

Session 3: Endpoints in CAT

Session 3:Endpoints

Part A

- Selecting Endpoints

Part B

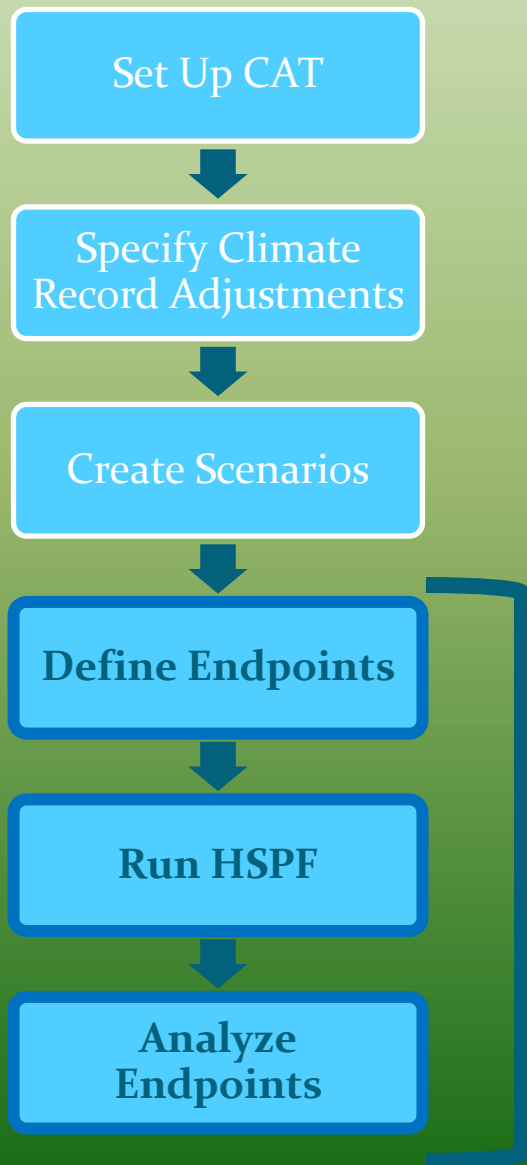
- Defining Endpoints

Part C

- Endpoint Analysis

Part D

- Exercises



Session 3: Endpoints



Session 3: Part A

Selecting Endpoints

Types of Endpoints

- Endpoints are measurable goals or targets
- Assessment endpoint -- formal expression of a valued environmental characteristic
Example: reproduction of piscivorous (fish-eating) birds
- Measurement endpoint – a measured response to a stress or disturbance
Example: water quality standards

CAT Endpoints

- CAT is set up to analyze the impact of climate change on hydrologic and water quality endpoints i.e., measurement endpoints.

Hydrologic Endpoints

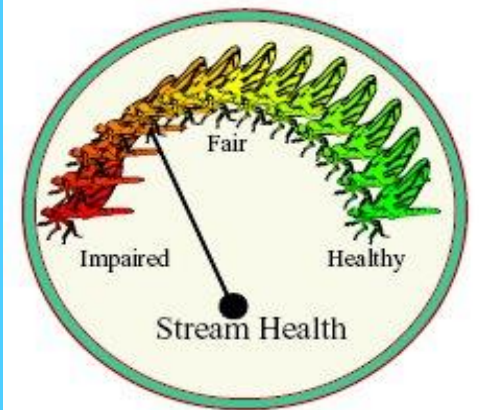
- Volume (daily, monthly, annual)
- Daily flow duration
- High storm peaks
- Low flow conditions

Water Quality Endpoints

- Sediment concentrations
- Water temperature
- Nutrients (N, P) concentrations
- DO concentrations

Aquatic Endpoints

- Fish and benthic macroinvertebrates are often used as endpoints. They are easily measured in the field and integrate impacts over time and from multiple stressors.
- AQUATOX predicts the impact of water quality on aquatic endpoints.
- An AQUATOX/CAT application has not been conducted to date



