International Groundwater Modeling Center

Newsletter

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MODFLOW 2001 and Other Modeling Odysseys

September 11-14, 2001

Call for Papers see page 2

Since the initial release by the U. S. Geological Survey in the early 1980s, MODFLOW, the modular three-dimensional finite-difference ground-water flow model, has come as close to being an international standard as any other code in the brief history of ground-water modeling. The popularity and wide acceptance of MODFLOW has spurred the development of a large number of MODFLOW compatible programs for contaminant transport modeling, parameter estimation, uncertainty analysis, management optimization, graphical interfaces and visualization packages. Today, MODFLOW, along with MODFLOW compatible models, is used for a majority of industrial applications, and as such, it plays a key role in shaping the future directions of ground-water modeling.

The productive conference MODFLOW'98 was held by the International Ground Water Modeling Center (IGWMC) in 1998. Now the USGS has released MODLFOW-2000 and it is time again for MODFLOW users and developers to gather and exchange ideas and information. **While MODFLOW is featured in this conference, the modeling "journeys" of other codes and tools will also be explored.**

The conference will include keynote speakers, contributed oral presentations and poster sessions (papers will be published in a proceedings volume), exhibitors, workshops, and software demonstrations. The purpose of this conference is to bring together the users and developers of MODFLOW, related modeling programs and alternative modeling programs to present the latest innovations in model applications, discuss the capabilities and limitations of MODFLOW, and to explore the needs and directions for future developments. The conference will feature a series of keynote speeches on a wide range of topics. The conference provides a forum for demonstration of the latest MODFLOW related software products. Attendees can participate in workshops offered in conjunction with the conference.

Free-ware : A General Analytical Solution for One-Dimensional Solute Transport

- Chris Neville

C.J. Neville, M. Ibaraki, and E.A. Sudicky have recently presented a general analytical solution for one-dimensional solute transport (Solute transport with multiprocess nonequilibrium: A semi-analytical approach, Journal of Contaminant Hydrology, vol. 44, pp. 141-159). They are making the code freely available, and are pleased that the IGWMC has offered to include the solution in their collection of freeware for hydrogeology.

This general analytical solution, designated MPNE1D, offers the ease of use, efficiency and reliability of a robust analytical solution with a flexibility that is usually only possible with numerical solutions. The solution is capable of representing any combination of the following transport processes:

- one-dimensional advection, dispersion;
- dual porosity mobile-immobile mass transfer;
- combined equilibrium and kinetic sorption; and
- first-order transformation reactions.

The solution is capable of simulating general initial and boundary conditions, including:

- an initially contaminated domain;
- specified concentration or flux-type inflow boundary conditions, with a general time-varying reservoir concentration; and
- a semi-infinite domain, or a finite domain with specified outflow concentration or gradient.

The MPNE1D solution is an ideal teaching tool, providing students with a straightforward tool for exploring solute transport processes. The solution has also been applied for the interpretation of complex column tests. The MPNE1D package includes source and executable code, example data sets, and a PDF version of the user's guide. The solution is coded in standard FORTRAN77 and has been compiled without modifications with PC (MS, Lahey F77L3, Salford FTN77), VAX and UNIX-based compilers.

IGWMC MEMBERSHIP FORM and /or SHORT COURSE REGISTRATION

For Membership Benefits See page 5

Please return with payment to: IGWMC, CSM, Golden, CO 80401
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MODFLOW-2000 RELEASED

for A Timely Update
by Evan Anderman
see page 3

New! Public Domain Master Tasker,

by Micki McKinley at Battelle Pacific Northwest Lab, will allow you to get your own code into a distributed processing mode. Download with UCODE 3.0
see page 4.

Call for Papers

MODFLOW 2001 and Other Modeling Odysseys

Call for Papers

Those interested in presenting a paper or poster should submit an approximately 200-word abstract via http://www.mines.edu/research/igwmc/events/modflow2001/abstract_form.shtml
no later than January 15, 2001. Abstracts must include sufficient detail to permit a thorough review by the Technical Committee. If the abstract is accepted for an oral or poster presentation, the author is required to submit a paper for publication in the proceedings by May 15, 2001. IGWMC will sponsor travel and registration for the student submitting the abstract judged to be the best. Format information for papers will be sent with the abstract acceptance notice.

