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PARSWMS: a parallelized model for simulating 3-D water flow and solute transport in soils

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To investigate the relation between soil structures and flow and transport processes in heterogeneous soils, a 3-D description of the flow and transport process is necessary. However, 3-D numerical solutions of the Richards and CDE equations are very computationally demanding. In order to reduce the simulation time, the computational load can be distributed over several processors by parallelizing the numerical code. We parallelized the SWMS_3D code (Simunek et al., 1995) and investigated the gain in simulation time compared with the original version. The original code was reprogrammed in C++ in order to take advantage of the dynamic allocation of all variables whereas most of the subroutines, functions and variable names have been kept the same. The input file format was not changed and only small changes were made in the output file format so that input files can be generated using the GUI of Hydrus-3D. The numerical accuracy of the parallel version was tested by comparing simulations with analytical solutions of the flow and transport equations and with simulations performed with the original code. A set of pre-conditioners and a parallel Conjugate Gradient solver that can be selected in the model were tested for robustness and convergence using two model scenarios. The code is based on free-ware libraries and can be implemented on different computer architectures, including both supercomputers and LINUX clusters.

Simunek, J., Huang, K., and Van Genuchten, M.Th. 1995. The SWMS_3D code for simulating water flow and solute transport in three-dimensional variably-saturated media. Version 1.0. Research Report n°139, U. S. Salinity Laboratory. Agricultural Research Service. U.S. Department of Agriculture, Riverside, California.