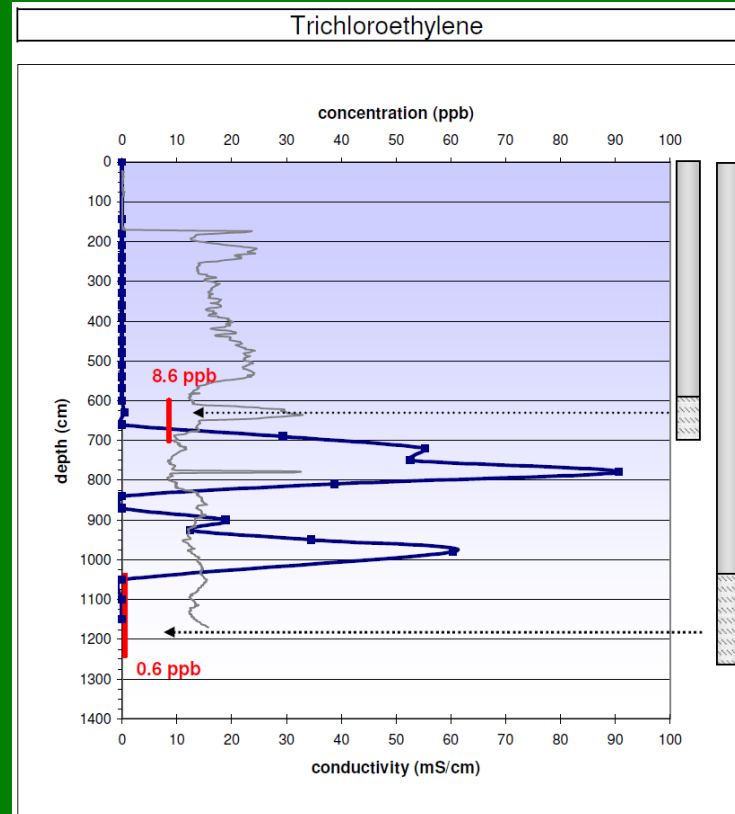
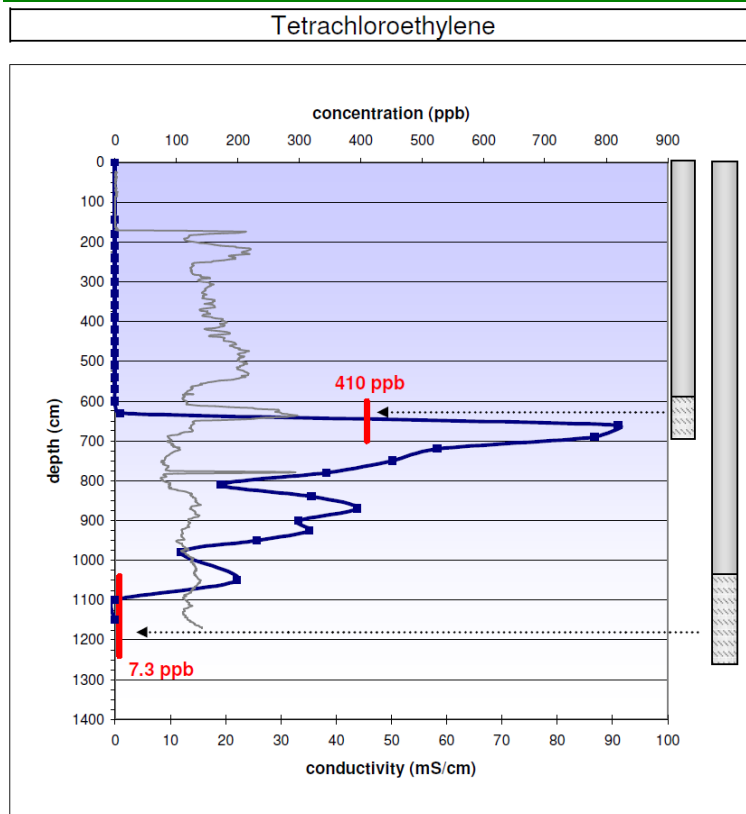
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Field results

