Review of HYDRUS-2D

*by **Scott Tyler, Ph.D.** – University of Nevada, Reno*

HYDRUS-2D is a fully interactive water, solute and heat transport, finite-element solver for unsaturated and saturated porous media. The code and associated GUI is widely used by researchers and professionals to solve a broad range of vadose zone problems. It is a particularly valuable learning tool, allowing more and more complex processes and problems to be incorporated when used in a semester-long course in soil physics or vadose zone hydrology. The underlying transport equations are written with sufficient breadth to allow investigation of the majority of processes governing transport in unsaturated media. The code can accommodate a wide range of boundary conditions including a robust precipitation/transpiration/root uptake simulator, making it applicable to "real world" simulations.

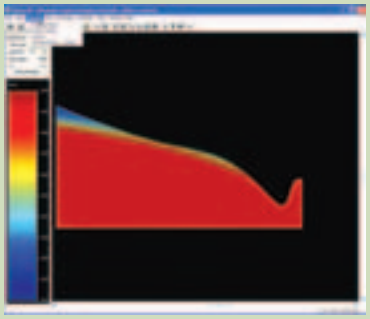
Water flow is represented using Richards' equation, and users can specify hydraulic properties using default parameterization, neural network algorithms, or the Van Genuchten or Brooks/Corey functions. Hysteresis can be specified in both the retention and conductivity functions. Hydraulic properties can be a function of temperature via temperature-dependent viscosity and surface tension relationships. The solute and heat transport portions of the code are governed by the advection-dispersion equation (solute) and convection-dispersion equation (heat). Mobile/immobile solute transport can be simulated, as can solute diffusion in the gas phase. Reactive transport is simulated using either linear or nonlinear user-defined isotherms.

Two-dimensional finite element grids can be generated using a regular or unstructured grid generator, making the solution of complex geometries simple and efficient. The grid generator is easy to use and the mesh can be refined quickly in areas of steep moisture or solute gradients. The numerical stability of the solution algorithms is maintained through automatically adjusted time stepping, but can also be defined by the user. The code includes an inverse algorithm for estimating hydraulic/solute/heat transport properties from observed laboratory or field data.

The graphical user interface walks the user through the necessary input steps, making the code easy to use. In addition to test cases included with the software, technical support, short courses, and a book of excellent examples of HYDRUS-2D applications are available. HYDRUS-2D packaged with MESHGEN can be purchased from the International Ground Water Modeling Center, with single user licenses beginning at $1,200.

Visit www.mines.edu/igwmc/software/igwncsoft. Contact Scott Tyler at www.ag.unr.edu/nres/directory/Tyler.htm.

HYDRUS-2D Software Review . . . . . .



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Ease of Use:
GUI:
Application:
Output/Plotting:
Documentation:
Speed:
OVERALL RATING:

Best Feature:
General formulation of transport equations allowing a wide range of transport problems to be investigated. In addition, the available boundary conditions represent most of the commonly found "real world" conditions, also, domain generator.

Worst Feature:
While the inversion algorithms are very good, the limited diagnostics and guidelines on inverse applications may frustrate some users initially.

Rating System for graphics:

- Excellent
- Very Good
- Good
- Satisfactory
- Poor

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