CALIFORNIA DEPARTMENT OF WATER RESOURCES

DSM2 Quick Start: Historical Simulation Demo and Hands-On

June 23, 2023

Brad Tom

Modeling Support Office, Delta Modeling Section

Overview

1. **Introduction to DSS**
2. Introduction to HDF5 (DSM2 tidefiles)
3. Quick Review of DSM2 input setup
4. Hands-on exercises

Historical base case	Run 1: Base historical study
Sac River Flow +30%	Run 2: Sacramento River flow increased by 30%
Temporary Barrier increased width	Run 3: Increased temporary barrier width (optional)

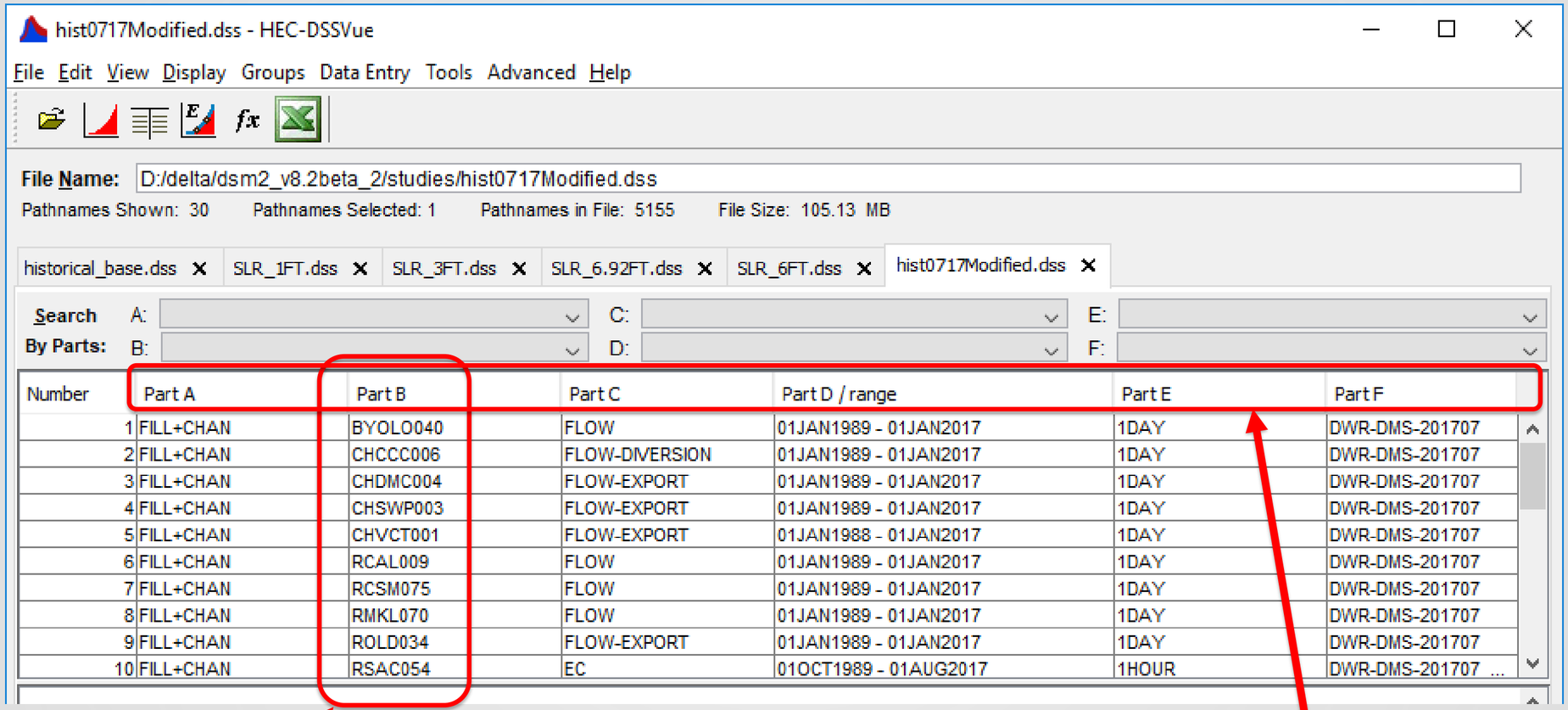
1a. Introduction to DSS

DSS = Data Storage System

- USACE Hydrologic Engineering Center (HEC) **D**ata **S**torage **S**ystem
- Time series database, **not** a relational database
- time series input and output
- HEC-DSSVue, Vista, pyhecdss
- For more information: HEC-DSS:
  - https://www.hec.usace.army.mil/software/hec-dss/

1b. Introduction to DSS

HEC-DSSVue



RKI Value = River Kilometer Index

River or slough abbreviation + distance from some downstream reference point

Example:
RSAC054 = Sacramento River, 54 km from Golden Gate (Martinez)

Column headers: Pathname Parts

1c. Introduction to DSS

HEC-DSSVue: Time Intervals

Regular Time Series data

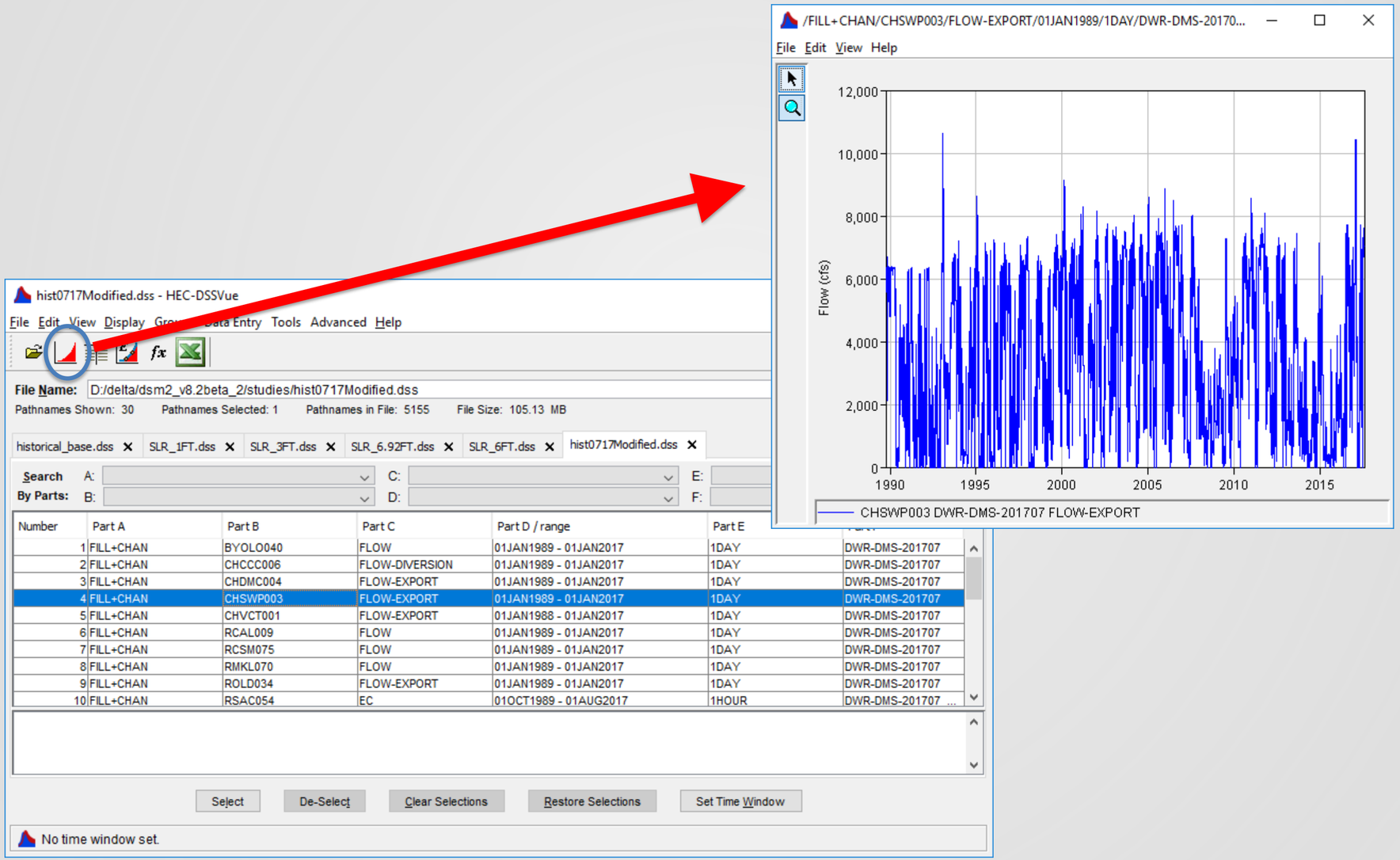
Number	Part A	Part B	Part C	Part D / range	Part E	Part F
1	FILL+CHAN	BYOLO040	FLOW	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707
2	FILL+CHAN	CHCCC006	FLOW-DIVERSION	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707
3	FILL+CHAN	CHDMC004	FLOW-EXPORT	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707
4	FILL+CHAN	CHSWP003	FLOW-EXPORT	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707
5	FILL+CHAN	CHVCT001	FLOW-EXPORT	01JAN1988 - 01JAN2017	1DAY	DWR-DMS-201707
6	FILL+CHAN	RCAL009	FLOW	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707
7	FILL+CHAN	RCSM075	FLOW	01JAN1989 - 01JAN2017	1DAY	DWR-DMS-201707

Irregular Time Series data

Number	Part A	Part B	Part C	Part D / range	Part E	Part F
1	HIST+GATE	CHWST000	POS	30Apr1971 - 01Aug2017	IR-YEAR	DWR-OM-JOC-DSM2
2	HIST+GATE	GL_CN	INSTALL	30Sep1986 - 01Jan2020	IR-DECADE	DWR-BDO
3	HIST+GATE	GL_CN	PIPE_OP_DOWN	30Sep1986 - 01Jan2020	IR-DECADE	DWR-BDO
4	HIST+GATE	GL_CN	WEIRELEVATION	30Sep1986 - 31Dec2019	IR-DECADE	DWR-BDO_NAVD
5	HIST+GATE	GL_CN	WEIRWIDTH	30Sep1986 - 31Dec2019	IR-DECADE	DWR-BDO
6	HIST+GATE	MID_R	INSTALL	30Sep1986 - 01Jan2020	IR-DECADE	DWR-BDO
7	HIST+GATE	MID_R	PIPE_OP_DOWN	30Sep1986 - 01Jan2020	IR-DECADE	DWR-BDO
8	HIST+GATE	MID_R	WEIRELEVATION	30Sep1986 - 18Nov2016	IR-DECADE	DWR-BDO_NAVD
9	HIST+GATE	MTZSL	BOATLOCK_OP	01Jan1980 - 01Jan2020	IR-DECADE	DWR-ESO
10	HIST+GATE	MTZSL	FLASHBOARD_OP	01Jan1980 - 01Jan2020	IR-DECADE	DWR-ESO

