



Parametric pipe detection on the urban site Sense-City using Ground-Penetrating Radar (GPR)

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Sub-surface probing using GPR



Parametric pipe detection on the urban site Sense-City using Ground-Penetrating Radar (GPR)

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Objectives

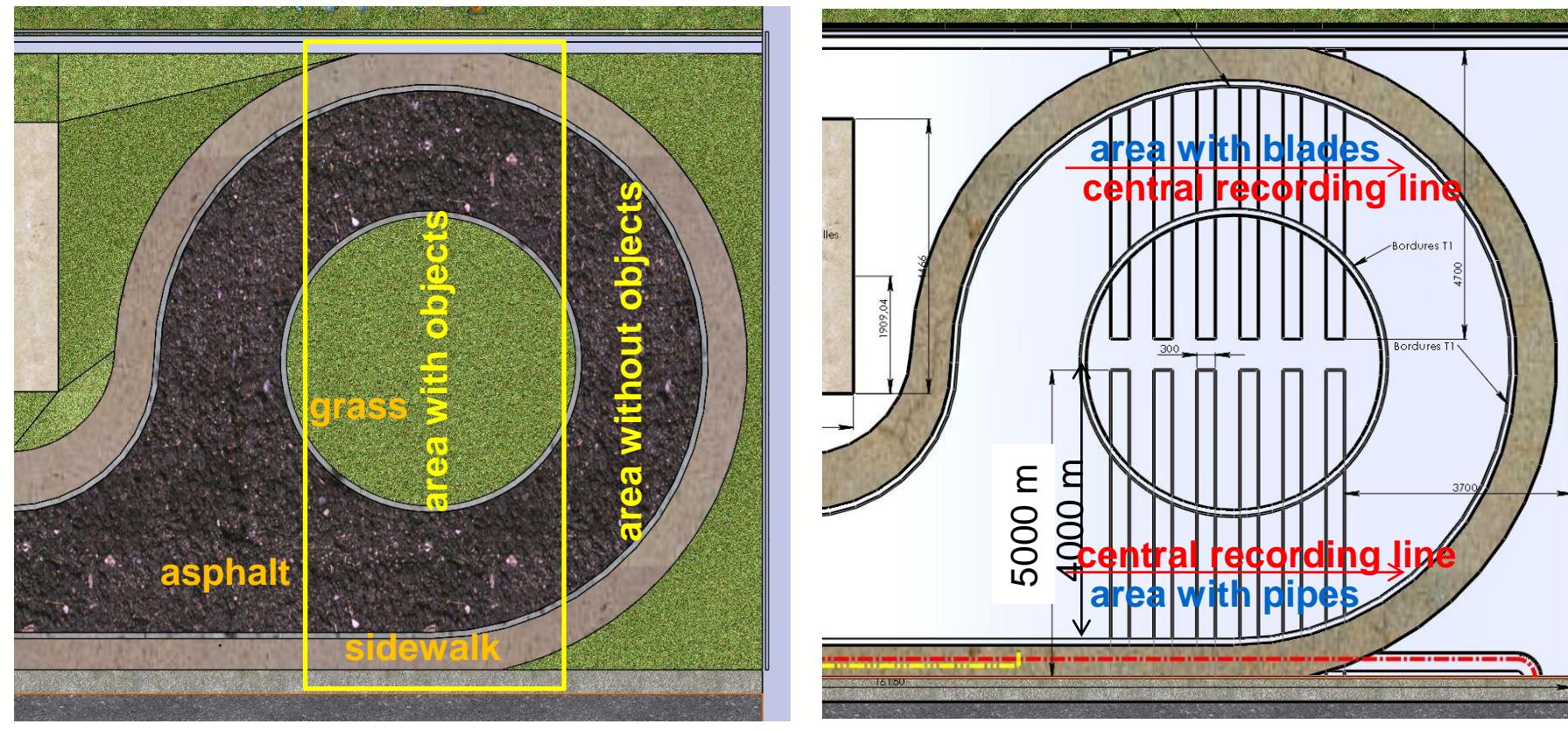
- Mapping the underground in a urban landscape with a non-destructive technique using electromagnetic waves to detect dielectric discontinuities
- Parametric detection of dielectric and conductive utilities with relative small diameters buried in different types of soils (nature, composition, moisture content) using ground-coupled georadar at several frequencies in the band [0.3;4] GHz
- Development of signal and image processing techniques for clutter removal, hyperbola detection and fitting, object and soil characterization

