Documentation of Conversion of the MODFLOW Subsidence (SUB) Package for MODFLOW-2005

This documentation describes the changes to the Subsidence (SUB) Package (Hoffmann and others, 2003) to convert it to work with MODFLOW-2005. See Chapter 9 of Harbaugh (2005) for further information about the MODFLOW-2005 program. The modified code is designated version 7, and this code has the same functionality as version 1 of this package, which is the version used in MODFLOW-2000.

1. Module SUBARRAYS was expanded and renamed GWFSUBMODULE. GWFSUBMODULE incorporates the capability to support Local Grid Refinement. The following table describes the data.

Variable Name	Size	Description
IIBSCB	Scalar	The unit number for saving cell-by-cell subsidence terms. (ISUBCB in the input instructions).
ITMIN	Scalar	The minimum number of iterations for which 1-D equations will be solved for flow in interbeds when the Strongly Implicit Procedure is used for solving the ground-water flow equations.
NNDB	Scalar	The number of systems of no-delay interbeds.
NDB	Scalar	The number of systems of delay interbeds.
NMZ	Scalar	The number of material zones needed to define the hydraulic properties of delay interbeds.
NN	Scalar	The number of nodes to discretize the half space in delay beds.
ND2	Scalar	The product of NN and the sum of the number of cells occupied by each delay interbed.
IDSAVE	Scalar	The unit number for saving restart records for delay interbeds.
AC1	Scalar	Acceleration parameter, $\omega_1$in equation 25.
AC2	Scalar	Acceleration parameter, ω,in equation 27.
NDF	LOGICAL	True if there are any delay interbeds.
NNDF	LOGICAL	True if there are any non-delay interbeds.
ISBOCF	6	Format codes for printing subsidence, model layer compaction, interbed system compaction, vertical displacement, no-delay preconsolidation head, and delay preconsolidation head.
ISBOCU	6	File units for saving subsidence, model layer compaction, interbed system compaction, vertical displacement, no-delay preconsolidation head, and delay preconsolidation head.
OCFLGS	LOGICAL,13,NSTPT	Flags for printing and saving information each time step. NSTPT is the total number of time steps.
OCLAY	LOGICAL,NLAY	Flags that indicate which layers have output.
ILSYS	NNDB	Used to store the no-delay interbeds in a model layer.
NTSSUM	NPER	Sum of the time steps prior to each stress period.
LN	NNDB	Layer assignment for each no-delay interbed.
LDN	NDB	Layer assignment for each delay interbed.
NZ	ND1	Material zone numbers for delay interbeds. ND1 is the number of delay interbeds.
RNB	ND1	Factor n_{equiv} (eq. 20) at each cell for delay interbeds. ND1 is the

		number of delay interbeds.
DH	ND2	Head in delay interbeds.
DHP	ND2	Head in delay interbeds for previous time step.
DHC	ND2	Preconsolidation head throughout the simulation for delay interbeds.
DZ	ND1	Equivalent thickness for delay interbeds. ND1 is the number of delay interbeds.
HC	NND1	Preconsolidation head throughout the simulation for no-delay interbeds. NND1 is the number of no-delay interbeds.
SCE	NND1	Dimensionless elastic skeletal storage coefficient for no-delay interbeds. NND1 is the number of no-delay interbeds.
SCV	NND1	Dimensionless inelastic skeletal storage coefficient for no-delay interbeds. NND1 is the number of no-delay interbeds.
DCOM	ND1	Starting compaction in delay interbeds. ND1 is the number of delay interbeds.
A1	NN	Main diagonal of the coefficient matrix in the delay interbed equation.
A2	NN	Off diagonal of the coefficient matrix in the delay interbed equation.
BB	NN	Right-hand side of the delay interbed equation.
SUB	NND1	Starting compaction for no-delay interbeds (input variable COM). NND1 is the number of no-delay interbeds.
DP	NMZ,3	Material properties for delay interbeds.
DVB	NDB,4	Budget terms for delay beds.

2. All subroutines were changed to designate 2 for the process version and 7 for the package version: GWF2SUB7.

3. Subroutines GWF2SUB7ALP and GWF2SUB7RPP were combined and renamed GWF2SUB7AR.

4. Subroutine arguments that are contained in Fortran modules were replaced with USE statements in all subroutines. SUB1 used one-dimensional subscripts to access two and three-dimensional arrays. The arrays in GWFSUBMODULE continue to be accessed using one-dimensional subscripts; however, the subscripts for accessing the arrays from the GLOBAL module that are used by SUB have been changed to three-dimensional subscripts.

5. Subroutine GWF2SUB7DA was created to deallocate memory.

6. To support the Local Grid Refinement capability, subroutine SGWF2SUB7PNT was created to set pointers to a grid, and subroutine SGWF2SUB7PSV was created to save the pointers for a grid. The grid number, IGRID, was added as a subroutine argument to all of the primary subroutines, and subroutines SGWF2SUB7PSV and SGWF2SUB7PNT are called as appropriate.

Input Instructions for SUB7

Input for version 7 of SUB is read from the file that has file type "SUB" in the MODFLOW name file. The input is the same as for version 1, which is included in MODFLOW-2000.

REFERENCES

Harbaugh, A.W., 2005, MODFLOW-2005,the U.S. Geological Survey modular ground-water model—the Ground-Water Flow Process: U.S. Geological Survey Techniques and Methods 6-A16, variously p.

Hoffmann, Jorn, Leake, S.A., Galloway, D.L., and Wilson, A.M., 2003, MODFLOW-2000 ground-water model—User guide to the Subsidence and Aquifer-System Compaction (SUB) Package: U.S. Geological Survey Open-File Report 03-233, 46 p.