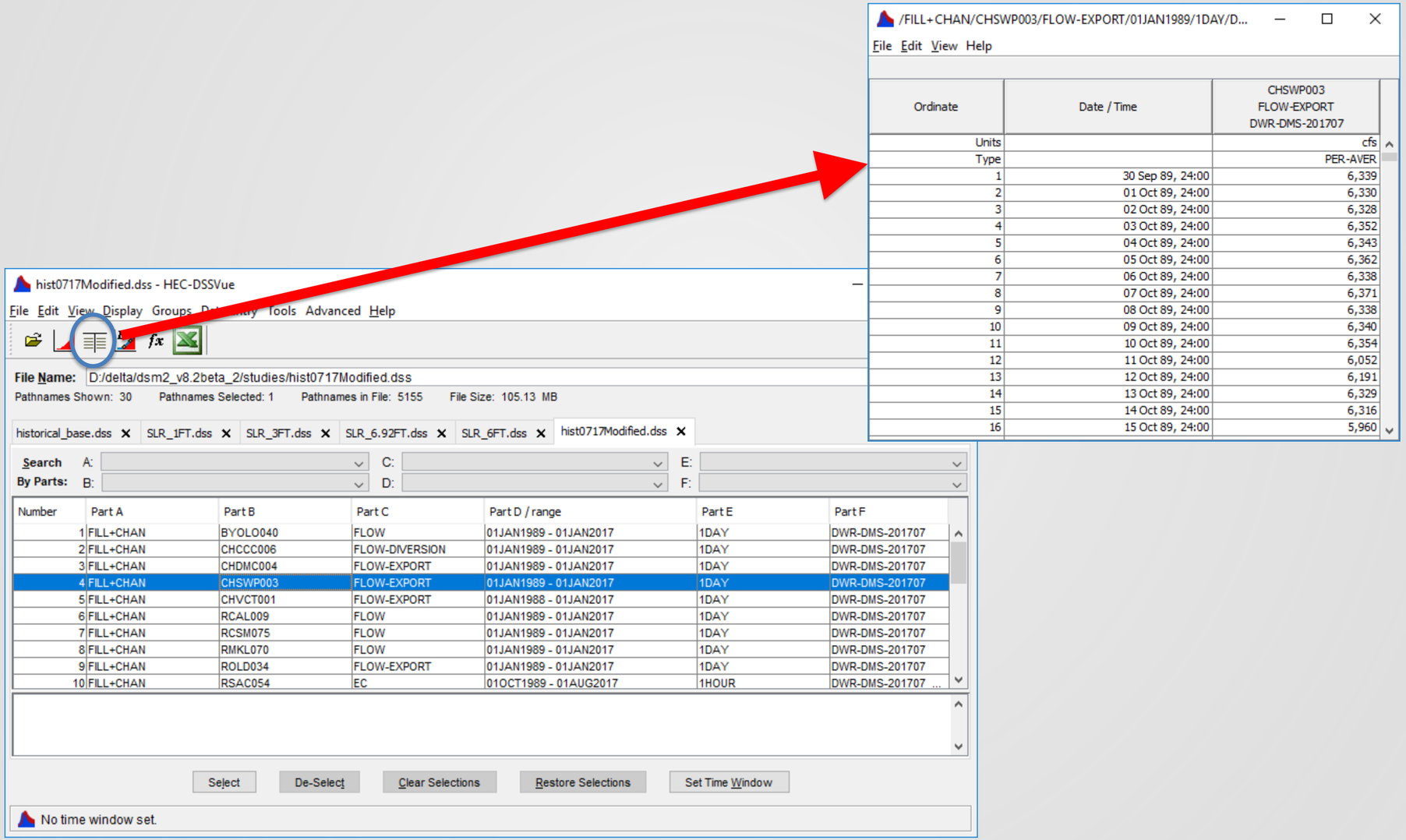
1d. Introduction to DSS

HEC-DSSVue: Plotting Data



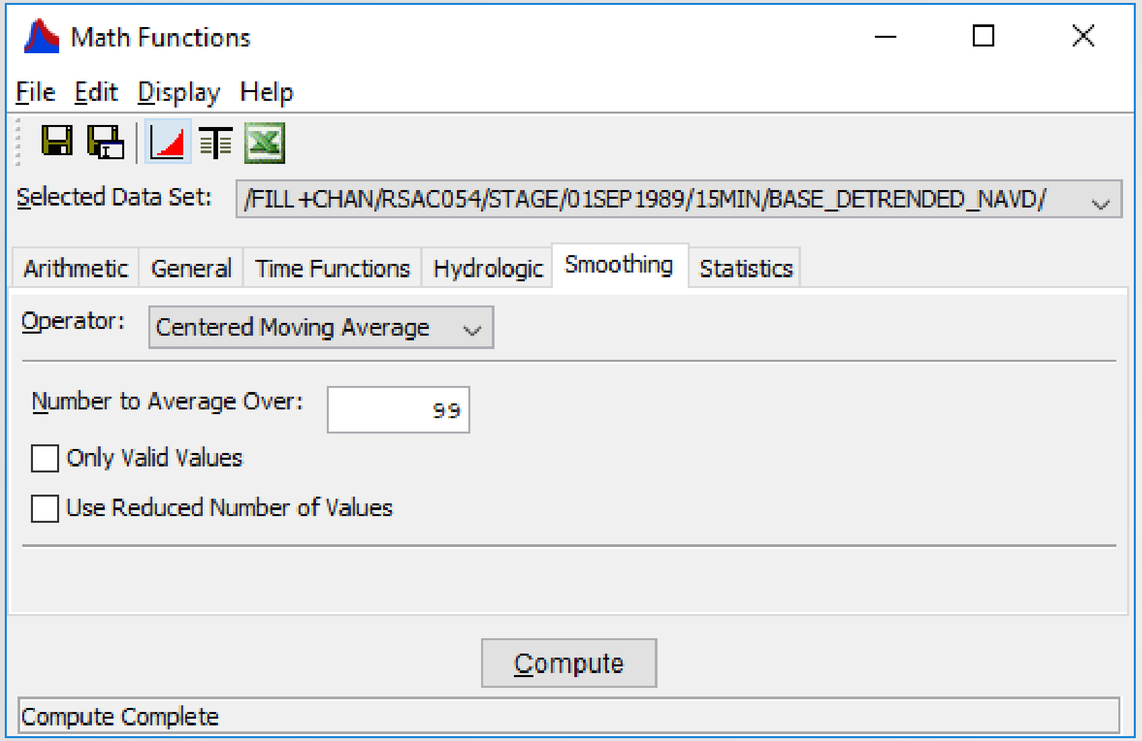
1e. Introduction to DSS

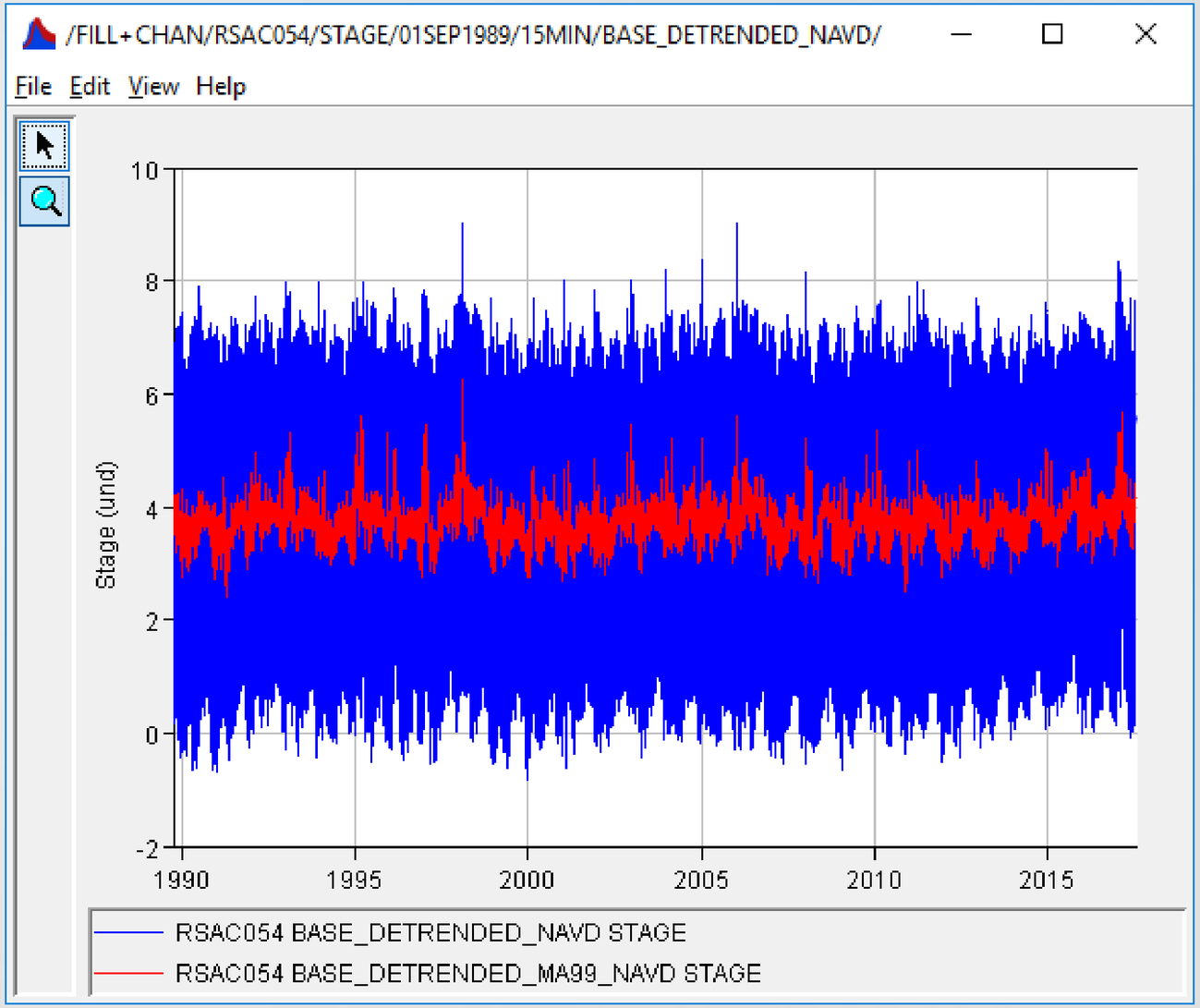
HEC-DSSVue: Tabulating Data



1f. Introduction to DSS

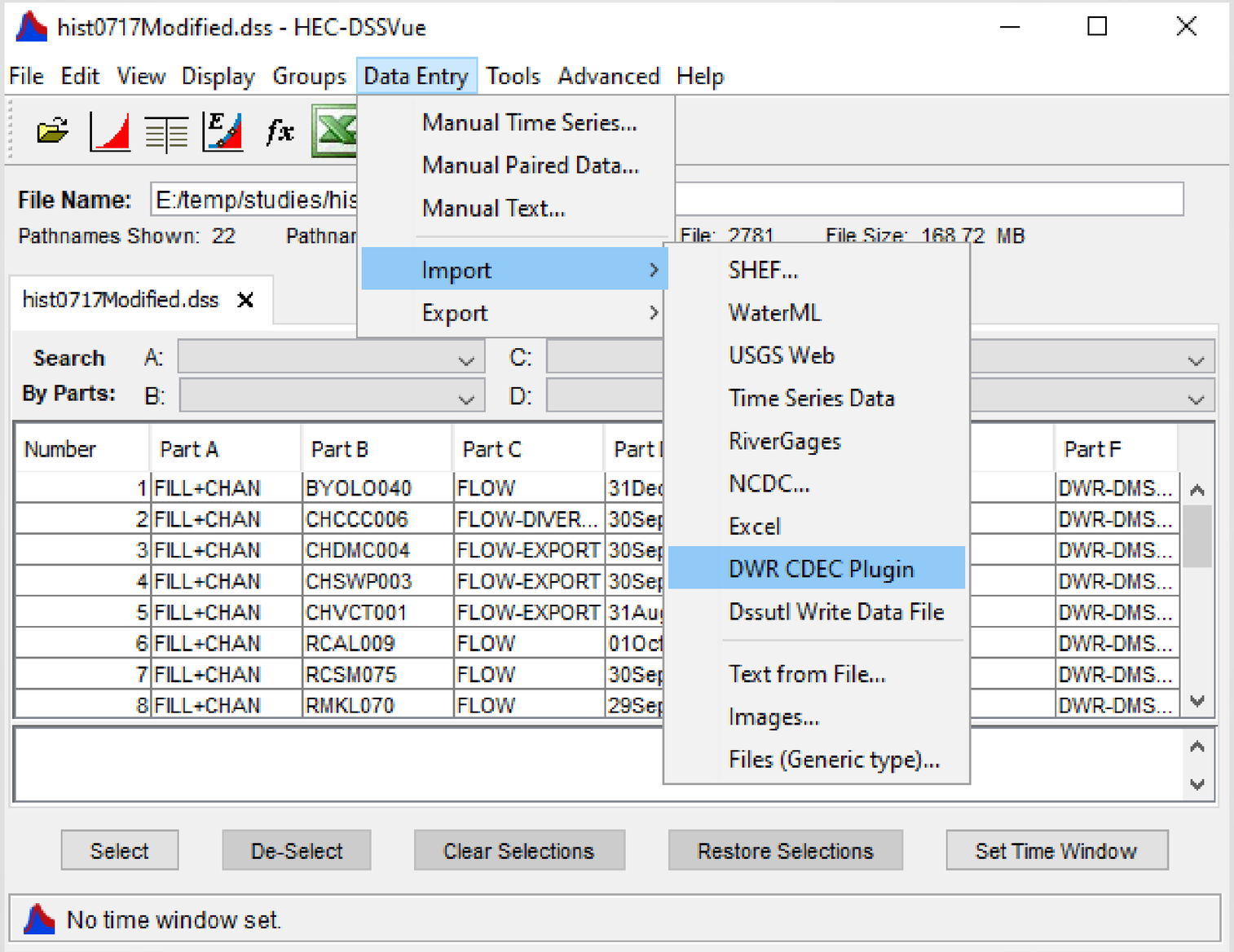
HEC-DSSVue: Smoothing Data





1g. Introduction to DSS

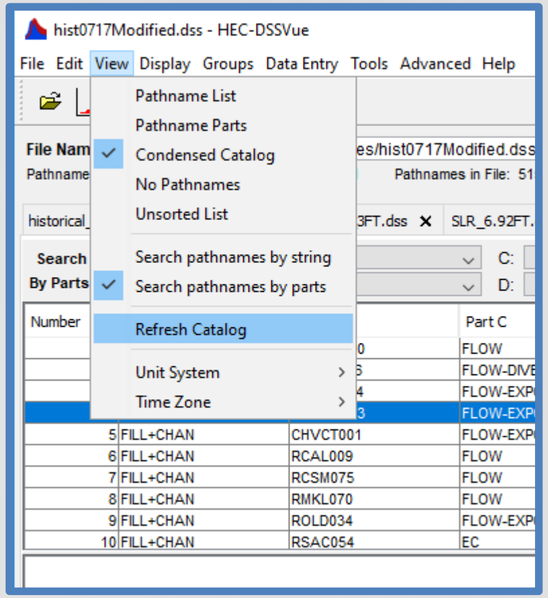
HEC-DSSVue: Importing data from web

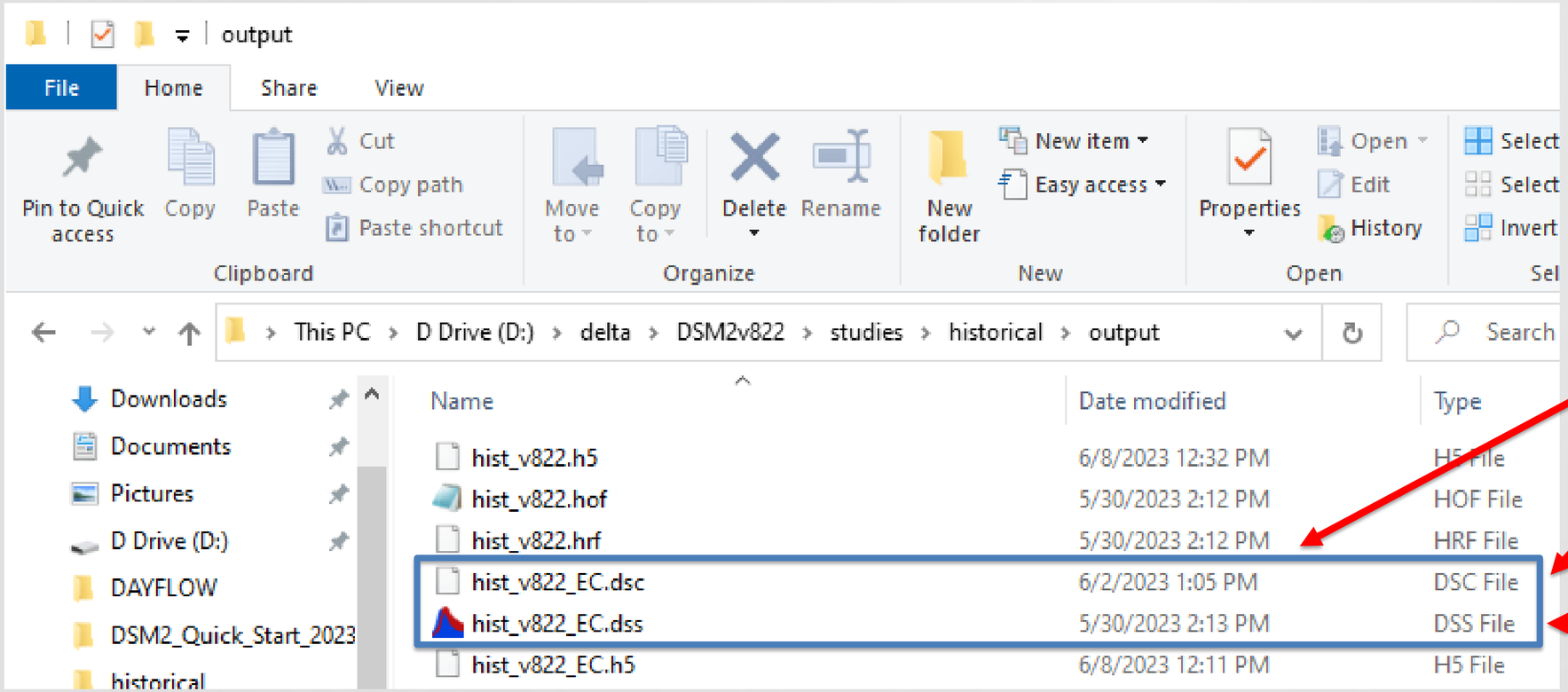


1h. Introduction to DSS

DSS Catalog files: check the revision date

- A text file
- Catalog files tell applications like HEC DSSVue how to find data in the file.
- **Revision date** should be same or later than DSS revision date
- If not, View-Refresh Catalog in DSS Vue or delete the catalog file





