Workshop on Hydrus

PC-Based Modeling of Water Flow and Contaminant Transport in the Vadose Zone and Groundwater

Fresno, California
December 10-11, 2004

Invited Instructors
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Jirka Simunek

Co-Sponsored by
Department of Earth and Environmental Sciences
College of Science and Mathematics

Division of Continuing and Global Education
California State University, Fresno

Overview

Soil and groundwater pollution is an ever-increasing, worldwide problem. Tens of billions of dollars are spent each year to remediate groundwater pollution, and to limit or prevent future contamination of the subsurface. Most subsurface pollution problems stem from activities involving the unsaturated (vadose) zone between the soil surface and the groundwater table. Consequently, the unsaturated zone provides the best opportunities to limit or prevent groundwater pollution. Once contaminants enter the saturated zone, remediation costs increase substantially.

Numerical modeling is becoming an increasingly important tool for analyzing complex problems involving water flow and contaminant transport in the unsaturated zone. This workshop is designed to familiarize participants with the principles and numerical analysis of variably-saturated flow and transport processes, and the application of state-of-the-art numerical codes to site-specific subsurface flow and transport problems.

This workshop is intended for individuals with basic flow and/or transport modeling experience. It has been organized by Dr. Zhi "Luke" Wang.

Workshop Location

The workshop will be held at California State University, Fresno, which is located in the beautiful central valley of California and surrounded by the Yosemite, Kings Canyon and Sequoia national parks. This workshop is scheduled two days before the start of 2004 Fall Meeting of American Geophysical Union (13-17 December 2004 in San Francisco) so that some participants can attend both meetings.

Workshop Description

The course begins with a detailed conceptual and mathematical description of water flow and solute transport processes in the vadose zone, followed by an overview of the use of finite element techniques for solving the governing flow and transport equations. Special attention is given to the highly nonlinear nature of the governing flow equation. Alternative methods for describing and modeling the hydraulic functions of unsaturated porous media are also described. "Hands-on" computer sessions will provide participants an opportunity to become familiar with the Windows-based RETC, STANMOD, HYDRUS-1D and HYDRUS-2D software packages. Emphasis will be on the preparation of input data for a variety of applications, including flow and transport in a deep vadose zone, nonlinear nonequilibrium solute transport, variably-saturated flow through a dam, flow and transport to a tile drain, and two-dimensional leachate migration from a landfill through the unsaturated zone into groundwater. Calibration will be discussed and demonstrated using both one-and two-dimensional model inversion.

Workshop Handouts

Course handouts include lecture notes prepared by the instructors, documentation of the RETC and STANMOD codes (including the software), and documentation of the HYDRUS-1D and HYDRUS-2D numerical models.

www.csufresno.edu/ees/HYDRUS

SOFTWARE

The course introduces a new generation of Windows-based numerical models for simulating water flow and solute transport in variably-saturated porous media. Two numerical models (HYDRUS-1D and HYDRUS-2D for one- and two-dimensional simulations, respectively) will be available during the course. Both models are supported by interactive graphics-based interfaces for data-preprocessing, generation of unstructured as well as structured finite element grid systems, and graphic presentation of the simulation results. The Windows-based versions of the RETC (for quantifying the hydraulic functions of unsaturated soils) and STANMOD (for evaluating solute transport in the subsurface using analytical solutions of the convection-dispersion equation) codes will also be demonstrated in the course. The RETC code will be provided to all participants.

INSTRUCTORS

Dr. Martinus Th. van Genuchten is a soil physicist with the George E. Brown, Jr. Salinity Laboratory, USDA, ARS, Riverside, CA. He received a B.S. and M.S. in irrigation and drainage from the Agricultural University of Wageningen, The Netherlands, and a Ph.D. in soil physics from New Mexico State University. He has published widely on variably-saturated flow and contaminant transport processes in the subsurface, analytical and numerical modeling, nonequilibrium transport, preferential flow, characterization and measurement of the unsaturated hydraulic functions, and root-water uptake.

Dr. Jirka Simunek is a professor of hydrology in the Department of Environmental Sciences, University of California, Riverside. He received an M.S. in Civil Engineering from the Czech Technical University, Prague, Czech Republic, and a Ph.D. in Water Management from the Czech Academy of Sciences, Prague. His expertise is in numerical modeling of subsurface water flow and solute transport processes, equilibrium and nonequilibrium chemical transport, multicomponent major ion chemistry, field-scale spatial variability, and inverse procedures for estimating the hydraulic properties of unsaturated porous media.

WORKSHOP OUTLINE

Friday, December 10, 2004

8 – 9 a.m.	Continental breakfast
9 – 9:30 am.	Registration
9:30 a.m.	Friday session begins
10 – 10:15 a.m.	Break
12 noon – 1:15 p.m.	Lunch (included in fee)
3 – 3:15 p..m.	Break
5 p.m.	Friday session concludes

Lecture 1: Conceptual and mathematical description of variably-saturated water flow and solute transport processes, root-water uptake, nonequilibrium transport, decay chains, initial conditions, boundary conditions;

Lecture 2: Analytical modeling of solute transport in the subsurface, equilibrium and nonequilibrium transport models, parameter estimation.

Computer session 1: Modeling subsurface solute transport using the STANMOD code; direct and inverse applications.

Lecture 3: Review of the hydraulic properties of unsaturated porous media; measurement, description, parameter estimation.

Computer session 2: Analyzing/estimating hydraulic properties with the RETC and Rosetta codes.

Lecture 4: Review of numerical methods for solving the variably-saturated water flow and solute transport equations; Application of finite element method to 1D flow and transport; The HYDRUS-1D software package - model structure and examples.

Computer session 3: Application of HYDRUS-1D to simple one-dimensional problems.

Saturday, December 11, 2004

8 – 9 a.m.	Continental breakfast
9 a.m.	Saturday session begins
5 p.m.	Saturday session concludes

Lecture 5: Inverse modeling; application of HYDRUS-1D to laboratory and field experiments.

Computer session 4: Advanced one-dimensional forward and inverse problems with HYDRUS-1D.

Lecture 6: Application of finite element method to 2D variably-saturated water flow and solute transport; The HYDRUS-2D software package - model structure, examples; Pre-and post-processing with HYDRUS-2D using the finite element mesh generator.

Computer session 5: Application of HYDRUS-2D to simple one-dimensional problem.

Computer session 6: Application of HYDRUS-2D to simple two-dimensional problem.

Computer session 7: Application of HYDRUS-2D to complex two-dimensional problem A.

Computer session 8: Application of HYDRUS-2D to complex two-dimensional problem B.

General session: Other applications; discussion

REGISTRATION FORM

PC-BASED MODELING OF WATER FLOW AND CONTAMINANT TRANSPORT IN THE VADOSE ZONE AND GROUNDWATER

DECEMBER 10 – 11, 2004

Name _____

Social Security/CSUF ID _____

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Fee: $350 non-credit, Class No. 84088

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