



COST Action TU1208

“Civil Engineering Applications of Ground Penetrating Radar”

**The open database of experimental and
synthetic GPR radargrams**

Lara Pajewski

Sapienza University, Rome, Italy

lara.pajewski@uniroma1.it



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TU1208 database

Idea: generate a database of numerical and experimental GPR responses from natural and manmade structures that will be at the disposal of the scientific community including geometrical and physical descriptions of the scenarios.

Researchers working on electromagnetic modelling, inversion, imaging and data-processing techniques can use these radargrams as reference datasets to test and compare their approaches and algorithms.

Past successful initiatives in different areas:

- Ipswitch and Fresnel databases in the field of free-space electromagnetic scattering.
- Marmousi database in exploration seismics.
- A hydrogeophysics workshop where one crosshole GPR dataset was inverted in a homework session by 7 groups and results were compared, resulting in very interesting discussions.



TU1208 database (synthetic)

- For each scenario, a subset of models with growing complexity is defined, starting from a simple representation of the scenario and ending with a more realistic one. In particular, the model's complexity increases from the geometrical point of view, as well as in terms of how the constitutive parameters of the involved media and GPR antennas are described.
- The database also includes simple scenarios with dielectric or perfectly-conducting cylindrical or three-dimensional scatterers in a half- space.

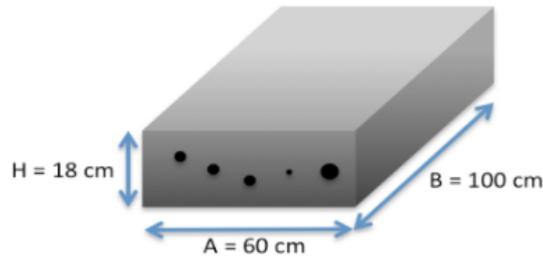


TU1208 database (synthetic)

- gprMax and CST Microwave Studio 2D and 3D models of a series of concrete cells with reinforcing elements, voids and aggregates

Concrete 1

Cells 1.1 – 1.3 can be simulated in 2D and 3D. In 2D, the concrete cell size is $A \times H$; in 3D, the cell size is $A \times B \times H$.



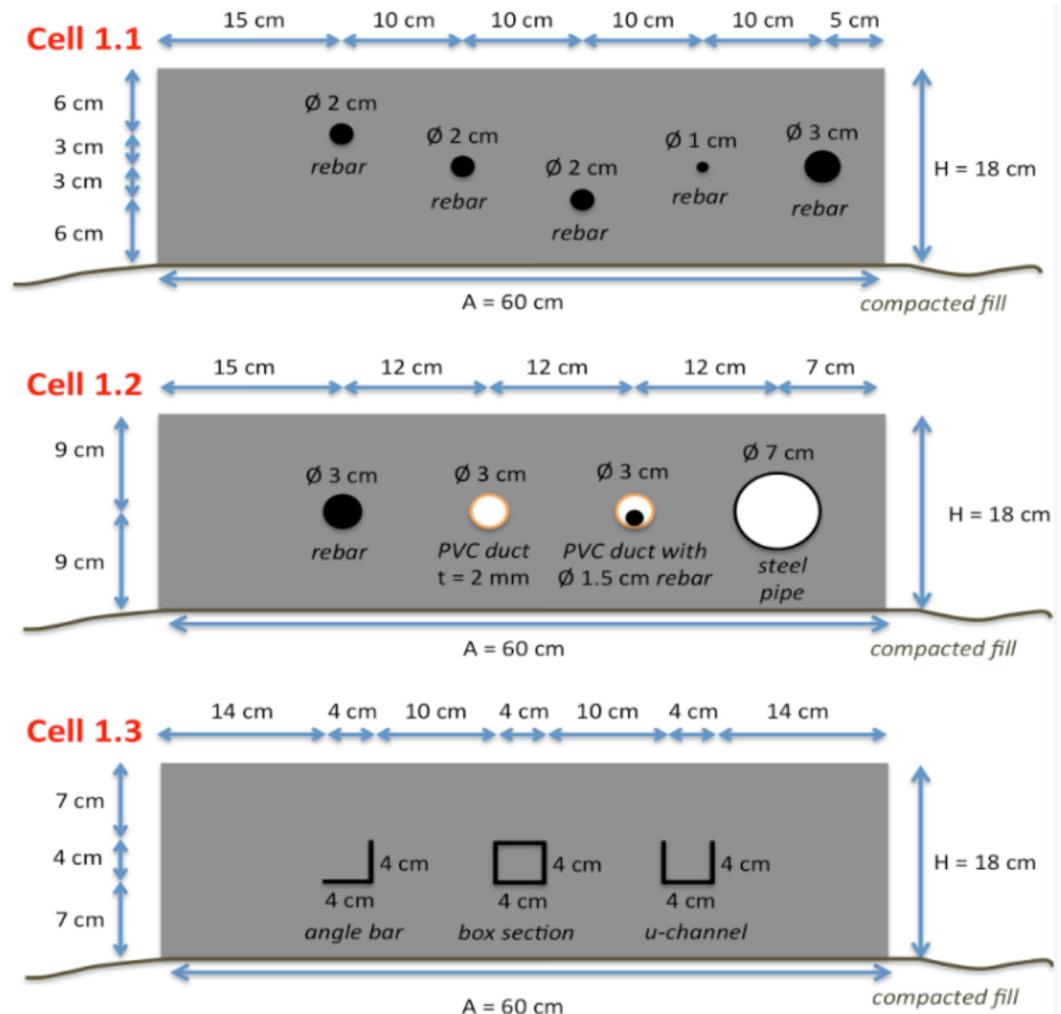
Transmitter:

- ✓ Central frequency: $f = 1.5$ GHz
- ✓ Pulse time-shape: Ricker
- ✓ 2D source: line of current
- ✓ 3D source:
 - Hertzian dipole // B or // A
 - Bow tie antenna // B or // A
 - GSSI antenna

- ✓ Rx and Tx are at 2 cm from concrete-air interface
- ✓ The distance between Tx and Rx is $d = 10$ cm