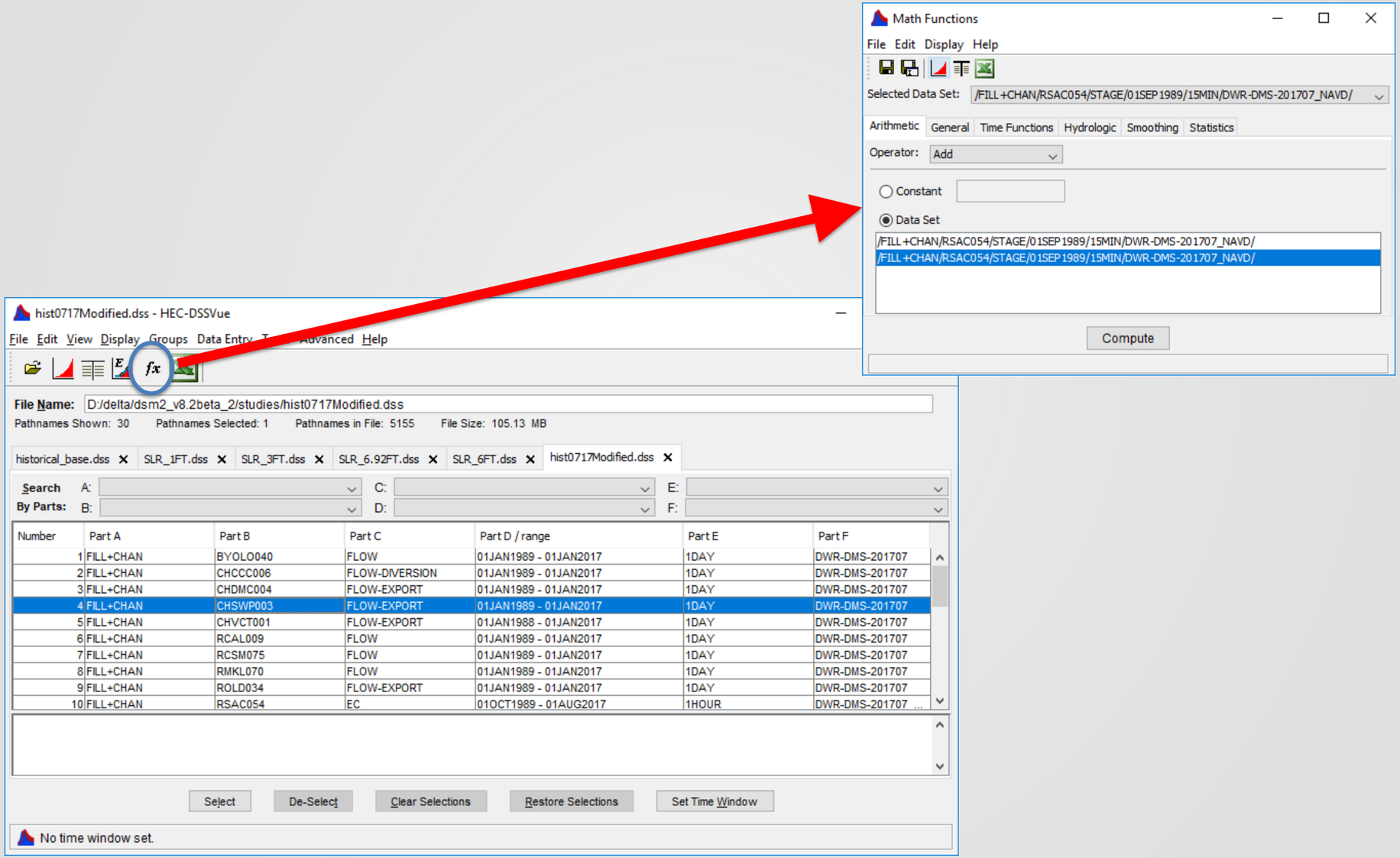
Revision dates

DSS catalog file

DSS database file

1i. Introduction to DSS

HEC-DSSVue: Math Functions



Overview

1. Introduction to DSS
2. **Introduction to HDF5 (DSM2 tidefiles)**
3. Quick Review of DSM2 input setup
4. Hands-on exercises

Historical base case	Run 1: Base historical study
Sac River Flow +30%	Run 2: Sacramento River flow increased by 30%
Temporary Barrier increased width	Run 3: Increased temporary barrier width (optional)

2. HDF5 files (DSM2 tidefiles, .h5)

- **H**ierarchical **D**ata **F**ormat
- Data stored in binary format-can’t use a text editor
- Data stored includes:
  - DSM2 fixed input
  - DSM2 output (Hydro), input (Qual, ECO-PTM, GTM)
- Viewing data
  - Vista (time series output)
  - HDF View (time series output, fixed input)
  - DSM2 animator
- For more information: https://www.hdfgroup.org/solutions/hdf5/

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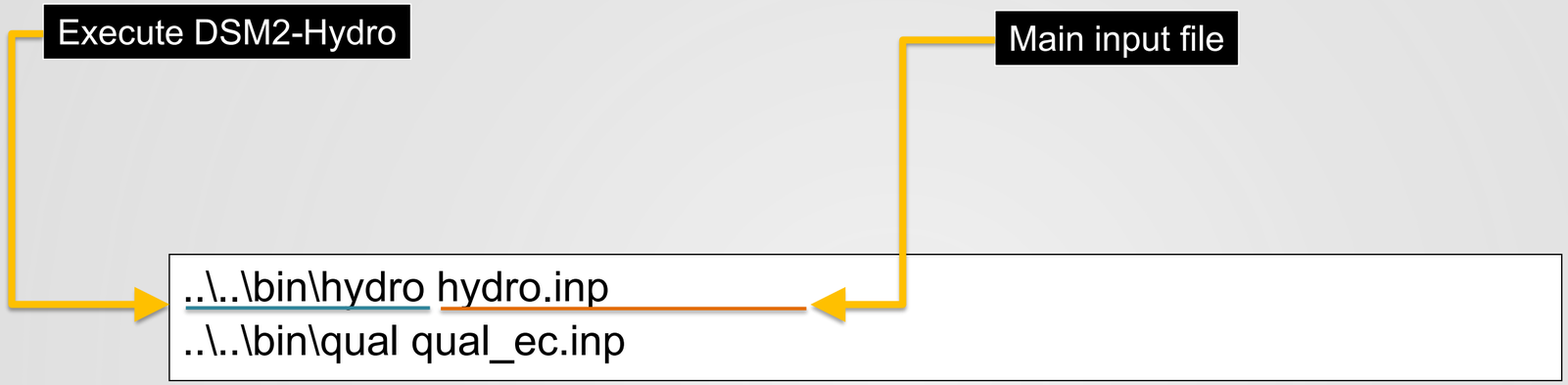
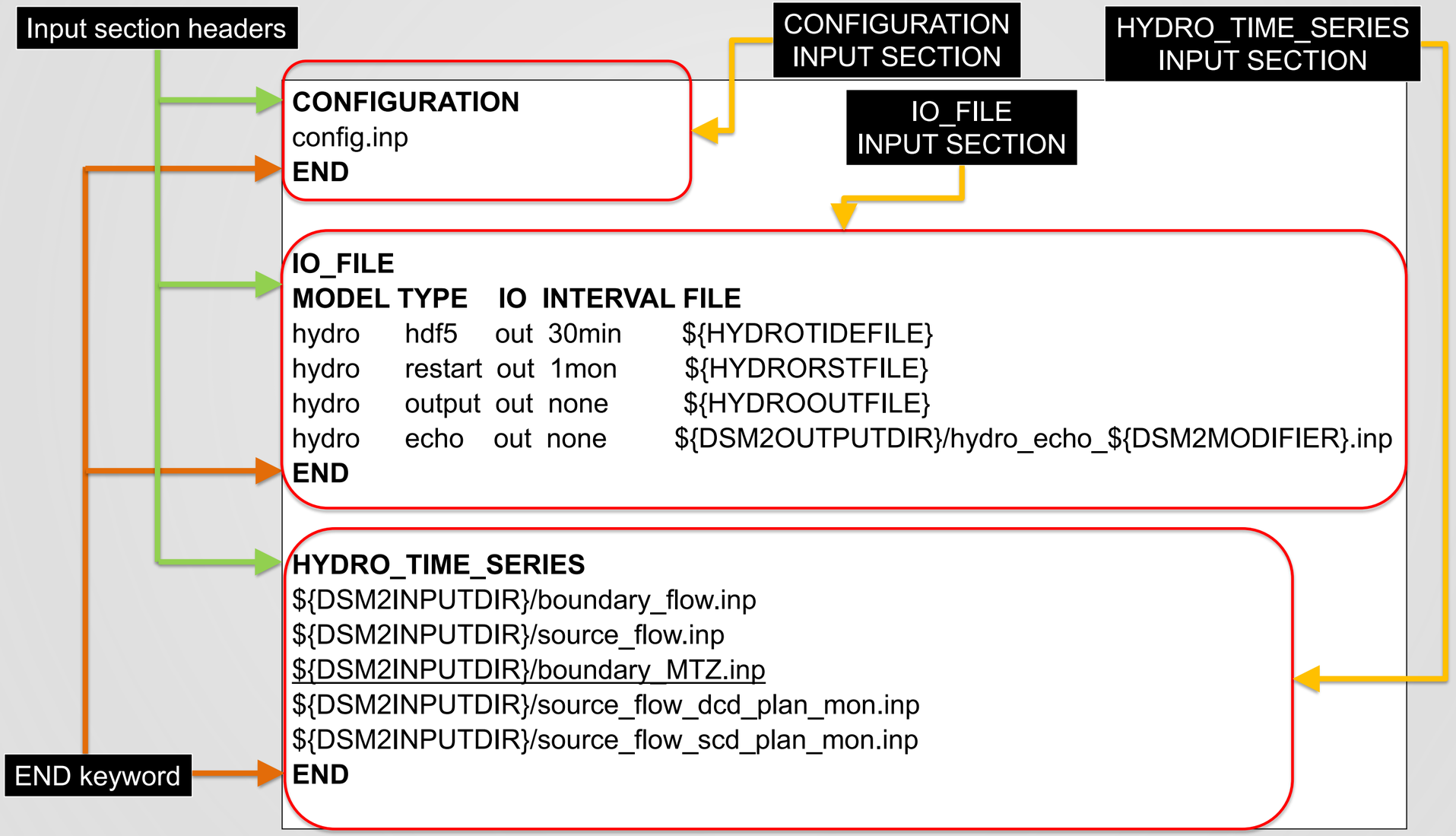
3a. Quick Review of DSM2 input setup

Setting up a DSM2 Study: dsm2.bat file



3b. Quick Review of DSM2 input setup

DSM2 Input files: hydro.inp



3c. Quick Review of DSM2 input setup

DSM2 Input files: config.inp

Defines environment variables, which are used to configure a DSM2 simulation

```
ENVVAR
NAME                VALUE
DSM2MODIFIER        historical      # Study name used for DSM2 output
START_DATE          01Jan1990
END_DATE            31Dec2019
END
```

Overview

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4. **Hands-on exercises**

Historical base case	**Run 1: Base historical study**
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Temporary Barrier increased width	Run 3: Increased temporary barrier width (optional)

4. Hands-on exercises

Reminders

1. Raise your hand (on Teams) when you complete each step
2. If you have a question, enter it into the Teams chat, even if you are in the room

4. Hands-on exercises

Input files to be modified for each study

Historical Base Case	**Sac River** **+30%**	**Temporary Barrier** Increase Width
config.inp	config.inp hist201712.dss boundary_flow_delta_historical.inp	config.inp hydro.inp gate_std_delta_grid.inp

