Colorado's Decision Support Systems (CDSS)

TSTool Training

Getting Started

Version: 10.00.01, 2011-05-05

Duration: Less than 30 minutes

Level: Introduction

Colorado Water Conservation Board and Division of Water Resources

This Presentation

- Provides an introduction to TSTool for new users
- Is designed for self-paced training
- Is accompanied by examples, each of which reside in a folder distributed with this presentation
  - See the doc/Training folder under the software installation
  - Full use of TSTool requires access to databases and internet (some examples will not work without such access)

TSTool Feature Summary

- Read and write time series in various formats

- Automate processing using a command language

- Fill/manipulate data

- Quality control

- Analyze data and generate products

TSTool Origins in CDSS

- Originally developed for Colorado's Decision Support Systems (CDSS)
    - Read time series data from HydroBase database and files
    - Fill missing data
    - Create input files for StateCU and StateMod models
    - Process model results into products
- Within CDSS, complements other software
    - TSTool processes time series
    - StateDMI processes some time series but focuses on other data files

TSTool …Beyond CDSS

- Read/write CADSWES RiverWare files
- Read MODSIM time series files
- Read/write Army Corps HEC-DSS files
- Read/write National Weather Service River Forecast System files
- Process ensembles of time series
- Retrieve files using FTP and URLs
- Run on Windows and Linux/UNIX
- Run external programs and Python Scripts
- …many enhancements beyond CDSS core

CDSS Data-Centered Approach

- Open access to data

- Share data for multiple uses

- Applications focus on analysis and generating results/products

- Concepts are applicable beyond CDSS

Data Collection

⬇

Data-Centered Management: GIS/HydroBase Database

⬇

Data Management Interfaces (DMIs)/Access Tools:
- **TSTool**, StateDMI,etc.
- StateView, Website

⬇

Applications/Models:
- Consumptive Use (StateCU)
- Water Allocation (StateMod)
- Groundwater (MODFLOW)
- Other

