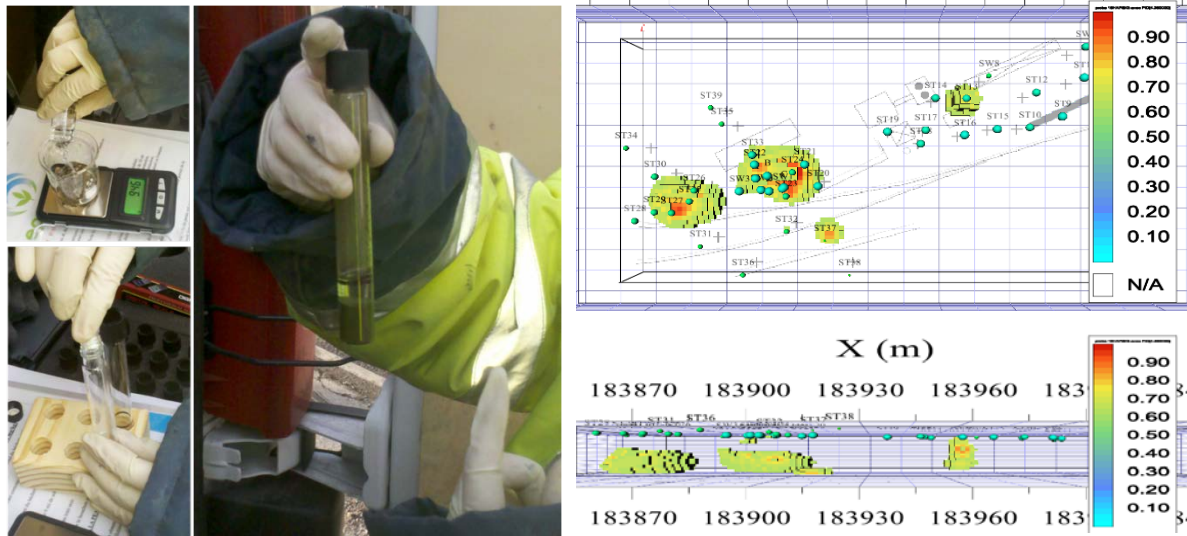


Advanced technology in characterisation and rehabilitation

SOLUTION TO APPLY THE PRINCIPLES OF CONTAMINATED SITES AND SOIL GEOSTATISTICS : « ON SITE » ANALYSIS



REM TECH 2013

- ENVISOL
- Principles of geostatistics
- Environmental assessments
- Cost / benefit study and conclusion

- **Engineering office founded in France in 2009**

Multidisciplinary team – 20 consultants (engineers, doctors, university graduates)

3 locations (Paris, Lyon and Montréal)

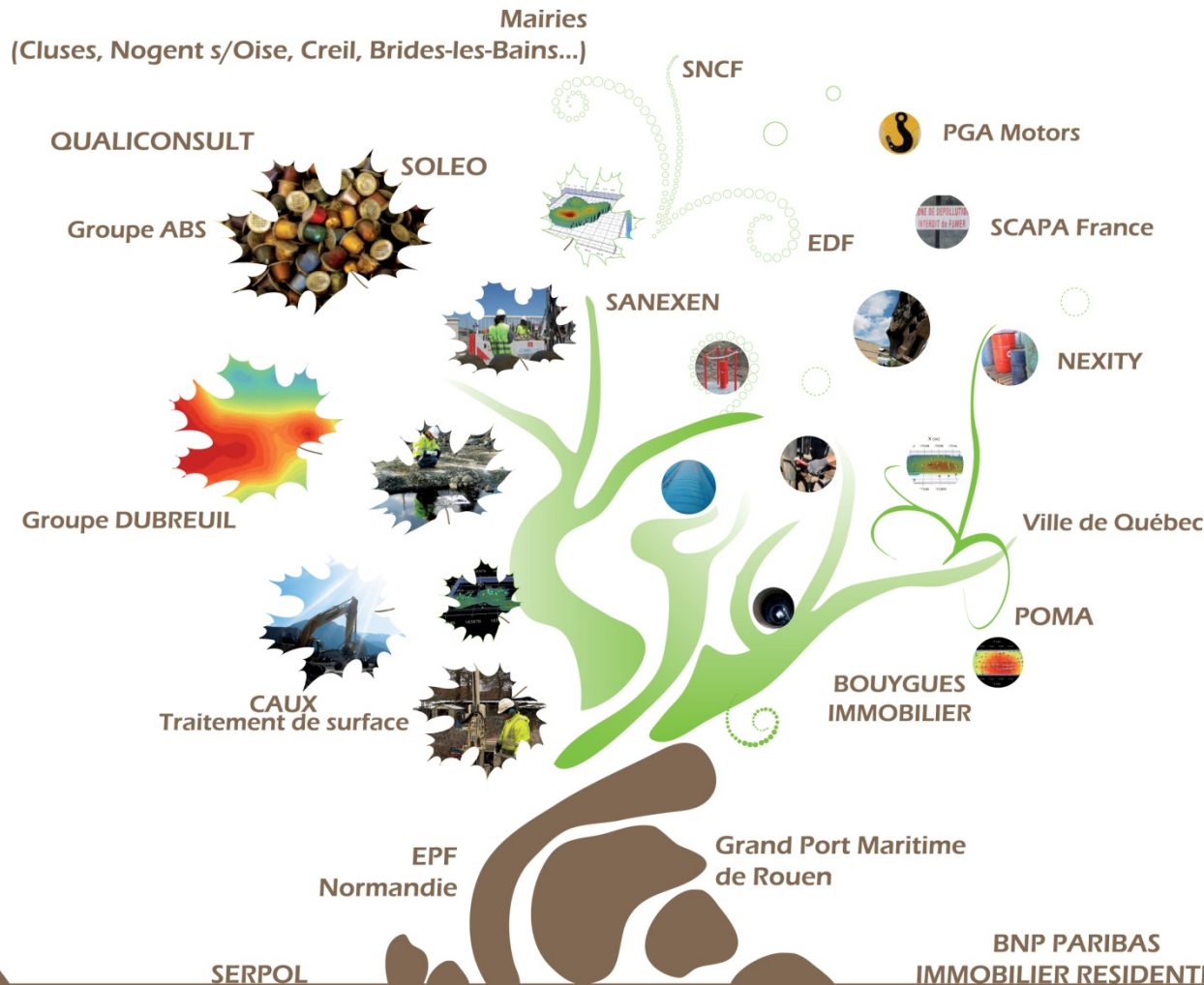
- **Envisol is specialized in characterizing and rehabilitation of contaminated sites**