Experiments in the test site Sense-city

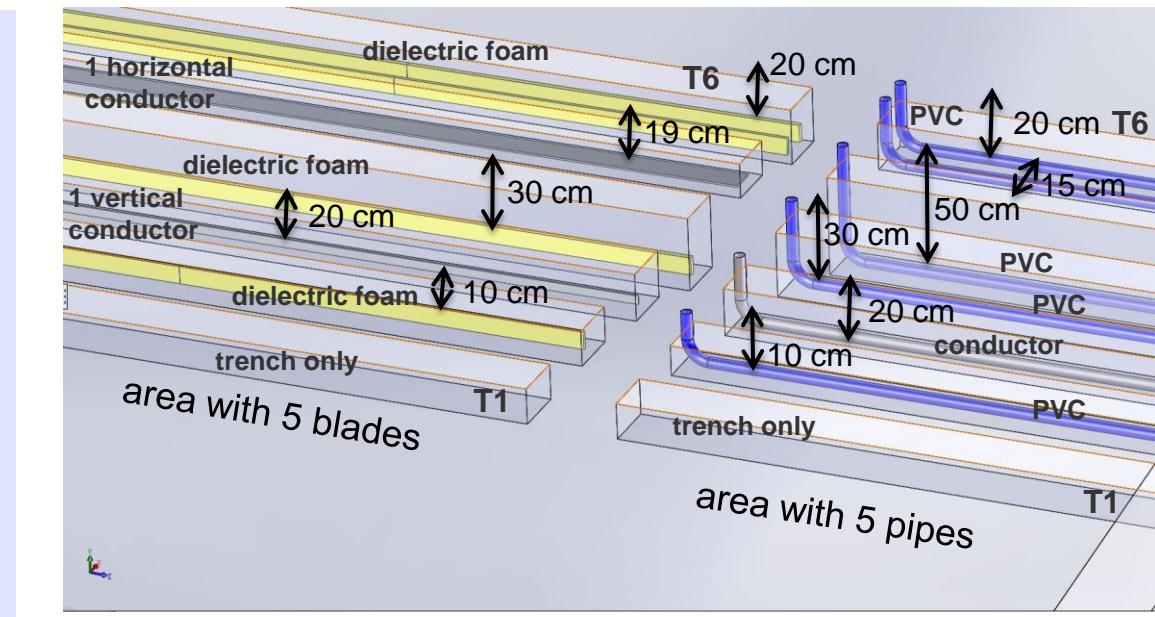
General view of the mini-city test bed



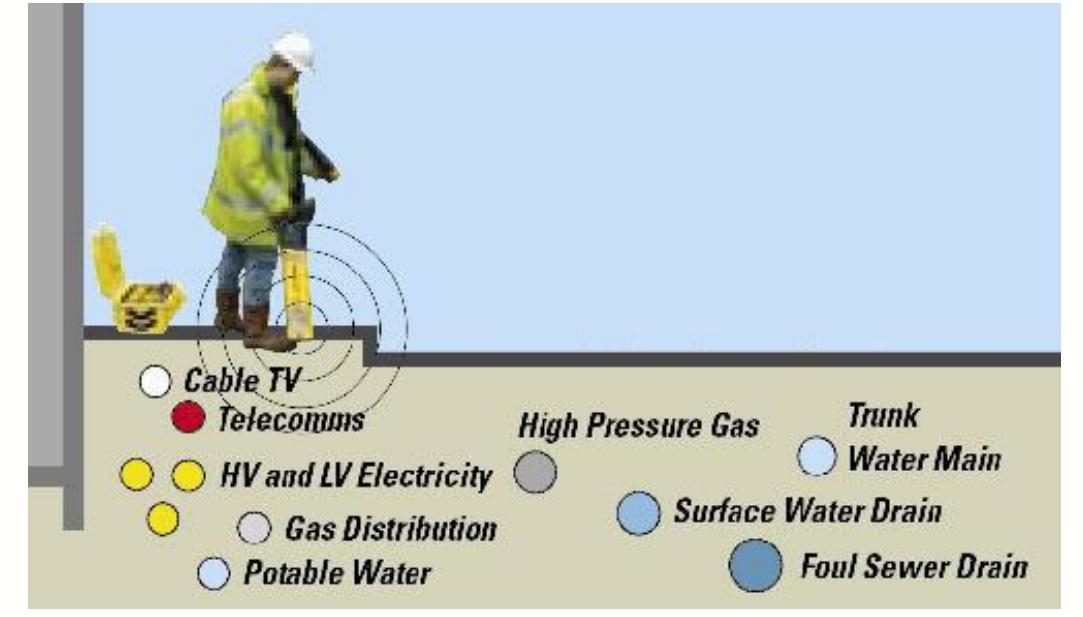
Top views