Tremelo (Belgium): Soil profile for PCE & TCE

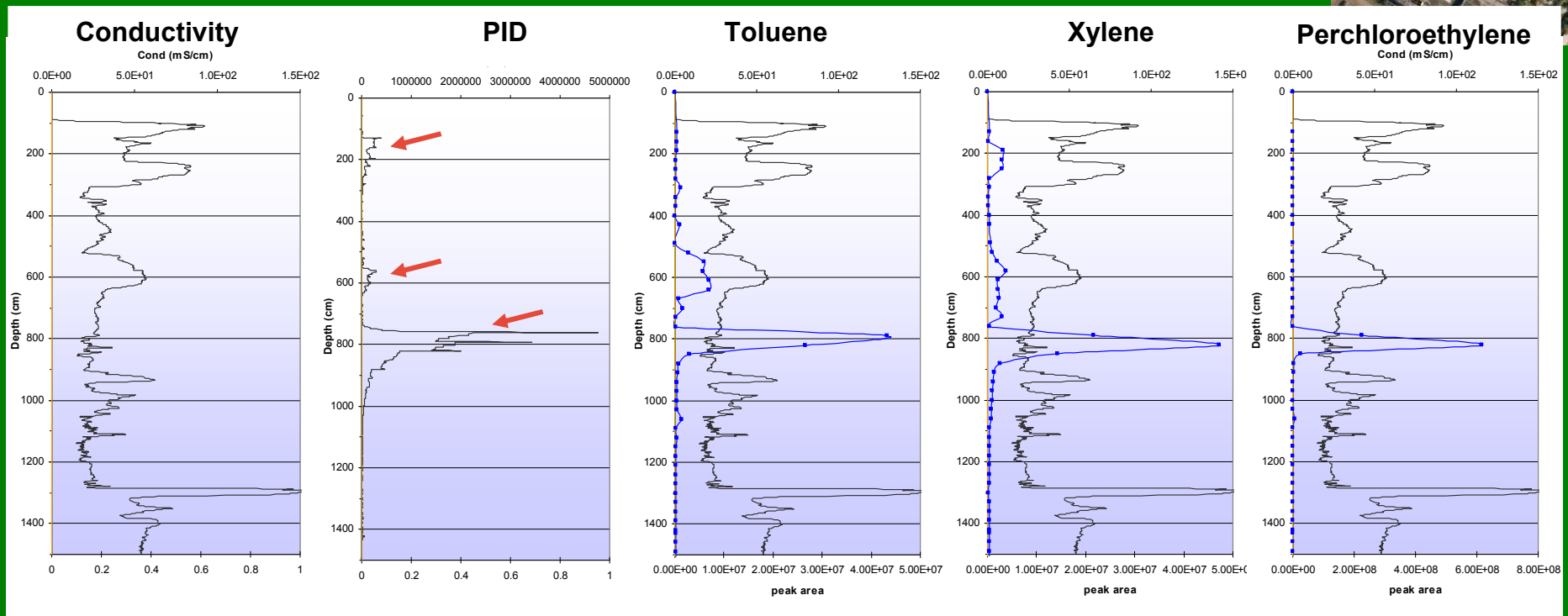




Field results

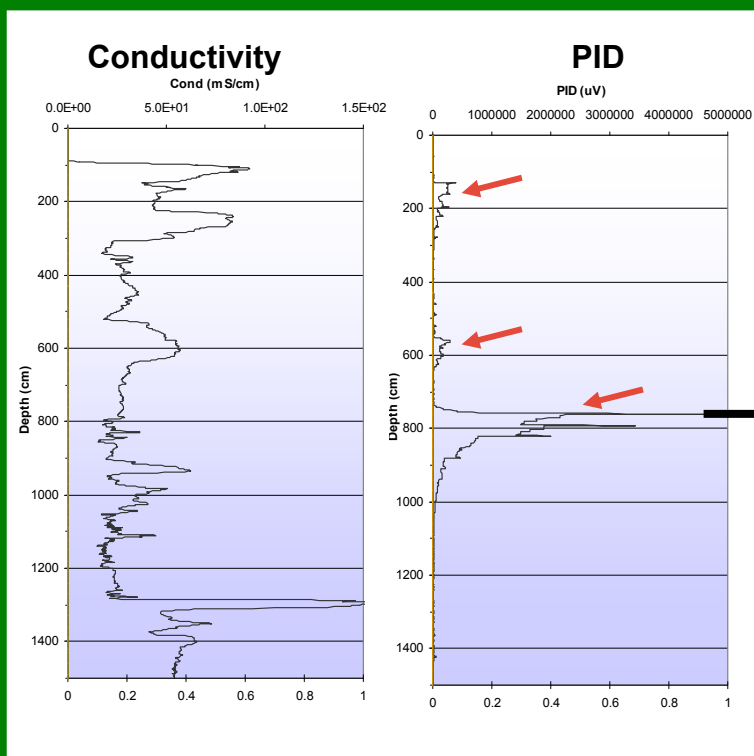
Machelen (Belgium)

A soil survey was performed on a former industrial site. The soil is contaminated due to the careless exploitation of a solvent recuperation & distillation unit. Moreover the site was burned out in 1993 which resulted in the draining of thousands of liters solvent.