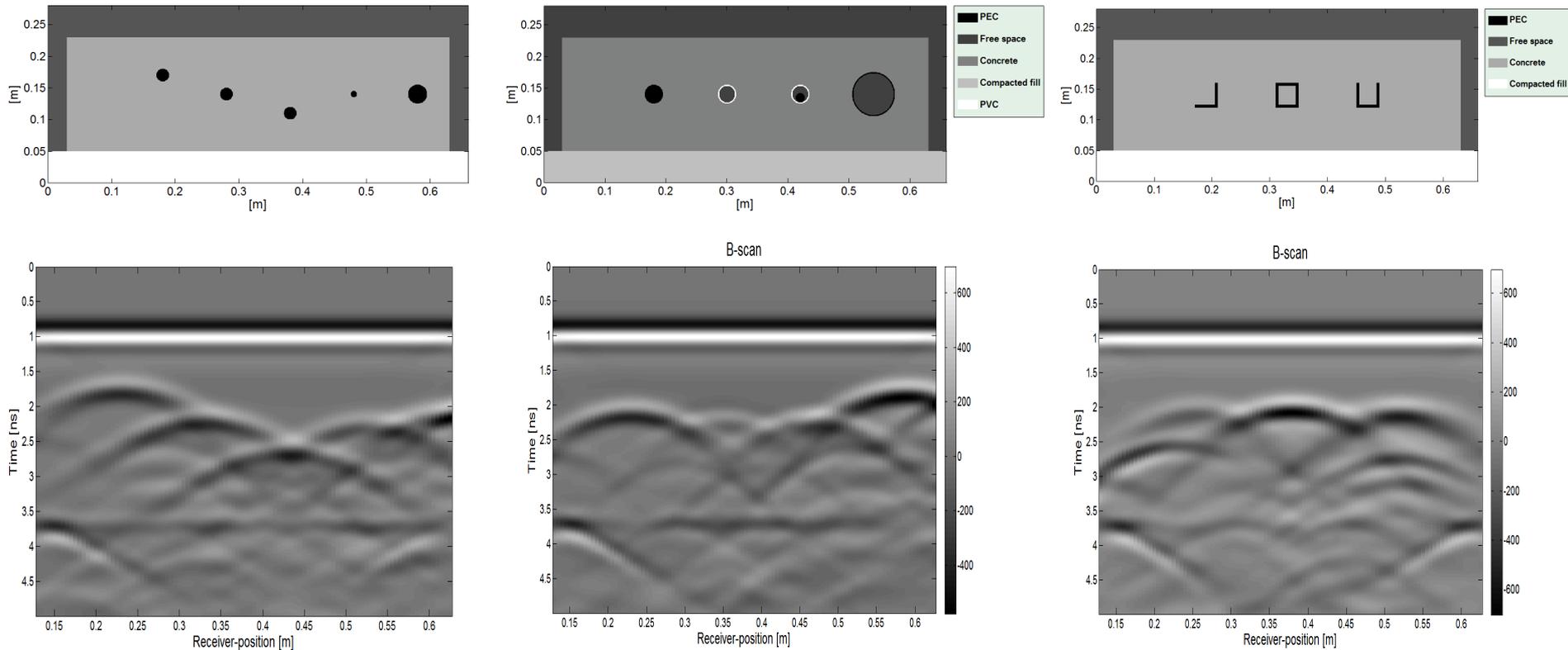
Output:

- ✓ B-Scan with step 5 mm
- ✓ A-Scan above the center of each scatterer
- Total field and back-scattered field
- Time window: 5 ns



