



MODFLOW-2000, THE U.S. GEOLOGICAL SURVEY MODULAR GROUND-WATER MODEL — DOCUMENTATION OF MODPATH COMPATIBILITY FOR THE ADVECTIVE-TRANSPORT OBSERVATION (ADV2) PACKAGE

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Preface

The computer software described in this report is a new capability of the Advective-Transport Observation (ADV2) Package for MODFLOW-2000, the U.S. Geological Survey's three-dimensional ground-water flow parameter-estimation model. The software is designed to support data input and production of a model output file that are designed to be consistent with MODPATH (Pollock, 1989).

All code developed by the U.S. Geological Survey for MODFLOW-2000 is available for downloading over the Internet from a U.S. Geological Survey software repository. The repository is accessible on the World Wide Web from the U.S. Geological Survey Water Resources Information web page at URL http://water.usgs.gov/software/ground_water.html, at the entry labeled 'MODFLOW-2000'.

The performance of the new capabilities of the ADV2 Package have 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 notify the U.S. Geological Survey of any errors found in this document or the computer program using the email address available on the website mentioned above. Updates might occasionally be made to both this document and to the effective-porosity parameters of the ADV2 Package, and users are encouraged to check the website periodically.

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Compatibility between ADV2 and MODPATH has been improved in two ways: creation of a pathline file and definition of offsets. These are described below. The two variables that control these two new features are optional. If they are omitted, ADV2 performance is unchanged. Thus, the modified version of the ADV2 Package is backward compatible.

Pathline Output File

A file compatible with the MODPATH pathline file can now be produced by ADV2. The file is written using the unit number defined by the new, optional variable IMPATHOUT, which is the eighth variable on the first line of the ADV2 input file. The unit number needs to be listed in the MODFLOW Name file using file type “data” (Harbaugh and others, 2000, p. 43-44). The name of the file is defined in the name file, and only needs to be “pathline” as needed for compatibility with postprocessors.

The file produced by ADV2 differs from that produced by MODPATH in that the value of “zloc”, which is the third column of real numbers, is set to zero.

As in the pathline file, observations are marked by the line being repeated, and the first repetition has a dash in front of the time. For example, in

Figure 1 there are observations defined at times 0.315E+09, 0.315000013000E+10, and 0.552000000000.

The file does not include the position of particles that are projected. If observations are missing from the file, check the MODFLOW-2000 LIST file to see if the particle was projected.

```

@ [ MODPATH Version 4.00 (BY ADV2 , 3-2006) (TREF= 0. 000000E+00 ) ]
1 0.155000000000E+05 0.165000000000E+05 0.000000000000E+00 0.100000000000E+03 0.000000000000E+00 16 2 1
1 0.151775156000E+05 0.164241797000E+05 0.000000000000E+00 0.859295883000E+02 -0.315000000000E+09 16 2 1
1 0.151775156000E+05 0.164241797000E+05 0.000000000000E+00 0.859295883000E+02 0.315000000000E+09 16 2 1
1 0.150000000000E+05 0.163846895000E+05 0.000000000000E+00 0.796949615000E+02 0.473424448000E+09 15 2 1
1 0.140000000000E+05 0.161249258000E+05 0.000000000000E+00 0.568575745000E+02 0.122554522000E+10 14 2 1
1 0.135978535000E+05 0.160000000000E+05 0.000000000000E+00 0.513925934000E+02 0.147886848000E+10 14 3 1
1 0.134686855000E+05 0.159631885000E+05 0.000000000000E+00 0.500000000000E+02 0.155058304000E+10 14 3 2
1 0.134686855000E+05 0.159631885000E+05 0.000000000000E+00 0.487818756000E+02 -0.157000000000E+10 14 3 2
1 0.134686855000E+05 0.159631885000E+05 0.000000000000E+00 0.487818756000E+02 0.157000000000E+10 14 3 2
1 0.134686855000E+05 0.159631885000E+05 0.000000000000E+00 0.400000000000E+02 0.170998336000E+10 14 3 2
1 0.130000000000E+05 0.158329414000E+05 0.000000000000E+00 0.344278641000E+02 0.202074662000E+10 13 3 2
1 0.120000000000E+05 0.154615869000E+05 0.000000000000E+00 0.256957741000E+02 0.264481894000E+10 12 3 2
1 0.111591699000E+05 0.150894834000E+05 0.000000000000E+00 0.203560085000E+02 -0.315000013000E+10 12 3 2
1 0.111591699000E+05 0.150894834000E+05 0.000000000000E+00 0.203560085000E+02 0.315000013000E+10 12 3 2
1 0.110000000000E+05 0.150134590000E+05 0.000000000000E+00 0.194475689000E+02 0.324472474000E+10 11 3 2
1 0.109763818000E+05 0.150000000000E+05 0.000000000000E+00 0.193278637000E+02 0.325876480000E+10 11 4 2
1 0.100000000000E+05 0.143941934000E+05 0.000000000000E+00 0.149983177000E+02 0.381633997000E+10 10 4 2
1 0.945826855000E+04 0.140000000000E+05 0.000000000000E+00 0.130486145000E+02 0.414769510000E+10 10 5 2
1 0.900000000000E+04 0.135802949000E+05 0.000000000000E+00 0.113982105000E+02 0.444817306000E+10 9 5 2
1 0.849111523000E+04 0.130000000000E+05 0.000000000000E+00 0.100792122000E+02 0.482227814000E+10 9 6 2
1 0.803972119000E+04 0.120000000000E+05 0.000000000000E+00 0.811218262000E+01 0.531745178000E+10 9 7 2
1 0.801245605000E+04 0.114727666000E+05 0.000000000000E+00 0.695629025000E+01 -0.552000000000E+10 9 7 2
1 0.801245605000E+04 0.114727666000E+05 0.000000000000E+00 0.695629025000E+01 0.552000000000E+10 9 7 2

