

TSTool Training: Introduction to Commands

Duration: ~30 minutes

Level: introduction

TSTool version used: 14.0.4

Updated: 2021-12-19



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Presentation Goals

- Provide an introduction to TSTool commands.
- Run working examples, each of which reside in a folder distributed with presentation:
 - See the `doc/training` folder under the software installation folder



Prerequisites

- TSTool software must be installed and must have internet access.
- See the “Getting Started” training lesson for TSTool installation instructions and general information about TSTool features.



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Command Files are Workflows to Support Decisions

Command Workflow

Command list

TSTool Command Processor

- Time series list
- look up using TSID and alias
- Table list
- look up using table identifier
- Datastore list
- look up using datastore name
- Other data
- properties, etc.

Information Products

Data files
Reports
Visualizations
Databases

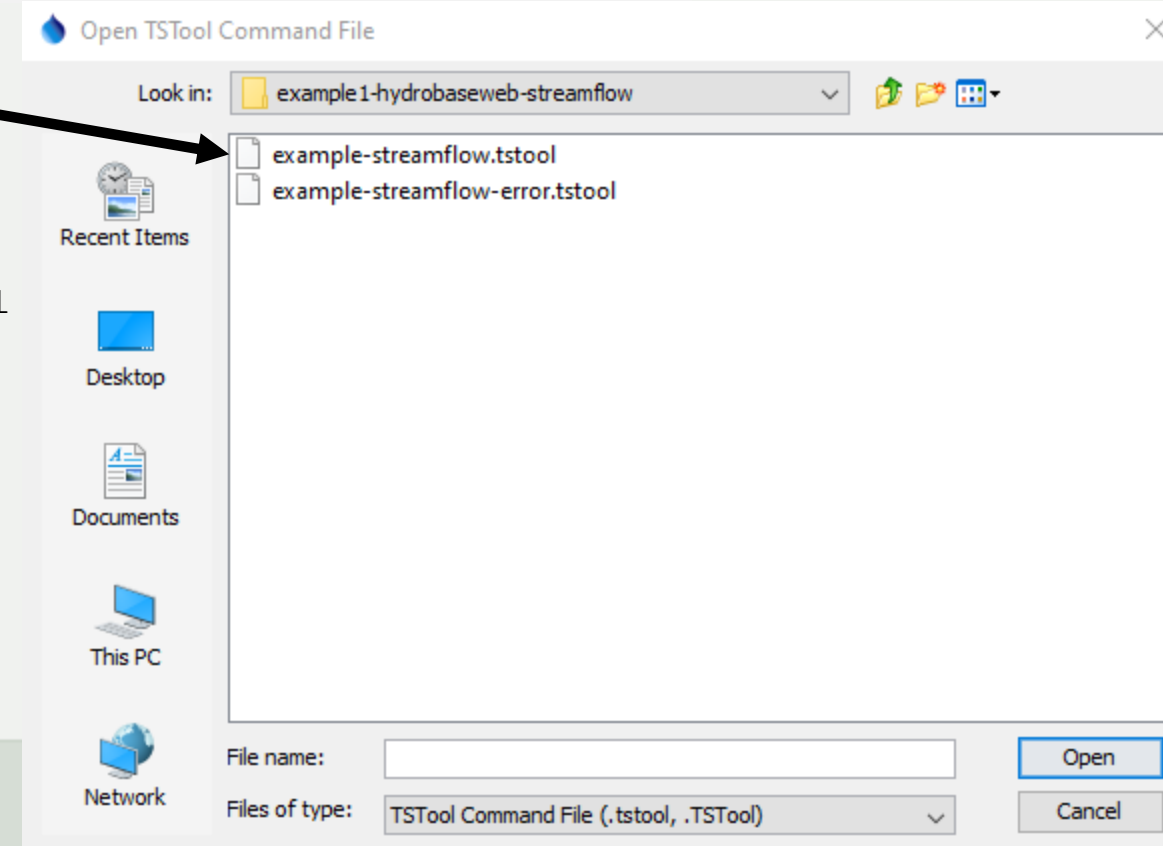
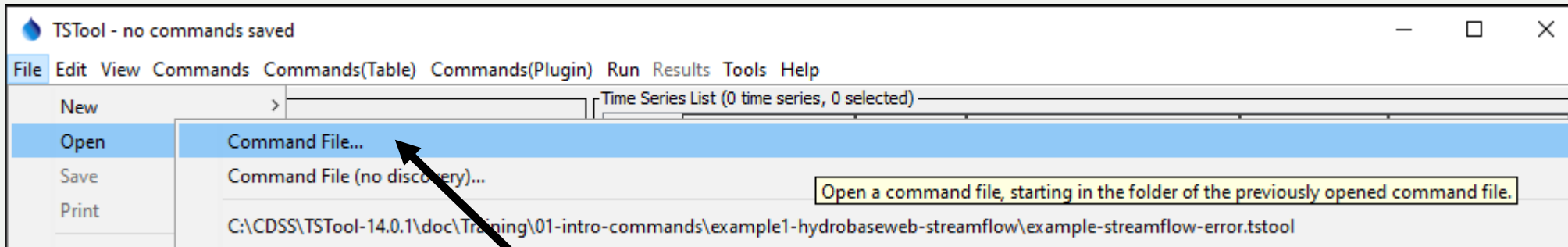