- **Our values: Passion – Expertise – Reactivity – Innovation**

- **R & D centre**

- **2013 forecast turnover : 2 millions CAD**

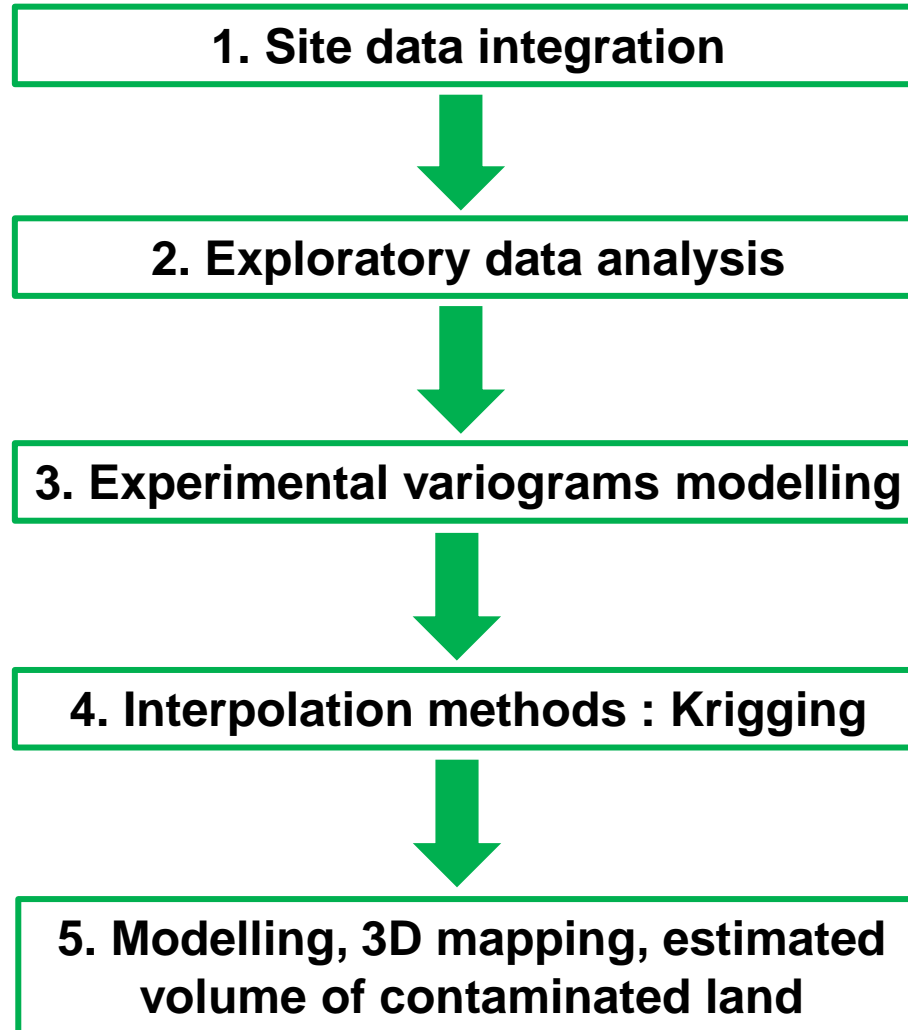
They trust us



- Petrochemical and chemical industry
- Real estate developer
- Mines
- Nuclear industry
- Rehabilitation company
- Transportation company
- Municipalities
- Government agency
- Army

- **Geostatistic : A tool commonly used and had been for decades in the oil and mining industry**
- **Geostatistic to optimize the remediation of contaminated sites**
- **Associate global site analysis for scientific approach :**
 - Refine volumes of contaminated soils depending on the spatial variability of soil contamination
 - Modelling, mapping 3D volumes of contaminated soil
 - Decontamination plan
 - Asses accuratly the financial risk of the project
- **Geostatistic greatly reduces the financial risk for remediation projects key in hand**
- **The larger the project is important (many drilling and analysis) the more geostatistic is effective**

Methodology



Detailed environmental assessment : step long, expensive and rough !

- Analytical laboratories expensive, time high
- Intervention (drills)
- Blindly sampling
- Result:
 - Decrease the number of analyzes and sampling point
 - Contaminated volumes : absence of estimation uncertainty



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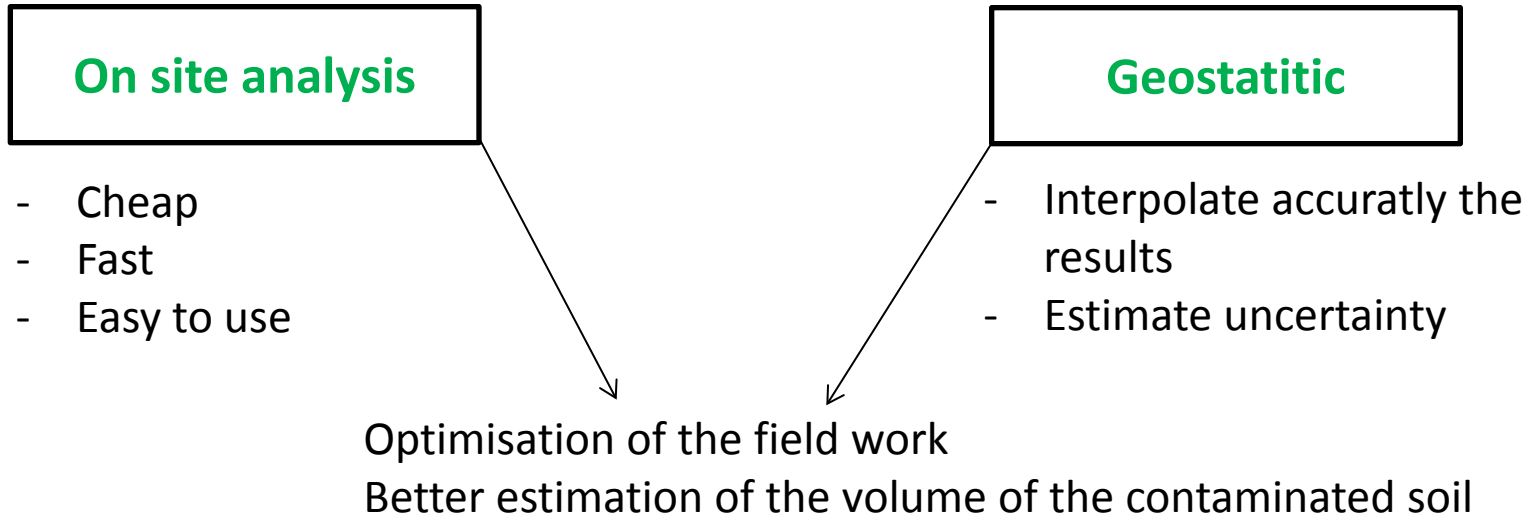
How to improve the characterization of contaminated sites ?

