SYLLABUS
GEOL/NRES 784
VADOSE ZONE HYDROLOGY

INSTRUCTOR: Dr. Scott Tyler; 784-6250; styler@unr.edu
TIME: 11-12:15
ROOM: LME 415
PREREQUISITES: Soil Physics or Equivalent
RECOMMENDED TEXTBOOK: Jury and Horton, Soil Physics;
Soil Physics with HYDRUS; Radcliff and Simunek.

COURSE OUTLINE (Tentative)

WEEK 1	Discussion of capillary forces, water retention functions for field soils Introduction to modeling with HYDRUS-1D
WEEK 2	Hydraulic conductivity functions for field soils; Introduction to Swiss Lysimeter Data
WEEK 3	Development of flow equation (Richards') for water
WEEK 4	Numerical analysis of one and two-dimensional flow
WEEK 5	Analytical solutions to the flow equation
WEEK 6	Field techniques for estimating hydraulic properties
WEEK 7	Hysteresis
WEEK 8	Scaling and spatial variability in field soils
WEEK 9	Problems of heat, vapor and gas transport in field soils (MID-TERM EXAM)
WEEK 10	Diffusion and dispersion in soils
WEEK 11	Development of contaminant transport equation in field soils
WEEK 12	Ground-water recharge estimation techniques, Chloride and Nitrogen in arid soils
WEEK 13-14	Contaminant transport in soils at the field scale with numerical methods
WEEK 15	Reactive transport in the Vadose Zone

INSTRUCTIONS FOR HYDRUS-1D

Throughout the course, we will be using the 1D flow and transport solver HYDRUS-1D. The code is described below:

HYDRUS-1D is 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. The software is a particularly valuable teaching tool, allowing more and more complex processes and problems to be incorporated through a semester-long course in soil physics or vadose zone hydrology. The underlying transport equations are written sufficiently broadly to allow the 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 very appropriate for "real world" simulations.

The water flow is governed by Richards' equation, and the operator is able to specify hydraulic properties using default parameterization, neural network algorithms or user specified parameters in either the Van Genuchten or Brooks and Corey functions. Hysteresis in both the retention and conductivity functions. The hydraulic properties can also be dependant upon temperature through temperature dependant viscosity and surface tension. The solute and heat transport portions of the code are governed by the advection (solute), convection (heat) dispersion equation. Mobile/immobile solute transport as well as solute diffusion in the gas phase can also be simulated. Reactive transport can be simulated using either linear or non-linear user-define isotherms.

One dimensional finite element grids can be generated in regular or specified spacing. The numerical stability of the solution algorithms is automatically adjusted through automatic time stepping, but can also be refined by the user. The code also includes an inverse algorithm for prediction of hydraulic/solute/heat transport properties from observed laboratory or field data.

INSTRUCTIONS FOR DOWNLOADING

1. Go tohttp://www.pc-progress.cz/ and follow the links to the download (http://www.pc-progress.com/en/Default.aspx?H1d-downloads) and get HYDRUS-1D and uers manual.
2. Complete the authorization information and download.
3. Get the latest version of H1D 4 16, this is version 4 and has lots of features. Also get the manual for version 4.08
4. I also suggest downloading some of the public library of projects. http://www.pc-progress.com/en/Default.aspx?h1d-library and tutorials http://www.pc-progress.com/en/Default.aspx?h1d-tutorials.
5. The textbook, Soil physics with Hydrus is a welcome help and we will be referring to it. http://www.pc-progress.com/en/Default.aspx?h3d-book