Central Water Commission

Hydrological Design Aids (Surface Water) Developed Under Hydrology Project-II

Part B: User Manual - 2

Volume II – HDA-Y

Revision-R_0

March 2015

JACOBS CES

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New Delhi, India

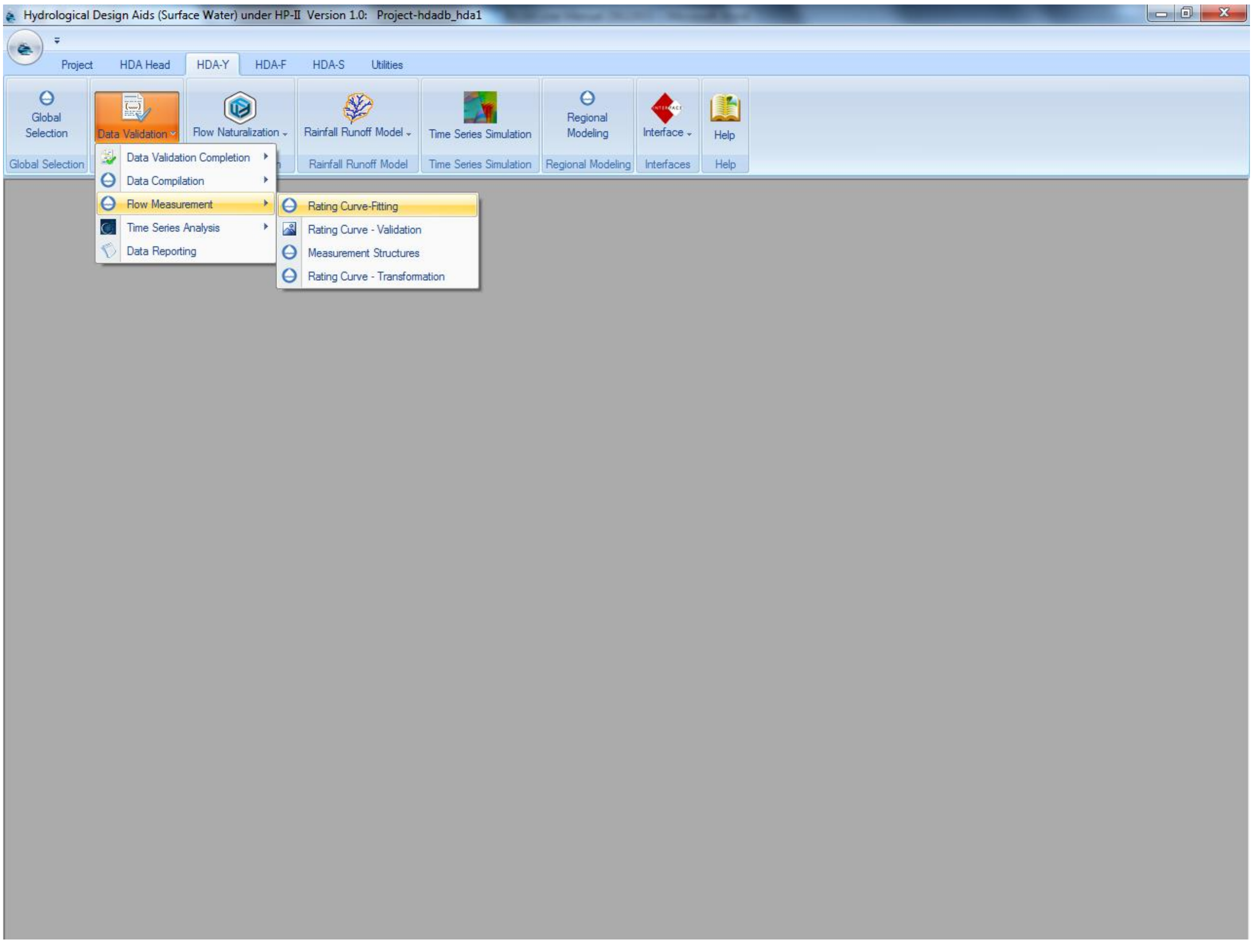
Contents

5. Flow Measurement

5.1. Rating Curve – Rating Curve Fitting

How to Access

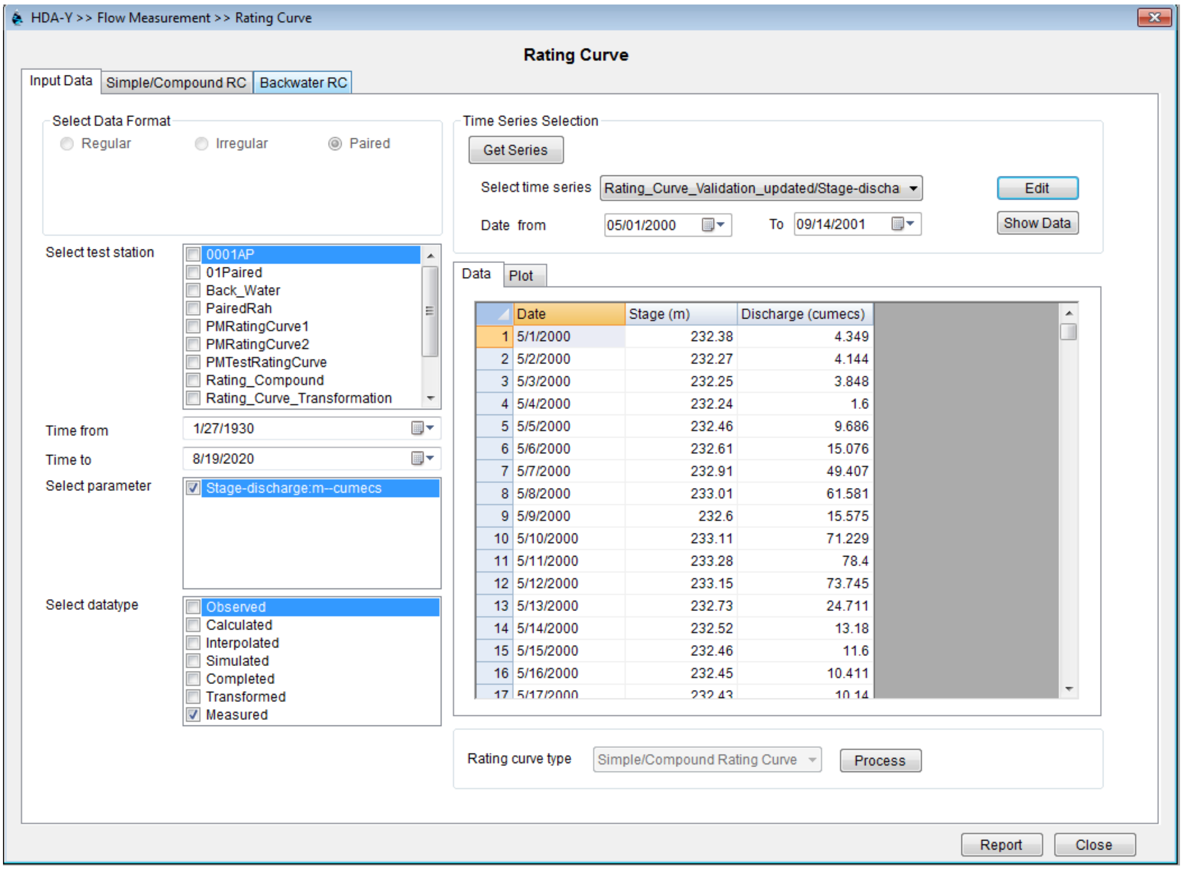
HDA-Y >> Flow Measurement >> Rating Curve



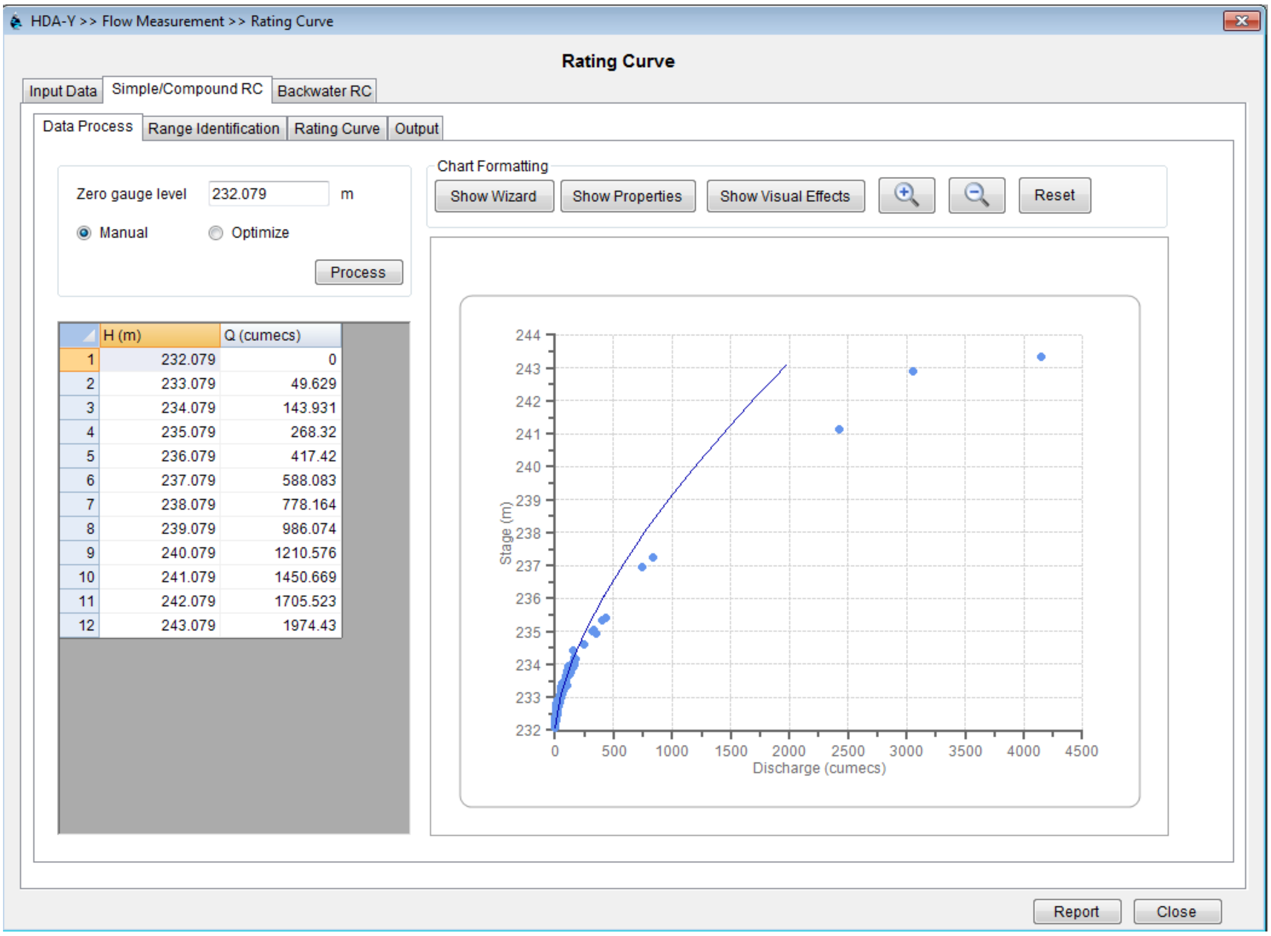
Operations

1. Use the menu path defined above to open the Rating Curve form.
2. In the "***Select Data Format***" section:
   2.1. Select Data Format.
   2.2. The time base associated with the selected data format is displayed in the "Select Time Base" section.
   2.3. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
   2.4. Click the ***"Get Series"*** button to get the series descriptor in combo boxes.
   2.5. Rating Curve will be performed only for "Measured" datatype.
3. Click dropdown of time series to select time series.

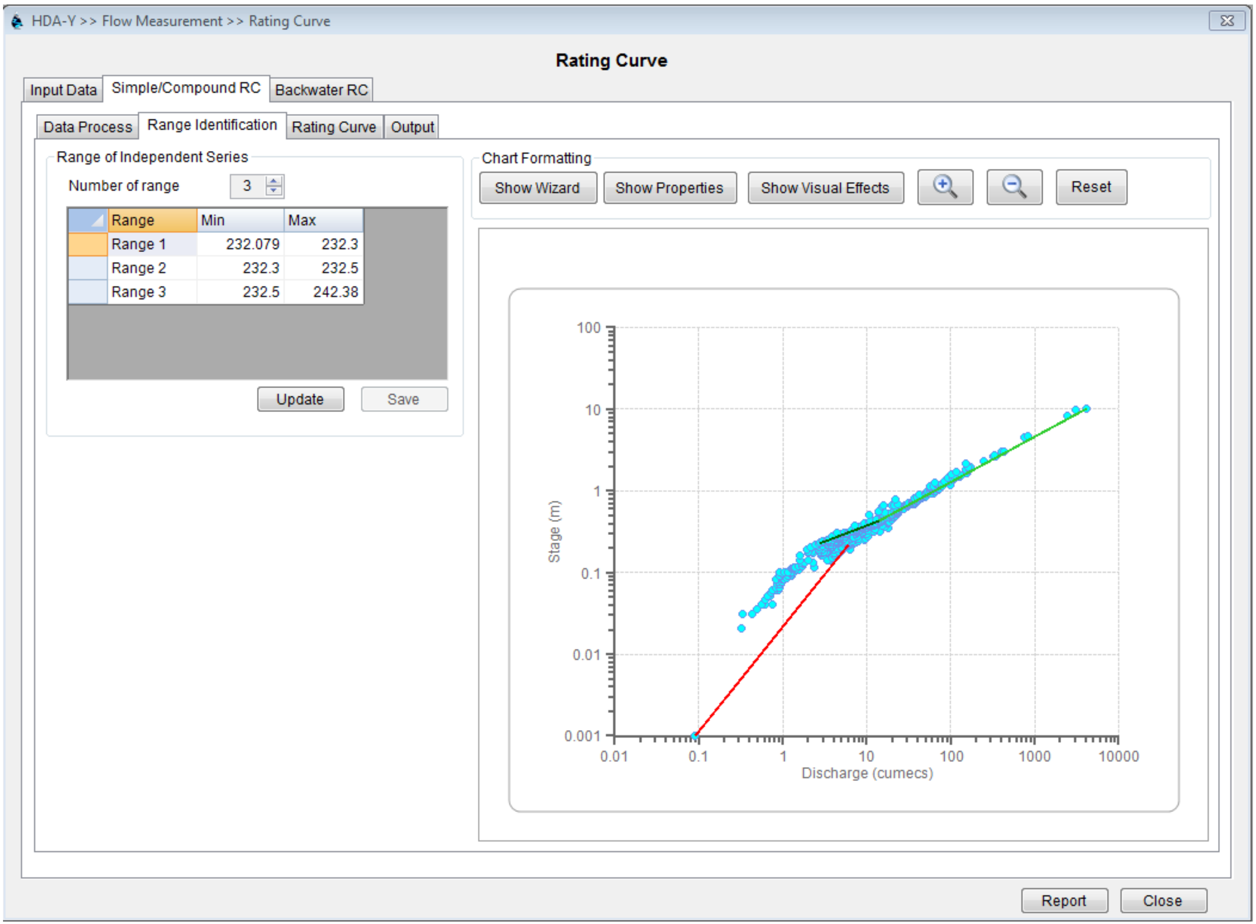
4. Date picker will automatically display the available date range of selected time series.
5. Date range for the time series can be changed from date picker.
6. Click ***"Show Data"*** button. The available data will be displayed in grid and accordingly plotted in the chart.



7. Now according to the series data, the method from which rating curve to be performed is selected. If the series selected contains only "Stage" data then rating curve will by default be selected to "Simple/Compound Rating Curve" and if "Stage-Auxiliary" data is present then it will be selected to "Back-water Rating Curve".
8. After the "Rating Curve type" is being selected, click on ***"Process"*** button.
9. Now based on rating curve type:
   9.1. If "Rating Curve type" is "Simple/Compound Rating Curve" then,
      9.1.1. User is directed to ***"Data Process"*** tab of "Simple/Compound RC", there user can enter the Zero gauge level and then process by selecting the Manual technique or Optimize technique. Data and plot will be displayed.

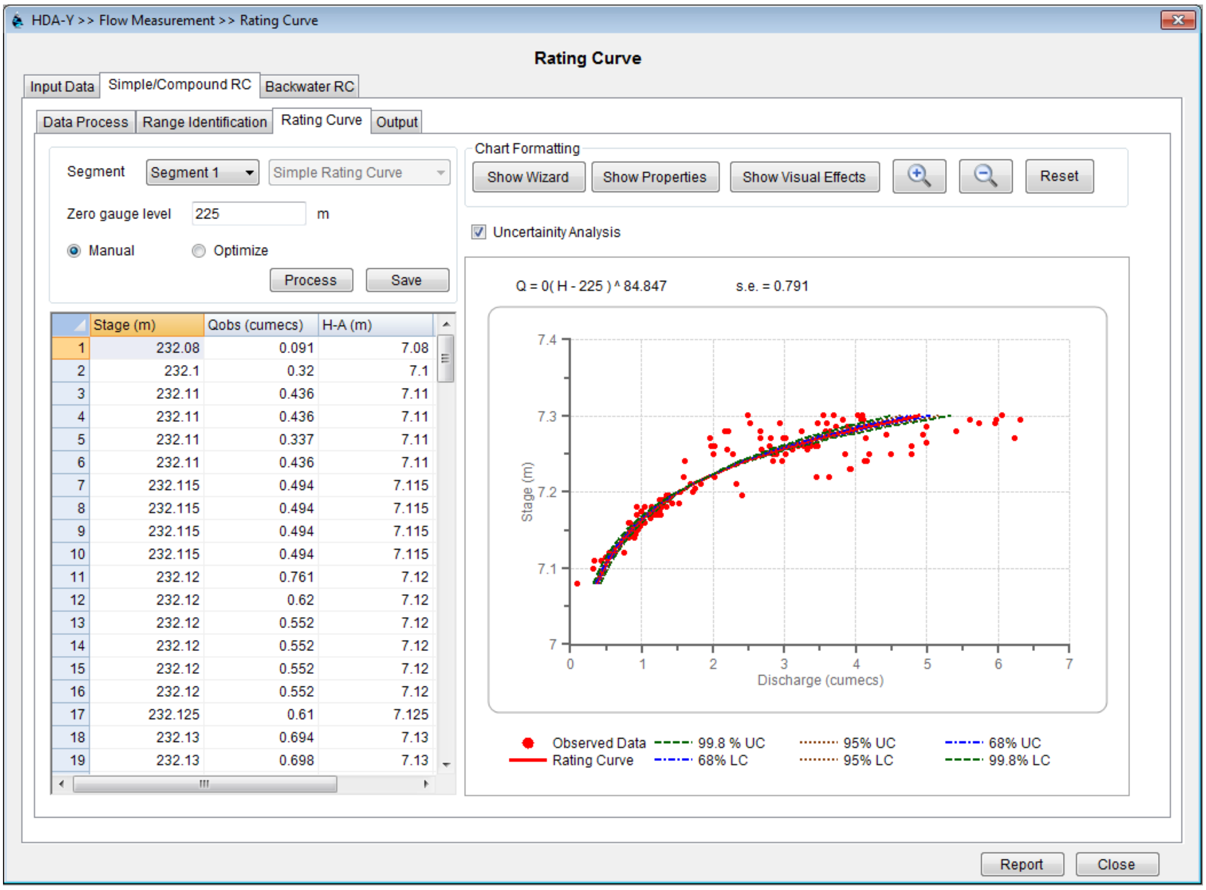


9.1.2.After viewing the results, User can move to ***"Range Identification"*** tab. In this tab User can identify the no. of range into which "Stage" data needs to be divided. Data is plotted according to the range that is identified. User needs to save the identified range for further processing.



9.1.3.Now user needs to develop the Rating Curve depending on the range of stage identified for it. User needs to select the Segment and its available rating curve type will be shown in next combo box.

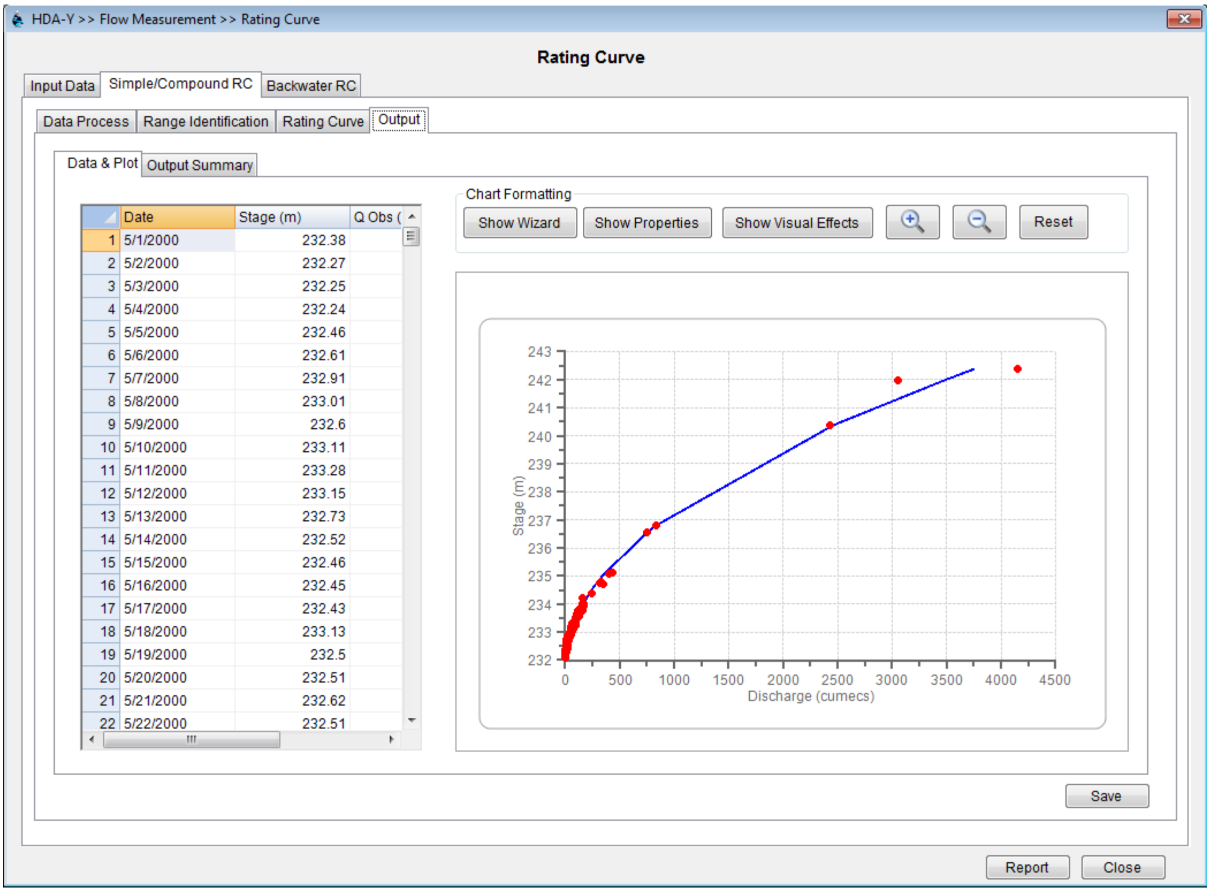
9.1.4.As User selects the Segment, default Zero gauge level corresponding to the segment is shown in textbox but User can change it. After selecting the calculation method of Manual/Optimize , User can process to see the Rating Curve.



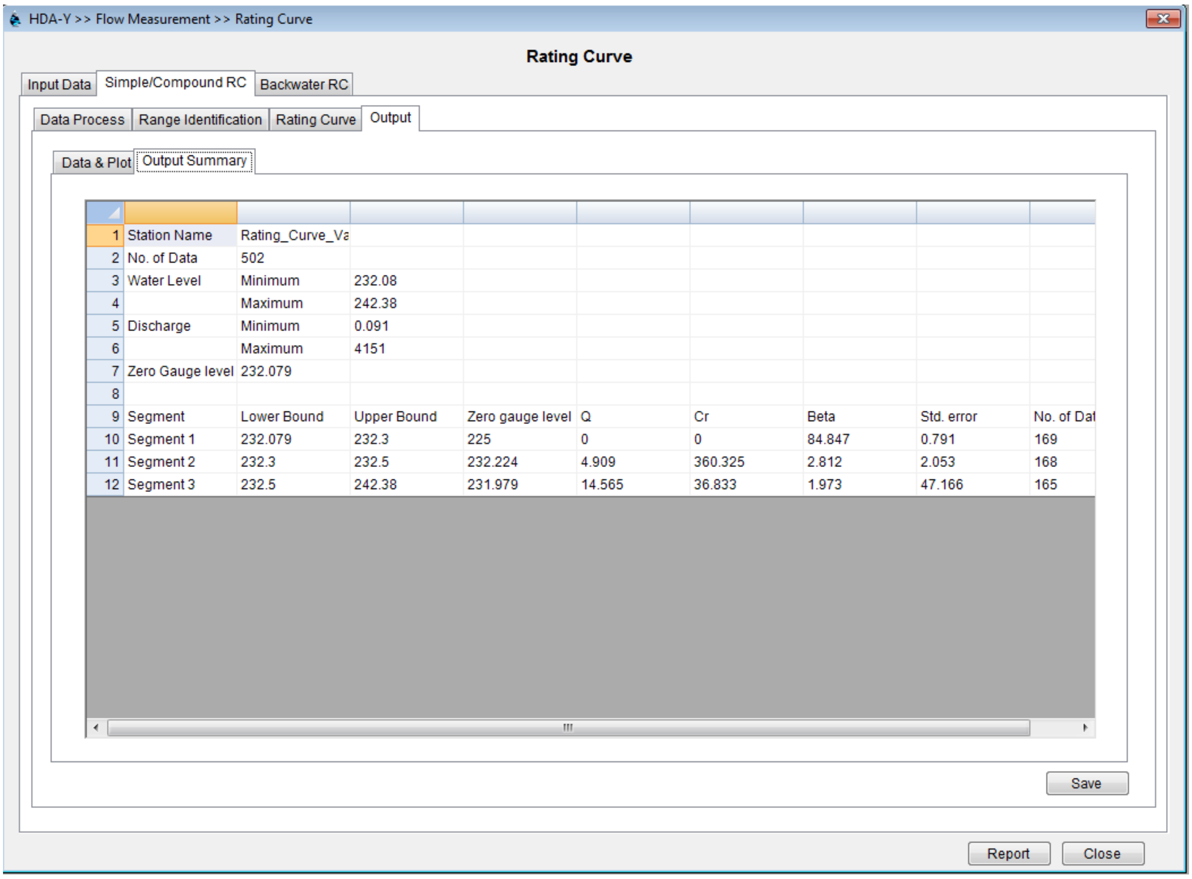
9.1.5. With the same process User needs to generate "Rating Curve" for all the available segments and save them simultaneously. When "Rating Curve" is performed for all the segments then ***"Output"*** tab is enabled.

