Exercise C1 – Adjusting Historic Precipitation and Air Temperature Records through the BASINS Climate Assessment Tool (CAT)

In this exercise, we will set up CAT to work with an existing HSPF simulation, while adjusting historic precipitation and temperature records to represent potential climate changes. These potential adjusted precipitation and air temperature records will be used in the following exercise to create climate change scenarios.

Questions addressed in this exercise:

- 1) How do I set up CAT to work with my project?
- 2) How do I adjust historical precipitation records to represent potential climate changes?
- 3) How do I adjust historical temperature records to represent potential climate changes?

A. BASINS CAT Setup

QUESTION ANSWERED: 1) How do I set up CAT to work with my project?

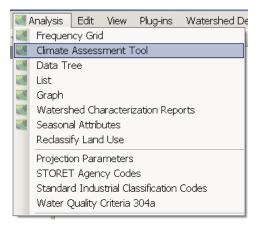
This section illustrates how to access CAT from within BASINS and the initial steps required to begin a climate change assessment. We will use a 'base' scenario similar to that used in Exercise 14. Before beginning the exercise, it is important to review the elements required for using BASINS CAT:

- A calibrated HSPF application
- WDM file containing HSPF input meteorological time series
- Output file(s) to which HSPF is saving results (WDM or HSPF binary)

BASINS CAT is one of various software plug-ins that make up the BASINS system. The first step in setting up BASINS CAT to run in BASINS is to be sure it is loaded as a plug-in. Select **Climate Assessment Tool** from the **Plug-ins:Analysis** submenu by placing a check next to it.

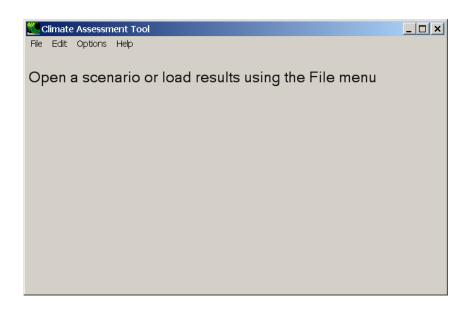
Plug-ins Watershed Delineation GIS Tools S	Shapefile	Editor Help
Edit Plug-ins		
Scripts	- F	
Analysis	•	Cligen
 Archive Project Tool 	F	 Climate Assessment Tool
BASINS 4		 Data Tree
CSV to Shapefile Converter		DFLOW
D4EM Data Download	•	Duration
EPA SWMM 5.0 Setup	L. L.	 Frequency Grid
EPA WASP 7.3 Setup	Ē	- Graph
🖌 GIS Tools		- List
Manual Delineation		 Lookup Tables
Model Segmentation		 Reclassify Land Use
Model Setup (HSPF/AQUATOX)		 Seasonal Attributes
🖌 Pollutant Loading Estimator (PLOAD)		Synoptic
 ScriptPlugin 		 Watershed Characterization Reports
 Shapefile Editor 	Ē	

This will add the **Climate Assessment Tool** to the **Analysis** menu as shown below.



Once the Climate Assessment Tool has been added as a plug-in, proceed through the following steps to begin a climate change assessment:

1. Select the **Analysis:Climate Assessment Tool** menu option. The following form will appear.



2. Before beginning the process of generating and analyzing climate change scenarios, a base scenario must be specified. All new climate change scenarios will be created from this scenario. To specify this scenario, go to the **File** menu and select **Open HSPF Scenario**.



3. Navigate to \BASINS\data\Climate\ and select the file base.uci. Click Open.

Open UCI file cont	aining base scenar	rio			<u>?</u> ×
Look in:	🗀 Climate		•	G 😰 📂 🎟 🗸	
My Recent Documents Desktop My Documents My Computer	Dase ud				
Places	, File <u>n</u> ame:	base.uci			en
	Files of type:	UCI files		Car	ncel

4. When this UCI file is selected, all input and output data files (including both WDM and HSPF binary file types) specified in the UCI file will be loaded into the BASINS project and made available for use in BASINS CAT. For these exercises, meteorological data are found in the file \BASINS\data\Climate\base.wdm. Leave the **New Scenario** name as "Modified."

Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
Start	Plot

5. It is advisable to save the state of the Climate Assessment Tool as exercises are completed. Doing so will save all current specifications made on the main BASINS CAT form (Base Scenario, New Scenario, Climate Data adjustments, Assessment Endpoints) to a file that can be opened at a later time to restore those specifications. This will allow later exercises, which depend on results from earlier exercises, to be run without rerunning the earlier exercises. To perform this save, select the File:Save Climate and Endpoints menu option from the Climate Assessment Tool form. A file dialogue will prompt the user for the name of a file in which the state of BASINS CAT will be saved. This saved state can then be retrieved at a later time using the File:Load Climate and Endpoints menu option. The file will be saved as type "XML file (*.xml)."

Save Variations as	XML Text				? ×
Save <u>i</u> n:	🗀 Climate		•	G 💋 📂 🎞 🔻	
My Recent Documents Desktop My Documents My Computer My Network Places	CAT-Tutorial.xml				
	File <u>n</u> ame:	CAT-Tutorial.xml		•	Save
	Save as type:	XML files (*xml)		•	Cancel

6. At this point, the generation and assessment of climate change scenarios can be performed.

B. Modifying Precipitation Data

QUESTION ANSWERED:

2) How do I adjust historical precipitation records to represent potential climate changes?

Climate change scenarios are created in BASINS CAT by modifying, or adjusting, historical meteorological time series data to reflect a desired change or set of changes. Adjustments can be applied to precipitation and temperature time series. The steps in this section illustrate the major types of adjustments that can be made to historical meteorological data using BASINS CAT.

The steps in this section demonstrate the following precipitation adjustments:

- Apply multiplier to full record
- Apply seasonal multiplier
- Modify partial record
- Represent storm intensification
- Add or remove storm events

The BASINS CAT Set-up (Section A, above) must be run before beginning this section. This is necessary to ensure that the Climate Assessment Tool form is properly initialized. The following steps demonstrate how to accomplish the different kinds of weather modifications listed above.

Example 1. Apply multiplier to full record

- First, click the 'Add' button to bring up the Modify Existing Data dialog window. This form contains the controls needed to define a record adjustment, including an identification label, the data set(s) to be modified, and how the data are to be modified. The Modification Name field is used to provide a text label for identifying the scenario being created. Begin defining this scenario by entering "Increase Precip" in the Modification Name field.
- 2. Click in the 'Existing Data to Modify' text box and the Select data to vary form will be displayed. In the top third of this form, titled Select Attribute Values to Filter Available Data, users can filter the type of data to select by Scenario, Location, or Constituent. The data matching your selections will appear in the middle third of the form, titled Matching Data. Data sets can then be selected from the Matching Data list, which will add them to the Selected Data list in the lower third of the form. Clicking on a selected data set in either the Matching Data or Selected Data lists will unselect it. If

Jala IIst.		
🚝 Select data to vary		
File Attributes Select Help		
- Select Attribute Values to Filter A	vailable Data	
Scenario	Location	Constituent
<u></u>		
OBSERVED	01594526	AGWET
PT-OBS	BELTSVIL	AGWI
SCEN	l:101	AGWO
base	LAUREL	AGWS
	P:101	AIRT
	P:102	
	D 100	
Matching Data (2221 of 2221)		
OBSERVED	01594526	FLOW 🔺
OBSERVED	LAUREL	HPRECIP
OBSERVED	UPMARLBR	HPRECIP
OBSERVED	BELTSVIL	PET
OBSERVED	BELTSVIL	AIRTMP
OBSERVED	WASH NAT	CLOUD
OBSERVED	WASH NAT	WIND
OBSERVED	WASH NAT	DEWPT
OBSERVED	WASH NAT	SOLRAD
Dates to Include		
All Comm Start none	non	
End none		Ok Cancel

all data sets in the **Matching Data** list are desired, it is not necessary to add each one to the Selected Data list.