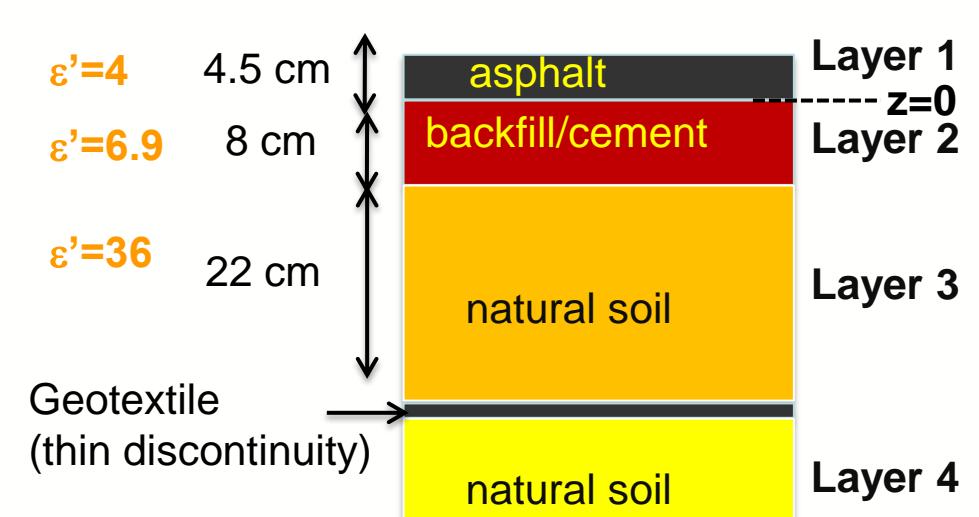
Distribution of the buried pipes/blades



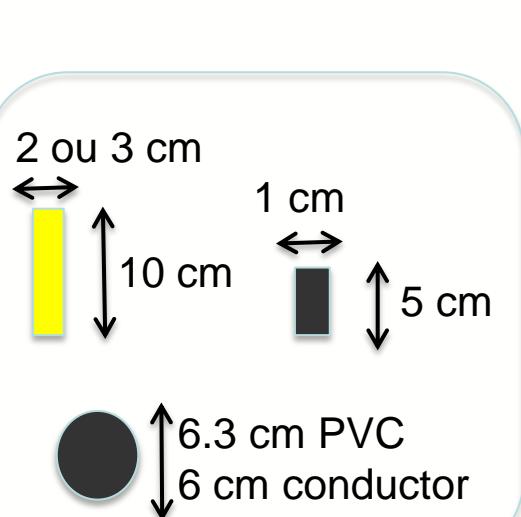
Mapping the urban underground



Structure of the subsurface



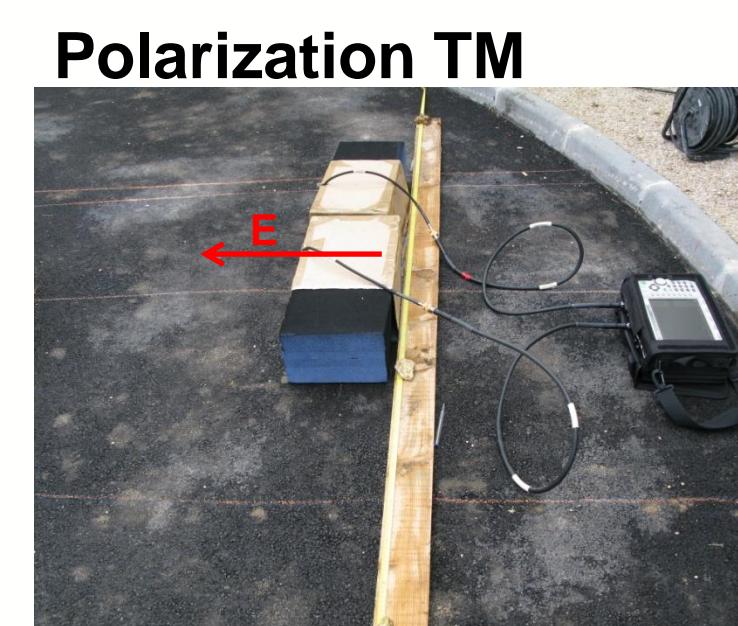