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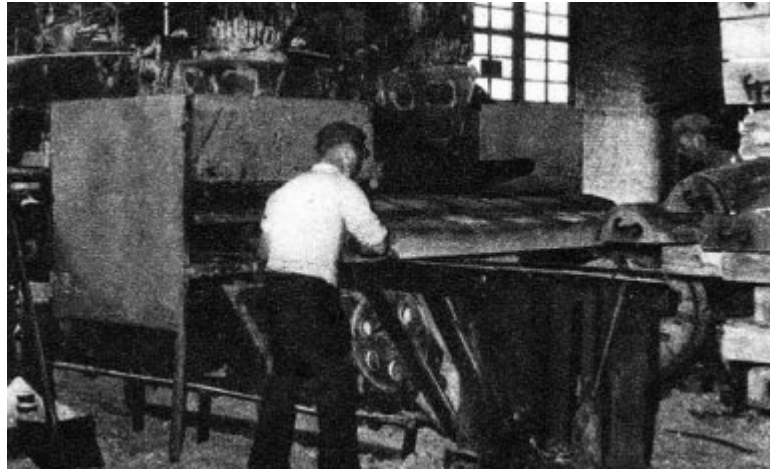
How to improve the characterization of contaminated sites ?



Studies



Manufacturing site of railway tie



Site :

- Old site, 1900
- The study was carried out on part of the site, 16 000 m²
- Preventive treatment of wood,
- Railway tie, electric poles,

Chimicals :

- Creosote
- Mixture of creosote and oil
- Compounds: PAHs and et BTEX (up to 90%);
- Denser than water



Geology, hydrogeology

- Alluvial deposits : sand, silt and gravel
- Groundwater is 6 m deep

Risk areas

Sump



Setting pond



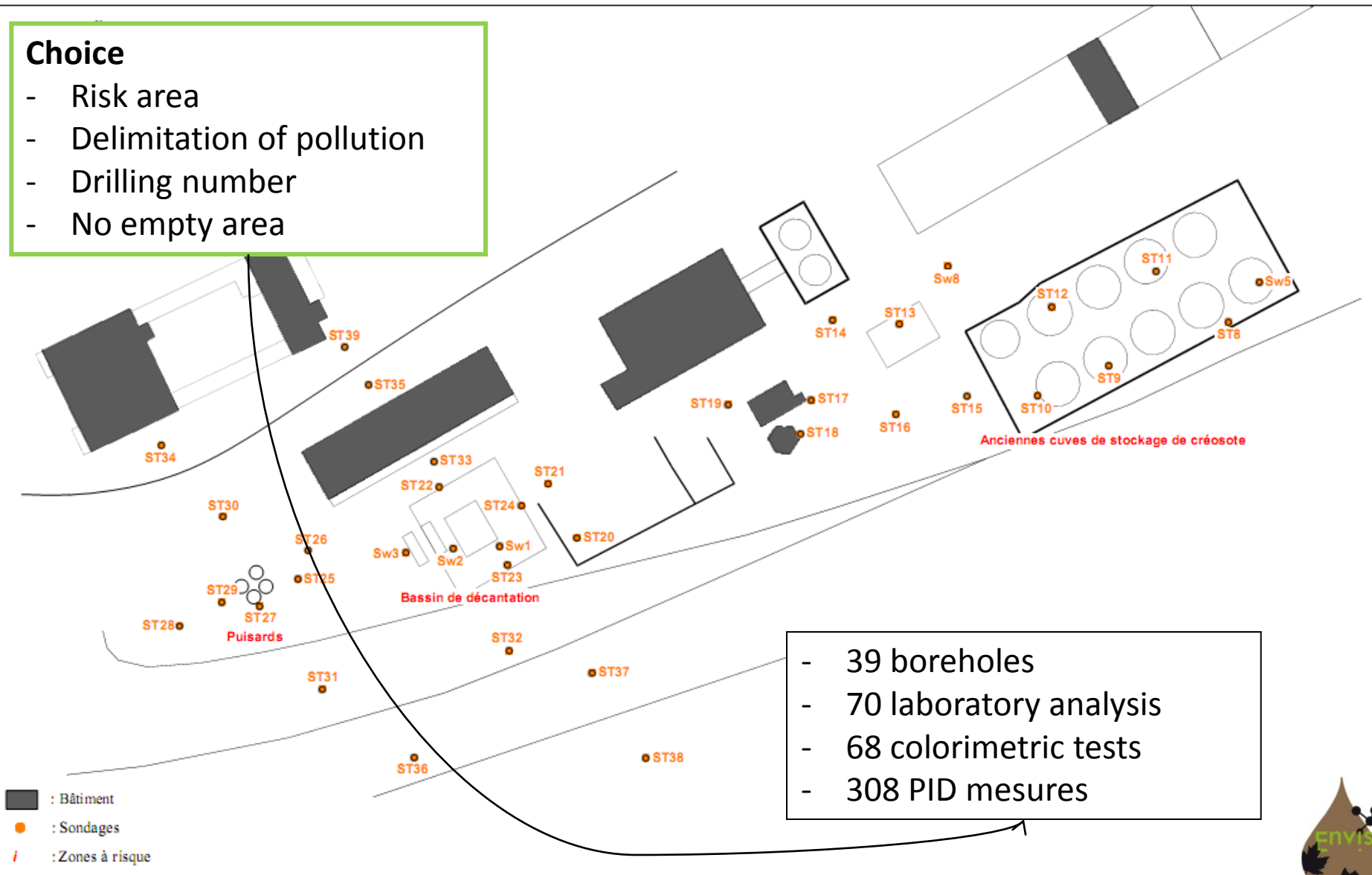
Storage of chemicals



Sampling strategy

Choice

- Risk area
- Delimitation of pollution
- Drilling number
- No empty area



Choice of on site analyzis

- Critères:**
- Contaminants
 - concentration range
 - data quality
 - practicality
 - Price