Starting TSTool

If not already installed, download and install the software from http://cdss.state.co.us (see the Products…DMI Utilities link).
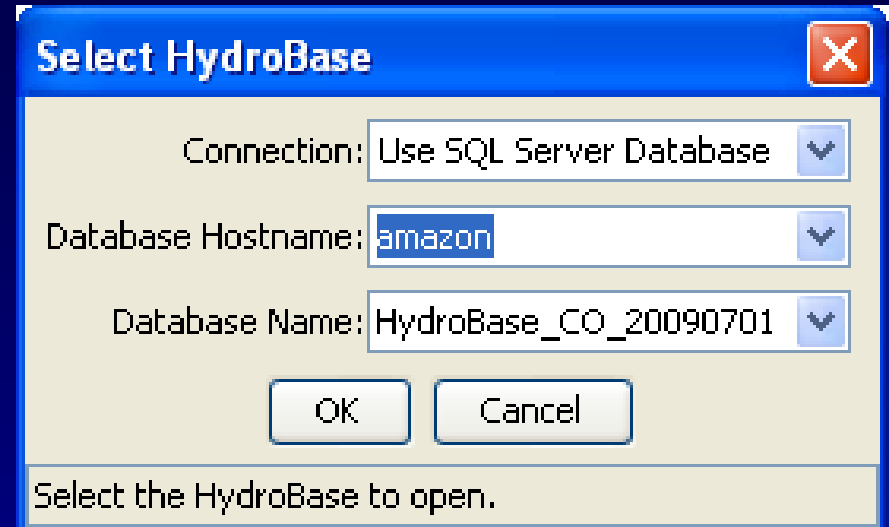
To run, for example:
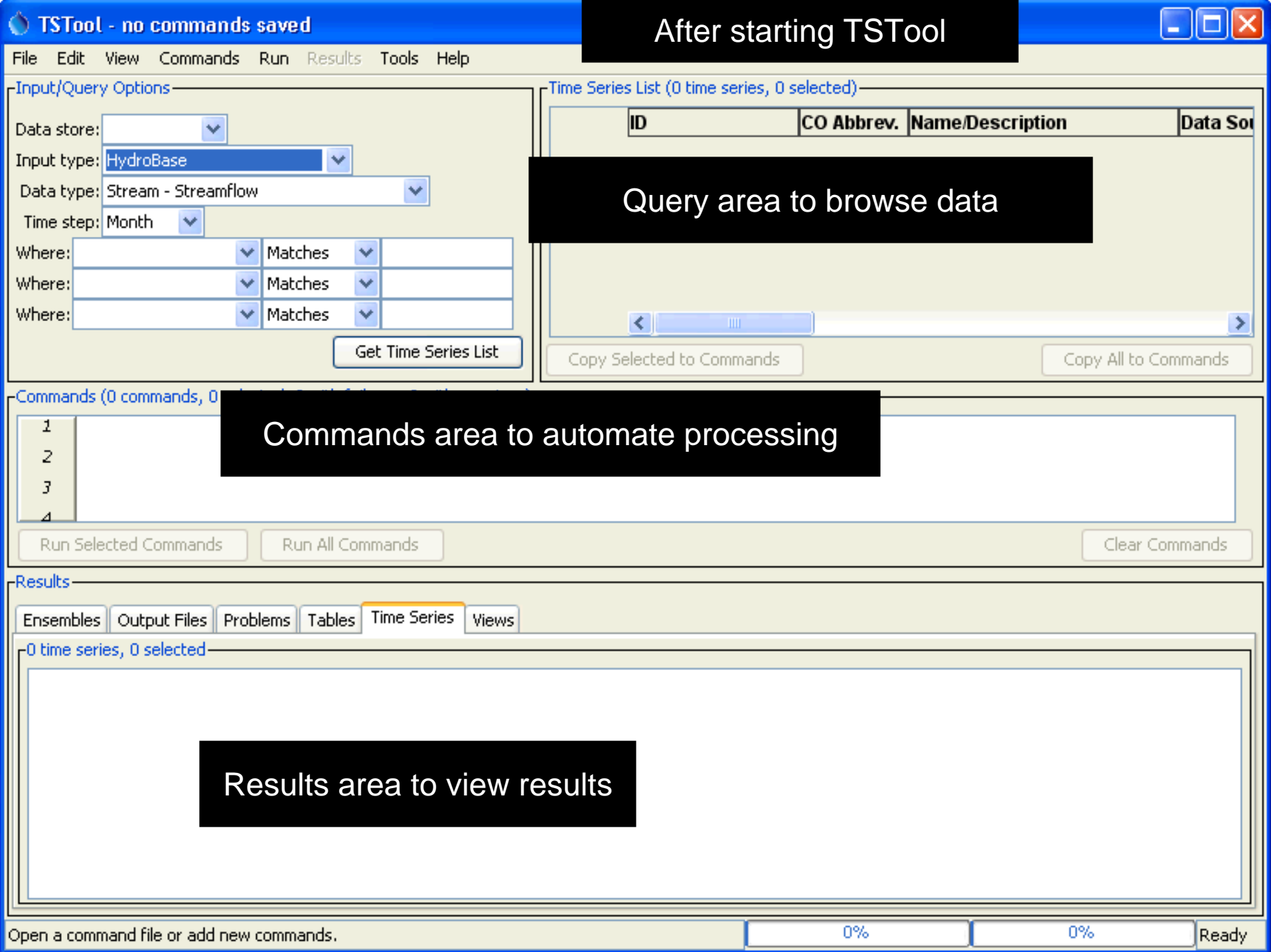
Start…All Programs…CDSS…TSTool-09.07.02

Multiple versions can be installed and will be listed in the CDSS menu.

Select HydroBase

- Select HydroBase server (can be local computer)

- Select available HydroBase version

Reading data from HydroBase will not be possible if HydroBase is not available (but web services and other options are available if internet access is available).

TSTool - no commands saved

File Edit View Commands Run Results Tools Help

After starting TSTool

Input/Query Options

Data store: [▼]

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 Sou

Query area to browse data

[Copy Selected to Commands]   [Copy All to Commands]

Commands (0 commands, 0 selected)

1
2
3
4

Commands area to automate processing

[Run Selected Commands] [Run All Commands]   [Clear Commands]

Results

Ensembles | Output Files | Problems | Tables | Time Series | Views

0 time series, 0 selected

Results area to view results

Open a command file or add new commands.   0%   0%   Ready

TSTool - no commands saved

File   Edit   View   Commands   Run   Results   Tools   Help

Input/Query Options

Data store:

Input type: HydroBase

Data type: Stream - Streamflow

Time step: Month

Where: District = 38 - Roaring Fork River Basin

Where: Matches

Where: Matches

1. Specify input and query options

Get Time Series List

Time Series List (71 time series, 0 selected)

	ID	CO Abbrev	Name/Description	Data
1	09072550	Sort Ascending	ROARING FORK RIVER ABV LOS...	USGS
2	09073005	Sort Descending	LINCOLN CREEK BELOW GRIZZL...	USGS
3	09073300	Original Order	ROARING FORK RIVER AB DIFFIC...	USGS
4	09073400	ROAASPCO	ROARING FORK RIVER NEAR AS...	USGS
5	09073500		ROARING FORK RIVER AT ASPE...	USGS
6	09073700		HUNTER CREEK ABOVE MIDWAY...	USGS
7	09073720		HUNTER CREEK FEEDER CONDUI...	USGS

Copy Selected to Commands   Copy All to Commands

3. View the time series list – right click on headings for sort options.

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

1
2
3
4
5
6
7
8

2. "Get Time Series List"

Run Selected Commands   Run All Commands   Clear Commands

Results

Ensembles | Output Files | Problems | Tables | Time Series | Views

0 time series, 0 selected

Each input type has choices and limitations based on the data

Open a command file or add new commands.   0%   0%   Ready

Graphing time series

TSTool - no commands saved

File Edit View Commands Run Results Tools Help

Input/Query Options

Data store:

Input type: HydroBase

Data type: Stream - Streamflow

Time step: Month

Where: District = 38 - Roaring Fork River Basin

Where: Matches

Where: Matches

Get Time Series List

Time Series List (71 time series, 0 selected)

	ID	CO Abbrev	Name Description	Dat
1	09072550	RO		
2	09073005	LI		
3	09073300	RO		
4	09073400	RO		
5	09073500			
6	09073700			
7	09073720		HUNTER CREEK FEEDER CONDUI...	USGS

1. Copy time series identifiers (TSIDs) to commands

Copy Selected to Commands   Copy All to Commands

Commands (142 commands, 0 selected, 0 with failures, 0 with warnings)

```
1   # 09072550 - ROARING FORK RIVER ABV LOST MAN CR NEAR ASPEN, CO
2   09072550.USGS.Streamflow.Month~HydroBase
3   # 09073005 - LINCOLN CREEK BELOW GRIZZLY RESERVOIR NR ASPEN, CO
4   09073005.USGS.Streamflow.Month~HydroBase
5   # 09073300 - ROARING FORK RIVER AB DIFFICULT C NR ASPEN, CO
6   09073300.USGS.Streamflow.Month~HydroBase
7   # 09073400 - ROARING FORK RIVER NEAR ASPEN
8   09073400.USGS.Streamflow.Month~HydroBase
9   # 09073500 - ROARING FORK RIVER AT ASPEN, CO.
10
```

2. Run commands

Run Selected Commands   Run All Commands   ands

Results

Ensembles | Output Files | Problems | Tables | Time Series | Views

71 time series, 71 selected

1) ROARING FORK RIVER ABV LOST MAN CR NEAR ASPEN, CO - 09072550.USGS.Streamflow.Month (198?-10 to 2009-09)
2) LINCOLN CREEK BELOW GRIZZLY RESERVOIR NR ASPEN, CO - ... -10 to 2009-09)
3) ROARING FORK RIVER AB DIFFICULT C NR ASPEN, CO. - 0907... to 2009-09)
4) ROARING FORK RIVER NEAR ASPEN, CO. - 09073400.USGS.St...
5) ROARING FORK RIVER AT ASPEN, CO. - 09073500.USGS.Strea...
6) HUNTER CREEK ABOVE MIDWAY CREEK, NEAR ASPEN, CO. - 09... 0 to 1980-09)
7) HUNTER CREEK FEEDER CONDUIT NEAR ASPEN, CO. - 09073720.USGS.Streamflow.Month (1980-05 to 1983-09)
8) MIDWAY CREEK FEEDER CONDUIT NEAR ASPEN, CO. - 09073790.USGS.Streamflow.Month (1980-05 to 1983-09)
9) MIDWAY CREEK NEAR ASPEN, CO. - 09073800.USGS.Streamflow.Month (1970-10 to 1980-09)
10) NO NAME CREEK FEEDER CONDUIT NEAR ASPEN, CO. - 09073890.USGS.Streamflow.Month (1980-05 to 1983-09)