9.1.6. ***"Output"*** tab consist of two tabs: Data & Plot and Summary.

9.1.7. In ***"Data & Plot"*** tab , input data series along with the Calculated Discharge is displayed and is plotted correspondingly.



9.1.8.In ***"Summary"*** tab , the detailed result related to Selected series and segment related results are displayed.



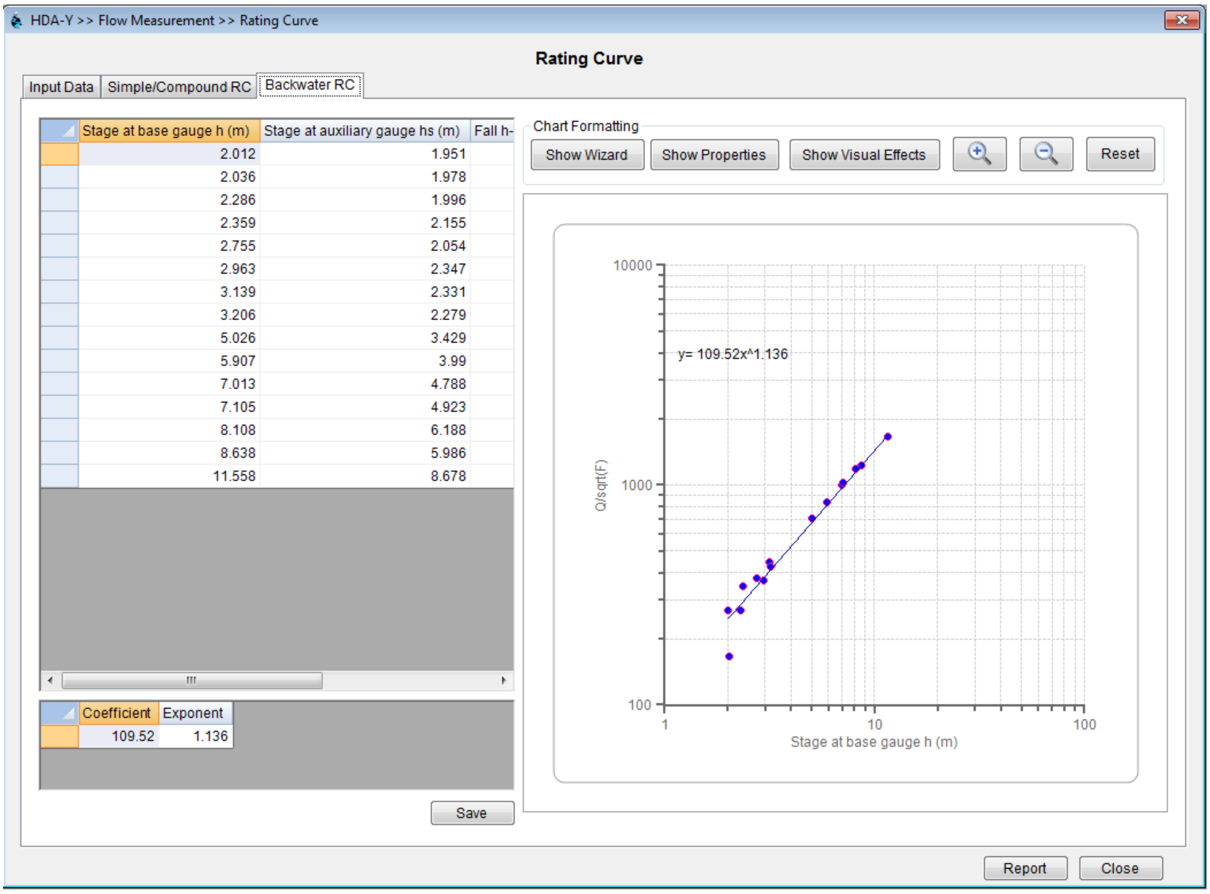
1	Station Name	Rating_Curve_Va							
2	No. of Data	502							
3	Water Level	Minimum	232.08						
4		Maximum	242.38						
5	Discharge	Minimum	0.091						
6		Maximum	4151						
7	Zero Gauge level	232.079							
8									
9	Segment	Lower Bound	Upper Bound	Zero gauge level	Q	Cr	Beta	Std. error	No. of Dat
10	Segment 1	232.079	232.3	225	0	0	84.847	0.791	169
11	Segment 2	232.3	232.5	232.224	4.909	360.325	2.812	2.053	168
12	Segment 3	232.5	242.38	231.979	14.565	36.833	1.973	47.166	165

9.1.9. Now User can save the final output by clicking ***"Save"*** button.

9.2. If "Rating Curve type" is "Backwater Rating Curve" then,

9.2.1. User is directed to ***"Backwater RC"*** tab as soon as ***"Process"*** button is clicked.

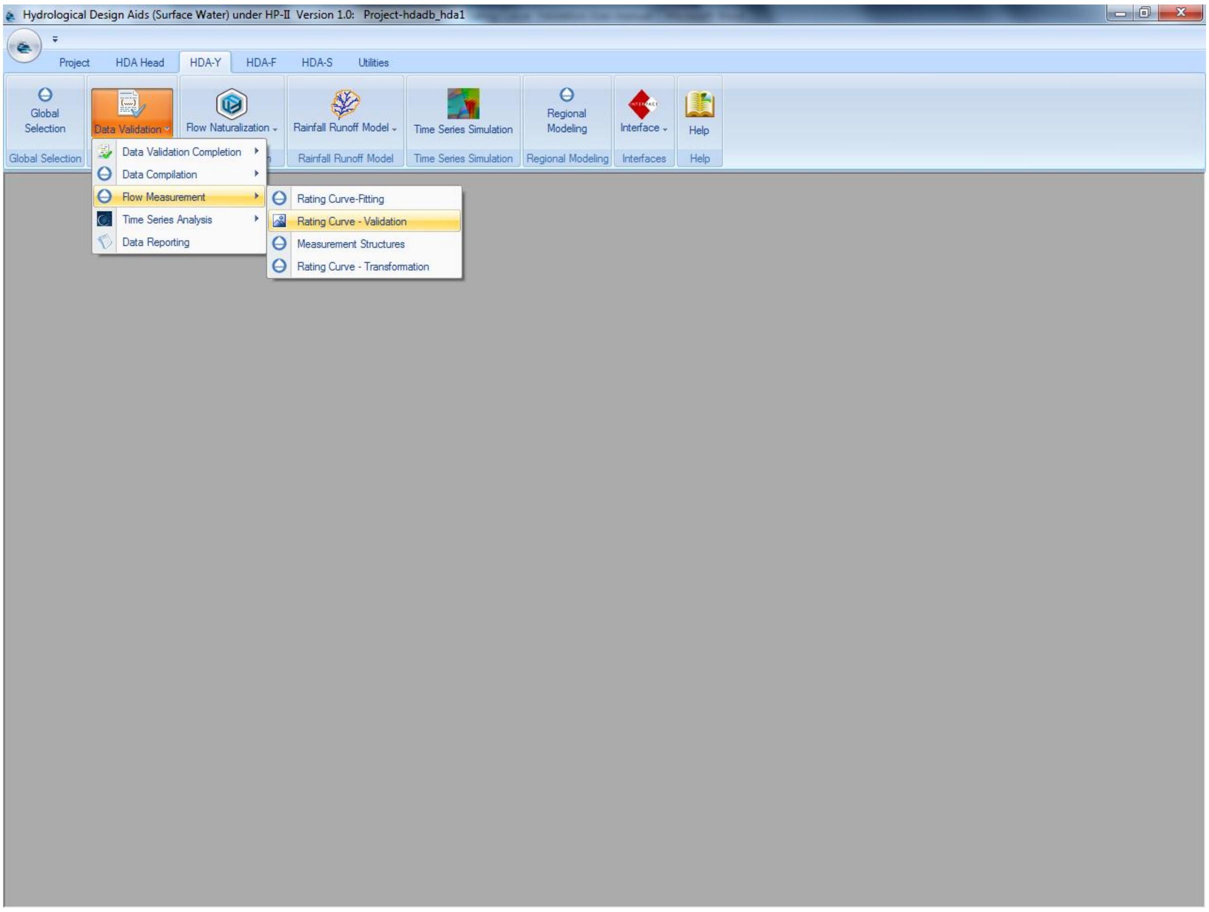
9.2.2. Results are displayed in grid with chart plotted corresponding to it. Also values of Coefficient and Exponent are also displayed.


HDA-Y >> Flow Measurement >> Rating Curve
Rating Curve
Input Data
Simple/Compound RC
Backwater RC
Stage at base gauge h (m)
Stage at auxiliary gauge hs (m)
Fall h-
2.012 1.951
2.036 1.978
2.286 1.996
2.359 2.155
2.755 2.054
2.963 2.347
3.139 2.331
3.206 2.279
5.026 3.429
5.907 3.99
7.013 4.788
7.105 4.923
8.108 6.188
8.638 5.986
11.558 8.678
Coefficient Exponent
109.52 1.136
Save
Chart Formatting
Show Wizard
Show Properties
Show Visual Effects
Reset
y= 109.52x^1.136
Q/sqrt(F)
Stage at base gauge h (m)
Report
Close

5.2. Rating Curve - Validation

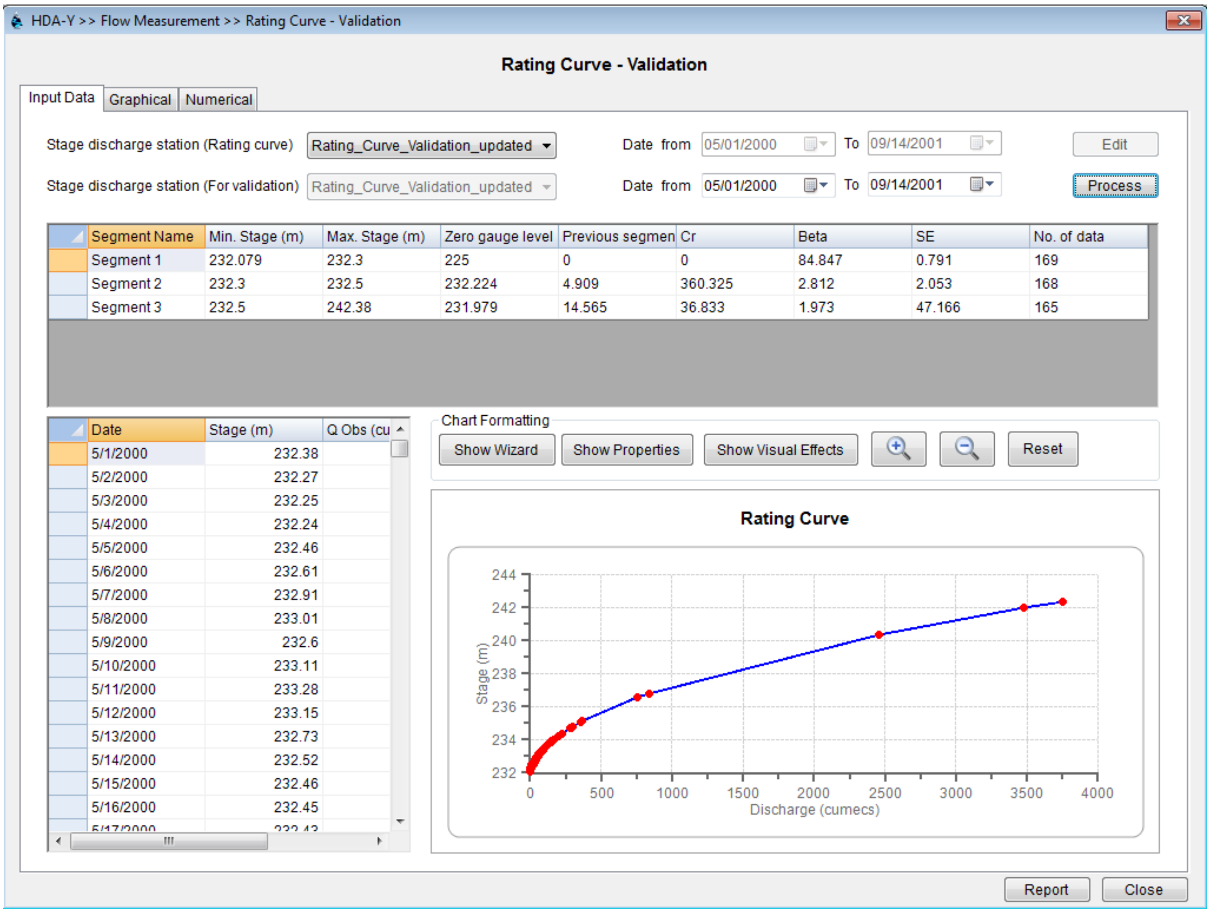
How to Access

HDA-Y >> Flow Measurement >> Rating Curve - Validation

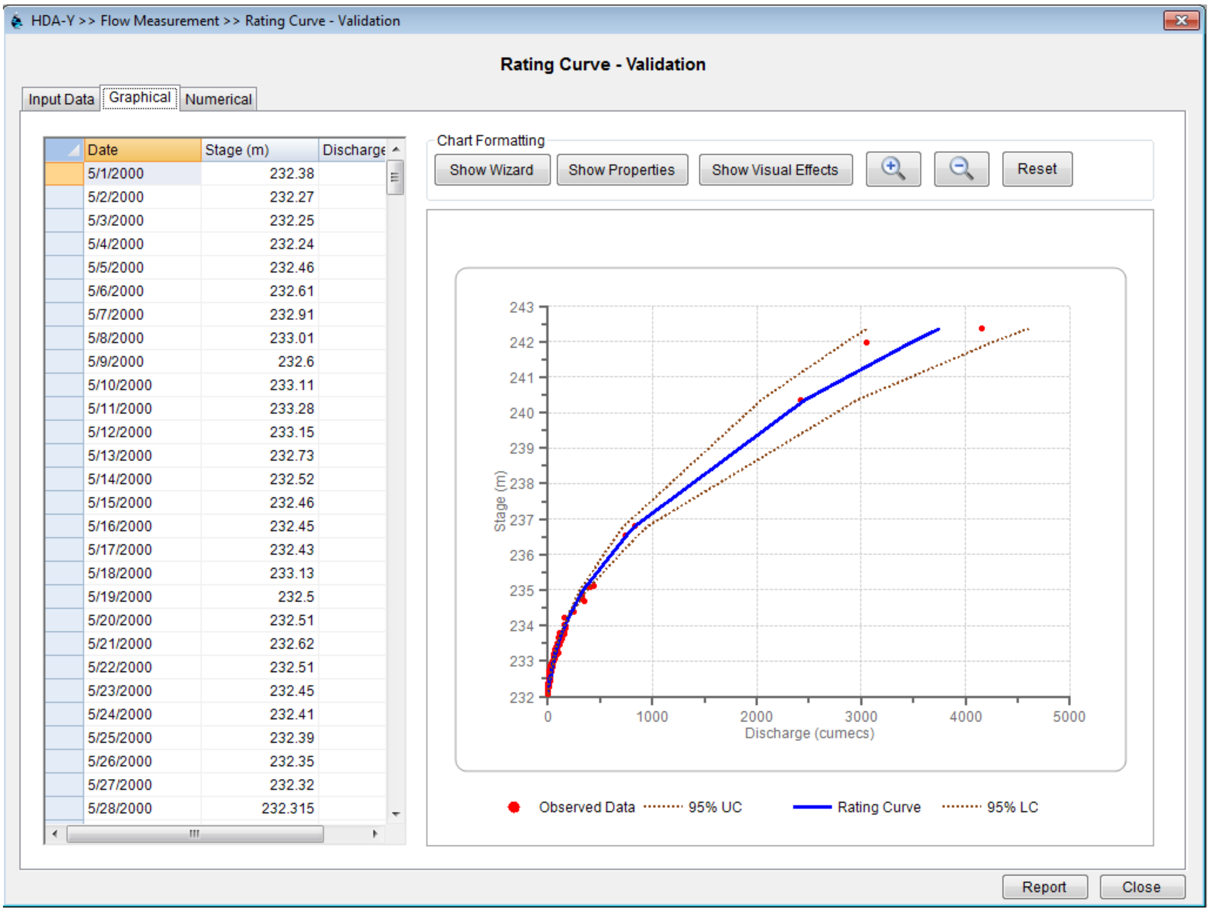


Operations

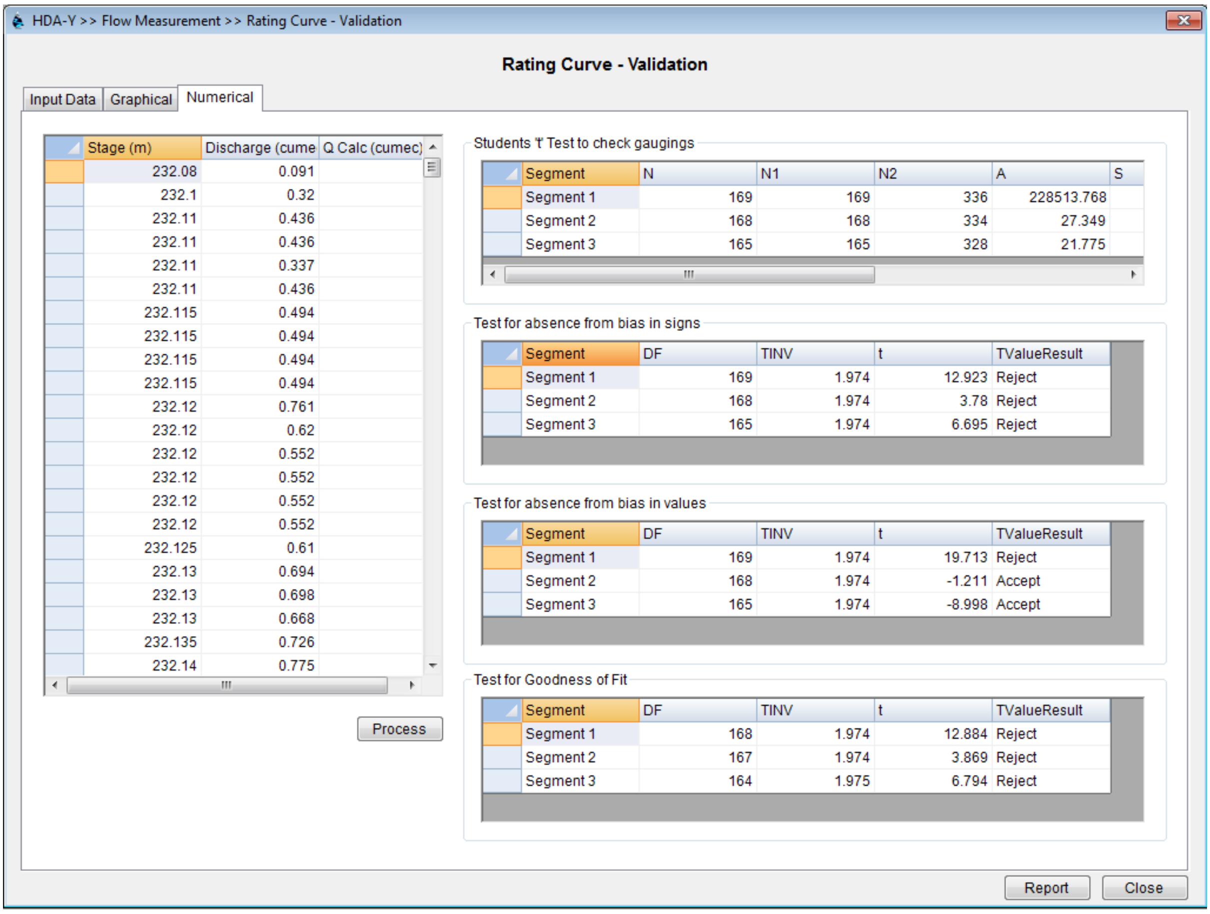
1. Use the menu path defined above to open the Rating Curve-Validation form.
2. In the ***"Input"*** tab section, only those Stage discharge station will be displayed whose Rating Curve has been generated and by default the same station will get selected for performing Validation also.
1. As User selects the Stage discharge station for Rating curve, the date get binds into the date picker for which rating curve has been generated. User can change date range for performing Validation.
1. Now User clicks on ***"Process"*** button and data related to Rating curve is displayed in grids and is also plotted on chart.



1. When User clicked ***"Process"*** button, the Graphical validation is done and the calculation for validated data is displayed in ***"Graphical"*** tab with its chart plotted.



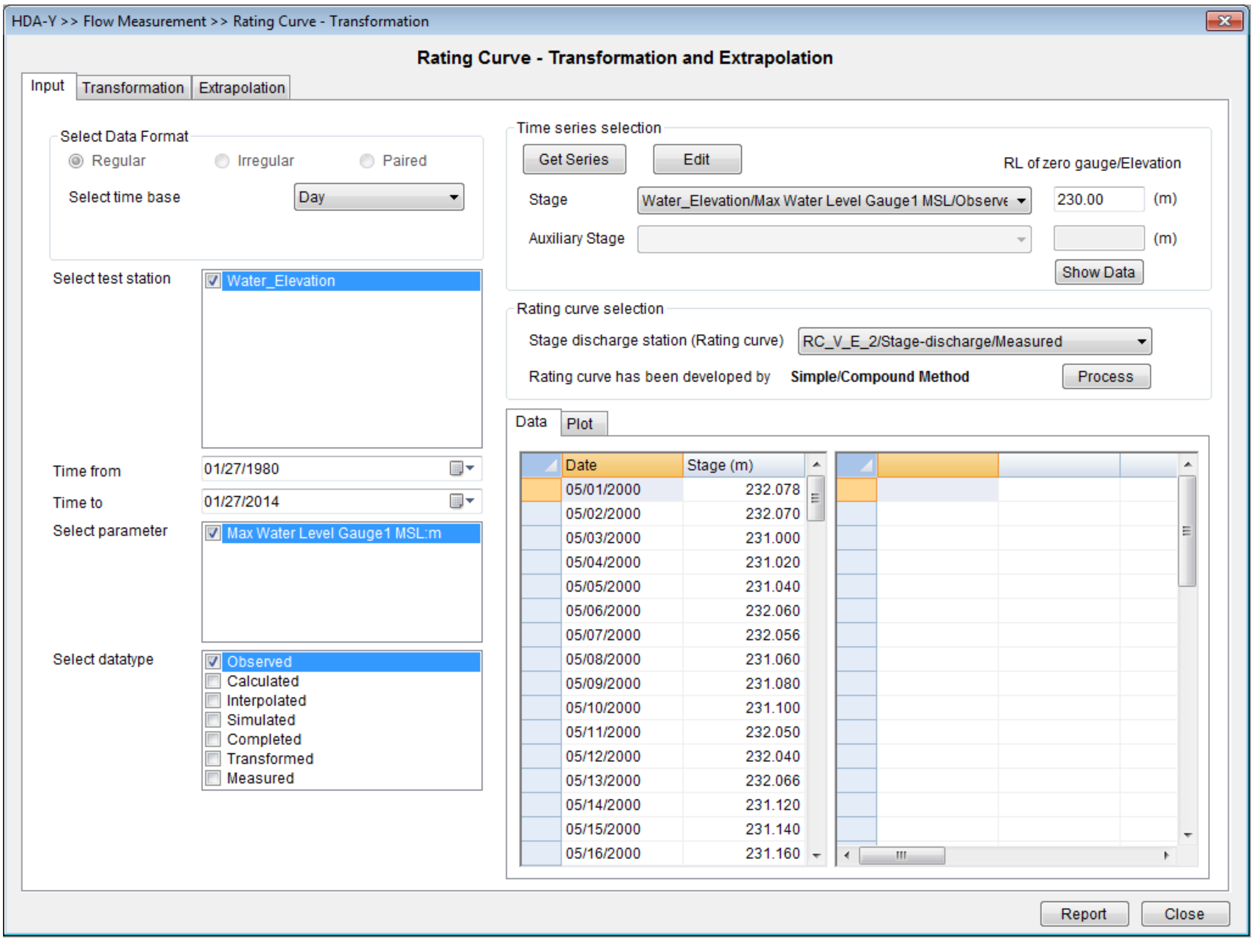
1. For Numerical validation, User has to navigate to ***"Numerical"*** tab in which data has been already displayed in grid. Now User clicks on ***"Process"*** button and the calculation is performed for related test.


