Tutorial 4: Time Varying Data

Task
Convert the boundary conditions and gate operations from constants to time varying input data.

Skills Gained

- Learn about HEC-DSS as a time series data storage system
- Learn how HEC-DSS path names are used to reference time series in DSM2 input files

The purpose of this tutorial is to incorporate time-varying information into the model. In the previous sections, all boundary conditions and gate timings were set as constant, and no input files were needed. In this section, the model is set to read time-varying information stored in HEC-DSS files.

US Army Corps of Engineers

The U.S. Army Corps of Engineers' Hydrologic Engineering Center Data Storage System, or HEC-DSS, is a database system designed to efficiently store and retrieve scientific data that is typically sequential. Such data types include, but are not limited to, time series data, curve data, spatial-oriented gridded data, and others. The system was designed to make it easy for users and application programs to retrieve and store data.

Data in HEC-DSS format can be viewed using special software including VISTA (DWR), or HEC-DSSVue. Each time series is described in the database using DSS Pathnames (see column headings in figure). For DSM2 the pathnames are typically used as follows:

A-Part: Data Source
B-Part: Location
C-Part: Variable
D-Part: Date range
E-Part: Data frequency
F-Part: Description (in the sample shown the F-Part is the CalSim run identifier.

Number	A part	B part	C part	D part / range	E part	F part
1	CALSIM	A1	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
2	CALSIM	A11	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
3	CALSIM	A12	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
4	CALSIM	A13	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
5	CALSIM	A15	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
6	CALSIM	A18	SURFACE-AREA	01JAN1920	1MON	2005A01A
7	CALSIM	A22	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
8	CALSIM	A25	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
9	CALSIM	A27	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
10	CALSIM	A28	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
11	CALSIM	A29	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A
12	CALSIM	A3	SURFACE-AREA	01JAN1910 - 01JAN2000	1MON	2005A01A

For more information see the HEC-DSS website:

http://www.hec.usace.army.mil/software/hec-dss/hecdss-dss.html

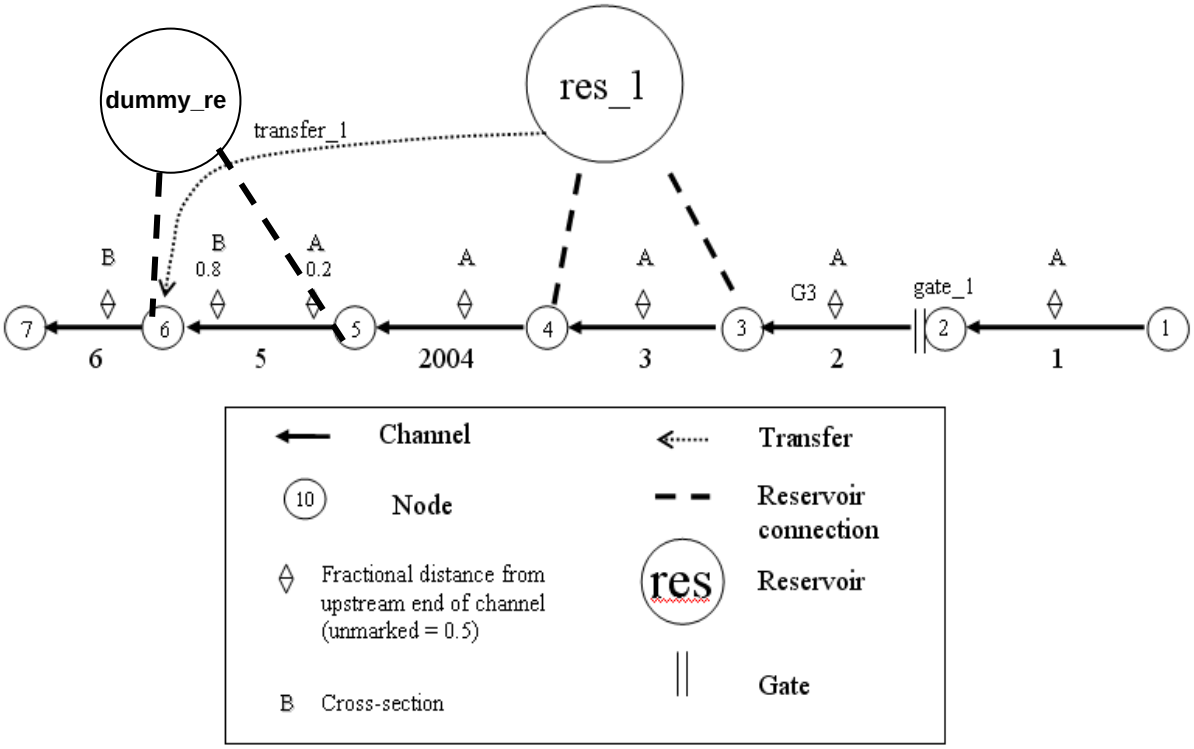

Figure 1: Simple channel with a reservoir, gate, flow transfer and dummy reservoir.

1. Change the Transfer Flows to HEC-DSS input:

The constant transfer flow from the previous tutorials will be changed to a time series.

a. Create a new file in Notepad++ or another text editor called input_hydro_ts_tutorial.inp

b. In the new file, create the *TRANSFER_TIME_SERIES table*:

```
INPUT_TRANSFER_FLOW
TRANSFER_NAME     FILLIN        FILE        PATH
END
```

c. Enter the following values into the appropriate fields:

i) Input Name: *transfer_1*

ii) Fillin: *linear*

iii) Input File: *${TUTORIALINPUT}*

iv) Path/Value: */TUTORIAL/TRANSFER/FLOW//15MIN/CONSTANT/*

> The HEC-DSS pathnames are referred to using forward slashes /A-Part/B-Part/C-Part/D-Part/E-Part/F-Part/
> In the example above, the A-Part is Tutorial, the B-Part is TRANSFER, etc. and the D-Part isn't specified.

d. Open hydro.inp. The input file uses an ENVVAR reference as the filename, so add the definition of TUTORIALINPUT. At the same time, set DSM2MODIFIER to timevar_1:

```
ENVVAR
NAME              VALUE
HYDROOUTDSSFILE output.dss
DSM2MODIFIER    timevar_1
TUTORIALINPUT   ../timeseries/tutorial.dss
END
```

e. We are going to replace the existing time series with the new file, so make sure it is listed below the other files as follows.

```
HYDRO_TIME_SERIES
input_boundary_hydro_tutorial.inp
input_transfer_flow_tutorial.inp
input_hydro_ts_tutorial.inp
END
```

f. Save the files.

g. Open qual.inp and set DSM2MODIFIER to timevar_1 as well (hydro.inp and qual.inp must agree or the tidefile won't be found).

2. Running HYDRO and QUAL

a. In Windows Explorer, navigate to the directory: *{DSM2_home}**tutorial**simple*\.

b. Right-click on the directory, *t4_timevar*, and select *Open Command Window Here*.

c. In the command window, type: *hydro hydro.inp*. Examine timebar_1_hydro_echo.inp. Did the time series assignment get used?

d. In the command window, type: *qual qual.inp*.

e. Open the *output.dss* file in the *t4_timevar* directory, and verify that the results are identical to the results from the previous tutorial (located in the *t3_layering* directory). Why is this?

Adjust DSM2MODIFIER to represent a variant scenario:

f. In Windows Explorer, navigate to the directory: *\{DSM2_home}\tutorial\simple\t4_timevar*

g. Open *hydro.inp* for editing.

h. In the *ENVVAR* section, change the *DSM2MODIFIER* environment variable from *timevar_1* to *timevar_2*.

i. Open *qual.inp* for editing.

j. In the *ENVVAR* section, change the *DSM2MODIFIER* environment variable from *timevar_1* to *timevar_2*.