Run 1. Base Historical Study

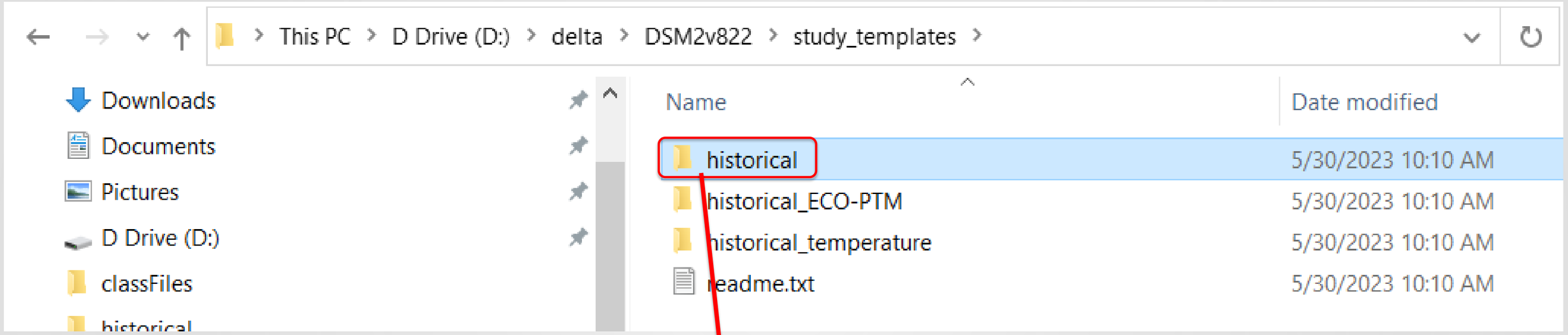
Task list

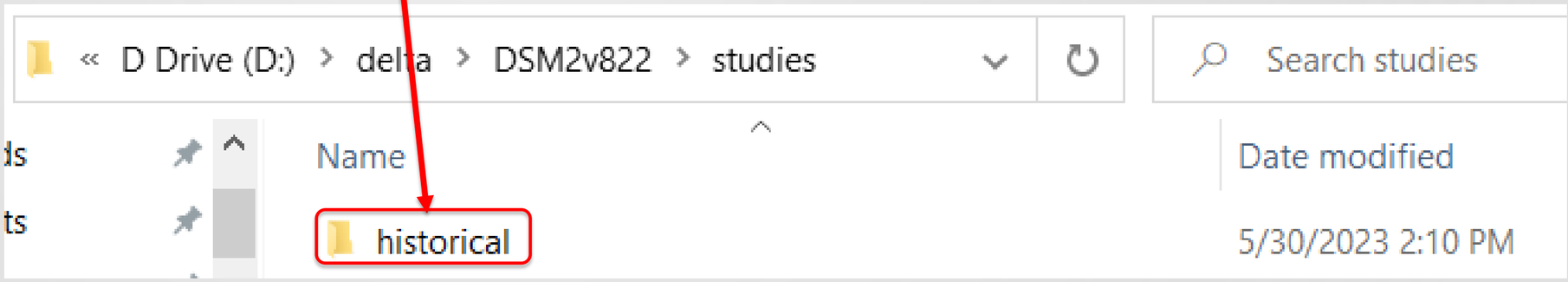
GOAL	Create 3 historical study folders with shortened runtime
TASKS	• Copy the "**historical**" folder from "**study_templates**" to "**studies**" • Modify the starting and ending dates in ***config.inp*** • Make two more copies of the modified "historical" folder: "**historical_sac_incr**" and "**historical_gate_mod**" • Edit the qual_ec.inp file, uncommenting the line that creates a qual tidefile
TOOLS	• Windows Explorer • Text editor

Use underscores _ instead of spaces in folder and file names

Run 1. Base Historical Study

copy the “historical” study folder from “study_templates” to “studies”





Only make the **historical** folder now

We will make other study folders later

Run 1. Base Historical Study

Changing starting and ending times in config.inp

config.inp

```
ENVVAR
NAME                VALUE
DSM2MODIFIER        hist_v822
END


#runtime
START_DATE          01Jan2005
QUAL_START_DATE     02Jan2005
END_DATE            31Jan2005
START_TIME          0000
END_TIME            0000
```

Historical
Base Case

Run 1. Base Historical Study

qual_ec.inp: Creating EC tidefile output

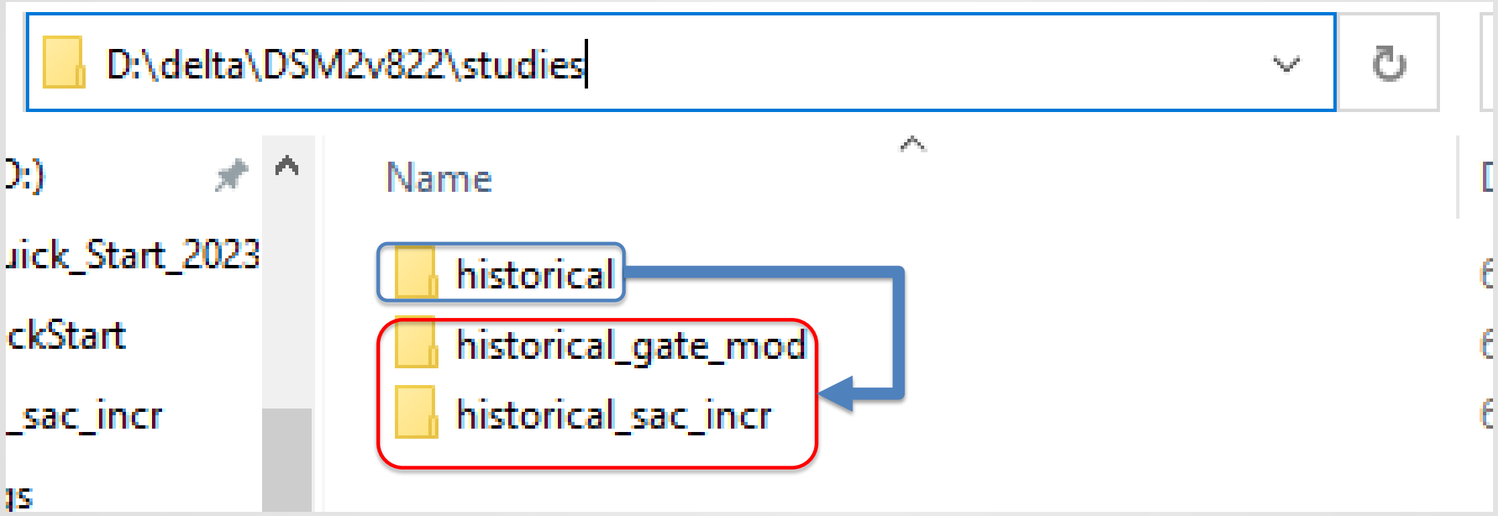
"Main Input File" for Qual: qual_ec.inp

```
IO_FILE
MODEL TYPE    IO  INTERVAL FILE
# qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  restart out 1mon     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qrf
qual  output  out none     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qof
qual  echo    out none     ${DSM2OUTPUTDIR}/qual_echo_${DSM2MODIFIER}_EC.inp
END
```

Historical Base Case

Run 1. Base Historical Study

Create 2 copies of the modified “historical” study folder



Run 1. Base Historical Study

Run hydro and qual models

Enter the following commands into a separate command prompt window:

Historical

```
cd D:\delta\DSM2v822\studies\historical\
DSM2_batch.bat
```

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Temporary Barrier increased width	Run 3: Increased temporary barrier width (optional)

Run 2. Increased Sac. R Flow Study

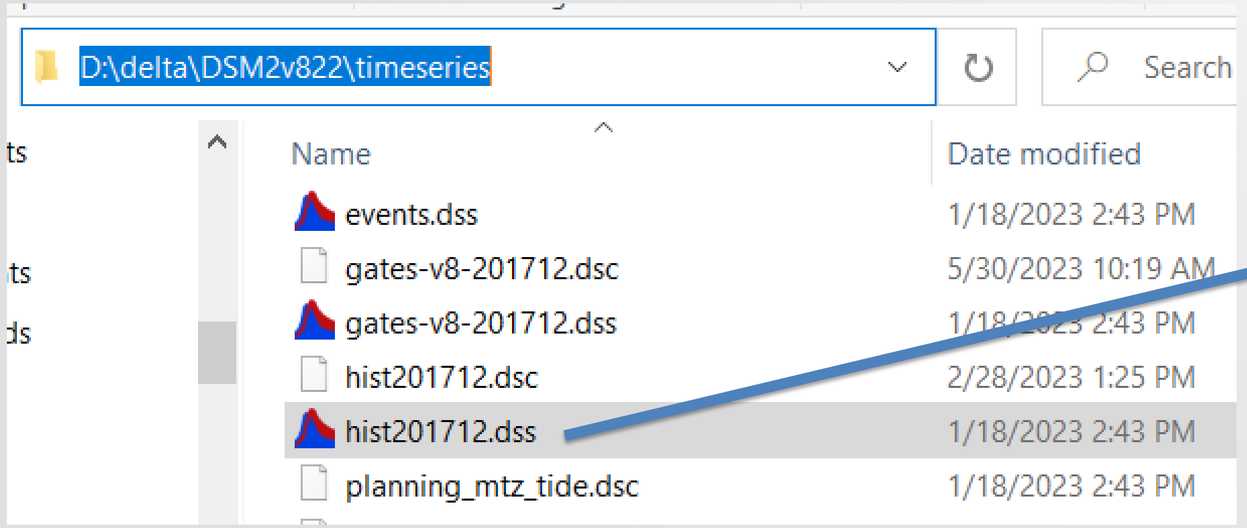
Configure the increased Sacramento River Flow study

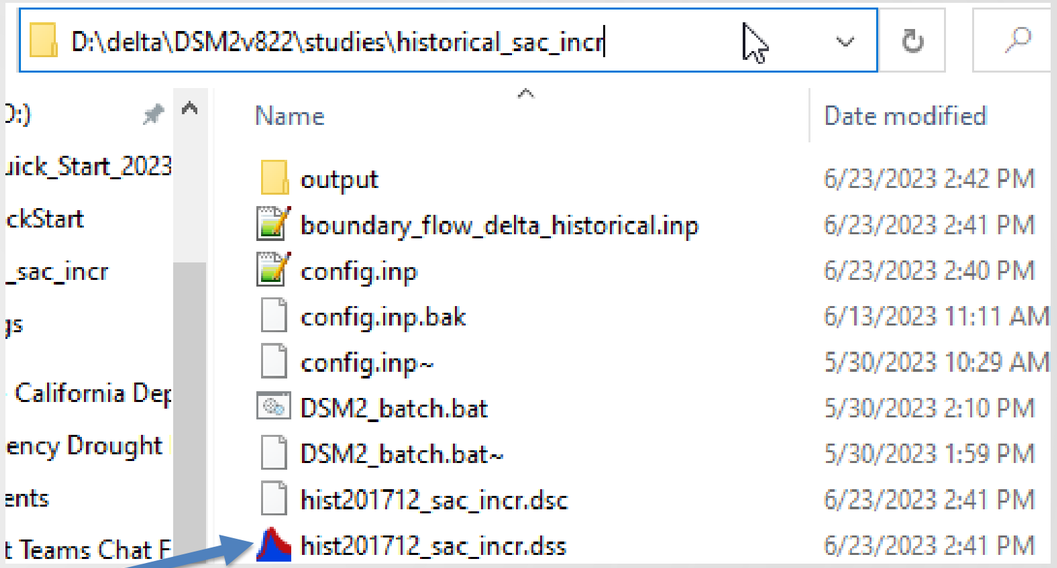
GOAL	Modify DSM2 historical simulation to **increase Sacramento River flow by 30%**
TASKS	• In the "**hist_sac_incr**" folder: • Change DSM2MODIFIER in ***config.inp*** • Add a copy of ***hist201712.dss*** • Edit the ***hist2017.dss*** file to increase Sac River flow by 30% • Add a copy of the boundary flow input file *(**boundary_flow_delta_historical.inp**)* • Edit hydro.inp to use the local copy of the file • Edit the boundary flow input file to point to the Sac + 30% *.dss time series • Edit the qual_ec.inp file, uncommenting the line that creates a qual tidefile
TOOLS	• Windows Explorer • HEC-DSSVue • Text editor • WinMerge

