Transfer of pollutants from on-site waste water treatment to ground water: a case study

Martin SEIDL[1], David RAMIER[2], Behzad NASRI[3], Olivier FOUCHÉ[1,3]

1. **LEESU**, Laboratoire Eau Environnement et Systèmes Urbains, ENPC,, 77455 Champs-sur-Marne, France
2. **Cerema** Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement , IDF, F-78190 Trappes-en-Yvelines, France
3. **GeF**, Laboratoire Géomatique et Foncier, EA 4630, Le Cnam, 72000 Le Mans, France.

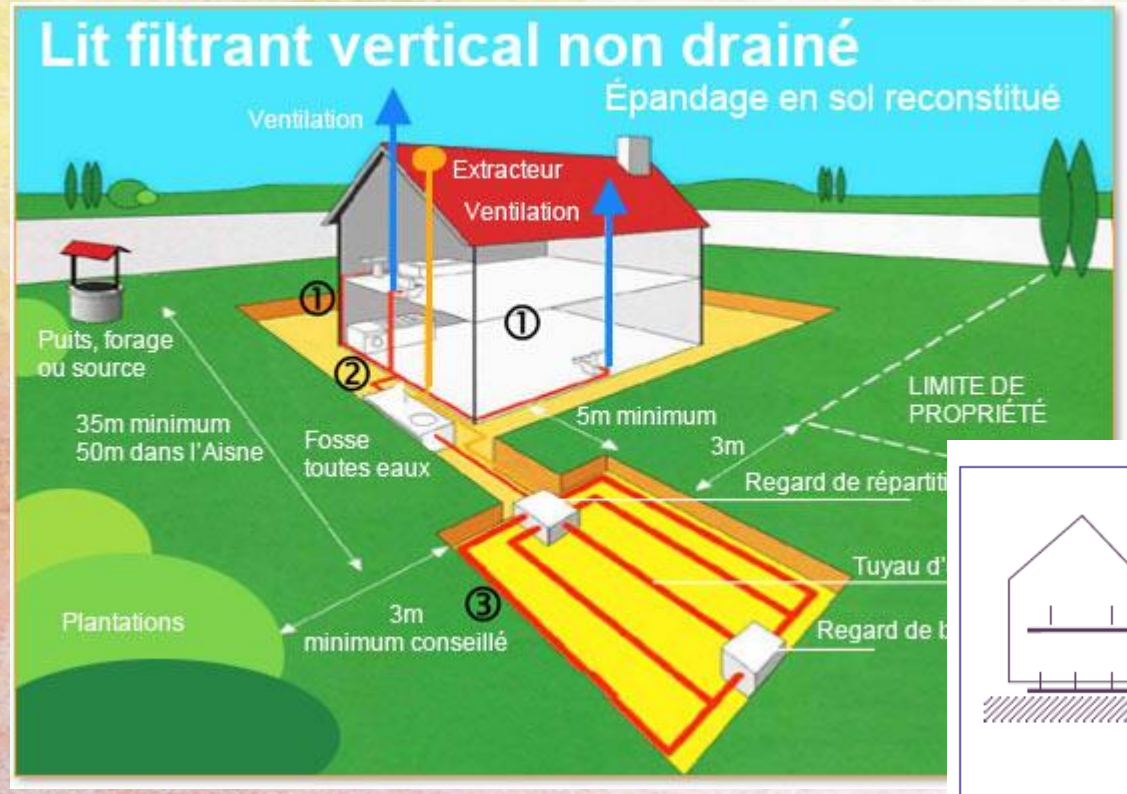
contact : martin.seidl@leesu.enpc.fr

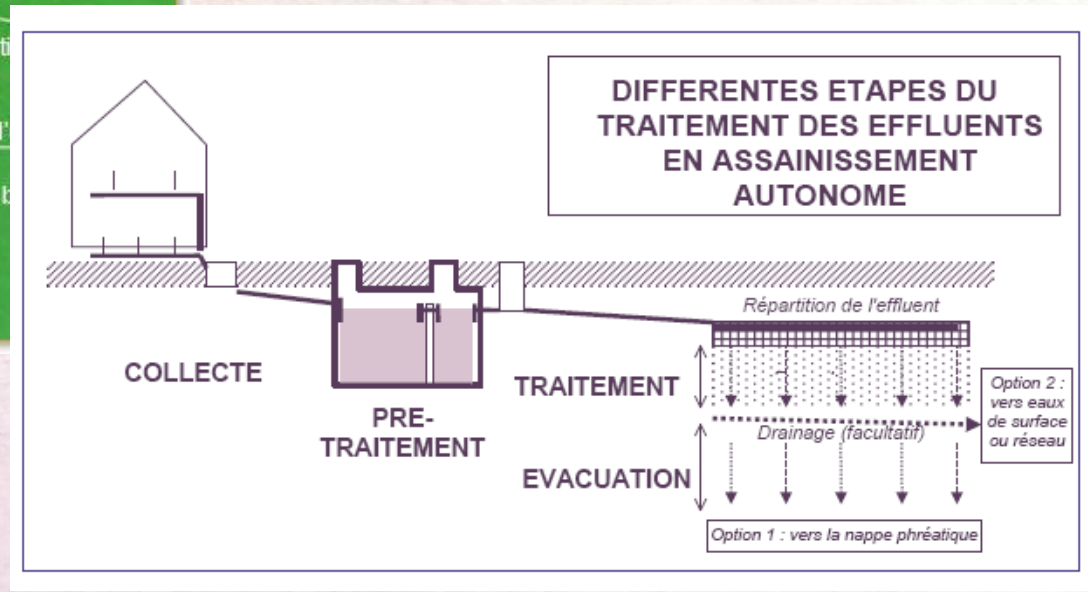
Background

On site waste water treatment (OWWT) is implemented where the population density is too low to make a collective disposal affordable. In France the OWWT concerns 20% of the population and is submitted to a recent regulation in terms of means rather than effluent quality. In most cases household water is settled and digested in a septic tank, where after the effluent is further treated followed by an aerobic sand filter. If the filter is not drained, the soil is acting as post treatment. **As the effluent will reach the ground water it's necessary to evaluate how the OWWT and the underlying soil mitigate the pollution.**