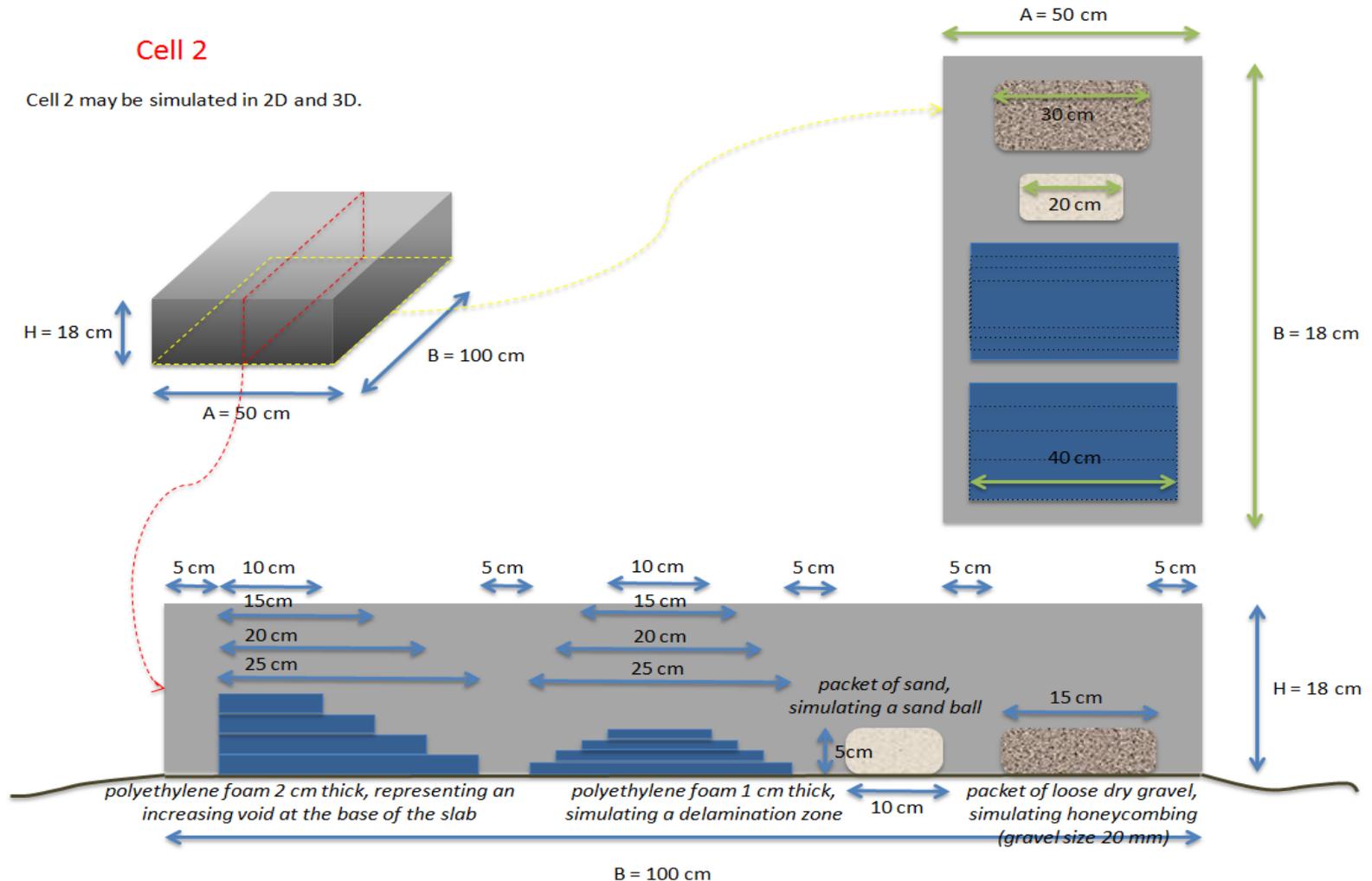
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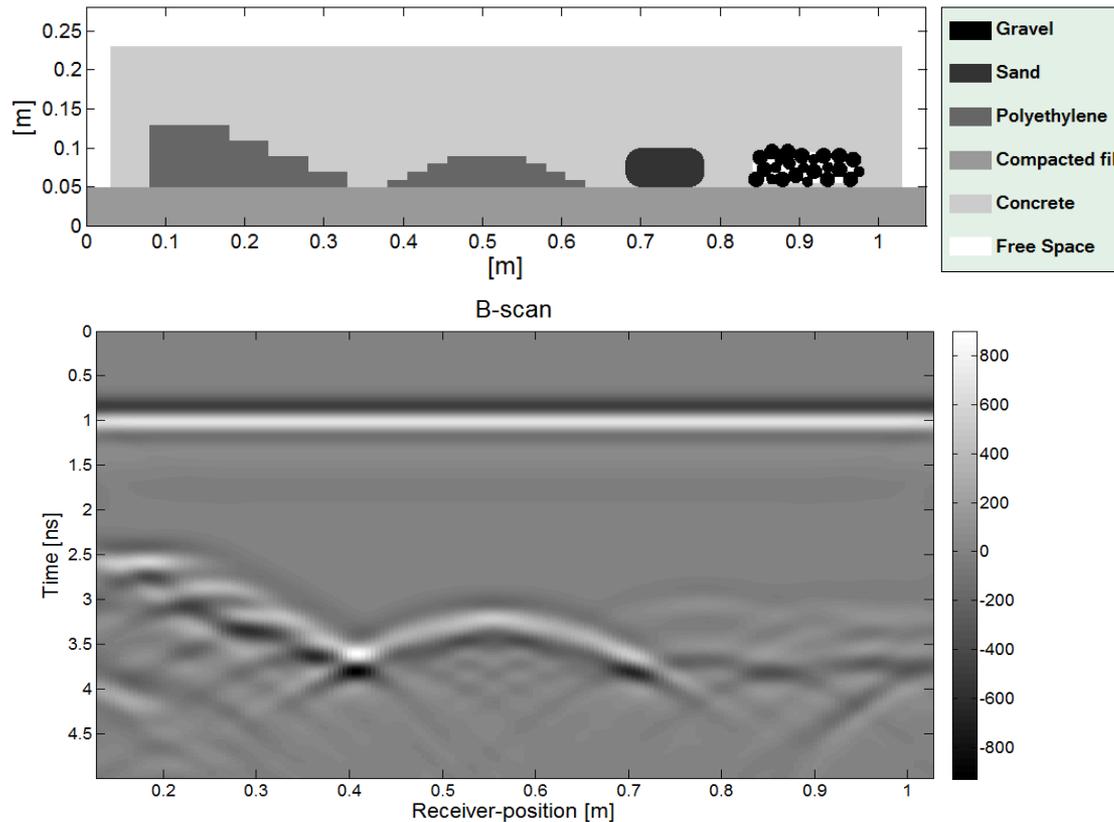
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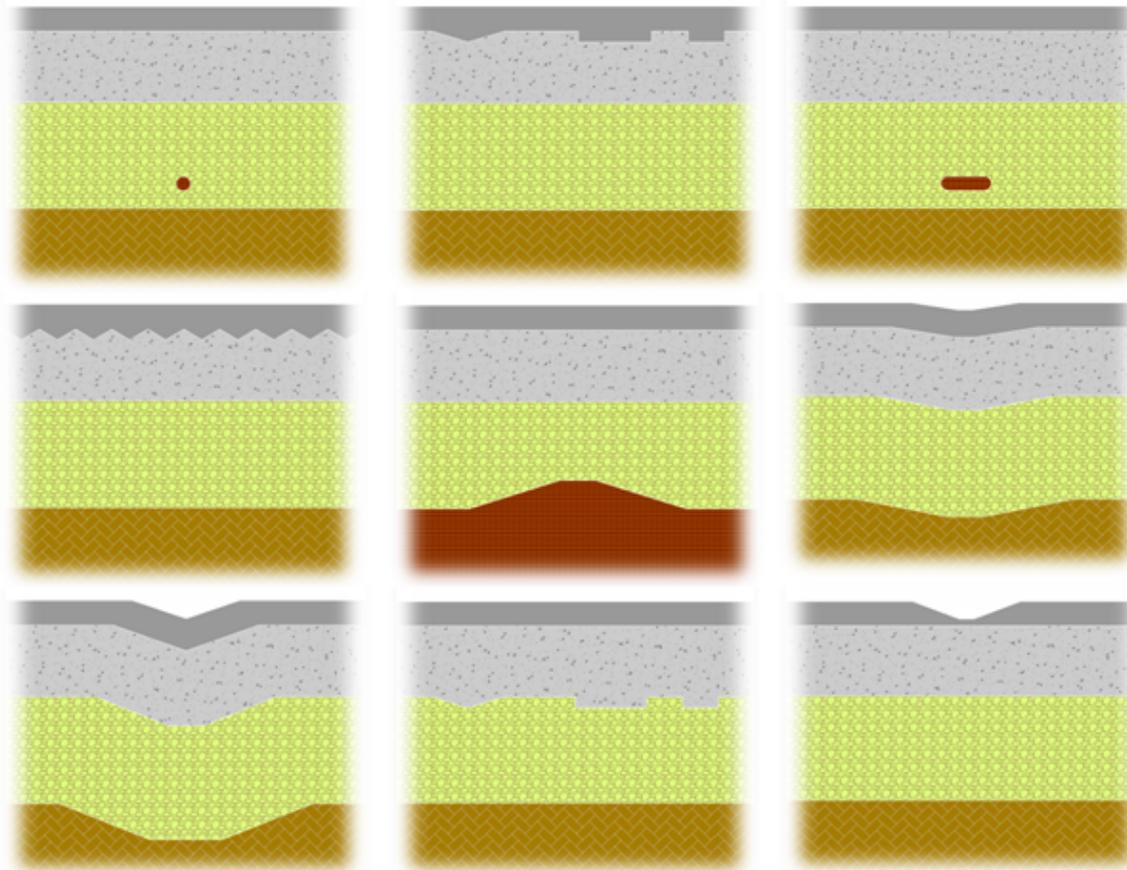
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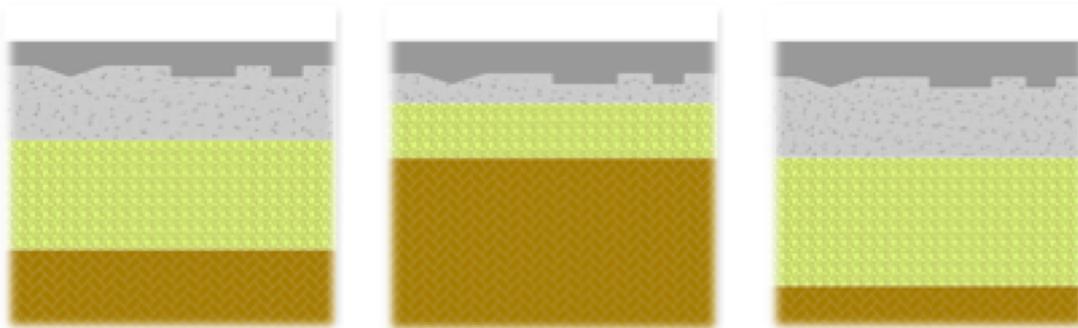
TU1208 database (synthetic)