Topics include:

- MODFLOW-2000, latest developments and related issues
- connections to MODFLOW for simulating processes not included in MODFLOW
- MODFLOW limitations and directions for future development
- typical problems encountered in modeling and their solutions
- new innovations in data collection for modeling purposes
- model calibration and parameter estimation
- constraining ground-water models using hydrogeologic information
- uncertainty analysis and risk assessment
- stochastic approaches and applications
- modeling of surface-water/ground-water interaction
- modeling in fractured environments
- new approaches and innovations in contaminant transport modeling
- coupling flow and reactive transport modeling
- unsaturated zone and multiphase modeling
- variable density modeling
- ground-water management and remediation design optimization
- code testing/performance and case studies
- new developments in graphical user interfaces and visualization software
- advances and applications of database management and graphical information systems (GIS)
- ground-water modeling for mining applications
- ground-water modeling for agricultural applications
- case histories involving unusual applications of ground-water models
- educational issues in ground-water modeling

Registration

The Conference registration fee is $595 (US), which includes the conference proceedings, evening receptions, lunches, and breaks. A reduced fee will apply for students registered for a degree. Address questions about the conference to IGWMC at 303/273-3103, fax 303/384-2037, e-mail: igwmc@mines.edu. For registration, contact: Colorado School of Mines, Office of Special Programs and Continuing Education at 303/273-3321, fax 303/273-3314, e-mail:space@mines.edu.

Opportunities exist for exhibit/information booths as well as for corporate support of conference events. Such participation will be publicly acknowledged. Please direct inquiries to IGWMC.

Location

The Conference will be held on the Colorado School of Mines Campus in Golden, Colorado, U.S.A. September 11-14, 2001. There are many hotels in the nearby Golden and Denver areas in which reservations can be made. Golden, Colorado is located at the foot of Lookout Mountain, 13 miles west of downtown Denver, on the majestic Front Range of the Colorado Rockies.

Organizing Committee

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Important Dates

January 15, 2001	Abstracts Due
February 28, 2001	Notification of Acceptance
May 15, 2001	Manuscripts Due
September 11-14, 2001	Conference

Dr. Mary C. Hill is the next Darcy Lecturer
She will present it at MODFLOW 2001 and Other Modeling Odysseys
"Guidelines For Effective Model Calibration (Any Model!)"

Models are used extensively to evaluate many kinds of systems and to predict their response in a variety of situations. Because many aspects of many systems are unknown and cannot be directly measured given present technology, many models need to be calibrated. In many fields, such as ground-water modeling, calibration has historically been achieved by trial and error alone, but these methods provide less insight than can be achieved. This talk focuses on how nonlinear regression and associated statistics can be used to dramatically improve how data are used to calibrate and test models. For example, parameters which cannot be estimated accurately and uniquely with the available data and the likely utility of potential new data can be clearly and quickly identified.

Parameter values that produce the best fit between simulated and observed values can be determined using nonlinear regression. Measures of prediction uncertainty are a natural consequence of regression methods. Examples are drawn from ground-water modeling, including modeling of the Death Valley regional ground-water system, which underlies the Nevada Test Site and the proposed U.S. high-level nuclear waste repository at Yucca Mountain.

An overview of the ideas I will be covering can be found in Poeter and Hill (1997) Ground Water 35(2): 250-260 and Hill et al. (1998) Ground Water 36(3): 520-535. The Death Valley regional flow system model is described in D'Agnese et al. (1999) Advances in Water Resources 22(8): 777-790.

MODFLOW-2000 : A Timely Update!

-Evan Anderman

MODFLOW-2000 (Harbaugh and others, 2000) is a major revision of the classic MODFLOW program (McDonald and Harbaugh, 1988) that is designed to accommodate the solution of equations in addition to the ground-water flow equation. Building on its modular roots, MODFLOW-2000 is a timely update to the old warhorse. Although MODFLOW was designed to be enhanced easily, the design was oriented toward additions to the ground-water flow equation. MODFLOW-2000 has been completely restructured to make it easier to solve additional equations, for example transport equations and equations for estimating parameter values that produce the best calibrated model. MODFLOW-2000 accomplishes this through the introduction of a new program design concept called processes in addition to the packages, procedures, and modules from previous versions of MODFLOW. The program has also been enhanced in many other areas.