Opening and Running an Existing Command File

- Command files can be saved and rerun, shared between users, and managed with version control systems.
- This helps to document and automate workflows, which increases transparency and efficiency.
- Select an existing TSTool command file using the ***File / Open / Command File...*** menu.
- Then press the ***Run All Commands*** button under the command list to run the commands.
- Then view the results.



example1: Open an Existing Command File



- Browse to a command file (above and then right).
- Or, pick from the list of previously opened files.
- Open the file:
`example1-hydrobaseweb-streamflow/example-streamflow.tstool`



Command file is shown in the title bar, with "modified" if changes have been made

Input/Query Options

Datstore: Input type

Input type: HydroBase

Data type: Stream - Streamflow

Time step: Month

Where: Matches

Where: Matches

Where: Matches

Get Time Series List

Time Series List (0 time series, 0 selected)

ID	CO Abbrev.	Name/Description	Data Source	Data Type	Time Step	Units	Start	End
<p>There is no need to browse for time series since the commands will query time series</p>								

Copy Selected to Commands

Copy All to Commands

Commands (11 commands, 0 selected, 0 with failures, 0 with warnings)

```

1 # Simple command file to read a HydroBaseWeb time series.
2 # Read one daily time series using three different approaches:
3 #
4 # First, read using a time series identifier (TSID) copied from the time series list.
5 # ROAGLECO (3802069) - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO.
6 abbrev:ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb
7 # Second, copy the above command, right click on the command, and
8 # "Convert TSID command to General ReadTimeSeries command"
9 ReadTimeSeries(TSID="abbrev:ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb",Alias="RoaringFork-day-2",IfNotFound=Warn)
10 # Third, use the ReadColoradoHydroBaseRest command found in the Commands / Read Time Series menu.
11 ReadColoradoHydroBaseRest(DataStore="HydroBaseWeb".TSID="ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb".Alias="RoaringFork-day-3")
    
```

Run Selected Commands

Run All Commands

Clear Commands

The contents of the selected command file is shown in the Commands area

1. Press "Run All Commands"

Results

Ensembles Networks Output Files Problems Properties Tables Time Series Views

3 time series, 3 selected

1) ROARING FORK RIVER AT GLENWOOD SPRINGS, CO. - abbrev:ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)
2) RoaringFork-day-2 - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO. - abbrev:ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)
3) RoaringFork-day-3 - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO. - ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)

Graph with template: TSAsEnsembleCalcStatsDefault.tsp

2. Select time series and then right-click to view data

Review of how to Create TSID Commands...

3. Right click on headings for sort options.

1. Specify input and query options

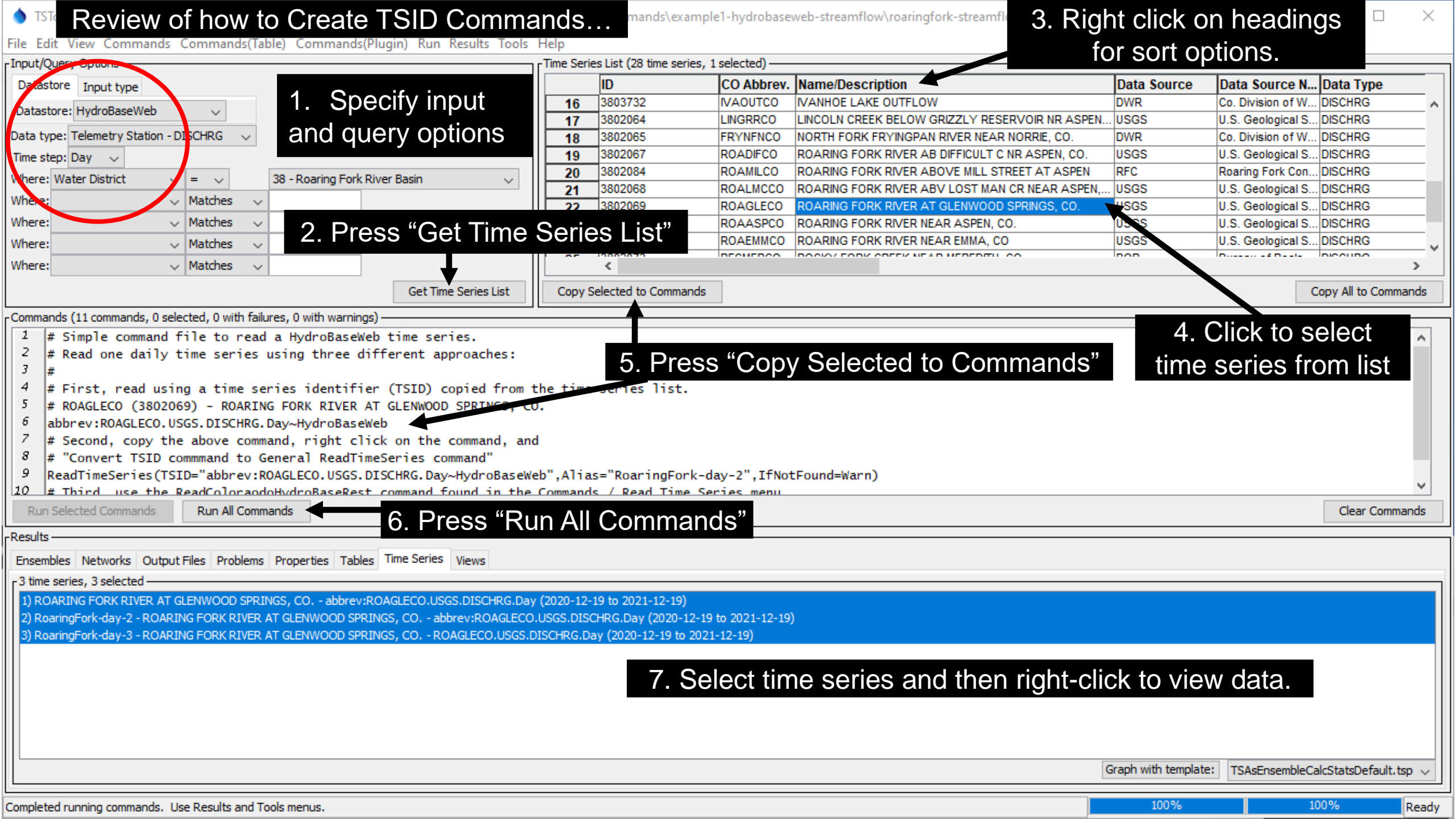
2. Press "Get Time Series List"