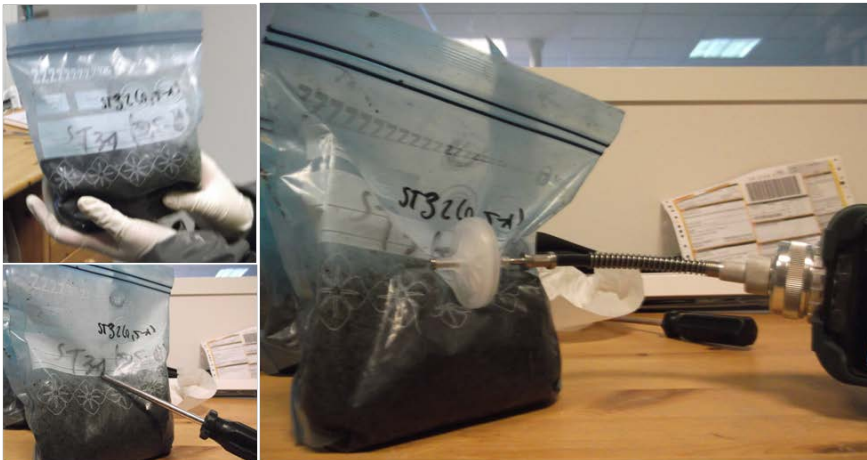


PID portable

- VOC
- Direct measurement

Colorimetric test

- THC / PAHs
- Extraction - visual



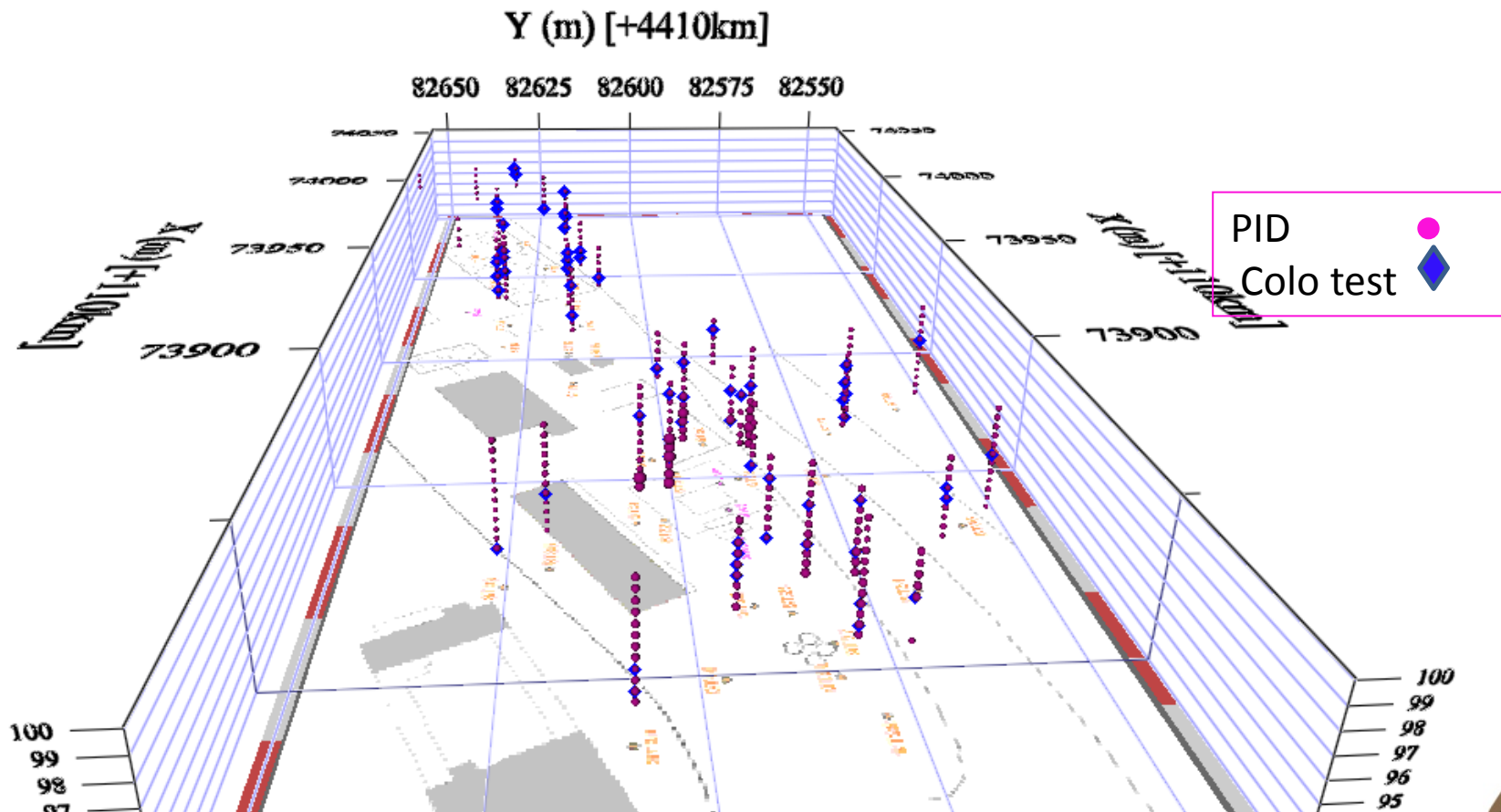
Sampling

Colorimetric test

- 2 boreholes analysis
- 68 samples
- 14 % in common with lab

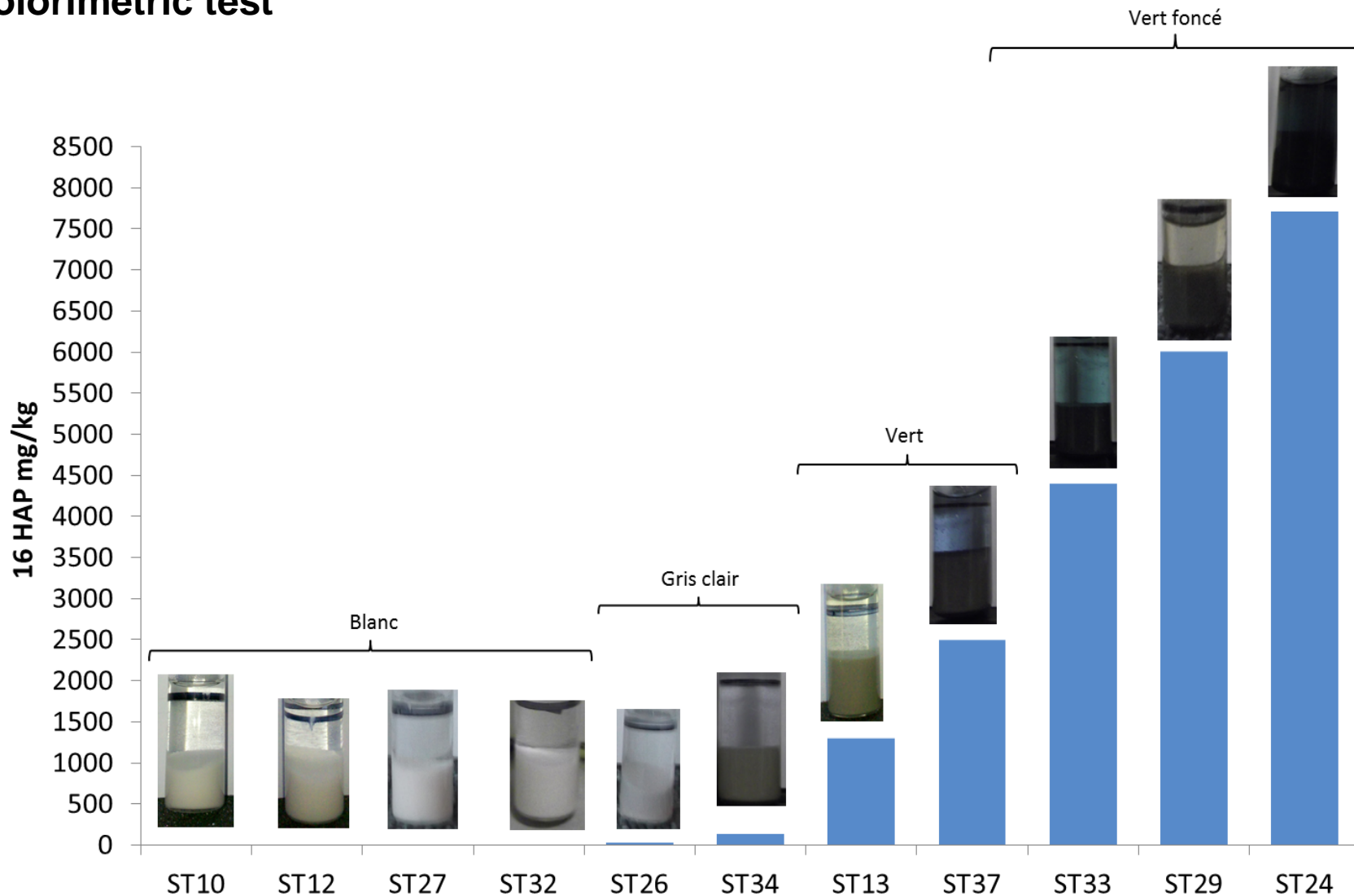
PID

- Measures each 0.50 m
- 308 measures
- 26 % in common with lab



On site analysis - geostatistic