- gprMax 2D models of a series of roads, with different damages

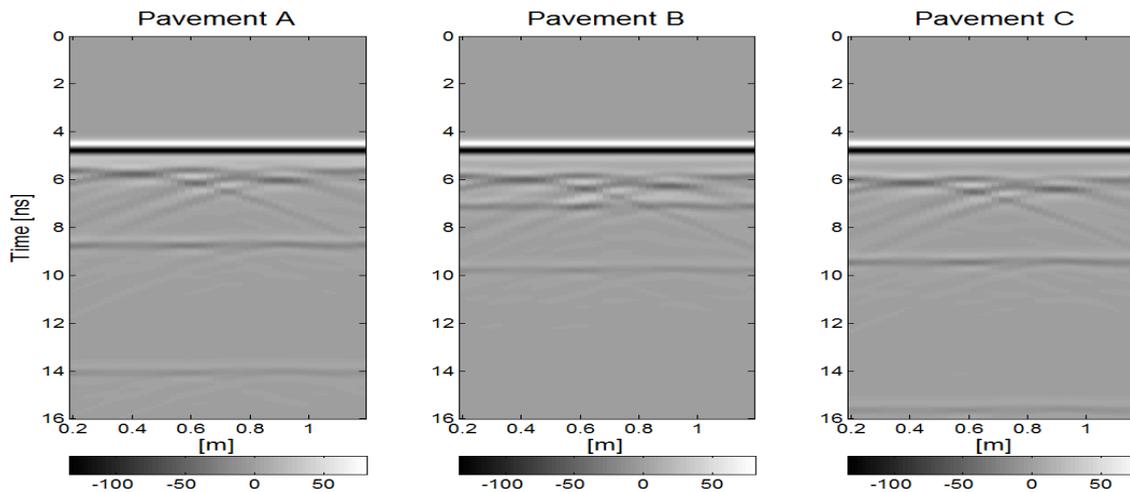


TU1208 database (synthetic)

- gprMax 2D models of a series of roads, with different damages



3 different layer thicknesses...
...and 3 different frequencies for
each of them

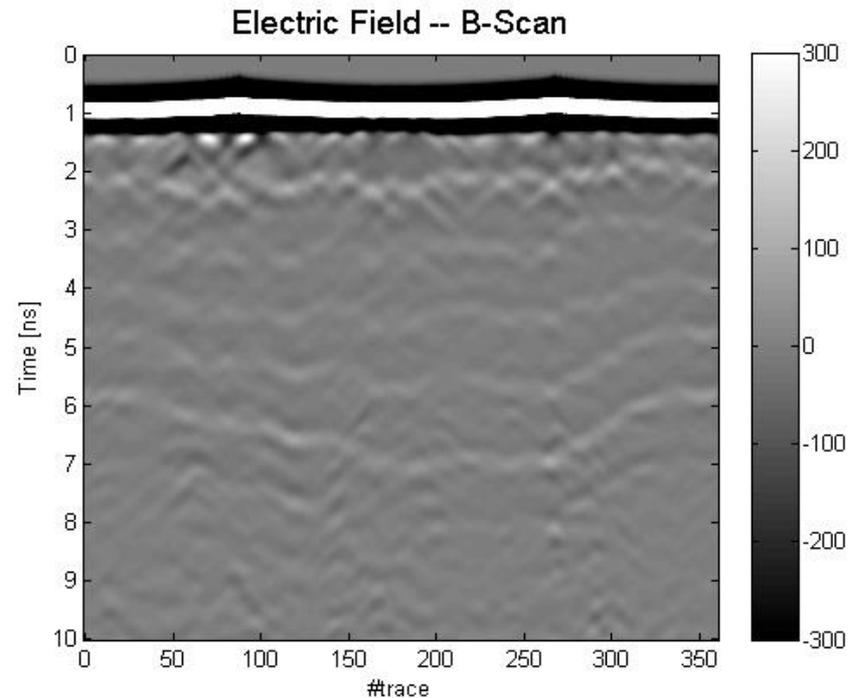
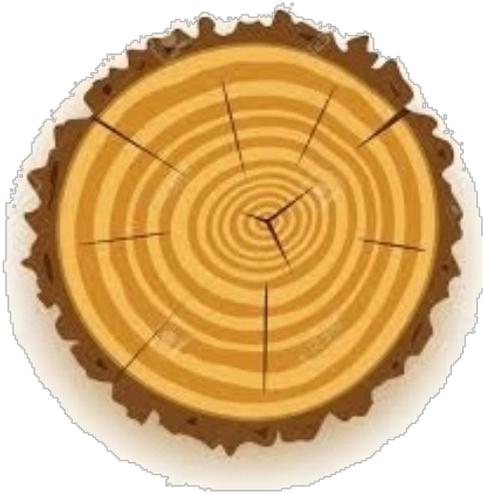