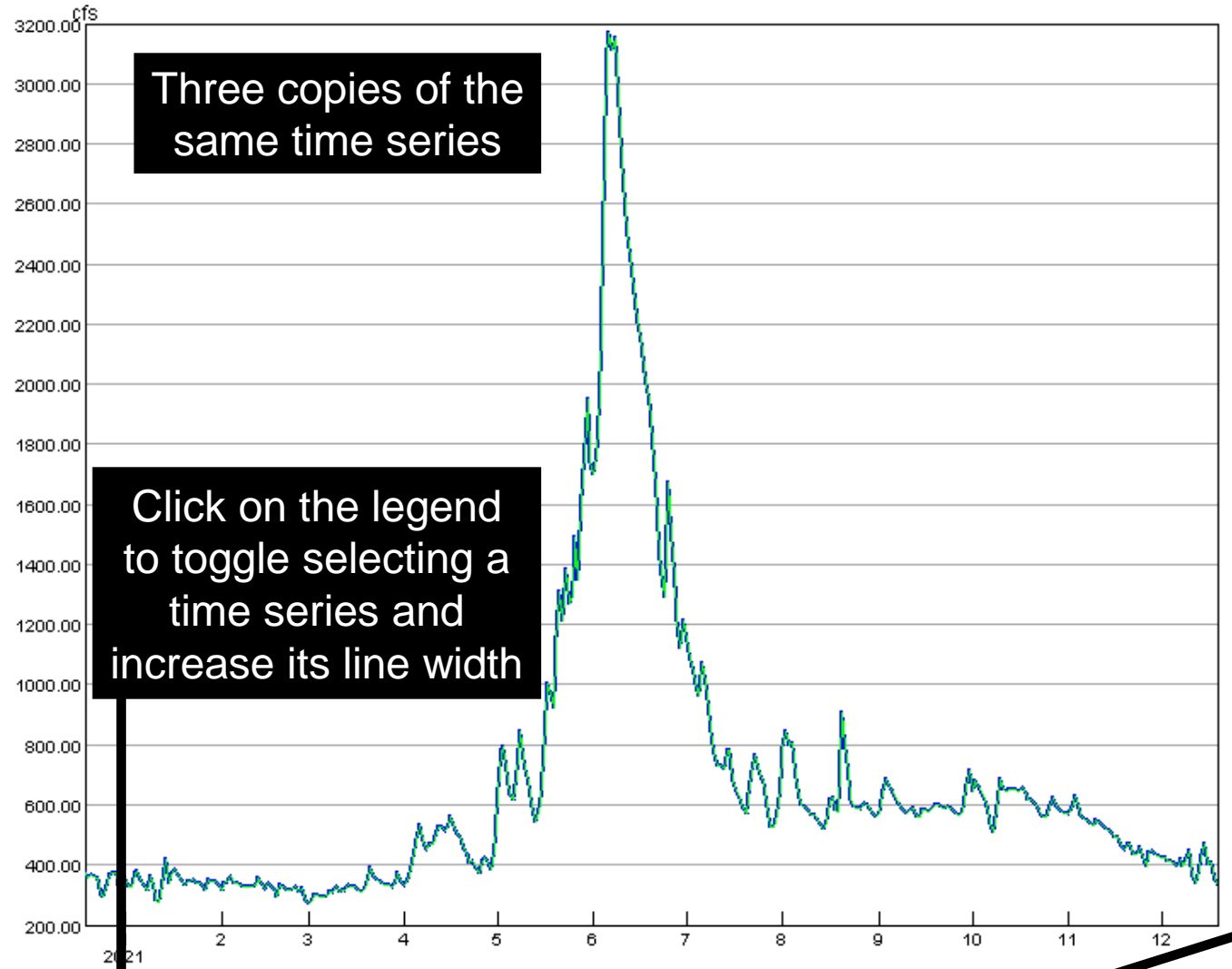
5. Press "Copy Selected to Commands"

4. Click to select time series from list

6. Press "Run All Commands"

7. Select time series and then right-click to view data.





Three copies of the same time series

Click on the legend to toggle selecting a time series and increase its line width

- ROARING FORK RIVER AT GLENWOOD SPRINGS, CO., abbrev:ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)
- RoaringFork-day-2 - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO., abbrev:ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)
- RoaringFork-day-3 - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO., ROAGLECO.USGS.DISCHRG.Day (2020-12-19 to 2021-12-19)

Visible Period (white):