The aim of the project was to study the pollutant transfer to ground water under different hydrological conditions

Basic principles



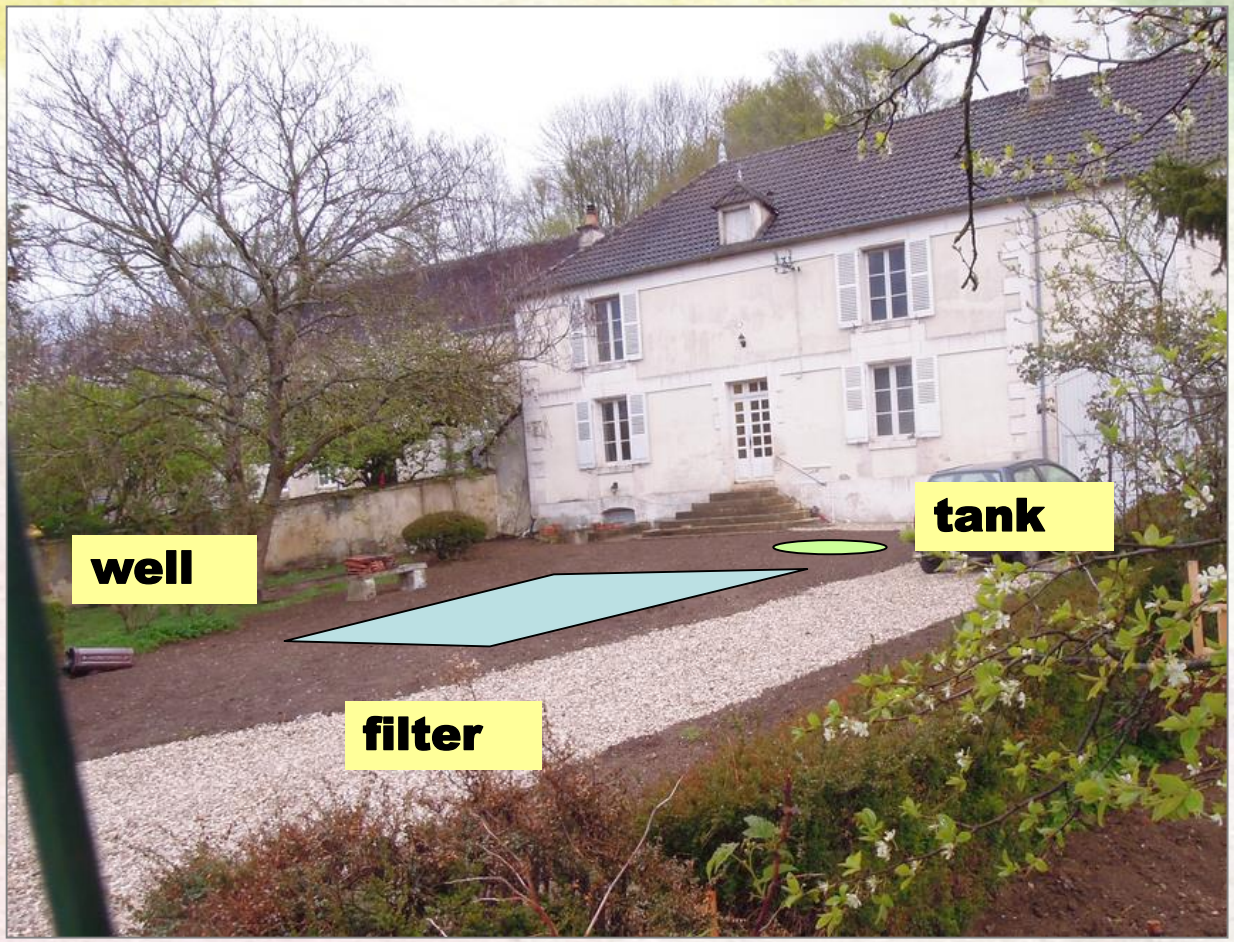


METHODOLOGY

Study site

A household consisting of a young couple without children equipped with a septic tank of 5 m3, followed by 20m² of un drained sand filter.

The house is situated in a small village called Usselot, 120 km south west of Paris at the bottom of a valley