2. Begin the selection process by looking at the first column, labeled **Scenario**, in the **Select Attribute Values to Filter Available Data** frame. Click on the **OBSERVED** item. All data sets with a Scenario attribute of OBSERVED will be added to the **Matching Data** list. In looking at the last column of the **Matching Data** list, and note that there are two data sets with the **Constituent** name **HPRECIP** (hourly precipitation). The HSPF model used in this example is only using precipitation from the Upper Marlboro gage, so click on the data set with **UPMARLBR** and **HPRECIP** as the respective **Location** and **Constituent**. When this data set has moved to the **Selected Data** list, click the **Ok** button.

File Attributes Sele	•				
-Select Attribute Value	s to Filter Av	ailable Data			
Scenario	•	Location	•	Constituent	-
OBSERVED		R:6	-	GWVS	
PT-OBS		RCH4		HPRECIP	
SCEN		RCH5		HRAD	
base		RCH6		HTEXCH	
		UPMARLBR		IFWI	
		WASH_NAT	-	IFWO	-
				10 × 10	
Matching Data (27 of 2	221)				
OBSERVED		01594526		FLOW	
OBSERVED		LAUREL		HPRECIP	
OBSERVED		UPMARLBR		HPRECIP	
OBSERVED		BELTSVIL		PET	
OBSERVED		BELTSVIL		AIRTMP	
OBSERVED		WASH_NAT		CLOUD	
OBSERVED		WASH_NAT		WIND	
OBSERVED		WASH_NAT		DEWPT	
OBSERVED		WASH_NAT		SOLRAD	
				ATD-NOS	
-Selected Data (1 of 22	221) ———				
OBSERVED		UPMARLBR		HPRECIP	
Dates to Include			_		
All	Comr				
	·				
Start 1955/12/31	1955/12/	31 1955/12/31			

Note: When selecting the time series data set to adjust, more than one data set may be selected. This allows users to apply the same adjustments to multiple data sets. This is particularly useful for creating climate change scenarios for multiple meteorological inputs (e.g., NCDC weather stations) used in an HSPF simulation. When multiple data sets are selected, this will be reflected on the **Modify Existing Data** form in the **Existing Data to Modify** box. The first data set selected will be listed as described above, but the text "and n more" will be added, where n is the number of additional time series selected. After making an adjustment, the name of the adjustment will not, however, indicate that it will be applied to multiple data sets. It is thus recommended that users select names for adjustments that are appropriately descriptive.

3. The Modify Existing Data form has now been updated with a description of the selected data set in the Existing Data to Modify box. The Compute PET box is for selecting the evapotranspiration data set to modify when a temperature climate scenario is being defined and can be ignored for this example. The How to Modify box contains a list of methods for modifying the data-set values. For this example, the "Multiply Existing Values by a Number" option will be used. In the Number to multiply existing data by frame, there are two modification options: Single Change or Iterate Changes. The Single Change option will result in one adjustment applied to the precipitation data set. The term "iterate", as used here, refers to the automation of multiple runs. The Iterate Changes option will result in a series of adjustments to the precipitation data set and is used to create synthetic climate change scenarios. For this example, we will use the Single Change option. Enter "1.2" in the Value field, thus defining the value by which all values in the precipitation data set will be multiplied. The Events and Seasons frames

are not used in this example, because the entire precipitation data record is being multiplied by the designated factor. Click the **Ok** button to complete the scenario definition process.

Modify Existing Data			_ 🗆 ×
Modification Name:	Increase Precip		_
Existing Data to Modify:	OBSERVED UPMARLBR	HPRECIP	View
Compute PET:	Click to specify PET to rep	lace>	View
How to Modify:	Multiply Existing Values by	a Number	
Number to multiply exist	ing data by		
Single Change C	Iterate Changes		
Value 1.2	multiplication factor		
Events	y in the following Events		
Seasons			
		Ok	Cancel

4. The **Climate Assessment Tool** form is now updated to show the newly defined climate scenario.

🚰 Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C:\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
Increase Precip Multiply 1.2	
Start Total iterations selected = 1 (0:09)	Plot

5. To view a listing of the modified precipitation data set, click on the newly created record adjustment to select it and then click the **View** button. The **Time series List** form opens, displaying a listing of the values in the modified data set.

🌉 Tim	ese	ries Lis	t	_ 🗆 🗙
File E	dit	View	Analysis	Help
Constitu	ent		HPF	RECIP 🔺
ld			105	5
Min			(ו
Max			3	3.072
Mean			(0.0057794
1955/12	/31	09:00	()
1955/12	/31	10:00	()
1955/12	/31	11:00	()
1955/12	/31	12:00	()
1955/12	/31	13:00	()
1955/12	/31	14:00	()
1955/12		15:00	()
1955/12	/31	16:00	()
1955/12		17:00	()
1955/12	/31	18:00	()
1955/12		19:00	()
1955/12	/31	20:00	()
1955/12	/31	21:00	()
1955/12	/31	22:00	()
1955/12	/31	23:00	()
1955/12	/31	24:00	(
1958/01	/01	01-00	ſ	

6. To view the modified data next to the original, select the **File:Select Data** menu option from the Timeseries List form, and the **Select Data** form will be displayed. Like earlier in this exercise, click the **OBSERVED** item from the **Scenario** list and then click the **OBSERVED**, **UPMARLBR**, **HPRECIP** data set from the **Matching Data** list. It will be added to the **Selected Data** list along with the modified precipitation data set that is already in the **Time series List** form. Click **Ok** and the two data sets values will be displayed.

🌉 Timeserie	es Lis	t	_ 🗆 ×
File Edit V	/iew	Analysis Help	
History 1		from base.wdm	from base.wdm 🔺
Constituent		HPRECIP	HPRECIP
ld		105	105
Min		0	0
Max		3.072	2.56
Mean		0.0057794	0.0048162
1955/12/31 09	9:00	0	0
1955/12/31 10	0:00	0	0
1955/12/31 1	1:00	0	0
1955/12/31 12	2:00	0	0
1955/12/31 13	3:00	0	0
1955/12/31 14	4:00	0	0
1955/12/31 15	5:00	0	0
1955/12/31 10	6:00	0	0
1955/12/31 17	7:00	0	0
1955/12/31 18	8:00	0	0
1955/12/31 19	9:00	0	0
1955/12/31 20	0:00	0 0 0	
1955/12/31 21	1:00	0	0
1955/12/31 22	2:00	0	0
1955/12/31 23	3:00	0	0
1955/12/31 24	4:00	0	0
1956/01/01 0	1:00	0	0
1956/01/01 02	2:00	0	0
1956/01/01 03	3:00	0	0
1956/01/01 04	4:00	0	0
1956/01/01 05	5:00	0	0
1956/01/01 08	6:00	0	0
1956/01/01 07	7:00	0	0
1956/01/01 08	8:00	0	0 💌
•			•

7. To complete this example, close the **Time series** List form and save the state of BASINS CAT, using the **File:Save Climate and Endpoints** menu option, if desired.

Example 2. Apply Seasonal Multiplier

A common climate scenario need is to adjust historical values during a particular month or season of the year over the entire span of the model run.

This example shows how a single multiplier can be applied to precipitation data during a specific month or season of the year. The final result of the example is a climate scenario that applies a multiplier to historical precipitation data only during a single season of the year, here the summer months, for use as model input.

1. To begin creating a new climate scenario, click the **Add** button. The **Modify Existing Data** form will be displayed. Begin defining this scenario by entering "Seasonal Precip" in the **Modification Name** field.

🚰 Modify Existing Data		_ 🗆 ×
Modification Name:	Seasonal Precip	
Existing Data to Modify:	<click data="" modify="" specify="" to=""></click>	View
Compute PET:	<click pet="" replace="" specify="" to=""></click>	View
How to Modify:	Multiply Existing Values by a Number	
Number to multiply exist		
© Single Change C		
Value 1.1	multiplication factor	
Events		
Vary precipitation on	y in the following Events	
Seasons		
□ Vary only in selected		
	Ok	Cancel

2. To select the precipitation data to modify, click in the **Existing Data to Modify** box and the **Select data to vary** form will be displayed. In the first column, under the **Scenario** label, click on the **OBSERVED** item. Click on the data set with **UPMARLBR** and **HPRECIP** as the respective **Location** and **Constituent**. When this data set has moved to the **Selected Data** list, click the **OK** button.