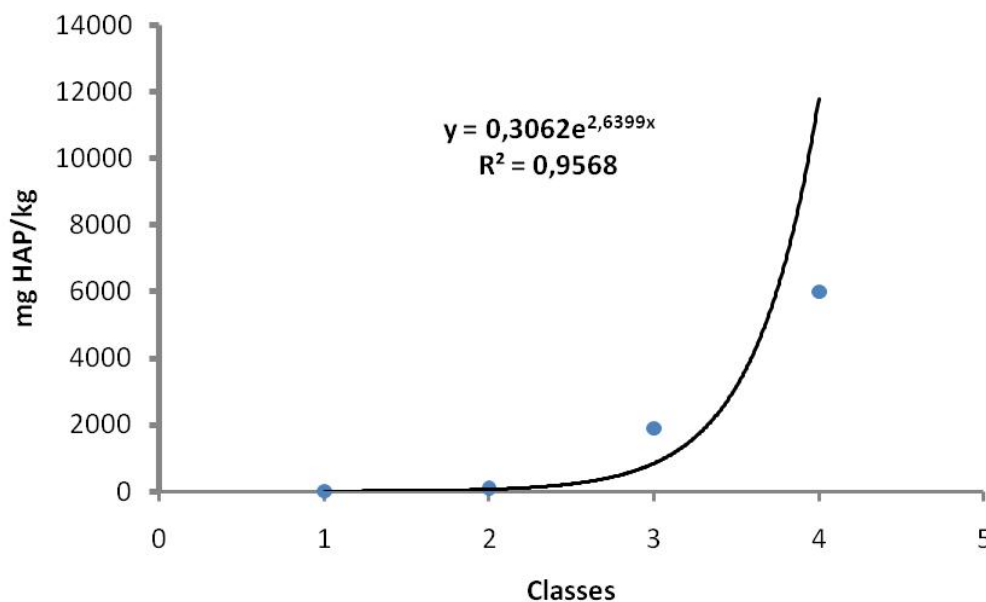
Colorimetric test



On site analysis - geostatistic

Colorimetric test

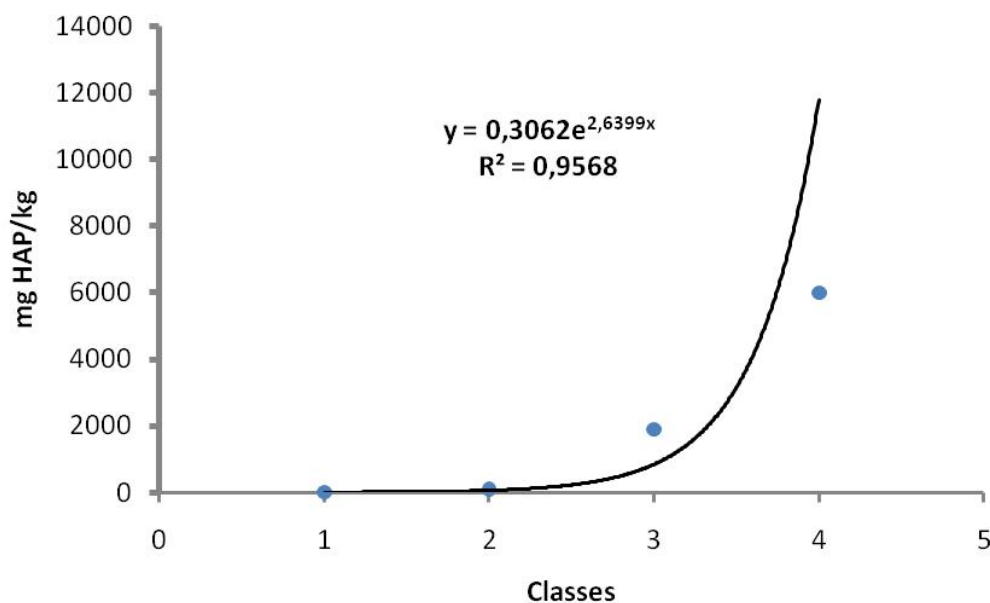
| Classe | Observations | Gamme de concentration 16 HAP (mg/kg) | moyenne de concentration 16 HAP (mg/kg) |
|--------|--------------|--|--|
| 1 | blanc | 0-4,8 | 2,5 |
| 2 | gris clair | 40-140 | 90 |
| 3 | vert | 1300-2500 | 1900 |
| 4 | vert foncé | 4400-7700 | 6000 |