The original MODFLOW program is now part of the new Ground-Water Flow Process, which consists of the alternative packages that solve the ground-water flow equation. The Block-Centered Flow (BCF) Package (McDonald and Harbaugh, 1988) is included in MODFLOW-2000, although it does not work with the Observation, Sensitivity, and Parameter-Estimation Processes. MODFLOW-2000 also includes the new Layer-Property Flow (LPF) Package (Harbaugh and others, 2000) and the Hydrogeologic-Unit Flow (HUF) Package (Anderman and Hill, 2000). The LPF Package basically replaces the BCF Package and will work with the Observation, Sensitivity, and Parameter-Estimation Processes. The HUF Package allows users to define the vertical geometry of the system hydrogeology using hydrogelogic units, which will typically have boundaries that are different from the boundaries of the model layers.

The parameter-estimation capabilities of MODFLOWP (Hill, 1992) are included in the new Observation, Sensitivity, and Parameter-Estimation Processes (Hill and others, 2000). The Observation Process generates model-calculated values for comparison with observed quantities. Observations can include measured hydraulic heads or temporal changes in hydraulic heads, measured gains and losses along head-dependent boundaries (such as streams), flows through constant-head boundaries, and advective transport through the system, which generally would be inferred from measured concentrations. A variety of statistics are calculated to quantify this comparison, including a weighted least-squares objective function. In addition, a number of files are produced which can be used to compare the values graphically. The Sensitivity Process calculates the sensitivity of hydraulic heads throughout the model with respect to specified parameters using the accurate sensitivity-equation method. The Parameter-Estimation Process uses a modified Gauss-Newton method to adjust values of user-selected input parameters in an iterative procedure to minimize the value of the weighted least-squares objective function.

Parameters are defined in the Ground-Water Flow Process input files and can be used to calculate most model inputs. The spatial variation of model inputs produced using defined parameters is very flexible, including interpolated distributions that require the summation of contributions from different parameters.

MODFLOW-2000 can be obtained from the U.S. Geological Survey website at http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html.

New Graphical Software Package for Simulation of Flow and Transport through the Unsaturated Zone

-Richard W. Healy

The U.S. Geological Survey's recently released VS2DI package contains all the tools that a user needs to create, run, and view results for a simulation of flow and transport through variably saturated porous media. The package seamlessly integrates a graphical user interface--within which the user can draw the simulated domain and enter or modify model parameters--with existing USGS models of flow and solute transport, and a postprocessor that displays simulation results.

The VS2DI software package includes three applications:

- VS2DTI - for simulation of water and solute transport
- VS2DHI - for simulation of water and energy transport
- VS2POST - a stand alone postprocessor for viewing results saved from previous simulation runs

The numerical models used for flow and transport calculations are the U.S. Geological Survey's computer models VS2DT (for solute transport) and VS2DH (for energy transport). These models have been updated to version 3.0 for implementation in the VS2DI package.

Experienced users of VS2DT and VS2DH will find that it is now much easier to construct simulations and to analyze results. Users unfamiliar with VS2DT and VS2DH will find that the VS2DI package allows for easy and rapid examination of water and contaminant (or heat) movement through various different hydrologic regimes. Typical applications of the programs are for studies of ground-water recharge, surface-water-ground-water exchange, and contaminant transport from waste disposal sites. An extensive on-line help manual provides all the information necessary to run the programs.

The VS2DI package is public domain software and may be freely downloaded at http://water.usgs.gov/software/vs2di.html Questions on the package can be directed to Rick Healy (rwhealy@usgs.gov).

CSM / IGWMC Receives Doctoral Fellowships for Modeling Research

Colorado School of Mines (CSM) has been awarded doctoral fellowships from the prestigious Graduate Assistantships in Areas of National Need (GAANN) program of the U.S. Department of Education. The fellowships will be awarded to six or more prospective Ph.D. students conducting research in the general area of computational contaminant transport processes. Students are expected to combine field or laboratory research with mathematical modeling, and are expected to teach upper level undergraduate courses. The philosophy of this GAANN program is to produce university faculty to serve in the field of computational geosciences. The GAANN fellowships include full payment of tuition and fees, an annual stipend, and some funds for research supplies and travel for up to four years. The principal investigator is Dr. John McCray, an assistant professor in the Department of Geology and Geological Engineering http://www.mines.edu/~jmccray/. Program faculty include Drs. Ning Lu assistant professor in the Engi neering Division http://egweb.mines.edu/ninglu/, and Tissa Illangasekare, professor in the Environmental Science and Engineering Division http://www.mines.edu/Academic/envsci/people/faculty/tillanga01.html. Students will also be affiliated with the International Ground Water Modeling Center at CSM. Fellowships are still available for students enrolling in spring and fall semesters of 2001. For more information, contact Dr. McCray.