Data collection

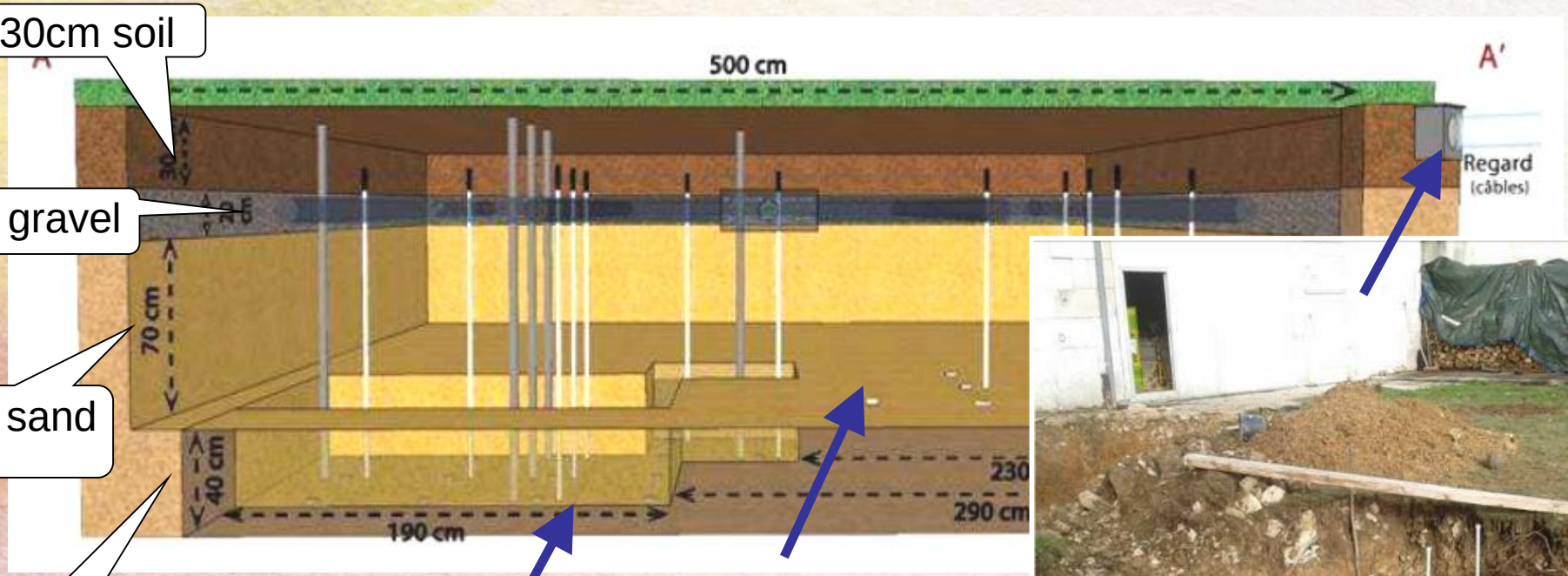
mesures

30cm soil

20cm gravel

70cm sand

40cm soil



pore water sampling

Parameters followed

- Hydrology (on-line)
  water content, suction, household water consummation, rainfall, water table level

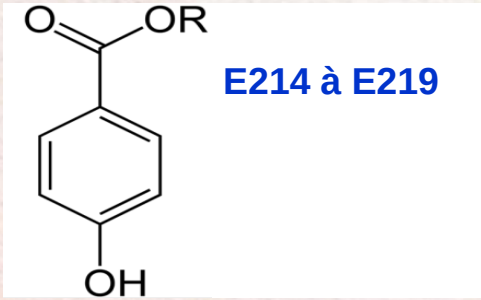
- Physico-chemistry
  Conductivity, Turbidity, Solids
- Nutriments
  Anion, cation -> ion chromatography,
- Micro-pollutants
  Paraben(s), triclosan -> LCMSMS
- Pathogens
  E. Coli

}

1 to 2 times a month for septic tank effluent, pore water and well

Domestic micro-polluants
Body care products

Parabènes (PBs)

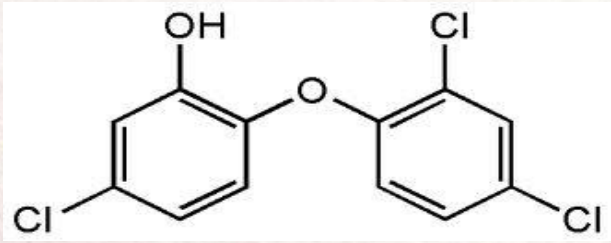


E214 à E219

Bactericide, preservative in body care products, cosmetics, medicaments and some food

produced since 1920

Triclosan (TCS)



Bactericide (fungicides): shampoos, deodorants, toothpastes

produced since 1964

RESULTATS & DISCUSSION

water table

summer, dry period

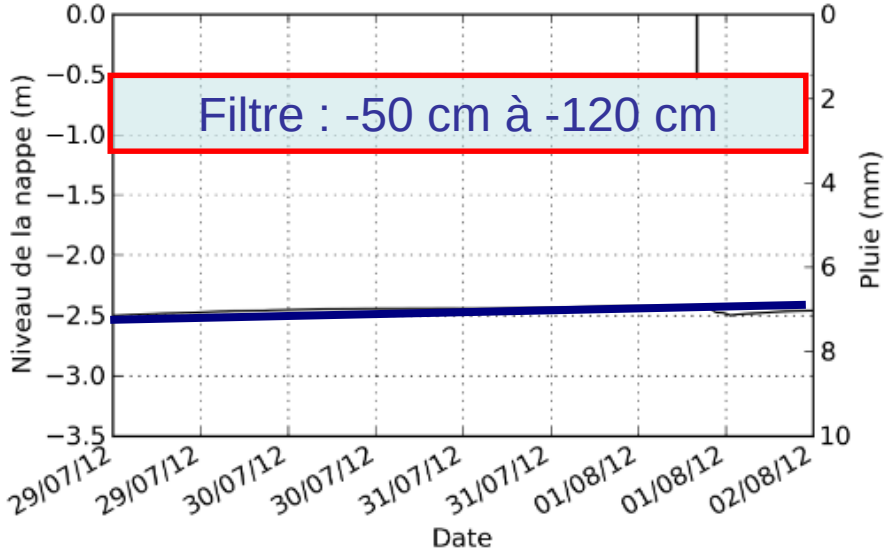


Figure 95. La variation de la nappe par rapport à la pluie pour la période sèche au site pilote.

