Colorado's Decision Support Systems (CDSS)

TSTool Training

Data Filling

Version: 10.00.01, 2011-05-09

Duration: 30 minutes

Level: Introduction

This Presentation

- Provides an introduction to TSTool data filling features
- 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

TSTool Data Filling Features

- Every time series has a missing data value indicator (-999 and NaN are common)
- Displays show blanks for missing data
- Many commands are available to fill missing data
- Filled values can be flagged and annotated in reports
- Tools are available to evaluate the extent of data gaps

TSTool Data Filling Commands

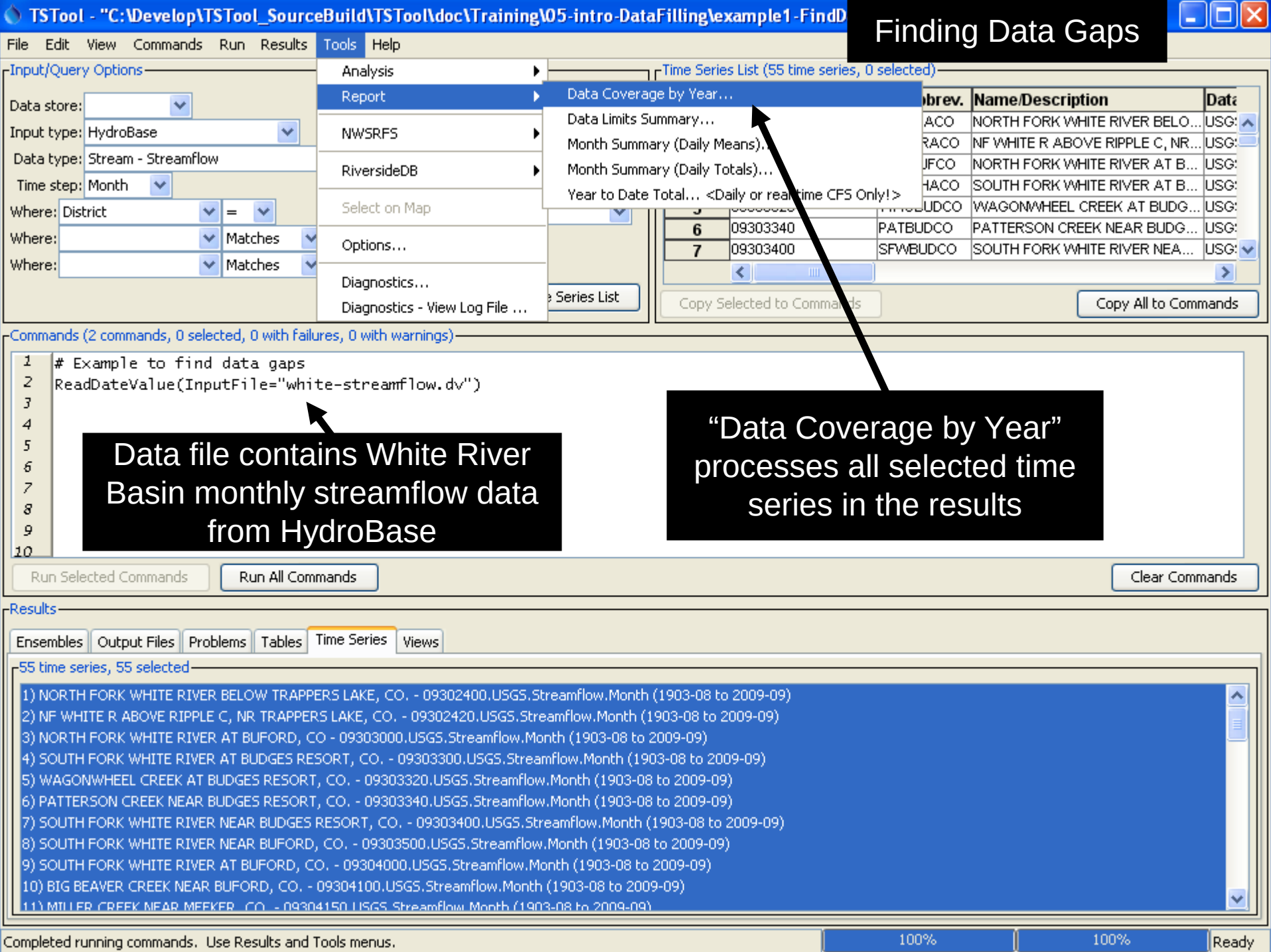
- FillConstant()
- FillDayTSFrom2MonthTSAnd1DayTS() – prorate “volume”
- FillFromTS() – useful for merging time series
- FillHistMonthAverage()
- FillHistYearAverage()
- FillInterpolate()
- FillMixedStation() – regression technique
- FillMOVE2() – regression technique
- FillPattern() – uses historical averages in wet/dry/average “bins”
- FillProrate()
- FillRegression()
- FillRepeat()