On site analysis - geostatistic

Colorimetric test

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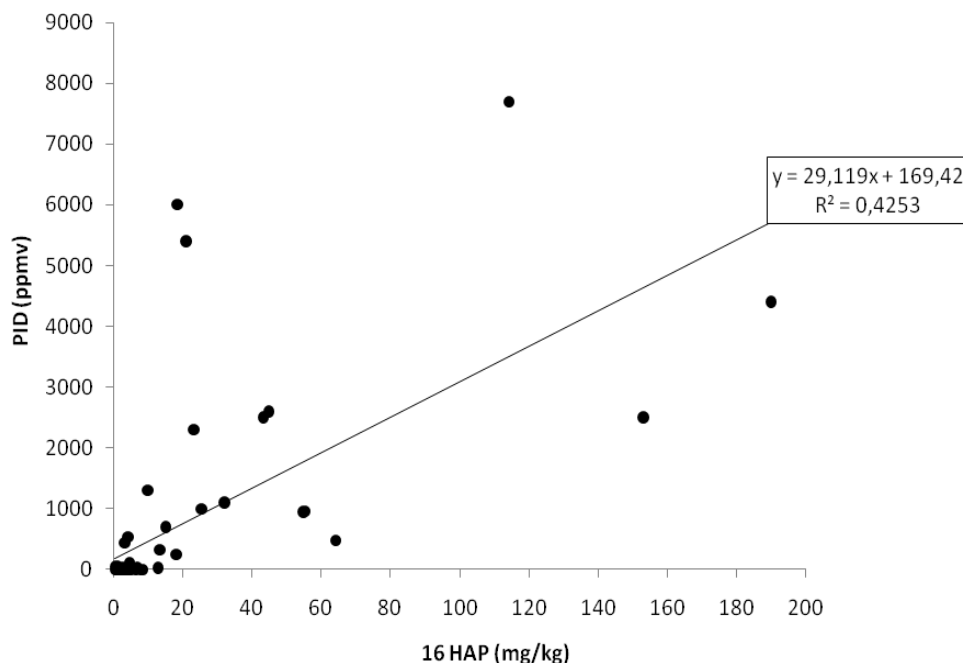


On site analysis - geostatistic

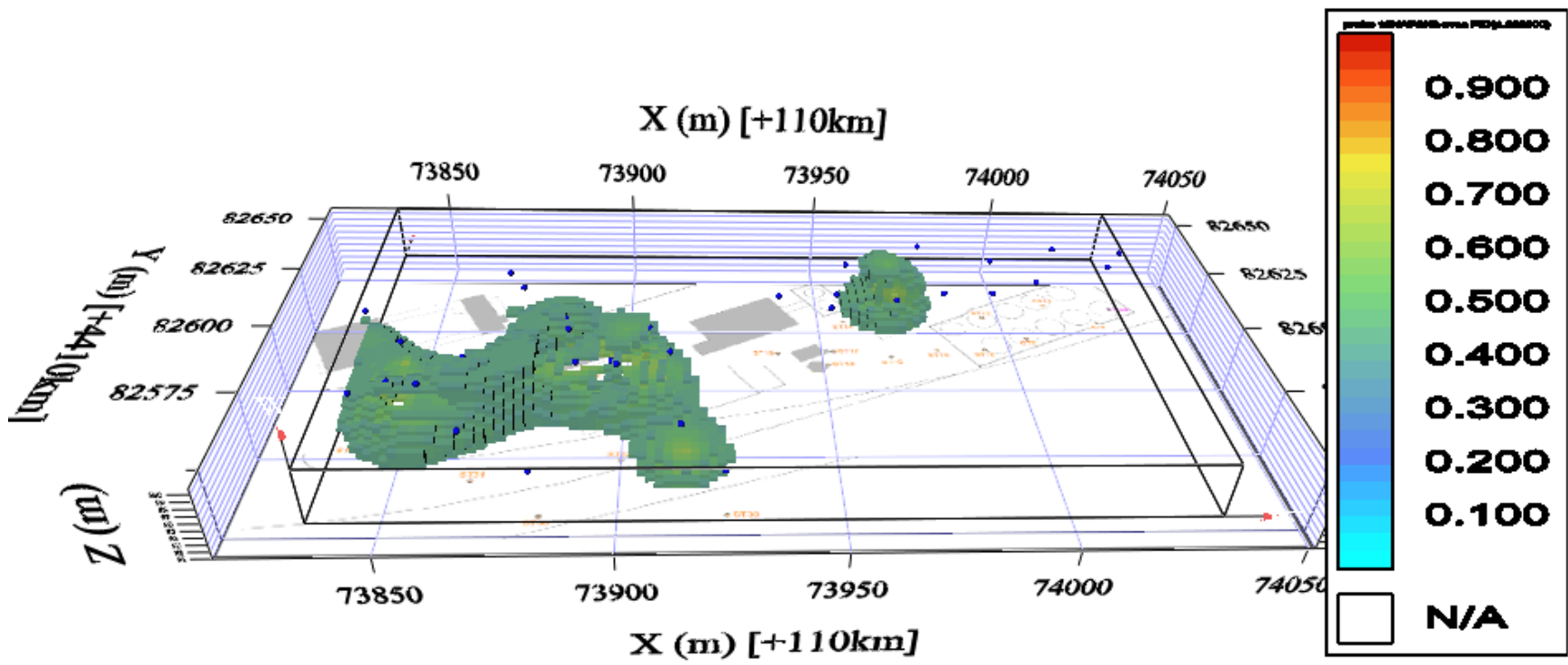


Mesures PID

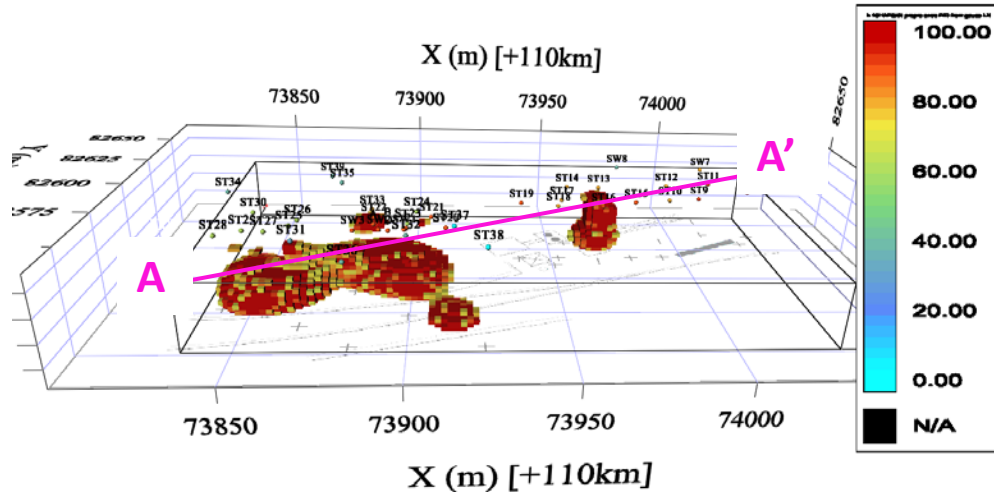
| | Nombre | Moyenne | Ecartype | Minimum | Maximum | Médiane | Coefficient de variation |
|------------------------------------|--------|---------|----------|---------|---------|---------|--------------------------|
| Mesures PID (ppmv) | 0 | 14,1 | 30,9 | 0,3 | 189,9 | 3,2 | 2,2 |
| Mesures 16 HAP laboratoire (mg/kg) | 79 | 542,6 | 1398,4 | 0 | 7700 | 12 | 2,6 |