winter, rainy period

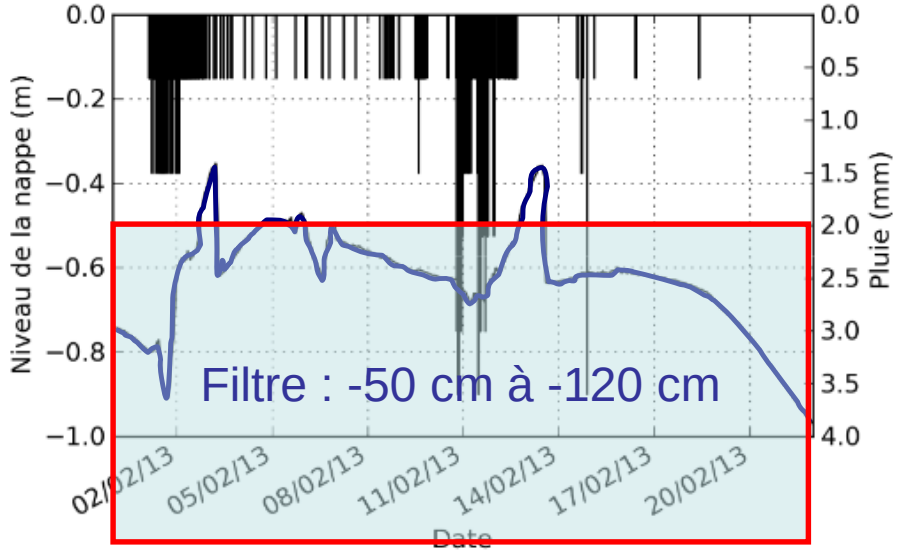
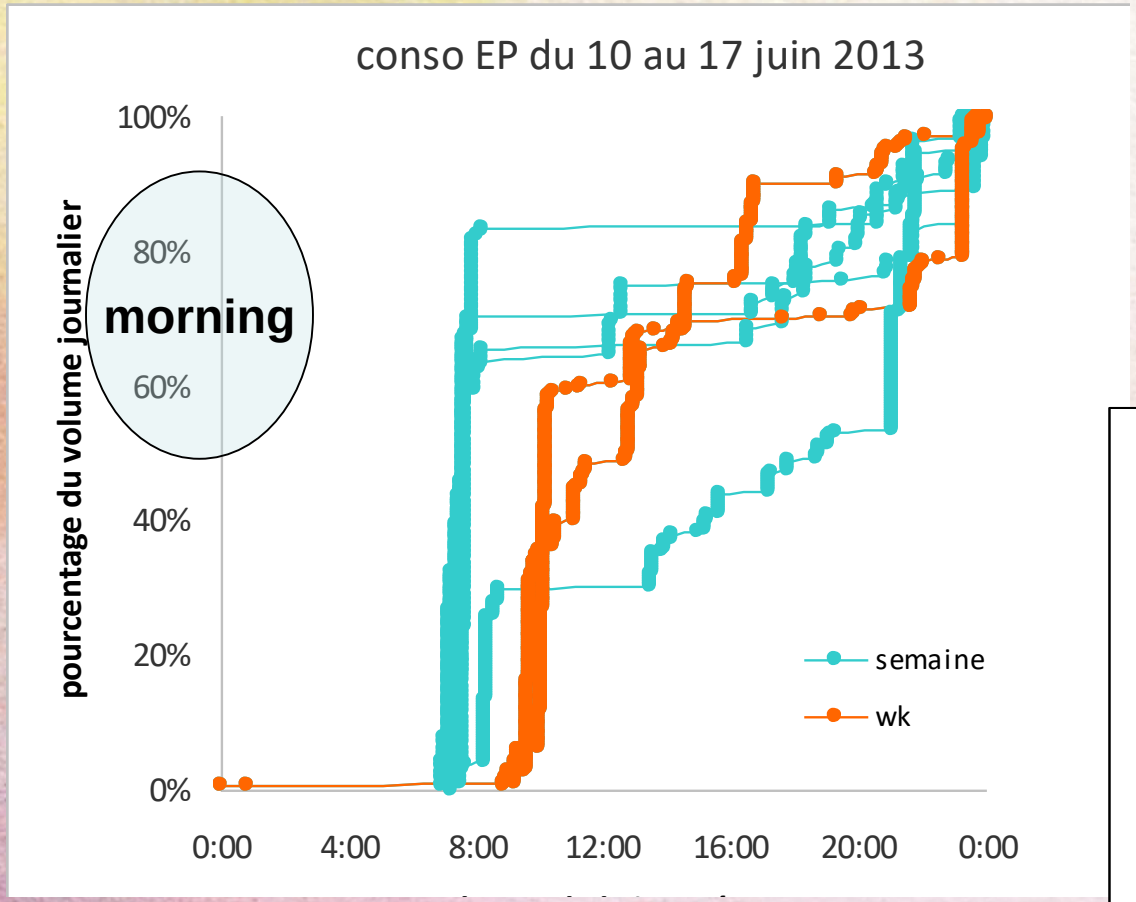
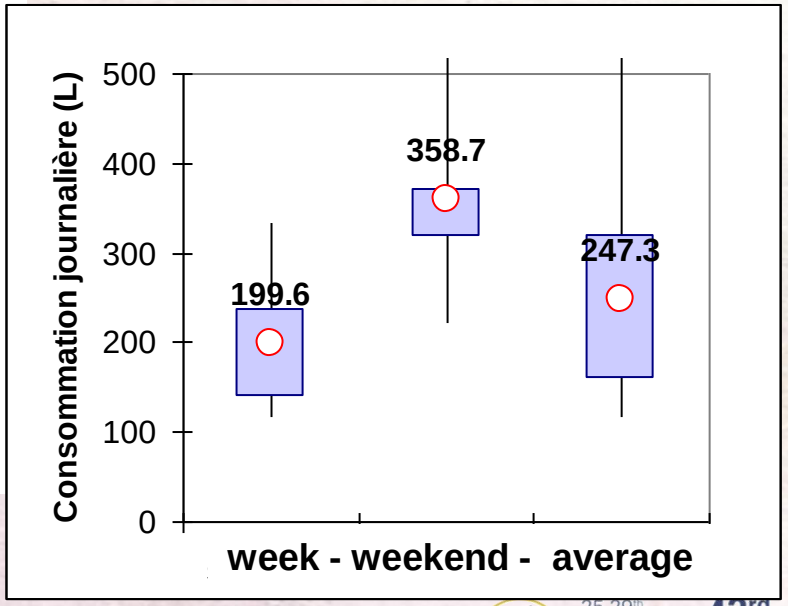