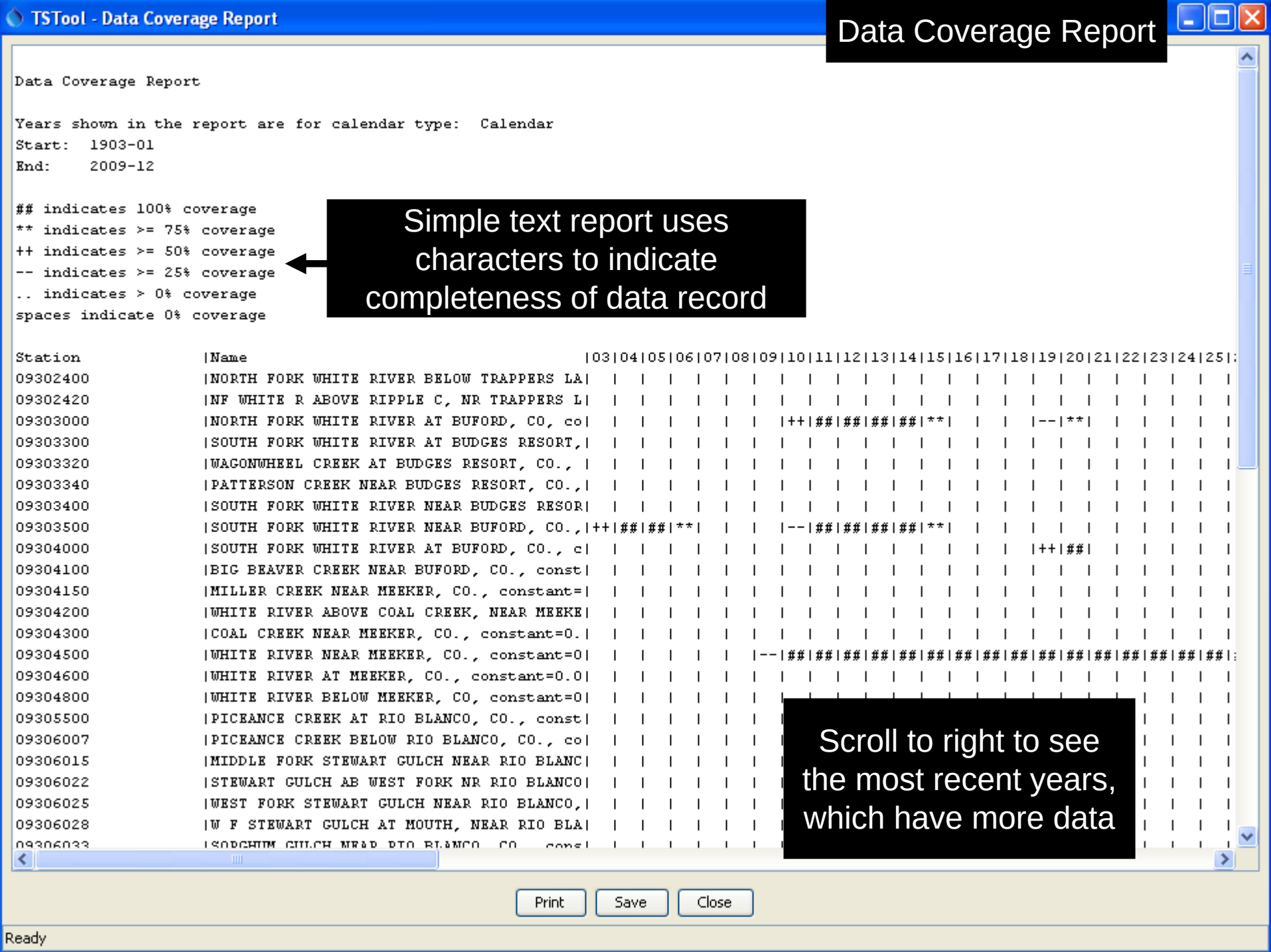
Not all the commands are discussed in this training – see the TSTool documentation.