HDA-Y >> Flow Measurement >> Rating Curve - Validation
Rating Curve - Validation
Input Data
Graphical
Numerical
Stage (m) Discharge (cume Q Calc (cumec)
232.08 0.091
232.1 0.32
232.11 0.436
232.11 0.436
232.11 0.337
232.11 0.436
232.115 0.494
232.115 0.494
232.115 0.494
232.115 0.494
232.12 0.761
232.12 0.62
232.12 0.552
232.12 0.552
232.12 0.552
232.12 0.552
232.125 0.61
232.13 0.694
232.13 0.698
232.13 0.668
232.135 0.726
232.14 0.775
Process
Students 't' Test to check gaugings
Segment N N1 N2 A S
Segment 1 169 169 336 228513.768
Segment 2 168 168 334 27.349
Segment 3 165 165 328 21.775
Test for absence from bias in signs
Segment DF TINV t TValueResult
Segment 1 169 1.974 12.923 Reject
Segment 2 168 1.974 3.78 Reject
Segment 3 165 1.974 6.695 Reject
Test for absence from bias in values
Segment DF TINV t TValueResult
Segment 1 169 1.974 19.713 Reject
Segment 2 168 1.974 -1.211 Accept
Segment 3 165 1.974 -8.998 Accept
Test for Goodness of Fit
Segment DF TINV t TValueResult
Segment 1 168 1.974 12.884 Reject
Segment 2 167 1.974 3.869 Reject
Segment 3 164 1.975 6.794 Reject
Report
Close

5.3. Rating Curve – Transformation and Extrapolation

How to Access

HDA-Y >> Flow Measurement >> Rating Curve >> Transformation and Extrapolation



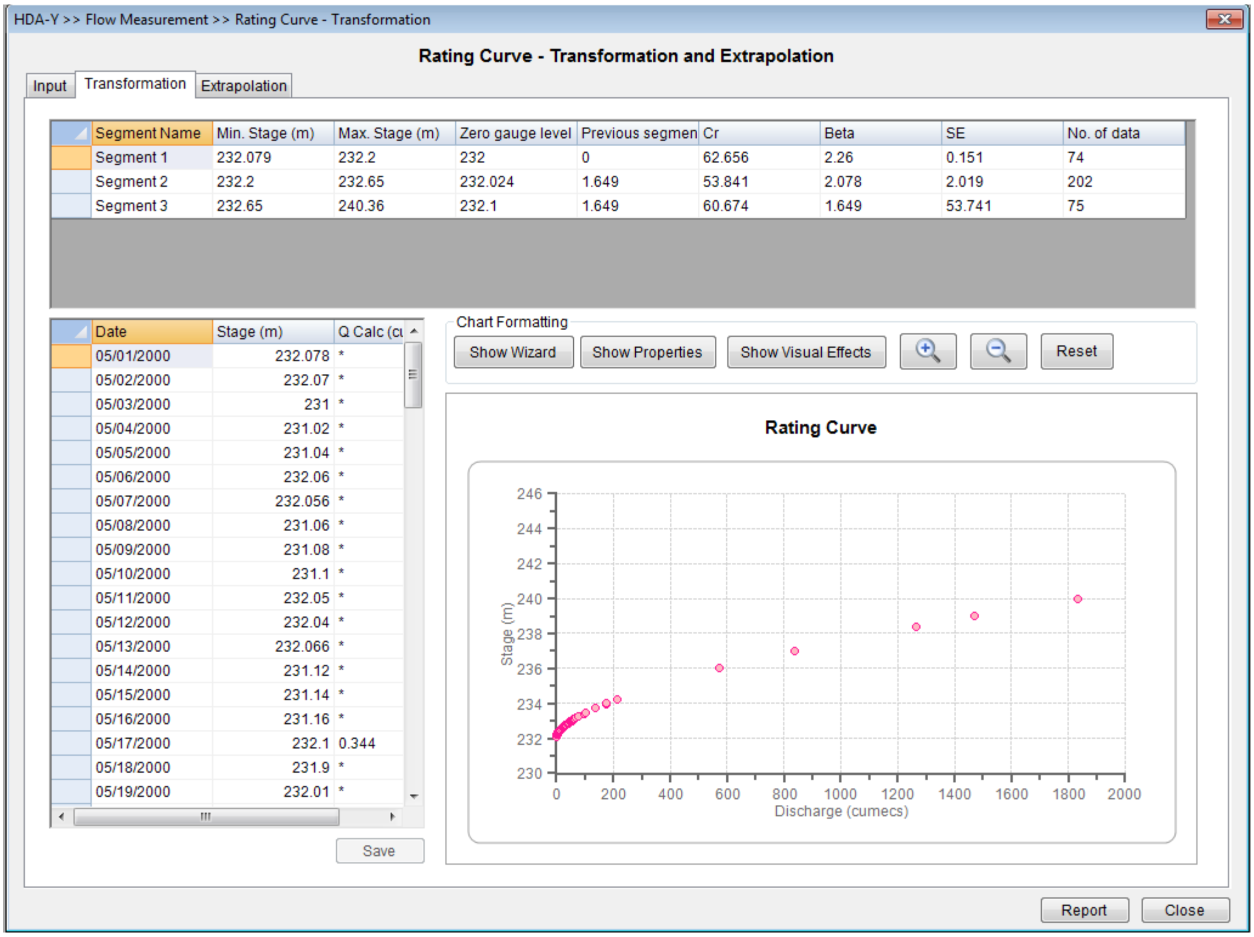
Operations

Use the menu path defined above to open the Rating Curve Transformation and Extrapolation

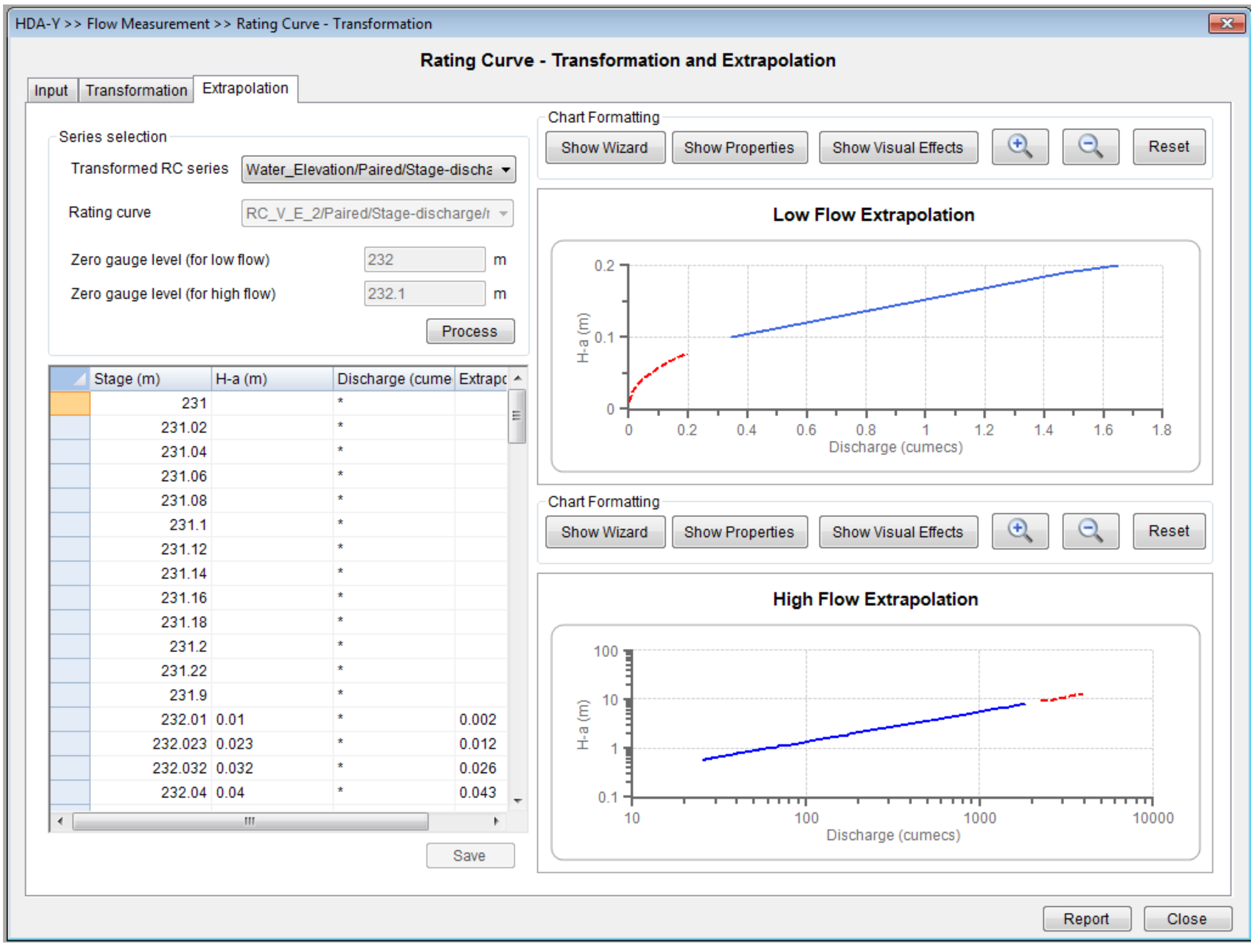
1. In the "***Select Data Format***" section:
   a) Select Data Format.
   b) The time base associated with the selected data format is displayed in the "Select Time Base" section. Select appropriate time base from dropdown.
   c) The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
2. Click on 

 button, Max Water Level Gauge1 MSL data time series descriptor will be filled in the Stage Dropdown for which transformation has to be performed. If transformation is required to done with the Backwater analysis then Auxilary Stage is also required, so user can select the Auxilary Stage from Auxilary Stage dropdown.
3. Click on ***"Show Data"*** button will display the data nad plot for the corresponding selected series.
4. Select the generated rating curve from the Stage-discharge station (Rating Curve) dropdown.

5. Click on ***"Process"*** button will calculate the discharge respective to the selected stage data, which is displayed in transformation tab.



6. In the Extrapolation tab select the Transformed Rating Curve series from the Transformed RC series dropdown.
7. Click on ***"Process"*** button will calculate the discharge as low flow and and high flow and also displayed on the plots.
8. On click of "Save" button stage dischage series will be saved in the database with the same station name as of the stage data staion name.

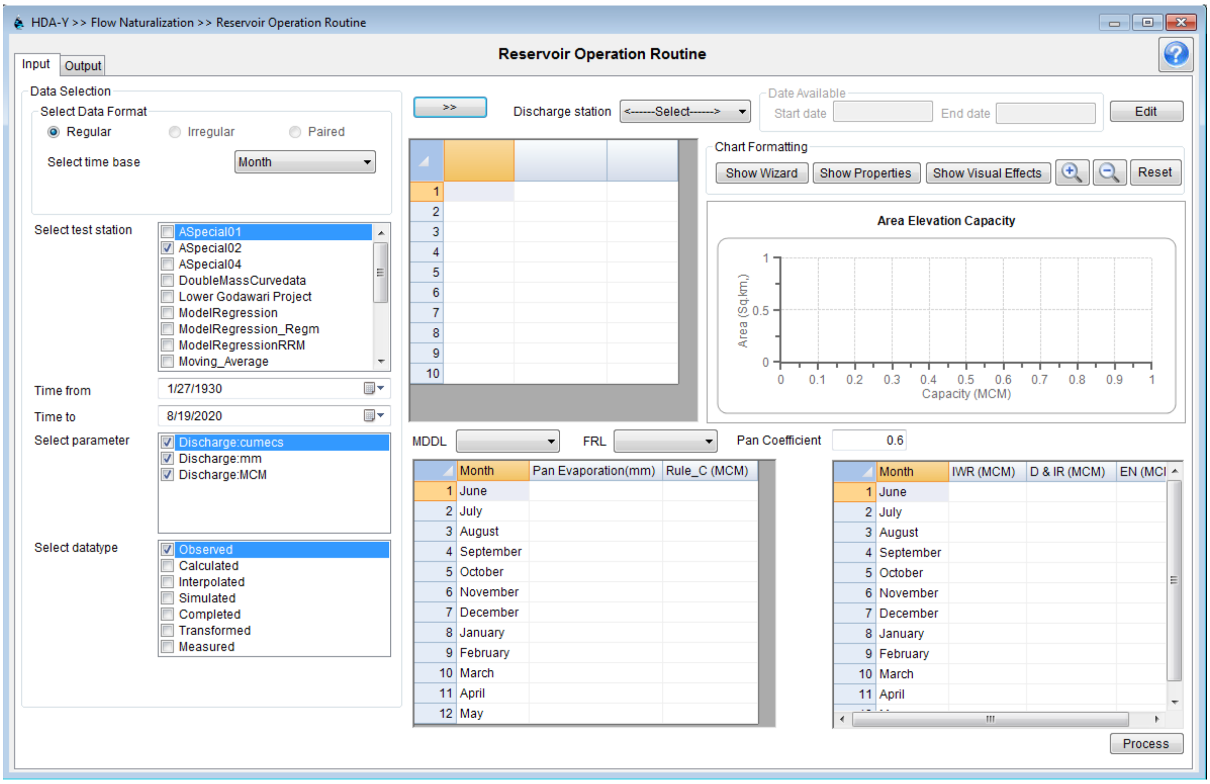

HDA-Y >> Flow Measurement >> Rating Curve - Transformation
Rating Curve - Transformation and Extrapolation
Input
Transformation
Extrapolation
Series selection
Transformed RC series
Water_Elevation/Paired/Stage-discha
Rating curve
RC_V_E_2/Paired/Stage-discharge/
Zero gauge level (for low flow)
232
m
Zero gauge level (for high flow)
232.1
m
Process
Stage (m)
H-a (m)
Discharge (cume
Extrapc
231
231.02
231.04
231.06
231.08
231.1
231.12
231.14
231.16
231.18
231.2
231.22
231.9
232.01 0.01 0.002
232.023 0.023 0.012
232.032 0.032 0.026
232.04 0.04 0.043
Save
Chart Formatting
Show Wizard
Show Properties
Show Visual Effects
Reset
Low Flow Extrapolation
H-a (m)
Discharge (cumecs)
High Flow Extrapolation
Report
Close

6. Flow Naturalization

6.1. Reservoir Operation Routine

How to Access

HDA-Y >> Flow Naturalization >> Reservoir Operation Routine

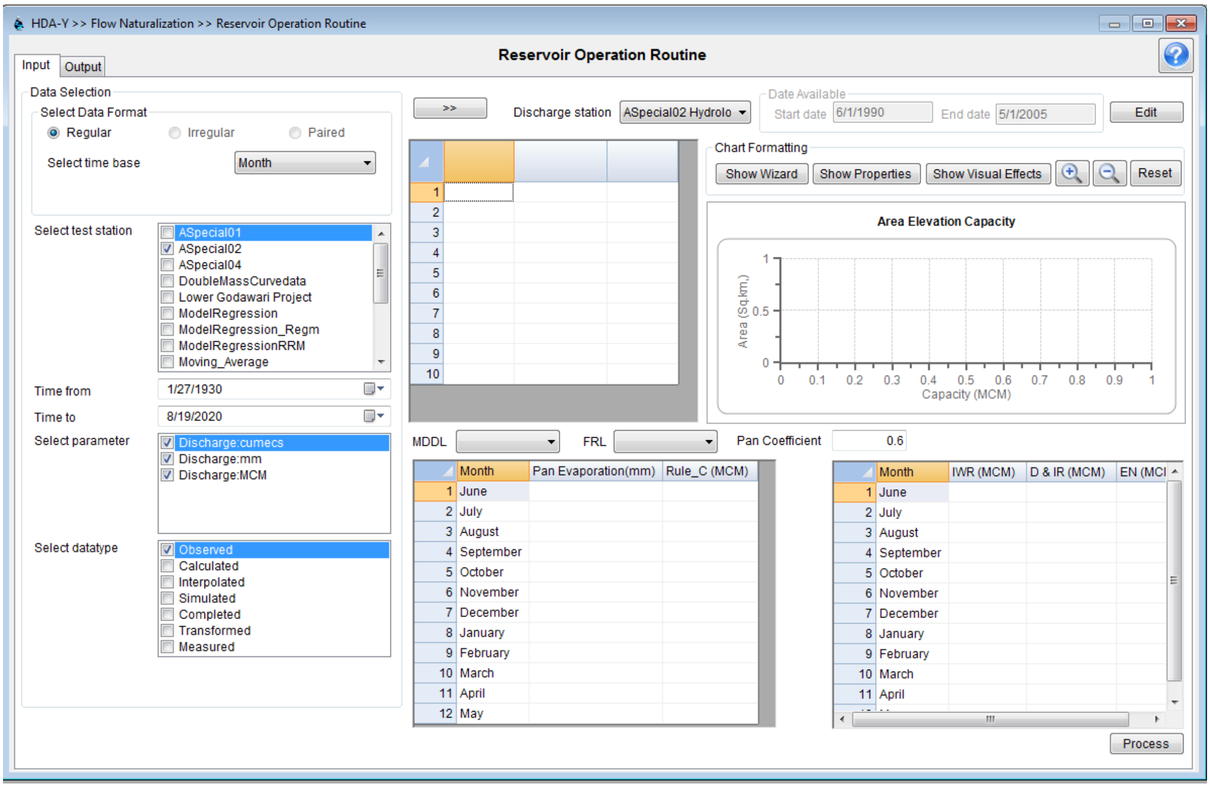


Operations

Use the menu path defined above to open the Reservoir Operation Routine.

9. In the “***Select Data Format***” section:
10. Select Data Format.
11. The time base associated with the selected data format is displayed in the “Select Time Base” section. Select “Month” from dropdown.
12. The stations associated with the time base is displayed in the “Select Station” and its corresponding parameters and data type are displayed in “Select Parameter” and “Select Data Type” section.
13. Click on 

button, Dischare station will be filled in corressponding Dropdown.
14. Select Dischare station from dropdown, the date available (start and end date) of corressponding station data series will be display in date available box.
15. ***“Edit”*** button- it is used for enable Reservoir Operation Routine window- For details description Please go to Step 8.



16. Now in this second Step fill data in all grids.

How to fill data

a. Copy data from excel and after that right click -> on grid to paste data. Or you can enter data manually.

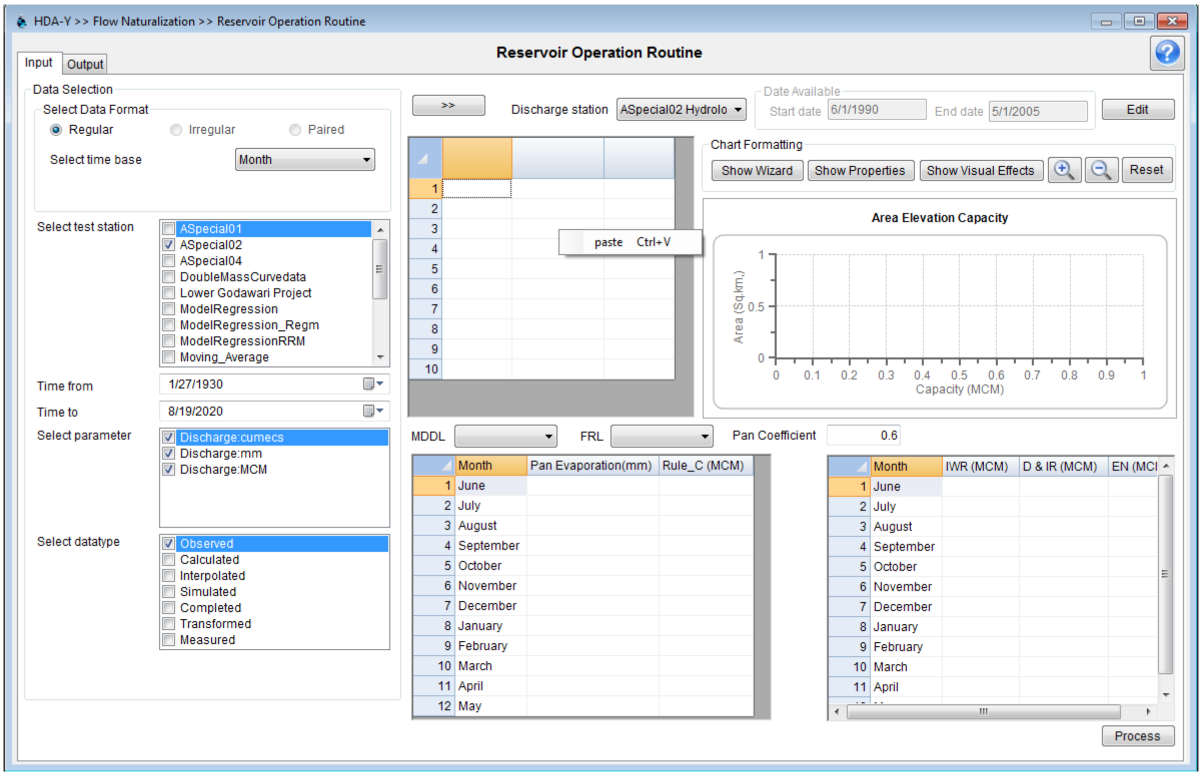
b. When you paste data in grid corresponding graph will show as given below figure. If user want to see the graph in large size please double click on graph area.

c. MDDL and FRL will also fill from capacity (MCM)

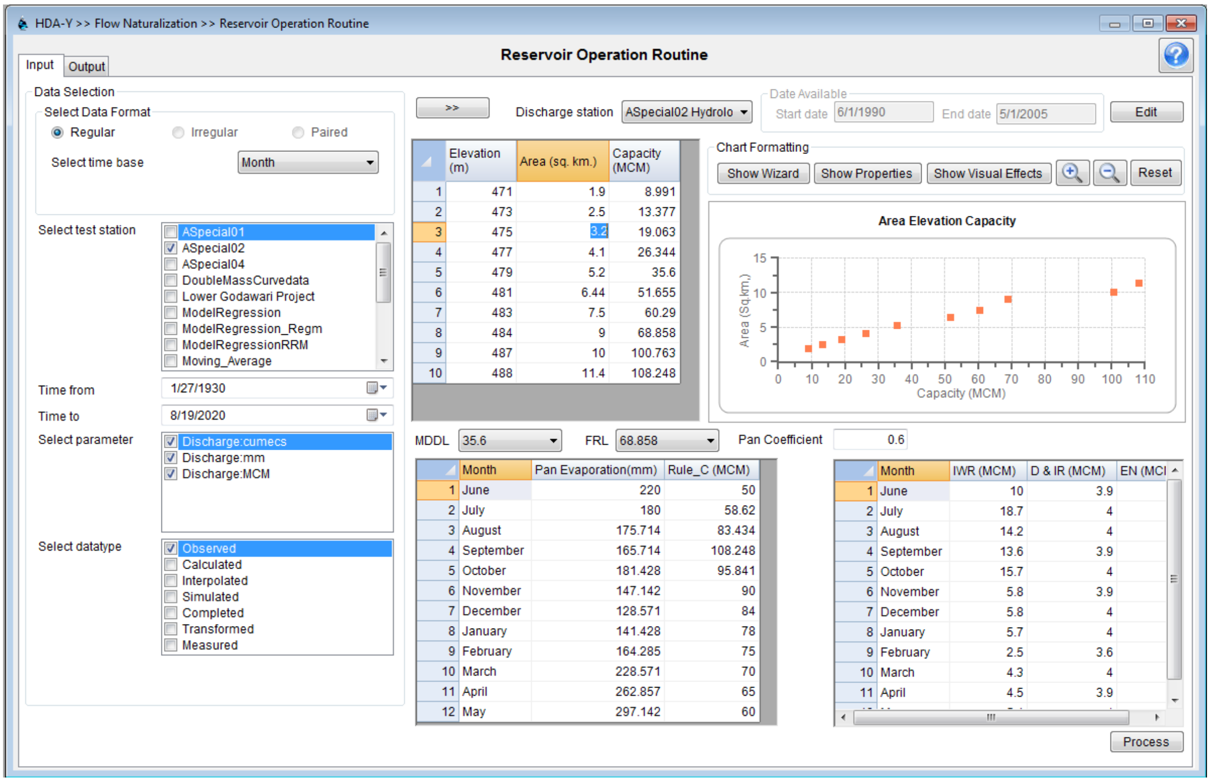
c.1. MDDL selected value is minimum capacity, but user can change.

c.2. FRL selected value is maximum capacity, but user can change.

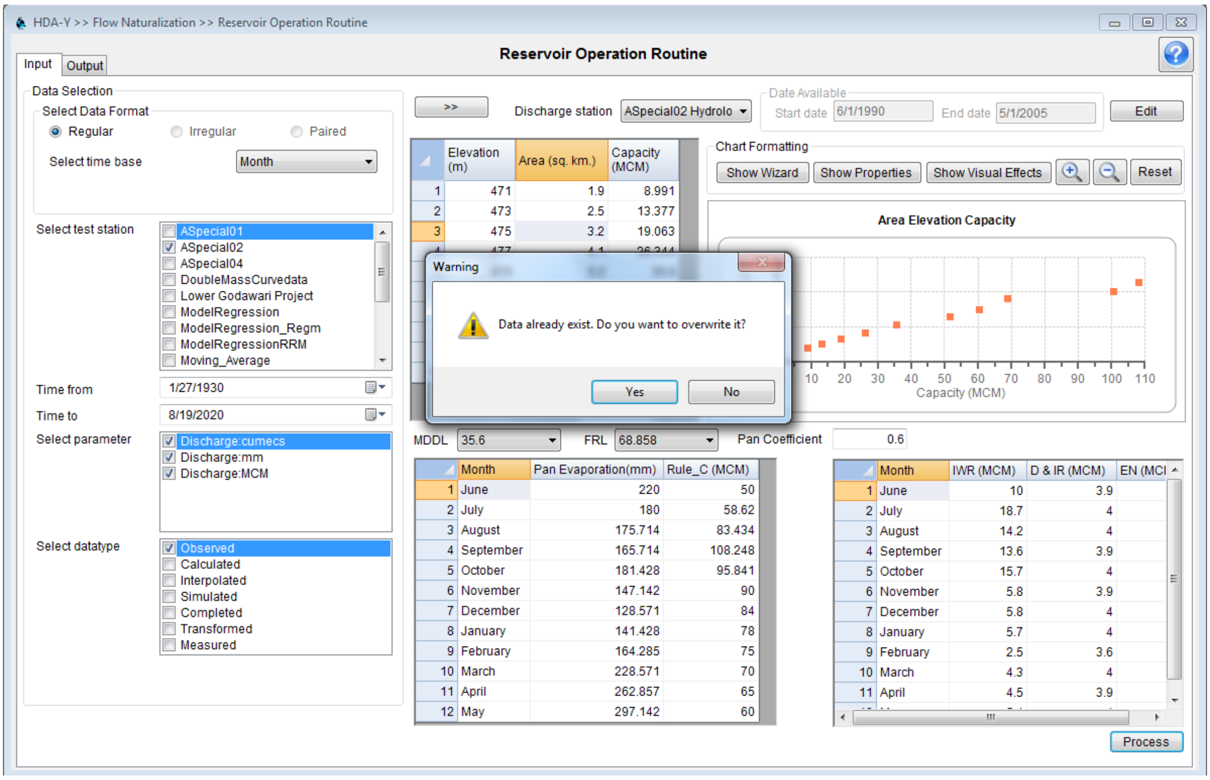
d. Enter pan coefficient value default value is 0.7.



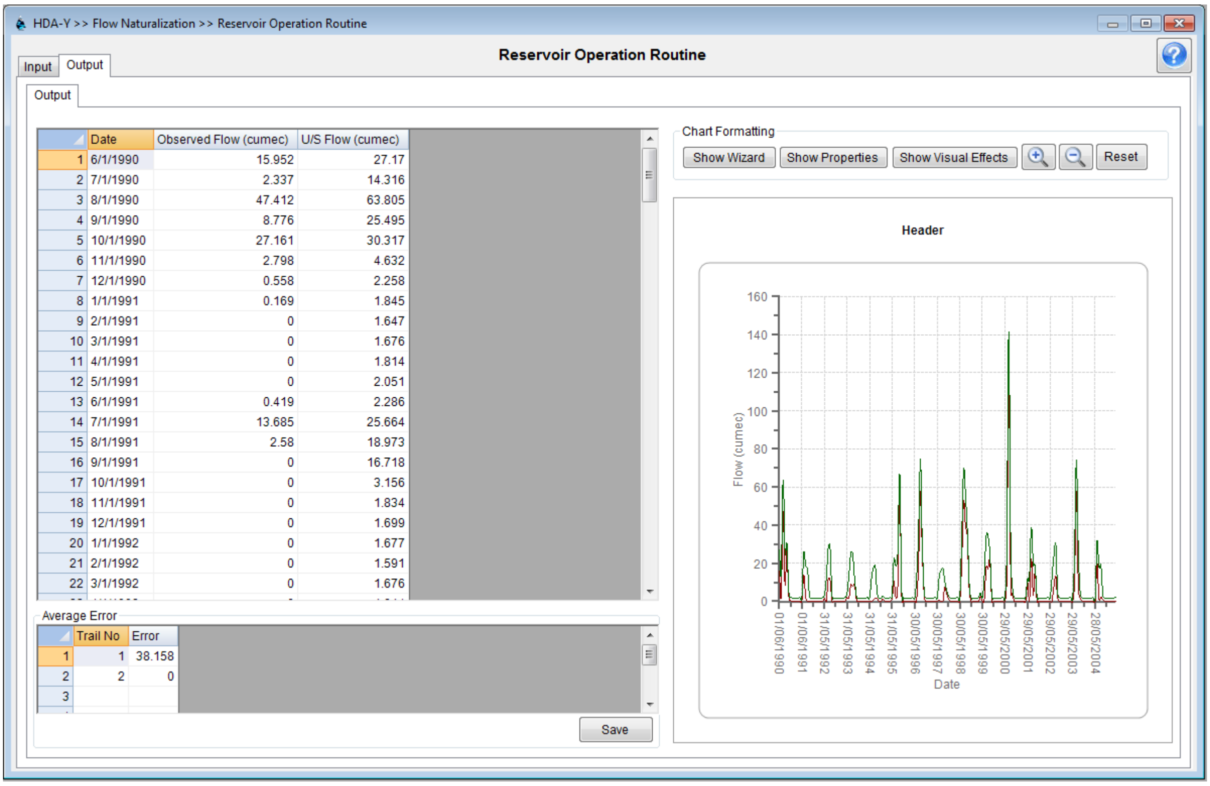
3. In this Step If user want to change some value in grids then he can change to click on grid cell (e.g. row-3), after final change click on process button.



