Model Calibration, Predictive Uncertainty Analysis and Decision Support Short Course

General

This three-part short course will instruct participants on the automated calibration of environmental models, analysis of the predictive uncertainty associated with such models, and on means through which the modeling process can better support environmental decision-making.

While the course is targeted at those who do modeling on an everyday basis, managers and decision-makers will also benefit from the course, as much of the discussion (particularly on the Monday) is focused on what models can and cannot achieve, and the role that modeling should play in environmental management.

The course is divided into three parts in order to accommodate different interests. Participants are welcome to attend any or all of these parts. The course is partitioned as follows.

**Part 1 (Monday)**  
Model-Based Environmental Management: an Overview.

**Part 2 (Tuesday and Wednesday)**  
Basic Parameter Estimation and Uncertainty Analysis

**Part 3 (Thursday and Friday)**  
Highly-Parameterized Inversion and Uncertainty Analysis

The principal instructor is the developer of PEST, the industry standard for automated calibration and predictive uncertainty analysis of environmental models. Also, a number of case studies will be presented by other experienced PEST users.

The focus of the course will be on surface water models, though groundwater modeling examples will also be presented. Some of the surface water models that will be used are HSPF, QUAL2KW, and CE-QUAL-W2. Participants are encouraged to bring their own modeling applications to use in exercises.

Who should attend?

Those across the whole spectrum of modeling experience will benefit from this course. There are many insights to be gained into the use of models, and what can be expected of models, from an understanding of the role that parameterization plays in providing integrity to model predictions, and in analyzing the extent to which those predictions may be in error. Hence managers, those who use models as a basis for environmental policy formation, as well as seasoned modelers, will all benefit from this course.

Day 1 is structured for managers and/or those who need to understand what models can and cannot achieve, while not actually using them too much. Days 2 and 3 are meant for those who model, but who have had limited experience in parameter estimation and uncertainty analysis. Days 4 and 5 are meant for those who would like to apply the full range of PEST functionality in their modeling work.
What you will learn

While the course will include coverage of the theory and applications of nonlinear parameter estimation and uncertainty analysis, there will also be a strong practical aspect of the course. Participants will gain hands-on experience in the use of PEST, including its advanced regularization and predictive analysis functionality, in the calibration of surface water quality and quantity models. **Attendees will need to provide their own laptops.**

The topics covered will include:

**Monday**
- An overview of modelling
- Sources of predictive uncertainty - Bayes equation
- The role of risk in decision-making
- The role of uncertainty analysis in establishing risk
- What a simple model can achieve
- What a complex model can achieve
- The effects of model imperfections
- The metrics for good modelling practice
- What calibration does for a model
- Basics of uncertainty analysis
- Model-based hypothesis testing
- Using models to encapsulate what we know
- Using models to quantify what we don’t know

**Tuesday and Wednesday**
- Theory of nonlinear parameter estimation
- Application of nonlinear parameter estimation to model calibration
- The “nuts and bolts” of using PEST
- Parameter nonuniqueness
- Model imperfections and structural noise
- Compensatory roles played by some parameters
- Optimal formulation of the inverse problem
- Formulation of a multi-component objective function
- Principles of global optimization
- Basic uncertainty analysis

**Thursday and Friday**
- The need for regularization
- Parameter identifiability
- Tikhonov and subspace regularization
- “SVD-Assist” as a mechanism for model calibration
- Linear model predictive uncertainty analysis
- Nonlinear model predictive uncertainty analysis
- Null-space Monte Carlo as a mechanism for exploring predictive uncertainty
- Optimization of data acquisition to reduce uncertainty
- Model-based hypothesis-testing using Pareto methods
- Model-based decision-making

What you will receive

Participants will receive a DVD containing the following:
- Latest version of PEST
- Latest version of all PEST support utilities (over 200 programs)
- Copies of files and documentation for over 12 PEST workshops
- Literature (mainly published papers) on the use of PEST
About the Instructor

Dr. John Doherty is the author of PEST. John has worked for over 34 years in the water industry, first as a groundwater exploration geophysicist, then as a modeler. He has worked in the public, private and education sectors. He now directs his own company, Watermark Numerical Computing, which undertakes software development and advanced modeling for mining, environmental, agricultural, water supply and remediation applications.

John has had over thirteen years experience in presenting short courses all over the world. Course material is presented clearly and descriptively with many practical examples and illustrations. He attempts to create a learning environment that is both educational and enjoyable.

Prices

Part 1 only: $125 (May 16, 2011 only)
Part 2 or 3 only: $295 (This includes Part 1)
All Parts: $495

Payment methods will be announced at a later date

When and Where

Date: May 16-20, 2011

Location: University Place Hotel & Conference Center, Portland, OR
http://www.pdx.edu/cegs/university-place-hotel-conference-center

Lodging

The location of the short course is in downtown Portland with several transit options. A block of rooms have been reserved at the University Place Hotel & Conference Center under “PEST Short Course”.

Contact:

Please email Kevin Brannan (brannan.kevin@deq.state.or.us) to get your spot reserved. Attendance for the first day only is limited to 30 people. There are only 15 spots available for the full short course, so get your spot now.