

# Introduction to FORTRAN Programming for MODFLOW Modelers

## Webinar

### Instructor:

**Jim Rumbaugh**

Environmental Simulations, Inc.

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### Location:

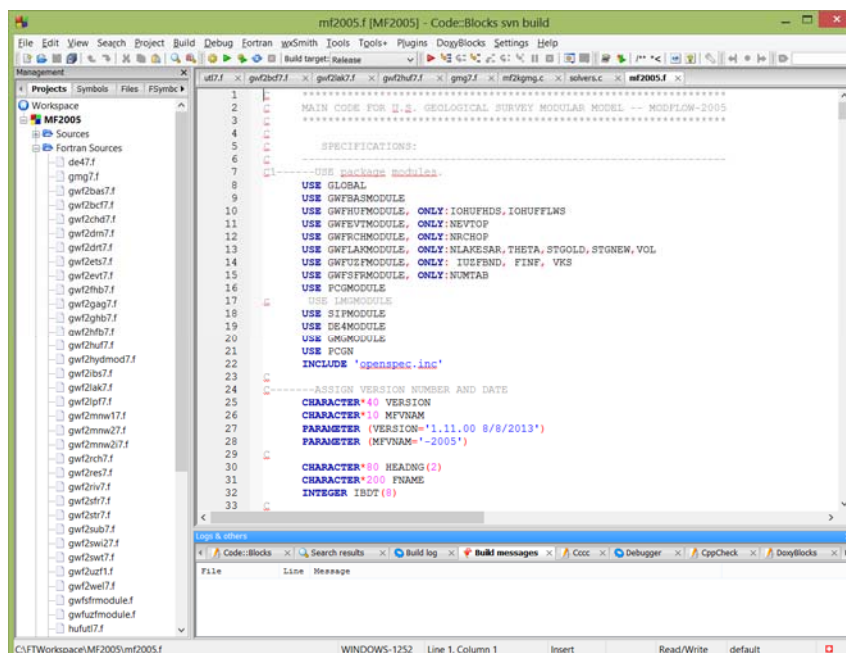
**Your Home or Office!**

### Cost

**Individual: \$950**

**Office: \$1,900**

Contact Jim Rumbaugh (see above) to Register



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-----SPECIFICATIONS-----  
-----THE package modules-----  
USE GLOBAL  
USE GWFBASMODULE  
USE GWFFHMODULE, ONLY: IORUFHDS, IOHUFFLMS  
USE GWFEVMODULE, ONLY: NEWTOP  
USE GWFRMODULE, ONLY: NRCHOP  
USE GWFLAMODULE, ONLY: NLAKESAR, THETA, STGOLD, STONEW, VOL  
USE GWFUZMODULE, ONLY: IUDFBND, FIMF, VKS  
USE GWFSFMODULE, ONLY: NUMTAB  
USE PCGMODULE  
USE STPMODULE  
USE DE4MODULE  
USE GNGMODULE  
USE PCGN  
INCLUDE 'spenspec.inc'  
-----ASSIGN VERSION NUMBER AND DATE-----  
CHARACTER\*40 VERSION  
CHARACTER\*10 MFWNAM  
PARAMETER (VERSION='1.11.00 8/8/2013')  
PARAMETER (MFWNAM='--2005')  
CHARACTER\*80 HEADING(2)  
CHARACTER\*200 FNAME  
INTEGER IBDT(8)

## **Instructor Bio:**

Jim Rumbaugh, hydrogeologist and groundwater modeler, has over 25 years of experience in application of groundwater models and in development of groundwater modeling software tools. He is the co-author of the Groundwater Vistas software and is President of Environmental Simulations, Inc., a company that specializes in groundwater modeling. Jim is an active member of the American Society for Testing and Materials (ASTM) where he is a past Chairman of ASTM Subcommittee D18.21 on Groundwater and Vadose Zone Investigations. Subcommittee D18.21 was funded by U.S. EPA to develop standards for groundwater modeling practice. Jim was honored by the National Ground Water Association with the 1999 John Hem Excellence in Science and Engineering Award by NGWA. This award is given to those who have made a significant, recent scientific or engineering contribution to the understanding of groundwater. NGWA also presented Jim with the 2014 Technology Award, which is given to those who have made a significant contribution to the groundwater industry in the development of ideas and tools, along with exemplary service to colleagues throughout the industry in sharing these ideas. Jim teaches groundwater modeling seminars throughout the USA, Europe, Australia, and New Zealand. The Australia and New Zealand seminars are co-taught with John Doherty, author of the PEST calibration software. Jim has an active consulting practice and has worked on hundreds of groundwater modeling projects throughout the world.