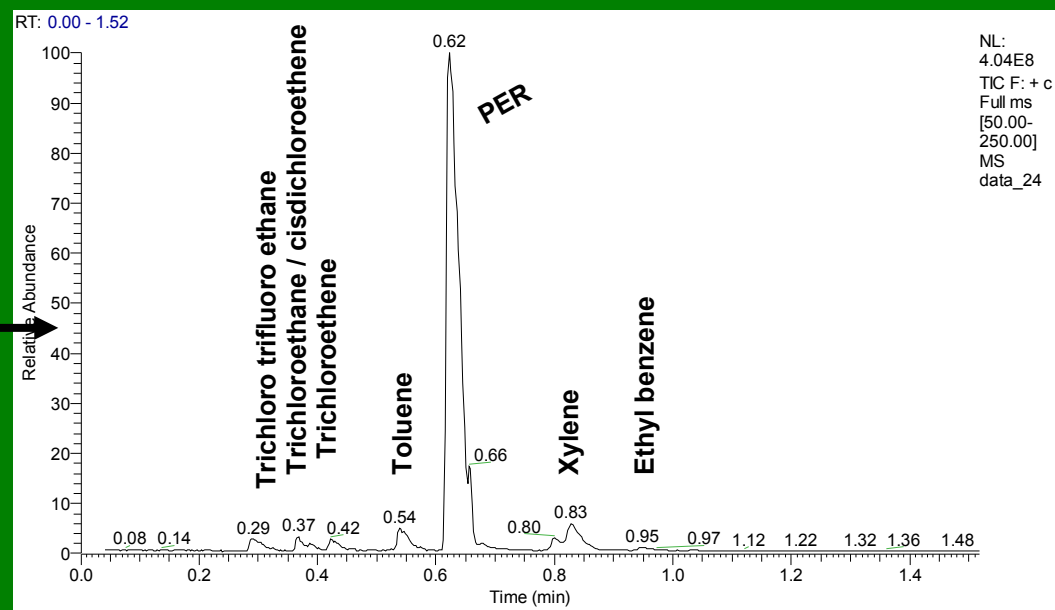




Field results

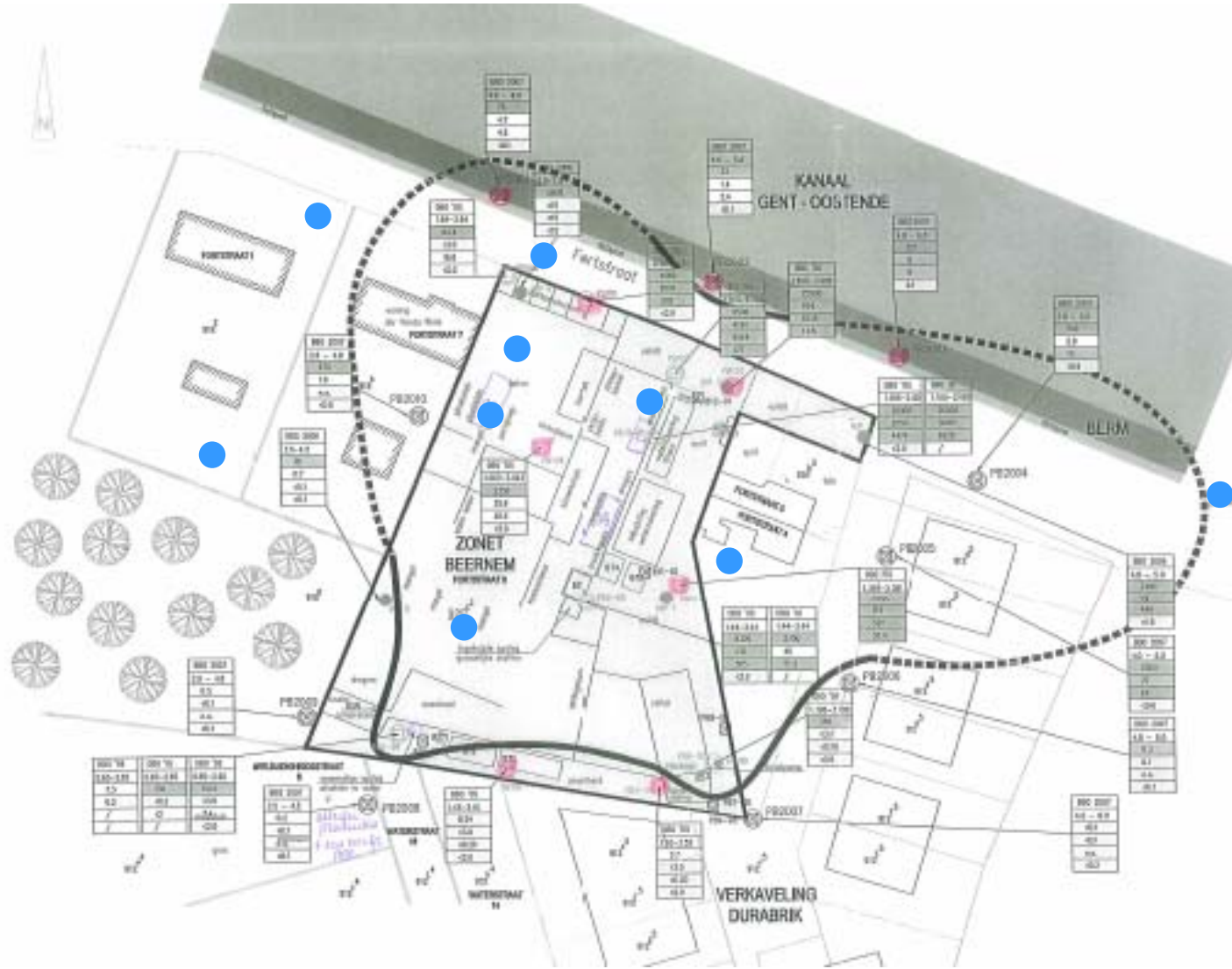


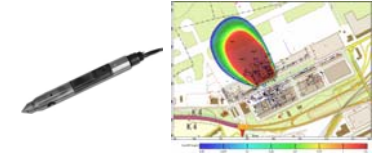