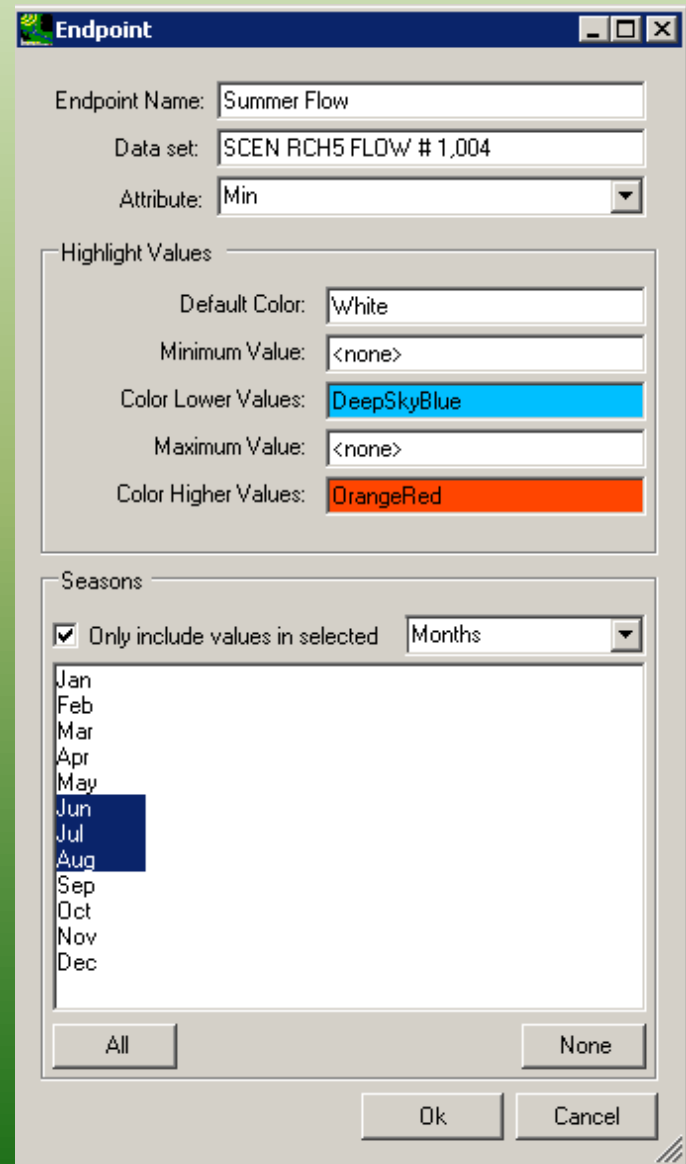


Session 3: Part B

Defining Endpoints

Defining Endpoints

- Endpoint Name
- Data set field
- Attribute pull-down list
- Highlight Values Frame
- Seasons



Endpoint

Endpoint Name: Summer Flow

Data set: SCEN RCH5 FLOW # 1,004

Attribute: Min

Highlight Values

Default Color: White

Minimum Value: <none>

Color Lower Values: DeepSkyBlue

Maximum Value: <none>

Color Higher Values: OrangeRed

Seasons

Only include values in selected Months

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

All None

Ok Cancel

Endpoint Options

- Any variable for which HSPF generates an output timeseries can be used as an endpoint for CAT analyses.
- Endpoint options can be as simple as a few outputs to WDM data sets in the External Targets block, or can be greatly expanded by using the binary output file.

Attributes

The different attributes of the time series are listed in a drop down menu:

- Min
- Max
- Sum
- Average annual sum of values
- Mean
- Geometric Mean
- Variance
- Standard Deviation
- Standard Error of Skew
- Serial Correlation Coefficient
- Coefficient of Variation
- 7Q10 low-flow event
- 100-year flood event

Range Values and Time Periods

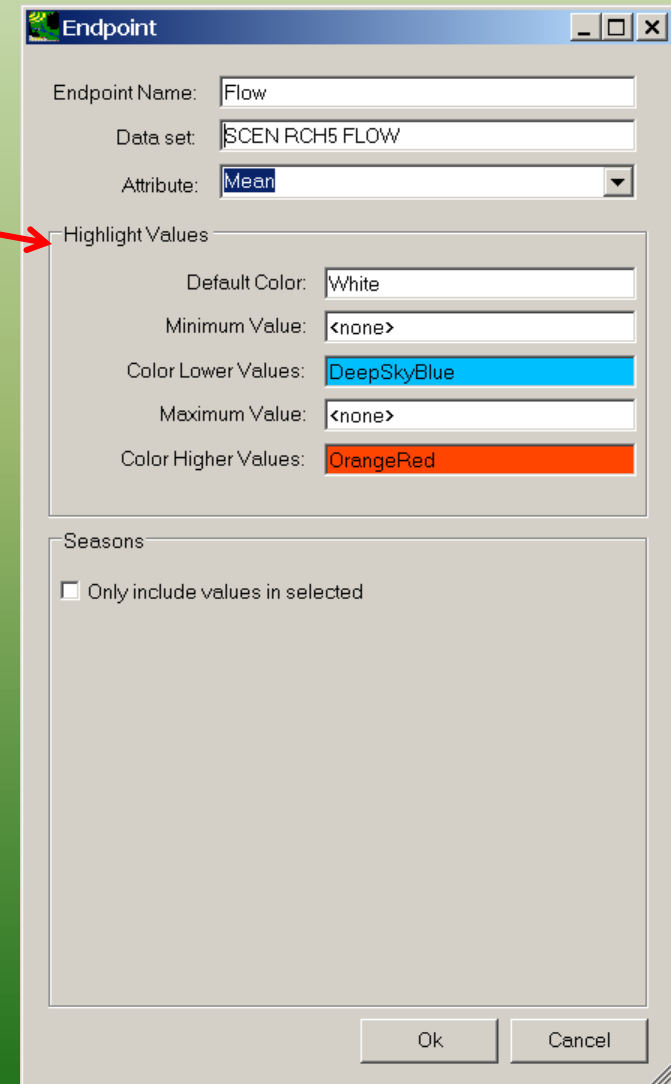
- Flagging endpoint values in Results Table
 - 3-tiered, low/favorable/high range color scheme
 - 2-tiered favorable versus unfavorable range color scheme
- Flagging may be used for the entire simulation or only for selected periods.

The threshold values, ranges, and time periods can be set by the user.