Navigation buttons: |< << < > >> >| Zoom Out Tracker: None

Summary **Table** Print Save Close

Zoom Mode X: 2021-04-01, Y: 465.20

DATE	ROAGLECO, DISCHRG, cfs	RoaringFork-day-2, DISCHRG, cfs	RoaringFork-day-3, DISCHRG, cfs
2020-12-19	373.00	373.00	373.00
2020-12-20	356.00	356.00	356.00
2020-12-21	367.00	367.00	367.00
2020-12-22	364.00	364.00	364.00
2020-12-23	357.00	357.00	357.00
2020-12-24	300.00	300.00	300.00
2020-12-25	292.00	292.00	292.00
2020-12-26	330.00	330.00	330.00
2020-12-27	370.00	370.00	370.00
2020-12-28	372.00	372.00	372.00
2020-12-29	372.00	372.00	372.00
2020-12-30	336.00	336.00	336.00
2020-12-31	335.00	335.00	335.00
2021-01-01	354.00	354.00	354.00
2021-01-02	330.00	330.00	330.00
2021-01-03	328.00	328.00	328.00
2021-01-04	371.00	371.00	371.00
2021-01-05	381.00	381.00	381.00
2021-01-06	353.00	353.00	353.00
2021-01-07	333.00	333.00	333.00
2021-01-08	319.00	319.00	319.00
2021-01-09	360.00	360.00	360.00
2021-01-10	327.00	327.00	327.00
2021-01-11	283.00	283.00	283.00
2021-01-12	274.00	274.00	274.00
2021-01-13	337.00	337.00	337.00
2021-01-14	419.00	419.00	419.00
2021-01-15	337.00	337.00	337.00
2021-01-16	366.00	366.00	366.00
2021-01-17	383.00	383.00	383.00
2021-01-18	370.00	370.00	370.00
2021-01-19	352.00	352.00	352.00
2021-01-20	332.00	332.00	332.00
2021-01-21	346.00	346.00	346.00
2021-01-22	343.00	343.00	343.00
2021-01-23	352.00	352.00	352.00
2021-01-24	338.00	338.00	338.00
2021-01-25	339.00	339.00	339.00
2021-01-26	327.00	327.00	327.00
2021-01-27	315.00	315.00	315.00

Flags: Not shown Graph Summary Save Close

Currently-selected worksheet interval: Day

All or Selected Commands Can Be Run

```
Commands (11 commands, 1 selected, 0 with failures, 0 with warnings)
1 # Simple command file to read a HydroBaseWeb time series.
2 # Read one daily time series using three different approaches:
3 #
4 # First, read using a time series identifier (TSID) copied from the time series list.
5 # ROAGLECO (3802069) - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO.
6 abbrev:ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb
7 # Second, copy the above command, right click on the command, and
8 # "Convert TSID command to General ReadTimeSeries command"
```

- All commands are run each time that the ***Run All Commands*** button is pressed.
- The ***Run Selected Commands*** button will run all commands if none are selected, or will run only the selected commands. See the note above the command list to confirm how many commands are selected.
- If necessary, right-click on commands and use the ***Deselect All Commands*** menu. Then select one or more commands to run.
- The results are (re)generated each time that commands run.



Command Syntax

Example command (line breaks inserted for readability):

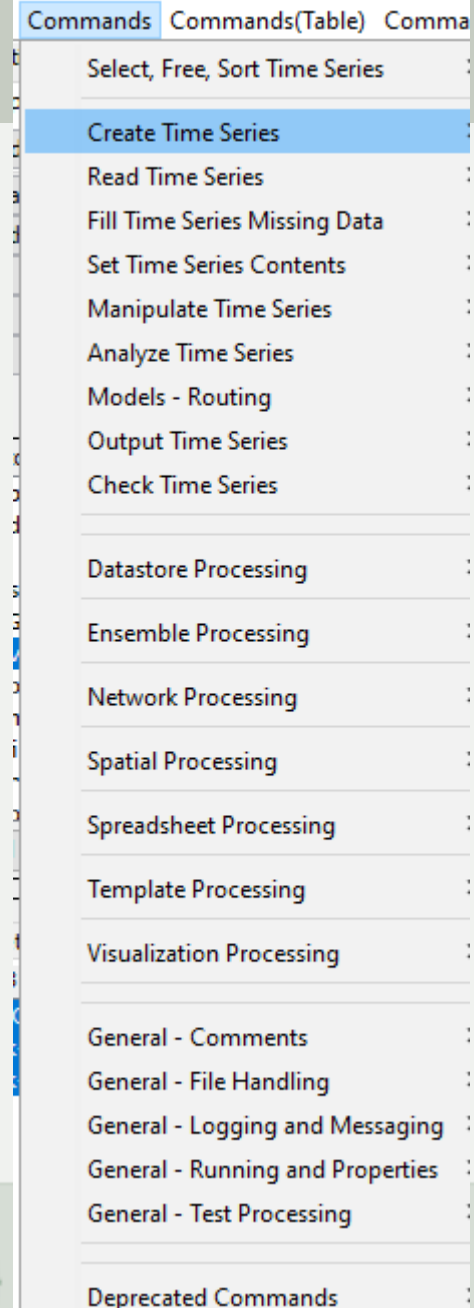
```
ReadTimeSeries (  
TSID="abbrev:ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb",  
Alias="RoaringFork-day-2", IfNotFound=Warn)
```

- The command name is followed by a list of parameters in parentheses.
- Each parameter has a name, equal sign, and value.
- Quotes around parameter values help ensure correct parsing.
- Parameters can be in any order; however, TSTool command editors will enforce a default order consistent with documentation.