Scenario	 Location 	-	Constituent	-
OBSERVED	01594526		AGWET	
PT-OBS	BELTSVIL		AGWI	-
SCEN	1:101		AGWO	
base	LAUREL		AGWS	
	P:101		AIRT	
	P:102	-	AIRTMP	
	D 400	·	10000	
Matching Data (27 of 2221)				
DBSERVED	01594526		FLOW	
DBSERVED	LAUREL		HPRECIP	
OBSERVED	UPMARLBR		HPRECIP	
OBSERVED	BELTSVIL		PET	-
OBSERVED	BELTSVIL		AIRTMP	
OBSERVED	WASH_NAT		CLOUD	
DBSERVED	WASH_NAT		WIND	
OBSERVED	WASH_NAT		DEWPT	
OBSERVED	WASH_NAT		SOLRAD	
	I IDMADI RD			
Selected Data (1 of 2221) =				
DBSERVED	UPMARLBR		HPRECIP	
Dates to Include				

3. The Modify Existing Data form has now been updated with a description of the selected data set in the Existing Data to Modify box. The Compute PET box is for selecting the evapotranspiration data set to modify when a temperature climate scenario is being defined and can be ignored for this example. The How to Modify box contains a list of methods for modifying the data-set values. For this example, as in the previous one, the "Multiply Existing Values by a Number" option will be used. We will again use the Single Change option. Enter "1.2" in the Value field, thus defining the value by which selected values in the precipitation data set will be multiplied.

🚰 Modify Existing Data		_ 🗆 ×
Modification Name:	Seasonal Precip	
Existing Data to Modify:	OBSERVED UPMARLBR HPRECIP	View
Compute PET:	<pre><click pet="" replace="" specify="" to=""></click></pre>	View
How to Modify:	Multiply Existing Values by a Number	
⊂Number to multiply existi	ng data by	
Single Change	Iterate Changes	
Value 1.2	multiplication factor	
Events		
Vary precipitation only	v in the following Events	
	,	
Seasons		
Vary only in selected		
	Ok	Cancel

4. The Seasons frame near the bottom of the form is used for specifying a time subset of the data set to which the modification will be applied. Begin defining this subset by clicking on the Vary only in selected check box. Two additional fields will be displayed. The first field is a drop-down list of time subset options that includes Calendar Years, Months, and Water Years. The second field will display a list of available time intervals based on the item selected in the first field. For example, selecting Water Years from the first field will populate the second field with a list of available water years based on the period of record of the data set. For this example, select the Months option. The second field will be populated with the months of the year. Items in the second field can be selected and unselected by clicking on them. Additionally, the buttons below the list can be used to select All or None of the items. To represent increased precipitation during summer months, select Jun, Jul, and Aug.

🚰 Modify Existing Data			_ 🗆 ×
Modification Name:	Seasonal Precip		1
Existing Data to Modify:	OBSERVED UPMARLB	R HPRECIP	View
Compute PET:	<click pet="" r<="" specify="" td="" to=""><td>eplace></td><td>View</td></click>	eplace>	View
How to Modify:	Multiply Existing Values I	by a Number 🔻	1
- ⊢Number to multiply existi	ng data by		
Single Change C	Iterate Changes		
Value 1.2	multiplication facto	r	
_			
Events	via the fellowing Events		
Vary precipitation only	y in the following Events		
Vary only in selected	Months		•
Jan Jun Nov			
Feb Jul Dec Mar Aug			
Apr Sep May Oct			
All			None
		Ok	Cancel

5. Click the **Ok** button to complete the scenario definition process. The **Climate Assessment Tool** form is now updated to show the newly defined climate scenario.

Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C:\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 ✓ Increase Precip Multiply 1.2 ✓ Seasonal Precip Multiply 1.2 Month: Jun Jul Aug 	
Start Total iterations selected = 1 (0:09)	Plot

6. To complete this example, save the state of CAT, using the **File:Save Climate and Endpoints** menu option, if desired.

Example 3. Modify Partial Record

A common climate scenario need is to adjust historical values during only a particular set of years, or partial record, of the model run. For example, assessing the impacts of increased drought severity can include decreasing the precipitation total for an already low-rainfall year(s), without adjusting rainfall in other years.

This example shows how a single multiplier can be applied to precipitation data during a specific portion of the model run. The final result of the example is a record adjustment that applies a multiplier to historical precipitation data during only a single year of a model run.

1. To begin creating a new climate scenario, click the **Add** button. The **Modify Existing Data** form will be displayed. Begin defining this scenario by entering "Partial Precip" in the **Modification Name** field.

💒 Modify Existing Data		_ 🗆 ×
Modification Name:	Partial Precip	
Existing Data to Modify:	<click data="" modify="" specify="" to=""></click>	View
Compute PET:	<click pet="" replace="" specify="" to=""></click>	View
How to Modify:	Multiply Existing Values by a Number	
Number to multiply existi	ng data by	
 Single Change 	Iterate Changes	
Value 1.1	multiplication factor	
Events	y in the following Events	
Seasons		
Vary only in selected		
	Ok	Cancel

 To select the precipitation data to modify, click in the Existing Data to Modify box. The Select data to vary form will be displayed. In the first column, under the Scenario label, click on the OBSERVED item. Click on the data set with UPMARLBR and HPRECIP as the respective Location and Constituent. When this data set has moved to the Selected Data list, click the Ok button.

Select Attribute Values to Fi	ner Avaliable Dala		
Scenario	 Location 	Constituent	<u> </u>
OBSERVED	01594526	AGWET	
PT-OBS	BELTSVIL	AGWI	
SCEN	l:101	AGWO	
base	LAUREL	AGWS	
	P:101	AIRT	
	P:102		
	D 100		
Matching Data (27 of 2221)			
DBSERVED	01594526	FLOW	
DBSERVED	LAUREL	HPRECIP	
OBSERVED	UPMARLBR	HPRECIP	
OBSERVED	BELTSVIL	PET	
DBSERVED	BELTSVIL	AIRTMP	
DBSERVED	WASH_NAT	CLOUD	
DBSERVED	WASH_NAT	WIND	
DBSERVED	WASH_NAT	DEWPT	
DBSERVED	WASH_NAT	SOLRAD	
	I IDMADI RD	ATD-NO3	
Selected Data (1 of 2221) =			
DBSERVED	UPMARLBR	HPRECIP	
Detects la skula			
Dates to Include			
All	Common		

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. The **Compute PET** box is for selecting the evapotranspiration data set to modify when a temperature climate scenario is being defined and can be ignored for this example. The **How to Modify** box contains a list of methods for modifying the data-set values. For this example, the "Multiply Existing Values by a Number" option will be used. For this example, we will use the **Single Change** option. Enter "0.8" in the **Value** field, thus defining the value by which the precipitation values will be multiplied during the year specified in the next step.

🚰 Modify Existing Data			<u> </u>
Modification Name:	Partial Precip		
Existing Data to Modify:	OBSERVED UPMARLBR	RHPRECIP	View
Compute PET:	Click to specify PET to respect to respec	eplace>	View
How to Modify:	Multiply Existing Values b	y a Number	 ▼
⊂Number to multiply existi	ng data by		
 Single Change 	Iterate Changes		
Value 0.8	multiplication factor		
Events	y in the following Events		
Seasons			
		Ok	Cancel

4. The Seasons frame near the bottom of the form is used for specifying a time subset of the data set to which the modification will be applied. Begin defining this subset by clicking on the Vary only in selected check box. Two additional fields will be displayed. The first field is a list of time subset options that includes Calendar Years, Months, and Water Years. The second field will display a list of available time intervals based on the item selected in the first field. For example, selecting Water Years from the first field will populate the second field with a list of available water years based on the period of record of the data set. Items in the second field can be selected and unselected by clicking on them. Additionally, the buttons below the list can be used to select All or None of the items. The sample HSPF model used here will be run for water years 1986 through 1988, with 1986 being the driest. Thus, to help assess the impact of drought, select the Water Years option and then select 1986 from the list of available water years.