Tools to Find Data Gaps

- Data coverage report
- Period of record graph

See example: example1-FindDataGaps\FindDataGaps.TSTool


TSTool - "C:\Develop\TSTool_SourceBuild\TSTool\doc\Training\05-intro-DataFilling\example1-FindD
Finding Data Gaps
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 =
Where: Matches
Where: Matches
Analysis
Report
NWSRFS
RiversideDB
Select on Map
Options...
Diagnostics...
Diagnostics - View Log File ...
Data Coverage by Year...
Data Limits Summary...
Month Summary (Daily Means)...
Month Summary (Daily Totals)...
Year to Date Total... <Daily or real-time CFS Only!>
Time Series List (55 time series, 0 selected)
Name/Description
NORTH FORK WHITE RIVER BELO...
NF WHITE R ABOVE RIPPLE C, NR...
NORTH FORK WHITE RIVER AT B...
SOUTH FORK WHITE RIVER AT B...
WAGONWHEEL CREEK AT BUDG...
6 09303340 PATBUDCO PATTERSON CREEK NEAR BUDG...
7 09303400 SFWBUDCO SOUTH FORK WHITE RIVER NEA...
Copy Selected to Commands
Copy All to Commands
Commands (2 commands, 0 selected, 0 with failures, 0 with warnings)
1 # Example to find data gaps
2 ReadDateValue(InputFile="white-streamflow.dv")
Data file contains White River Basin monthly streamflow data from HydroBase
"Data Coverage by Year" processes all selected time series in the results
Run Selected Commands
Run All Commands
Clear Commands
Results
Ensembles Output Files Problems Tables Time Series Views
55 time series, 55 selected
1) NORTH FORK WHITE RIVER BELOW TRAPPERS LAKE, CO. - 09302400.USGS.Streamflow.Month (1903-08 to 2009-09)
2) NF WHITE R ABOVE RIPPLE C, NR TRAPPERS LAKE, CO. - 09302420.USGS.Streamflow.Month (1903-08 to 2009-09)
3) NORTH FORK WHITE RIVER AT BUFORD, CO - 09303000.USGS.Streamflow.Month (1903-08 to 2009-09)
4) SOUTH FORK WHITE RIVER AT BUDGES RESORT, CO. - 09303300.USGS.Streamflow.Month (1903-08 to 2009-09)
5) WAGONWHEEL CREEK AT BUDGES RESORT, CO. - 09303320.USGS.Streamflow.Month (1903-08 to 2009-09)
6) PATTERSON CREEK NEAR BUDGES RESORT, CO. - 09303340.USGS.Streamflow.Month (1903-08 to 2009-09)
7) SOUTH FORK WHITE RIVER NEAR BUDGES RESORT, CO. - 09303400.USGS.Streamflow.Month (1903-08 to 2009-09)
8) SOUTH FORK WHITE RIVER NEAR BUFORD, CO. - 09303500.USGS.Streamflow.Month (1903-08 to 2009-09)
9) SOUTH FORK WHITE RIVER AT BUFORD, CO. - 09304000.USGS.Streamflow.Month (1903-08 to 2009-09)
10) BIG BEAVER CREEK NEAR BUFORD, CO. - 09304100.USGS.Streamflow.Month (1903-08 to 2009-09)
Completed running commands. Use Results and Tools menus.
100%
100%
Ready