Screening measurement





Field results

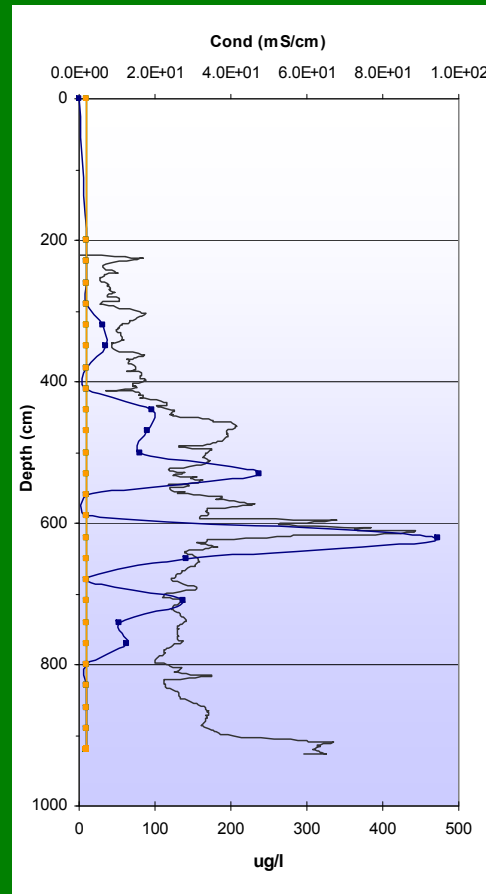
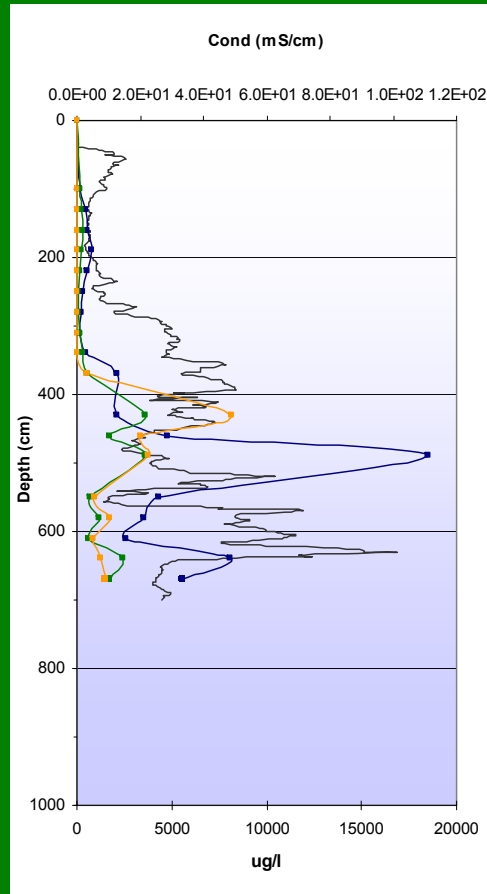
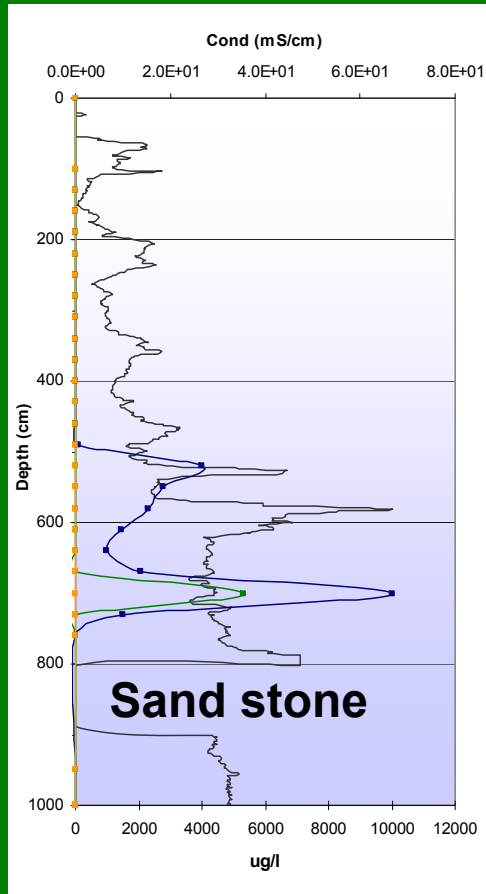