4. If data already exist then a warning message will show, otherwise warning message will not show



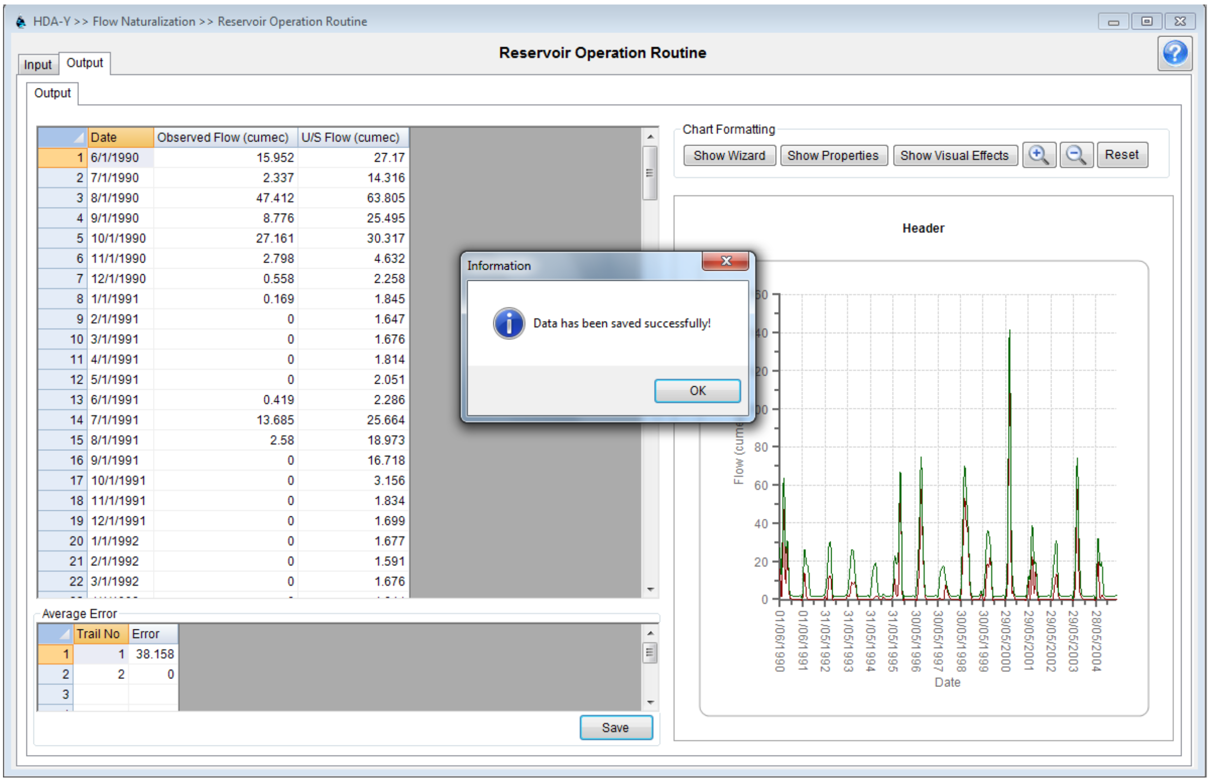
5. Calculation performs internally, and output tab will open. Please see the figure given bellow



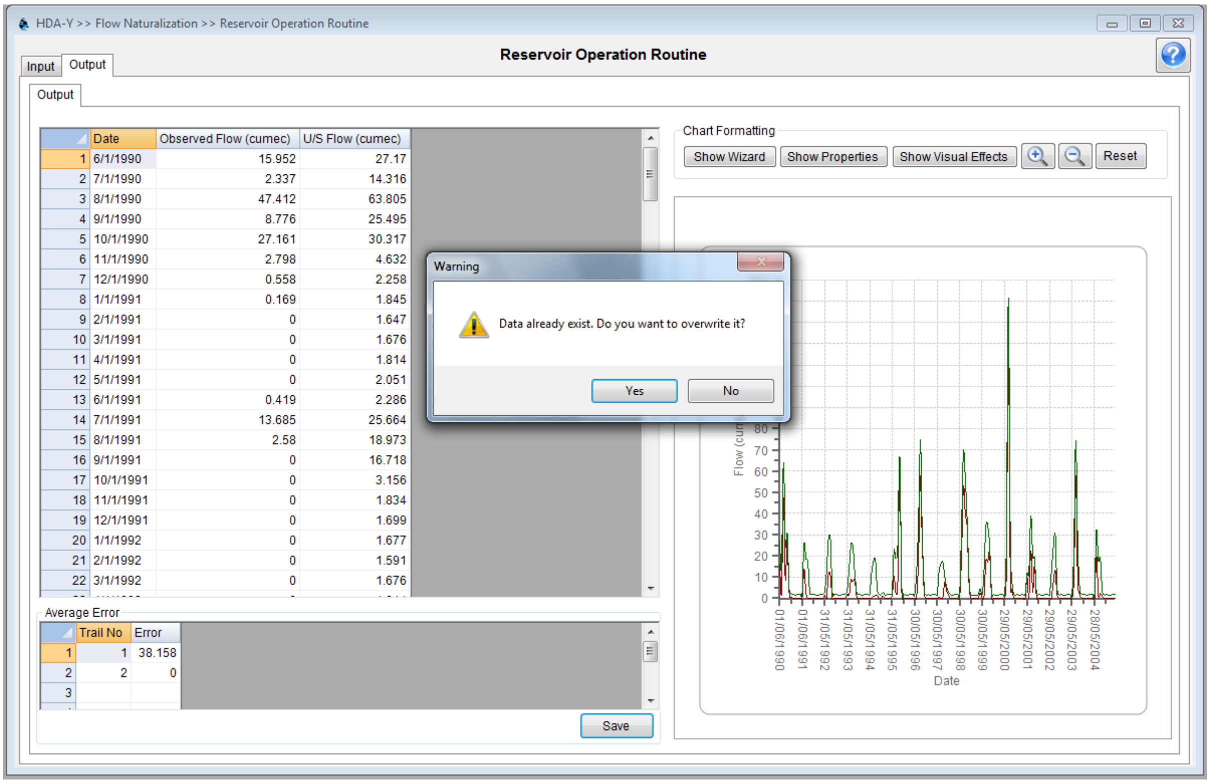
6. Here in this tab output data will display with corresponding graph and average error.

7. Now you can save data, click on Save button 

When you click on save button data will save and the message window will show.



8. In this message window when you click on "***OK"*** button Reservoir Operation Routine will become disable, if you want to perform this operation again, Please go input tab and click on "***Edit"*** button, Reservoir Operation Routine window will be enables and after that user can perform the operation as above instructions.
9. If data already saved then a warning message will show "Data already exist. Do you want to overwrite it", if you click on "***Yes"*** button previous data will overwrite by newly calculated data, and if you click on "**No"** then previous data will remain.

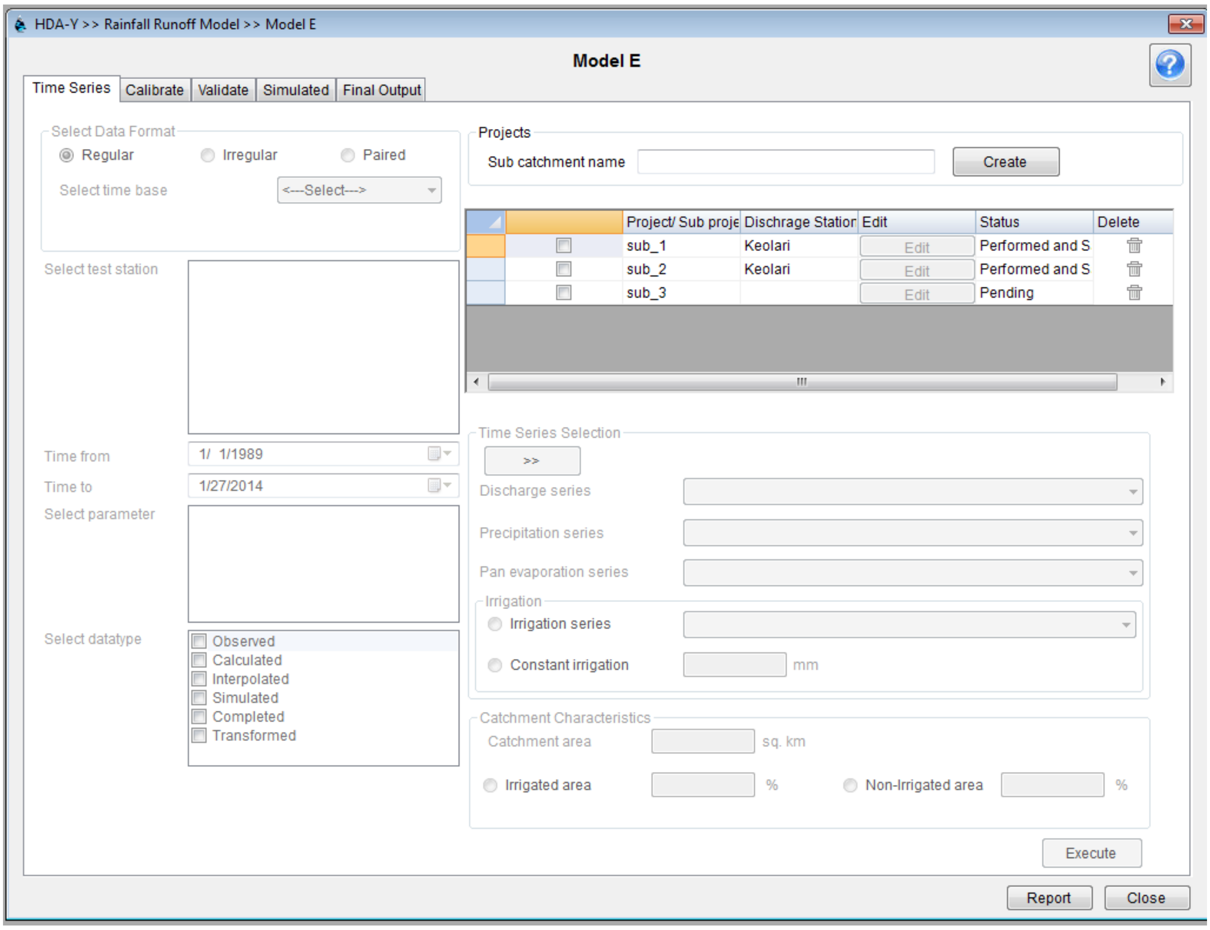

HDA-Y >> Flow Naturalization >> Reservoir Operation Routine
Reservoir Operation Routine
Input
Output
Chart Formatting
Show Wizard
Show Properties
Show Visual Effects
Reset
Warning
Data already exist. Do you want to overwrite it?
Yes
No
Average Error
Save
Date

7. Rainfall Runoff Model

7.1. Model E

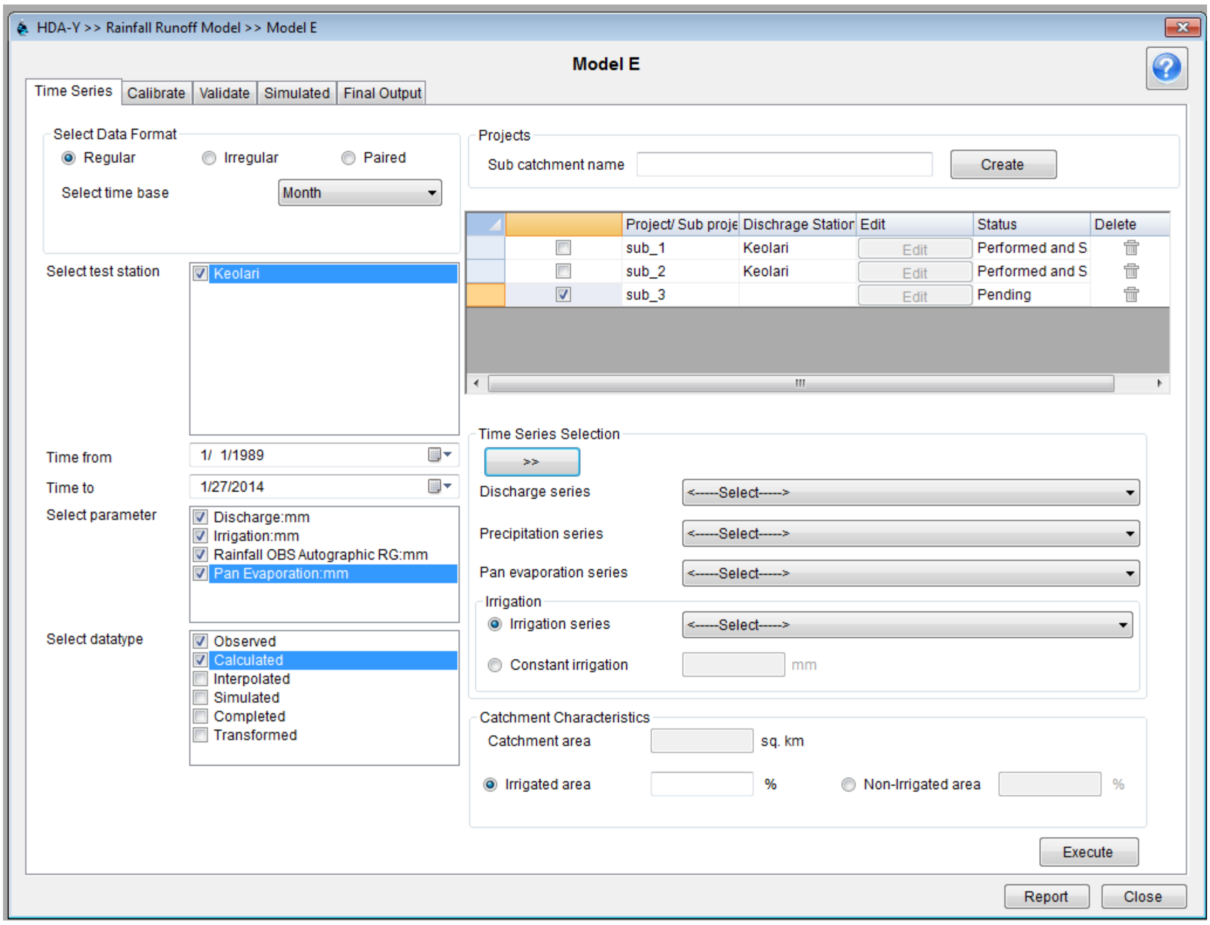
How to Access

HDA-Y >> Rainfall Runoff Model >> Model E

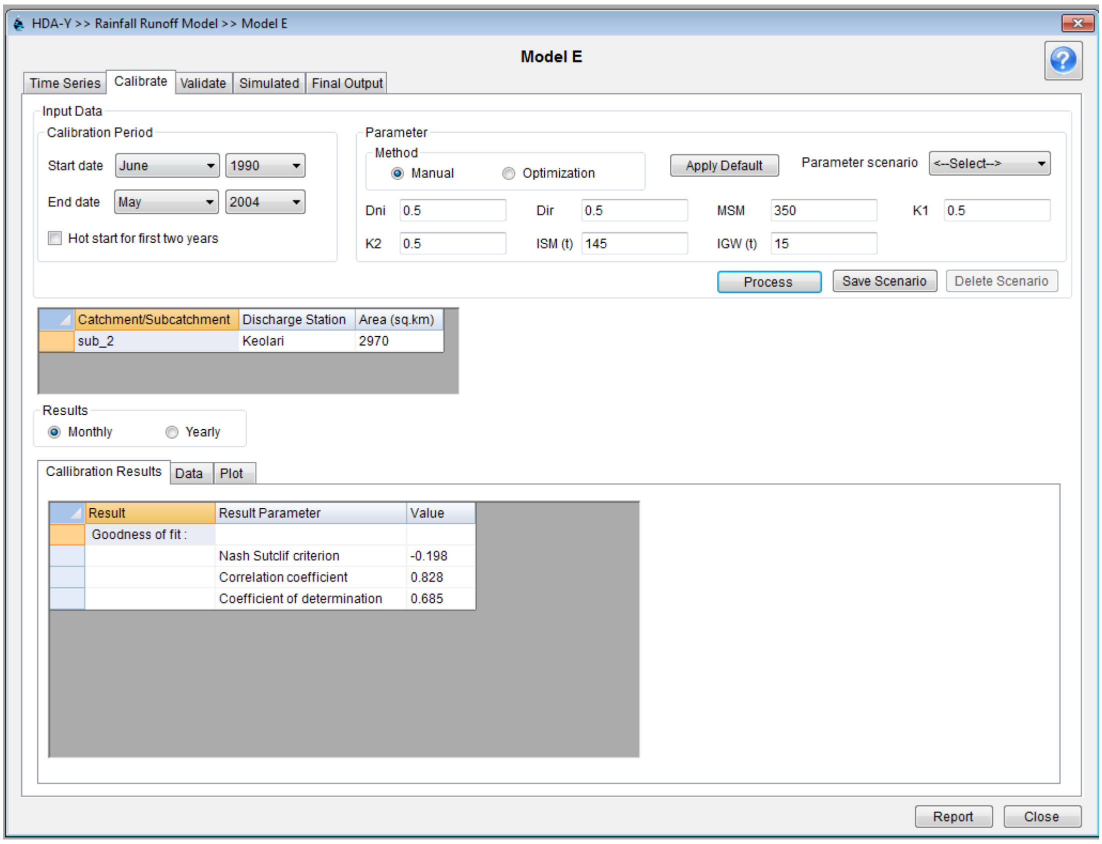


Operations

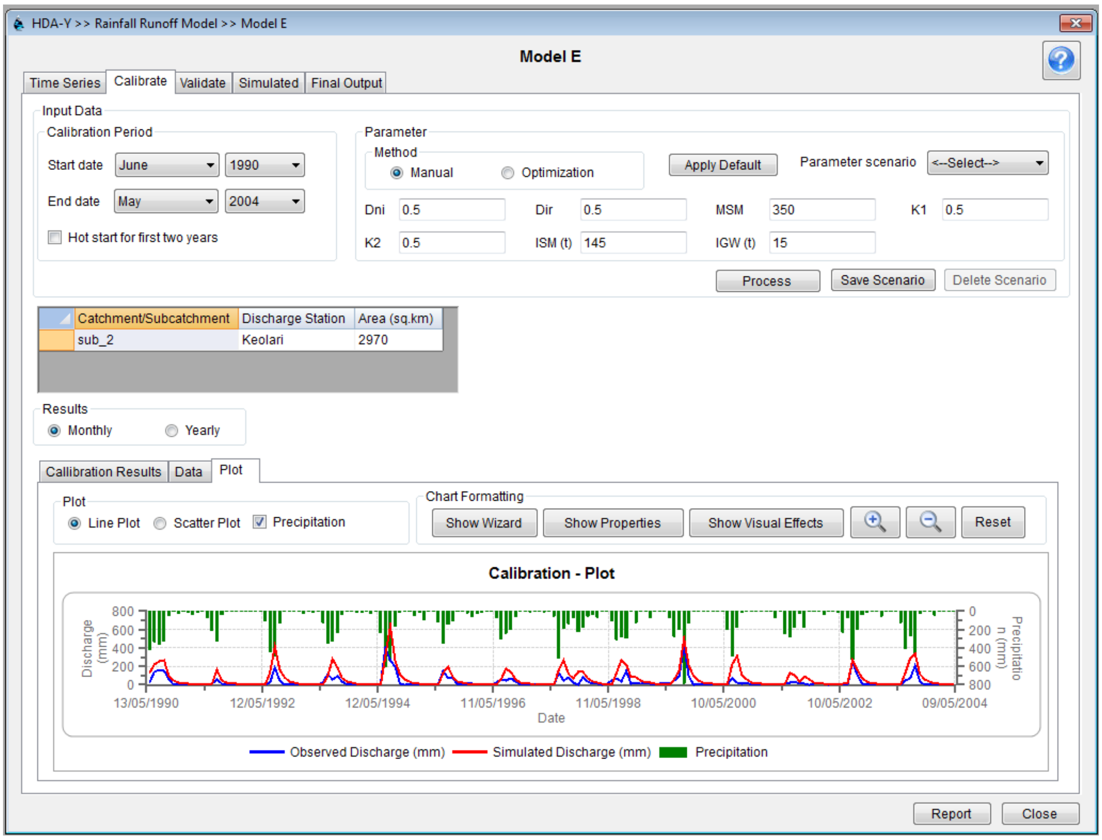
1. Use the menu path defined above to open the Model E form.
2. First Step is to create the sub catchment by giving sub catchment name.

a. 

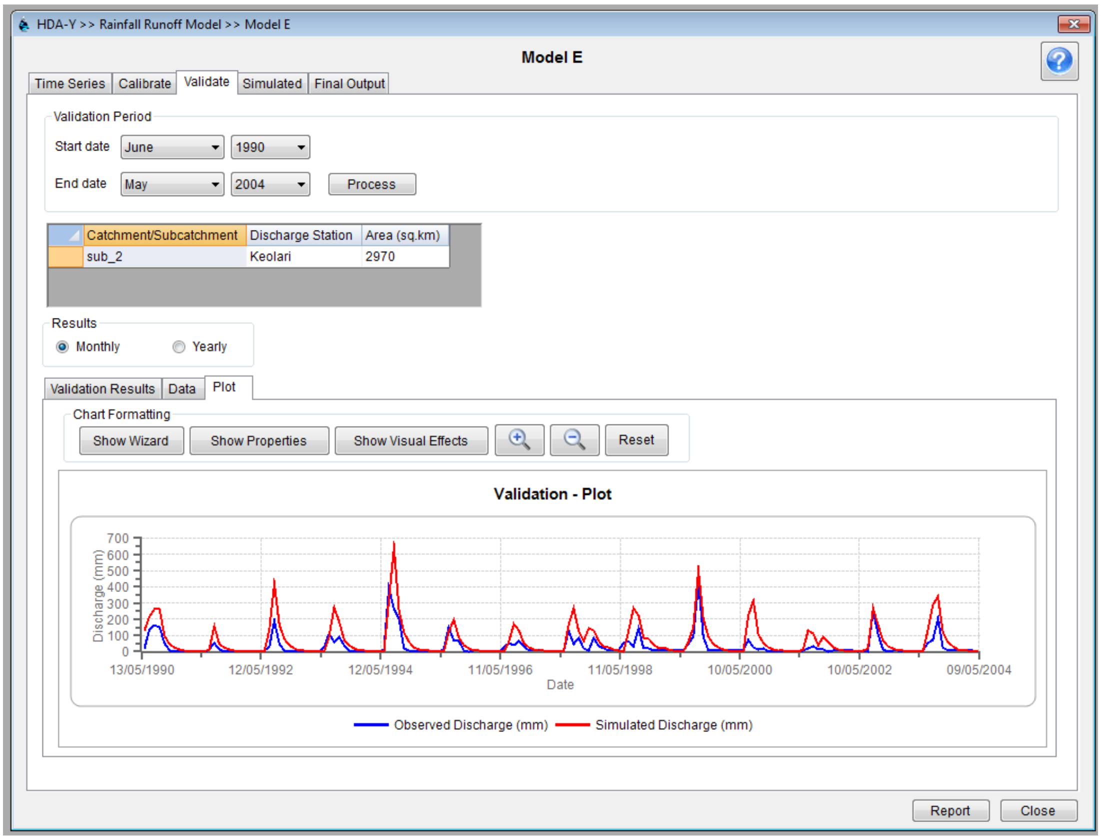
3. The status of newly formed sub catchment will be as "Pending" and will be by default checked. All the selections and calculations will be for checked sub catchment.
4. In the "***Select Data Format***" section:
   a. Select Data Format.
   b. The time base associated with the selected data format is displayed in the "Select Time Base" section. Select "Day" from dropdown.
   c. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
   d. Click the button ***">>"*** to get the series descriptor in combo boxes.
5. Click dropdown of Discharge time series to select discharge time series.
6. Click dropdown of Precipitation time series to select precipitation time series.
7. Click dropdown of Pan Evaporation time series to select pan evaporation time series.
8. Click dropdown of Irrigation time series to select irrigation time series.
9. Click Execute button. Now Calibrate tab will opened as given in the following screen.



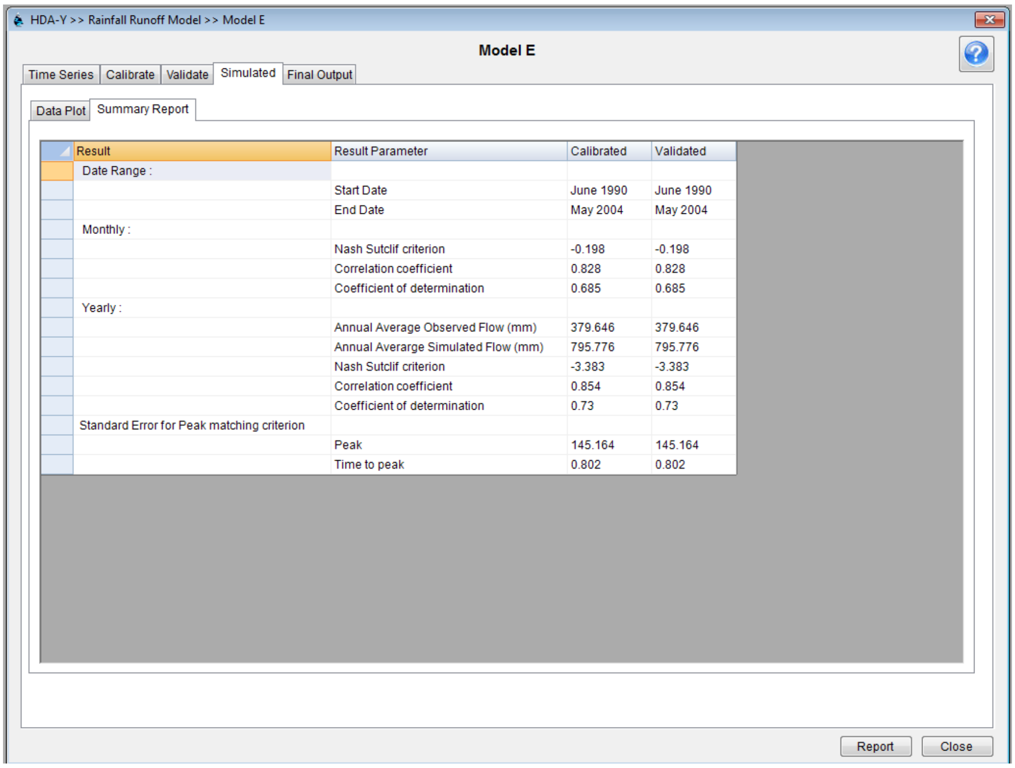
10. Select Calibration period and Method and then click “***Execute”*** button.