Run 2. Increased Sac. R Flow Study

copy hist201712.dss to the study folder

Copy input DSS file to study folder, and **rename**





Sac +30%

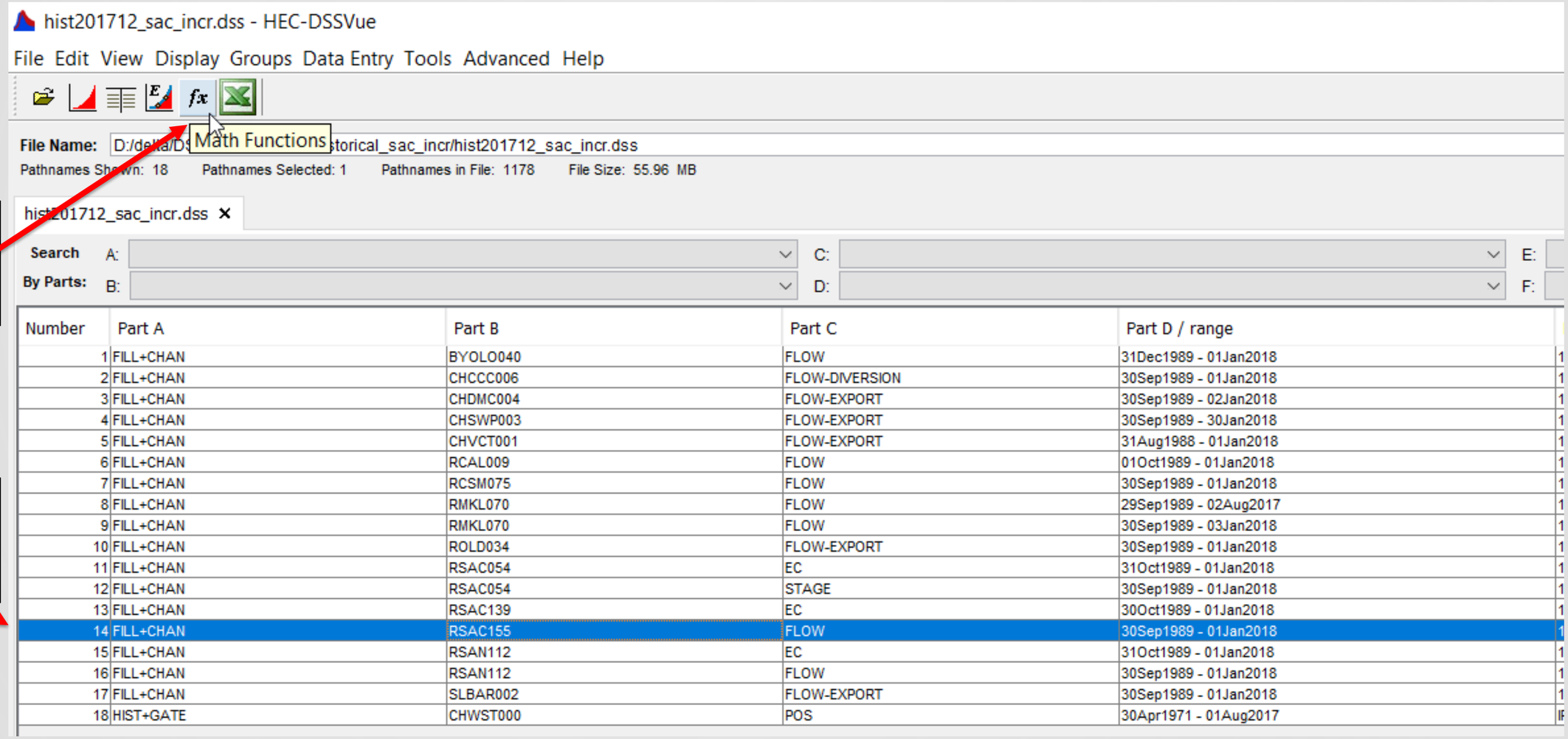
Run 2. Increased Sac. R Flow Study

HEC DSS-Vue: open Math Functions Window

Sac +30%

2. Click the Math Functions (“fx”) button

1. Select the Sacramento River Inflow path

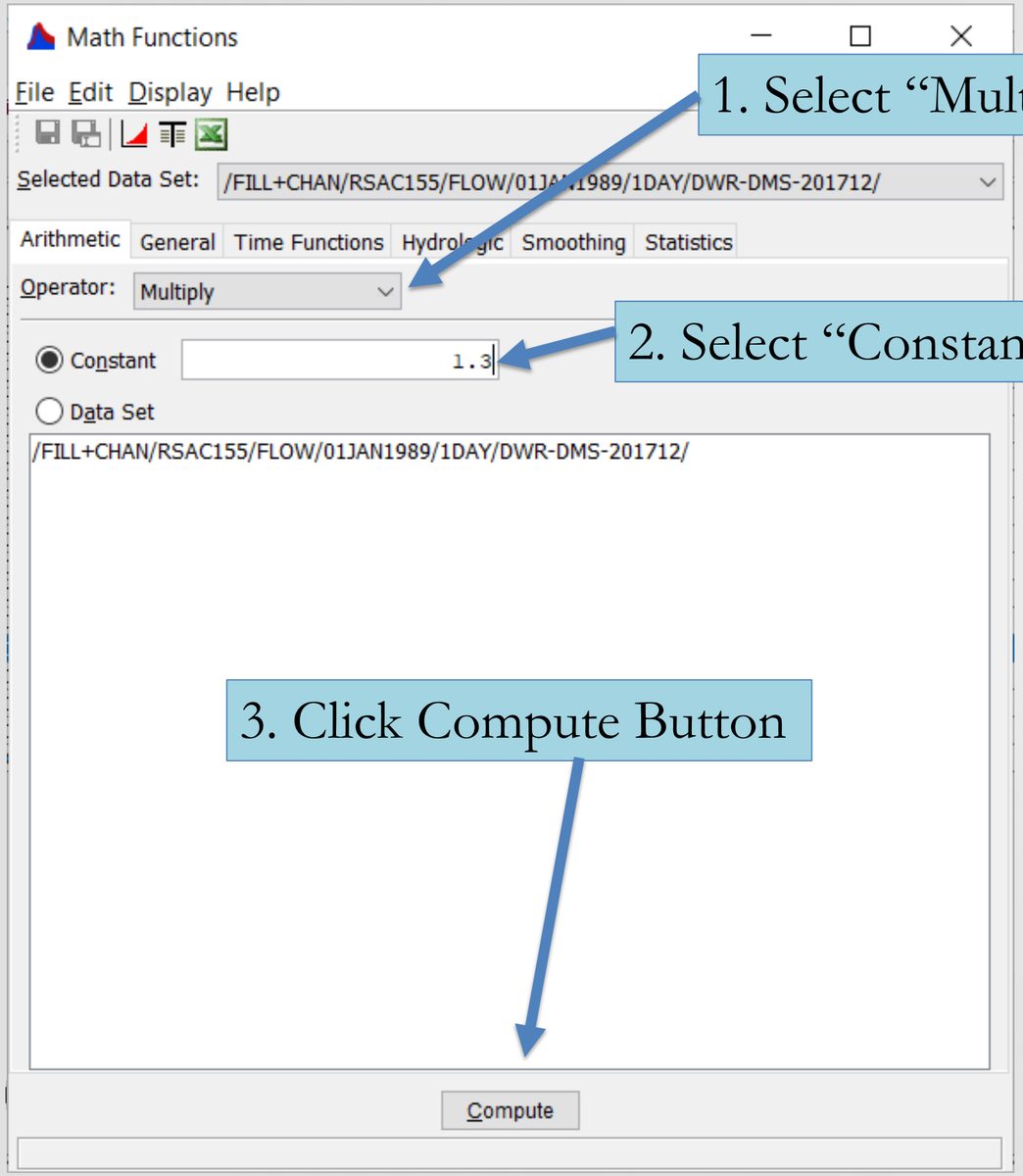


Number	Part A	Part B	Part C	Part D / range
1	FILL+CHAN	BYOLO040	FLOW	31Dec1989 - 01Jan2018
2	FILL+CHAN	CHCCC006	FLOW-DIVERSION	30Sep1989 - 01Jan2018
3	FILL+CHAN	CHDMC004	FLOW-EXPORT	30Sep1989 - 02Jan2018
4	FILL+CHAN	CHSWP003	FLOW-EXPORT	30Sep1989 - 30Jan2018
5	FILL+CHAN	CHVCT001	FLOW-EXPORT	31Aug1988 - 01Jan2018
6	FILL+CHAN	RCAL009	FLOW	01Oct1989 - 01Jan2018
7	FILL+CHAN	RCSM075	FLOW	30Sep1989 - 01Jan2018
8	FILL+CHAN	RMKL070	FLOW	29Sep1989 - 02Aug2017
9	FILL+CHAN	RMKL070	FLOW	30Sep1989 - 03Jan2018
10	FILL+CHAN	ROLD034	FLOW-EXPORT	30Sep1989 - 01Jan2018
11	FILL+CHAN	RSAC054	EC	31Oct1989 - 01Jan2018
12	FILL+CHAN	RSAC054	STAGE	30Sep1989 - 01Jan2018
13	FILL+CHAN	RSAC139	EC	30Oct1989 - 01Jan2018
14	FILL+CHAN	RSAC155	FLOW	30Sep1989 - 01Jan2018
15	FILL+CHAN	RSAN112	EC	31Oct1989 - 01Jan2018
16	FILL+CHAN	RSAN112	FLOW	30Sep1989 - 01Jan2018
17	FILL+CHAN	SLBAR002	FLOW-EXPORT	30Sep1989 - 01Jan2018
18	HIST+GATE	CHWST000	POS	30Apr1971 - 01Aug2017

Run 2. Increased Sac. R Flow Study

Math Functions: Increase Sac. R Flows

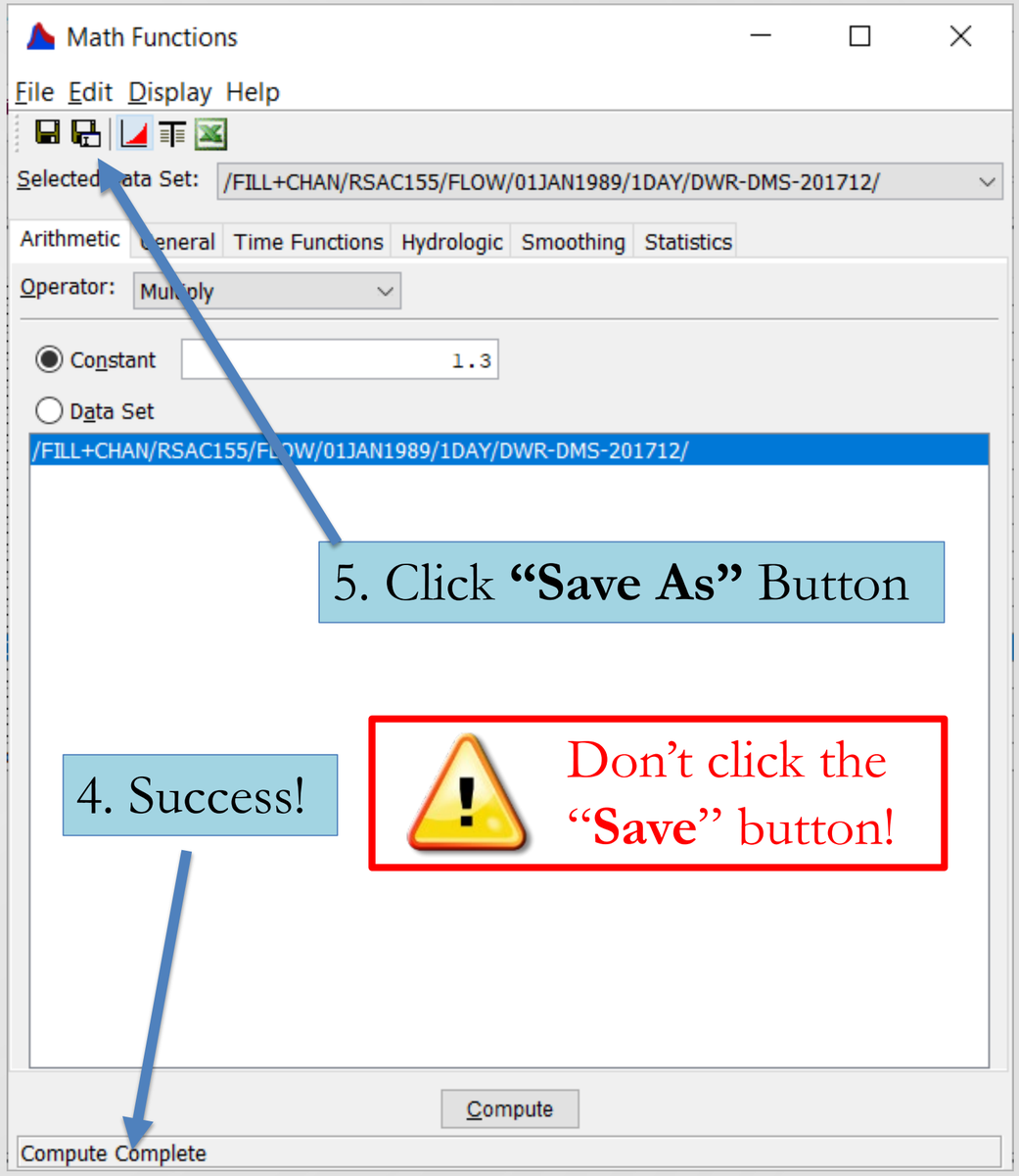
Sac +30%



1. Select "Multiply"

2. Select "Constant", and enter 1.3

3. Click Compute Button



5. Click **"Save As"** Button

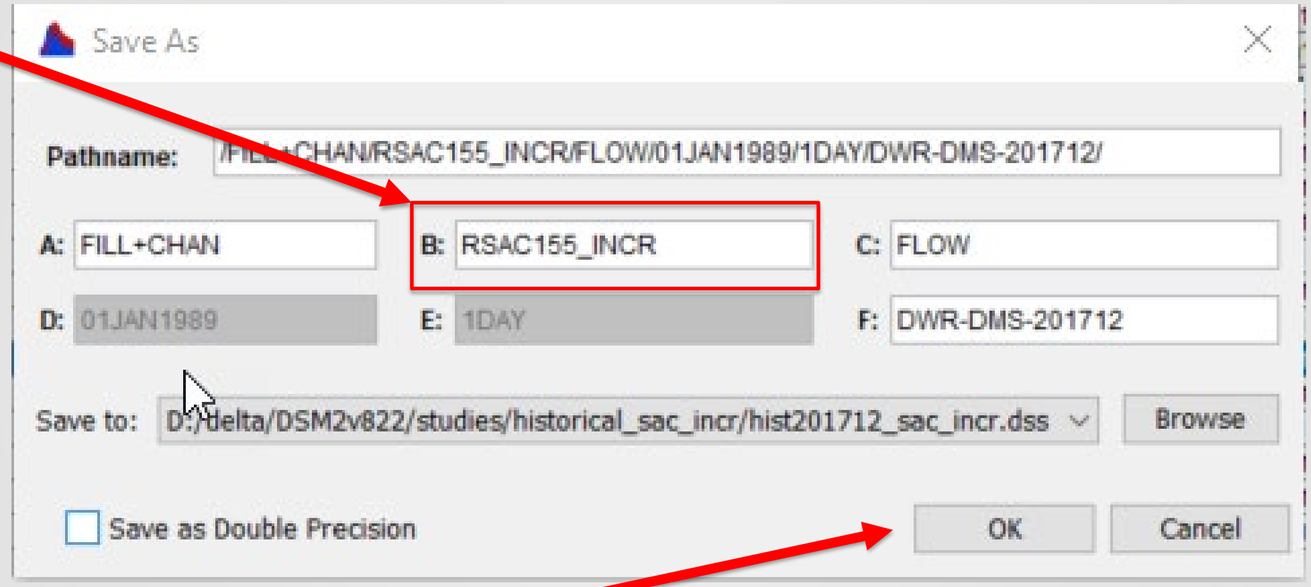
4. Success!

Don't click the "**Save**" button!