3. Add Source information into HYDRO:

a. In *input_hydro_ts_tutorial.inp*, create the table for node sources:

```
SOURCE_FLOW
NAME      NODE     SIGN      FILLIN         FILE          PATH
END
```

b. Enter the following values into the appropriate fields:

i) Name: *source1*

ii) Node: *5*

iii) Input File: *${TUTORIALINPUT}*

iv) Path/Value: */TUTORIAL/SOURCE/FLOW//15MIN/CONSTANT/*

v) Sign: *1*

vi) Fillin: *linear*

c. Save the current settings.

4. Add Corresponding Source information into QUAL:

a. Create a file called *input_qual_ts_tutorial.inp*.

1) In input_qual_ts_tutorial.inp, create the NODE_CONCENTRATION table

```
NODE_CONCENTRATION
NAME    NODE_NO    VARIABLE    FILLIN    FILE    PATH
END
```

2) Enter the following values into the appropriate fields:
   i) Input Name: *source1*
   ii) Node: *5*
   iii) Variable: *ec*
   iv) Input File: *${TUTORIALINPUT}*
   v) Path/Value: */TUTORIAL/SOURCE/EC//15MIN/CONSTANT/*
   vi) Fillin: *last*
3) Add the ENVVAR definition for TUTORIALINPUT in qual.inp

```
TUTORIALINPUT   ../timeseries/tutorial.dss
```

b. In qual.inp, make sure that the file gets used:

```
QUAL_TIME_SERIES
input_node_conc_tutorial.inp
input_qual_ts_tutorial.inp
END
```

5. Add Time-varying Tide Information for Downstream Boundary in HYDRO:

1) Reopen *Input_hydro_ts_tutorial.inp*
2) Create the *BOUNDARY_STAGE* table.

```
BOUNDARY_STAGE
NAME    NODE   FILLIN    FILE   PATH
END
```

3) In the *Boundary Stage table* enter the following values into the appropriate fields:
   i) Input Name: *downstream_stage*
   ii) Node: *7*
   iii) Input File: *${TUTORIALINPUT}*
   iv) Path/Value: */TUTORIAL/DOWNSTREAM/STAGE//15MIN/REALISTIC/*
   v) Fillin: *linear*

6. Add Downstream Boundary in QUAL:

a. Re-open *input_qual_ts_tutorial.inp*.

b. In the *Node Concentration table*:

1) Enter the following values into the appropriate fields:

i) Input Name: *downstream_stage*

ii) Node: *7*

iii) *Variable: ec*

iv) Input File: *${TUTORIALINPUT}*

v) Path/Value: */TUTORIAL/DOWNSTREAM/EC//15MIN/REALISTIC/*

vi) Fillin: *last*

7. Add a Gate Time Series to HYDRO:

This gate time series will control the weir. The pipe is to be left open all the time (its default).

a. Create a file for the gate input called *input_ gate_tutorial.inp*

b. Create the *gate time series table* INPUT_GATE:

c. In the table enter the following values into the appropriate fields:

i) Gate: *gate_1*

ii) Device: *weir*

iii) Variable: *op_from_node*

iv) Input File: *${TUTORIALINPUT}*

v) Path/Value: */TUTORIAL/GATE/FLAP_OP//IR-YEAR/TIMEVAR/*

vi) Fillin: *none* (Can you tell why fillin is “none” for this time series?)

d. Add the include file to hydro.inp. The time series block should look as follows:

```
HYDRO_TIME_SERIES
input_boundary_hydro_tutorial.inp
input_transfer_flow_tutorial.inp
input_hydro_ts_tutorial.inp
input_gate_tutorial.inp
END
```

e. Save the current settings.

Running HYDRO and QUAL

f. In Windows Explorer, navigate to the directory: *{DSM2_home}**tutorial**simple*\.

g. Right-click on the directory, *t4_timevar*, and select *Open Command Window Here*.

h. In the command window, type: *hydro hydro.inp*.

i. In the command window, type: *qual qual.inp*.

j. Open the *output.dss* file in the *t4_timevar* directory, and examine the results.