Range Values

- Value of an endpoint relative to some critical range or threshold value

Example: a low flow threshold at which a fish species is subject to harm, or a numeric state water quality standard for chemical endpoint



Endpoint

Endpoint Name: Flow

Data set: SCEN RCH5 FLOW

Attribute: Mean

Highlight Values

Default Color: White

Minimum Value: <none>

Color Lower Values: DeepSkyBlue

Maximum Value: <none>

Color Higher Values: OrangeRed

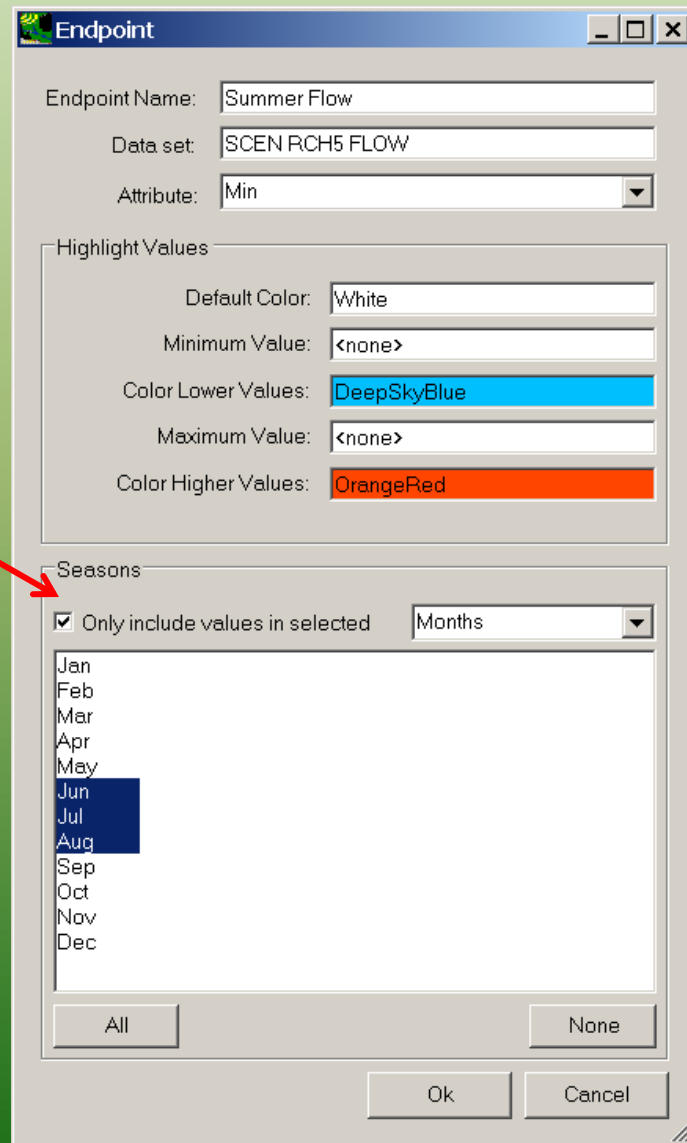
Seasons

Only include values in selected

Ok Cancel

Time Periods

- Specifying a particular season of each year, or during a specific year (or water year) within the record



Endpoint

Endpoint Name: Summer Flow

Data set: SCEN RCH5 FLOW

Attribute: Min

Highlight Values

Default Color: White

Minimum Value: <none>

Color Lower Values: DeepSkyBlue

Maximum Value: <none>

Color Higher Values: OrangeRed

Seasons

Only include values in selected Months

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

All None

Ok Cancel

Example Endpoint Specification 1: 1-Day Flow with 100-Year Recurrence Interval

Endpoint

Endpoint Name:

Data set:

Attribute:

Highlight Values

Default Color:

Minimum Value:

Color Lower Values:

Maximum Value:

Color Higher Values:

Seasons

Only include values in selected

Ok Cancel

Climate Assessment Tool

File Edit Options Help

Climate Data Assessment Endpoints Results Table Pivot Table

Save All Results

Show Progress of Each Run

Add Remove Edit Copy Top ^ v Bottom

Flow 1High100

Start Total iterations selected = 1 (0:09) Plot

Example Endpoint Specification 2: Average Annual Total Nitrogen Load

Endpoint

Endpoint Name:

Data set:

Attribute:

Highlight Values

Default Color:

Minimum Value:

Color Lower Values:

Maximum Value:

Color Higher Values:

Seasons

Only include values in selected

Ok Cancel

Climate Assessment Tool

File Edit Options Help

Climate Data Assessment Endpoints Results Table Pivot Table

Save All Results

Show Progress of Each Run

Add Remove Edit Copy

Top ^ v Bottom

Flow 1High100

Total N SumAnnual

Start Total iterations selected = 1 (0:09) Plot

Example Endpoint Specification 3: Mean Flows Within Range

Endpoint

Endpoint Name:

Data set:

Attribute:

Highlight Values

Default Color:

Minimum Value:

Color Lower Values:

Maximum Value:

Color Higher Values:

Seasons

Only include values in selected

Ok Cancel

Climate Assessment Tool

File Edit Options Help

Climate Data Assessment Endpoints Results Table Pivot Table

Save All Results

Show Progress of Each Run

Add Remove Edit Copy

Top ^ v Bottom

Flow 1High100

Total N SumAnnual

Flow Mean from 90 to 150

Start Total iterations selected = 1 (0:09) Plot

Example Endpoint Specification 4: Minimum Flows Within Temporal Range

Endpoint

Endpoint Name: Summer Flow

Data set: SCEN RCH5 FLOW

Attribute: Min

Highlight Values

Default Color: White

Minimum Value: <none>

Color Lower Values: DeepSkyBlue

Maximum Value: <none>

Color Higher Values: OrangeRed

Seasons

Only include values in selected Months

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

All None

Ok Cancel

Climate Assessment Tool

File Edit Options Help

Climate Data Assessment Endpoints Results Table Pivot Table

Save All Results

Show Progress of Each Run

Add Remove Edit Copy

Top ^ v Bottom

Flow 1High100

Total N SumAnnual

Flow Mean from 90 to 150

Summer Flow Min Month: Jun Jul Aug

Start Total iterations selected = 1 (0:09) Plot



Session 3: Part C

Endpoint Analysis

Endpoint Analysis

Climate Assessment Tool

File Edit Options Help

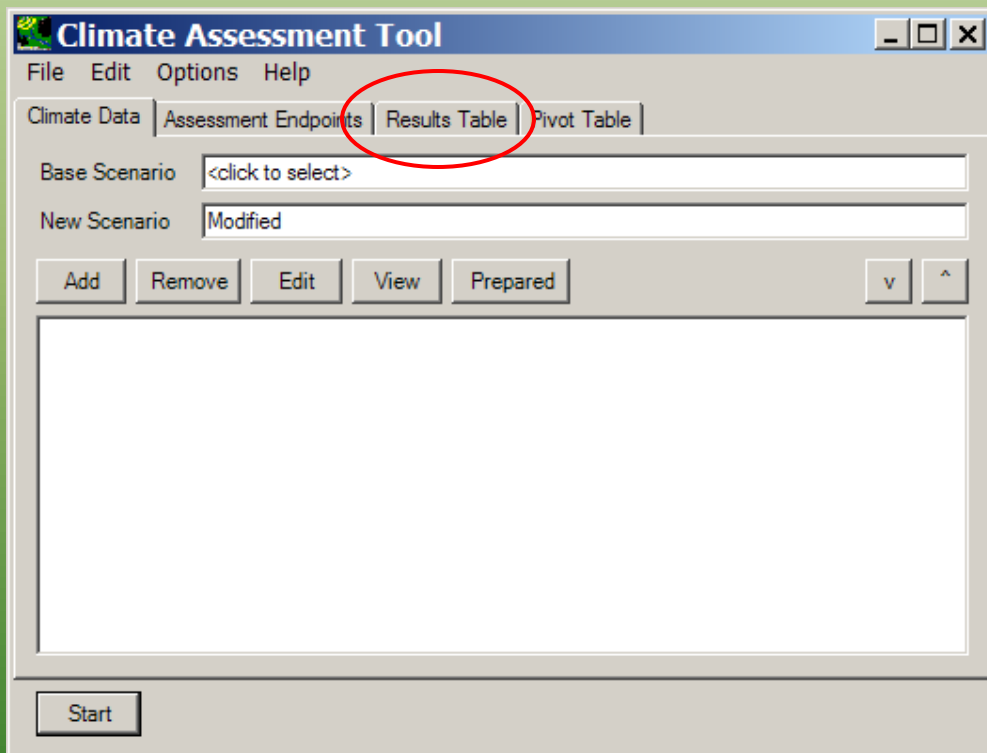
Climate Data | Assessment Endpoints | Results Table | Pivot Table

Run	Partial Precip	Partial Temp	Total N	Flow	Summer Flow
	Multiply	Add	SumAnnual	Mean	Min
	Current Value	Current Value	SCEN RCH5 TN-LOAD	SCEN RCH5 FLOW	SCEN RCH5 FLOW
	WaterYear (1986)	WaterYear (1986)			Month (Jun Jul Aug)
1	0.8	3	289,260	81.142	10.109

Start Finished with 1 runs

CAT presents results in the form of assessment endpoint values computed from model output time series data.

Results Table



Contains user-defined values for each endpoint (i.e., for each attribute [e.g., mean, min] of each HSPF output variable [e.g., streamflow, sediment load] selected as an endpoint).

Results Table Tab

Climate Assessment Tool [-] [□] [X]