These are results at 1 GHz



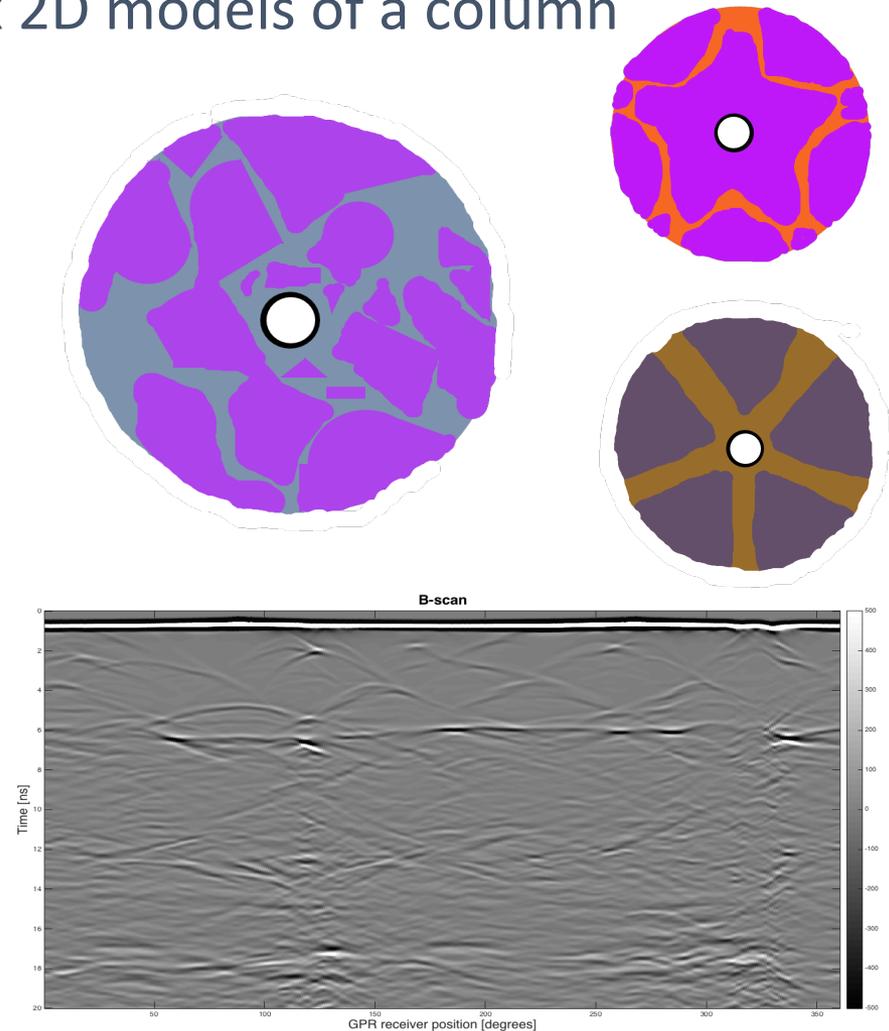
TU1208 database (synthetic)

- gprMax 2D model of a tree



TU1208 database (synthetic and experimental)

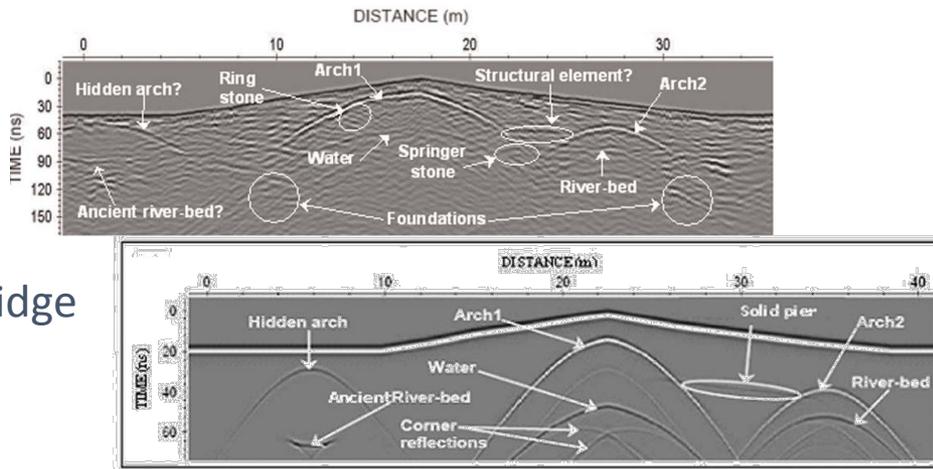
- experimental results and gprMax 2D models of a column



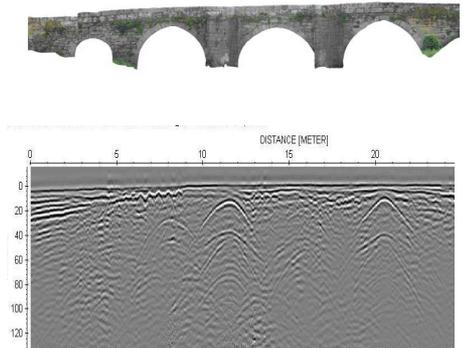
TU1208 database (synthetic and experimental)

- experimental results and gprMax 2D models of bridges

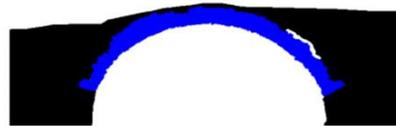
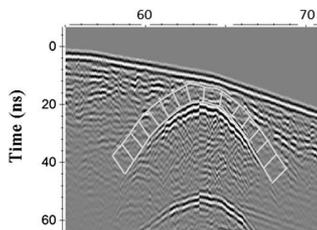
Sant'Anton bridge