Modify Exis	ting Data					>
Modification N	ame:	Partial Preci	p			
Existing Data t	o Modify:	OBSERVED	UPMARLBR	HPRECIP		View
Compute PET	:	<click spe<="" td="" to=""><td>cify PET to re</td><td>place></td><td></td><td>View</td></click>	cify PET to re	place>		View
How to Modify		Multiply Exis	ting Values by	y a Number	-	
-Number to m	ultiply existi	r ng data by —				
 Single Ch 	ange C	lterate Chang	es			
Value	0.8	multipl	ication factor			
Events	ipitation only	r in the followi	ng E∨ents			
	pitation only	r in the followi	ng Events			
☐ Vary preci		r in the following with the foll				_
 ✓ Vary preci Seasons ✓ Vary only i 1964 19 1965 19 1966 19 	in selected 368 19	Water Yes 72 1976 73 1977 74 1978	ars 1980 1981 1982	1984 1985 1985 1987	1988 1989 1990 1991	•
 ✓ Vary preci Seasons ✓ Vary only i 1964 19 1965 19 1966 19 	in selected 368 19 369 19 370 19	Water Yes 72 1976 73 1977 74 1978	ars 1980 1981 1982	1985 1986	1989 1990	
 ✓ Vary preci Seasons ✓ Vary only i 1964 19 1965 19 1966 19 	in selected 368 19 369 19 370 19	Water Yes 72 1976 73 1977 74 1978	ars 1980 1981 1982	1985 1986	1989 1990 1991	None

5. Click the **Ok** button to complete the scenario definition process. The **Climate Assessment Tool** form is now updated to show the newly defined climate scenario.

💒 Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
✓ Increase Precip Multiply 1.2 ✓ Seasonal Precip Multiply 1.2 Month: Jun Jul Aug	
☑ Partial Precip Multiply 0.8 Water Year: 1986	
1	
Start Total iterations selected = 1 (0:09)	Plot

6. To complete this example, save the state of BASINS CAT, using the **File:Save Climate and Endpoints** menu option, if desired.

Example 4. Represent Storm Intensification

BASINS CAT has the ability to adjust storm volumes only within selected events within the historical record. This capability allows users to represent changes in the proportion of precipitation occurring in larger versus smaller events.

This example shows how to make adjustments to represent storm intensification. The final result of the example is a climate scenario that applies an increase in storm volumes only to those events within a specified size class.

1. To begin creating a new climate scenario, click the **Add** button. The **Modify Existing Data** form will be displayed. This form contains the controls needed to define a record adjustment, including an identification label, the data set(s) to be modified, and how the data are to be modified. Begin defining this scenario by entering "Storm Intensity" in the **Modification Name** field.

🌉 Modify Existing Data			_ 🗆 ×
Modification Name:	Storm Intensity		_
Existing Data to Modify:	click to specify data to r	modify >	View
Compute PET:	click to specify PET to r	replace>	View
How to Modify:	Multiply Existing Values I	by a Number	
 Number to multiply exist	,		
Single Change C			
Value 1.1	multiplication facto	r	
Events	luin the following Events		
 Vary precipitation on 	ly in the following Events		
Seasons			
Vary only in selected			
		ok	Cancel

2. To select the precipitation data to modify, click in the Existing Data to Modify box. Since we will be modifying historical precipitation data, begin the selection process by clicking on the OBSERVED item under the Scenario list. Click on the data set with UPMARLBR and HPRECIP as the respective Location and Constituent. When this data set has moved to the Selected Data list, click the Ok button.

01594526 A BELTSVIL	AGWET AGWI
	AGWI
1:101	
	AGWO
LAUREL	AGWS
P:101	AIRT
P:102	AIRTMP
- +oo	40000
01594526	FLOW
LAUREL	HPRECIP
UPMARLBR	HPRECIP
BELTSVIL	PET
BELTSVIL	AIRTMP
WASH_NAT	CLOUD
WASH_NAT	WIND
WASH_NAT	DEWPT
WASH_NAT	SOLRAD
LIDMADI RD	
UPMARLBR	HPRECIP
	P:102

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. The **Compute PET** box is for selecting the evapotranspiration data set to modify when a temperature climate scenario is being defined and can be ignored for this example. The **How to Modify** box contains a list of methods for modifying the data-set values. For this example, select "Add/Remove Volume in Extreme Events." The form will be updated to allow for specification of storm intensity modifications.

🚰 Modify Existing Data					_ 🗆 ×
Modification Name:	Storm Intensity				
Existing Data to Modify:	BSERVED UP	MARLBF	RHPRECIP		View
Compute PET:	click to specify F	PET to re	eplace>		View
How to Modify:	dd/Remove Vo	lume in l	Extreme Eve	ents 👻	
Percent Change in Volume					
Single Change C Ite	erate Changes				
Value 1.1	%				
Events					
Vary precipitation only in	the following Ev	/ents	Change	<u> </u>	of volume
Hourly intensity above	0	in/hr			
Allow gaps up to	0	hours			
Total volume above	0	inches			
Total duration abo∨e	0	hours			
Seasons					
Vary only in selected					
			Ok		Cancel

4. In the Percent Change in Volume frame, leave the Single Change option selected and enter a value of "10" percent. It is important to note that this value indicates the percent change in the total water volume for the entire data set. This is the total volume change that will be distributed among the events we specify in the following steps. In the **Events** frame, there are two components available for specifying storm intensification: Vary precipitation only in the following Events and Change a specified % of volume. By default, the option to Vary precipitation only in the following Events is checked. Values can be entered for any or all of the four elements that define an extreme event. Enter "0.1" in the **Hourly intensity above** field, indicating that only events with greater than 0.1 inches/hour will be considered storm events. The Change ... % of volume field is used to specify the percentage of the qualifying events to be modified. Leaving this field blank will result in the specified volume change being applied to all qualifying events. Entering a percentage value will result in the volume change being applied to the highest storms that total the specified percentage of the data set's volume. Enter a value of "20" percent of the volume, which will result in a more intense modification being applied to a smaller subset of storms. BASINS CAT will calculate and add volume to the highest 20% of events over 0.1 inches/hour such that the total added volume equals 10% of the total volume for the entire base data set.

🚰 Modify Existing Data					_ 🗆 ×
Modification Name:	Storm Intensity				
Existing Data to Modify:	OBSERVED UP	/ARLBF	RHPRECIF	>	View
Compute PET:	<click f<="" specify="" td="" to=""><td>PET to r</td><td>eplace></td><td></td><td>View</td></click>	PET to r	eplace>		View
How to Modify:	Add/Remove Vo	lume in	Extreme Ev	/ents 💌	
Percent Change in Volum	e				
Single Change	terate Changes				
Value 10	%				
Events					
Vary precipitation only	in the following Ev	/ents	Change	20 %	of volume
Hourly intensity abov	e 0.1	in/hr			
Allow gaps up to	0	hours			
Total volume above	0	inches			
Total duration above	0	hours			
Seasons					
Vary only in selected					
			Ok		Cancel

5. Click the **Ok** button at the bottom of the form. This scenario, as summarized on the main BASINS CAT form, will **intensify** the storms defined on the previous form by adding 10% of the data set's total volume to them.

💒 Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C:\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 ✓ Increase Precip Multiply 1.2 ✓ Seasonal Precip Multiply 1.2 Month: Jun Jul Auq ✓ Partial Precip Multiply 0.8 Water Year: 1986 ✓ Storm Intensity Intensity 10 	
Start Total iterations selected = 1 (0:09)	Plot

6. After defining this scenario, the user can use the **View** button to see the values in the modified data sets. Users may also want to save the state of BASINS CAT using the **File:Save Climate and Endpoints** menu option.

Example 5. Add or Remove Storm Events

BASINS CAT has the ability to represent changes in storm frequency by adding or removing storms to a historical record.

This example shows how to make adjustments to represent a change in storm frequency. The final result of the example is a climate scenario that increases the total volume of precipitation by a specified percent by adding storms during selected months in the year.

 To begin creating a new climate scenario, click the Add button. The Modify Existing Data form will be displayed. Begin defining this scenario by entering "Storm Frequency" in the Modification Name field.