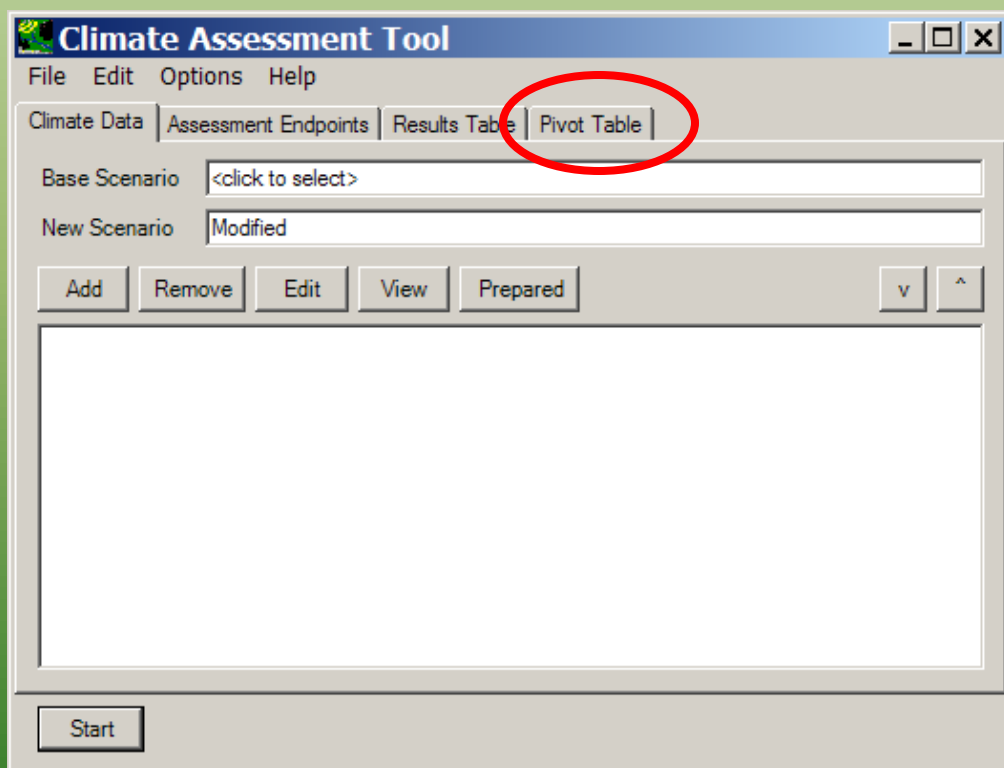
File Edit Options Help

Climate Data | Assessment Endpoints | **Results Table** | Pivot Table

Run	Partial Precip	Partial Temp	Total N	Flow	Summer Flow
	Multiply	Add	SumAnnual	Mean	Min
	Current Value	Current Value	SCEN RCH5 TN-LOAD	SCEN RCH5 FLOW	SCEN RCH5 FLOW
	WaterYear (1986)	WaterYear (1986)			Month (Jun Jul Aug)
1	0.8	3	289,260	81.142	10.109

Start Finished with 1 runs

Pivot Tables



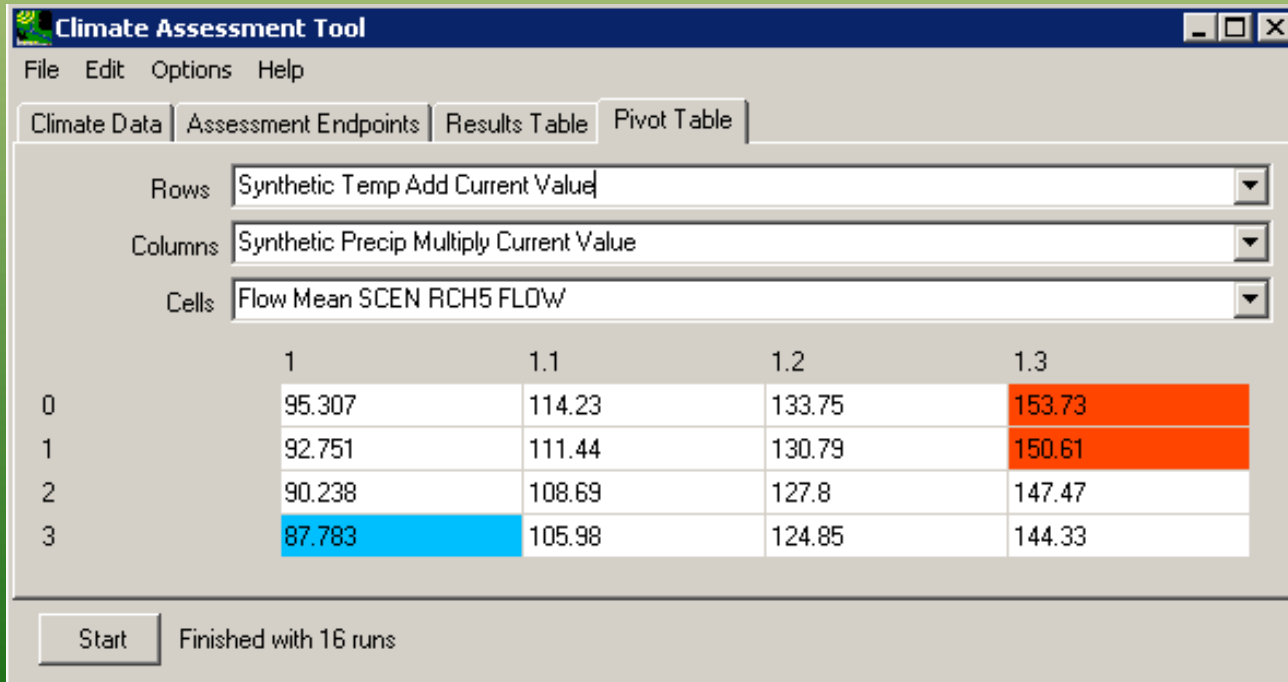
Summarizes large amounts of data.