Insert and Edit a New Command

- Use the **Commands** menu to insert a command at the end of the command file or before the first selected command. The menu is organized by logical order at the top, and then grouped by categories of commands.
- If necessary, right-click on commands and use the **Deselect All Commands** menu. Then select a command to insert before.
- See the documentation command reference or use the **Help** button on command editors to view the documentation for a specific command.
- There are about 300 commands to process time series, tables, and other data.



Read a single time series from the HydroBaseWeb datastore

- Commands provide more granular control than general TSID commands when reading time series.
- Read commands are available for many data sources, which have appendices in the documentation to help understand data.
- The main TSTool time series list can help identify time series of interest and properties such as period of record.
- The command formatted as text is shown at the bottom of the editor and is useful when command files are edited with a text editor.
- Use the **Help** button to view command documentation for the current TSTool version (or “latest” if version-specific documentation is not available).

Edit ReadColoradoHydroBaseRest Command

Read 1+ time series from a Colorado HydroBase REST web services datastore, using options from the choices below.
Refer to the HydroBase REST web services documentation for information about data types.
Specifying the period will limit data that are available for later commands but can increase performance.
Reading a single time series TSID takes precedence over reading multiple time series.

Datastore: Required - HydroBase web service datastore.

Data type: Required - data type for time series.

Water class: Optional - use for specific WaterClass.

Data interval: Required - data interval (time step) for time series.

Indicate how to match time series in HydroBase

Match Single Time Series Match 1+ Time Series

Single time series must match a simple data type. Use "Match 1+ Time Series" for Structure WaterClass.

Location: Required - for example, station ID or structure WDID.

Data source: Optional - for example: USGS, DWR.

TSID (full): Created from above parameters.

Alias to assign: => Optional - use %L for location, etc. (default=no alias).

Input start: Optional - overrides the global input start.

Input end: Optional - overrides the global input end.

Specify how to fill missing values in HydroBase diversion records

Fill daily diversion records using carry forward: Optional - fill daily diversion records using carry forward (default=True).

Flag for diversion carry forward filled values: Optional - flag for filled carry forward values (default="c").

Fill diversion records using comments: Optional - fill diversion records using annual comments (default=False).

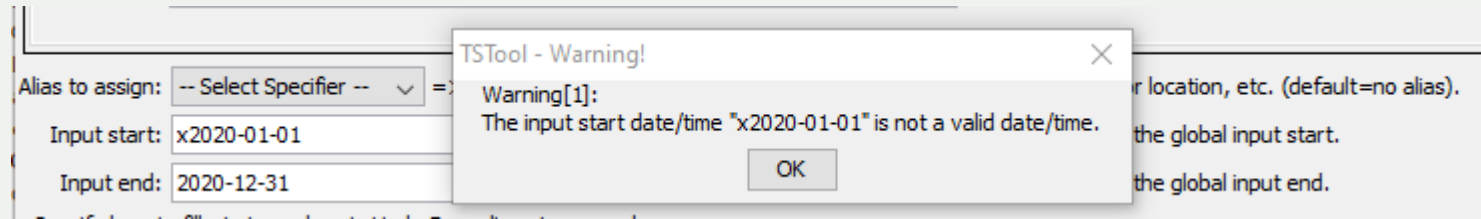
Flag for diversion comment filled values: Optional - flag for filled diversion comment values (default="Auto" to use "notUsed" value).

If missing: Optional - how to handle missing time series (blank=Warn).

Command:

```
ReadColoradoHydroBaseRest (DataStore="HydroBaseWeb", TSID="ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb", Alias="RoaringFork-day-3")
```


Command Editor Input Validation



- Commands editors attempt to verify input and will display a warning when editing changes are saved.
- Invalid command parameter values must be corrected before saving the command edits.
- To facilitate editing, commands that read or create time series run in “discovery” mode when a command file is opened or a new command is added with an editor. This allows later commands to select time series identifiers from previous commands.



Edit an Existing Command

- Double-click on a command to edit.
- Or, right-click on a command and use the popup ***Edit*** menu.
- Command files can also be edited with a text editor and can be created by other software, but be careful when mixing editing tools during an editing session because changes will reflect the tool that saves the changes last.



Copy / Paste / Delete Commands

- Commands can be copied and pasted using the main **Edit** menu, or right-click popup menu in the **Commands** list.
- Delete commands by selecting (highlighting) commands to be deleted and then use the **Delete Command(s)** item from the **Edit** menu, press the **Delete** key or use the **Clear Commands** button below the command list.
- Use the **View / Command File Diff** menu to review unsaved changes, but this requires installing KDiff3 or other software to compare files.



example2: Troubleshooting Using the Command Status

Commands (12 commands, 0 selected, 0 with failures, 1 with warnings)

```
2 # Read one daily time series using three different approaches.
3 # Purposefully introduce an error in the station identifier to illustrate error-handling.
4 #
5 # First, read using a time series identifier (TSID) copied from the time series list.
6 # ROAGLECO (3802069) - ROARING FORK RIVER AT GLENWOOD SPRINGS, CO.
7 ⚠ abbrev:xROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb
8 # Second, copy the above command, right click on the command, and
9 # "Convert TSID command to General ReadTimeSeries command".
10 ReadTimeSeries(TSID="abbrev:ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb",Alias="RoaringFork-day-2",IfNotFound=Warn)
11 # Third, use the ReadColoradoHydroBaseRest command found in the Commands / Read Time Series menu.
12 ReadColoradoHydroBaseRest(DataStore="HydroBaseWeb",TSID="ROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb",Alias="RoaringFork-day-3")
```

Run Selected Commands Run All Commands Clear Commands

- Open and run the `example2-error/example-streamflow-error.tstool` command file.
- A warning or failure (error) will be indicated by yellow markers on left and right of the command list.
- The **Commands** list title will also indicate the number of commands with failures and warnings.
- Mouse over the symbol on the left to view the command log.
- Right-click on the command and use the **Show Command Status (Success/Warning/Failure)** menu (see the next slide).



