Introduction to Groundwater Flow & Transport Modeling with Groundwater Vistas

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Instructor:

Jim Rumbaugh

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Location:

Marriott Courtyard/Valley Forge-King of Prussia

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Cost

$1,200

Cost includes lunch each day
Participants are asked to bring a laptop computer*
Contact Jim Rumbaugh (see above) to Register
Limited to 12-14 participants

**If you cannot bring a laptop computer, contact Jim Rumbaugh as soon as possible to arrange for a computer.*

Instructor Bio:

Jim Rumbaugh, hydrogeologist and groundwater modeler, has over 25 years of experience in application of groundwater models and in development of groundwater modeling software tools. He is the co-author of the Groundwater Vistas software and is President of Environmental Simulations, Inc., a company that specializes in groundwater modeling. Jim is an active member of the American Society for Testing and Materials (ASTM) where he is a past Chairman of ASTM Subcommittee D18.21 on Groundwater and Vadose Zone Investigations. Subcommittee D18.21 was funded by U.S. EPA to develop standards for groundwater modeling practice. Jim was honored by the National Ground Water Association with the 1999 John Hem Excellence in Science and Engineering Award by NGWA. This award is given to those who have made a significant, recent scientific or engineering contribution to the understanding of groundwater. Jim teaches groundwater modeling seminars throughout the USA, Europe, Australia, and New Zealand. The Australia and New Zealand seminars are co-taught with John Doherty, author of the PEST calibration software.

Registration:

To register for this seminar, simply send Jim an email at **JRumbaugh@GroundwaterModels.com,** give us a call at (610) 670-3400, or pay by credit card on our web site at www.groundwatermodels.com and click Online Store. Invoices will be sent out approximately 6 weeks prior to the course date. Payment can be by check, credit card, or wire transfer to our bank.

The course is limited to 12 to 14 attendees.

Other Notes:

- Lunch will be provided each day. Please let us know if you have special dietary needs at least 2 weeks prior to the course.

- Please bring a laptop computer to the seminar. If you do not have a license for Groundwater Vistas on the laptop, we will provide a temporary license for the seminar. If you cannot bring a laptop, please let us know and we will provide one for you. Groundwater Vistas Version 5 will be used in the seminar, along with the latest version of PEST.

- You are welcome to bring project work with you to try these modeling techniques on a model that is familiar to you.

- For financial reasons, we do not arrange for a special block of rooms at the hotel. The seminar will be at the Courtyard Marriott Hotel near Valley Forge, PA and there are lots of other hotels nearby if you prefer to stay elsewhere.

- The seminar starts at 9 am the first day. On the last day, the last lecture ends around 3 pm. From 3 to 5 pm on the last day, you are free to work on seminar computer exercises or head to the airport if you have an early flight.

Course Description:

Introduction to Groundwater Modeling using ESI Groundwater Vistas Software

The Introduction to Groundwater Modeling seminar taught by James Rumbaugh of Environmental Simulations, Inc. is designed for beginning and intermediate level modelers. The course covers the basics of groundwater modeling using ESI's Groundwater Vistas software. The course is divided into lecture and hands-on computer exercises. Time is about evenly split between the two activities. The following is a detailed description of the course contents.

Length of Course: 3 days

DAY ONE

Lecture 1:
Groundwater Modeling Protocols

The first lecture is an overview of the modeling process, as described in ASTM's Standard D5447-93 for application of a groundwater flow model to a site-specific problem. A brief description of each modeling step from conceptualization through calibration and predictive simulations is presented. Each step will be described more fully in later lectures.

Lecture 2:
Introduction to GV & MODFLOW$_{win32}$

MODFLOW is the most widely used groundwater flow model in the world. There are many different versions available commercially. The lecture describes both MODFLOW in general and ESI's version, MODFLOW$_{win32}$, in particular. The lecture also introduces Groundwater Vistas (GV), ESI's Windows environment for numerical modeling. GV allows users to design models interactively, run the models, and view the results.