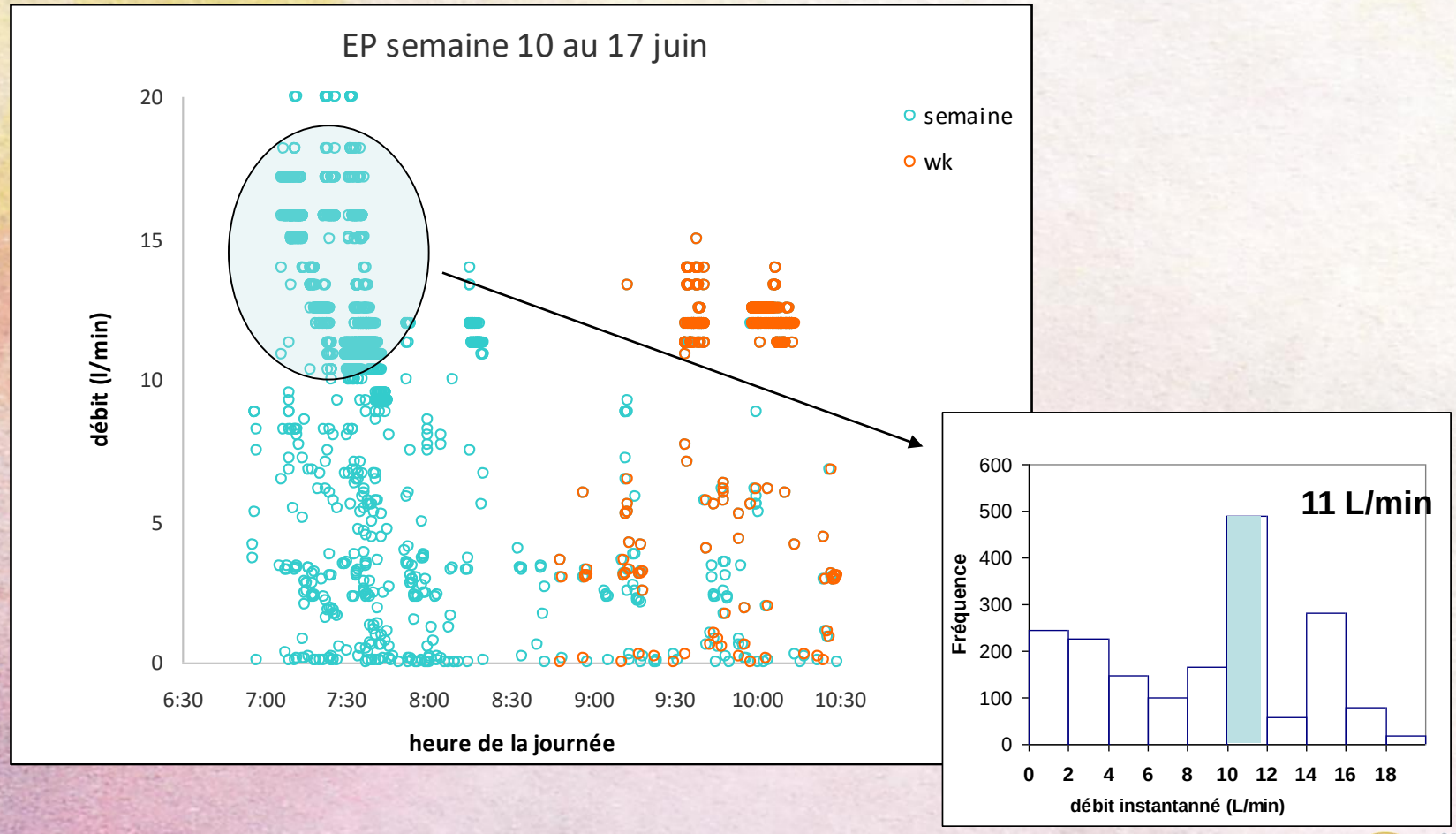
Figure 96. La variation de la nappe par rapport à la pluie pour la période pluvieuse au site pilote.