Modify Existing Data			_ 🗆 🗙
Modification Name:	Storm Frequency		
Existing Data to Modify:	<click data="" n<="" specify="" td="" to=""><td>nodify></td><td>View</td></click>	nodify >	View
Compute PET:	<click pet="" r<="" specify="" td="" to=""><td>eplace></td><td>View</td></click>	eplace>	View
How to Modify:	Multiply Existing Values b	oy a Number	•
Number to multiply existi	ng data by		
Single Change	lterate Changes		
Value 1.1	multiplication factor	r	
Events	y in the following Events		
Vary only in selected			
		Ok	Cancel

2. To select the precipitation data to modify, click in the Existing Data to Modify box. Since we will be modifying historical precipitation data, begin the selection process by clicking on the OBSERVED item under the Scenario list. Click on the data set with UPMARLBR and HPRECIP as the respective Location and Constituent. When this data set has moved to the Selected Data list, click the Ok button.

015945 BELTS\ 1:101		AGWET AGWI	
	/IL	1044	
F101		AGWI	-
1.101		AGWO	
LAUREI	_	AGWS	
P:101		AIRT	
P:102	-1	AIRTMP	
D 100		10000	
015945	26	FLOW	
LAURE	L	HPRECIP	
UPMAR	LBR	HPRECIP	
BELTS	/IL	PET	
BELTS	/IL	AIRTMP	
WASH_	NAT	CLOUD	
WASH_	NAT	WIND	
WASH_	NAT	DEWPT	
WASH_	NAT	SOLRAD	
	1 RD		
UPMAR	LBR	HPRECIP	
	P:101 P:102 D 105945 LAUREI UPMAR BELTSV BELTSV BELTSV WASH_ WASH_ WASH_ UDMAR	P:101 P:102 D:1594526 LAUREL UPMARLBR BELTSVIL BELTSVIL BELTSVIL WASH_NAT WASH_NAT WASH_NAT WASH_NAT WASH_NAT	P:101 AIRT P:102 AIRT O1594526 FLOW LAUREL HPRECIP UPMARLBR HPRECIP BELTSVIL PET BELTSVIL AIRTMP WASH_NAT CLOUD WASH_NAT DEWPT WASH_NAT SOLRAD UIDMADLBD ATD_NO3

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. The **Compute PET** box is for selecting the evapotranspiration data set to modify when a temperature climate scenario is being defined and can be ignored for this example. The **How to Modify** box contains a list of methods for modifying the data-set values. For this example, select "Add/Remove Storm Events." The form will be updated to allow for specification of storm intensity modifications.

Modify Existing Data					_ 🗆 ×
Modification Name:	Storm Frequency	/			
Existing Data to Modify:	OBSERVED UP	MARLB	RHPRECIP		View
Compute PET:	<click specify<="" td="" to=""><td>PET to r</td><td>eplace></td><td></td><td>View</td></click>	PET to r	eplace>		View
How to Modify:	Add/Remo∨e St	orm Eve	nts	J	
Percent Change in Volume	e				
Single Change C It	erate Changes				
Value 1.1	%				
Events Vary precipitation only i	n the following E [.]	vents			
Hourly intensity above		in/hr			
	0				
Allow gaps up to		hours			
Total volume above	0	inches	:		
Total duration abo∨e	0	hours			
Seasons					
Vary only in selected					
			Ok		Cancel

4. In the Percent Change in Volume frame, leave the Single Change option selected and enter a value of "10" percent, indicating the percent change in the total water volume for the entire data set. In the Events frame, checking the Vary precipitation only in the following Events box causes four fields to be displayed for defining what qualifies as a storm event. Qualifying events will then be randomly selected and duplicated to meet the 10% increase specified above. (Note: Unchecking the box, Vary precipitation only in the following Events, results in all precipitation values considered as events qualifying for duplication.) Values can be entered for any or all of the four elements. Enter "0.1" in the Hourly intensity above field, indicating that only events with greater than 0.1 inches/hour will be considered storm events.

🚰 Modify Existing Data					×
Modification Name:	Storm Frequency	/			
Existing Data to Modify:	OBSERVED UP	MARLBR	RHPRECIP	View	
Compute PET:	<click i<="" specify="" td="" to=""><td>PET to r</td><td>eplace></td><td> View</td><td></td></click>	PET to r	eplace>	 View	
How to Modify:	Add/Remove Sto	orm Eve	nts	→	
Percent Change in Volum	, ne				
Single Change	lterate Changes				
Value 10	%				
Events					
Vary precipitation only	in the following Ev	vents			
Hourly intensity abov	e 0.1	in/hr			
Allow gaps up to	0	hours			
Total volume above	0	inches	;		
Total duration above	0	hours			
Seasons					
□ Vary only in selected					
			Ok	Cancel	

5. The Seasons frame near the bottom of the form is used for specifying a time subset of the data set to which the modification will be applied. Begin defining this subset by clicking on the Vary only in selected check box. Two additional fields will be displayed. The first field is a list of time subset options that includes Calendar Years, Months, and Water Years. The second field will display a list of available time intervals based on the item selected in the first field. For example, selecting Water Years from the first field will populate the second field with a list of available water years based on the period of record of the data set. For this example, select the Months option and the second field will be populated with the months of the year. Items in the second field can be selected and unselected by clicking on them. Additionally, the buttons below the list can be used to select All or None of the items. To represent increased storm frequency during spring months, select Mar, Apr, and May.

Modify Existing Data					
Modification Name:	Storm Frequency	/			
Existing Data to Modify:	OBSERVED UP	MARLBF	HPRECIP		View
Compute PET:	<click i<="" specify="" td="" to=""><td>PET to re</td><td>place></td><td></td><td>View</td></click>	PET to re	place>		View
How to Modify:	Add/Remove St	orm Ever	its	-	
- Percent Change in Volume	e			_	
 Single Change It 	erate Changes				
Value 10	%				
Events					
Vary precipitation only i	n the following Ev	vents			
Hourly intensity above		in/hr			
Allow gaps up to	0	hours			
Total volume above	0	inches			
Total duration above	0	hours			
Total duration above	Ju	nours			
Seasons					
Vary only in selected	Months				•
Jan Jun No∨ Feb Jul Dec					
Mar <mark>Aug</mark> Apr Sep					
May Oct					
,					
All					None
			Ok		Cancel

6. Click the **Ok** button at the bottom of the form. This scenario, as summarized on the main BASINS CAT form, will **Add** storms during **Mar**, **Apr**, **and May** until a 10% increase in the data set's original volume has been achieved.

Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C:\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 Increase Precip Multiply 1.2 Seasonal Precip Multiply 1.2 Month: Jun Jul Auq Partial Precip Multiply 0.8 Water Year: 1986 Storm Intensity Intensify 10 Storm Frequency AddEvents 10 Month: Mar Apr May 	
Start Total iterations selected = 1 (0:09)	Plot

7. After defining this scenario, the user can use the **View** button to see the values in the modified data sets. Save the state of BASINS CAT using the **File:Save Climate and Endpoints** menu option.

C. Modifying Temperature Data

QUESTION ANSWERED:

3) How do I adjust historical temperature records to represent potential climate changes?

BASINS CAT can modify historical air temperature records and regenerate corresponding evapotranspiration records. The exercises in this section demonstrate the following adjustments to air temperature records.

- Applying a change to the entire air temperature record and regenerating PET.
- Applying a seasonal change and regenerating PET.
- Applying a change to a portion of the temperature record and regenerating PET.

To ensure that the Climate Assessment Tool form is properly initialized, the BASINS CAT Set-up steps in Section A must be run before beginning these examples. As with the precipitation data modification, examples for modifying temperature data are presented below.

Example 1. Add or Subtract a Constant to Full Record and Regenerate Evapotranspiration

The simplest method of modifying air temperature is to apply a multiplier to historical values over the entire span, or full record, of the model run. Potential evapotranspiration (PET) data are then regenerated using the modified temperature values.

This example shows how a single change can be applied to an entire historical air temperature data record and how PET data are regenerated from the modified data. The final result of the example is a record adjustment that applies a uniform increase to historical air temperature. PET data will be regenerated, based on the adjusted air temperature record, for use as model input.