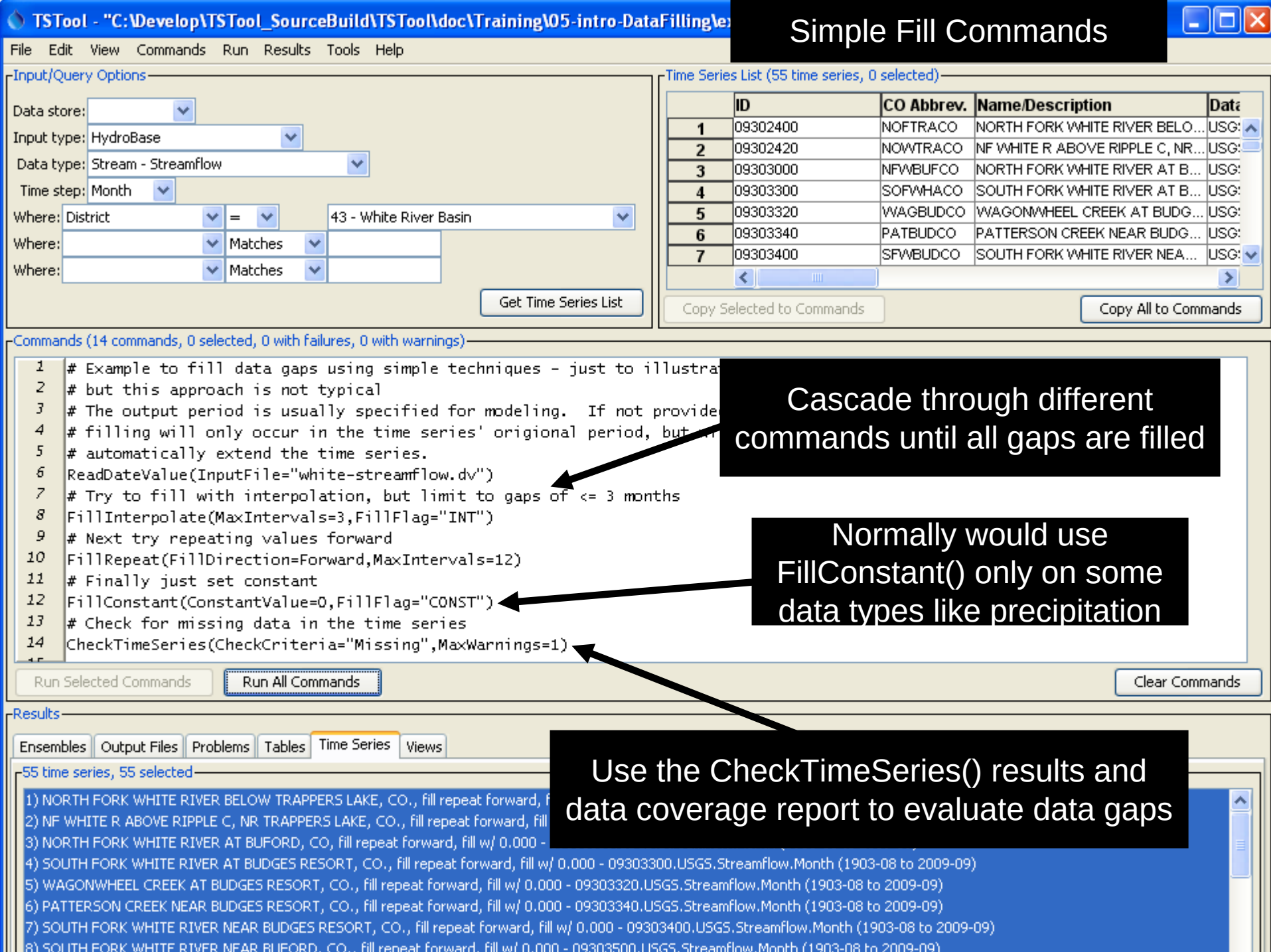



```
Data Coverage Report

Years shown in the report are for calendar type:  Calendar
Start:  1903-01
End:    2009-12

## indicates 100% coverage
** indicates >= 75% coverage
++ indicates >= 50% coverage
-- indicates >= 25% coverage
.. indicates > 0% coverage
spaces indicate 0% coverage

Station          |Name                                    |03|04|05|06|07|08|09|10|11|12|13|14|15|16|17|18|19|20|21|22|23|24|25|
09302400         |NORTH FORK WHITE RIVER BELOW TRAPPERS LA|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09302420         |NF WHITE R ABOVE RIPPLE C, NR TRAPPERS L|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09303000         |NORTH FORK WHITE RIVER AT BUFORD, CO, co|  |  |  |  |  |  |  |++|##|##|##|##|**|  |  |  |--|**|  |  |  |  |  |
09303300         |SOUTH FORK WHITE RIVER AT BUDGES RESORT,|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09303320         |WAGONWHEEL CREEK AT BUDGES RESORT, CO., |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09303340         |PATTERSON CREEK NEAR BUDGES RESORT, CO.,|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09303400         |SOUTH FORK WHITE RIVER NEAR BUDGES RESOR|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09303500         |SOUTH FORK WHITE RIVER NEAR BUFORD, CO.,|++|##|##|**|  |  |  |--|##|##|##|##|**|  |  |  |  |  |  |  |  |  |  |
09304000         |SOUTH FORK WHITE RIVER AT BUFORD, CO., c|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |++|##|  |  |  |  |  |