11. By default, the results displayed are for daily time period. User can also view for monthly and yearly by the available radio button option.
12. Now if user wants to perform validation, then user can perform validation from ***"Validate"*** tab or can directly proceed for simulation.

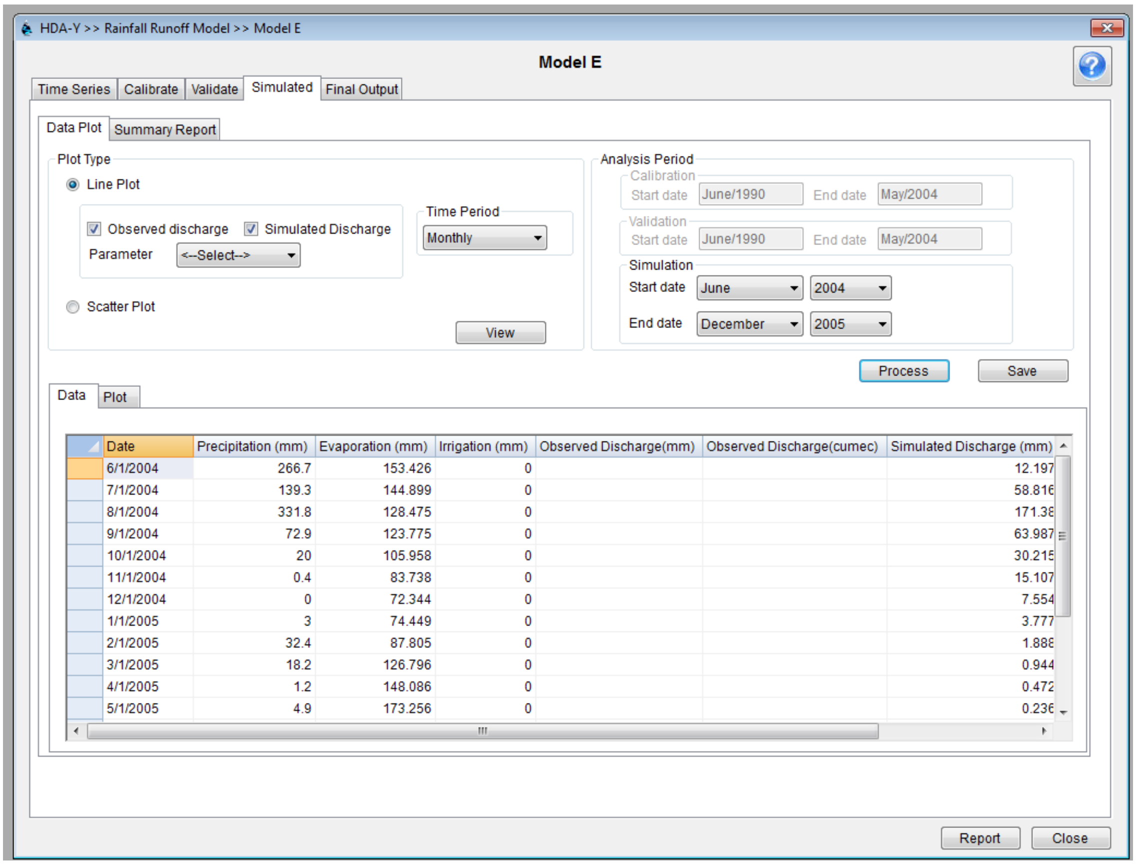


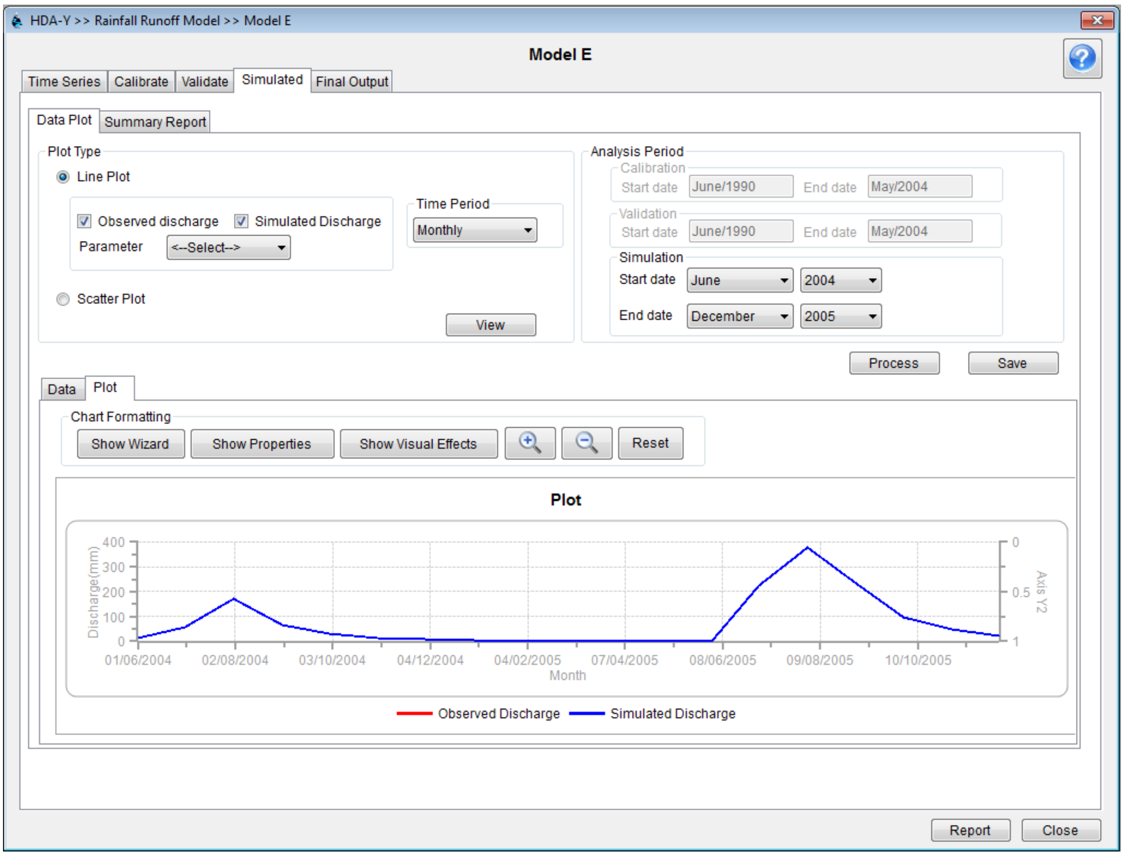
13. Simulation tab consist of two tabs: Summary Tab & Data and Plot
14. Summary result for calibration and validation is shown in summary tab.



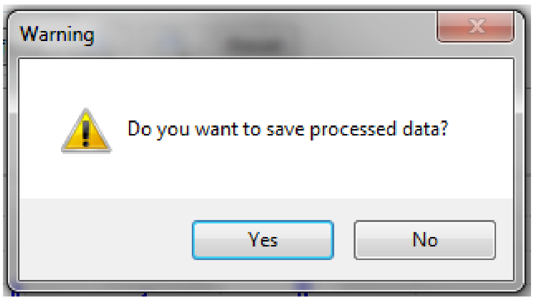
Result	Result Parameter	Calibrated	Validated
Date Range :			
	Start Date	June 1990	June 1990
	End Date	May 2004	May 2004
Monthly :			
	Nash Sutclif criterion	-0.198	-0.198
	Correlation coefficient	0.828	0.828
	Coefficient of determination	0.685	0.685
Yearly :			
	Annual Average Observed Flow (mm)	379.646	379.646
	Annual Avergare Simulated Flow (mm)	795.776	795.776
	Nash Sutclif coefficient	-3.383	-3.383
	Correlation coefficient	0.854	0.854
	Coefficient of determination	0.73	0.73
Standard Error for Peak matching criterion			
	Peak	145.164	145.164
	Time to peak	0.802	0.802

15. In Data and Plot tab select plot type and analysis period and then click on ***"Simulate"*** button to perform simulation.

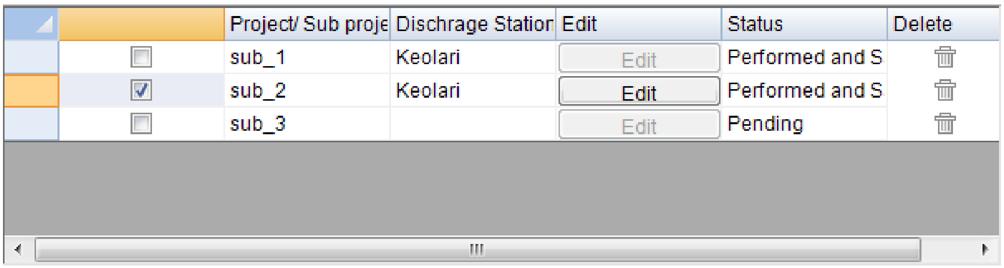




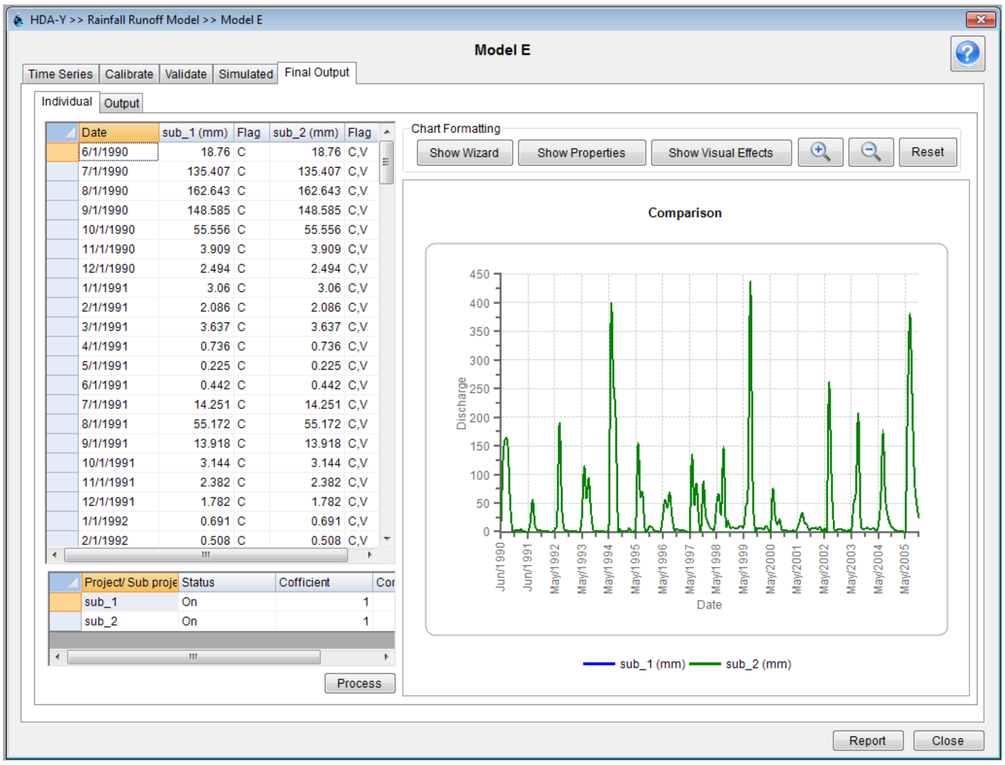
16. On Clicking the ***"Save"*** button the popup will appear.



17. Clicking on ***"Yes"*** button, data will be saved.
18. After the data has been saved successfully the status of subproject changed to "Performed and Saved".

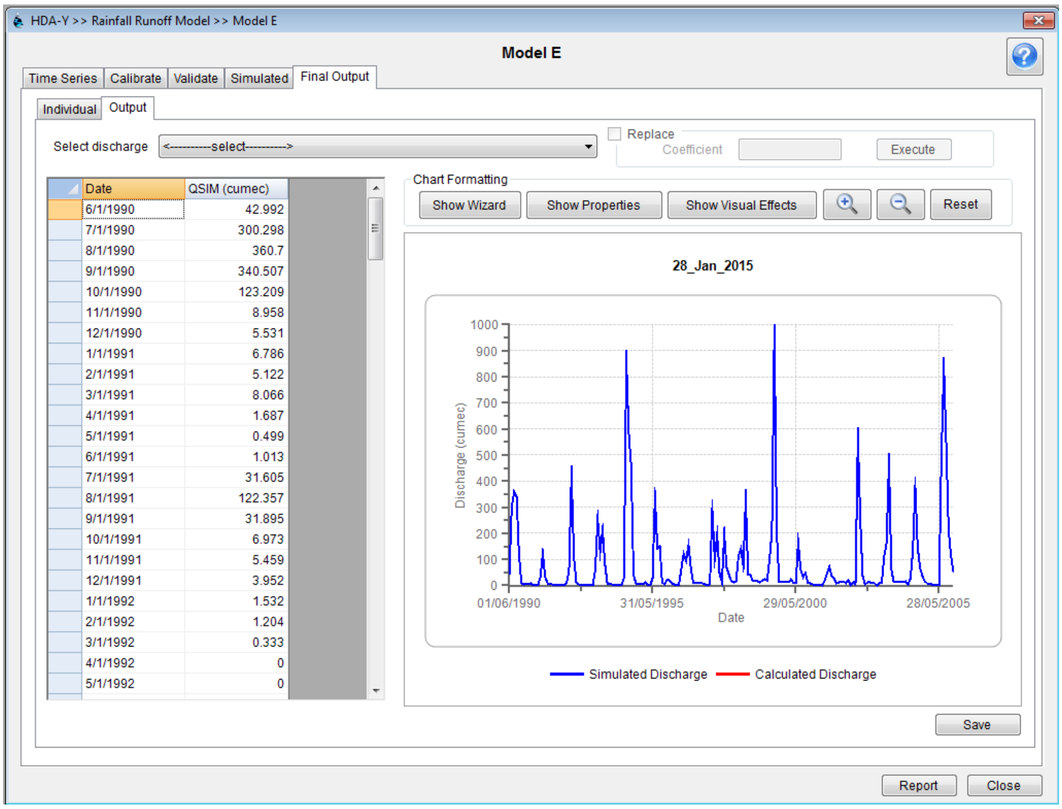


19. After the status of sub catchment changes to "Performed and Saved" the sub catchment can be Edited and Deleted.
20. After the data has been successfully saved, the final tab will be opened.

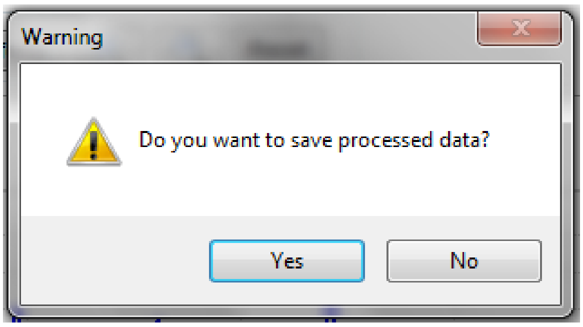


21. Final output tab contains two sub tabs : Individual & Output.
22. In individual tab user can change the status, coefficient and constant.

23. Click ***"Process"*** button to calculate simulated discharge.



24. On Clicking the ***"Save"*** button the popup will appear.

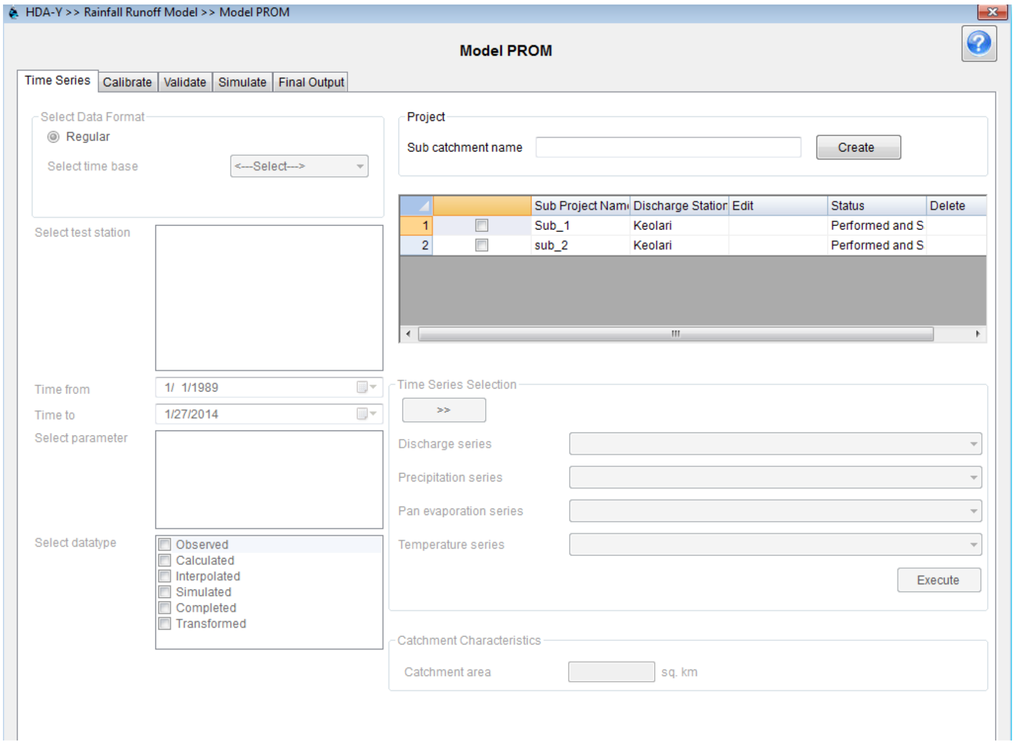


25. Clicking on ***"Yes"*** button, data will be saved as simulated series.

7.2. Model PROM

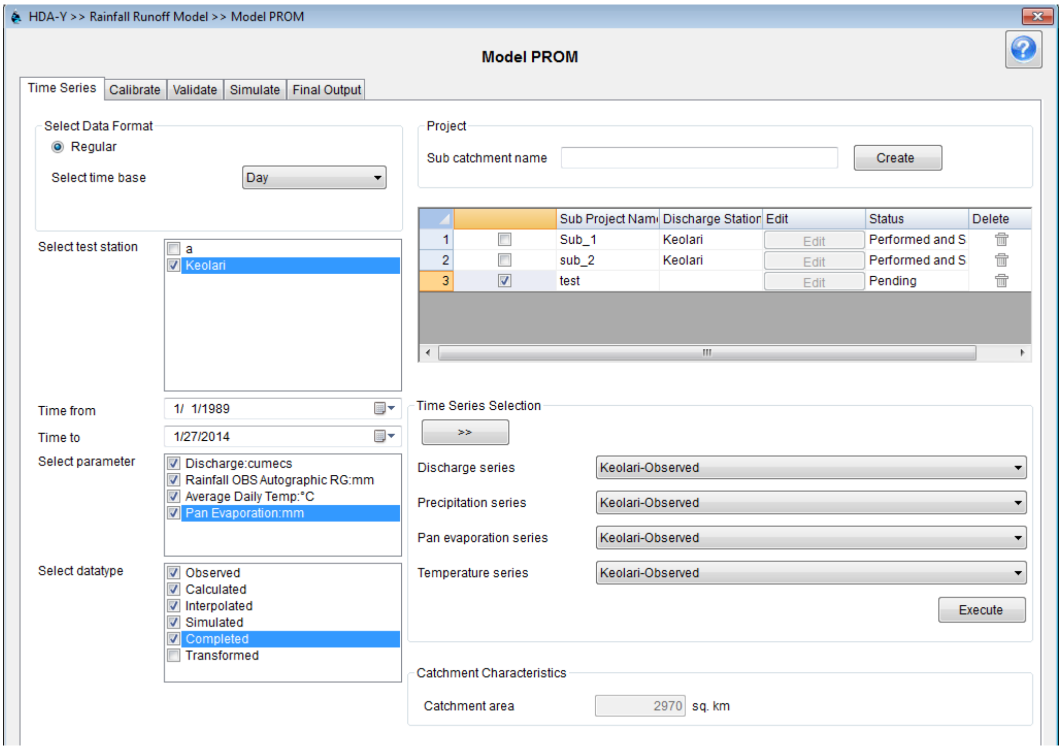
How to Access

HDA-Y >> Rainfall Runoff Model >> Model PROM



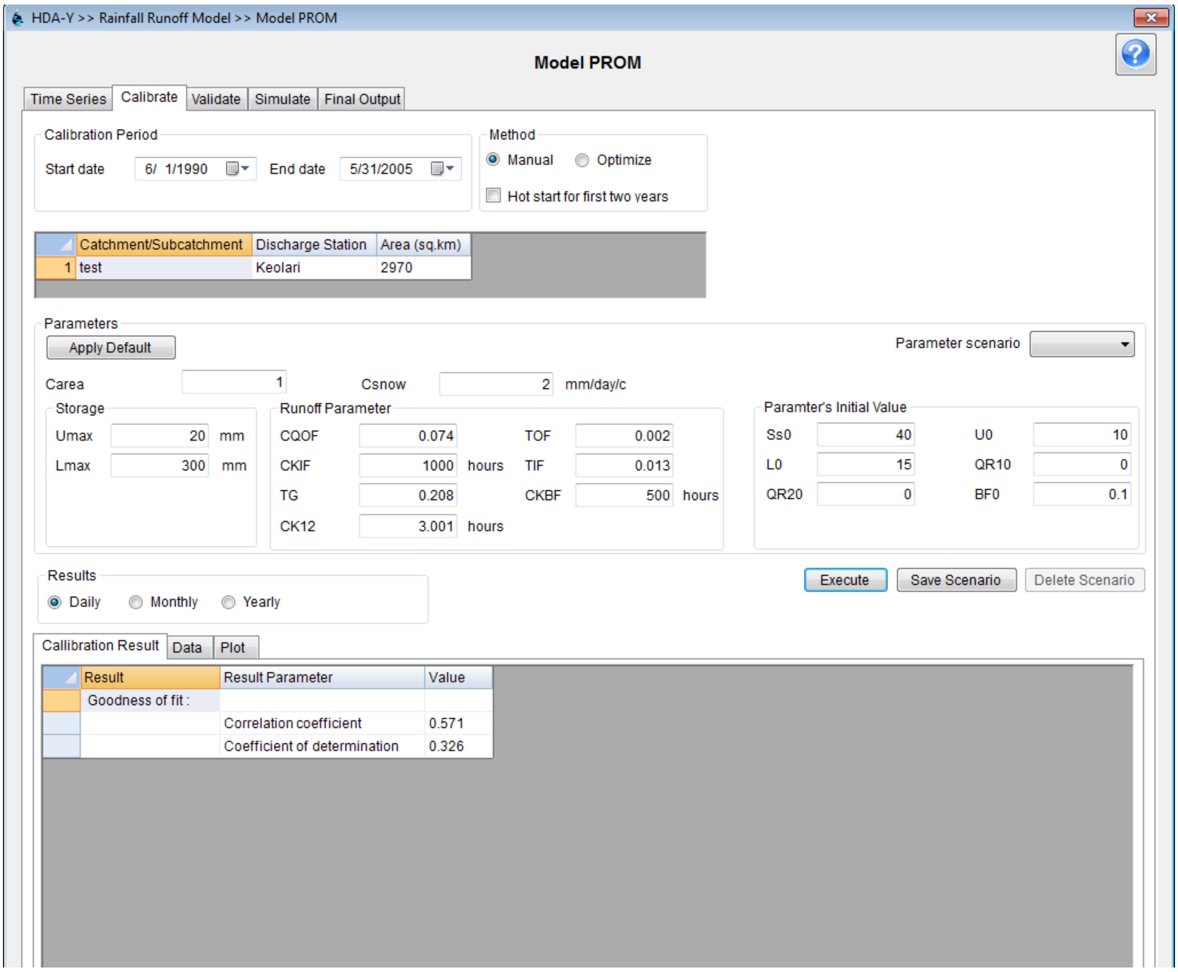
Operations

1. Use the menu path defined above to open the Model PROM form.
2. First Step is to create the sub catchment by giving sub catchment name.

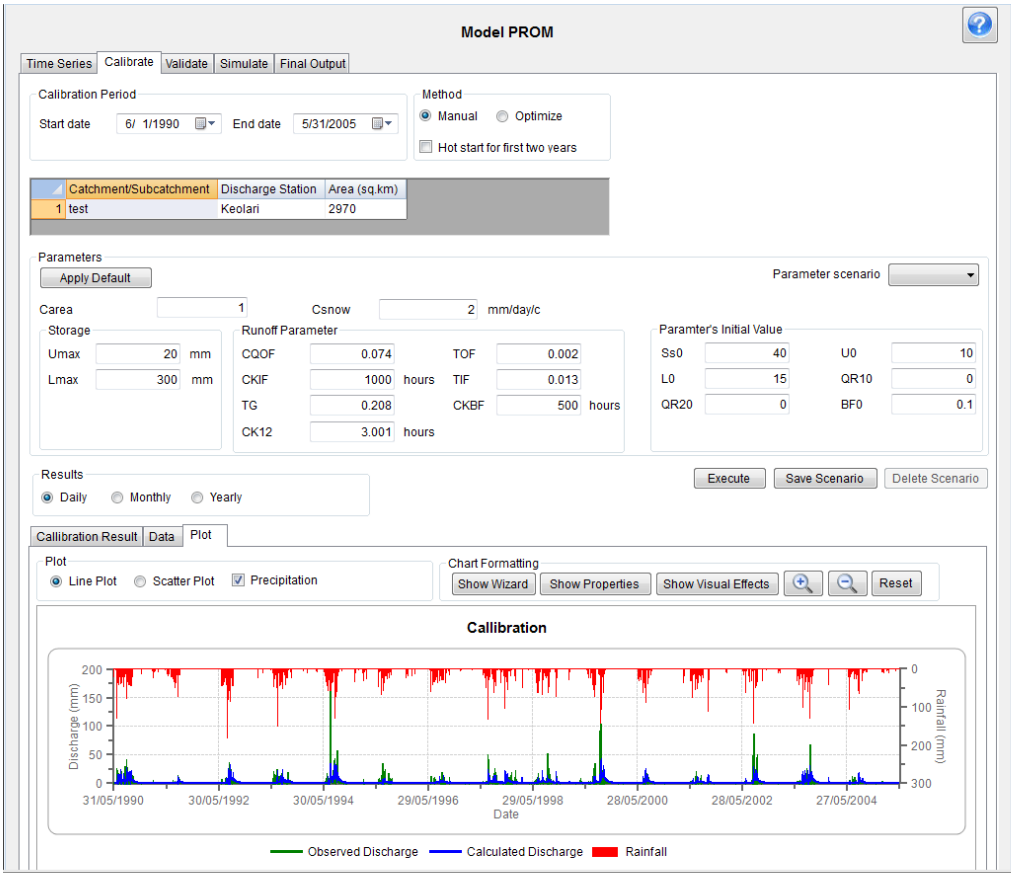


3. The status of newly formed sub catchment will be as "Pending" and will be by default checked. All the selections and calculations will be for checked sub catchment.
4. In the "***Select Data Format***" section:
    b. Select Data Format.
    c. The time base associated with the selected data format is displayed in the "Select Time Base" section. Select "Day" from dropdown.
    d. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
    e. Click the button ***">>"*** to get the series descriptor in combo boxes.