1. To begin creating a new record adjustment, click the **Add** button. The **Modify Existing Data** form will be displayed. Begin defining this scenario by entering "Temperature" in the **Modification Name** field.

Modify Existing Data	1		_ [] ;
Modification Name:	Temperature		_
Existing Data to Modify:	<click data="" moc<="" specify="" td="" to=""><td>dify≯</td><td>View</td></click>	dify≯	View
Compute PET:	<click pet="" repla<="" specify="" td="" to=""><td>ace></td><td>View</td></click>	ace>	View
How to Modify:	Multiply Existing Values by a	a Number	- -
Number to multiply exis	ting data by		
 Single Change) Iterate Changes		
Value 1.1	multiplication factor		
Events			
	ly in the following Events		
recipitation on	iy in the following Events		
Seasons			
🗖 Vary only in selected	ł		
		Ok	Cancel

2. To select the air temperature data to modify, click in the Existing Data to Modify box. The Select data to vary form will open. Begin the selection process by looking at the first column, labeled Scenario, in the Select Attribute Values to Filter Available Data frame. Click on the OBSERVED item, and all data sets with a Scenario attribute of OBSERVED will be added to the Matching Data list. In looking at the last column of the Matching Data list, note the data set with the Constituent name AIRTMP (air temperature). Click on this data set and it will be added to the Selected Data list. Click the Ok button to close the form.

Scenario	_	Location		Constituent	-
Scenario	•	Location	•	Constituent	
OBSERVED		01594526		AGWET	
PT-OBS		BELTSVIL		AGWI	
BCEN		l:101		AGWO	
base		LAUREL		AGWS	
		P:101		AIRT	
		P:102		AIRTMP	
		D 100		*~~~~	
Matching Data (27 of 2	221)				
OBSERVED		01594526		FLOW	
DBSERVED		LAUREL		HPRECIP	
OBSERVED		UPMARLBR		HPRECIP	
OBSERVED		BELTSVIL		PET	
OBSERVED		BELTSVIL		AIRTMP	
OBSERVED		WASH_NAT		CLOUD	
OBSERVED		WASH_NAT		WIND	
OBSERVED		WASH_NAT		DEWPT	
OBSERVED		WASH_NAT		SOLRAD	
negeo//en		LIDMADI RD		ATD-NO9	
Selected Data (1 of 2	221)				
OBSERVED		BELTSVIL		AIRTMP	
Dates to Include					
	1 .				
All	Com	non			

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. When modifying temperature, it is necessary to also re-compute the potential evapotranspiration (PET) using the modified temperature data. Click in the **Compute PET** box to specify which PET data to re-compute.

📒 Modify Existing Data			<u>_ 🗆 ×</u>
Modification Name:	Temperature		_
Existing Data to Modify:	BSERVED BELTSVIL		View
	<pre>click to specify PET to r</pre>		View
Compute PET:			
How to Modify:	Multiply Existing Values b	by a Number	_
Number to multiply existi			
 Single Change 			
Value 1.1	multiplication factor	r	
 E∨ents			
Vary precipitation only	y in the following E∨ents		
Seasons			
□ Vary only in selected			
		1	
		Ok	Cancel

4. In the **Select data to vary** form, again click on the **OBSERVED** item in the **Scenario** column, and then click the **OBSERVED BELTSVIL PET** data set from the **Matching Data** list. Click the **Ok** button to close the **Select data to vary** form.

Select PET to replace with values computed from air temperature					
File Attributes Select Help Select Attribute Values to Filter Available Data					
Scenario		•	Constituent		
OBSERVED	01594526		AGWET		
PT-OBS	BELTSVIL	٦	AGWI		
SCEN	1:101		AGWO		
base	LAUREL		AGWS		
	P:101		AIRT		
	P:102		AIRTMP		
	D 100		•••••••		
Matching Data (27 of 2221)					
OBSERVED	01594526		FLOW 🔺		
OBSERVED	LAUREL		HPRECIP		
OBSERVED	UPMARLBR		HPRECIP		
OBSERVED	BELTSVIL		PET		
OBSERVED	BELTSVIL		AIRTMP		
OBSERVED	WASH_NAT		CLOUD		
OBSERVED	WASH_NAT		WIND		
OBSERVED	WASH_NAT		DEWPT		
OBSERVED	WASH_NAT		SOLRAD		
Selected Data (1 of 2221)					
OBSERVED	BELTSVIL		PET		
Dates to Include					
All Comr	non				
Start 1972/01/01 1972/01/					
End 1990/12/31 1990/12/	31 1990/12/31		Ok Cancel		

6. The Modify Existing Data form has been updated with a description of the selected data set in the Compute PET box. The How to Modify box contains a list of methods for modifying the data-set values. For this example, select the "Change Temperature" option. In the Degrees to add to each existing temperature value frame, there are two modification options: Single Change or Iterate Changes. The term "iterate", as used here, refers to the automation of multiple runs. The Single Change option will result in one adjustment applied to the temperature data set. For this example, we will use the Single Change option. In the Value field, enter "2," thus defining the amount to be added to all values in the temperature data set. Click the Ok button to complete the scenario definition process.

🚰 Modify Existing Data			<u>_ 🗆 ×</u>
Modification Name:	Temperature		_
Existing Data to Modify:	OBSERVED BELTSVIL	ARTMP	View
Compute PET:	OBSERVED BELTSVIL F	РЕТ	View
How to Modify:	Change Temperature		
-	existing temperature value		
 Single Change 	Iterate Changes		
Value 2	degrees		
Events			
Vary precipitation onl	v in the following Events		
	,		
Seasons			
Vary only in selected			
		Ok	Cancel

7. The **Climate Assessment Tool** form is now updated to show the newly defined climate scenario.

Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 ☑ Increase Precip Multiply 1.2 ☑ Seasonal Precip Multiply 1.2 Month: Jun Jul Auq ☑ Partial Precip Multiply 0.8 Water Year: 1986 ☑ Storm Intensity Intensity 10 ☑ Storm Frequency AddEvents 10 Month: Mar Apr May ☑ Temperature Add 2 	
Start Total iterations selected = 1 (0:09)	Plot

8. To complete this example, close the data listing and save the state of CAT, using the **File:Save Climate and Endpoints** menu option, if desired.

Example 2. Add or Subtract a Constant to a Specified Season and Regenerate Evapotranspiration.

BASINS CAT allows for the adjustment of temperature (and computed PET) values during only a specified month or season of the year. This flexibility is useful for representing changes that vary seasonally within the year.

This example shows how a change can be applied to a historical air temperature data record for only a specified season of the year, and how PET data are regenerated from the modified data. The final result of the example is an air temperature time series with two different record adjustments, one for cool months, and one for warm months. PET data will be regenerated, based on the adjusted air temperature records, for use as model input.

1. To begin creating the temperature adjustment for cool months, click the **Add** button and the **Modify Existing Data** form will be displayed. Begin defining this scenario by entering "Temp Cool Season" in the **Modification Name** field.

Modify Existing Data	×		
Modification Name: Temp Cool S	Geason		
Existing Data to Modify: <a> 	cify data to modify> View		
Compute PET: <a>	cify PET to replace> View		
How to Modify: Multiply Exist	ing Values by a Number		
Number to multiply existing data by —			
Single Change C Iterate Change	es		
Value 1.1 multipli	cation factor		
Events			
Vary precipitation only in the followin	a Events		
The vary precipitation only in the following Events			
Seasons			
Vary only in selected			

2. To select the air temperature data to modify, click in the Existing Data to Modify box and the Select data to vary form will be displayed. In the first column, under the Scenario label, click on the OBSERVED item and all data sets with a Scenario attribute of OBSERVED will be added to the Matching Data list. Look at the last column of the Matching Data list, and note the data set with the Constituent name AIRTMP (air temperature). Click on this data set and it will be added to the Selected Data list. Click the Ok button to close the form.

