Geophysical Research Abstracts
Vol. 13, EGU2011-7694-1, 2011
EGU General Assembly 2011

Comparison of 3D ground-penetrating radar simulations with measurements on the ASSESS-GPR test site

Jorrit Fahlke (1), Jens Buchner (2), Olaf Ippisch (1), Kurt Roth (2), and Peter Bastian (1)

(1) University of Heidelberg, Interdisciplinary Center for Scientific Computing, Heidelberg, Germany (jorrit@jorrit.de), (2) University of Heidelberg, Institute for Environmental Physics, Heidelberg, Germany (Jens.Buchner@iup.uni-heidelberg.de)

We present 3D simulations of ground-penetrating radar (GPR) measurements of a real-world setup. We use the wave equation of the electric field in the time-domain to model the physical problem. For discretization we use a finite-element time-domain (FETD) method with conforming edge-based finite elements. While finite-differences time-domain (FDTD) solvers are faster, the use of FETD allows us to resolve complicated structures and avoid staircase approximations. This way we can fit the finite element mesh to the layer structure of the experimental setup.

We gain real data from the ASSESS-GPR test site near Heidelberg, a 20 m x 4 m x 2 m body artificially packed with different sands. The architecture consists of several layers and includes different slopes and a wedge. The site is instrumented with an array of TDR-probes for local measurements of liquid water content and with a corresponding array of temperature-probes. At the lower boundary, a well-defined water table is maintained. Water flow is driven by natural rainfall and evaporation, monitored by an on-site weather station. The hydraulic dynamics of the site is simulated numerically such that the spatial structure of the dielectric permittivity is reasonably well known.

Finally, we compare the results obtained from the simulation with results obtained from real GPR measurements.

The software for the simulation has been developed using the Distributed and Unified Numerics Environment (DUNE) and its PDELab discretization module. This allowed us to write a uniform implementation for both 2D and 3D problems. The 3D-implementation has been parallelized using MPI to make computations of this size feasible.