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Three-dimensional high-resolution simulation of water transport on the field scale

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There is often a mismatch between simulations and observations of water transport in the vadose zone at the field scale which cannot be reduced by parameter estimation. This mismatch can be due to

1. measurement errors
2. spatial and temporal averaging of the measurement device
3. heterogeneity
4. a wrong effective process model.

A discrimination of the different reasons with experiments is hard to realize.

Assuming the validity of Richards' equation we create highly resolved three-dimensional virtual field soils which are "realistic enough" to test different measurement and optimisation approaches. A necessary precondition in our opinion is the inclusion of at least two orders of heterogeneity. We use the Bluegene/P type supercomputer JUGENE to simulate seasonal cycles for a $10 \times 10 \times 10$ m domain with an average resolution of 1 cm and hourly weather data using a cell-centred Finite-Volume scheme on a structured grid. The solver scales well and was tested with up to 1 billion elements on 4096 processors.