Field results



Beernem (Belgium): Soil profile for PCE & TCE & DCE



- conductivity
- Tetrachloroethene
- Trichloroethene
- Cis dichloroethene





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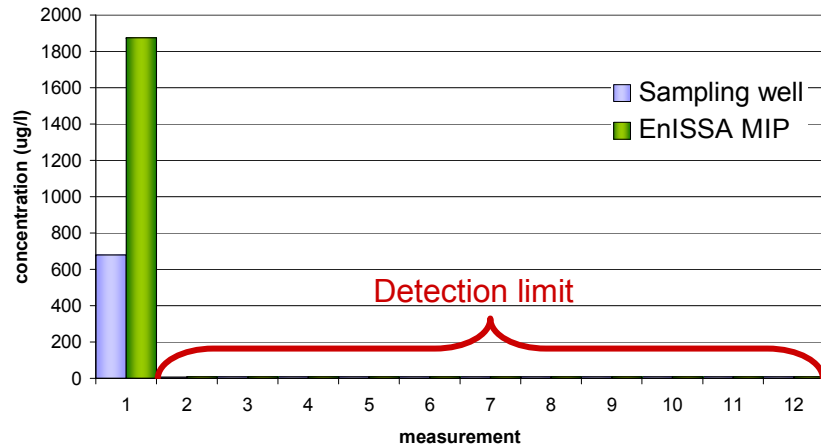




