Schlumberger
WATER SERVICES

Who should attend this course?

This course will be of interest to any environmental professional interested in developing models or regulating modeling activities. The range of topics covered in the course will provide the novice modeler with the ability to start a new project, swsle the advanced topics covered will provide experienced professionals with insight into better modeling practices.

When do I register?

Register now and take advantage of the **Early Registration Special**. Register 3 months prior to the course date and receive a $100 USD discount!

How do I register?

- Register online at: **www.swstechnology.com** Click on **Training** and **Register Now**.
- Or complete the registration form on the back and fax it to us!

Can't make the Course?

Contact us about our "ON-SITE Custom Training" program. We're ready to deliver any one of our popular courses or tailor the course topics to address your specific organizational needs!

Questions? Contact Us!

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Course Objectives

From hands-on experience, you will learn...

- Apply Visual MODFLOW to 3D groundwater flow and contaminant transport projects
- Use MODFLOW to develop several simple to complex groundwater flow models using hands-on laboratory exercises
- Integrate GIS data directly into your Visual MODFLOW model
- Calibrate flow and transport models to observed field data
- Use MODPATH to model 3-D particle tracking for capture zone delineation
- Use ZoneBudget to assess sub-regional water budgets within the model domain
- Use RT3D, MT3DMS and MT3D99 to simulate 3-D reactive transport
- Use WinPEST to improve model calibration and assess uncertainty ZoneBudget
- 3D Visualization of model input and results

Course Schedule *Note: Breaks & lunches are not listed*

Day 1

Lecture: Introduction to Groundwater Modeling
Exercise: Intro: An Introduction to Visual MODFLOW
Lecture: How to Build a Model
Exercise: Intro: an introduction to Visual MODFLOW
Lecture: Insights into GIS Analysis for Modeling
Exercise: Open Pits: Transient MODFLOW modeling

Day 2

Lecture: Principles of USGS MODFLOW
Exercise: Open Pits: Transient MODFLOW modeling
Lecture: Principles of MODPATH
Exercise: 3DCap: Capture Zone Modeling
Lecture: Principles of ZoneBudget
Exercise: Drumco: Contaminant Plume Remediation

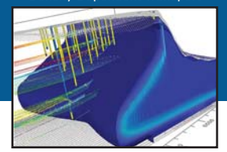
Day 3

Lecture: Principles of Solute Transport Modeling
Exercise: Drumco: Contaminant Plume Remediation
Lecture: Principles of SEAWAT
Exercise: Saltwater: SEAWAT simulations
Lecture: Pumping Well Optimization
Exercise: MGO: Optimizing Well Performance

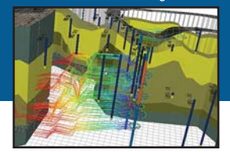
Day 4

Demo: Intro to Model Calibration using WinPEST
Lecture: Theoretical Approaches to Model Calibration
Exercise: Valley - Calibrating a Transient Flow Model
Lecture: Interpreting Calibration Results Course
Exercise: Emcan - Contaminant Boundary Choices

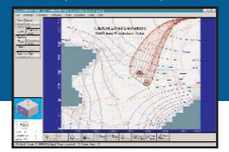
Density Dependent Transport



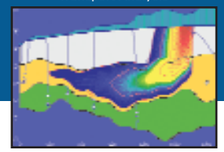
Particle Tracking



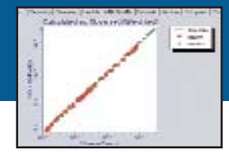
Capture Zone Analysis



Transport Analysis



Automated Calibration



Applied Groundwater Flow & Contaminant Transport Modeling

This 4-day applied groundwater modeling course was designed to present the theory behind MODFLOW, MODPATH, MT3D, Zonebudget, SEAWAT, and WinPEST, and to illustrate the practical development of groundwater flow and solute transport models using Visual MODFLOW. This course introduces the modeling process including conceptual model development, numerical model implementation, model calibration and the presentation of model results. It alternates between lectures and laboratory exercises to illustrate the ease of using Visual MODFLOW. New exercises have been developed to show the attributes and usefulness of MODFLOW in conjunction with MT30, RT30 and SEAWAT. We also use WinPEST to perform automated parameter estimation to evaluate the quality of model calibration.

Groundwater Model Development

The first step in model development is the conceptualization of the groundwater flow system. Simple GIS data analysis is used to illustrate the 3-dimensional representation of the data needed to develop the numerical model. The data is interpolated and exported from GIS, and then imported and interpreted in Visual MODFLOW. Model parameter distributions, boundary conditions and field-observations are assigned in Visual MODFLOW to complete the model development process. MODFLOW, MODPATH, MT3D and ZoneBudget are run to make predictions of groundwater flow and solute transport within the model domain.

Course Topics

- Fundamental concepts and theory of MODFLOW, MODPATH, MT3D, ZoneBudget, SEAWAT, and WinPEST
- Principles of the modeling process – data collection, model development, model calibration and prediction of results
- Conceptual model development using borehole data, cross-sections & aquifer test analysis
- Fundamentals of groundwater flow modeling
- Basic principles of finite difference grid design, refinement and optimization
- Setting appropriate boundaries for developing a defensible groundwater model
- Particle tracking, pathline analysis and wellfield capture zone delineation
- Sub-regional water budget analysis using ZoneBudget
- Contaminant transport modeling using MT3D and RT3D
- Saltwater intrusion modeling using SEAWAT
- Calibration and verification of 3D flow and transport models
- Tools to help decide how well a model is calibrated
- Theory of automated parameter estimation, and interpreting calibration results using PEST
- 3D Visualization of model input and results

Contaminant Transport Model Predictions

Contaminant tranpsort modeling is based on the mechanisms of advection, dispersion, sorption and reaction. In this course, we provide an overview of these mechanisms, the parameters needed to model them, and the process of natural attenuation that impacts solute transport within the groundwater flow system. Hands-on exercises will show the use of different transport boundaries to illustrate their impact on predicted concentrations.

The course goes beyond these introductory topics and provides advice on how to choose appropriate parameter distributions and model boundaries to develop defensible groundwater models. Attendees will gain a more complete understanding of the integration of GIS in the model development process. Groundwater resource applications that are covered include model calibration to heads and flows, new well development, capture zone delineation, well interference assessment, well optimization and stream impact investigations. Contaminant transport topics include transport model development, model calibration to contaminant concentrations, source area design, choice of appropriate concentration boundary conditions, comparison of transport solvers, saltwater intrusion modeling and 3D visualization of flow and transport results. This course is ideally suited for hydrogeologists and modelers with some knowledge of field investigation and groundwater modeling who wish to advance their modeling knowledge, and whose responsibilities include model development, review and project management.

Course Software: Visual MODFLOW Premium

http://www.swstechnology.com