Houshold water use

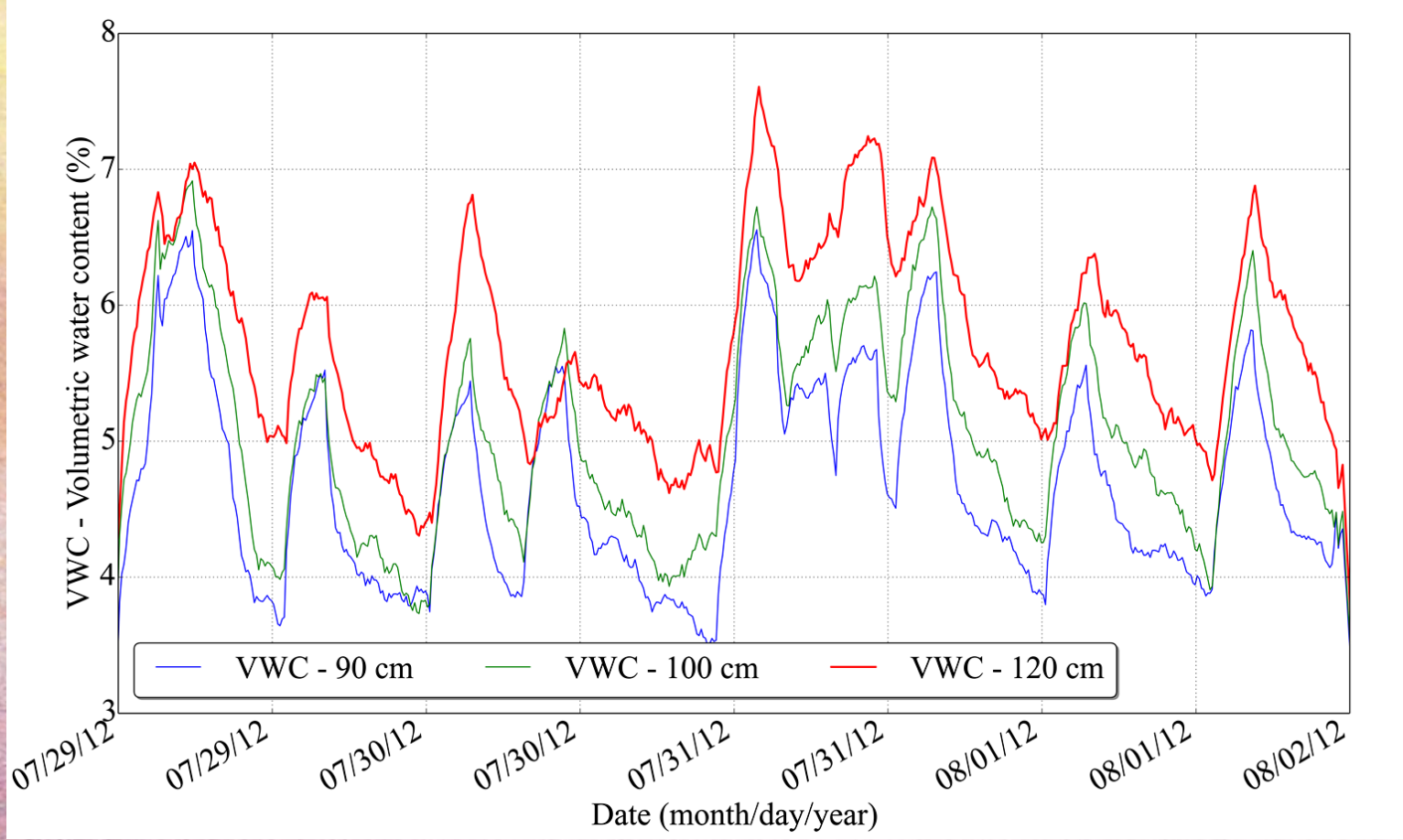


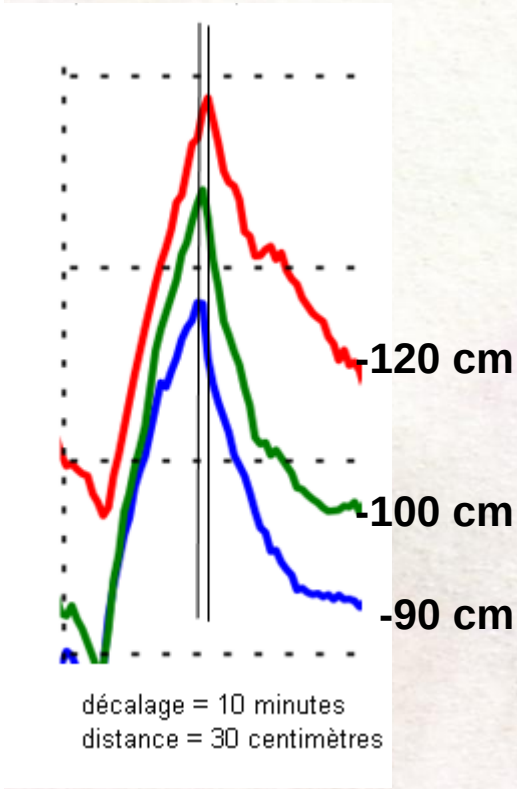


Flow rates

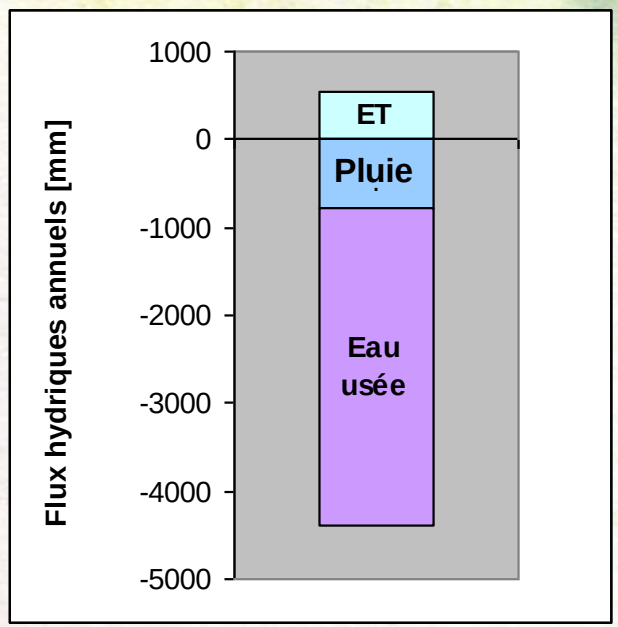

EP semaine 10 au 17 juin
semaine
wk
débit (l/min)
heure de la journée
11 L/min
Fréquence
débit instantanné (L/min)