Troubleshooting Using the Command Status

- Show the status for a command by right-clicking on the command and use the **Show Command Status (Success/Warning/Failure)** menu.
- Each command may be processed using three phases, with a status for each phase.
- Command log messages are generated when a problem occurs, describe the problem and provide recommendations to fix the problem.

The screenshot shows a window titled "TSTool - Command Status". The command being executed is "abbrev:xROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb". The Command Status Summary table shows the following phases and statuses:

Phase	Status/Max Severity
INITIALIZATION	SUCCESS
DISCOVERY	UNKNOWN
RUN	WARNING

Below this is the Command Status Details table, which shows one warning:

#	Phase	Severity	Problem	Recommendation
1	RUN	WARNING	Time series "abbrev:xROAGLECO.USGS.DISCHRG.Day~HydroBaseWeb" has no data.	Verify that the identifier information is correct and that data exist.

At the bottom of the window are buttons for "Print", "Save", and "Close".



Troubleshooting Using the TSTool Log File

- The TSTool log file may need to be checked during troubleshooting.
- The log file may need to be provided to support.
- Use the ***Tools / Diagnostics – View Log File (Startup)...*** menu to view startup messages, including information about configuration.
- The `StartLog` command can be used to start a new log file, which can be viewed with the ***Tools / Diagnostics – View Log File...*** menu.



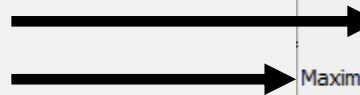
example3: Running Average

- Open and run the `example3-running-average/example-running-average.tstool` command file.
- This example builds on `example1` by adding several new commands.
- The following slides show how to use other commands to process and output time series.



Use a StartLog Command for Troubleshooting

- Use as the first command to track all commands in a workflow.
- See the **Commands / Logging and Messaging** menu.
- Use a filename that is the same as the command file with “.log” at end to avoid confusion.
- Can limit the log file size.
- Use the **Tools / Diagnostics - View Log File...** menu to view the log file contents.



Edit StartLog() command

(Re)start the log file. This is useful when it is desirable to have a log file saved for a command file.
A blank log file name will restart the current file.
The log file can be specified using a full or relative path (relative to the working directory).
The working directory is: C:\CDSS\TSTool-14.0.1\doc\Training\01-intro-commands\example3-running-average
The Browse button can be used to select an existing file to overwrite.
Specifying a suffix for the file will insert the suffix before the "log" file extension.

Log file: ... Abs

Maximum file size: Optional - maximum log file size, bytes (default=unlimited).

Suffix: Optional - suffix for log file (blank=none).

Command:
`StartLog (LogFile="example-running-average.tstool.log",MaxSize="1000000")`

OK Cancel Help



Use a SetInputPeriod Command to Control Reading

- Use the `SetInputPeriod` command to set a global read period.
- See the **Commands / Read Time Series** menu.
- Some read commands return all available data by default. However, HydroBase web services return a short recent period by default.
- Use the TSTool main window browser to view the available data period for time series and pick a period that is suitable.
- Some commands allow the period to be set only for that command.
- Once data are viewed, additional commands can be used to fill missing data.

Edit SetInputPeriod Command

The default input period constrains the period when reading data from files and databases. Use this command if a limited data period is necessary (e.g., to improve performance) or if the default input period is overly constrained. Using a `SetInputPeriod()` command may result in incomplete data being available for data filling. Enter date/times to a precision appropriate for time series being read. For example:

Year data: YYYY
Month data: MM/YYYY or YYYY-MM
Day data: MM/DD/YYYY or YYYY-MM-DD
Hour data: MM/DD/YYYY HH or YYYY-MM-DD HH
Minute data: MM/DD/YYYY HH:mm or YYYY-MM-DD HH:mm

Special values are also recognized (for all precisions):
CurrentToYear = the current date to year precision
CurrentToMinute = the current date/time to minute precision
CurrentToMinute - 7Day = current date/time minus 7 days
CurrentToMinute + 7Day = current date/time plus 7 days

The above Current* values can have modifiers as shown in the following examples (can chain multiple modifiers):
CurrentToMinute.Round(5Min).RoundDirection(>) - round to the next even 5min
CurrentToMinute.Round(6hour).TimeZone() - round to the previous even 6hour and set time zone to blank

\$(Property) = processor property as DateTime object or date/time string

The time zone is by default the computer time zone for hour or smaller interval and blank otherwise - if necessary, specify in date/time string or use .TimeZone().

Leave blank to read all available data (default if `SetInputPeriod()` command is not used).

Input period start:

Input period end:

Command:

OK Cancel Help



Use the RunningStatisticTimeSeries Command for Analysis

- See the **Commands / Create Time Series** menu.
- The “TS list” indicates which time series should be processed.
- The “Statistic” is calculated for each sample.
- The **Sample** tab indicates how to determine the sample for each calculated statistic. In this case, each value from the same day for the last 5 years is used.
- Also use the **Output** tab to specify the alias of the output time series.
- See the command documentation for a full explanation.