```

Figure 1. Example pathline file produced by ADV2.

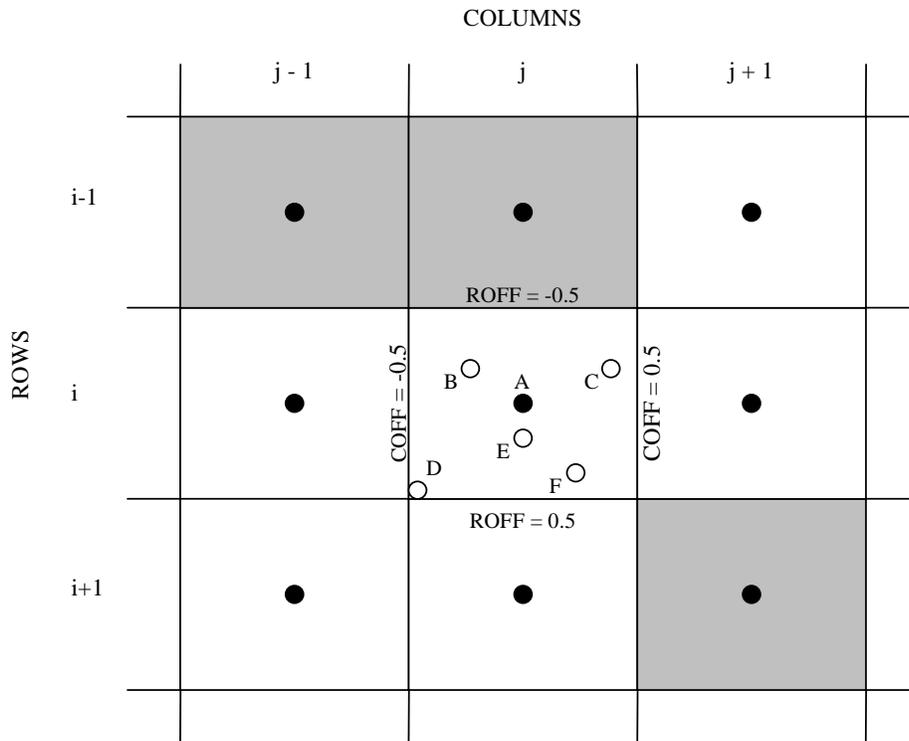
Offsets

The layer, row, and column offsets defined in the ADV2 input file can now either be defined as described in the ADV2 documentation or as described in the MODPATH documentation. The two ways of defining offsets are compared in the next paragraph.

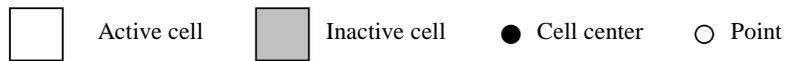
The ADV2 conventions for row and column offsets are illustrated in Figure 2; the MODPATH conventions are illustrated in Figure 3. Using the ADV2 convention, values of the offsets vary between -0.5 and +0.5. Using the MODPATH convention, offsets vary between 0.0 and 1.0.

The offsets for columns and layers increase in value in the same direction in the two conventions, so ADV2 convention values of -0.5 and 0.5 are equivalent to MODPATH convention values of 0.0 and 1.0, respectively. For column offsets, Figures 2 and 3 show that the values increase in the same direction that column numbers increase: to the right in the figures. For layer offsets, the values increase going up. In MODFLOW, model layer numbers increase going down, so in both the ADV2 and MODPATH conventions the offsets increase in the opposite direction that model layer numbers increase.

The row offsets in the ADV2 and MODPATH conventions increase in value in the opposite direction, as shown in Figures 2 and 3. For row offsets, an ADV2-convention value of -0.5 is equivalent to a MODPATH convention value of 1.0; an ADV2-convention value of 0.5 is equivalent to a MODPATH convention value of -1.0.