3. Select time series and right click to graph

Graph - Area
Graph - Area (stacked)
Graph - Bar (left of date)
Graph - Bar (center on date)
Graph - Bar (right of date)
Graph - Duration
Graph - Line
Graph - Line (log Y-axis)
Graph - Period of Record
Graph - Point
Graph - Predicted Value (under development)
Graph - Predicted Value Residual (under development)
Graph - XY-Scatter

Table

Report - Summary (HTML)
Report - Summary (Text)

Find Time Series...
Select All for Output
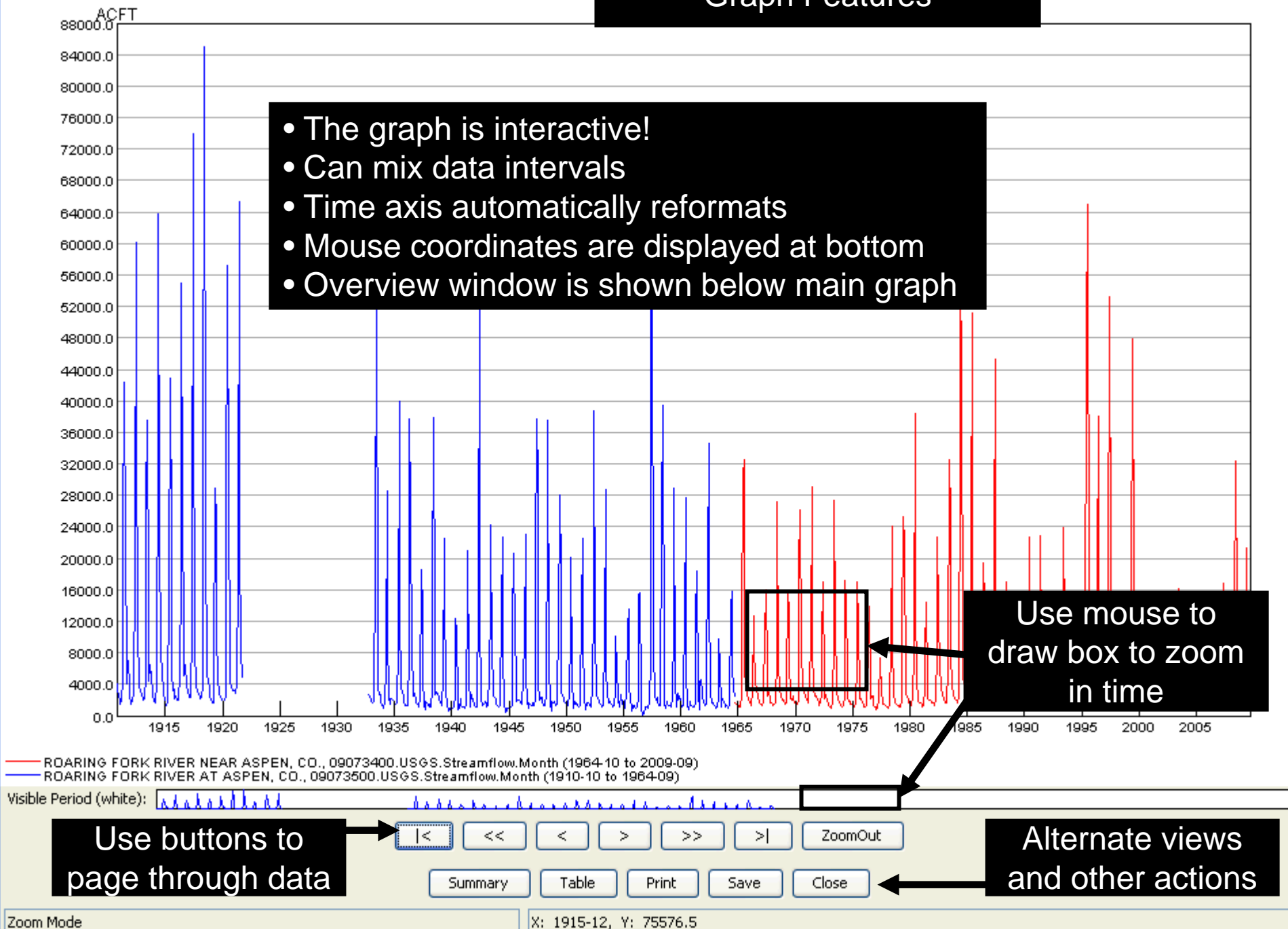Deselect All