Edit RunningStatisticTimeSeries Command

Create running statistic time series, where each new value is a statistic determined from a moving window of sample data (e.g., a running average).
An AllYears statistic is computed from all values (statistic will be the same every year).
A centered running statistic is computed from the values at a date/time and on either side.
Previous and future running statistics use points only on one side of the current point, and optionally inclusive of the current point.
An NYear running statistic uses the values for the date/time and previous years (N years total).
An NAllYear running statistic uses the values for the date/time and all previous years.

TS list: AllMatchingTSID Optional - indicates the time series to process (default=AllTS).

TSID (for TSList=AllMatchingTSID): RoaringFork-day

EnsembleID (for TSList=EnsembleID):

Statistic: Mean Required - statistic to calculate.

Distribution **Sample** Normal Output

These parameters indicate how to determine the sample for each timestep in the output time series.
Statistic values will be calculated for the analysis period (see also the Normal and Output period).

Analysis start: Optional - analysis start date/time (default=full time series period).

Analysis end: Optional - analysis end date/time (default=full time series period).

Sample method: NYear Required - how to determine sample to analyze.

Number of years: 5 Required (except for NAllYear,AllYears).

Bracket (by month): Optional - 12 monthly bracket values 4,1,... (Jan first).

Custom bracket (by month): Optional - 12 monthly bracket ranges 1-3,3-6,... (Jan first).

Allow missing count: 1 Optional - number of missing values allowed in sample (default=no limit).



Minimum sample size: Optional - minimum sample size to do calculation (default=no limit).

Command: RunningStatisticTimeSeries (TSList=AllMatchingTSID, TSID="RoaringFork-day", Statistic=Mean, SampleMethod=NYear, Bracket=5, AllowMissingCount=1, Alias="RoaringFork-5YearMean-day")

OK Cancel Help



Use the CheckTimeSeries Command for Quality Control

- See the **Commands / Check Time Series** menu.
- Use the **Time Series** tab to indicate which time series to check. 
- Use the **Check Criteria and Actions** tab to specify the criteria, in this case check for missing values. 
- Optionally, use the **Analysis Period and Window** tab to specify analysis window such as seasons.
- Optionally, use the **Output Table** tab to save output to a table, which can be viewed and output.
- See also the `CheckTimeSeriesStatistic` command.
- Comment out the command if issues are known and don't want to see a warning.

Edit CheckTimeSeries Command ✕

Check time series data values for critical values (see also the CheckTimeSeriesStatistic() command).
Check results can be saved to a table for output for further processing.
Or, use the WriteCheckFile() command to save the results of all checks from command status messages.

Time Series | **Check Criteria and Actions** | Analysis Period and Window | Output Table | Output Properties

Specify criteria to check for and actions to be taken when check criteria are met.
A warning will be generated for each case where a value matches the specified condition(s).
Specify dates with precision appropriate for the data, use blank for all available data, or \${Property} for processor property.

Check criteria:	Missing	Required - may require other parameters.
Value 1:	<input type="text"/>	Optional - minimum (or only) value to check.
Value 2:	<input type="text"/>	Optional - maximum value in range, or other input to check.
Problem type:	<input type="text"/>	Optional - problem type to use in output (default=check criteria).
Maximum warnings:	<input type="text"/>	Optional - maximum # of warnings/time series (default=no limit).
Flag:	<input type="text"/>	Optional - flag to mark detected values.
Flag description:	<input type="text"/>	Optional - description for flag.
Action:	<input type="text"/>	Optional - action for matched values (default=no action).

Command:
`CheckTimeSeries (TSLIST=AllMatchingTSID,CheckCriteria="Missing")`

OK Cancel Help



Output Results Using WriteDelimitedFile or other Command

- Output files allow other software to use the results.
- Many commands are available for different file formats, databases, Excel, etc.

Edit WriteDelimitedFile Command

Write time series to a simple delimited file (e.g., comma-separated-value, CSV), useful to input to other programs. Minimal metadata is saved. For a more detailed format, see WriteDateValue() and other write commands. The working directory is: C:\CDSS\TSTool-14.0.1\doc\Training\01-intro-commands\example3-running-average. Enter date/times to a precision appropriate for output time series.

TS list: Optional - indicates the time series to process (default=AllTS).

TSID (for TSList=AllMatchingTSID):

EnsembleID (for TSList=EnsembleID):

Delimited file to write: ... Abs

Date/time column name: Optional - name for date/time column (default=Date or DateTime).

Date/time format: ----- Select Specifier ----- => Optional - format string for data date/time formatter (default=ISO).

Value column(s): -- Select Specifier -- => Optional - %L for location, \${ts:property} for property (default=%L_%T).

Heading surround character: Optional - character to surround headings, \" for quote (default=none).

Delimiter character: Optional - delimiter between columns (default=comma, \t=tab, \s=space).

Output precision: Optional - digits after decimal (default=4).

Missing value: Optional - value to write for missing data (default=initial missing value).

Output start: Optional - override the global output start (default=write all data).

Output end: Optional - override the global output end (default=write all data).