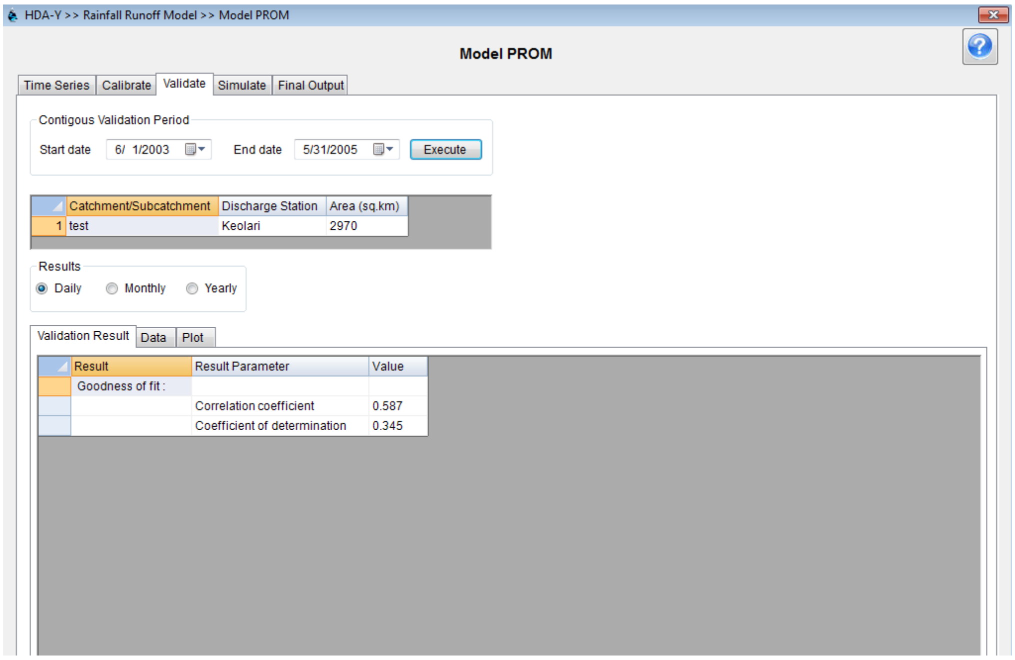
5. Click dropdown of Discharge time series to select discharge time series.
1. Click dropdown of Precipitation time series to select precipitation time series.
2. Click dropdown of Pan Evaporation time series to select pan evaporation time series.
3. Click dropdown of Temperature time series to select temperature time series.
4. Click "***Execute"*** button. Now Calibrate tab will opened as given in the following screen.

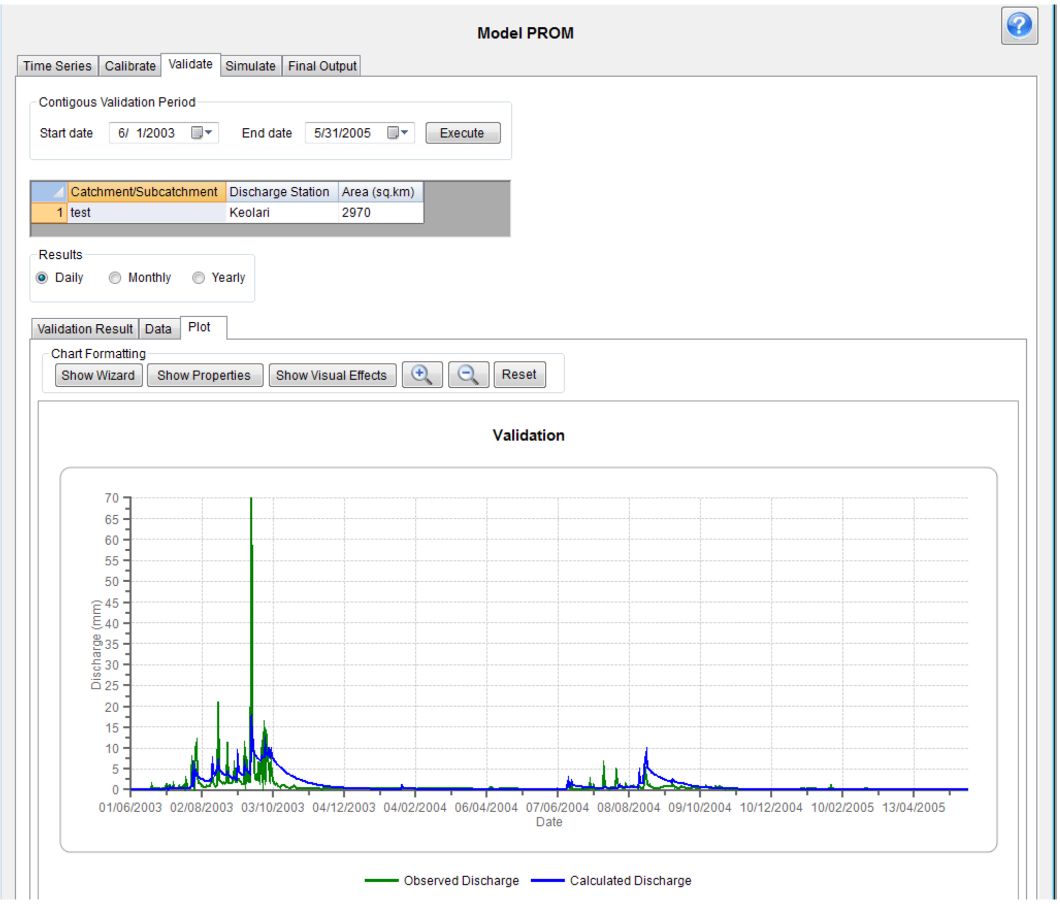


5. Select Calibration period and Method and then click ***"Execute"*** button.

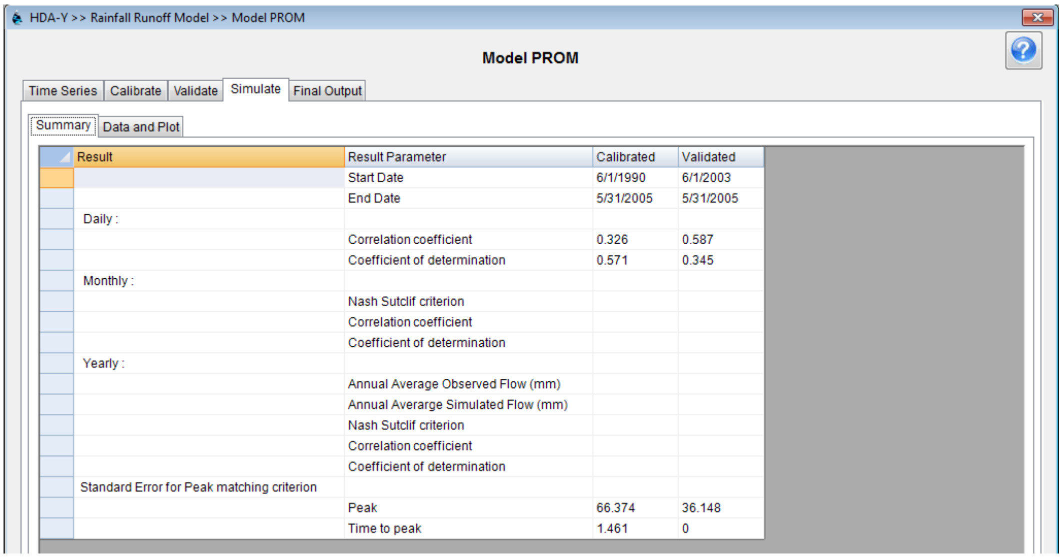


6. By default, the results displayed are for daily time period. User can also view for monthly and yearly by the available radio button option.
7. Now if user wants to perform validation, then user can perform validation from Validate tab or can directly proceed for simulation.

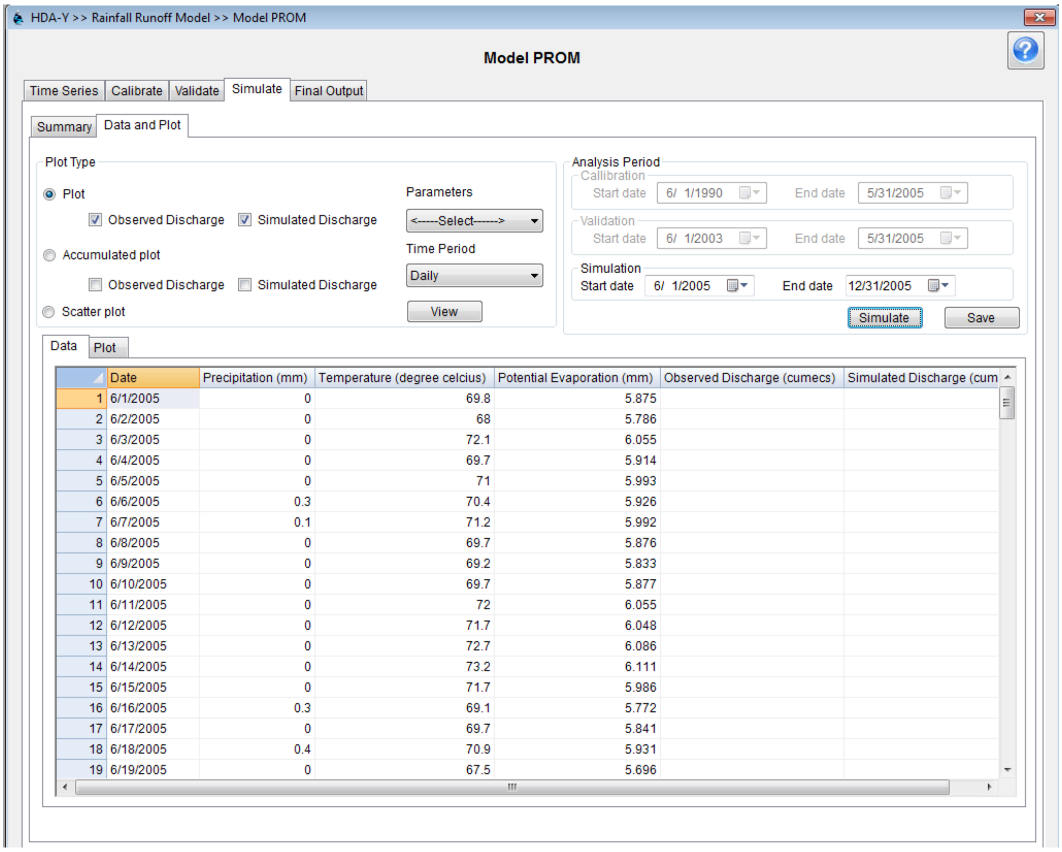


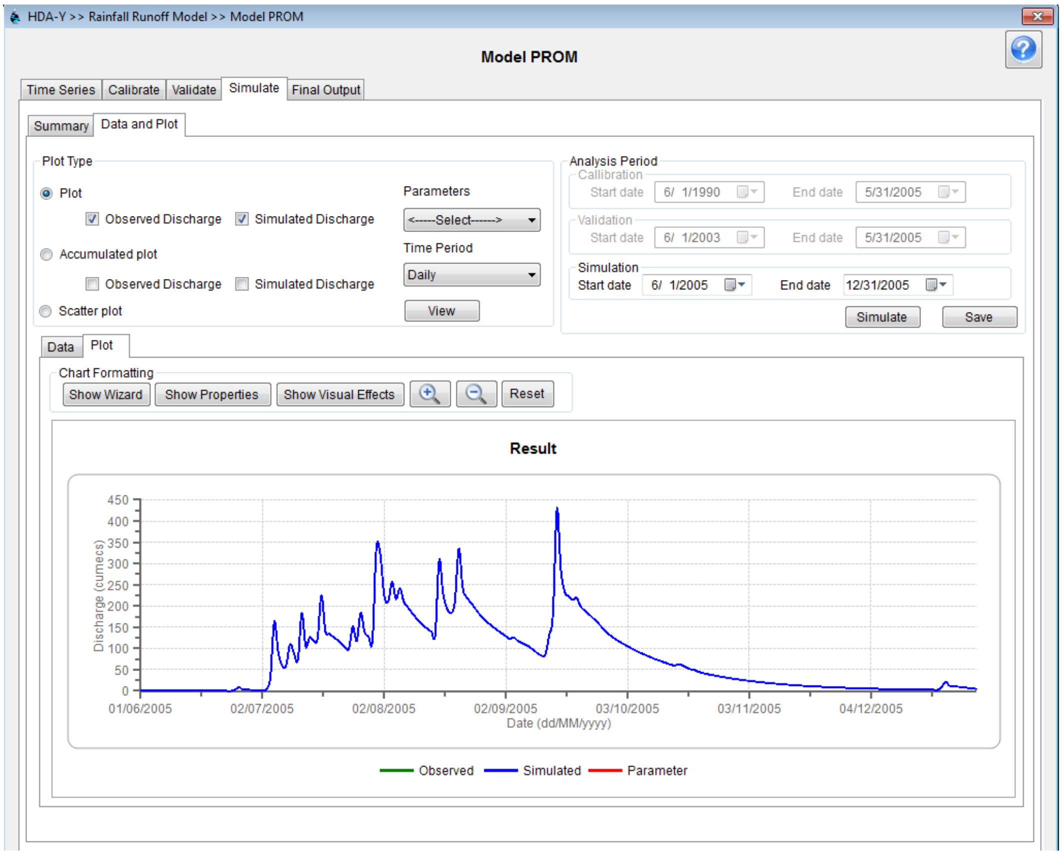


8. Simulation tab consist of two tabs: Summary Tab & Data and Plot
9. Summary result for calibration and validation is shown in summary tab.

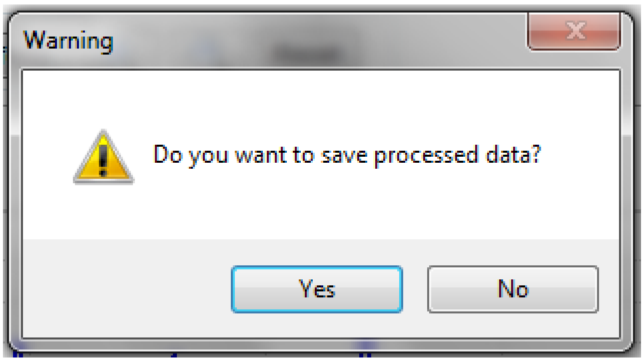


10. In Data and Plot tab select plot type and analysis period and then click on ***"Simulate"*** button to perform simulation.

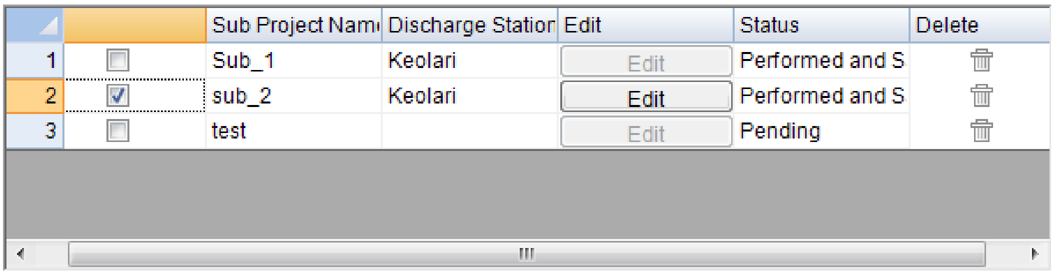




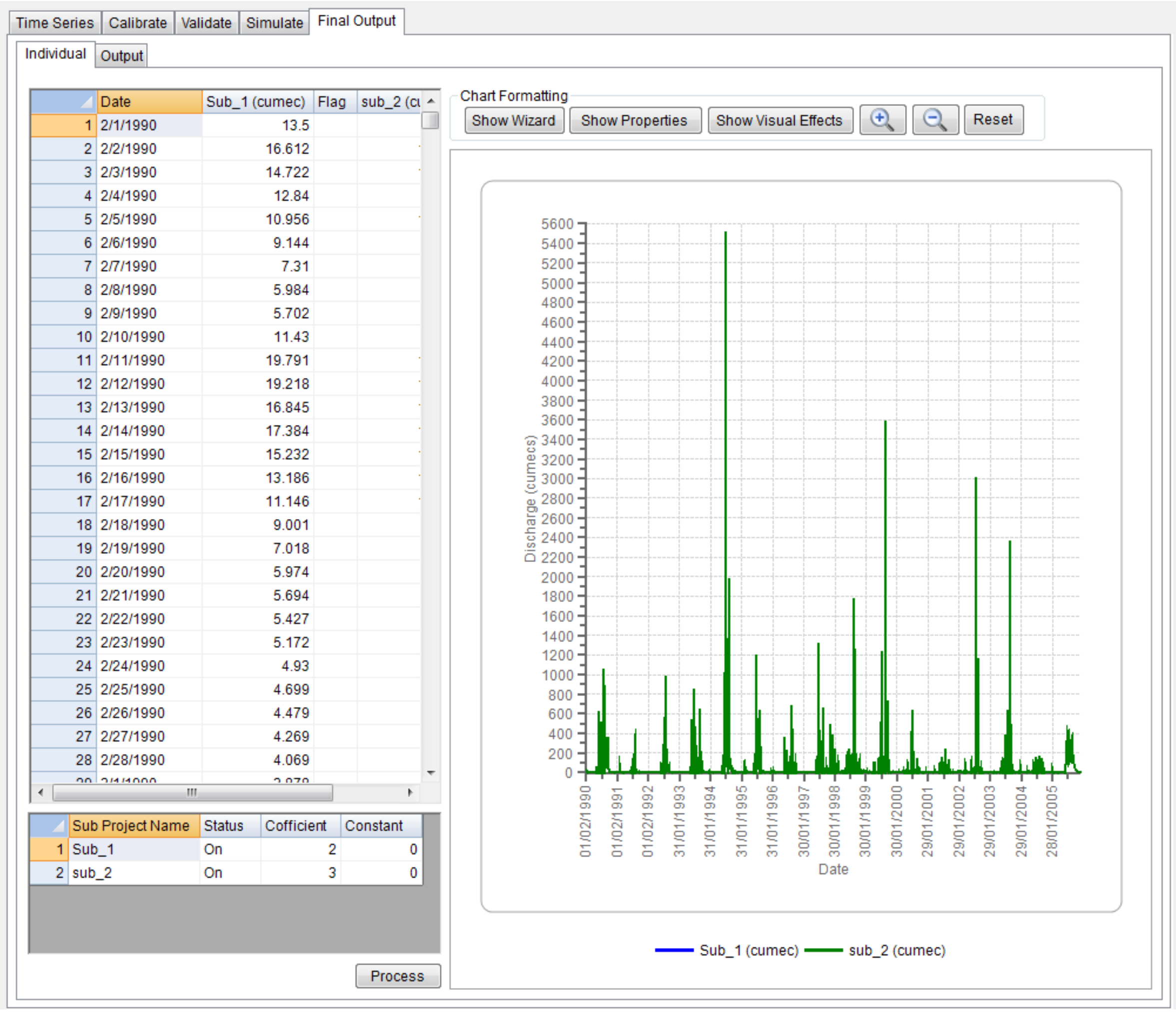
11. On Clicking the ***"Save"*** button the popup will appear.



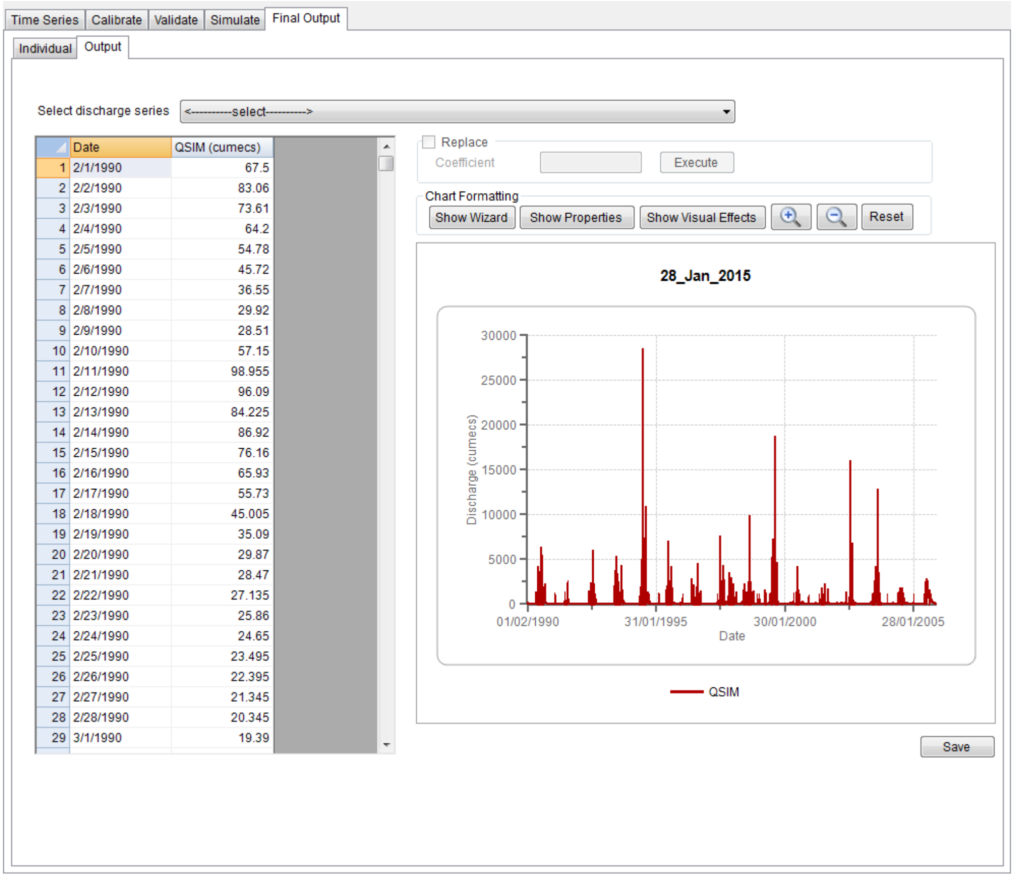
12. Clicking on ***"Yes"*** button, data will be saved.
13. After the data has been saved successfully the status of subproject changed to "Performed and Saved".



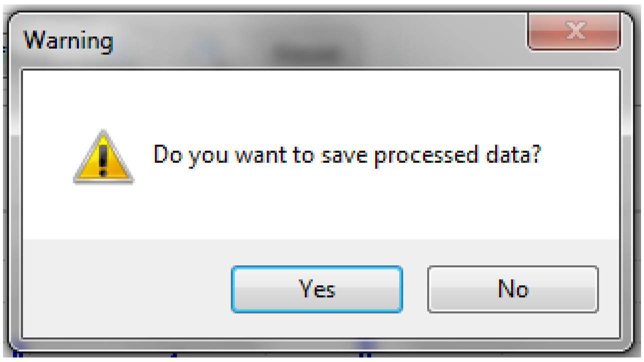
14. After the status of sub catchment changes to "Performed and Saved" the sub catchment can be Edited and Deleted.
15. After the data has been successfully save the final tab will be opened.



16. Final output tab contains two sub tabs : Individual & Output.
17. In individual tab user can change the status, coefficient and constant.
18. Click “***Process”*** button to calculate simulated discharge.