Discerns patterns and relationships within a data set.

Organizes data into a format for plots with user-defined variables.

Pivot Table Tab

- Select rows and columns fields from lists
- Specify element to vary in rows and columns
- Specify element to be displayed in cells



The screenshot shows the 'Climate Assessment Tool' software interface. The 'Pivot Table' tab is active. The 'Rows' field is set to 'Synthetic Temp Add Current Value', the 'Columns' field is 'Synthetic Precip Multiply Current Value', and the 'Cells' field is 'Flow Mean SCEN RCH5 FLOW'. Below these settings is a data table with 4 rows (0-3) and 4 columns (1, 1.1, 1.2, 1.3). The cell at row 0, column 1.3 is highlighted in red, and the cell at row 3, column 1 is highlighted in blue. At the bottom, there is a 'Start' button and a status indicator 'Finished with 16 runs'.

	1	1.1	1.2	1.3
0	95.307	114.23	133.75	153.73
1	92.751	111.44	130.79	150.61
2	90.238	108.69	127.8	147.47
3	87.783	105.98	124.85	144.33

Start Finished with 16 runs

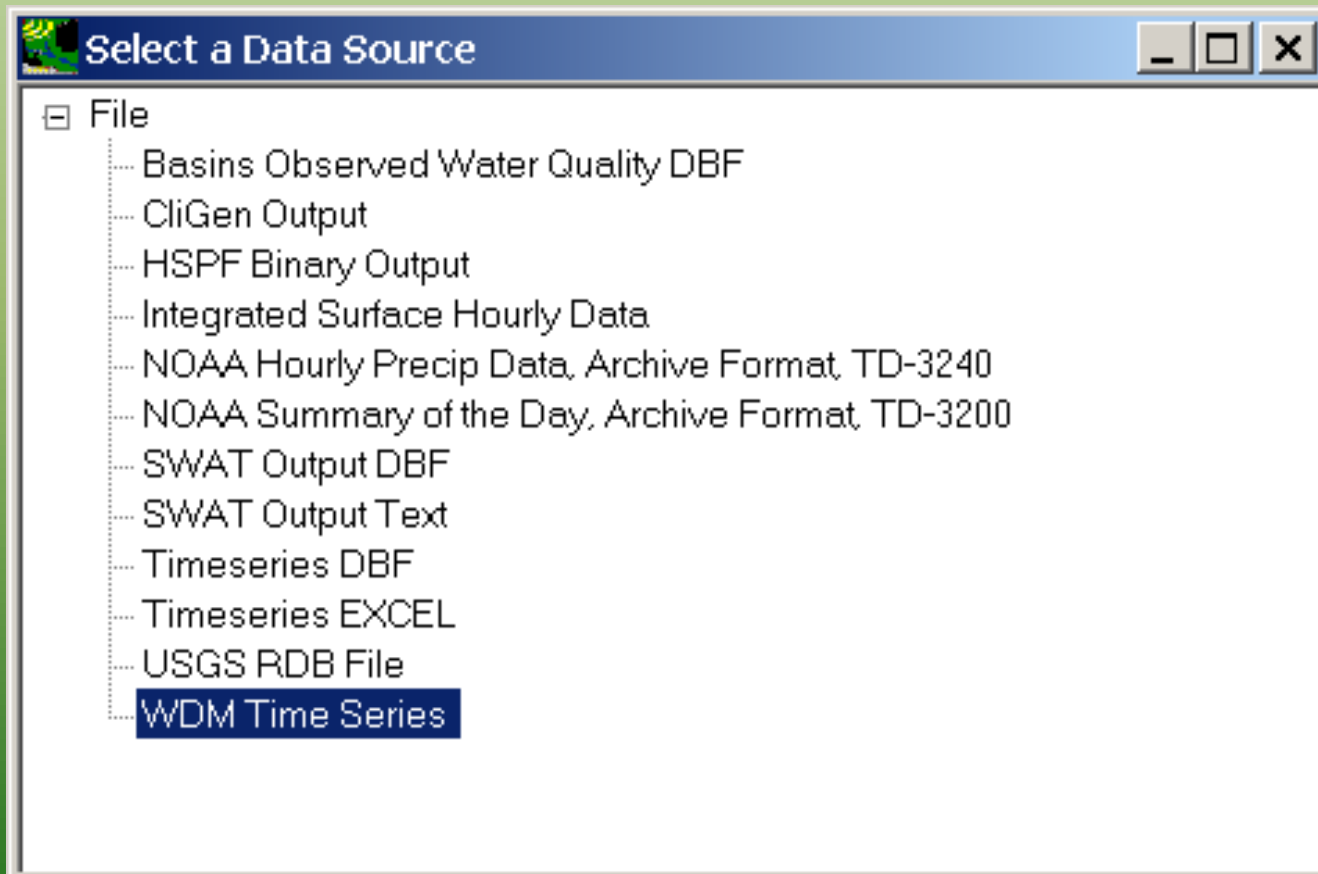
Exporting Option

- Output tables can be saved to an external file
- Use Save Results items in the File menu
- Or, the Edit:Copy Results menu option

