All Models Are Wrong: How Do We Know Which Are Useful?

Dr. Eileen Poeter
National Groundwater Association 2006 Darcy Lecturer

Friday September 15 at 4:00 p.m.
642 Dow Environmental Sciences Bldg.

Lecturer: Dr. Eileen Poeter is currently a professor of geological engineering at the Colorado School of Mines and Director of the International Ground Water Modeling Center. Before entering academia, she worked for Golder Associates in the early 1980s and has continued to consult throughout her academic career. Poeter earned a B.S. in geology from Lehigh University in 1975, and an M.S. in 1978 and a Ph.D. in 1980 in engineering science from Washington State University. Her research focuses on parameter estimation (e.g., development of UCODE-a universal inverse code) and multimodel evaluation (e.g., development of MMRI). Eileen is part of the JUPITER (Joint Parameter IdenTification and Evaluation of Reliability) development team. JUPITER is an application-programming interface (API) intended to energize the science and technology of evaluating sensitivity, assessing data needs, estimating parameters, selecting/ranking models, and evaluating uncertainty. This API, and associated codes, are currently under development by the U.S. Geological Survey, in coordination with the Environmental Protection Agency to interface with their software modeling frameworks.

Poeter's lecture details how the ground water profession today is searching for appropriate approaches to developing conceptual models, evaluating which are useful, and describing the uncertainty associated with their predictions.

Abstract:

Hydrology is modeling, starting from the moment a hydrologist stands on a hill and develops a concept of the system; continuing with application of an analytical model such as Darcy's law, the Theis equation, or chemical equilibria; and sometimes extending to elaborate numerical models. Darcy created the first quantitative ground water model in 1856, driven by the practical goal of providing a clean water supply to Dijon, France. It was clearly useful because it not only served his immediate purpose, but hydrologist still call upon it daily. Today we strive to solve complex ground water flow and transport problems, and we are asked to use model results to make decisions without the luxury of a long assessment period. Consequently, the ground water profession is searching for appropriate approaches for developing conceptual models, evaluation which models are useful, and describing the uncertainty associated with their predictions. Formulation of a reasonable set of alternative conceptual models, coupled with quantitative representation (which may range from simple to complex), is critical to the process. In spite of its apparent simplicity, this task is more difficult than numerical modeling because it reaches beyond consideration of scientific principles and quantitative algorithms into the realm of human nature and judgment. The problem is exacerbated by the dense, opaque character of the subsurface that makes data acquisition expensive, causing us to accomplish the work with sparse, uncertain information. Nevertheless, movements to meet this challenge are gaining momentum in the ground water profession. Currently available practical approaches to the problem are presented in down-to-earth terms and future challenges are considered.

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