Header comments:

Command:

```
WriteDelimitedFile (OutputFile="example-running-average.csv")
```

OK Cancel Help



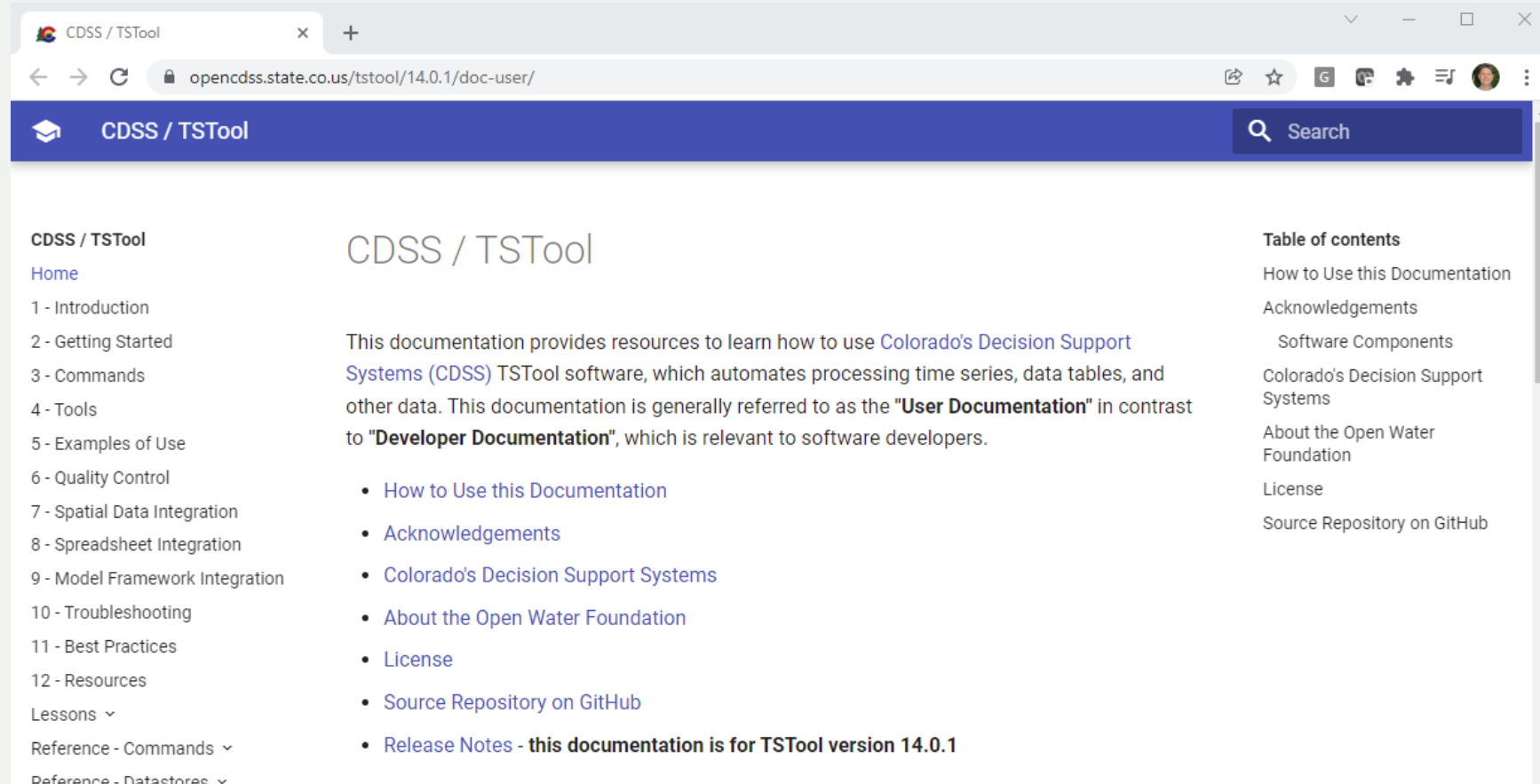
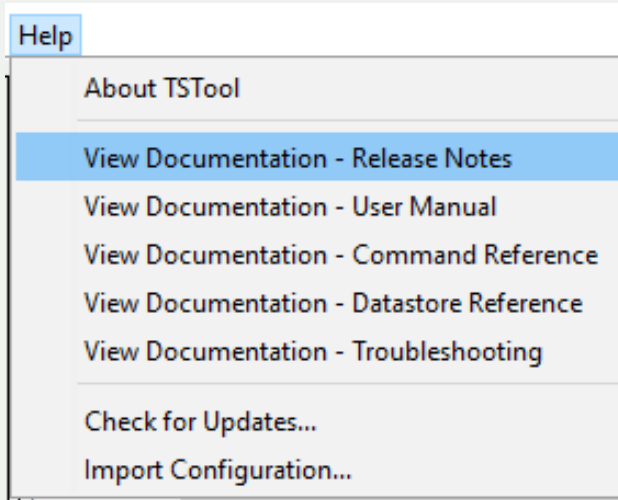
Command File Best Practices

- Use comments to describe the command workflow.
- Use a `StartLog` command as the first command, to help with troubleshooting. Comment out if not required for troubleshooting.
- Use relative paths for file names to allow files to be easily moved and shared, without dependency on a specific computer.
- Use `CheckTimeSeries` and other commands to check for missing data and other problems.
- Use time series, table, and file naming conventions that are consistent and allow a workflow to be modified.
- For more complex workflows, use a folder for log and output files to separate results from input files.



More Information

See the TSTool *Help* menu for links to online documentation.



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Next Steps

- Review the TSTool documentation to gain an appreciation for processing that can be done. The Examples section of each command's documentation includes a link to command files that are used to test the software.
- Create command files to automate processing.



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