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Version 3.01.1000 - May 1, 2018
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New Features and Changes (related to GUI):

1. Flowing particles in 3D projects
2. Streamlines
3. Graphical Manipulator
4. Clipping and Slicing
5. Velocity vectors in raster points
6. New options for Mesh-Sections and selection of mesh entities
7. Inactive objects
8. Named Views
9. Numbering of isolines
10. Export data to Paraview
11. Optimization and 64-bit version

New Features and Changes (related to computational modules):

1. Reservoir Boundary Condition
2. Expanded Root Growth Features

9. Time-variable internal pressure head or flux nodal sinks/sources (previously only constant internal sinks/sources).
10. Fluxes across meshlines in the computational module for multiple solutes (previously only for one solute).
11. HYDRUS calculates and reports surface runoff, evaporation and infiltration fluxes for the atmospheric boundary.
12. Water content dependence of solute reactions parameters using the Walker's [1974] formula was implemented.
13. An option to consider root solute uptake, including both passive and active uptake [Šimunek and Hopmans, 2009].
14. The Per Moldrup's tortuosity models [Moldrup et al., 1997, 2000] were implemented as an alternative to the Millington and Quirk [1960] model.
15. An option to use a set of Boundary Condition records multiple times.
16. Executable programs are about 1.5 - 3 times faster than in the standard version due to the loop vectorization.
17. A new CWM1 constructed wetland module (in addition to the CW2D module).
18. New options related to the fumigant transport (e.g., removal of tarp, temperature dependent tarp properties, additional injection of fumigant).

Fixed Errors:
1. Fixed error: The Wetland module had a wrong format statement when writing the CumQ.out file.
2. Fixed error: FE-mesh generation could fail if stretching factors were >1 and the domain boundary contained polylines and (at the same time) splines or arcs.
3. Fixed error: Activation energy coefficients in the temperature dependence functions were incorrectly converted when time units changed.
4. Fixed error: Unit conversion of the area associated with transpiration was incorrected when length units chanded.
5. Fixed error: Conversion of some first- and zero-order rate constants with respect to length units.

Support of ParSWMS

Three-dimensional applications often require a large number of finite elements to discretize realistically large transport domains. Even with the fast personal computers currently available, it is virtually impossible to solve within a reasonable computational time problems having more than about half a million nodes or more. To decrease the required computational time, Hardelauf et al. (2007) parallelized SWMS_3D to develop ParSWMS that distributes problems with a large number of elements over multiple processors working in parallel. SWMS_3D is the simplified predecessor of the 1.0 version of HYDRUS (2D/3D). While SWMS_3D simulates water flow and solute transport in three-dimensional domains, it does not consider some of the advanced features of HYDRUS, such as dual-porosity systems, hysteresis, and nonlinear and nonequilbrium solute transport. The ParSWMS code was developed for the LINUX or UNIX workstations using the installed free-wares MPI, PETSc and PARMETIS. Hardelauf et al. (2007) demonstrated that doubling the number of processors may decrease the computational time by up to nearly 50%.

An extended version of HYDRUS GUI supports fully ParSWMS. It allows users to create the three-dimensional flow and transport project in HYDRUS GUI and then save it using the format of ParSWMS input files. These input files can then be taken to a parallelized platform (a supercomputer or a cluster of PCs), on which ParSWMS can be run. Created output files can then be copied back to a PC with HYDRUS GUI, which will convert ParSWMS-created output files into the HYDRUS format. The results can then be analysed in HYDRUS GUI using all its graphical tools and confort.

Šimůnek, J., K. Huang, and M. Th. van Genuchten. 1995. The SWMS_3D code for simulating water flow and solute transport in three-dimensional variably saturated media. Version 1.0, Research Report No. 139, U.S. Salinity Laboratory, USDA, ARS, Riverside, California, 155 pp

Hardelauf, H., M. Javaux, M. Herbst, S. Gottschalk, R. Kasteel, J. Vanderborght, and H. Vereecken. 2007. PARSWMS: a parallelized model for simulating 3-D water flow and solute transport in variably saturated soils. V Zone Journal, 6(2):255-259.

Support of UNSATCHEM

The geochemical UNSATCHEM module (Simunek and Suarez, 1994; Šimůnek et al., 1996) has been implemented into the two-dimensional computational module of the HYDRUS (2D/3D) software package. The geochemical UNSATCHM module simulates the transport of major ions in variably-saturated porous media, including major ion equilibrium and kinetic non-equilibrium chemistry. The resulting code is intended for prediction of major ion chemistry and water and solute fluxes in soils during transient flow. The major variables of the chemical system in UNSATCHEM-2D are Ca, Mg, Na, K, SO4, Cl, NO3, H4SiO4, alkalinity, and CO2. The model accounts for various equilibrium chemical reactions between these components, such as complexation, cation exchange and precipitation-dissolution. For the precipitation-dissolution of calcite and dissolution of dolomite, either equilibrium or multicomponent kinetic expressions can be used, which includes both forward and back reactions. Other dissolution-precipitation reactions considered include gypsum, hydromagnesite, nesquehonite, and sepiolite. Since the ionic strength of soil solutions can vary considerably in time and space and often reach high values, both the modified Debye-Hückel and the Pitzer expressions are incorporated into the model to calculate single ion activities. The effect of solution chemistry on the hydraulic conductivity is also considered. Water flow and heat transport modules are similar (almost identical) as in regular HYDRUS. Application of the UNSATCHEM module is demonstrated on several examples.

Šimůnek, J., and D. L. Suarez, Two-dimensional transport model for variably saturated porous media with major ion chemistry, Water Resour. Res., 30(4), 1115-1133, 1994.

Šimůnek, J., D. L. Suarez, and M. Šejna, The UNSATCHEM software package for simulating one-dimensional variably saturated water flow, heat transport, carbon dioxide production and transport, and multicomponent solute transport with major ion equilibrium and kinetic chemistry, Version 2.0, Research Report No. 141, U.S. Salinity Laboratory, USDA, ARS, Riverside, California, 186 pp., 1996.

Walker, A., A simulation model for prediction of herbicide persistence, J. Environ. Quality, 3(4), 396-401, 1974.