Buried objects



Commercial GPR systems operating in the time domain

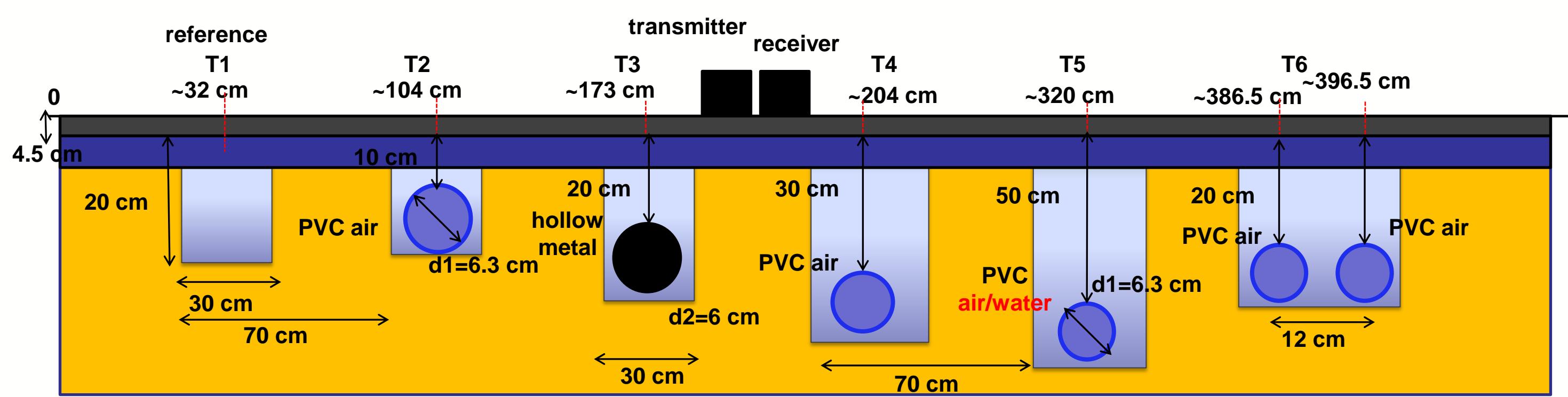


Laboratory-made GPR system operating in the frequency domain (FMCW)