Other Summary and Visualization Tools

- Graph a time series or multiple time series
- Create a data tree
- Compute frequency statistics
- Calculate and display statistics for user-defined seasons or time periods
- Generate one time series from multiple time series

Data Source Form



Time Series List

Data Sources

File Edit View Analysis Help

- WDM
 - C:\BASINS\data\Climate\base.wdm (42)
 - C:\BASINS\data\Climate\Modified.base.wdm (42)
- HSPF Binary Output
 - C:\BASINS\data\Climate\base.hbn (2179)

Timeseries::WDM
C:\BASINS\data\Climate\Modified.b
42 Timeseries
1,802,240 bytes
Modified 10/4/2009 4:27:43 PM

Select Data

File Attributes Select Help

Select Attribute Values to Filter Available Data

Data Source	Location	Constituent
C:\BASINS\data\Climate\Modi+	01594526	TAU
C:\BASINS\data\Climate\base+	BELTSVIL	TN-LOAD
C:\BASINS\data\Climate\base+	I:101	TOC
	LAUREL	TOTAL-N
	P:101	TOTAL-P
	P:102	TW
	P:103	TAU

Matching Data (2 of 2263)

Data Source	Location	Constituent
C:\BASINS\data\Climate\base.+	RCH5	TN-LOAD
C:\BASINS\data\Climate\Modifi+	RCH5	TN-LOAD

Selected Data (0)