Computer Exercise 1a:
Introduction to MODFLOW$_{win32}$ and Groundwater Vistas

Participants will design a simple 3D model using GV, run the model with MODFLOW$_{win32}$, and contour the results. GV is a general modeling environment for Microsoft Windows that supports several models, including MODFLOW, MODPATH, and MT3D. The software is both a preprocessor and postprocessor and provides a seamless interface to the supported models. The new MODFLOW2000 will also be discussed.
Lecture 3:

MODFLOW Versions and Features

There are so many versions of MODFLOW now that using it has become more complex. This lecture describes all of the new versions of MODFLOW, how they differ, and explains some of the new packages developed by the USGS.

Computer Exercise 1b:
Introduction to MODFLOW and Groundwater Vistas

This exercise continues from the first exercise. The example model is used to illustrate particle-tracking and concepts of model calibration. An introduction to contaminant transport modeling and transient flow modeling is also provided.

DAY 2

Lecture 4:
Designing Models Part 1

The first part of designing groundwater models focuses on grid design (both horizontally nd vertically), as well as assigning aquifer properties. Tips are provided on how to design an efficient grid without getting overly complex.

Computer Exercise 2a:
Designing Groundwater Models

This exercise illustrates the effect that boundary conditions have no model predictions and model calibration. A simple model is constructed using three different types of boundary conditions. Under no stress, each model yields the same flow field. When stressed with a pumping well, however, the models give very different predictions.

Lecture 5:
Designing Models Part 2

Following from the computer exercise, a discussion of model boundary conditions is presented, including a strategy for proper selection of model boundaries. The lecture also addresses the use of GIS in model design and strategies for transient flow analysis.

Computer Exercise 2b:
Designing Groundwater Models

A real-world 3D groundwater model is constructed. The exercise illustrates how information is imported from a GIS, how to manipulate rows, columns, and layers in the grid, and how to assign boundary conditions and properties in a more complex model.

Lecture 6:
Interpretation of MODFLOW & MODPATH Simulations

Once a model has been run there are many ways of interpreting the results. This lecture shows the many features in Groundwater Vistas for displaying results, making calculations, making figures for reports, creating customized reports, and visualizing results in 3D.

Computer Exercise 3:
Particle Tracking and Special Problems in Modeling

Exercise 3 is broken into two parts. In the first part, the model created in Exercise 2b is used with MODPATH in a particle-tracking analysis. The second part then uses the same model to evaluate impacts from mining and from water supply development.

Lecture 7:
Model Calibration

Model calibration is one of the most important steps in the modeling process. The lecture presents a structured approach to calibration that saves time and generally produces the best possible match between model results and field measurements. Both trial-and-error and automatic methods of calibration are presented. Sensitivity analysis, a key part of the calibration process, is described in detail.

Computer Exercise 4:
Model Calibration

An example model is calibrated using automated sensitivity analysis and inverse techniques. Both MODFLOW2000 and Pest are used to illustrate how inverse models can be useful tools in calibrating models.

DAY 3

Lecture 8:
Contaminant Transport

This lecture covers the fundamental issues of contaminant transport modeling. Topics include dispersion, chemical reactions, biologic decay, and numerical problems with transport models. The U.S. EPA model MT3D is also discussed as this is the most widely used transport model in this country.

Computer Exercise 5:
Contaminant Transport at the Example Site

Participants are asked to determine whether contamination on the example site could impact a nearby well field under various conditions. If the well field could be impacted, the students are instructed to design a remediation system that will mitigate this impact. This exercise uses the MT3D contaminant transport model.

Lecture 9:
Modeling for Remediation Design

The last lecture focuses on the techniques used in modeling to simulate remediation systems. Systems that are readily modeled include pump & treat, caps, slurry walls, natural attenuation, phyto-remediation, and reactive walls. Other more complex types of remediation systems will also be covered. The Brute Force optimization technology will also be discussed.

Lecture 10:
Case Study and General Discussion

The last lecture presents a case study to tie all of the course information together. There is also an opportunity for discussing other topics not covered in the course that are of interest to attendees.

Computer Exercise 6:(Remaining Time)
Free Time to Finish Exercises