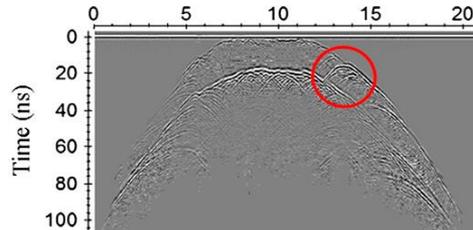
Traba bridge



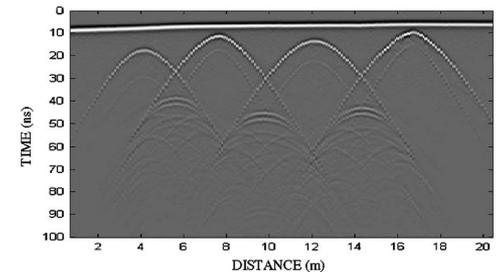
Distance (m)



Distance (m)



Monforte
bridge

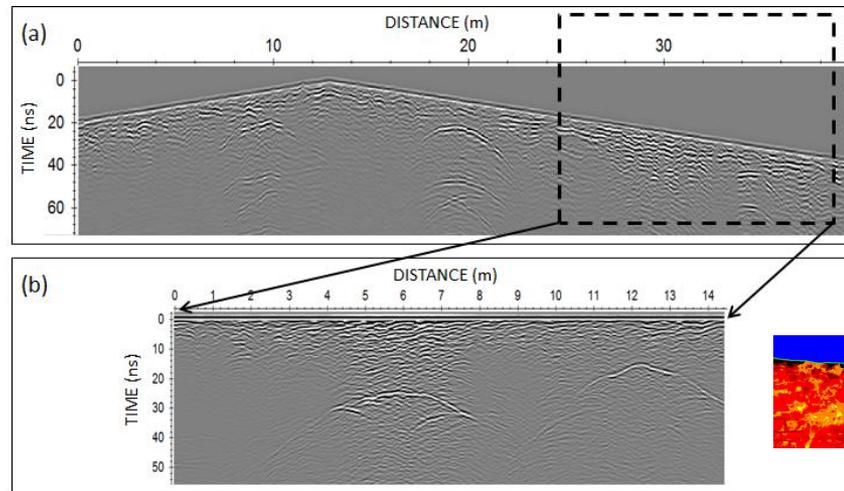


TU1208 database (synthetic and experimental)

- experimental results and gprMax 2D models of bridges



Lubians bridge



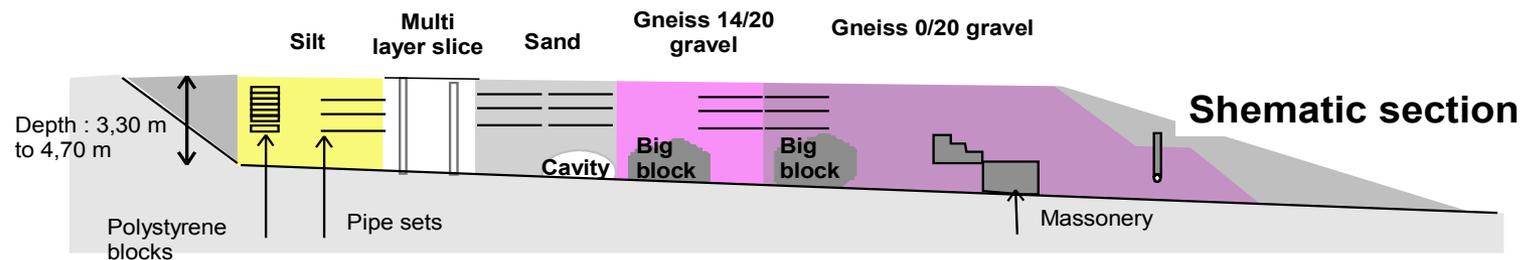
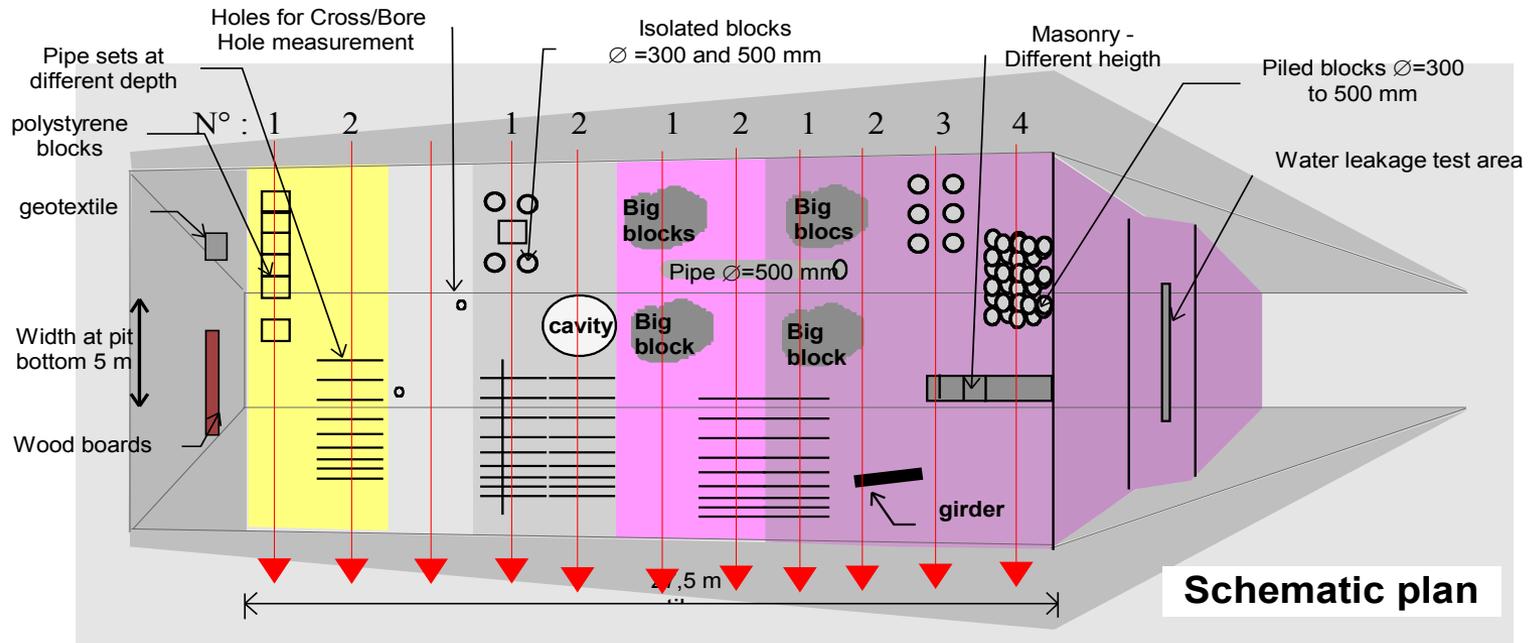
*real field data (a)
vs
synthetic data (b)*