PEST-ASP: A New Version of PEST

- John Doherty

In the Beginning..

Since its inception in 1994 PEST has undergone a series of major upgrades. When it was first released, it was the only program available for "model-independent parameter estimation". It achieves its model-independence through its ability to communicate with a model through the model's own input and output files. Thus a model can be used with PEST without the need for any re-programming. Furthermore, through inclusion of a number of executable programs in a batch or script file, a modeller can easily build a model of arbitrary complexity, and still use it with PEST. The components of such a "composite model" might include, for example, a flow model followed by a transport model, or any kind of environmental simulator together with a number of pre- and post-processors.

Complementary to PEST's model independence is a very robust parameter estimation algorithm that works well even where a model's output is sometimes "granular" due to idiosyncrasies of its numerical solution method. Another important aspect of its model-independence is PEST's ability to set upper and lower bounds on parameters throughout the parameter estimation process. Many models will simply cease execution with an error message if a parameter transgresses legal limits. Furthermore, PEST is able to enforce these bounds in a way that actually increases the stability and efficiency of the optimisation process.

Upgrades to PEST

Since 1994, PEST has undergone many upgrades. Chief amongst these were the introduction of two new modes of operation in addition to its traditional "parameter estimation mode".

"Predictive analysis mode" was introduced in late 1999 with PEST2000. This allows the user to maximise or minimise a key model "prediction" while ensuring that PEST uses a parameter set that maintains the model in a calibrated state. The "prediction" can be any function of the model's parameters, for example (a) a model outcome calculated on the basis of future stress conditions, (b) a particular property of the system integrated over part or all of the model domain, or (c) the value of a particular parameter. In all cases, calculation of the maximum or minimum "prediction" takes place without reliance on any linearity assumption

"Regularisation mode" was introduced with the latest version of PEST, named PEST-ASP ("ASP" stands for "Advanced Spatial Parameterisation"). This mode of operation is particularly useful in the parameterisation of "spatial models" such as groundwater models, because it facilitates the introduction of smoothness or geostatistical constraints into the parameterisation of these model domains. This allows the use of more complex parameterisation methodologies such as may be required, for example, for the simulation of contaminant movement, and for an exploration of the dependence on contaminant fate on geological fine detail. Use of PEST in regularisation mode maintains stability of the inversion process while simultaneously accommodating the large number of parameters that may be required in the definition of a complex property distribution.

External Derivatives

Another new feature of PEST-ASP is PEST's ability to make use of parameter sensitivities generated by a model, if these are available. Such sensitivities are often more precise, and can be calculated more quickly by the model than by PEST. This new functionality allows PEST to operate quite effectively with MODFLOW 2000, extending the capabilities of MODFLOW 2000 where it is required that the parameterisation process include use of at least one other model (such as MT3DMS), or the use of PEST's advanced predictive analysis or regularisation capabilities.

PEST is presently supplied with a suite of utility software that facilitates its use in both the groundwater and surface water modelling contexts. Over the next few months this suite will be expanded; new utilities will include the ability to characterise spatially complex domains using geostatistical and other techniques in ways that complement PEST-ASP's abilities to undertake complex predictive analysis and regularisation tasks based on these characterisations.

For more information on PEST, see the PEST web pages at:-
http://www.ozemail.com.au/~wcomp/

UCODE 3.0 Release

- Eileen Poeter

In 1998, UCODE a universal inversion code, was released, thanks to joint funding by U.S.DOD, IGWMC, and the U.S.GS. UCODE performs inverse modeling, posed as a parameter-estimation problem, using nonlinear regression and was developed to estimate parameters; and evaluate statistics for:

- identifying inadequate data and parameters that probably cannot be estimated,
- evaluating estimated parameter values,
- evaluating the accuracy of the model's representation of the active processes, and
- quantifying the uncertainty associated with the prediction made using the estimated parameters