Run 2. Increased Sac. R Flow Study

Change the DSS "B part" before saving

1. Modify B part, adding "_incr"



2. Click "OK"

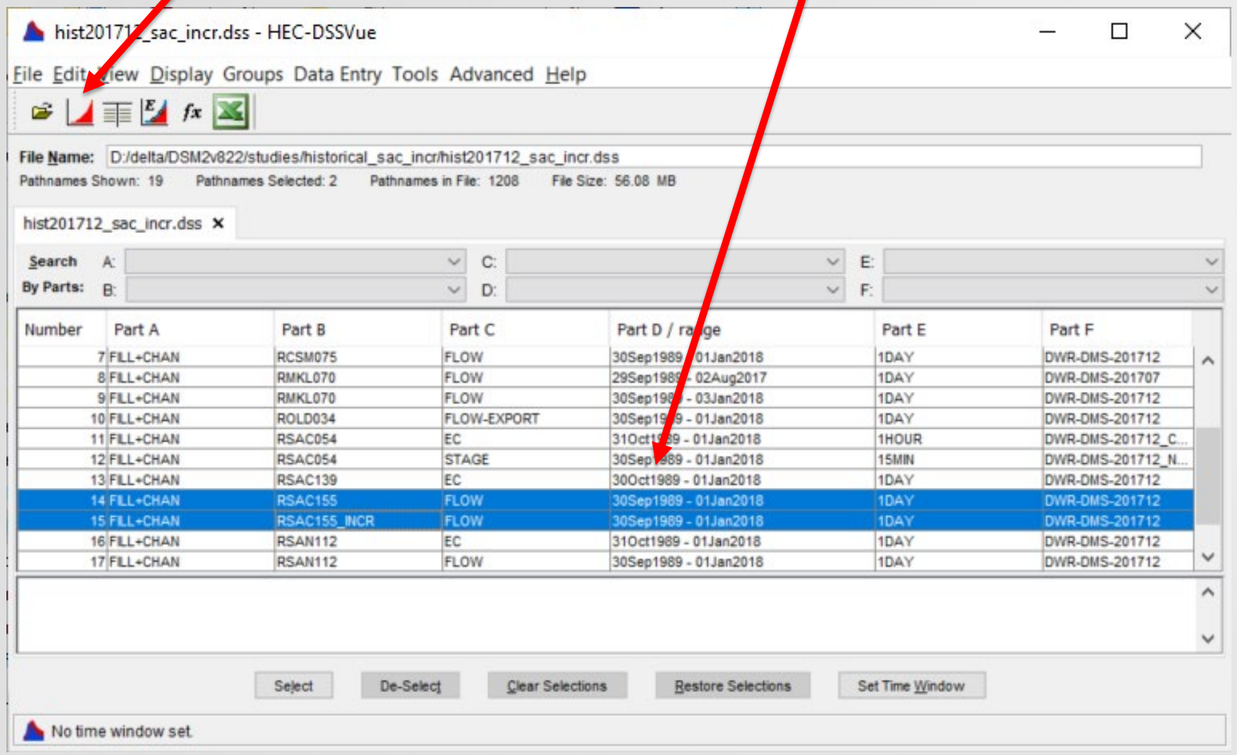
Sac +30%

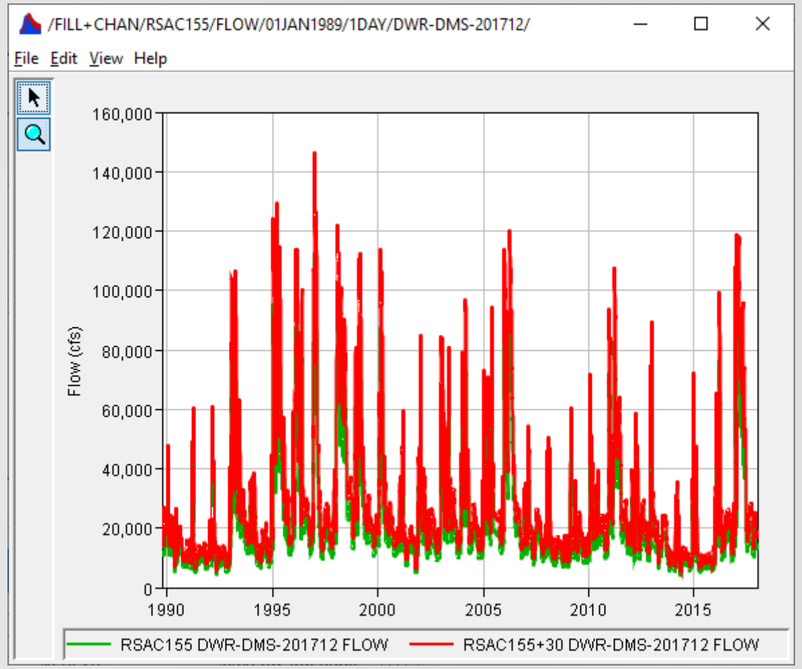
Run 2. Increased Sac. R Flow Study

Verification: compare historical Sac. R flow with modified data set

2. Click the plot button

1. Select both data sets



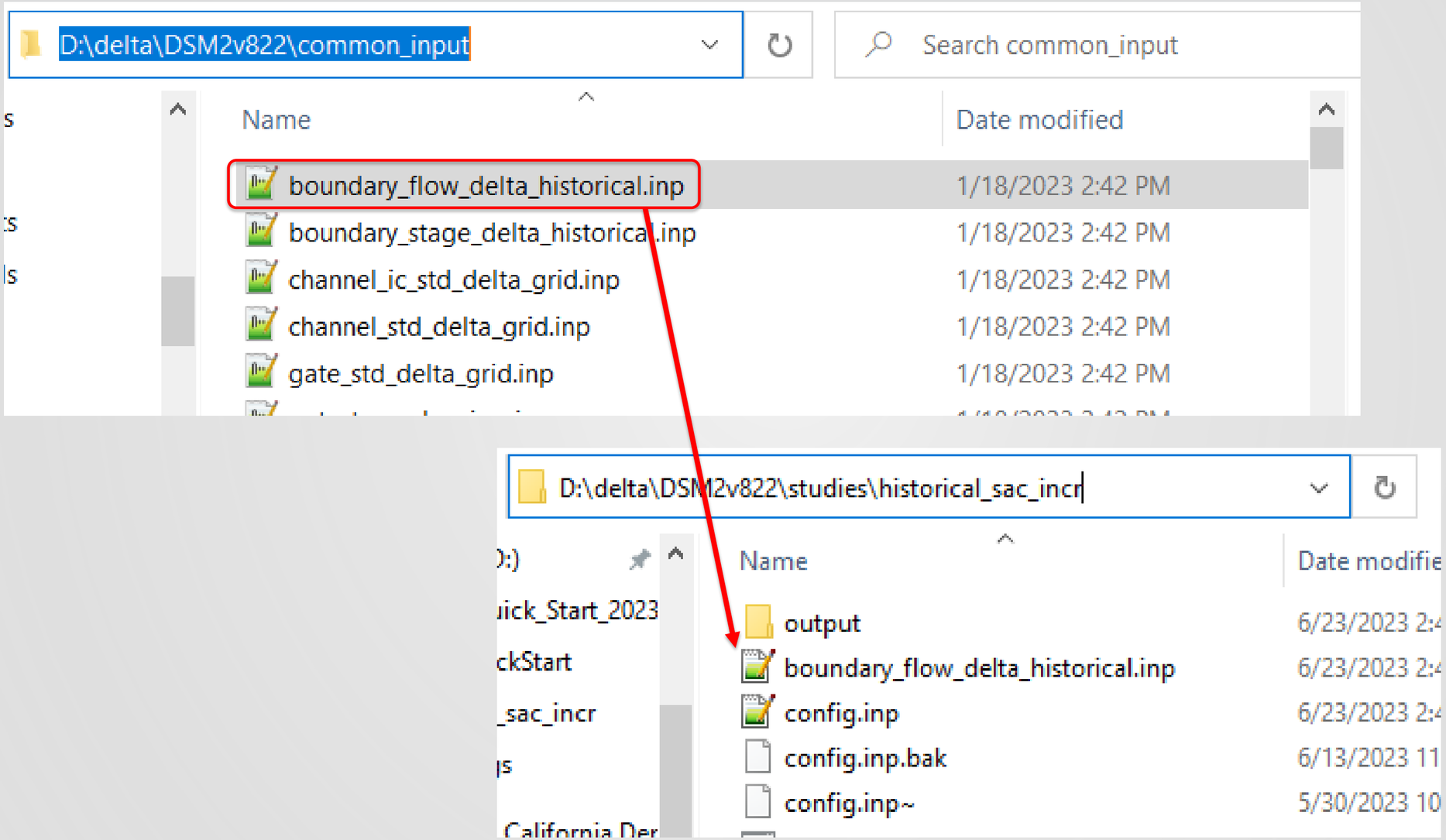


3. Use plot to compare data sets

Sac +30%

Run 2. Increased Sac. R Flow Study

Copying the boundary_flow_delta_historical.inp file



Sac +30%

Run 2. Increased Sac. R Flow Study

Change DSM2MODIFIER in config.inp

```
ENVVAR
NAME                    VALUE
DSM2MODIFIER            hist_v822_sac_incr
DSM2INPUTDIR            ../../common_input
VERSIONDATE             201712
HISTFLOWVERSION         DWR-DMS-${VERSIONDATE}
HISTSTAGEVERSION        ${HISTFLOWVERSION}
HISTQUALVERSION         DWR-DMS-${VERSIONDATE}
```

Sac
+30%

Run 2. Increased Sac. R Flow Study

Edit the main input file hydro.inp

```
HYDRO_TIME_SERIES
# ${DSM2INPUTDIR}/boundary_flow_delta_historical.inp
boundary_flow_delta_historical.inp        #20090715
${DSM2INPUTDIR}/source_flow_delta_historical.inp
${DSM2INPUTDIR}/boundary_stage_delta_historical.inp
${DSM2INPUTDIR}/source_flow_dcd_historical_daily.inp
${DSM2INPUTDIR}/source_flow_jones_hydro.inp
${DSM2INPUTDIR}/source_flow_scd_historical_daily.inp
END
```

Run 2. Increased Sac. R Flow Study

Edit the copied boundary_flow_delta_historical.inp file

```
# Description:
# Historical boundary flows to Delta
# 20090715
BOUNDARY_FLOW
NAME       NODE  SIGN  FILLIN  FILE           PATH
calaveras    21     1  last    ${BNDRYINPUT}  /FILL+CHAN/RCAL009/FLOW//1DAY/${HISTFLOWVERSION}/
cosumnes    446     1  last    ${BNDRYINPUT}  /FILL+CHAN/RCSM075/FLOW//1DAY/${HISTFLOWVERSION}/
moke        447     1  last    ${BNDRYINPUT}  /FILL+CHAN/RMKL070/FLOW//1DAY/${HISTFLOWVERSION}/
north_bay   273    -1  last    ${BNDRYINPUT}  /FILL+CHAN/SLBAR002/FLOW-EXPORT//1DAY/${HISTFLOWVERSION}/
#sac         330     1  last    ${BNDRYINPUT}  /FILL+CHAN/RSAC155/FLOW//1DAY/${HISTFLOWVERSION}/
sac         330     1  last    hist201712_sac_incr.dss  /FILL+CHAN/RSAC155_incr/FLOW//1DAY/${HISTFLOWVERSION}/
vernalis     17     1  last    ${BNDRYINPUT}  /FILL+CHAN/RSAN112/FLOW//1DAY/${HISTFLOWVERSION}/
yolo        316     1  last    ${BNDRYINPUT}  /FILL+CHAN/BYOLO040/FLOW//1DAY/${HISTFLOWVERSION}/
END
```

Sac +30%

Run 2. Increased Sac. R. Flow Study

qual_ec.inp: Creating EC tidefile output

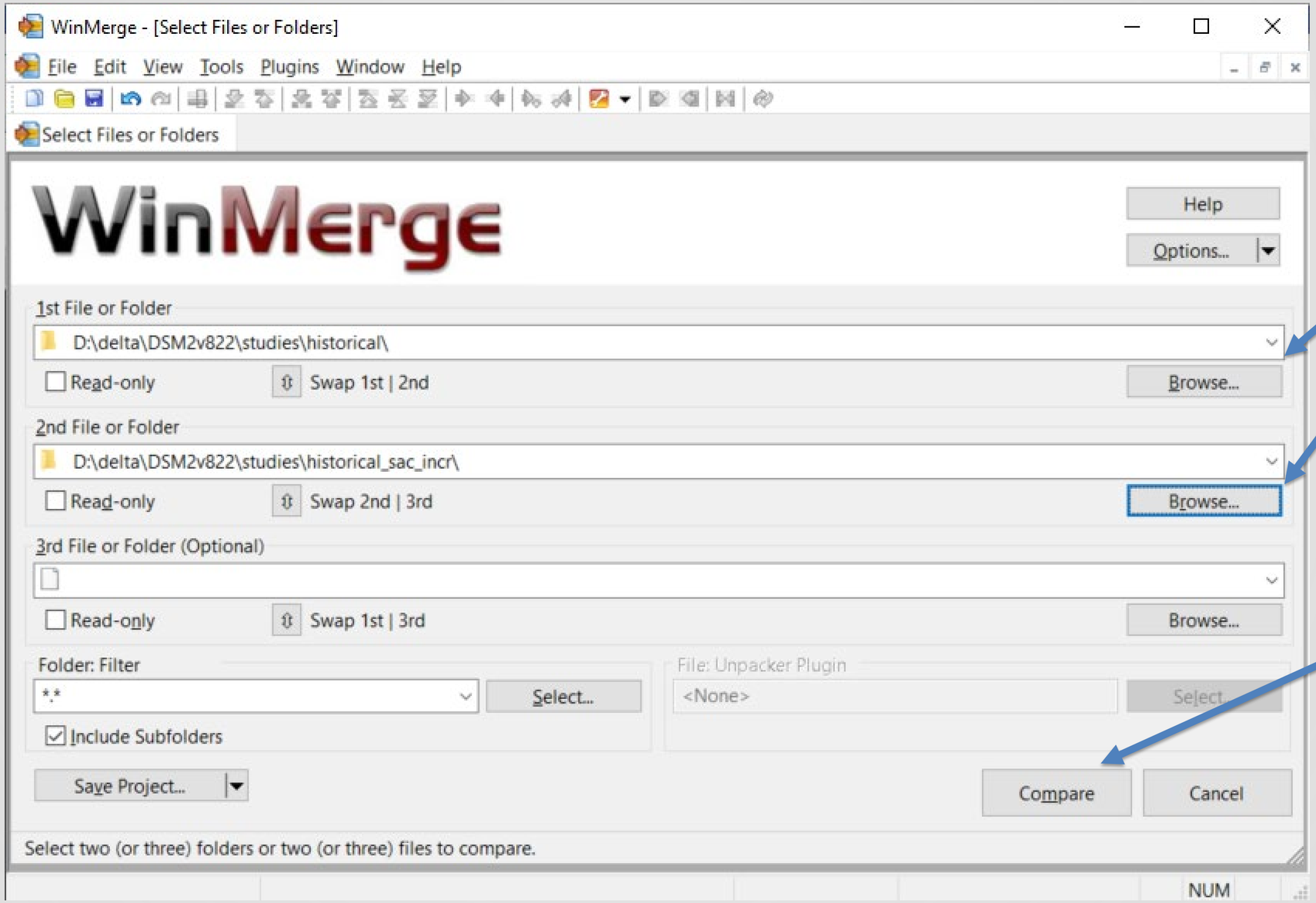
"Main Input File" for Qual: qual_ec.inp

```
IO_FILE
MODEL TYPE    IO  INTERVAL FILE
# qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  restart out 1mon     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qrf
qual  output  out none     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qof
qual  echo    out none     ${DSM2OUTPUTDIR}/qual_echo_${DSM2MODIFIER}_EC.inp
END
```