09304100         |BIG BEAVER CREEK NEAR BUFORD, CO., const|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09304150         |MILLER CREEK NEAR MEEKER, CO., constant=|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09304200         |WHITE RIVER ABOVE COAL CREEK, NEAR MEEKE|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09304300         |COAL CREEK NEAR MEEKER, CO., constant=0.|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09304500         |WHITE RIVER NEAR MEEKER, CO., constant=0|  |  |  |  |  |  |--|##|##|##|##|##|##|##|##|##|##|##|##|##|##|##|##|##|
09304600         |WHITE RIVER AT MEEKER, CO., constant=0.0|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09304800         |WHITE RIVER BELOW MEEKER, CO, constant=0|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09305500         |PICEANCE CREEK AT RIO BLANCO, CO., const|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306007         |PICEANCE CREEK BELOW RIO BLANCO, CO., co|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306015         |MIDDLE FORK STEWART GULCH NEAR RIO BLANC|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306022         |STEWART GULCH AB WEST FORK NR RIO BLANCO|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306025         |WEST FORK STEWART GULCH NEAR RIO BLANCO,|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306028         |W F STEWART GULCH AT MOUTH, NEAR RIO BLA|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
09306033         |SORGHUM GULCH NEAR RIO BLANCO, CO., cons|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
```