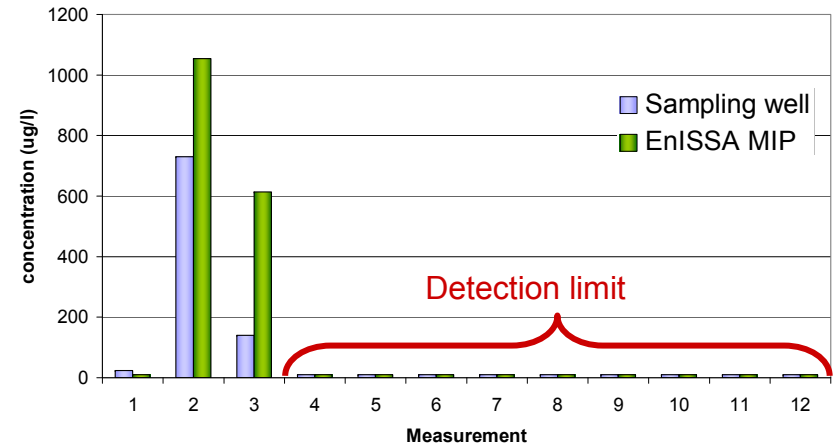
EnISSA results <-> Traditional sampling



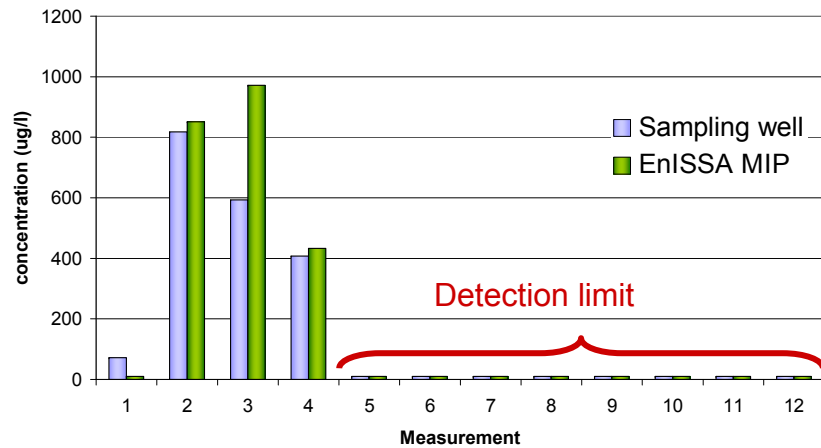
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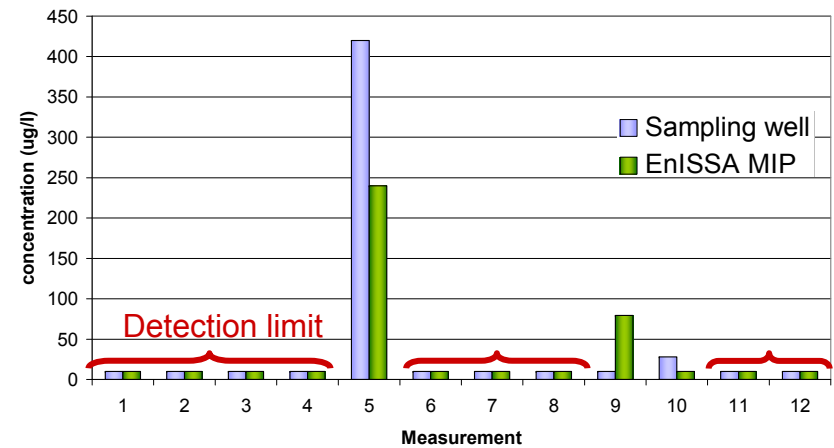
TRI



DCE



VC





EnISSA results <-> Traditional sampling



- **Semi-quantitative tool: intrinsic overall system variability (soil+sampling+detection system) yields semi-quantitative results within one order of magnitude**
- **False negatives: 6% → A high concentration of one component increases detection limit for the other compounds**
- **Real False negatives: 2% → no signal with EnISSA but contaminants measured in sampling well**
- **“False” positives: 4% → due to point measurements of MIP**

