DSM2 Bay-Delta Tutorial 1: Historical Simulation

Purpose: This tutorial will demonstrate how to launch a basic run of the historical HYDRO and QUAL simulations. You will also get practice using the study templates that are distributed with DSM2, see how the configuration file is used, make some changes in the output and learn about the post-processing “transfer” script for averaging your output.

Except as part of a re-calibration, it is rare to make big changes in the historical simulation. More commonly, you will want to add a few output locations or scalars. Large scale policy or physical changes are usually analyzed within a Planning simulation framework, covered in a later tutorial.

HYDRO and QUAL

1. **Copy the historical template:**
    a. In windows, copy the folder *\{DSM2_home}\study_template\historical* to the tutorial directory, creating *\{DSM2_home}\tutorials\historical*.
    b. Open *historical_hydro.inp* and *historical_qual_ec.inp.* Note the CONFIGURATION sections of both reference a file *configuration_historical.inp*. By containing variables such as run dates in this file, you can more easily synchronize the models.
    c. Examine *common_input*. By looking at *historical_hydro.inp* and the other main input files, you will see that many of the included files for the models are in the directory ${DSM2INPUTDIR}. In this distribution, this variable points to */dsm2/common_input* -- a repository in which all the distributed DSM2 input files are housed. Later, you may want to copy the input files locally and repoint ${DSM2INPUTDIR} to this local directory. In fact, there are tools to help with this. Regardless of whether you copy them, please resist changing the files directly – it is much easier to diagnose problems if you make your changes in the main file (*historical_hydro.inp, historical_qual_ec.inp*…) or in a new file of your own making.

2. **Modify the Run Times in the Configuration File:**

   In the configuration file, set the runtime definitions as follows.

```
#runtime
START_DATE        01JAN1996
START_TIME         0000
QUAL_START_DATE    02JAN1996
PTM_START_DATE     ${QUAL_START_DATE}
END_DATE            31DEC1996
END_TIME           2400
```

3. **Note the Output Step in HYDRO:**

   If you look in the channel_output files (e.g. *output_channel_std_hydro_rki.inp)*, you will find that the time step of the output is itself an ENVVAR definition called ${FINE_OUT}. This is usually defined as 15 minutes. Although DSM2 v8 will perform daily averages, it is recommended that you use the finer output and aggregate as a postprocessing step (we will cover this shortly).

4. **Add some Output**

   In historical_hydro.inp, add a block containing an extra flow output for Old River at Head. Notice that the name in this case is a "practical" name. Although you may sometimes add input with names like "ch56_0", such a name is redundant with the other information in the line, is difficult for non-modelers to understand and causes confusion if the grid numbering changes.

```
OUTPUT_CHANNEL
NAME    CHAN_NO DISTANCE VARIABLE INTERVAL    PERIOD_OP FILE
oldr_head    56        0 flow     ${FINE_OUT} inst      ${HYDROOUTDSSFILE}
END
```

5. **Run HYDRO and QUAL:**

   a. In Windows Explorer, navigate to the directory, *\{DSM2_home}\tutorial*
   b. Right-click on the *historical* directory, and select, *Open Command Window Here.*
   c. In the command window, type: *hydro historical_hydro.inp*.
   d. Wait for HYDRO to complete its runs.
   e. Now type: *qual qual_ec.inp*

6. Aggregate the Output

Above we recommended that you use post-processing to aggregate your output.

Lets see how this works. At a command prompt in the study/output directory, type:

```
> transfer -–help
```

This command should give you the options for the “transfer.py” script that will help you aggregate your output.

For instance, if you want to create a daily average of all your flow output, type (this is all one line):

```
>transfer --out=postpro.dss --selection=///FLOW////
   --transform=period_ave --interval=1DAY historical.dss
```

As another example, you may want to take a Godin average of all the stage output and put it in the same file:

```
>transfer --out=postpro.dss --selection=///STAGE////
   --transform=godin historical.dss
```

You can similarly do monthly averages by making the interval 1MON and you can “slice” in time by specifying a time window (the syntax is given by the help command:

```
> transfer -–help
```

7. Running QUAL with Nonconservative Constituents: (PENDING DATA)

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

b. Open *qual_do.inp*.

c. Open *configuration_historical.inp*.