Water mouvements in the OWWT



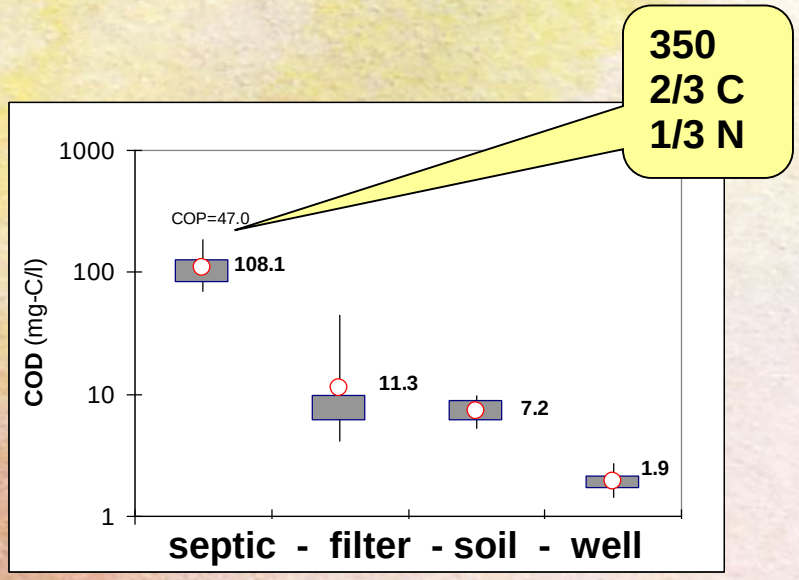


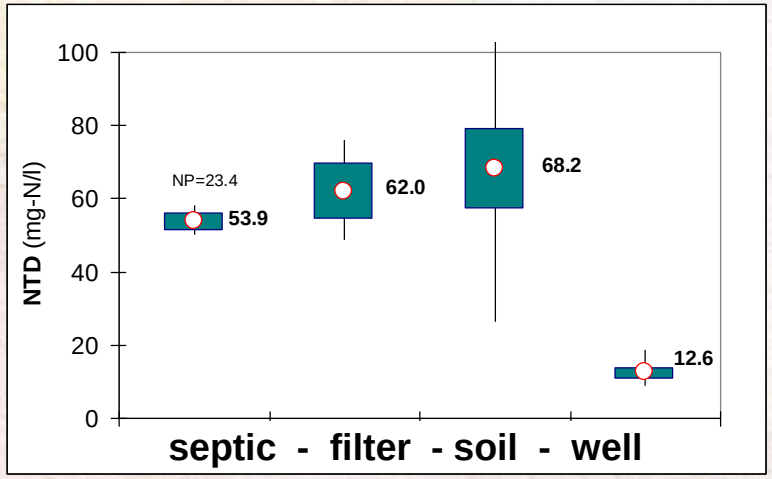
Hydraulics

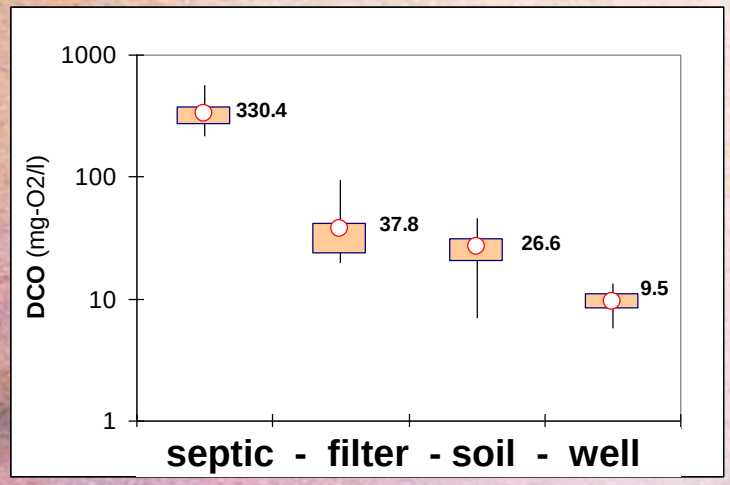


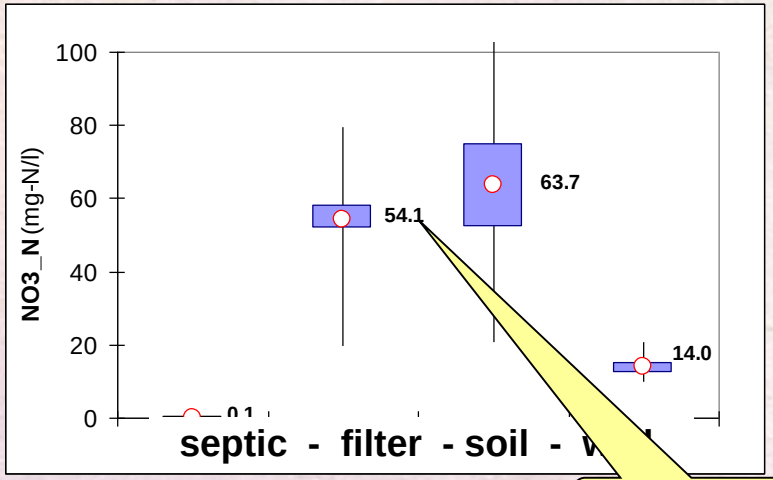
Detention T. : ~1 min | 5 - 8 h | ~20 min, ~ 3 cm/min | ~ 2 h (0 – 5), ~0.4 cm/min

Nutrients elimination







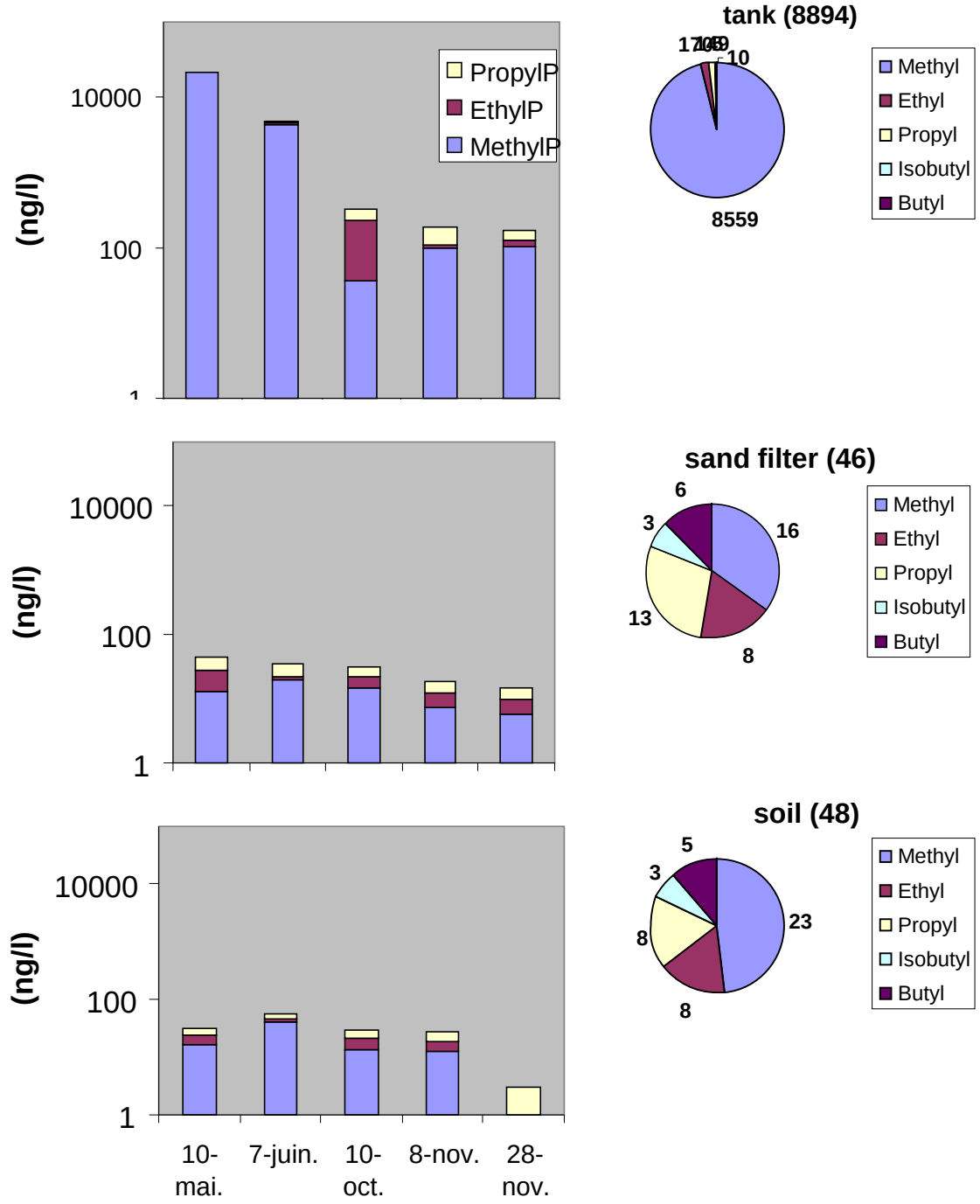


Expected, elimination of carbonaceous pollution by the biofilm of the sand filtere. Weak but significant contribution of the soil.