Dates to Include

All Common

Start none

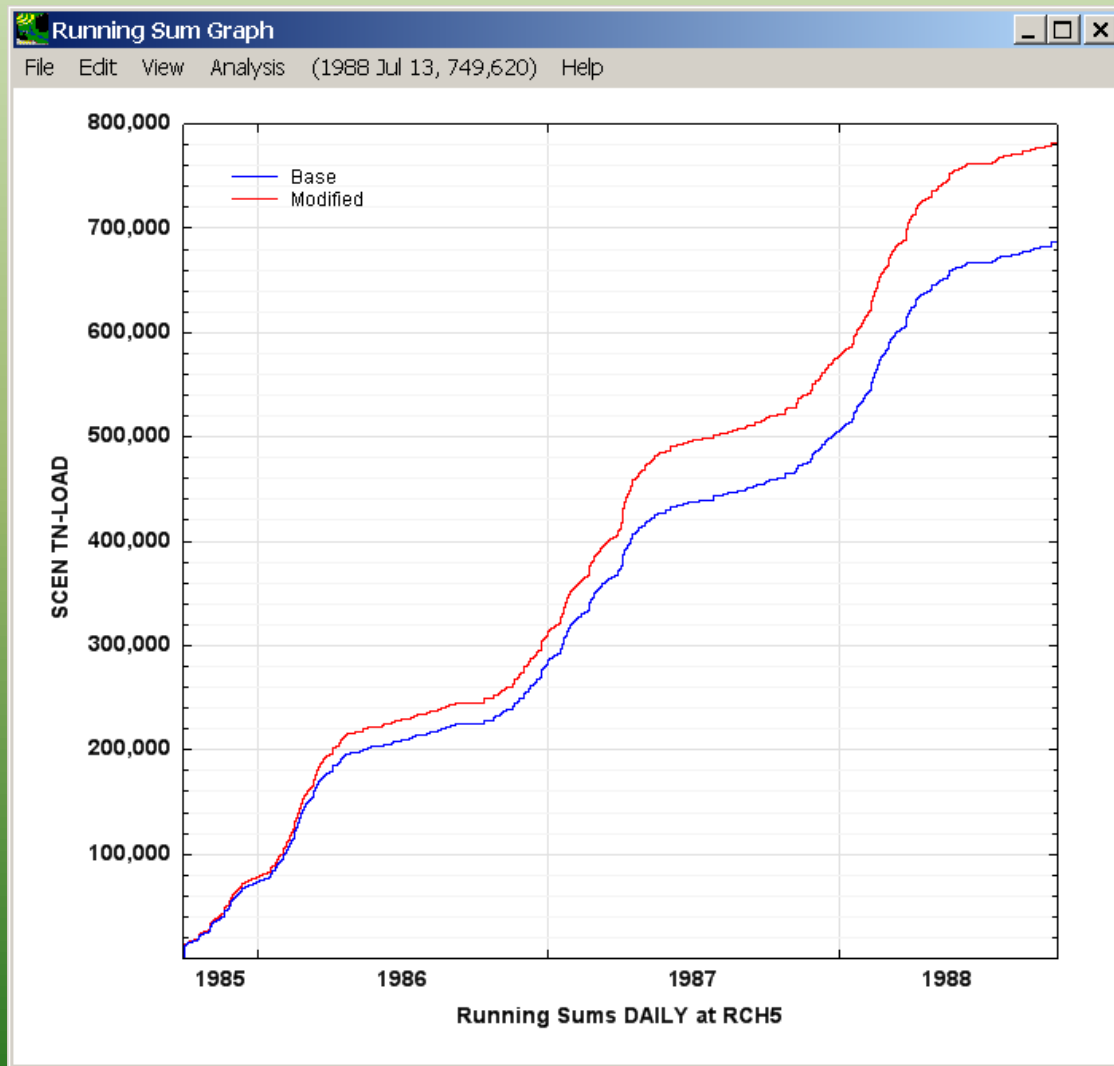
End none

Ok Cancel

Timeseries List

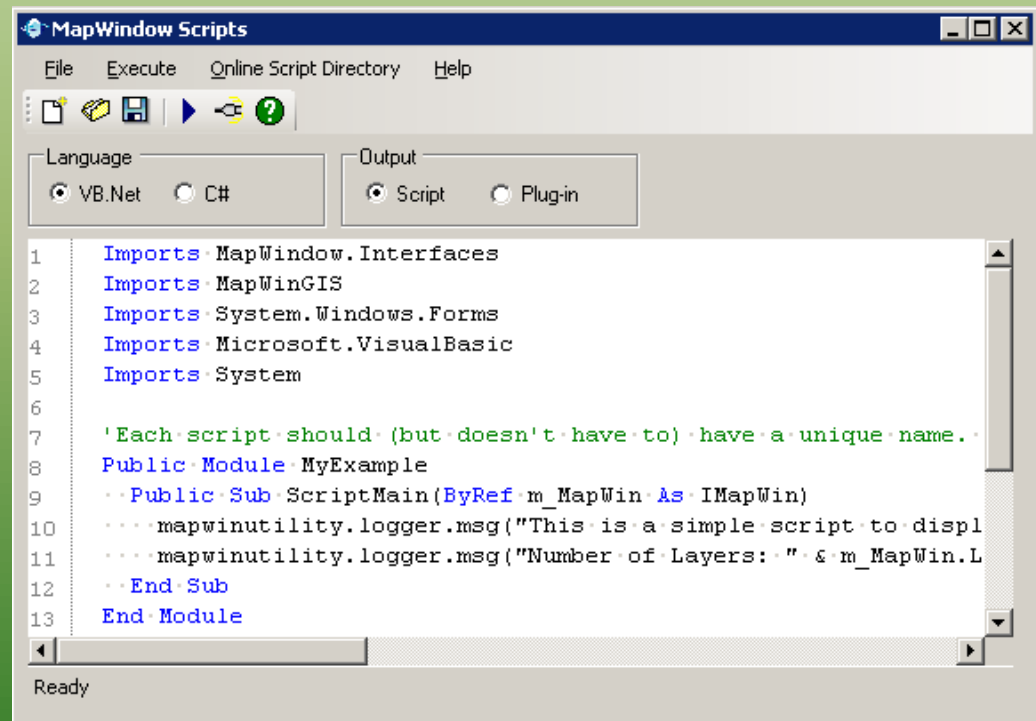
File Edit View Analysis Help

Constituent	TN-LOAD	TN-LOAD
History 1	from base.wdm	from Modified.base.wdm
Max	11,020	11,504
Mean	625.49	713.03
Min	3.9019	4.3894
SumAnnual	228,510	260,490
1985/10/01 24:00	163.58	163.58
1985/10/02 24:00	849.26	1,006.4
1985/10/03 24:00	11,020	11,504
1985/10/04 24:00	267.79	278.6
1985/10/05 24:00	604.84	650.71
1985/10/06 24:00	679.62	727.14
1985/10/07 24:00	601.42	641.71
1985/10/08 24:00	522.34	556.87
1985/10/09 24:00	259.36	276.52
1985/10/10 24:00	118.9	127.79
1985/10/11 24:00	94.873	101.83
1985/10/12 24:00	239.72	256.34
1985/10/13 24:00	141.76	150.43
1985/10/14 24:00	469.52	476.14
1985/10/15 24:00	390.83	393.01
1985/10/16 24:00	148.28	155.77
1985/10/17 24:00	172.96	181.99
1985/10/18 24:00	121.97	127.5



Using Scripts

- Provide an efficient and reproducible method for performing repetitive tasks
- BASINS and MapWindow are designed to extend CAT and other tools/models through the use of scripts



```
MapWindow Scripts
File  Execute  Online Script Directory  Help
[Icons]
Language:  VB.Net   C#
Output:  Script   Plug-in
1  Imports MapWindow.Interfaces
2  Imports MapWinGIS
3  Imports System.Windows.Forms
4  Imports Microsoft.VisualBasic
5  Imports System
6
7  'Each script should (but doesn't have to) have a unique name.
8  Public Module MyExample
9      Public Sub ScriptMain(ByRef m_MapWin As IMapWin)
10         ...mapwinutility.logger.msg("This is a simple script to displ
11         ...mapwinutility.logger.msg("Number of Layers: " & m_MapWin.L
12     End Sub
13 End Module
Ready
```



Session 3: Part D

Exercises C3 and C4

Exercise C3

- How do I specify endpoints from HSPF output for climate change impact analysis?
- How do I specify value ranges of concern?
- How do I specify time periods of concern (seasonal and/or partial records)?

Exercise C4

- How do I run an HSPF simulation using BASINS CAT?
- How do I use results tables of values for assessment endpoints?
- How do I use pivot tables of values for assessment endpoints?
- How do I export assessment endpoint results to files?
- How do I use the additional BASINS tools for analysis and display?