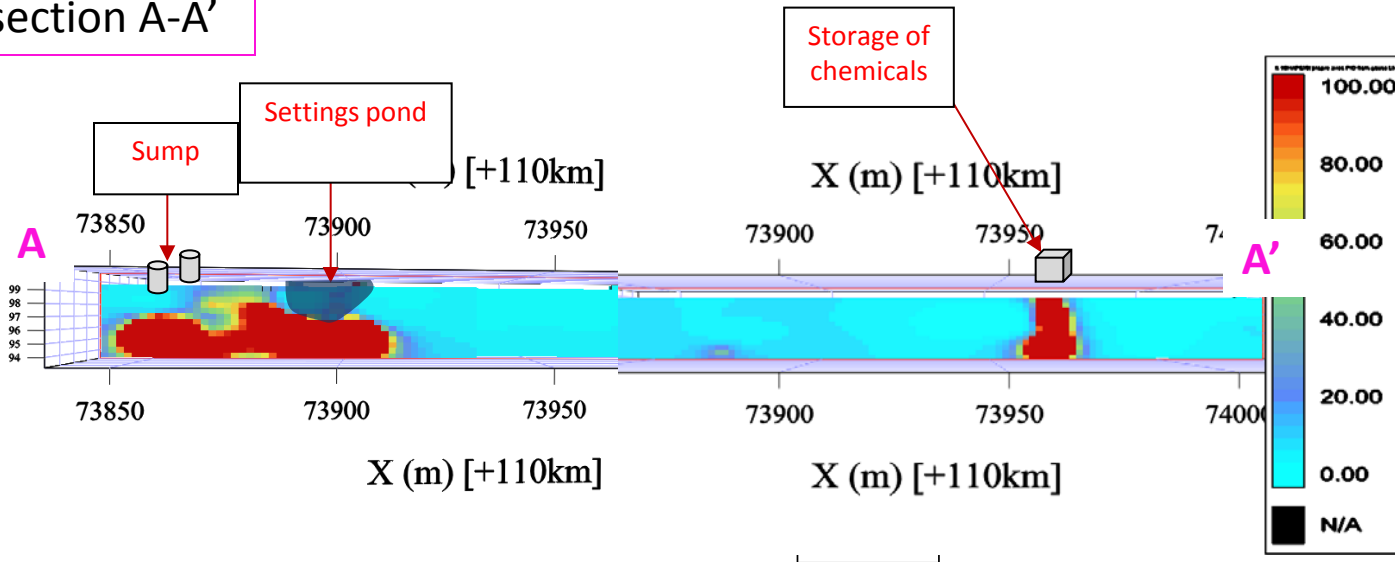
Results



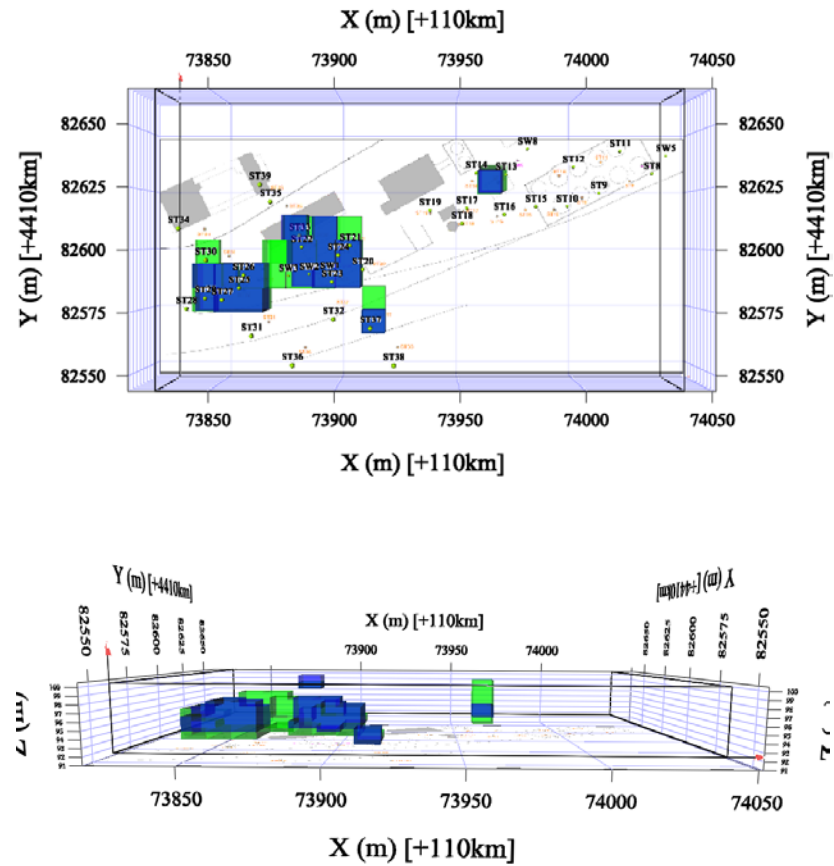
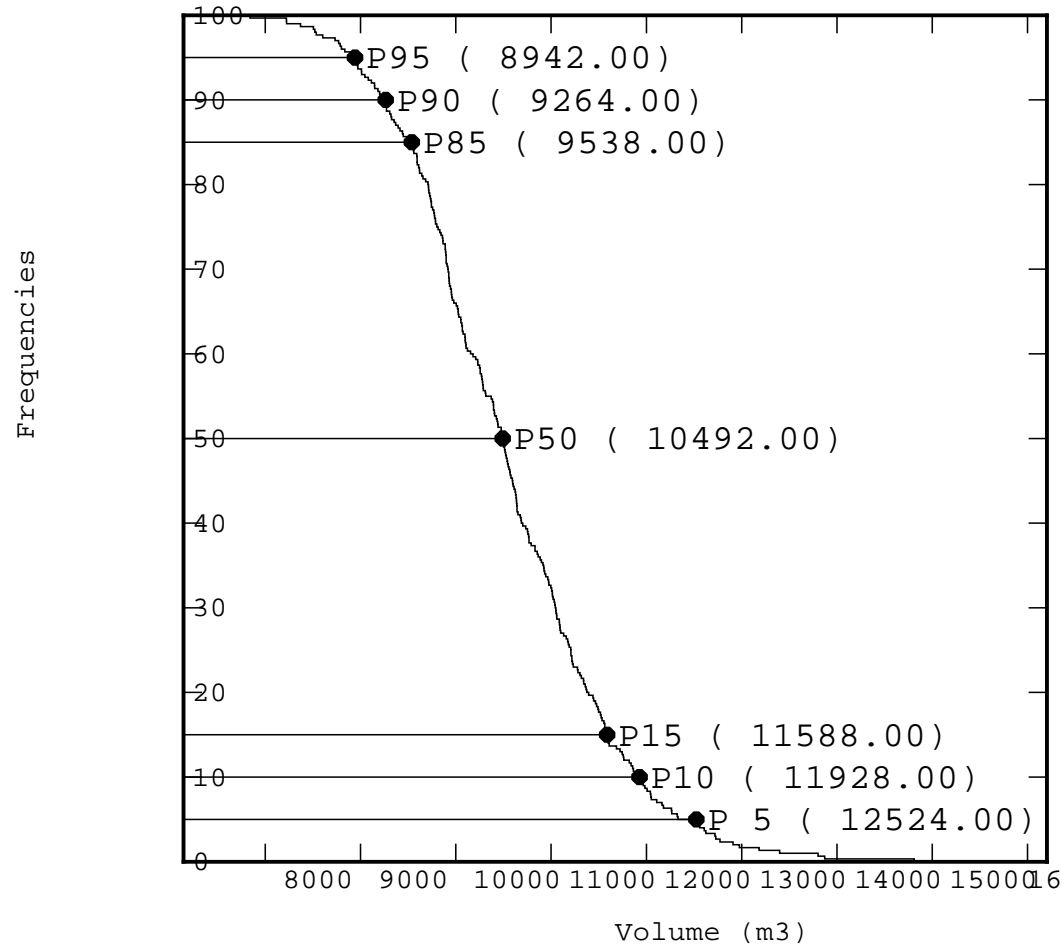
Results



