Alterations to HSPF Data Input

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Introduction

This report briefly documents some alterations that have been made to HSPF to enhance its use with PEST. The purpose of these alterations is to allow HSPF to read numbers recorded with greater-than-normal precision on its input files. The "official" version of HSPF receives its ASCII input data from a "UCI" file which is read using strict FORTRAN formatting conventions. This places limits on the number of significant figures that can be used for data input on many occasions. Where HSPF is used with PEST, and where part of its input dataset is generated by a pre-processor (such as the PEST parameter transformation utility PAR2PAR), the loss of precision incurred by transferral of numbers between the preprocessor and HSPF through a normal HSPF input file can have serious deleterious consequences for the inversion process.

HSPF Input

Most of the real numbers read by HSPF from its UCI input file are read using subroutine *rtable* found in file *hspfitab.for*. This complex subroutine reads (and reports) a sequence of numbers extracted from one line of a UCI file. In implementing the changes documented herein, subroutine *rtable* was enhanced and another subroutine added to file *hspfitab.for*. These enhancements allow HSPF to read just about any set of real numbers disposed on one line of a UCI file using greater precision than that which would otherwise be possible.

Supplementary Input File

In implementing the new data input functionality, a new file (called a "supplementary input file") can be supplied to HSPF along with its normal UCI file. Figure 1 shows part of such a file.

```
101 12       monthly manning's n; perlnds 2 and 3
0.433  0.444  0.555  0.666  0.606  0.546  0.503  0.498  0.404  0.387  0.372  0.2
102 12       monthly lower et perlnd 1
0.30 0.30 0.30 0.30 0.27 0.25 0.25 0.25 0.25 0.25 0.35 0.33
103 12       monthly manning's n; perlnd 1
0.4  0.4  0.4  0.4  1.6  1.1  1.1  1.3  1.3  1.3  1.1  0.9
104 12       monthly et perlnd 2
0.25 0.25 0.25 0.25 0.30 0.35 0.40 0.40 0.45 0.35 0.30 0.2
82   7       pwater info part 2 for perlnds 1 and 3
0.000       8.0     0.100      350.     0.010       0.5      0.98
```

Figure 1. Part of a HSPF supplementary input file.

A supplementary input file is comprised of a series of pairs of lines, each pair pertaining to a line of data read from a UCI file. The first line of each pair must contain two integers; these can be optionally followed by any text or numbers (ignored by HSPF). The first integer is an "array identifier"; this must be unique to each pair of lines appearing in the supplementary input file. The second integer

informs HSPF of the number of entries on the following line. The next line contains an array of real numbers.

Note the following:-

1. All numbers are read from a supplementary input file using list-directed (ie. free-field) input. Thus they must be space or comma delimited. They can be represented with as much precision as desired.

2. Only limited checking is made of this file; it is the user's responsibility to ensure that its basic design features are respected, for example that there are as many real numbers represented on a line as is indicated by the pertinent integer on the previous line.

3. Because of the ubiquitous use of the *rtable* subroutine in reading its input data, just about any HSPF parameters can be read from a supplementary input file. These include hydraulic properties and data supplied in monthly lists.

The UCI File

Where there is a line of data in the UCI file which the user would prefer to be read from a supplementary input file, HSPF must be informed of this. This is done by placing the string "~*n*~" somewhere in the relevant line of the UCI input file. Here *n* is the identifier of the array occurring in the supplementary input file (ie. the first of the 2 integers in the header line preceding each array). Two examples are provided in Figures 2 and 3.

```
N-LZETPARM
<PLS >  Only required if VLEFG=1 in PWAT-PARM1                ***
# -  #  Lower zone ET parameter at start of each month       ***
JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC ***
1    2 0.20 0.20 0.20 0.23 0.23 0.25 0.60 0.80 0.75 0.50 0.30 0.20
3      0.25 0.25 0.25 0.25 0.30 0.35 0.40 0.40 0.45 0.35 0.30 0.25 ~104~
```

Figure 2. Example of part of a modified UCI file.

```
AT-PARM2
<PLS > ***   PWATER input info: Part 2
# -  # ***FOREST        LZSN     INFILT      LSUR      SLSUR     KVARY      AGWRC
1    2      0.000 ~82~  8.0      0.100       350.      0.010      0.5        0.98
3           0.010       9.0      0.150       350.      0.010      0.5        0.98
```

Figure 3. Another example of part of a modified UCI file.

In the case of Figure 2, HSPF will read the monthly lower zone ET parameters for PERLND 3 from the array identified as ~104~ in the supplementary input file. In the case of Figure 3, HSPF will read the PWATER parameters for PERLNDs 1 and 2 from the array identified as "82" in the supplementary input file.

Note the following:-

1. HSPF assumes that a UCI file is 80 characters wide at the most (this painful fact is a part of HSPF's generic design). This **must** be respected when adding the "~*n*~" string, ie. do not allow any part of this string to reside past the 80th character position on any line.

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2. Many data lines on a UCI file begin with 2 integers (denoting the hydrologic units to which the data applies); these are followed by the array of real numbers. Only the array of real numbers is read from the supplementary input file.

3. The "~*n*~" string must not be placed at the beginning of the line of the UCI file, or amidst the integers. It must be placed amidst the real numbers, **while not offsetting those numbers from the positions dictated by the input formatting requirements of HSPF**, or at the end of the line (whilst respecting the 80 character line length limit). This string is actually replaced by blank spaces after being read by the code added to the *rtable* subroutine, but before the original HSPF code reads it.

4. The array in the supplementary input file to which HSPF is directed must contain the same number of entries as the number of real numbers on the line of the UCI file which directed HSPF to that file.

5. The modified HSPF is presently set up to read a maximum of 200 arrays, with a maximum number of 20 entries in each, from the supplementary input file. These limits can be extended through trivial re-coding if desired.

A supplementary input will not be read (and need not be present) unless there is at least one "~*n*~" string in the UCI file. If such a string is found, HSPF will prompt for the name of the supplementary input file upon commencement of execution. (If running HSPF under the control of PEST, the response to this, as well as HSPF's other prompt for the name of its UCI file, should be placed in a text file and provided to HSPF through the keyboard input redirection mechanism, ie. through use of the "<" character in the command line.)

HSPF Output File

The fact that replacement values have been read from the supplementary input file for certain numbers in the UCI file is recorded in the HSPF run record file (which often has an extension of *ech*). Text written to this output file provides the following information:-

1. It informs the user that the supplementary input file was read.

2. It informs the user of numbers read from the UCI file.

3. It informs the user of replacement numbers read from the supplementary input file. The user should check this file to ensure that these numbers have been read correctly.

If an error conditions occurs (for example if the user-specified supplementary input file is not found, if a particular array was not present in that file, if an array could not be read, if the number of elements in the array is different from the number of values sought, etc), an appropriate error message will be written to the HSPF text output file and to the screen; execution of HSPF will then be immediately terminated.

Problems

If there are any problems, contact John Doherty:-

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