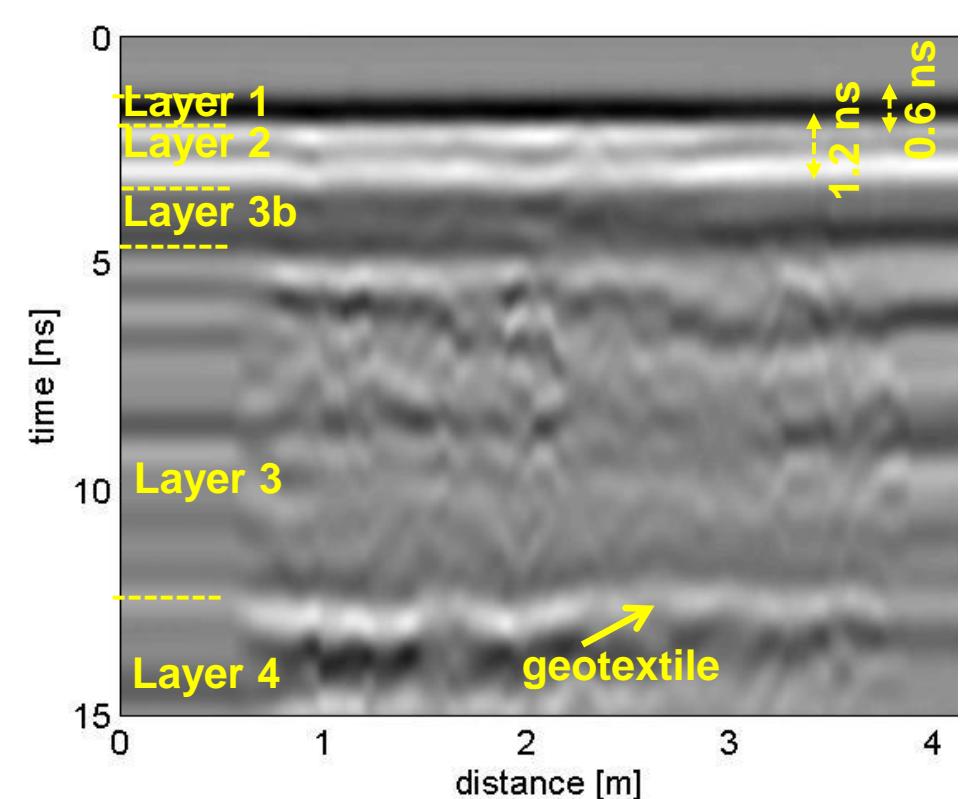
Measurements in the pipe area

A cut view of the pipe zone

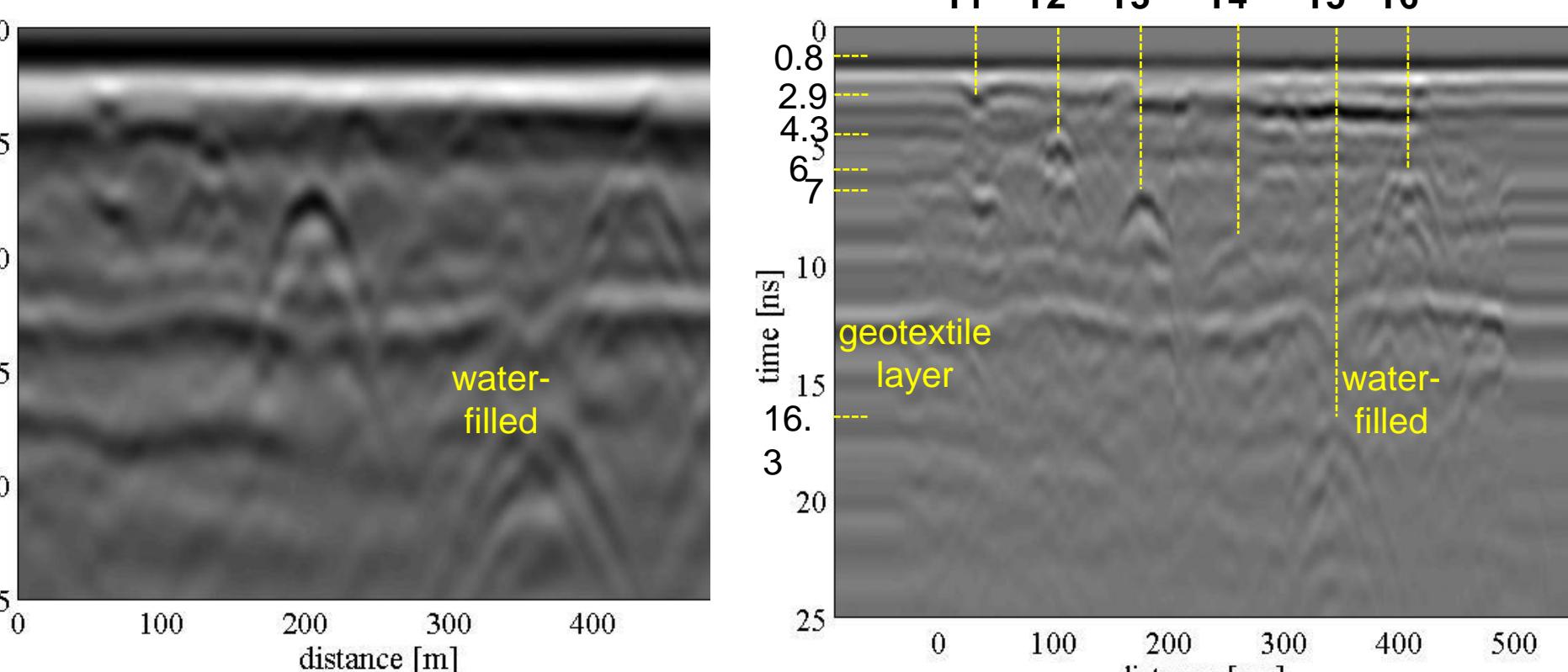


Measurements in the time domain