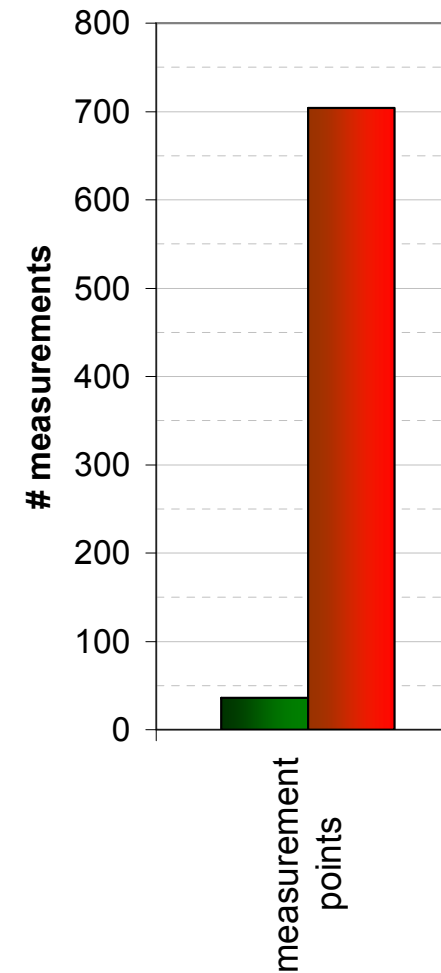
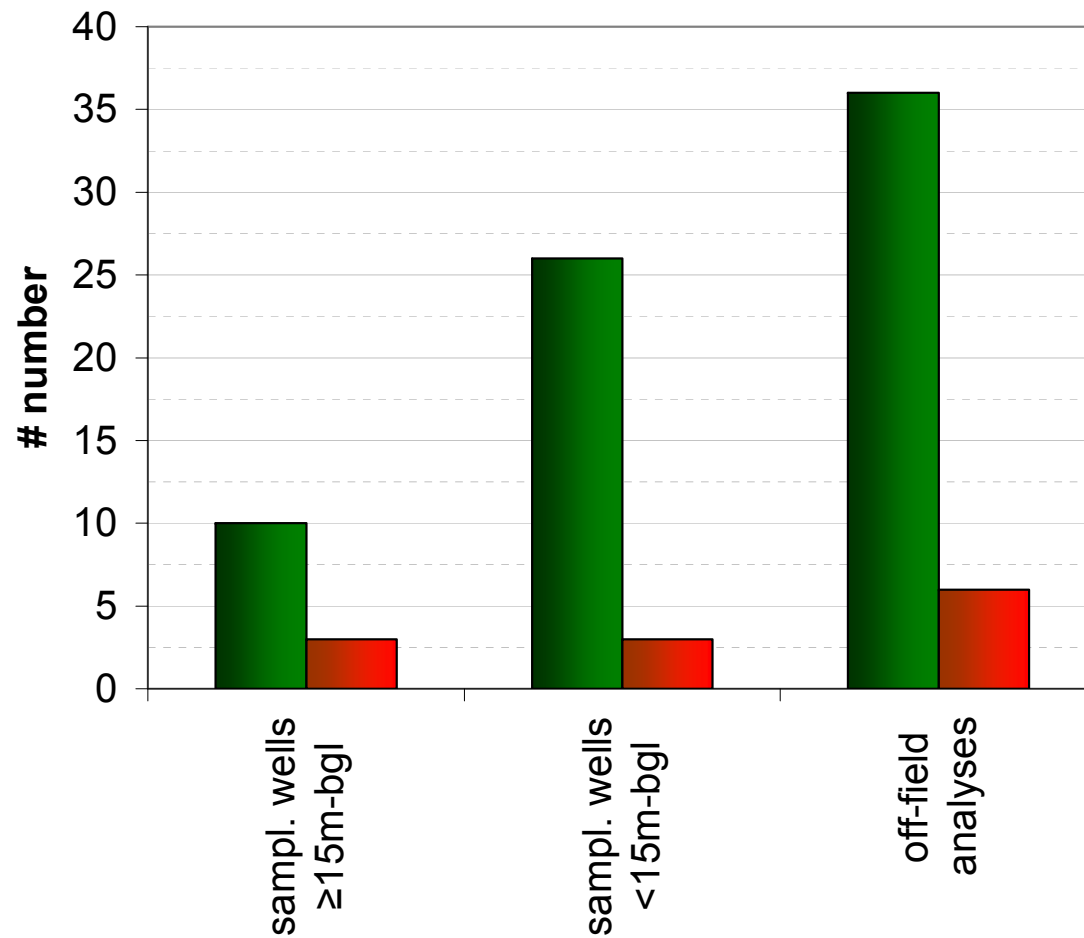




EnISSA cost <-> Traditional cost



■ soil survey based on traditional sampling wells ■ soil survey based on EnISSA MIP