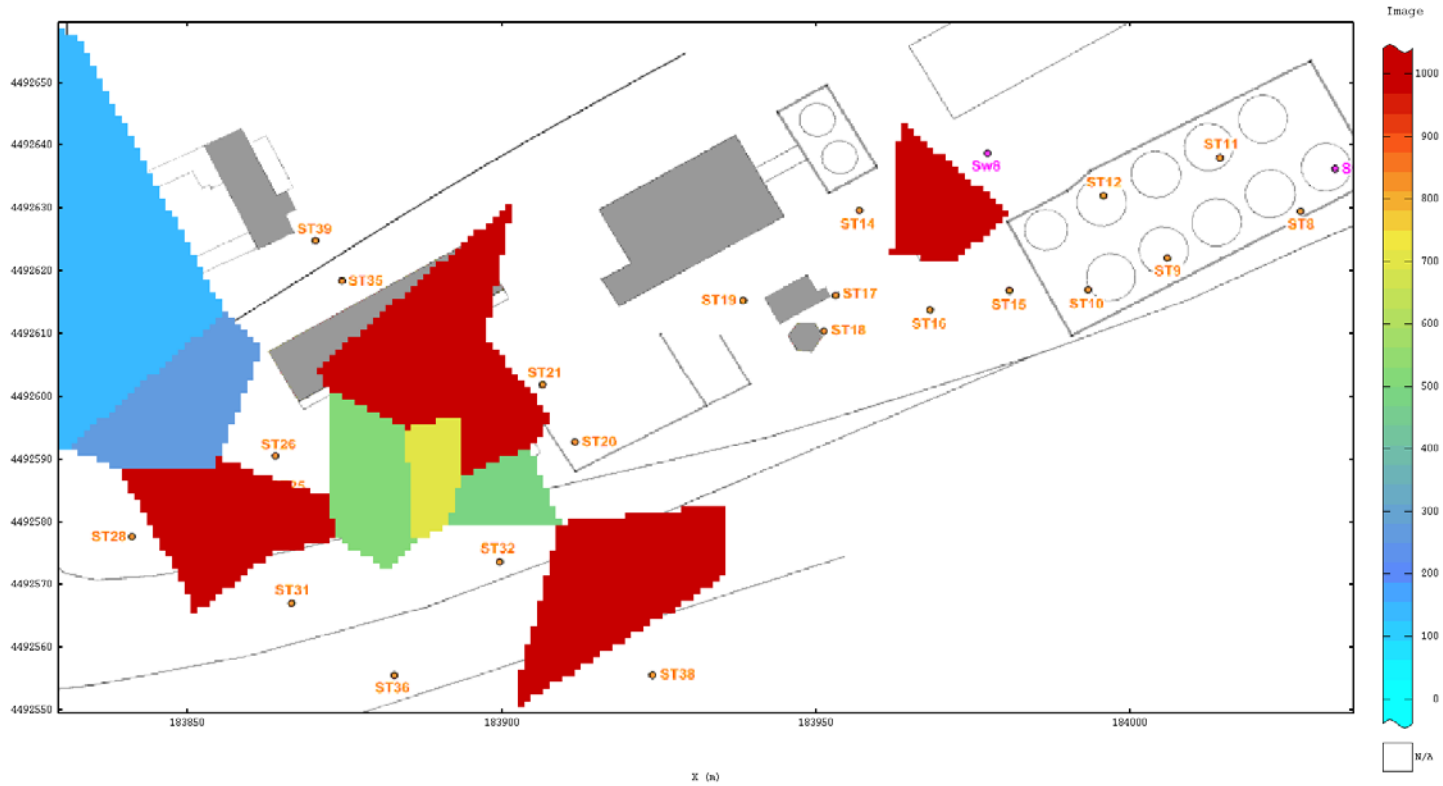
section A-A'



Results



Thyssen Polygons



Volume = 20 305 m³





Conventional method versus innovative approach

- **Volume of polluted soil**
 - Real : 11 000 m³
 - Geostatistic : 10 500 m³ ; 4.5 %
 - Conventional : 20 000 m³ ; 80 %
- **Cost/benefit study**
 - Time spent in the field : + 40 %
 - Time spent at the office : + 15 %
 - Total analysis cost : + 10 %

Conventional method versus innovative approach

| | Conventiionnal method | Innovative approach : Geostatistic + on site analysis |
|---|-----------------------|---|
| Time spent in the field | ++ | + |
| Specific field equipment | ++ | ++ |
| Sampling precision | + | +++ |
| Additional borehole to define pollution | + | +++ |
| Cost laboratory if only 1 campaign | ++ | ++ |
| Need of a 2nd campaign - cost laboratory | + | +++ |
| Time spent in the field for the 2nd campaign | ++ | +++ |
| Time spent at the office | ++ | + |
| accuracy of volume calculation of contaminated soil | + | +++ |
| clarity of the schemas / didactic explanations | + | +++ |
| RATING | 15 | 24 |

- + Disadvantage
- ++ Neutral
- +++ Benefit



Thank you for your attention