Soil characterization at 900 MHz (with linear gain, $\Delta y \sim 1$ cm)



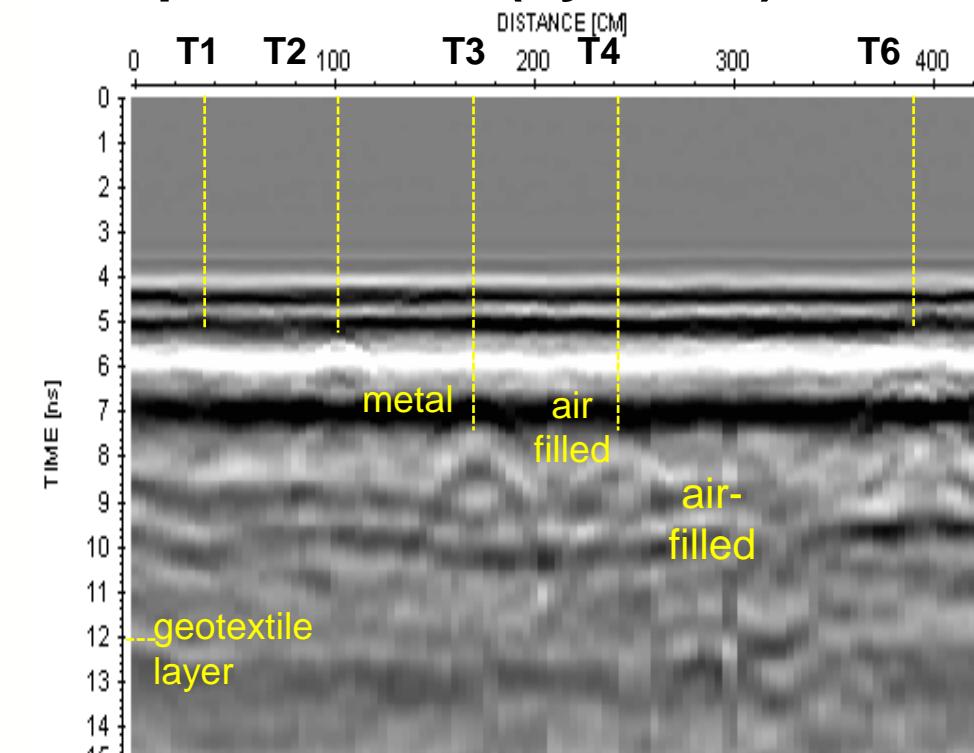
Pipe radargram (with linear gain)
500 MHz ($\Delta y \sim 1$ cm)