Time Series Properties

Completed running commands. Use Results and Tools menus.   100%   100%   Ready

TSTool - Time Series - Table

Table Features

DATE	09073400, Streamflow, ACFT	09073500, Streamflow, ACFT
1963-10		1844.3
1963-11		1457.9
1963-12		1168.3
1964-01		1229.8
1964-02		1035.4
1964-03		930.3
1964-04		1477.7
1964-05		13832.9
1964-06		15858.1
1964-07		6267.9
1964-08		3350.1
1964-09		2453.6
1964-10	1701.8	
1964-11	1404.3	
1964-12	1467.8	
1965-01	1390.4	
1965-02	1146.5	
1965-03	1188.1	
1965-04	2765.0	
1965-05	10917.2	
1965-06	30692.7	
1965-07	32507.6	
1965-08	5434.8	
1965-09	4078.1	
1965-10	4917.1	
1965-11	2848.3	
1965-12	2015.2	
1966-01	1701.8	
1966-02	1376.5	
1966-03	1652.3	
1966-04	2941.5	
1966-05	12688.4	
1966-06	9223.3	
1966-07	4280.4	
1966-08	3429.5	
1966-09	2271.1	
1966-10	2265.2	
1966-11	1658.2	

Column headings default to information from time series

Table scrolling, with rows and columns limited only by computer memory

Select cells, right-click for clipboard and export options

Alternate views and other actions

Graph   Summary   Save   Close

Currently-selected worksheet interval: Month

TSTool - Time Series - Summary

Summary Features

```
Time Series Identifier  = 09073400.USGS.Streamflow.Month
Description             = ROARING FORK RIVER NEAR ASPEN, CO.
Data source            = USGS
Data type              = Streamflow
Data interval          = Month
Data units             = ACFT
Period                 = 1964-10 to 2009-09
Orig./Avail. period    = 1964-10 to 2009-09


Comments:
Station and time series information from HydroBase determined at time of query:
Time series identifier      = 09073400.USGS.Streamflow.Month
Description                 = ROARING FORK RIVER NEAR ASPEN, CO.
Data source                = USGS
Data type                  = Streamflow
Data interval              = Month
Data units                 = ACFT
HydroBase query period     = Query All
HydroBase available period = 1964 to 2009
State of CO abbreviation   = ROAASPCO
Located in water div, district = 5, 38
Located in county, state   = PITKIN, CO
Located in HUC             = 14010004
Latitude, longitude       =   39.179989, -106.801979
Drainage area             = 108.00 SQ MI
Non-natural contributing area = 108.00 SQ MI
Elevation                 = 8014.01 FT


Time series creation history:
Read HydroBase time series from 1964-10 to 2009-09.
```

General time series metadata

Additional information if available (e.g., from HydroBase)

Default report format for data interval

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1964	NC	NC	NC	NC	NC	NC	NC	NC	NC	1701.8	1404.3	1467.8	NC
1965	1390.4	1146.5	1188.1	2765.0	10917.2	30692.7	32507.6	5434.8	4078.1	4917.1	2848.3	2015.2	99901
1966	1701.8	1376.5	1652.3	2941.5	12688.4	9223.3	4280.4	3429.5	2271.1	2265.2	1658.2	1507.5	44995
			.6	2891.9	10409.4	16044.5	5724.4	2447.6	3060.5	2189.8	1691.9	1616.6	50507

Alternate views and other actions

Graph Table Search Print Save Close

Time Series Identifier (TSID)

- LocID.Source.DataType.Interval
- LocID.Source.DataType.Interval~InputType
- LocID.Source.DataType.Interval~InputType~Filename
- LocID.Source.DataType.Interval~DataStore

The TSID uniquely identifies the time series and allows TSTool to find the time series in a database, files, or website.
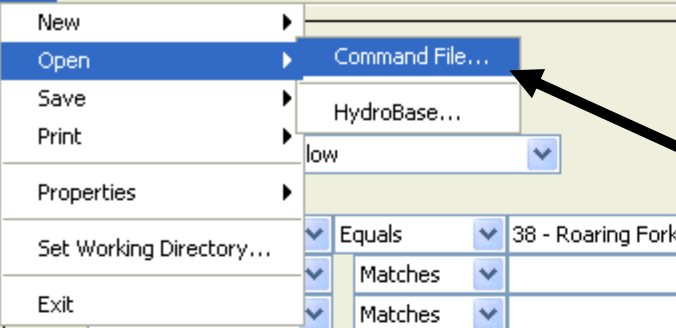
The DataStore concept is being phased in and allows more flexibility in configuring input and output.