*Simulation: gprMax
Processing: ReflexW.*



TU1208 database (synthetic)

- experimental results and gprMax 2D and 3D models of the IFSTTAR geophysical test site: the most complete dataset



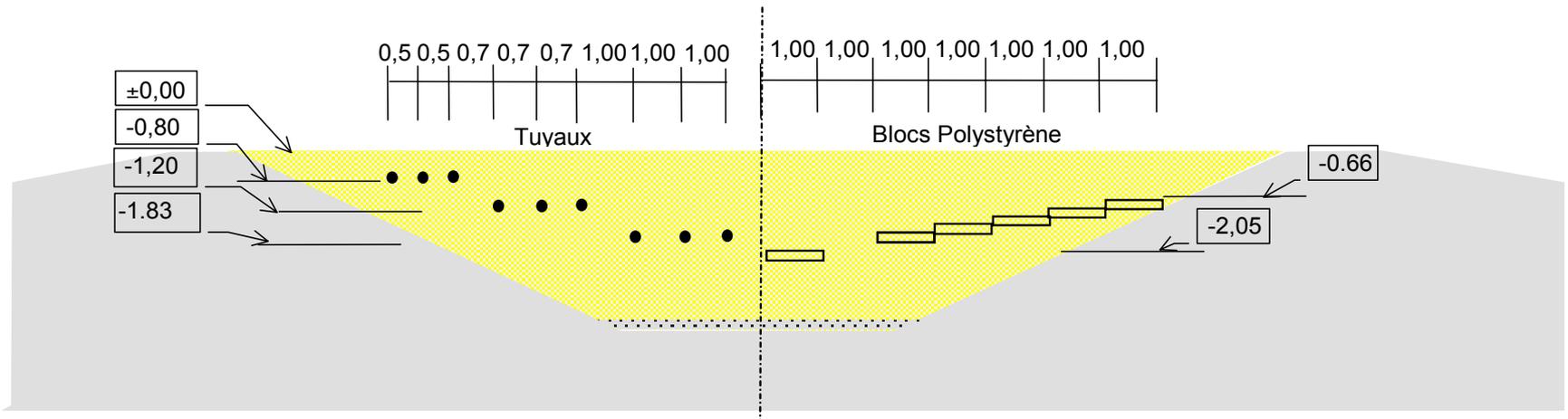
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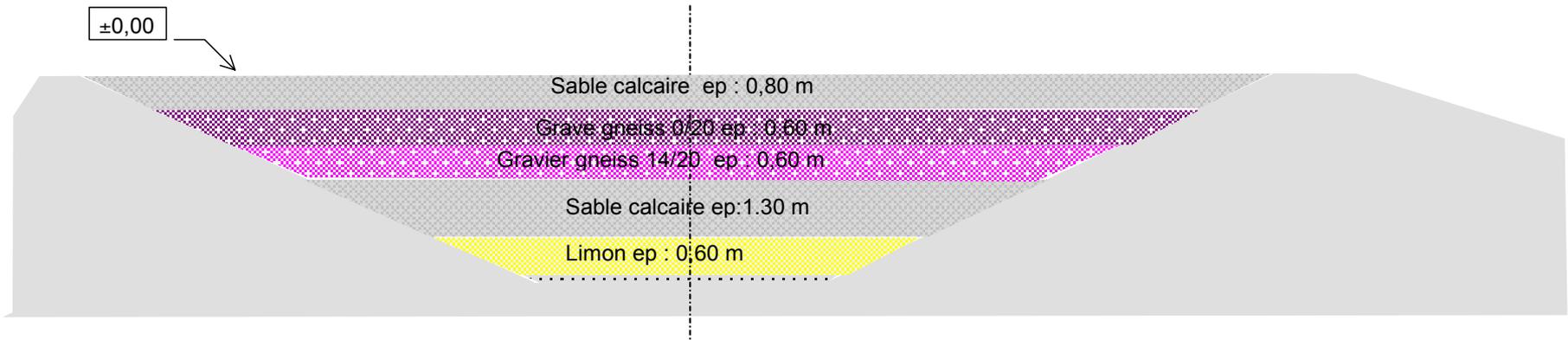


- 200 Mhz (lines 1 and 2)
- 250 MHz (line 1; two different GPR)
- 400 MHz (lines 1 and 2)
- 500 MHz (line 1; three different GPR)
- 800 MHz (line 1; two different GPR)
- 900 MHz (lines 1 and 2)



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- experimental results and gprMax 2D and 3D models of the IFSTTAR geophysical test site: the most complete dataset



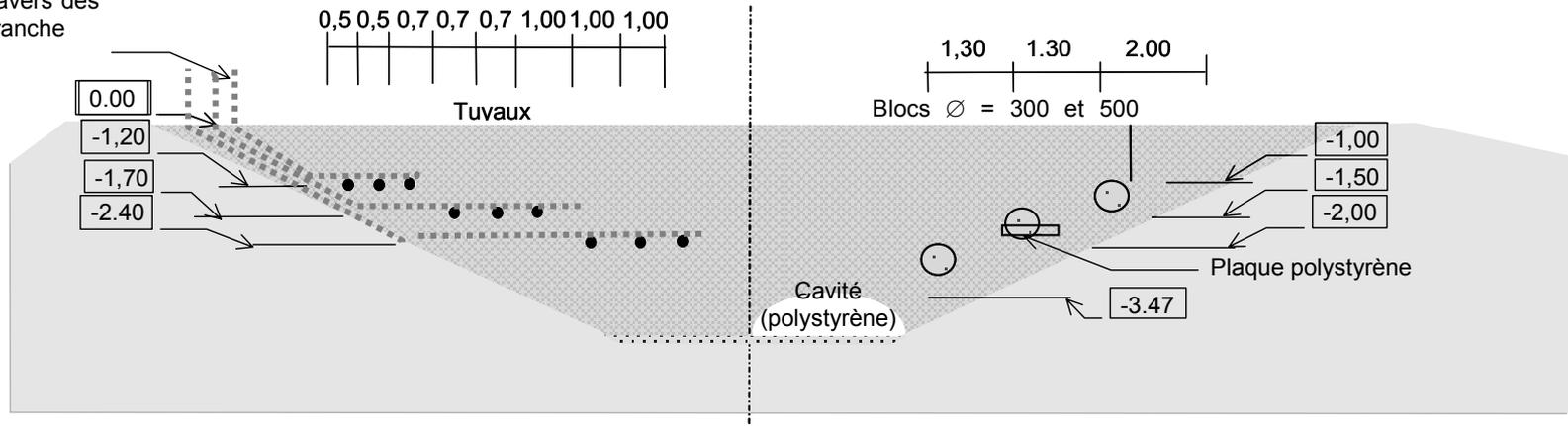
250 MHz (two different GPR)
400 MHz
500 MHz (two different GPR)
900 MHz (lines 1 and 2)



