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A WINDOW INTO THE EARTH:
NEW SOFTWARE TOOL ANALYZES
GROUND WATER FLOW IN 3-D MODELS

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Ground water flow and contaminant transport can be simulated -- and therefore, possibly predicted -- with a new software tool that may be used to produce three-dimensional models of multilayered, underground water systems.

Developed by Dr. Mustafa Aral at the Georgia Institute of Technology, the software could be useful for planning clean-up operations, predicting potential contamination problems, and performing environmental research.

"Until recently, when we talked about water pollution, we were mainly talking about surface water pollution," says Aral, an associate professor of civil engineering. "Now the emphasis is shifting to the analysis of ground water pollution -- realizing that these systems are connected through infiltration from lakes, rivers or other surface water sources."

Underground storage tanks and waste disposal sites also contribute to ground water contamination, he said. Unfortunately, clean-up procedures are expensive, complicated and time-consuming. By using the new software, Aral said, engineers and scientists can reduce the analysis time from a matter of months to just days.

The software will be released in January 1990, along with Ground Water Modeling in Multilayer Aquifers - Steady Flow, the first of three related books. Distributed by Lewis Publishers of Chelsea, Michigan, the books and accompanying software provide guidelines for analyzing leakage problems under various conditions, throughout a specific geographic region.

Dubbed SLAM (for Steady Layered Aquifer Model), the first edition of the software can be used to analyze "steady state" ground water flow conditions, when the flow rate and other variables remain constant. This information may then be used to study contaminant transport in a multilayered aquifer, or underground water system. For example, Aral said, SLAM might help identify the most suitable location for a gasoline storage tank or landfill.

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A second book scheduled for release in February 1990 will provide instructions for tracking the "unsteady state" scenario, when the flow rate and environmental conditions are constantly changing. Professionals could use this program to monitor or predict the progress of clean-up operations. When underground water is contaminated, Aral explained, it's often pumped to the surface for treatment before being discharged back into the ground. The procedure is lengthy and expensive. Alternative methods are equally complicated, and since much of the work is performed underground, Aral said, it's difficult to assess the effectiveness of clean-up efforts. By processing information needed to generate a graphic model of the aquifer, Aral's software provides a "window" into the earth.

Combining information from the previous books, a third book will outline methods for predicting actual contaminant transport within the underground environment.

How Does the Software Work?

The programs are based on a numerical solution known as the finite element method. In this way, known laws about ground water flow and contaminant transport -- such as fluid dynamics or momentum -- are expressed through mathematical statements called partial differential equations. Thus, an entire aquifer system can be represented mathematically.

First, the user collects information on the geologic and hydrologic characteristics of the region being analyzed. After the region is characterized through finite element analysis, input data files are prepared. The operating system contains a companion program called IDEAL, which allows the user to plot certain types of data that characterize a particular aquifer. Input files are processed through the software, and the system generates output data containing all the information needed to complete an evaluation.

Output data files may be sent to a printer or maintained on disk files for viewing on the the computer screen. Or, the user can prepare a three-dimensional graphics representation of the aquifer, using commercially available plotting software. Aral described his analysis method in a recent issue of Ground Water journal.

To help ensure accuracy, the system operates in an input data format, rather than the more familiar menu-operated, screen input format. Aral hopes this system will promote a higher degree of reliability by prompting the user to prepare and check the input data files before processing them. He emphasizes that the program shouldn't be used as an exact substitute of the physical system modeled, but rather, as a tool to assist practical applications.

The software was designed for use with microcomputers. Users need an IBM AT or compatible equipped with a standard 640 K memory and 360 K disk drive. Each book with software is priced at $90.00, retail price. To reach Lewis Publishers, call 1-800-525-7894, 121 South Main Street, P.O. Box 519, Chelsea, Michigan 48118.

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