An alias also can be used to identify time series and can be set in some commands that create time series. Aliases are in many cases interchangeable with TSIDs and allow users to identify time series using metadata that is more relevant for a specific application.

Opening and Running an Existing Command File

- File…Open…Command File

- Select a *.TSTool file (in this case choose example1-StreamflowCommands\ StreamflowCommands.TSTool)

- Press the Run All Commands button under the command list

- View the results

Opening and Running a Command File

TSTool - "C:\Develop\TSTool_SourceBuild\TSTool\doc" ...treamflow...

File Edit View Commands Run Results Tools Help

New
Open ▶ Command File...
Save   HydroBase...
Print
Properties
Set Working Directory...
Exit

Open an existing command file

Get Time Series List

Copy Selected to Commands   Copy All to Commands

Time Series List (71 time series, 0 selected)

	ID	CO Abbrev.	Name/Description	Da
1	09072550	ROALMCCO	ROARING FORK RIVER ABV LOS...	US
			NCOLN CREEK BELOW GRIZZL...	US
			OARING FORK RIVER AB DIFFIC...	US
			OARING FORK RIVER NEAR AS...	US
			OARING FORK RIVER AT ASPE...	US
6	09073700		HUNTER CREEK ABOVE MIDWAY...	US
7	09073720		HUNTER CREEK FEEDER CONDUI...	US

Commands (4 commands, 0 selected, 0 with failures, 0 with warnings)

```
1  # Simple command file to read a DateValue file, which contains all the
2  # daily streamflow time series from HydroBase for Water District 38
3  # (Roaring Fork).  After reading the time series are read in, they can be viewed.
4  ReadDateValue(InputFile="RoaringFork-Streamflow-Month.dv")
5
6
7
8
9
10
```

Commands have a readable text form, with comments used to describe processing

Run Selected Commands   Run All Commands   Clear Commands

Run commands to generate results

Results

Ensembles Output Files Problems Tables Time Series Views

71 time series, 71 selected

1) MIDDLE CUNNINGHAM CREEK FEEDER CANAL NR. - CUNCANCO.DWR.Streamflow.Month (1906-04 to 2009-09)
2) ROCKY FORK CREEK NEAR MEREDITH, CO. - 09080300.DWR.Streamflow.Month (1906-04 to 2009-09)
3) ROARING FORK RIVER BELOW MAROON CREEK NEAR ASPEN - ROABMCCO.DWR.Streamflow.Month (1906-04 to 2009-09)
4) THOMPSON CREEK FEEDER DITCH NEAR HAYSTACK, CO - THOMUPCO.DWR.Streamflow.Month (1906-04 to 2009-09)
5) ROARING FORK RIVER ABV LOST MAN CR NEAR ASPEN, CO - 09072550.USGS.Streamflow.Month (1906-04 to 2009-09)
6) LINCOLN CREEK BELOW GRIZZLY RESERVOIR NR ASPEN, CO - 09073005.USGS.Streamflow.Month (1906-04 to 2009-09)
7) ROARING FORK RIVER AB DIFFICULT C NR ASPEN, CO. - 09073300.USGS.Streamflow.Month (1906-04 to 2009-09)
8) ROARING FORK RIVER NEAR ASPEN, CO. - 09073400.USGS.Streamflow.Month (1906-04 to 2009-09)
9) ROARING FORK RIVER AT ASPEN, CO. - 09073500.USGS.Streamflow.Month (1906-04 to 2009-09)
10) HUNTER CREEK ABOVE MIDWAY CREEK, NEAR ASPEN, CO. - 09073700.USGS.Streamflow.Month (1906-04 to 2009-09)

Completed running commands. Use Results and Tools menus.   100%   100%   Ready

More Information

Help…View Documentation to view the TSTool documentation