   1) In the ENVVAR section, locate the environmental variable, DSM2MODIFIER from *hist* to hist_*nonconserve*.

   2) Save *configuration_historical.inp*.

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

Particle Tracking Modeling (PTM)

1. **Run PTM**
   a. In the command window, type: ptm historical_ptm.inp
      1) If necessary, reduce the running time period by modifying *END_DATE* in *configuration_historical.inp*.

Making animation of Particle Tracking Modeling (PTM)

1. **Modify the PTM input file to make text output and to turn on the dispersion parameters:**
   a. In Windows Explorer, copy the folder *ptm_animate* (with subfolders) from *\{DSM2_home}\study_templates\ptm_animate*
      to the study directory, creating:
      \{DSM2_home}\tutorials\historical\ptm_animate
   b. With the PTM, it is useful to be able to switch easily between text and dss output formats -- note that the animator requires text files. The *configuration_historical.inp* file is structured so that we can swap the environmental variable *PTMOUTPUTFILE*. We are going to point *PTMOUTPUTFILE* to *PTMOUTPUTTEXT* so we can use the animator.
      i) Locate the *PTMOUTPUTFILE* at the end of the file, and modify as:

```
PTMOUTPUTFILE   ${PTMOUTPUTTEXT}
```

   c. Open the file, *historical_ptm.inp*.
      1) Locate the SCALARS section. Check all of the dispersion parameters to be *t*.

```
ptm_ivert    t   # Use Vertical velocity profile
ptm_itrans   t   # Use Transverse velocity profile
ptm_iey       t   # Use transverse mixing
ptm_iez       t   # Use vertical mixing
```

2. **Run PTM:**
   a. In the command window, type: *ptm historical_ptm.inp*.
   b. In Windows Explorer:

1) Navigate to the directory,

   \{DSM2_home}\tutorials\historical\output

2) Examine the output in the *ptmout.txt* file.
3) Copy the files, *anim_db.bin* and *ptmout.txt*.
4) Navigate to the directory,

   \{DSM2_home}\tutorials\historical\ptm-animate\dual\left_panel

5) Paste the files in the *left_panel* directory.

3. Repeat with Dispersions Parameters Turned Off:

a. In Windows Explorer, navigate to the directory,

   \{DSM2_home}\tutorials\historical

b. Open the file, *historical_ptm.inp*.
   1) Locate the SCALARS section.
   2) Change all of the dispersion parameters from *t* to *f*.

      ptm_ivert *f* # Use Vertical velocity profile
      ptm_itrans *f* # Use Transverse velocity profile
      ptm_iey *f* # Use transverse mixing
      ptm_iez *f* # Use vertical mixing

c. In the command window, type: *ptm historical_ptm.inp*.
d. In Windows Explorer:
   1) Navigate to the directory,

      \{DSM2_home}\tutorials\historical\output

   2) Copy the files, *anim_db.bin* and *ptmout.txt*.
   3) Navigate to the directory,

   \{DSM2_home}\tutorials\historical\ptm-animate\dual\right_panel

   4) Paste the files in the *right_panel* directory.
   5) Navigate to the directory,

      \{DSM2_home}\tutorials\historical\ptm-animate

   6) Double-click on *dual.bat* to open the animator.
   7) Press start to start the animator and use the controls to adjust the speed.

4. Modifying the Animator Display:

a. The *left_panel* and *right_panel* directories contain files needed for operation:
   1) *fluxInfoDB.data* stores file and path information for the PTM output (the flux output in the text file is labeled with DSS-like path names). The listings in this file will be turned into the small flux bar graphs you see in the animator. The integer you see above the file name is node, which is how you identify locations in the animator (see *network.dat* below)
   2) *labelsDB.data* stores label information. You list labels and their location (using nodes, see *network.dat* below)
   3) *network.dat* stores *x*- and *y*-locations for nodes and channels. Pseudo-nodes are used for labels and other annotations as noted above. Please note that the nodes that are used in *network.dat* are internal node numbers, not external. This makes the file very hard to edit, a point that will probably be addressed in the future. If you want a mapping of external-to-internal numbers, look at your echoed hydro output file (*.out or *.hof).
b. Examine these files and the labels in them. Change the labels to something creative and reopen the animator.