💒 Select data to vary		
File Attributes Select Help		
Select Attribute Values to Filter Av	ailable Data	
Scenario 💌	Location 🗨	Constituent 💌
OBSERVED	01594526	AGWET
PT-OBS	BELTSVIL	AGWI
SCEN	1:101	AGWO
base	LAUREL	AGWS
	P:101	AIRT
	P:102	AIRTMP
	D 400	••••••
Matching Data (27 of 2221)		
OBSERVED	01594526	FLOW 🔺
OBSERVED	LAUREL	HPRECIP
OBSERVED	UPMARLBR	HPRECIP
OBSERVED	BELTSVIL	PET
OBSERVED	BELTSVIL	AIRTMP
OBSERVED	WASH_NAT	CLOUD
OBSERVED	WASH_NAT	WIND
OBSERVED	WASH_NAT	DEWPT
OBSERVED	WASH_NAT	SOLRAD
Selected Data (1 of 2221)		
OBSERVED	BELTSVIL	AIRTMP
Dates to Include		
All Comr	non	
Start 1980/01/01 1980/01/	01 1980/01/01	
End 1990/12/31 1990/12/	31 1990/12/31	Ok Cancel

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. When modifying temperature, it is necessary to also re-compute the potential evapotranspiration (PET) using the modified temperature data. Click in the **Compute PET** box to specify which PET data to re-compute.

🚰 Modify Existing Data			_ 🗆 ×
Modification Name:	Temp Cool Season		
Existing Data to Modify:	BSERVED BELTSVIL	AIRTMP	View
Compute PET:	click to specify PET to r	eplace>	View
How to Modify:	Multiply Existing Values I	oy a Number	•
Number to multiply exist	ing data by		
Single Change	Iterate Changes		
Value 1.1	multiplication facto	r	
Events			
Vary precipitation onl	∨ in the following Events		
Seasons			
Vary only in selected			
		Ok	Cancel

4. In the **Select data to vary** form, again click on the **OBSERVED** item in the **Scenario** column, and then click the **OBSERVED BELTSVIL PET** data set from the **Matching Data** list. Click the **Ok** button to close the **Select data to vary** form.

🗶 Select PET to replace with values computed from air temperature			
File Attributes Select Help			
Select Attribute Values to Filter Available Data			
Scenario 💌	Location	Constituent	
OBSERVED	01594526	AGWET A	
PT-OBS	BELTSVIL	AGWI	
SCEN	1:101	AGWO	
base	LAUREL	AGWS	
	P:101	AIRT	
	P:102		
	D 100		
Matching Data (27 of 2221)			
OBSERVED	01594526	FLOW 🔺	
OBSERVED	LAUREL	HPRECIP	
OBSERVED	UPMARLBR	HPRECIP	
OBSERVED	BELTSVIL	PET	
OBSERVED	BELTSVIL	AIRTMP	
OBSERVED	WASH_NAT	CLOUD	
OBSERVED	WASH_NAT	WIND	
OBSERVED	WASH_NAT	DEWPT	
OBSERVED	WASH_NAT	SOLRAD	
	I IDMADI RD		
Selected Data (1 of 2221)			
OBSERVED	BELTSVIL	PET	
Dates to Include			
All Com	mon		
Start 1972/01/01 1972/01	/01 1972/01/01		
End 1990/12/31 1990/12	/31 1990/12/31	Ok Cancel	

5. The **Modify Existing Data** form has been updated with a description of the selected data set in the **Compute PET** box. The **How to Modify** box contains a list of methods for modifying the data-set values. For this example, the "Change Temperature" option will be used. For this example, we will use the **Single Change** option. In the **Value** field, enter "2," which will be the temperature increase applied to the air temperature values in the season defined in the next step.

🚰 Modify Existing Data			_ 🗆 ×
Modification Name:	Temp Cool Season		
Existing Data to Modify:	OBSERVED BELTSVIL	AIRTMP	View
Compute PET:	OBSERVED BELTSVIL	PET	View
How to Modify:	Change Temperature	•	
Degrees to add to each	existing temperature value	,	
Single Change C	Iterate Changes		
Value 2	degrees		
Events			
Vary precipitation onl	y in the following E∨ents		
Seasons			
Vary only in selected			
		Ok	Cancel

6. The Seasons frame near the bottom of the form is used for specifying a time subset of the data set to which the modification will be applied. Begin defining this subset by clicking on the Vary only in selected check box and two additional fields will be displayed. The first field is a list of time subset options that includes Calendar Years, Months, and Water Years. The second field will display a list of available time intervals based on the item selected in the first field. For example, selecting Water Years from the first field will populate the second field with a list of available water years based on the period of record of the data set. For this example, select the Months option and the second field will be populated with the months of the year. Items in the second field can be selected and unselected by clicking on them. Additionally, the buttons below the list can be used to select All or None of the items. To apply the 2-degree increase to cooler months, select Nov through Apr.

🚰 Modify Existing Data			<u> </u>
Modification Name:	Temp Cool Season		
Existing Data to Modify:	OBSERVED BELTSVIL	AIRTMP	View
Compute PET:	OBSERVED BELTSVIL	PET	View
How to Modify:	Change Temperature	•	
Degrees to add to each	existing temperature value)	
Single Change	Iterate Changes		
Value 2	degrees		
Events			
Vary precipitation onl	y in the following E∨ents		
Seasons	Months		
✓ Vary only in selected Jan Jun Nov	Imonitis		<u> </u>
Feb Jul Dec			
Mar Aug Apr Sep			
May Oct			
All			None
		Ok	Cancel

7. Click the **Ok** button to complete defining the cooler month's temperature adjustment. The newly defined adjustment will be shown on the **Climate Assessment Tool** form. To begin defining the warm month's air temperature adjustment, click the **Add** button again.

🚰 Climate Assessment Tool	_ 🗆 ×
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 ☑ Increase Precip Multiply 1.2 ☑ Seasonal Precip Multiply 1.2 Month: Jun Jul Auq ☑ Partial Precip Multiply 0.8 Water Year: 1986 ☑ Storm Intensity Intensity 10 	
 Storm Frequency AddEvents 10 Month: Mar Apr May Temperature Add 2 	
☑ Temp Cool Season Add 2 Month: Jan Feb Mar Apr Nov Dec	
Start Total iterations selected = 1 (0:09)	Plot

8. From the **Modify Existing Data** form, enter "Temp Warm Season" in the **Modification Name** field. Next, repeat steps 2 through 4 to select the same air temperature and PET data sets as before. For the warm month's adjustment, we will apply a 4-degree increase to the historical data. Select **Change Temperature** from the **How to Modify** list and then enter "4" in the **Value** field. In the **Seasons** frame, again select **Months** from the first list and then select **May** through **Oct**.

📒 Modify Existing Data			_ 🗆 ×
Modification Name:	Temp Warm Season		
Existing Data to Modify:	OBSERVED BELTSVIL AIRTM	>	View
Compute PET:	OBSERVED BELTSVIL PET		View
How to Modify:	, Change Temperature	_	
-	existing temperature value		
_	Iterate Changes		
Value 4	degrees		
	, , , , , , , , , , , , , , , , , , , ,		
Events			
Vary precipitation only	r in the following E∨ents		
Seasons Vary only in selected	Months		-
Jan Jun Nov			
Feb Jul Dec Mar Aug			
Apr Sep			
May Oct			
All			None
		Ok	Cancel
			lh

9. Click the **OK** button to complete defining the warm month's temperature adjustment. The newly defined adjustment will be shown on the **Climate Assessment Tool** form.

💒 Climate Assessment Tool	_ 🗆 🗙
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
☑ Increase Precip Multiply 1.2 ☑ Seasonal Precip Multiply 1.2 Month: Jun Jul Aug	
Partial Precip Multiply 0.8 Water Year: 1986	
✓ Storm Intensity Intensity 10 ✓ Storm Frequency AddEvents 10 Month: Mar Apr May	
☑ Temperature Add 2	
Temp Cool Season Add 2 Month: Jan Feb Mar Apr Nov Dec Temp Warm Season Add 4 Month: May Jun Jul Aug Sep Oct	
Prenip Wann Season Add 4 Month, May sun sur Add Sep Oct	
Start Total iterations selected = 1 (0:09)	Plot

10. To complete this example, save the state of CAT, using the **File:Save Climate and Endpoints** menu option, if desired.