Temp Barrier

Run 2. Increased Sac. R Flow Study

Compare two folders



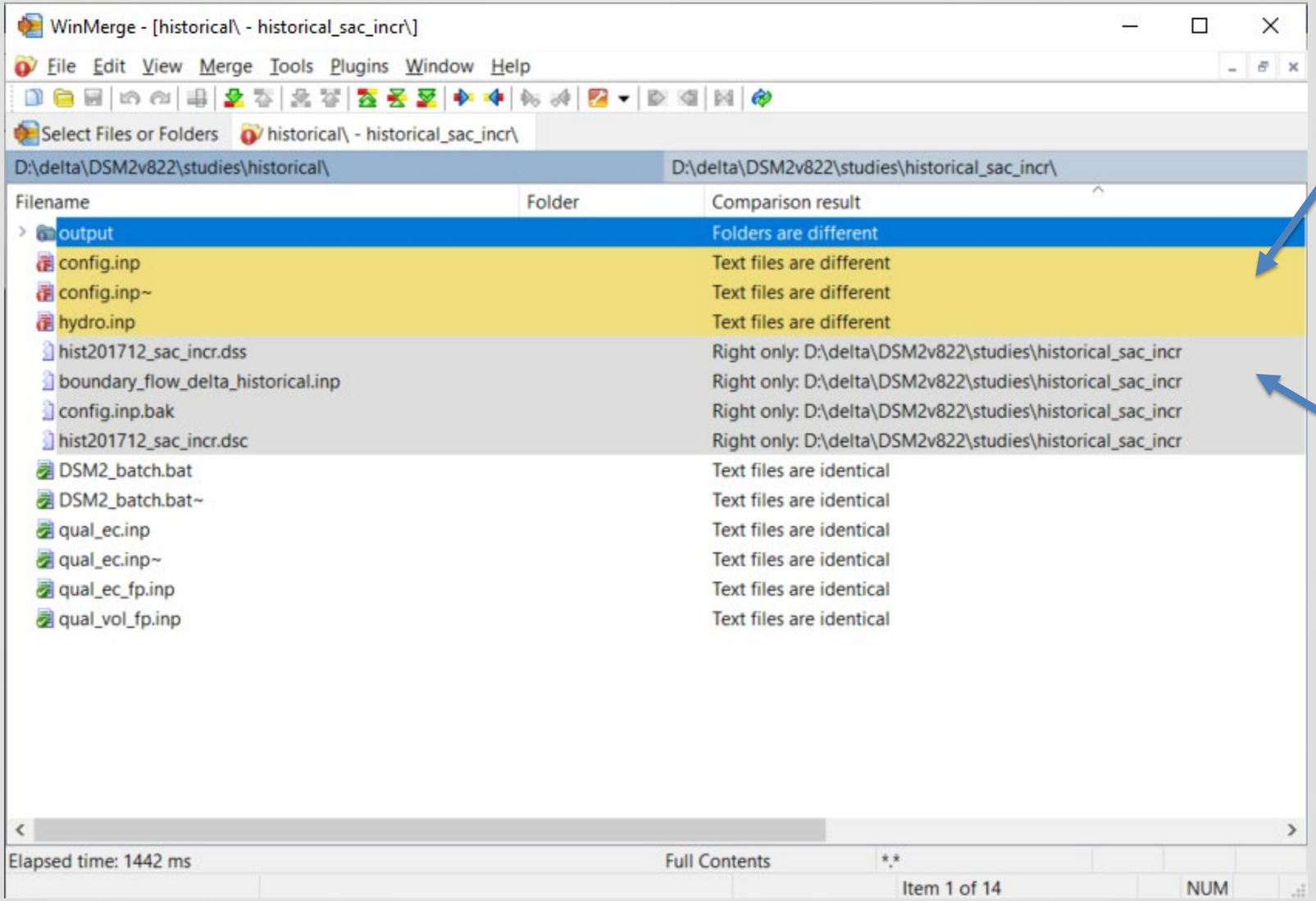
1. Click "Browse" buttons to specify the two study folders to compare

2. Click "Compare" button

Sac +30%

Run 2. Increased Sac. R Flow Study

Comparing historical vs Sac+30 study folders



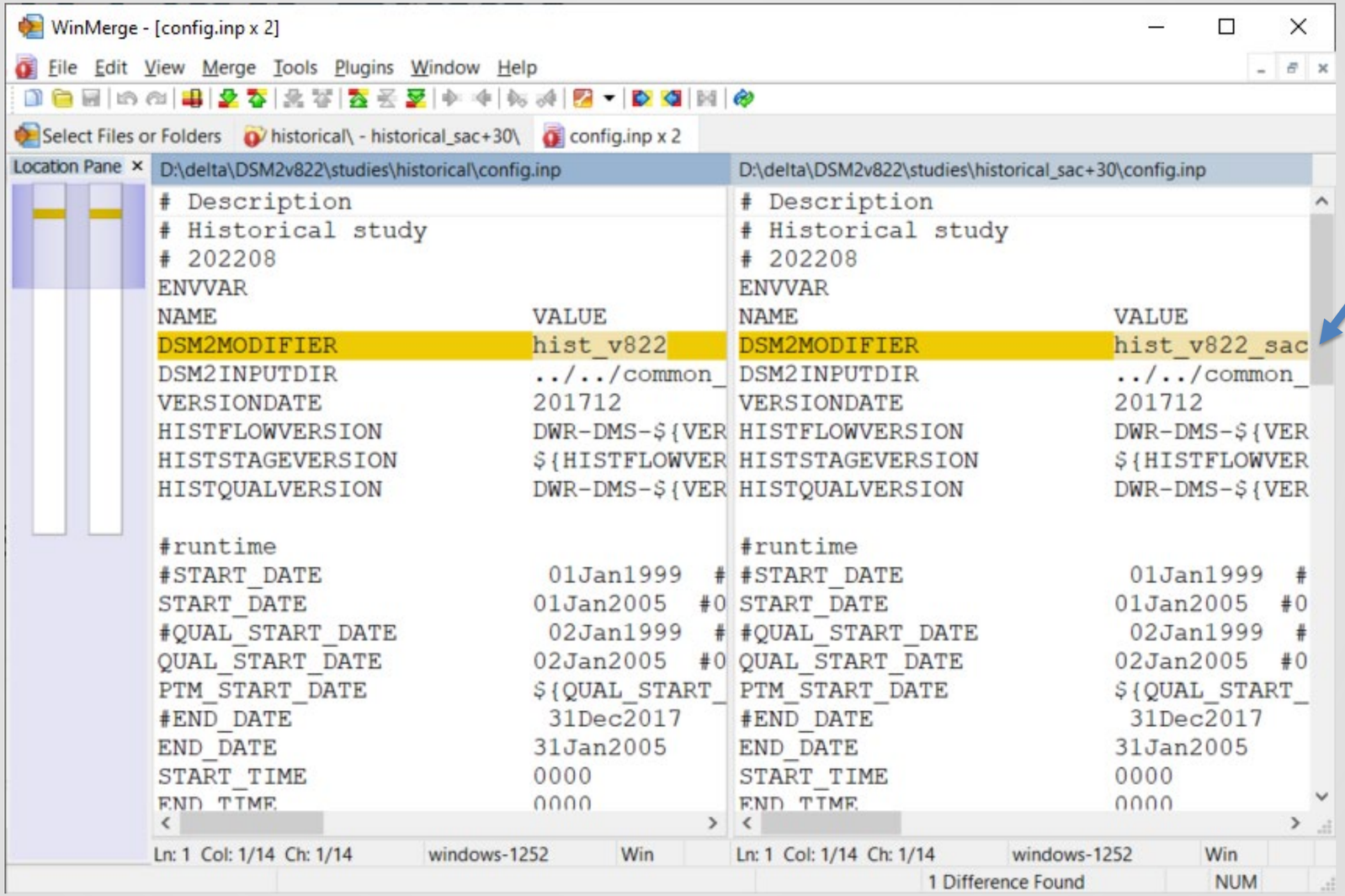
1. files/folders with differences shown in yellow

1. Files/folders existing in only 1 of the folders shown in grey.

Sac +30%

Run 2. Increased Sac. R Flow Study

comparing two versions of the config.inp file



Lines with differences shown in yellow

Sac +30%

Run 2. Increased Sac. R Flow Study

Run hydro and qual

Enter the following commands into a separate command prompt window:

Sac R +30%

```
cd D:\delta\DSM2v822\studies\historical_sac_incr\
DSM2_batch.bat
```

Overview

1. **Introduction to DSS**
2. Introduction to HDF5 (DSM2 tidefiles)
3. Quick Review of DSM2 input setup
4. **Hands-on exercises**

Historical base case	Run 1: Base historical study
Sac River Flow +30%	Run 2: Sacramento River flow increased by 30%
Temporary Barrier increased width	**Run 3: Increased temporary barrier width**

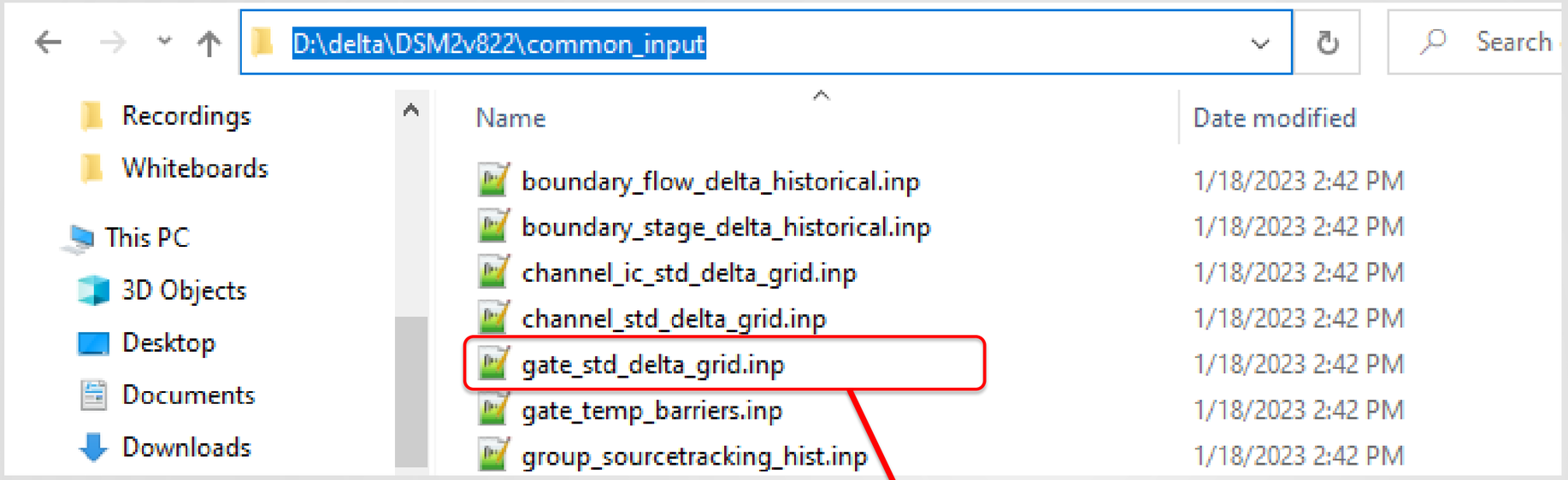
Run 3. Increased Temp. Barr. Width Study

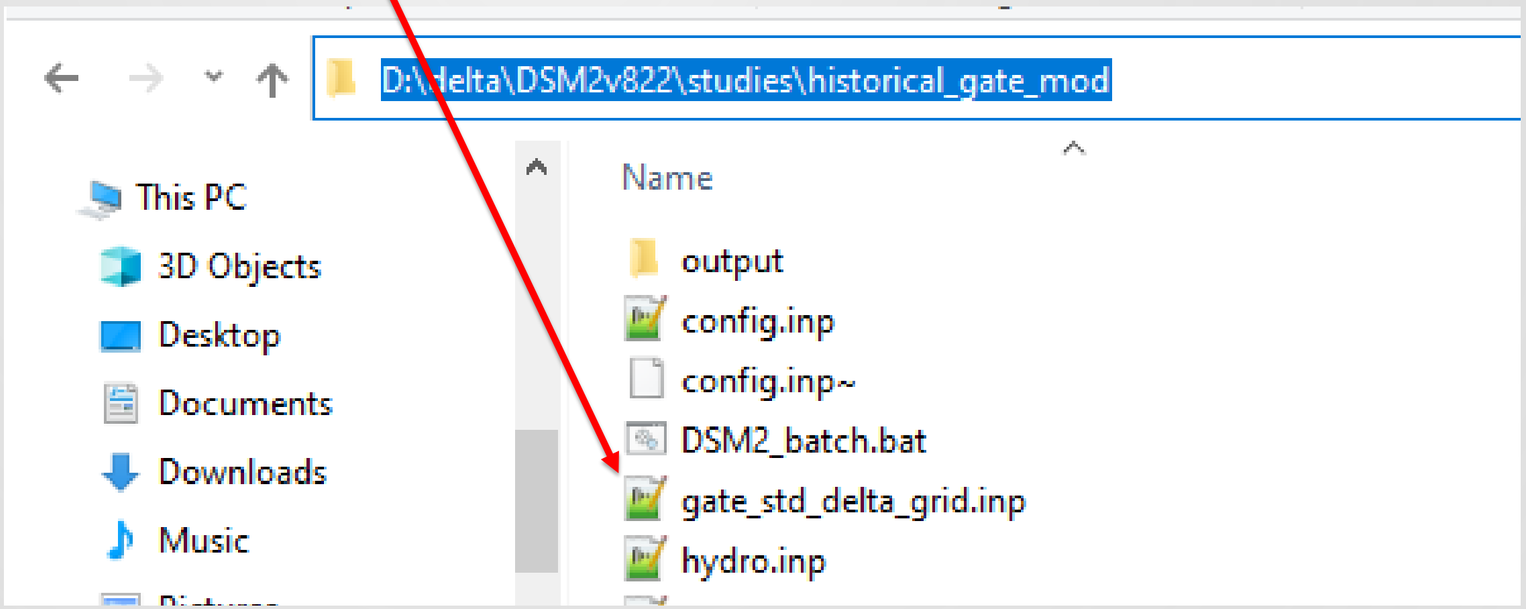
Configuring the “modified temporary barrier width” study

GOAL	Modify DSM2 historical simulation to **increase temporary barrier width**
TASKS	• In the “**historical_gate_mod**” folder: • Change DSM2MODIFIER in ***config.inp*** • Add a copy of the gate input file, ***gate_std_delta_grid.inp*** • Edit ***hydro.inp*** to use the local copy of the gate file • Edit the gate input file to increase the width of the fall Head of Old River barrier to **932ft** • Edit the qual_ec.inp file, uncommenting the line that creates a qual tidefile
TOOLS	• Windows Explorer • Text editor • WinMerge