Any application model or set of models can be used if they have text input and output files and carry sufficient significant digits. Application models can include pre- and post-processors, as well as models related to the processes of interest. An estimated parameter can be a quantity that appears in the input files of the application model(s), or that can be used in conjunction with user-defined functions to calculate a quantity that appears in the input files. An observation can be any quantity for which a simulated equivalent value can be produced for comparison with the observation. UCODE can produce simulated equivalent values using data from the application model output files and functions defined by the user. Prior, or direct, information on estimated parameters also can be included in the regression. The nonlinear regression problem is solved by minimizing a weighted least-squares objective function using a modified Gauss-Newton method. Sensitivities needed for the method are calculated approximately by forward or central differences. UCODE is intended for use on any computer operating system.

In brief, the new features of UCODE 3.0 include:

- "parallel" (i.e. distributed processing) option
- association of observations with space and time coordinates
- residual statistics by group for different types of observations
- unique weighting scheme for concentration observations
- printing of lists to separate files for shorter main output file
- control of the coefficients determining the Marquardt parameter
- a more elaborate restart option
- option to extract simulated equivalents directly (no *.ext!)
- option to include headers in the graphing files
- additional files including sensitivities "by observation"
- graphing file containing confidence intervals on parameters
- option to request not to check the observation name list
- improved format and information in the main output

For more extensive information download the code:
http://water.usgs.gov/software/ucode.html

MasterTasker, by Micki McKinley at Pacific Northwest National Laboratory, serves as a **network task manager to facilitate implementation of distributed processing** for codes with multiple independent tasks that must be accomplished in sequence on a sole processor. It is useful for accomplishing any task that can be done simultaneously on multiple systems such as data manipulation or analysis.

RESEARCH CORNER: New Option for weighting residuals in UCODE 3.0

- Evan Anderman and Eileen Poeter

Weights are applied to residuals to reflect their importance to obtaining a close fit between the simulated value and the field observation. Generally, the inverse of the variance of the measurement is used to weight squared-residuals. Errors associated with some types of measurements (e.g. hydraulic head in a ground-water system) are independent of the magnitude of the observation. While for some types of measurements, the error is related to the magnitude of the true value in the field setting (e.g. concentration in a ground-water system). It is appropriate to allow weights for such observations to be proportional to their value. This approach facilitates attainment of equally desirable fit to both large and small values. The true concentrations are not known, so either the observed or the simulated values need to be used to determine the weight. Researchers[2, 3, 5, 7] experimented with using the simulated concentration to determine the weight. These researchers used the same relative weight for any given type of observation. In UCODE the user defines a dimensionless factor, CV_j , reflecting the confidence associated with the simulated value, $\hat{c}_j$, thus the weight is:

$$w_{c_j} = \frac{1}{\left(cv_j \hat{c}_j\right)^2} \qquad (1)$$

Others[4, 6] used the observed values, $\tilde{c}_j$, to calculate weights and some[4] added a constant, η to prevent large differences between simulated and observed values at low concentrations from dominating the regression, thus:

$$w_{c_j} = \frac{1}{\left(cv_j \tilde{c}_j + \eta\right)^2} \qquad (2)$$

The estimated parameter values are sensitive to the value of the constant[6]. If the constant is too small then large deviations at the periphery of the plume will dominate, they suggest η be 10-percent of the source strength.

Use of observed concentration to determine the weight can produce biased estimated parameter values[1] (estimates were up to 35 percent, different than the true values). Calculation of weights using simulated concentration produced unbiased parameter estimates. They[1] demonstrated that this deviation is due to the fact that the weighted residuals based on observed concentrations are not normally distributed, even when the true errors are normal, while the weighted residuals based on the simulated concentrations are normally distributed. They further indicated that using simulated values to calculate the weights was problematic when parameter values are not close to the optimal parameter values because the simulated values and, thus, the weights, are unrealistic. They[1] improved the regression by using observed concentrations to calculate weights for early parameter iterations and simulated concentrations when estimated parameter values changed less than 10 percent between parameter-estimation iterations. Other researchers[3] introduced a scaling parameter to replace the numerator in [1] and [2] so that the hydraulic-head and concentration residuals form a single population with a uniform variance and that both types of observations contribute equally to the calibration. Initially 1.0, it is calculated for each iteration as, the ratio of the average weighted squared residual for hydraulic heads and for concentrations.