19. On Clicking the ***"Save"*** button the popup will appear.

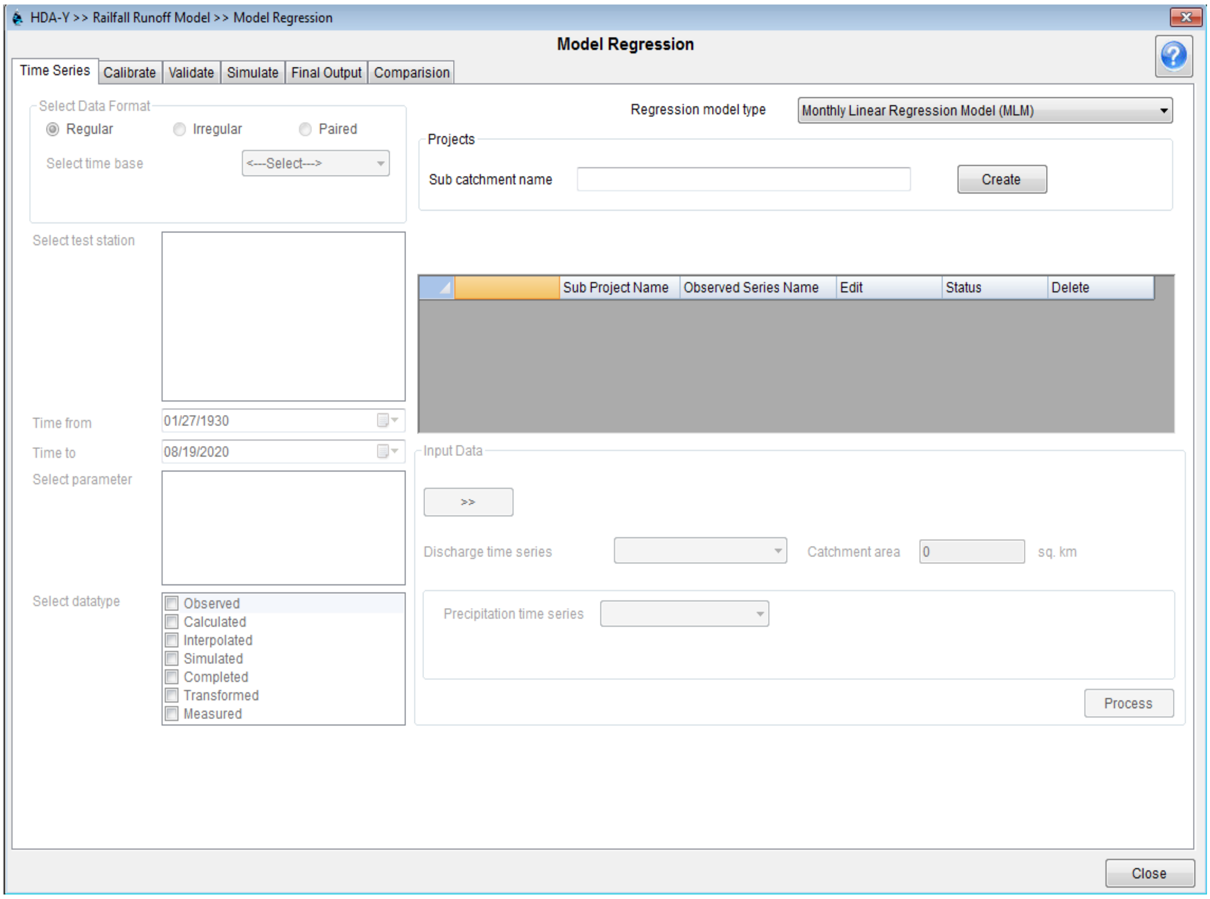


20. Clicking on ***"Yes"*** button, data will be saved as simulated series.

7.3. Regression Model REGM

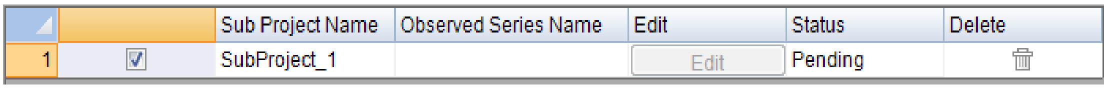
How to Access

HDA-Y >> Rainfall Runoff Model >> Model Regression



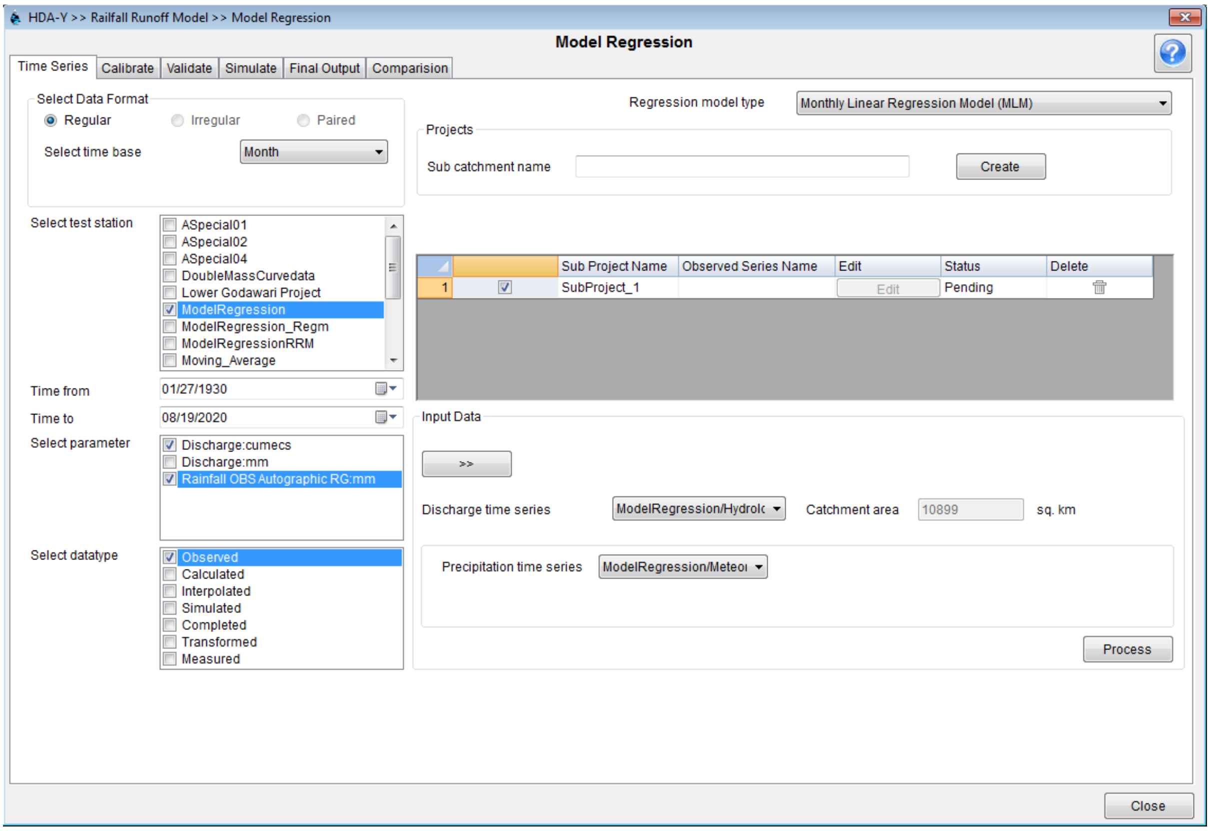
Operations

1. Use the menu path defined above to open the Model Regression form.
2. Select Regression model type e.g. Monthly Linear Regression Model (MLM) from drop down.
3. To create a sub project write the name of sub project in sub catchment name text box and press "***Create***" button, now sub project name is displayed in the grid with status as **"Pending"** as given below:

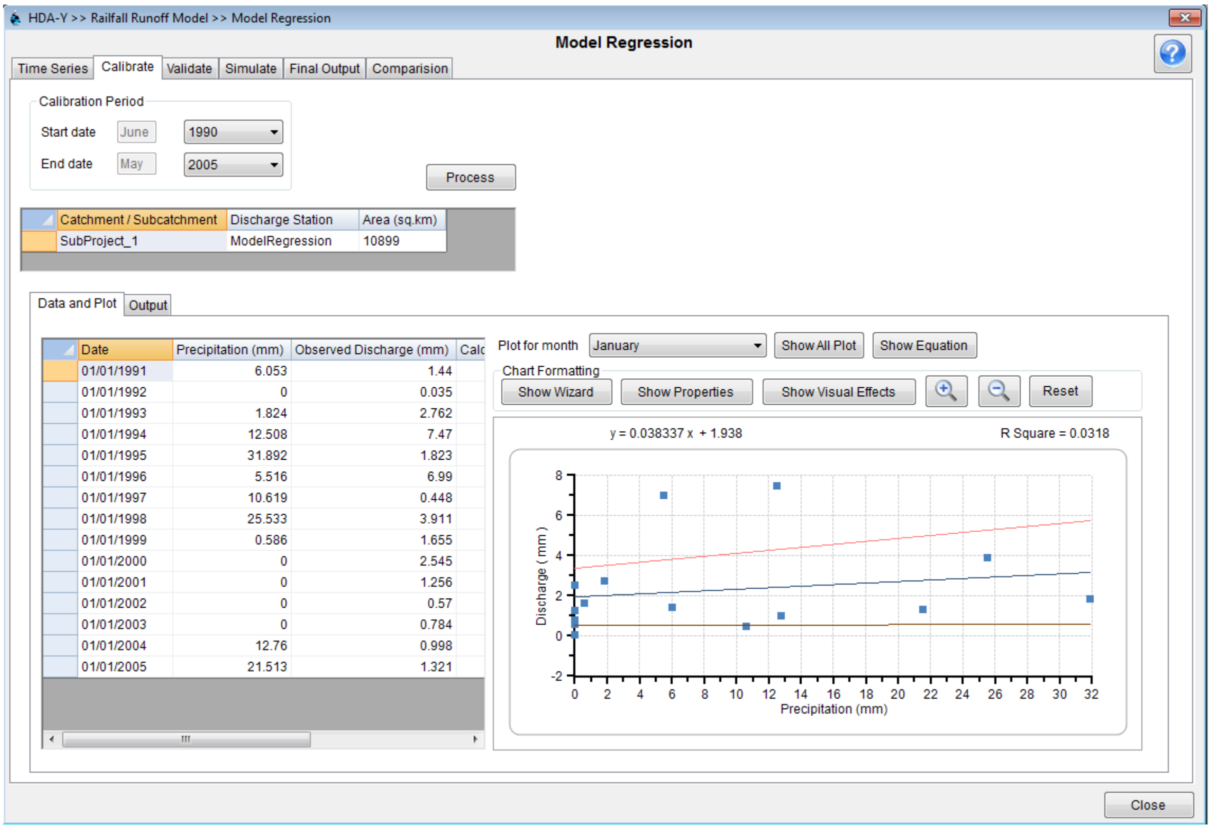


4.
5. Select check box against your sub project.
6. In the "***Select Data Format***" section:
   a. Select Data Format.
   b. The time base associated with the selected data format is displayed in the "Select Time Base" section. Select "Year" from dropdown.
   c. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
7. Click the button  to get fill the time series descriptor in combo boxes.

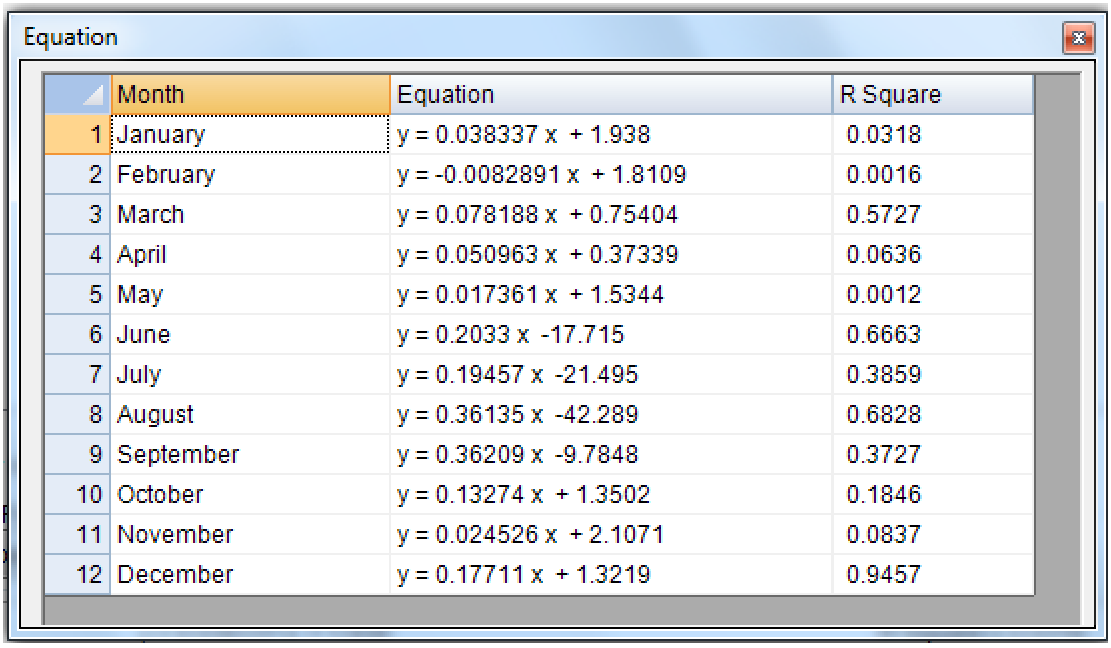
8. There must be at least two series to perform MLM model.
9. Click dropdown of Discharge time series and select discharge time series.
10. Click dropdown of Precipitation time series and select precipitation time series.



11. Click "***Process***" button. Now Calibrate tab will be opened automatically as given in the following screen.
12. Select Calibration period and click "***Process***" button.



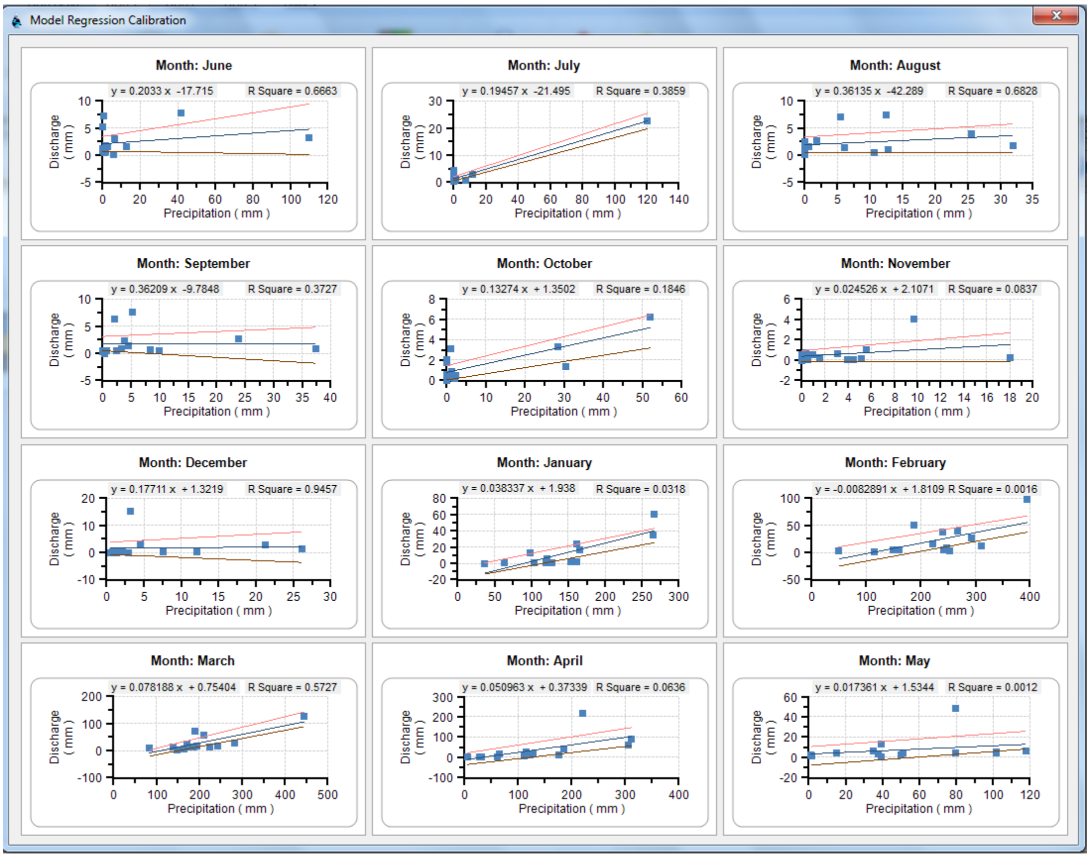
13. By selecting the month names e.g. January or February from "**Plot for month**" drop down Data and Plots of each month can be seen one by one.
14. R square values and Equations for all months can be seen by clicking on "***Show Equation***" button like in the following screen.



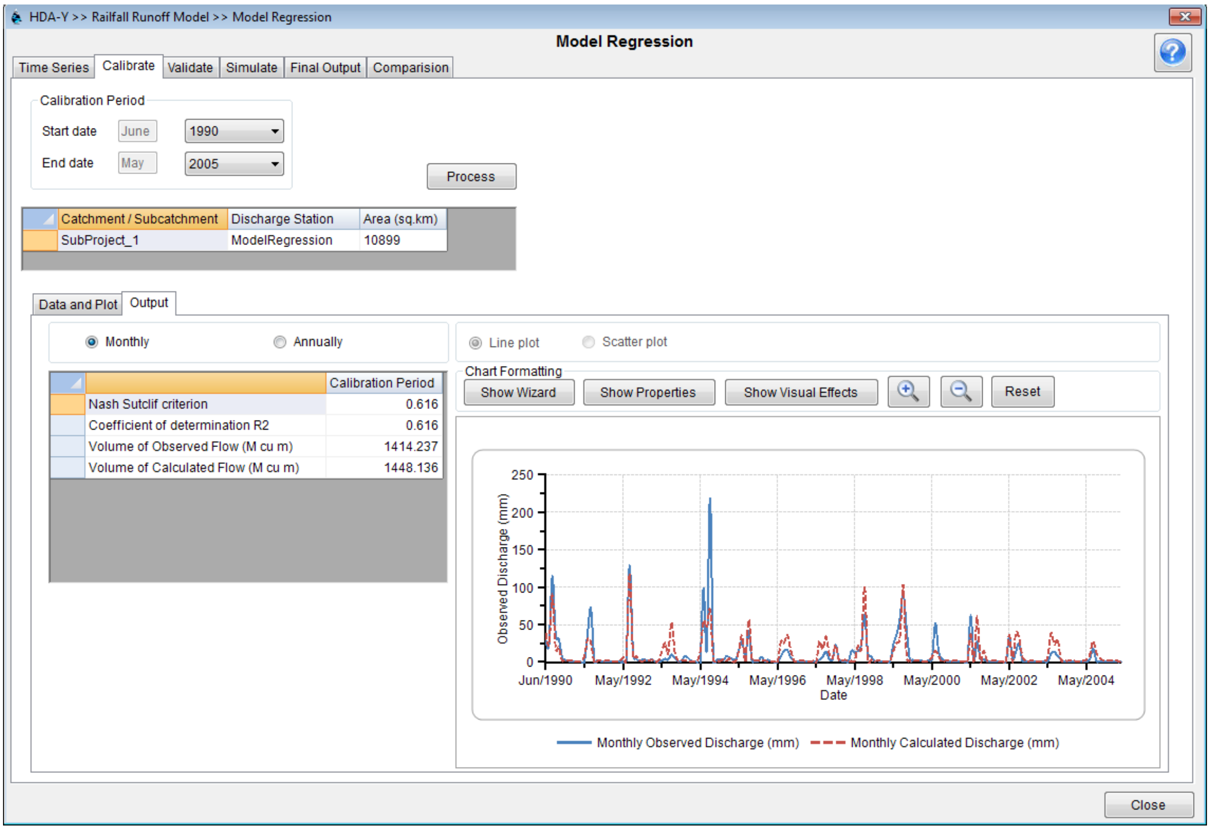
Equation

	Month	Equation	R Square
1	January	y = 0.038337 x + 1.938	0.0318
2	February	y = -0.0082891 x + 1.8109	0.0016
3	March	y = 0.078188 x + 0.75404	0.5727
4	April	y = 0.050963 x + 0.37339	0.0636
5	May	y = 0.017361 x + 1.5344	0.0012
6	June	y = 0.2033 x -17.715	0.6663
7	July	y = 0.19457 x -21.495	0.3859
8	August	y = 0.36135 x -42.289	0.6828
9	September	y = 0.36209 x -9.7848	0.3727
10	October	y = 0.13274 x + 1.3502	0.1846
11	November	y = 0.024526 x + 2.1071	0.0837
12	December	y = 0.17711 x + 1.3219	0.9457

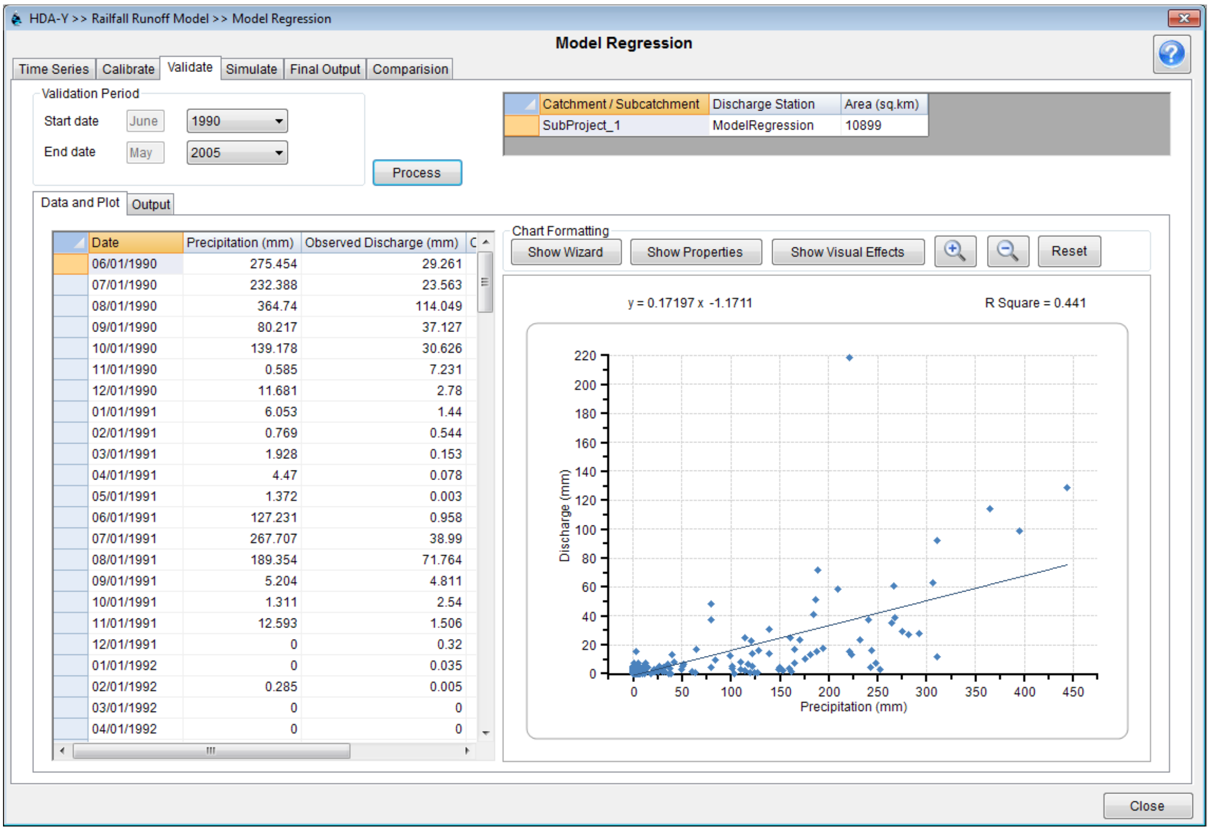
15. By clicking on "***Show All Plot***" button you can see Data and Plot for all months in one go as given in the following screen.



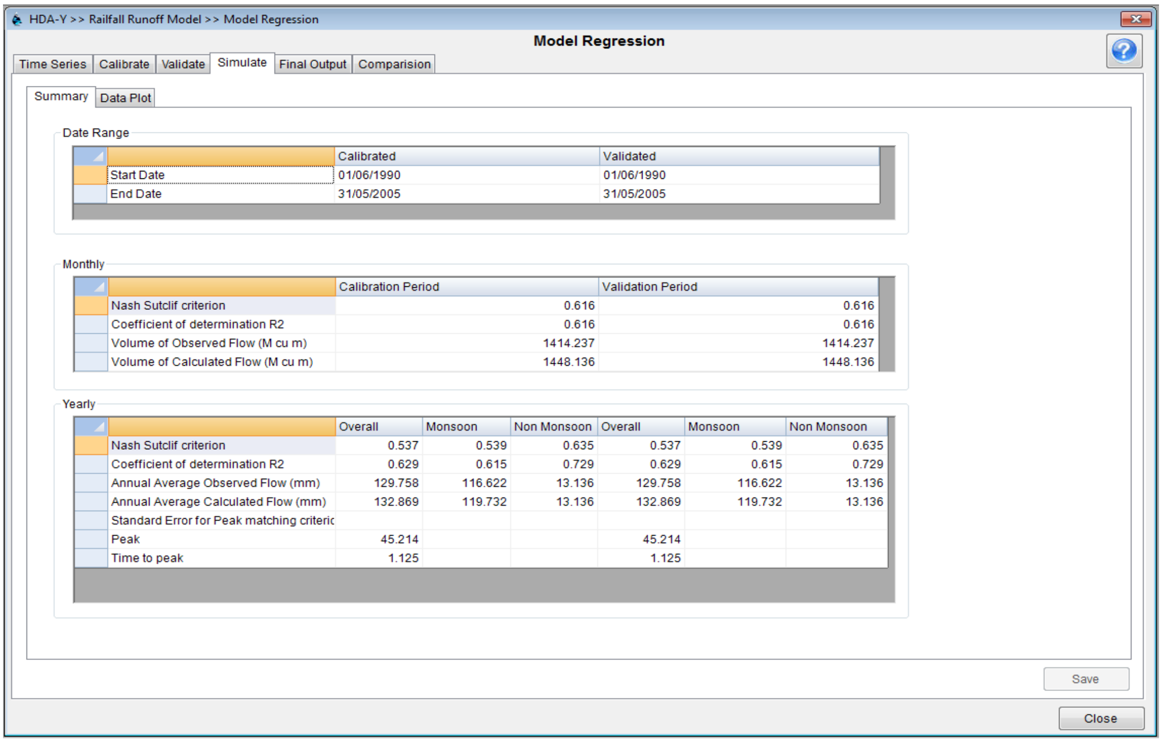
16. In "**Output**" tab monthly summary and output summary can be seen with linear and scatter plots as given below:



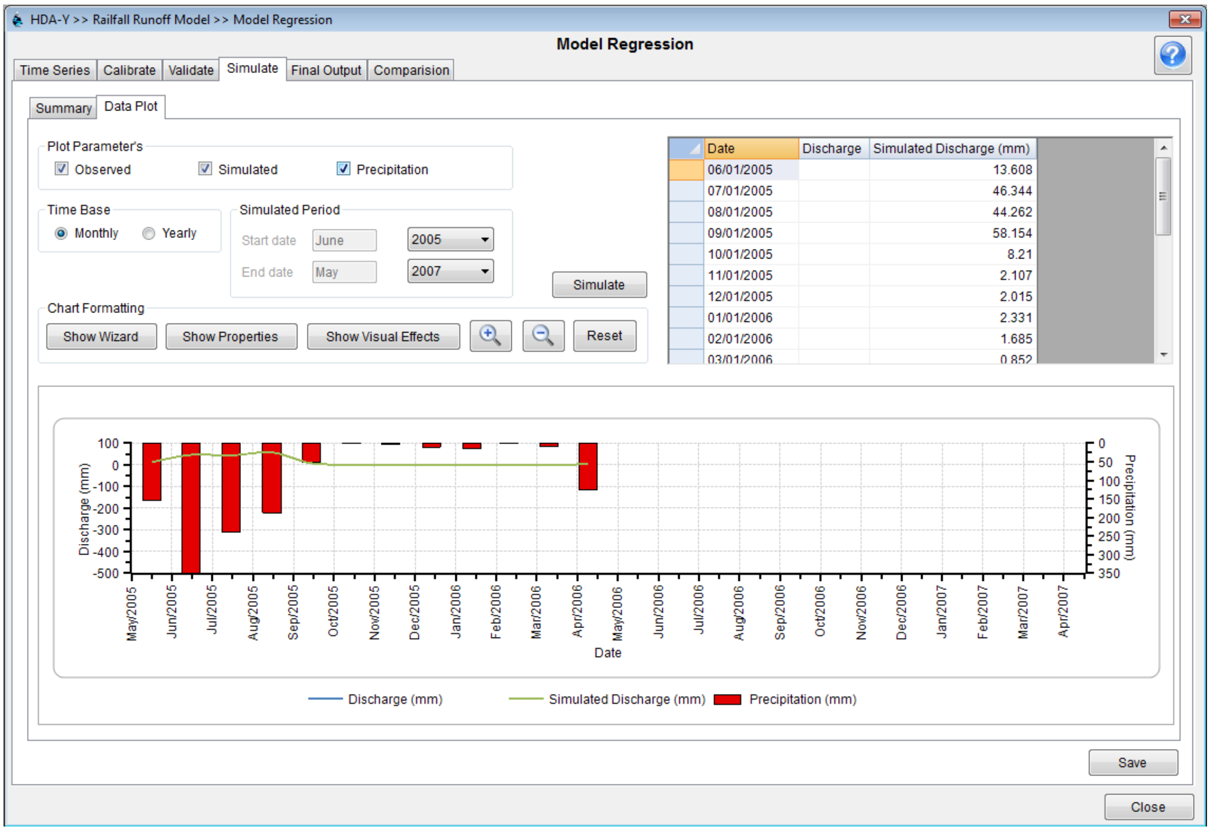
17. Select the **"Validate"** tab if you want to perform validation.
18. Select validation period and click "***Process***" button.



