

## Documentation of Conversion of the MODFLOW Segmented Evapotranspiration (ETS) Package For MODFLOW-2005

This documentation describes the changes to the Segmented Evapotranspiration (ETS) Package (Banta, 2000) 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. Fortran module GWFETSMODULE was created to store the shared data for the ETS Package; GWFETSMODULE incorporates the capability to support Local Grid Refinement. The following table describes the data.

| Variable Name | Size             | Description   |
|---------------|------------------|---|
| NETSOP        | Scalar           | ETS option code   |
| IETSCB        | Scalar           | File unit for saving ETS cell-by-cell budget data                           |
| NPETS         | Scalar           | The number of ETS parameters  |
| IETSPF        | Scalar           | Format code for printing ETSR data after parameter substitution             |
| NETSEG        | Scalar           | The number of segments used to define evapotranspiration                    |
| IETS          | NCOL,NROW        | Layer indicator   |
| ETSR          | NCOL,NROW        | Maximum evapotranspiration flux   |
| ETSX          | NCOL,NROW        | The evapotranspiration extinction depth                                     |
| ETSS          | NCOL,NROW        | The elevation of the evapotranspiration surface                             |
| PXDP          | NCOL,NROW,NETSEG | Proportions of the extinction depth to apply to ETS segments                |
| PETM          | NCOL,NROW,NETSEG | Proportions of the maximum evapotranspiration rate to apply to ETS segments |

2. All subroutines were changed to designate 2 for the process version and 7 for the package version: GWF2ETS7.

3. Subroutines GWF2ETS7ALP and GWF2ETS7RPPD were combined and renamed GWF2ETS7AR.

4. GWF2ETS7AR was modified to use ALLOCATE statements to reserve memory for the data in GWFETSMODULE rather than reserving space in the RX and IR arrays used by MODFLOW-2000.

5. GWF2ETS7RPSS was renamed GWF2ETS7RP.

6. Subroutine arguments that are contained in Fortran modules were replaced with USE statements in all subroutines.

7. Subroutine GWF2ETS7DA was created to deallocate memory.

8. To support the Local Grid Refinement capability, subroutine SGWF2ETS7PNT was created to set pointers to a grid, and subroutine SGWF2ETS7PSV 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 SGWF2ETS7PSV and SGWF2ETS7PNT are called as appropriate.

## **Input Instructions for ETS7**

Input for version 7 of ETS is read from the file that has file type "ETS" in the MODFLOW name file. The input is the same as for the modified version 1 included in MODFLOW-2000, which incorporates the option to use parameter instances.

## **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.

Banta, E.R., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model – documentation of packages for simulating evapotranspiration with a segmented function (ETS1) and drains with return flow (DRT1): U.S. Geological Survey Open-File Report 00-466, 127 p.