Simple Fill Commands

- Fill with constant, interpolation, or repeat, use when more a complex method is not possible
- Also use as a final fill technique when gaps remain after other fill techniques (e.g, fill precipitation with zero if no other choice)

See example: example2-SimpleFill\SimpleFill.TSTool


TSTool - "C:\Develop\TSTool_SourceBuild\TSTool\doc\Training\05-intro-DataFilling\ex
Simple Fill Commands
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 = 43 - White River Basin
Where: Matches
Where: Matches
Get Time Series List
Time Series List (55 time series, 0 selected)
ID CO Abbrev. Name/Description Data
1 09302400 NOFTRACO NORTH FORK WHITE RIVER BELO... USG
2 09302420 NOWTRACO NF WHITE R ABOVE RIPPLE C, NR... USG
3 09303000 NFWBUFCO NORTH FORK WHITE RIVER AT B... USG
4 09303300 SOFWHACO SOUTH FORK WHITE RIVER AT B... USG
5 09303320 WAGBUDCO WAGONWHEEL CREEK AT BUDG... USG
6 09303340 PATBUDCO PATTERSON CREEK NEAR BUDG... USG
7 09303400 SFWBUDCO SOUTH FORK WHITE RIVER NEA... USG
Copy Selected to Commands
Copy All to Commands
Commands (14 commands, 0 selected, 0 with failures, 0 with warnings)
1 # Example to fill data gaps using simple techniques - just to illustra
2 # but this approach is not typical
3 # The output period is usually specified for modeling. If not provide
4 # filling will only occur in the time series' origional period, but
5 # automatically extend the time series.
6 ReadDateValue(InputFile="white-streamflow.dv")
7 # Try to fill with interpolation, but limit to gaps of <= 3 months
8 FillInterpolate(MaxIntervals=3,FillFlag="INT")
9 # Next try repeating values forward
10 FillRepeat(FillDirection=Forward,MaxIntervals=12)
11 # Finally just set constant
12 FillConstant(ConstantValue=0,FillFlag="CONST")
13 # Check for missing data in the time series
14 CheckTimeSeries(CheckCriteria="Missing",MaxWarnings=1)
Cascade through different commands until all gaps are filled
Normally would use FillConstant() only on some data types like precipitation
Run Selected Commands
Run All Commands
Clear Commands
Results
Ensembles Output Files Problems Tables Time Series Views
55 time series, 55 selected
1) NORTH FORK WHITE RIVER BELOW TRAPPERS LAKE, CO., fill repeat forward,
2) NF WHITE R ABOVE RIPPLE C, NR TRAPPERS LAKE, CO., fill repeat forward, fill
3) NORTH FORK WHITE RIVER AT BUFORD, CO, fill repeat forward, fill w/ 0.000 -
4) SOUTH FORK WHITE RIVER AT BUDGES RESORT, CO., fill repeat forward, fill w/ 0.000 - 09303300.USGS.Streamflow.Month (1903-08 to 2009-09)
5) WAGONWHEEL CREEK AT BUDGES RESORT, CO., fill repeat forward, fill w/ 0.000 - 09303320.USGS.Streamflow.Month (1903-08 to 2009-09)
6) PATTERSON CREEK NEAR BUDGES RESORT, CO., fill repeat forward, fill w/ 0.000 - 09303340.USGS.Streamflow.Month (1903-08 to 2009-09)
7) SOUTH FORK WHITE RIVER NEAR BUDGES RESORT, CO., fill repeat forward, fill w/ 0.000 - 09303400.USGS.Streamflow.Month (1903-08 to 2009-09)
8) SOUTH FORK WHITE RIVER NEAR BUFORD, CO., fill repeat forward, fill w/ 0.000 - 09303500.USGS.Streamflow.Month (1903-08 to 2009-09)
Use the CheckTimeSeries() results and data coverage report to evaluate data gaps

Command Problem Summary

Check File HTML Report

Total number of failures: 0
Total number of commands with failures: 0
Total number of warnings: 216
Total number of commands with warnings: 1

#	Time, sec.	Warnings	Failures	Command
1	0.000	0	0	# Example illustrating errors in commands
2	0.000	0	0	# Problem is that the filename is incorrect (remove X to fix)
3	0.047	0	0	ReadDateValue(InputFile="streamflow.dv")
4	0.000	0	0	# Fill the time series with historical monthly average
5	0.016	0	0	FillHistMonthAverage(FillFlag="Auto")
6	0.000	0	0	# Write the filled time series to a different filename
7	0.093	0	0	WriteDateValue(OutputFile="streamflow-filled.dv",Precision=2)
8	0.000	0	0	# Check the time series for missing data and write a check file
9	0.016	216	0	CheckTimeSeries(CheckCriteria="Missing",Flag="MISSING",FlagDesc="No recorded value")
10	0.000	0	0	WriteCheckFile(OutputFile="streamflow-checks.html",Title="Streamflow Missing Data Checks.")
	0.172	216	0	

List of commands with count of warnings and failures

Command Problem Details

Details about each warning and failure

Total number of failures: 0
Total number of commands with failures: 0
Total number of warnings: 216
Total number of commands with warnings: 1

#	Severity	Type	Command	Problem	Recommen
1	WARNING	Missing	CheckTimeSeries(CheckCriteria="Missing",Flag="MISSING",FlagDesc="No recorded value")	Time series 06711590.USGS.Streamflow.Month value -999.000000 at 1902-01 is missing	
				Time series	

Fill Using Regression

- Ordinary Least Squares regression or MOVE2
- Log transform (or no transform)
- See FillRegression() and FillMOVE2() commands

Fill HydroBase Diversion Records Using Diversion Comments

- Special case where annual values are recorded to indicate zero diversion
- Can also use “currently in use” flag to fill with additional zeros
- See FillUsingDiversionComments() command

Fill Using Historical Averages

- Suitable for controlled data such as diversion and reservoir time series
- Use FillHistMonthAverage() to fill monthly time series with historical averages
- For more detail, use AnalyzePattern() to determine wet/dry/average characteristics of indicator time series and then fill data with FillPattern()

More Information

Help…View Documentation to view the TSTool documentation