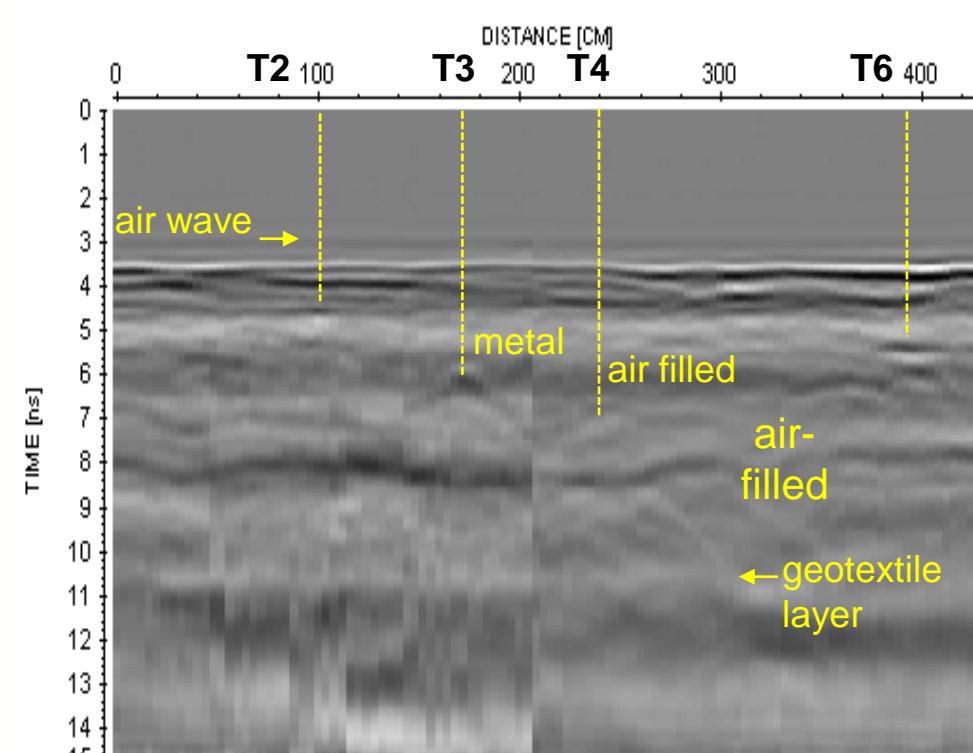
Measurements in the frequency domain

Radargrams at 900 MHz (with gain)

TE polarization ($\Delta y=4$ cm)



TM polarization



• Images of the pipe zone using 3 different GPR systems (SIR 3000, Utility scan with 2 frequencies, radar FMCW) at the following nominal frequencies :

- 500 MHz, 900 MHz, 1600 MHz
- 300 et 800 MHz (double frequencies)
- [50 MHz; 4 GHz] (FMCW, 2 polarizations)

- T5 at depth 54.5 cm : air-filled not detected in the polarization TM, water-filled better detected in the polarization
- 900 MHz appears the best frequency in the compromise between resolution and penetration

Interpretation using migration