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- experimental results and gprMax 2D and 3D models of the IFSTTAR geophysical test site: the most complete dataset

Cable électrique en travers des tuyaux sur une demi tranche

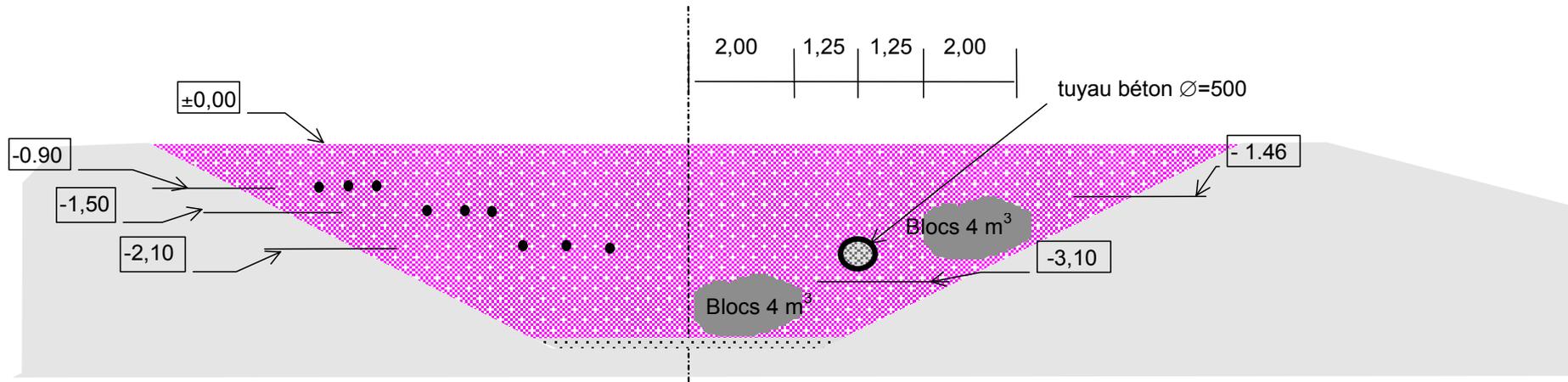


- 200 Mhz (line 2)
- 250 MHz (line 2; two different GPR)
- 400 MHz (lines 1 and 2)
- 500 MHz (line 2; two different GPR)
- 800 MHz (line 2; two different GPR)
- 900 MHz (lines 1 and 2)



TU1208 database (synthetic)

- experimental results and gprMax 2D and 3D models of the IFSTTAR geophysical test site: the most complete dataset



200 Mhz (line 2)

250 MHz (line 2; two different GPR)

400 MHz (line 1)

500 MHz (lines 1 and 2; two different GPR)

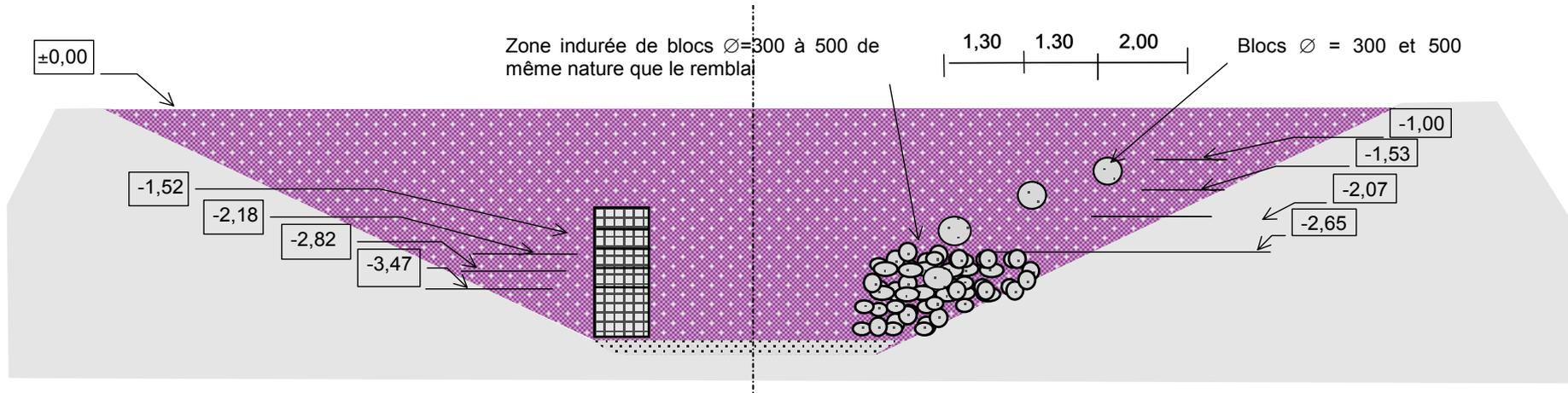
800 MHz (line 2; two different GPR)

900 MHz (lines 1 and 2)



TU1208 database (synthetic)

- experimental results and gprMax 2D and 3D models of the IFSTTAR geophysical test site: the most complete dataset



400 MHz (lines 3 and 4)

900 MHz (lines 3 and 4)





Thank you!

Join COST Action TU1208!

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lara.pajewski@uniroma1.it



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