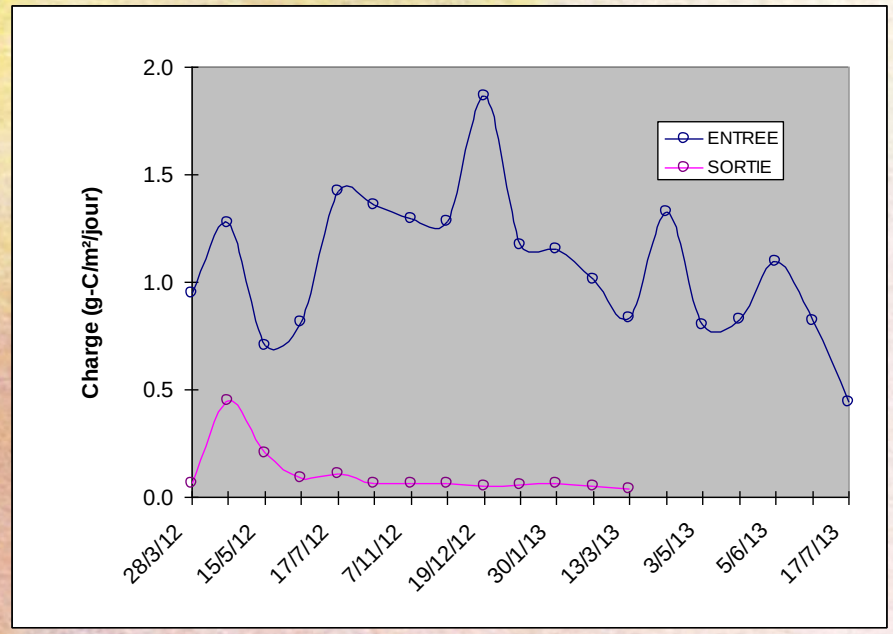
Parabens

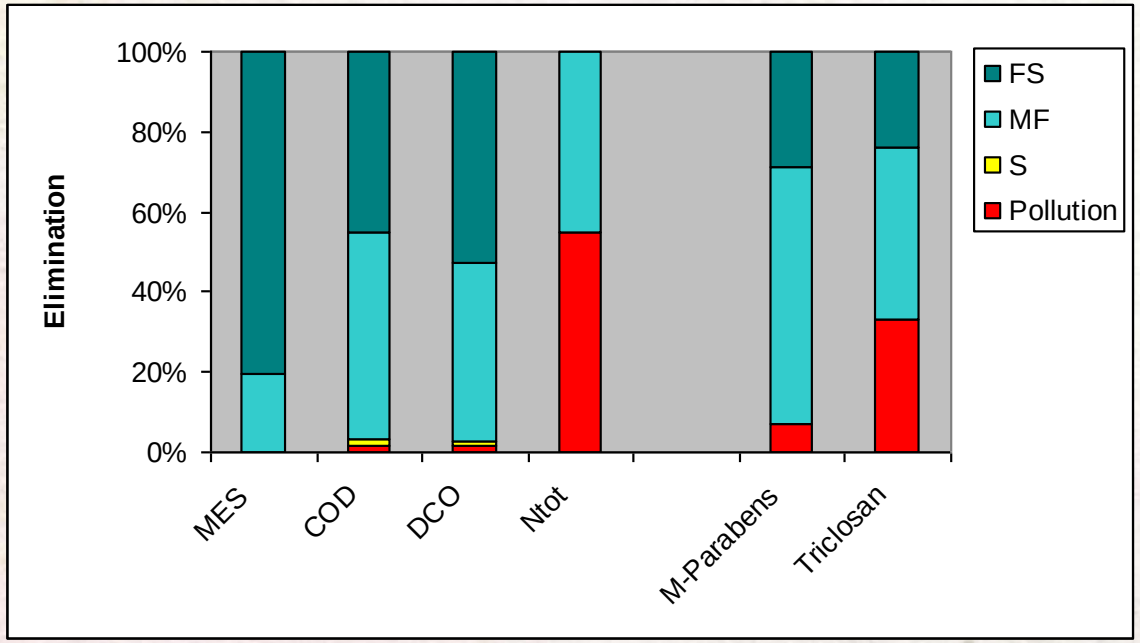
Filter : main contribution to degradation of Methyl-parabens but little Propyl-parabens

Soil : NO or little contribution to degradation



Treatment capacity





Charge filter : OWWT filter /individual ~ 0.1 EH/m², aeration natural
planted filter / collective ~ 1 EH/m² , aeration forced

Groundwater contamination

Household production	Paris g/EH/d	OWWT g/EH/d
N_tot	11.6	8.7
BOD5	54	43.5
Carbon	36	19
M-Parabens (mg/EH/d)	18	1.1
Water	310	125

Flux towards groundwater	g/year	EH/year
N_tot	3158	316
COD	2466	23
Carbon	672	35
M-Parabens (mg)	4.1	4
Solids	0.0	0

28 March 2102 to 17 July 2013, n = 11 à 17

CONCLUSION

First answers

- In our OWWT system the water (and the pollutants) need between 11 and 14 hours to get to water table. During wet weather this is 5 hours less.
- Due to good carbon elimination within the system, the OWWT protects effectively the ground water against carbon pollution
- This is also partly true for parabens and triclosan
- but not true for nitrogen, where 50% goes to ground water

- The pollutant leakage towards ground water is faster during rainy periods when the filter is partly in contact with the water table

Thank you for your attention

Acknowledgments to program GESSOL
financed by ADEM and MEDDE