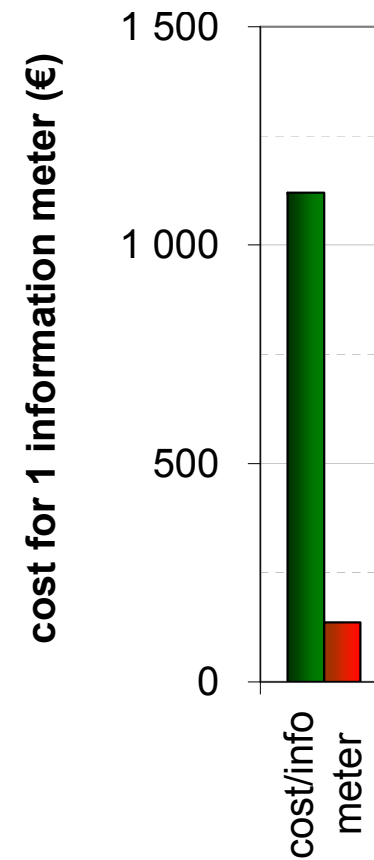
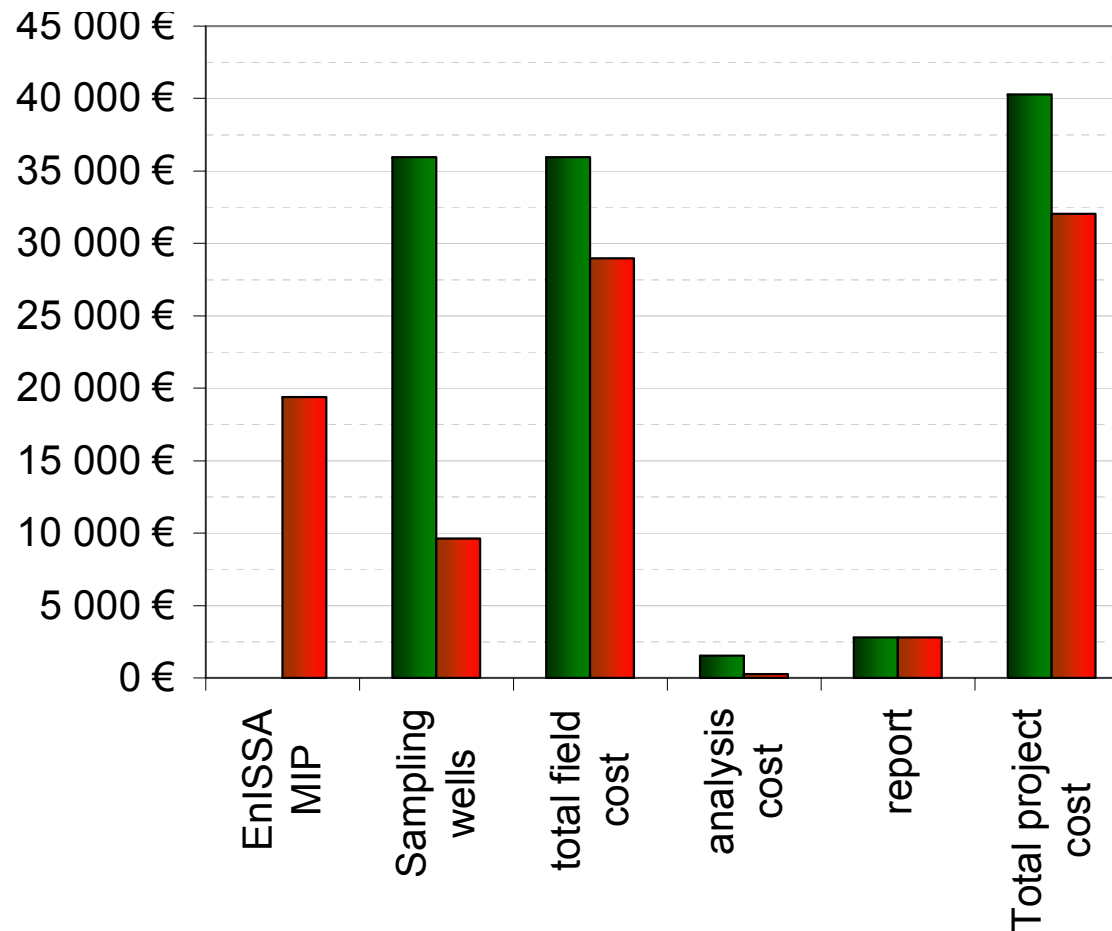




EnISSA cost <-> Traditional cost



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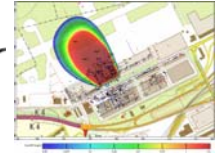




Conclusions

- **entire delineation of contamination: source + plume**
 - EnISSA MIP measures on ppb level
 - source and plume
 - (conventional MIP measures typically on (sub-)ppm level)
- **“On site” information on pollution cocktails:**
 - EnISSA MIP measures individual compounds in contrast to the sum-detectors used in conventional MIP
- **strategic sampling well locations:**
 - The entire delineation of source and plume obtained by EnISSA MIP makes it possible to place sampling wells at strategic locations reducing sampling costs and time.
- **Natural degradation pathways / target remediation**
- **Heated transfer line** (decrease variability and increase scope towards less-volatile pollutants!)





Questions?