Example 3. Add or Subtract a Constant to a Partial Record and Regenerate Evapotranspiration

A common climate scenario need is to adjust historical values during only a particular set of years, or partial record, of the model run. For example, assessing the impacts of increased drought severity can include increasing the air temperature values, and re-computing PET values, for a specified year or years within the record.

This example shows how a single change can be applied to a historical air temperature data record for a specified portion of the model run, and how PET data are regenerated from the modified data. The final result of the example is a record adjustment that increases historical air temperature data for only a single year. PET data are also regenerated based on the adjusted air temperature record for use as model input.

1. To begin creating a new climate scenario, click the **Add** button. The **Modify Existing Data** form will be displayed. Begin defining this scenario by entering "Partial Temp" in the **Modification Name** field.

Modify Existing Data			
Modification Name:	Partial Temp		
Existing Data to Modify:	<click data="" n<="" specify="" td="" to=""><td>nodify></td><td>View</td></click>	nodify >	View
Compute PET:	click to specify PET to respectively.	eplace>	View
How to Modify:	Multiply Existing Values b	y a Number	•
Number to multiply exist	ing data by		
Single Change	Iterate Changes		
Value 1.1	multiplication factor		
Events			
Vary precipitation onl	ly in the following E∨ents		
Seasons			
Vary only in selected			
		Ok	Cancel

2. To select the air temperature data to modify, click in the Existing Data to Modify box. The Select data to vary form will be displayed. In the first column, under the Scenario label, click on the OBSERVED item and all data sets with a Scenario attribute of OBSERVED will be added to the Matching Data list. Look at the last column of the Matching Data list, and note the data set with the Constituent name AIRTMP (air temperature). Click on this data set and it will be added to the Selected Data list. Click the Ok button to close the form.

Coloct data to yory		
Select data to vary		
File Attributes Select Help		
Select Attribute Values to Filter Av	allable Data	
Scenario 💌	Location 🗨	Constituent 💌
OBSERVED	01594526	AGWET
PT-OBS	BELTSVIL	AGWI 🗕
SCEN	1:101	AGWO
base	LAUREL	AGWS
	P:101	AIRT
	P:102	
	D 100	******
Matching Data (27 of 2221)		
OBSERVED	01594526	FLOW
OBSERVED	LAUREL	HPRECIP
OBSERVED	UPMARLBR	HPRECIP
OBSERVED	BELTSVIL	PET
OBSERVED	BELTSVIL	AIRTMP
OBSERVED	WASH_NAT	CLOUD
OBSERVED	WASH_NAT	WIND
OBSERVED	WASH_NAT	DEWPT
OBSERVED	WASH_NAT	SOLRAD
Selected Data (1 of 2221)		
OBSERVED	BELTSVIL	AIRTMP
Dates to Include		
All Comr	non	
Start 1980/01/01 1980/01/	01 1980/01/01	
End 1990/12/31 1990/12/	31 1990/12/31	Ok Cancel

3. The **Modify Existing Data** form has now been updated with a description of the selected data set in the **Existing Data to Modify** box. When modifying temperature, it is necessary to also re-compute the potential evapotranspiration (PET) using the modified temperature data. Click in the **Compute PET** box to specify which PET data to re-compute.

🚰 Modify Existing Data			_ 🗆 ×
Modification Name:	Partial Temp		_
Existing Data to Modify:	BSERVED BELTSVIL	AIRTMP	View
Compute PET:	<pre>click to specify PET to r</pre>	eplace>	View
How to Modify:	Multiply Existing Values t	oy a Number 📃 🔻	 -
Number to multiply exist	ing data by		
Single Change C	Iterate Changes		
Value 1.1	multiplication factor	r	
Events			
Uary precipitation on	y in the following E∨ents		
Seasons			
Vary only in selected			
		Ok	Cancel

4. In the **Select data to vary** form, again click on the **OBSERVED** item in the **Scenario** column, and then click the **OBSERVED BELTSVIL PET** data set from the **Matching Data** list. Click the **Ok** button to close the **Select data to vary** form.

Scenario	-	Location	•	Constituent	-
OBSERVED		01594526		, AGWET	
PT-OBS		BELTSVIL		AGWI	
SCEN		1:101		AGWO	
base		LAUREL		AGWS	
50.50		P:101		AIRT	
		P:102		AIRTMP	
		D 100	_	10000	· · · · · · · · · · · · · · · · · · ·
Matching Data (27 of 2	221)				
OBSERVED		01594526		FLOW	
OBSERVED		LAUREL		HPRECIP	
OBSERVED		UPMARLBR		HPRECIP	
OBSERVED		BELTSVIL		PET	_
OBSERVED		BELTSVIL		AIRTMP	
OBSERVED		WASH NAT		CLOUD	
OBSERVED		WASH NAT		WIND	
OBSERVED		WASH_NAT		DEWPT	
OBSERVED		WASH NAT		SOLRAD	
					_
Selected Data (1 of 22	221)				
OBSERVED		BELTSVIL		PET	
Dates to Include					
All	Comm	ion			
	1972/01/0	1972/01/0			

5. The Modify Existing Data form has been updated with a description of the selected data set in the Compute PET box. The How to Modify box contains a list of methods for modifying the data-set values. For this example, the "Change Temperature" option will be used. For this example, we will use the Single Change option. In the Value field, enter "3," which will be the temperature increase applied to the air temperature values in the year specified in the next step.

🚰 Modify Existing Data		_ 🗆 🗙
Modification Name:	Partial Temp	
Existing Data to Modify:	OBSERVED BELTSVIL AIRTMP	View
Compute PET:	OBSERVED BELTSVIL PET	View
How to Modify:	Change Temperature	
	existing temperature value Iterate Changes degrees	
Events	y in the following E∨ents	
Seasons Vary only in selected		
	Ok	Cancel

6. The Seasons frame near the bottom of the form is used for specifying a time subset of the data set to which the modification will be applied. Begin defining this subset by clicking on the Vary only in selected check box. Two additional fields will be displayed. The first field is a list of time subset options that includes Calendar Years, Months, and Water Years. The second field will display a list of available time intervals based on the item selected in the first field. For example, selecting Water Years from the first field will populate the second field with a list of available water years based on the period of record of the data set. Items in the second field can be selected and unselected by clicking on them. Additionally, the buttons below the list can be used to select All or None of the items. The sample HSPF model used here is run for water years 1986 through 1988, with 1986 being the driest. Thus, to help assess the impact of drought, select the Water Years option and then select 1986 from the list of available water years.

Modify Existing Data		_ 🗆 ×
Modification Name:	Partial Temp	
Existing Data to Modify:	OBSERVED BELTSVIL AIRTMP	View
Compute PET:	OBSERVED BELTSVIL PET	View
How to Modify:	Change Temperature	
-	existing temperature ∨alue Iterate Changes degrees	
Events	y in the following E∨ents	
Seasons		
Vary only in selected	Water Years	•
	390 391	
All		None
	Ok	Cancel

7. Click the **Ok** button to complete the scenario definition process. The **Climate Assessment Tool** form is now updated to show the newly defined climate scenario.

🚰 Climate Assessment Tool	
File Edit Options Help	
Climate Data Assessment Endpoints Results Table Pivot Table	
Base Scenario C\BASINS\data\Climate\base.uci	
New Scenario Modified	
Add Remove Edit View Prepared	v ^
 Increase Precip Multiply 1.2 Seasonal Precip Multiply 1.2 Month: Jun Jul Auq Partial Precip Multiply 0.8 Water Year: 1986 Storm Intensity Intensity 10 Storm Frequency AddEvents 10 Month: Mar Apr May Temperature Add 2 Temp Cool Season Add 2 Month: Jan Feb Mar Apr Nov Dec Temp Warm Season Add 4 Month: May Jun Jul Aug Sep Oct Partial Temp Add 3 Water Year: 1986 	
Start Total iterations selected = 1 (0:09)	Plot

8. To complete this exercise, save the state of CAT, using the **File:Save Climate and Endpoints** menu option.