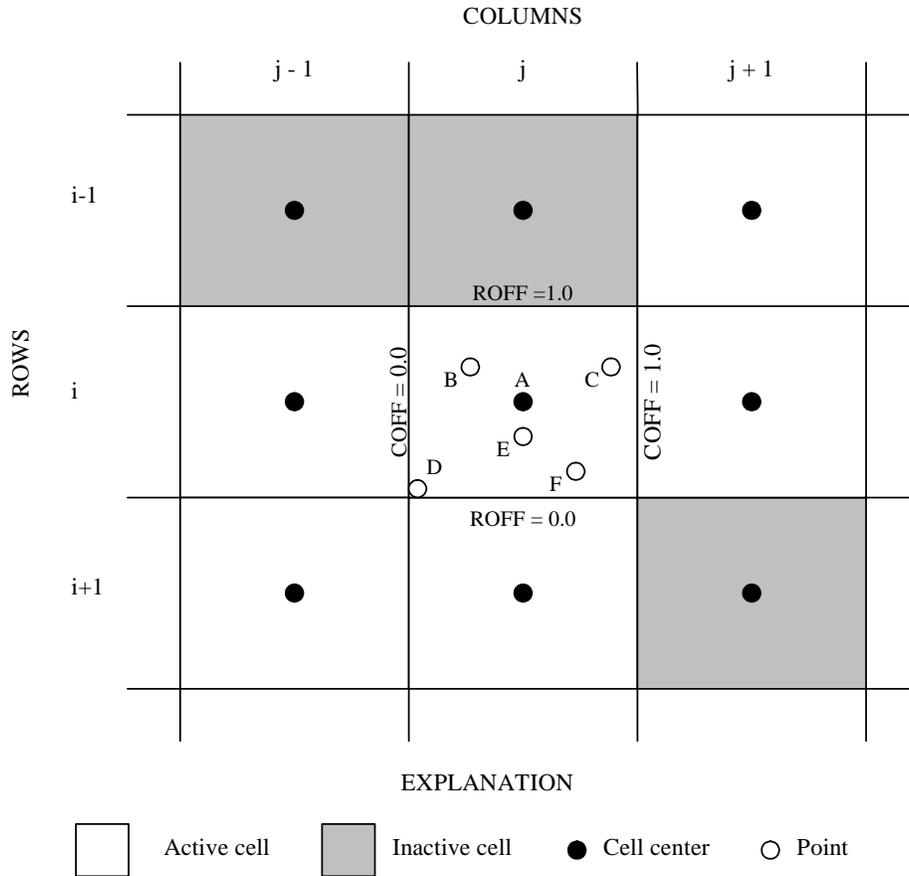


EXPLANATION



POINT	ROFF	COFF
A (Cell center)	0.0	0.0
B	-0.25	-0.25
C	-0.2	0.4
D	0.45	-0.45
E	0.25	0.0
F	0.4	0.25

Figure 2. Locating points within a finite-difference cell using ADV2 conventions and row and column offsets (ROFF and COFF, respectively). (from Hill and others, 2000, fig. 2)



POINT	ROFF	COFF
A (Cell center)	0.5	0.5
B	0.75	0.25
C	0.7	0.9
D	0.05	0.05
E	0.25	0.5
F	0.1	0.75

Figure 3. Locating points within a finite-difference cell using MODPATH conventions for row and column offsets (ROFF and COFF, respectively).

The convention used for the offsets is defined by the new, optional variable named IMPATHOFF. The new variable is now the ninth argument on the first line of the ADV2 input file. If IMPATHOFF is omitted or set to zero, the offsets in the ADV2 input file need to be defined using the ADV2 convention. If IMPATHOFF equals 1, the offsets need to be defined using the MODPATH convention.

Revised ADV2 input file

The first line of the ADV2 input file now contains the following nine variables.

1. NPTH NLOC IOUTADV KTFLG KTREV ADVSTP FSNK [IMPATROUT
IMPATROFF]

The last two variables are optional. However, to include the second optional variable requires that a number be included for first one.

The first eight variables are documented by Anderman and Hill (2001). The last two variables are documented in this report.

The new variables are defined as follows.

IMPATROUT – is a flag and a unit number.

If $IMPATROUT > 0$, it is the unit number to which particle tracking information will be written using the conventions of the MODPATH pathline file.

If $IMPATROUT = 0$, no file is produced.

IMPATROFF – is a flag indicating the convention used to interpret the offsets in items 3 and 4 (see Anderman and Hill, 2001, p. 49). The offsets for particle starting locations are defined in input item 3 by variables SLOFF, SROFF, and SCOFF. The offsets for observation locations are defined in input item 4 by variables LOFF, ROFF, and COFF.

References Cited

Anderman, E.R. and Hill, M.C., 2001, MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- Documentation of the ADVective-Transport observations (ADV2) Package: U.S. Geological Survey Open-File Report 01-54, 69p.

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Pollock DW (1994). User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model. U.S. Geological Survey Open-File Report 94-464.