MODFLOW-2005, The U.S. Geological Survey Modular Ground-Water Model—the Ground-Water Flow Process

By Arlen W. Harbaugh

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PREFACE

This report describes an enhanced version of the U.S. Geological Survey modular ground-water model, called MODFLOW-2005. The model program can be obtained using the Internet at address *http://water.usgs.gov/software/ground_water.html/*. The performance of the program has been tested in a variety of applications. Future applications, however, might reveal errors that were not detected in the test simulations. Users are requested to send notification of any errors found in this User Guide or the model program to:

Office of ground Water
U.S. Geological Survey
411 National Center
Reston, VA 20192
(703) 648-5001

Updates might be made to both the report and to the model program. Users can check for updates at the above Internet address.

Contents

Figures

Tables

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Abstract

This report presents MODFLOW-2005, which is a new version of the finite-difference ground-water model commonly called MODFLOW. Ground-water flow is simulated using a block-centered finite-difference approach. Layers can be simulated as confined or unconfined. Flow associated with external stresses, such as wells, areal recharge, evapotranspiration, drains, and rivers, also can be simulated. The report includes detailed explanations of physical and mathematical concepts on which the model is based, an explanation of how those concepts are incorporated in the modular structure of the computer program, instructions for using the model, and details of the computer code.

The modular structure consists of a MAIN Program and a series of highly independent subroutines. The subroutines are grouped into "packages." Each package deals with a specific feature of the hydrologic system that is to be simulated, such as flow from rivers or flow into drains, or with a specific method of solving the set of simultaneous equations resulting from the finite-difference method. Several solution methods are incorporated, including the Preconditioned Conjugate-Gradient method. The division of the program into packages permits the user to examine specific hydrologic features of the model independently. This also facilitates development of additional capabilities because new packages can be added to the program without modifying the existing packages. The input and output systems of the computer program also are designed to permit maximum flexibility.

The program is designed to allow other capabilities, such as transport and optimization, to be incorporated, but this report is limited to describing the ground-water flow capability. The program is written in Fortran 90 and will run without modification on most computers that have a Fortran 90 compiler.