UCODE allows the user to choose the alternative weighting scheme and to define: weighting factors for each observation; observations to receive alternative weighting, which observations are included in the numerator of the scaling parameter, the constan η , and the threshold level for using the simulated or observed value for calculating the weight.

References

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2) Barlebo, H. C., Hill, M. C., Rosbjerg, D., and Jensen, K.H., 1998, Concentration Data and Dimensionality in Groundwater Models: Evaluation Using Inverse Modeling, Nordic Hydrology, v. 29, p. 149-178.

3) Gailey, R. M., Gorelick, S. M., and Crowe, A. S., 1991, Coupled Process Parameter Estimation and Prediction Uncertainty Using Hydraulic Head and Concentration Data, Adv. in Water Res.,14(5), p.301-314.

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6) Van Rooy, D., Keidser, A., and Rosbjerg, D., 1989, Inverse Modelling of Flow and Transport, in Groundwater Contamination (Proceedings of the Symposium held during the Third IAHS Scientific Assembly, Baltimore, MD, May 1989), Linda Abriola ed., IAHS Publ. no. 185, p. 11-23.

7) Wagner, B. J. and Gorelick, S. M., 1987, Optimal Groundwater Quality Management Under Parameter Uncertainty, Water Res. Research, 23(7), p. 1162-1174.

Colorado Ground-Water Atlas

The Colorado Ground-Water Association has released the Colorado Ground-Water Atlas. This book was conceived as a document addressing ground-water resources in the State of Colorado for both laymen and ground-water professionals. Books are available at $30 for CGWA members and $35 for non CGWA members.

Government agencies are no longer supporting entities such as the IGWMC. Yet, if many groundwater oriented professionals and companies maintain a membership in the center, the IGWMC can continue to provide valuable advising, teaching, information dissemination, software distribution and research services to the profession. Maintaining a membership in IGWMC provides stable support to ensure that IGWMC services are there when you want them, assists groundwater students, and provides you with reduced rates.

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MODFLOW 2000

Short Courses

IGWMC SHORT COURSES

COURSE (Short descriptions are provided at http://www.mines.edu/igwmc/short-course/)	Instructors	Start Date No. of Days	End Date Times	Fee Late Fee/Date
Advanced Modeling of Water Flow and Contaminant Transport in the Vadose Zone **ID # 00-6**	Rien van Genuchten Jirka Simunek	December 14, 2000 4 days	December 15 8am-5pm	$575 $650/Dec.1
Applied Environmental statistics **ID # 01-1**	Dennis Helsel Ed Gilroy	March 12, 2001 5 days	March 16 8am-5pm	$1295 $1495/Feb. 23
Polishing Your Ground-Water Modeling Skills **ID # 01-2**	Peter Anderson Robert Greenwald	March 13, 2001 4 days	March 16 8am-5pm	$1345 $1545/Feb. 23
MODFLOW: Introduction to Numerical Modeling **ID # 01-3**	Eileen Poeter Evan Anderman	September 8, 2001 4 days	September 11 8am-5pm	$895 w/MODFLOW 2001, $1095 w/o
Subsurface Multiphase Fluid Flow and Remediation Modeling **ID # 01-4**	John E. McCray Ronald W. Falta	September 9, 2001 2.5 days	September 11 8am-5pm	$895 w/MODFLOW 2001, $1095 w/o
UCODE - Universal Inversion Code for Automated Calibration **ID # 01-5**	Eileen Poeter Evan Anderman	September 10, 2001 2 days	September 11 8am-5pm	$795 w/MODFLOW 2001, $995 w/o
Practical Simulation/Optimization Modeling for Optimal Groundwater Management **ID # 01-6**	Richard Peralta Jim Rumbaugh	September 10, 2001 2 days	September 11 8am-5pm	$845 w/MODFLWO 2001, $1045 w/o
Model Calibration and Predictive Analysis Using PEST **ID # 01-7**	John Doherty	September 14, 2001 2 days	September 16 Fri.evening-Sun.noon	$795 w/MODFLOW 2001, $995 w/o
MT3DMS Workshop **ID # 01-8**	Chunmiao Zheng	September 15, 2001 1 days	September 15 8am-5pm	$395 w/MODFLOW 2001, $495 w/o