## **Registration:**

To register for this seminar, simply send Jim an email at

[JRumbaugh@GroundwaterModels.com](mailto:JRumbaugh@GroundwaterModels.com), give us a call at (610) 670-3400, or pay by credit card on our web site at [www.groundwatermodels.com](http://www.groundwatermodels.com) and click Online Store. Registration is not confirmed until we receive payment for the Webinar. Cost is \$950 for an individual or \$1,900 for an office (purchase 2 webinars at the online store for the office registration). Note that "office" means one physical location.

## **Webinar Information:**

- The Webinar is divided into 6 lectures lasting between 1 and 2 hours. After each lecture, there will be computer exercises that you may work on at your own pace. Help with exercises is provided by email ([support@groundwatermodels.com](mailto:support@groundwatermodels.com)).
- Lectures are live **but will be recorded** in case you cannot attend all of them. There will be periodic question/answer sessions during the lecture. You will call into the Webinar using either VoIP (provided) or telephone. Optional Question & Answer sessions are held periodically.
- Computer exercises are based on the gfortran compiler and code::blocks development environment. **Participants must also purchase a copy of FORTRAN Tools from [www.fortran.com](http://www.fortran.com). This is a very nominal cost of \$49.00.** The main benefit is that you can send email to them for help with FORTRAN issues AND this is the setup we will be using for the computer exercises. We will NOT provide support if you decide to use another compiler, although the concepts learned in the course are applicable to any FORTRAN environment. We can provide some help if you are using Microsoft Visual Studio with Intel FORTRAN, though.
- ESI reserves the right to cancel the Webinar if there are less than 6 participants

- Each lecture will start at 3:00 pm Eastern Time. Webinar Lectures will be on Monday, Tuesday, and Wednesday for 2 consecutive weeks. Question & Answer sessions will be held on Thursdays. Consult our webinar schedule for exact dates.

# Course Description:

## Introduction to FORTRAN Programming for MODFLOW Modelers

In the early days of groundwater modeling (circa 1970's and 1980's), most groundwater modelers were proficient in FORTRAN programming. This was in the days before user interfaces. Now, most modelers have no programming experience and FORTRAN is no longer taught in many universities. MODFLOW is still written in FORTRAN and having at least a basic understanding of FORTRAN is very helpful. There are many cases where it would be easier to write a program to manipulate the MODFLOW input or output files to solve a particular problem than to figure out a way of getting a GUI to do the same thing. In some situations, the GUI cannot solve your problem.

The Intro FORTRAN webinar is designed for groundwater modelers who use MODFLOW but have no programming background. This webinar would also benefit those who used to know some FORTRAN but need a refresher course to bring back past knowledge. Experienced programmers would not benefit from this introductory course.

We will use the open source gfortran compiler and the code::blocks development environment during this course. While these programs can be downloaded at no charge from the web, **we strongly suggest that you purchase the package called FORTRAN Tools from [www.fortran.com](http://www.fortran.com). The cost is only \$49.00** and provides you with these open source tools and other information in a convenient package that is easy to install and configures the system so you are ready to start programming. Our exercises are predicated on having this system. You may use the generic open source version or other compilers for the computer exercises. However, **we may not be able to answer questions about your programming problems if you do not use FORTRAN Tools.**

As part of the course we will be providing you with gfortran projects for all of the main versions of MODFLOW, including MODFLOW96, MODFLOW2000, MODFLOW2005, and MODFLOW-NWT. We will also have a workbook that includes programming exercises and other information.

The following topics will be covered in the Webinar:

### *Lecture 1:*

- Installing the compiler from FORTRAN Tools
- Command line refresher
- Using batch files
- FORTRAN Versions
- Elements of a simple FORTRAN program
- Compiling and running a simple program

### *Lecture 2:*

- Starting a new program
- Variable types
- Arrays
- Mathematical operations
- Loops & If Blocks
- Command line I/O

### *Lecture 3:*

- Using Text Files for Input and Output
- Fixed - Free - Binary Files
- Memory Allocation
- Subroutines
- Using the Debugger

### *Lecture 4:*

- Obtaining FORTRAN code and compiling it
- Working with MODFLOW Input Files
- Understanding MODFLOW Input Instructions
- Creating a Well counting program
- Read a csv file and make a Well input file

### *Lecture 5:*

- Working with MODFLOW Binary Files
- MT3D Binary Files
- Evaluating the ZoneBudget program
- Creating a Binary to Text File Conversion Program

### *Lecture 6:*

- Introduction to the MODFLOW Source Code
- MODFLOW Versions
- Compiler optimization
- Analysis of the main MODFLOW program