Run 3. Increased Temp. Barr. Width Study

Copying the gate_std_delta_grid.inp file





Temp Barrier

Run 3. Increased Temp. Barr. Width Study

Change DSM2MODIFIER in config.inp

```
ENVVAR
NAME                    VALUE
DSM2MODIFIER            hist_v822_gate_mod
DSM2INPUTDIR            ../../common_input
VERSIONDATE             201712
HISTFLOWVERSION         DWR-DMS-${VERSIONDATE}
HISTSTAGEVERSION        ${HISTFLOWVERSION}
HISTQUALVERSION         DWR-DMS-${VERSIONDATE}
```

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Temp Barrier

Run 3. Increased Temp. Barr. Width Study

hydro.inp & gate_std_delta_grid.inp

"Main Input File" for Hydro: hydro.inp

```
GRID
${DSM2INPUTDIR}/channel_std_delta_grid.inp
${DSM2INPUTDIR}/reservoir_std_delta_grid.inp
# ${DSM2INPUTDIR}/gate_std_delta_grid.inp
gate_std_delta_grid.inp
${DSM2INPUTDIR}/gate_temp_barriers.inp
END
```

gate_std_delta_grid.inp

```
GATE_WEIR_DEVICE
GATE_NAME              DEVICE       DUPLICATE WIDTH  ELEV HEIGHT CF_FROM_NODE CF_TO_NODE DEFAULT_OP
#old_r@head_barrier    fall_barrier           1  32.0  2.326  9999.0         0.7        0.7  gate_open
old_r@head_barrier     fall_barrier           1 932.0  2.326  9999.0         0.7        0.7  gate_open
END
```

Temp Barrier

Run 3. Increased Temp. Barr. Width Study

qual_ec.inp: Creating EC tidefile output

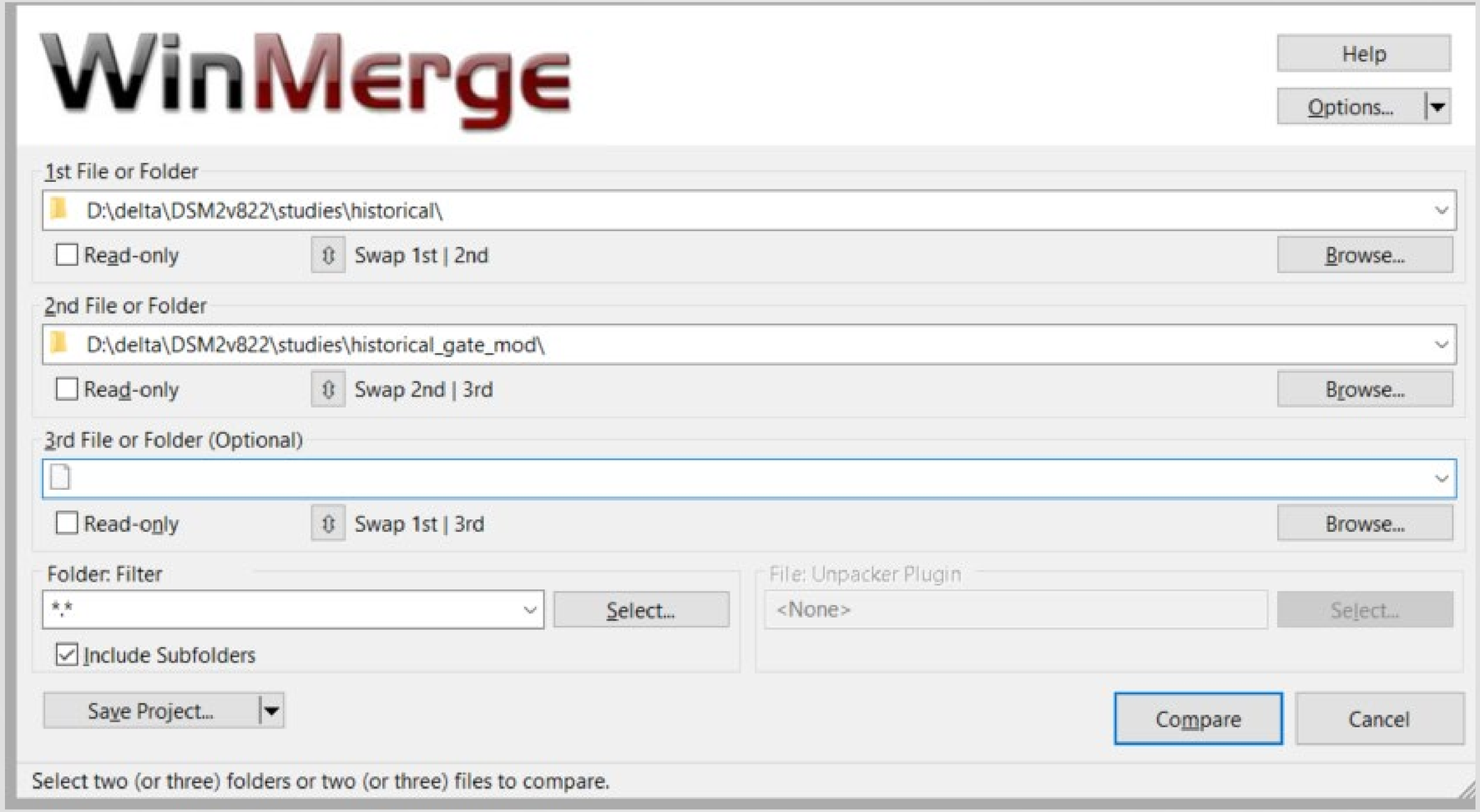
"Main Input File" for Qual: qual_ec.inp

```
IO_FILE
MODEL TYPE    IO  INTERVAL FILE
# qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  hdf5    out 1hour    ${DSM2OUTPUTDIR}/${DSM2MODIFIER}_EC.h5
qual  restart out 1mon     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qrf
qual  output  out none     ${DSM2OUTPUTDIR}/qual_${DSM2MODIFIER}_EC.qof
qual  echo    out none     ${DSM2OUTPUTDIR}/qual_echo_${DSM2MODIFIER}_EC.inp
END
```

Temp Barrier

Run 3. Increased Temp. Barr. Width Study

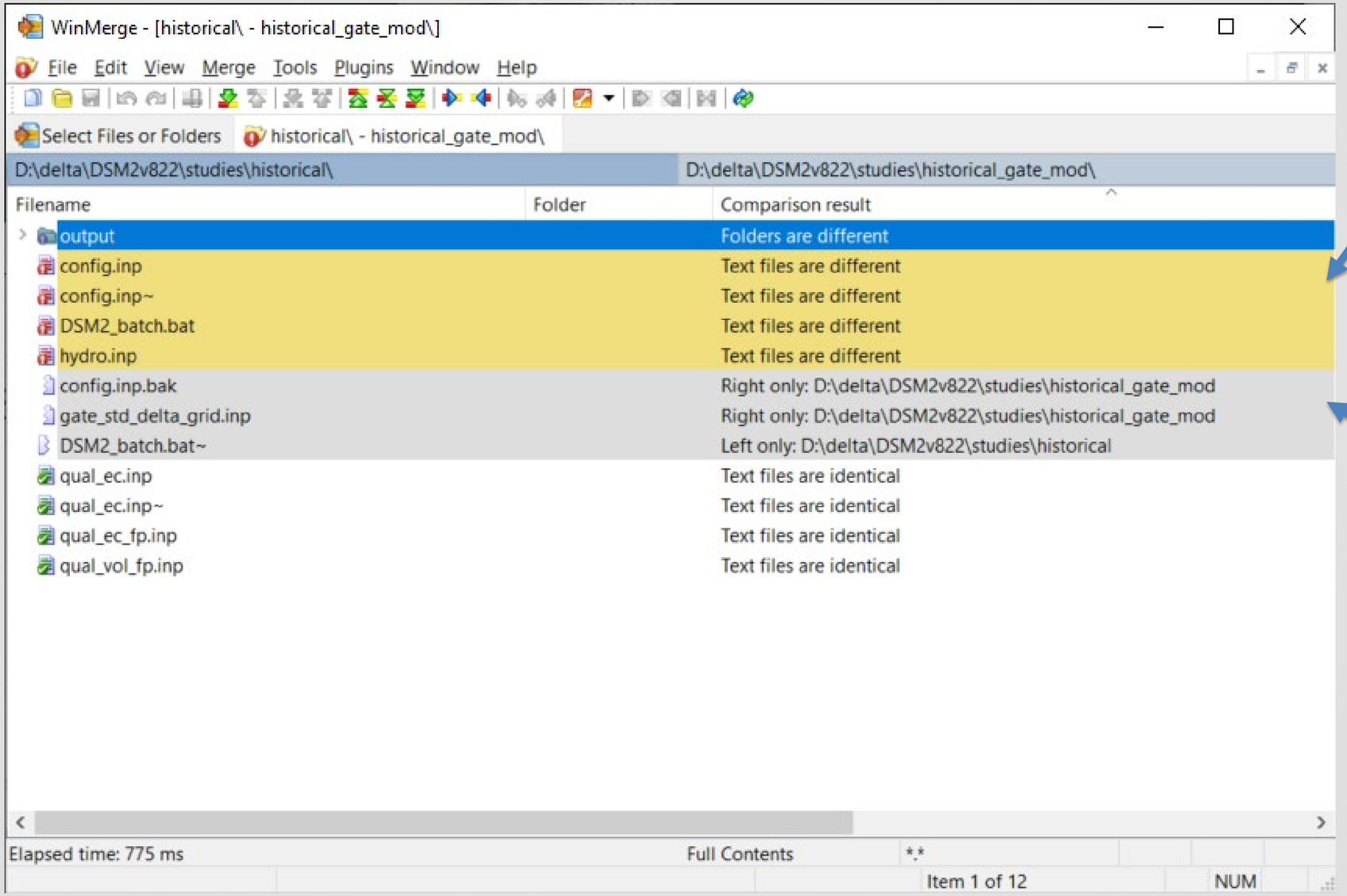
Compare study folders with WinMerge



Temp Barrier

Run 2. Increased Temp. Barr. Width Study

Comparing historical vs Sac+30 study folders



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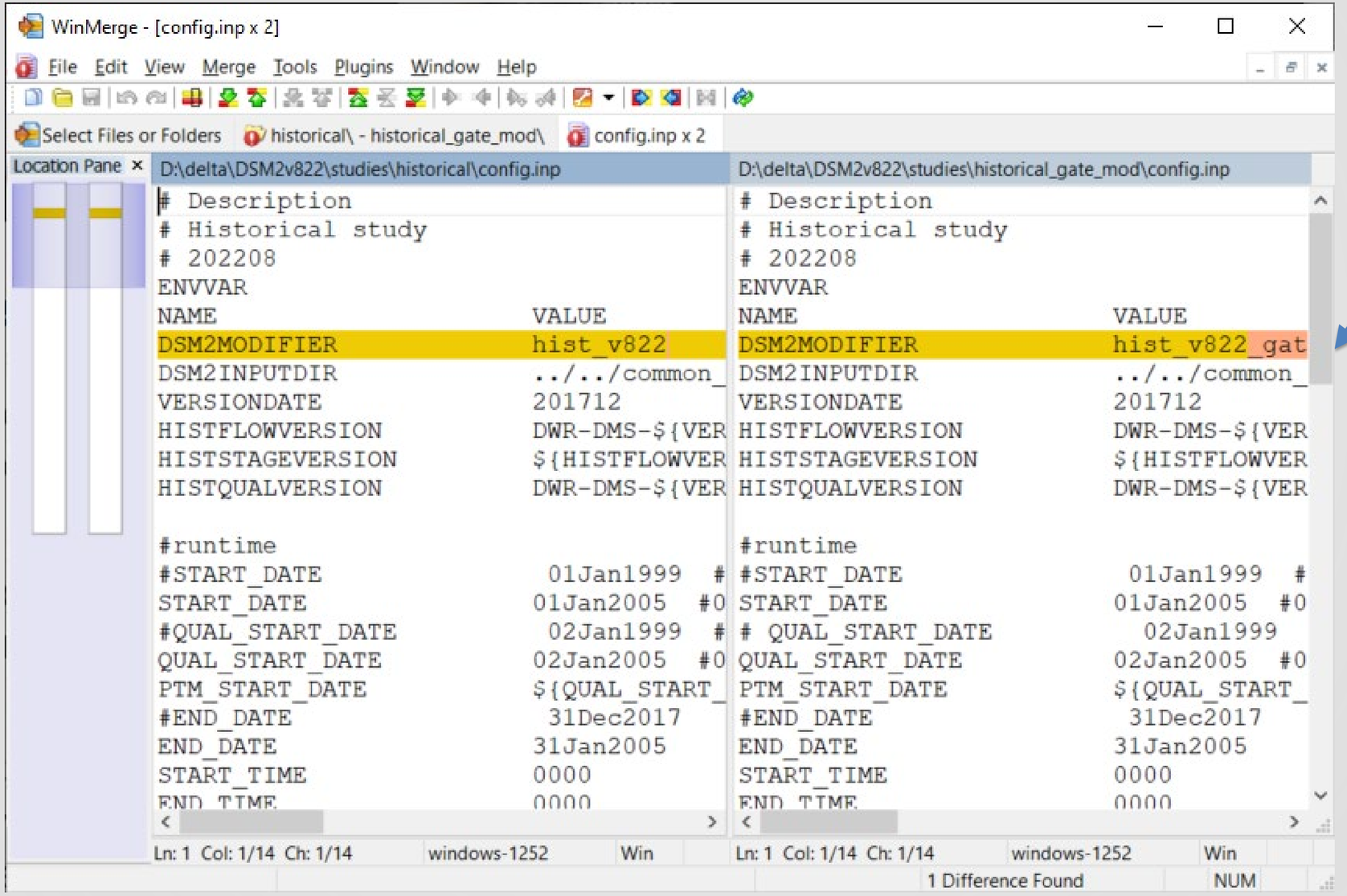
Temp Barrier

Run 2. Increased Temp. Barr. Width Study

comparing two versions of the config.inp file



Lines with differences shown in yellow

Temp Barrier

Run 3. Increased Temp. Barr. Width Study

Run hydro and qual

Enter the following commands into a separate command prompt window:

Temp Barrier

```
cd D:\delta\DSM2v822\studies\historical_gate_mod\
DSM2_batch.bat
```

Questions?

Please enter questions into the chat

Brad Tom (Bradley.Tom@water.ca.gov)