Geophysical Research Abstracts
Vol. 21, EGU2019-15482, 2019
EGU General Assembly 2019

Modeling numerical challenging problems of water flow in unsaturated, heterogeneous soil using the Method of Lines approach

Robert Mietrach and Niels Schütze

TU Dresden, Institute of Hydrology and Meteorology, Chair of Hydrology, Dresden, Germany
(robert.mietrach@tu-dresden.de)

The numerical method of lines (MOL) has already be shown to be an efficient and stable alternative for solving the mixed form of Richards' equation. In addition to its advanced capabilities in numerical challenging scenarios, MOL allows for an easier integration of additional differential equations, which proves advantageous where further processes should be included in the modeling.

In this work the DAE-MOL approach is used to solve the head-based Richards' equation. A finite differencing scheme is applied to the spatial derivative and the resulting system of ordinary differential equations is reformulated as differential-algebraic system of equations. The open source code IDAS from the Sundials suite is used to solve the DAE system.
Different one-dimensional benchmarks for numerical challenging problems were compiled from the literature and implemented successful using the DAE-MOL approach. The results show that the DAE-MOL approach is able to reproduce the published results, keeps mass conservation and is easy to implement without the need for problem specific adjustments such as non-linear transformation of the pressure head or modification of the solvers' iteration scheme. In some cases it proves to be more efficient yielding the same results while using a coarser spatial discretization.

The implemented DAE-MOL approach has been wrapped and is provided as Matlab and Python libraries with utilities for the definition of water flow problems in variable saturated soils, e.g. boundary conditions and source terms can be defined as time dependent functions with the ability to switch boundary conditions between pressure and flux type at any time.