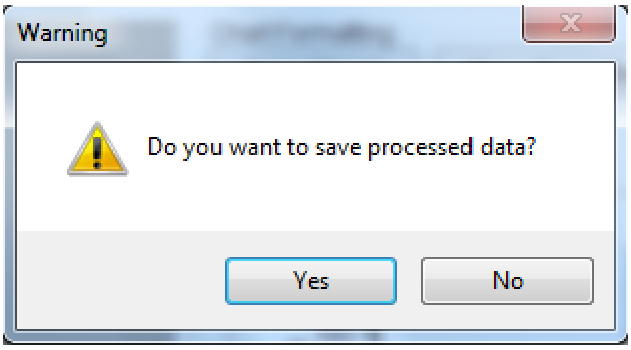
19. In **"Simulate"** tab select **"Summary"** tab to see the summary as given below:



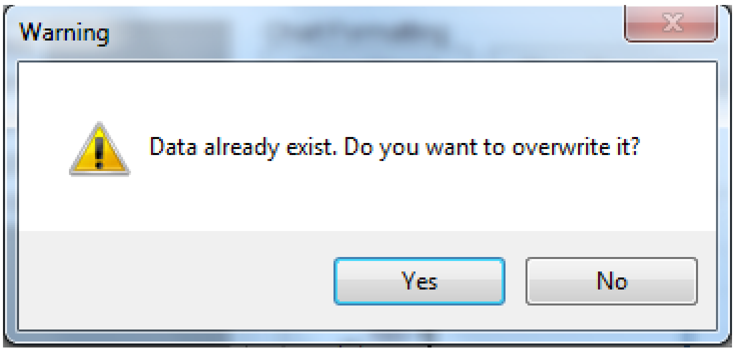
20. In **“Simulate”** tab select **“Data Plot”** tab for simulation. Select time period and press **“Simulate”** button to see the plot and simulated data. To on and off the series from chart put the check boxes on or off. You can also select “Time Base” as given below:



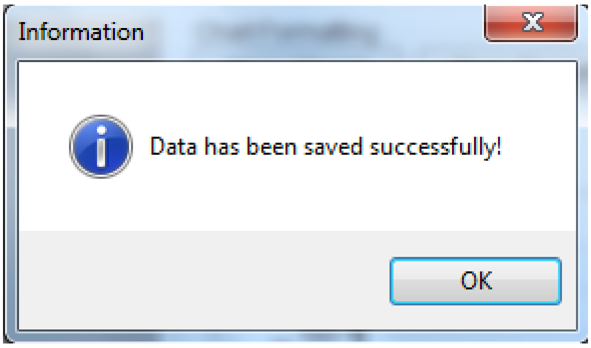
21. Click **“Save”** button to save data after pressing **“Save”** Button the warning message will be displayed as:



a. Press **“Yes”** button if want to save.

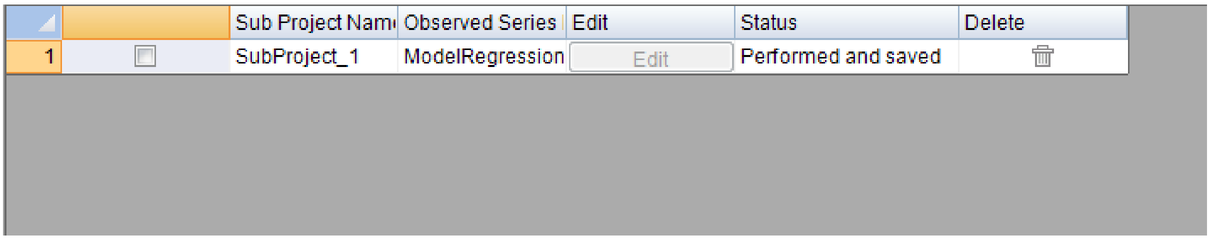


a. Click "***Yes***" button if want to overwrite the data. If user clicks "***No***" button the save operation is cancelled.

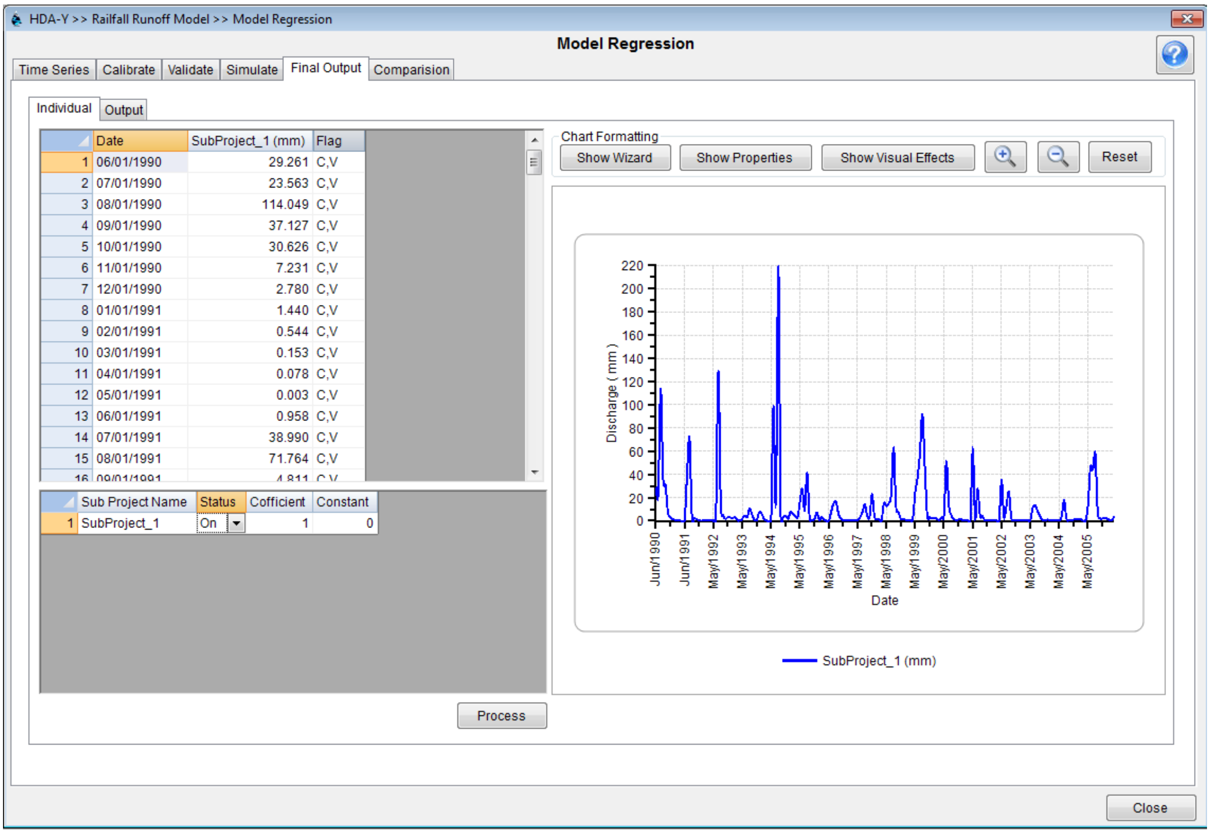


a. Click "***Ok***" button to proceed.

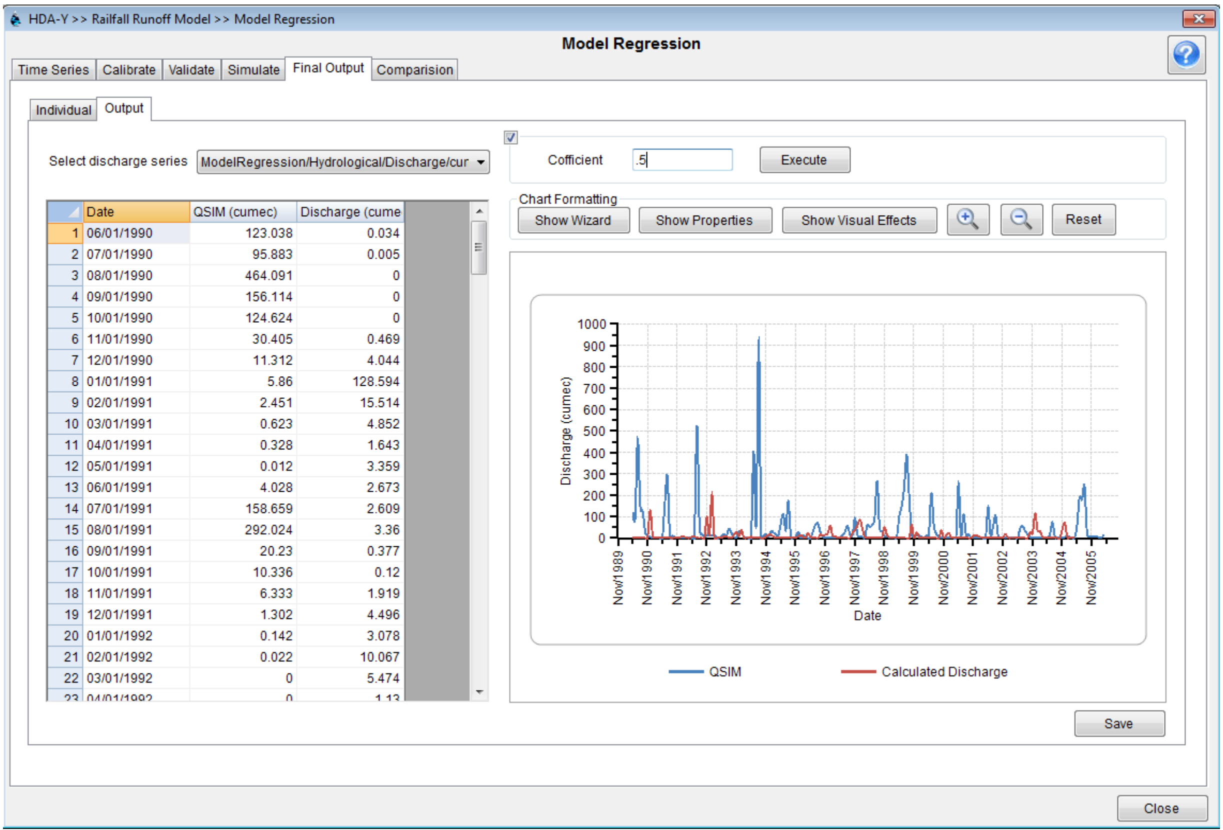
22. After the data is saved status of sub project will be **"Performed and Saved"**. Here you can edit or Delete the subproject by clicking ***"Edit"*** or button of the grid as shown below:



23. If you delete the subproject it will be deleted for all the models (e.g. MLM, MLM1 etc.). To Edit and Delete please check the check box of the related subproject so that **"Edit"** and buttons can be enabled.
24. After the data are saved **"Final Output"** tab will be opened automatically, which has 2 tabs named as **"Individual"** and **"Output"**. Individual tab shows two grids. One of the these two grids shows the simulated series data with flags C, V, S. In second grid we can On or Off the series status by double clicking on the cell , and can also provide coefficient and constant for every series to produce one series by using multiple series which is displayed in the grid of the **"Output"** tab.

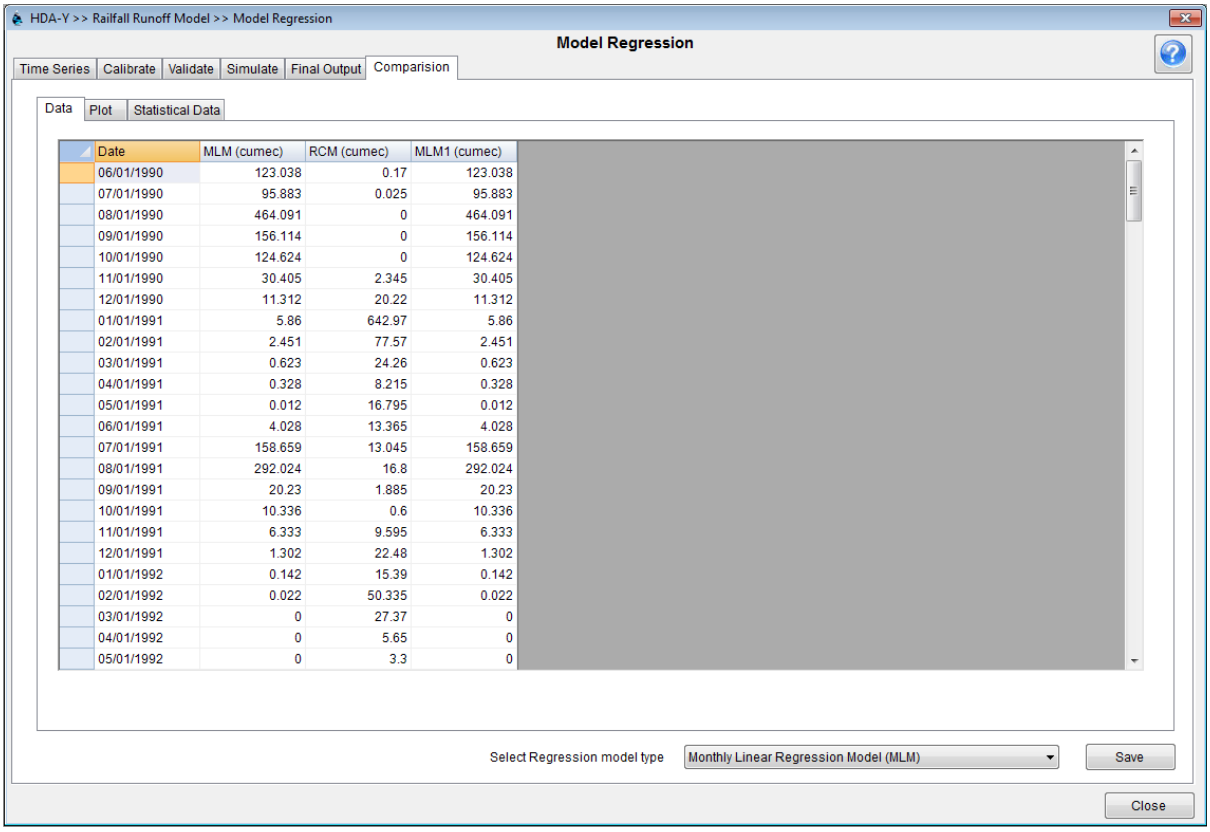


25. Click ***"Process"*** button to see the output in the ***"Output"*** tab as given below:



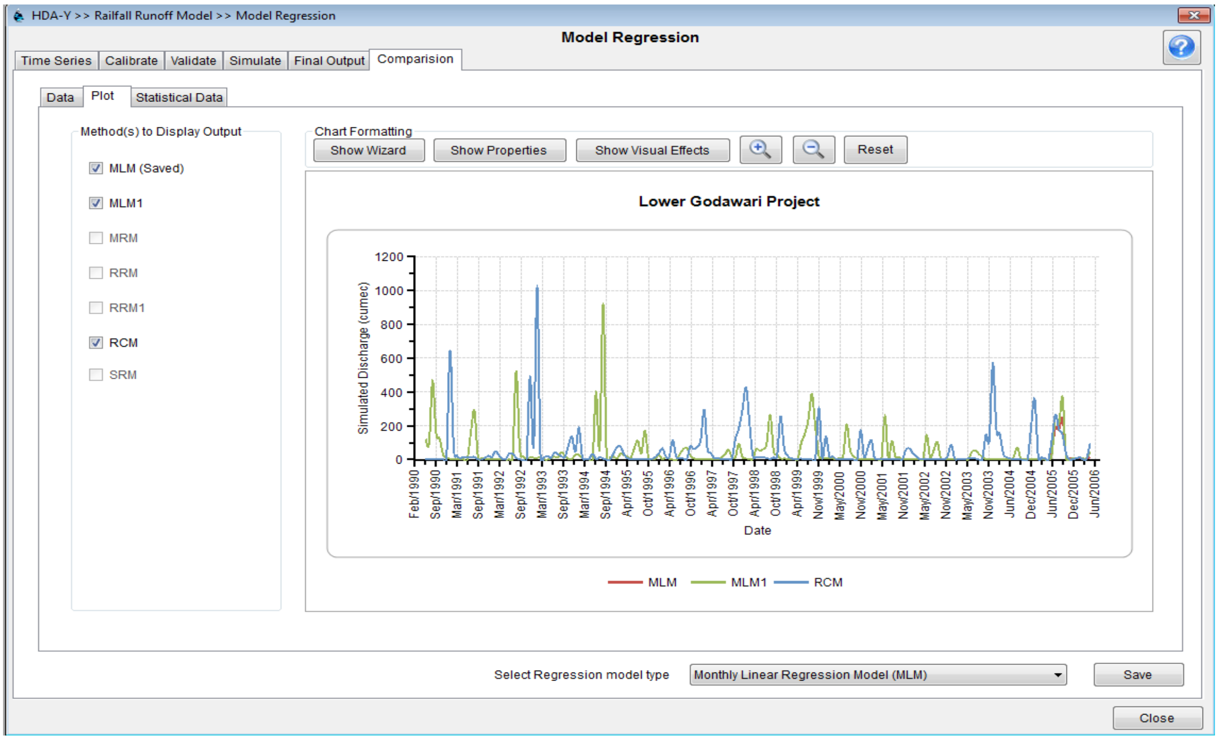
26. You can select a discharge time series from **"Select discharge series"** dropdown which will be displayed in the grid. Give coefficient value and press ***"Execute"*** button to modify the QSIM series.

27. Click the ***"Save"*** button to save the final simulated series of the model for Comparison of different models in the **"Comparison"** tab. In **"Data"** tab final simulated series of models you have performed are displayed as below:

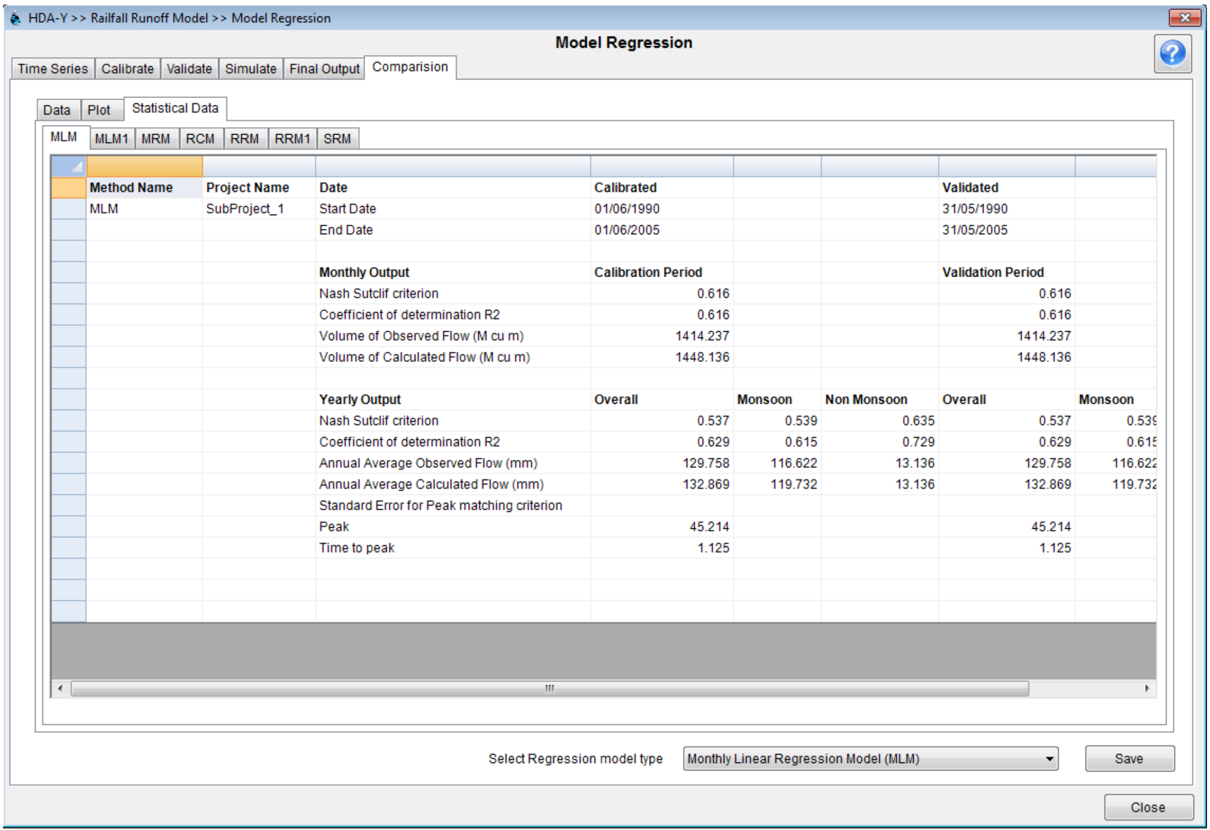


Date	MLM (cumec)	RCM (cumec)	MLM1 (cumec)
06/01/1990	123.038	0.17	123.038
07/01/1990	95.883	0.025	95.883
08/01/1990	464.091	0	464.091
09/01/1990	156.114	0	156.114
10/01/1990	124.624	0	124.624
11/01/1990	30.405	2.345	30.405
12/01/1990	11.312	20.22	11.312
01/01/1991	5.86	642.97	5.86
02/01/1991	2.451	77.57	2.451
03/01/1991	0.623	24.26	0.623
04/01/1991	0.328	8.215	0.328
05/01/1991	0.012	16.795	0.012
06/01/1991	4.028	13.365	4.028
07/01/1991	158.659	13.045	158.659
08/01/1991	292.024	16.8	292.024
09/01/1991	20.23	1.885	20.23
10/01/1991	10.336	0.6	10.336
11/01/1991	6.333	9.595	6.333
12/01/1991	1.302	22.48	1.302
01/01/1992	0.142	15.39	0.142
02/01/1992	0.022	50.335	0.022
03/01/1992	0	27.37	0
04/01/1992	0	5.65	0
05/01/1992	0	3.3	0

28. In the **"Plot"** tab comparison of simulated series of different model are compared by checking on and off the model names enabled check boxes.



29. You can click ***"Save"*** button by selecting Regression model type from dropdown to save the one final simulated series after comparing all models.
30. Statistical data for each subproject of a every performed model e.g. MLM , MLM1 etc. can be seen in **"Statistical Data"** tab as given below:



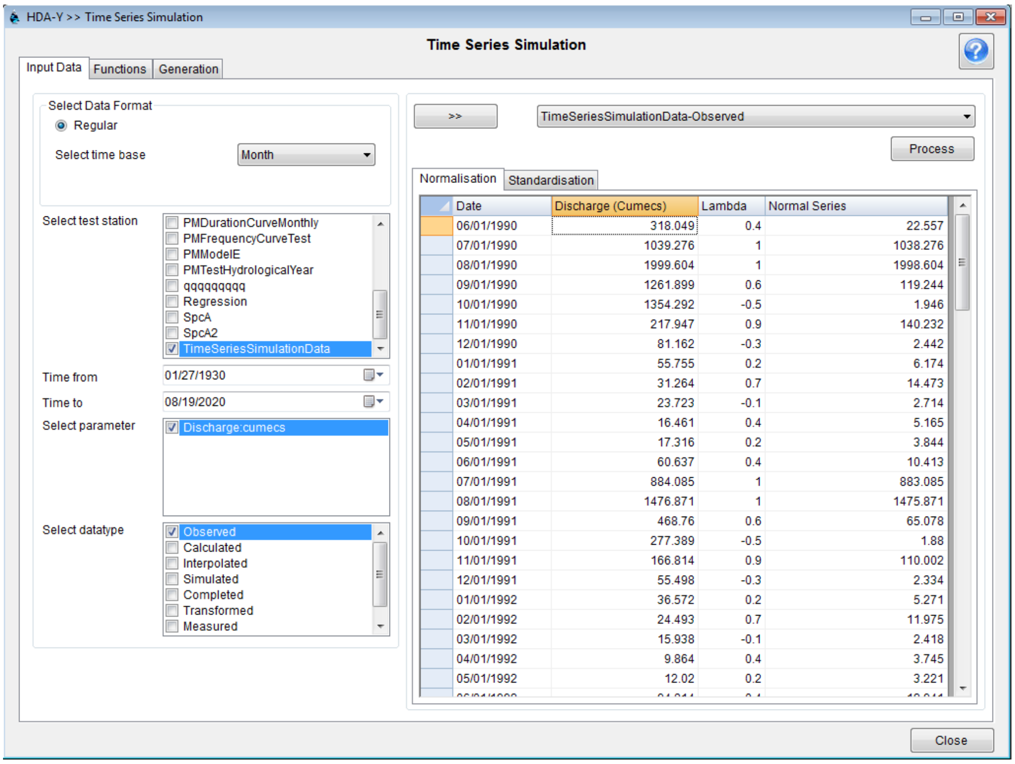
Important features:

i. Right click on graphs using mouse two options "***Save as Image Ctrl + S***" and "***Print Ctrl + P***" is displayed. To save the graph as an image file either click "***Save as Image Ctrl + S***" option using mouse or press "***Ctrl + S***" using keyboard after selecting graph. To print the graph directly either click "***Print Ctrl + P***" option using mouse or press "***Ctrl + P***" using keyboard after selecting graph.
ii. The enhanced graph functionalities available in "***Show Wizard***", "***Show Properties***", "***Show Visual Effects***", "***Zoom In***" and "***Zoom Out***" is described in Section 3 : Common Features and Functionalities.
iii. For form specific help, click  on the upper right hand side of form.
iv. For form specific design aids details, click  on the upper right hand side of the form.
v. For closing and exiting form, click "***Close***" button on the lower right hand side of form or user can click  option available of the upper right hand corner of the form.

8. Time Series Simulation

How to Access

HDA-Y >> Time Series Simulation

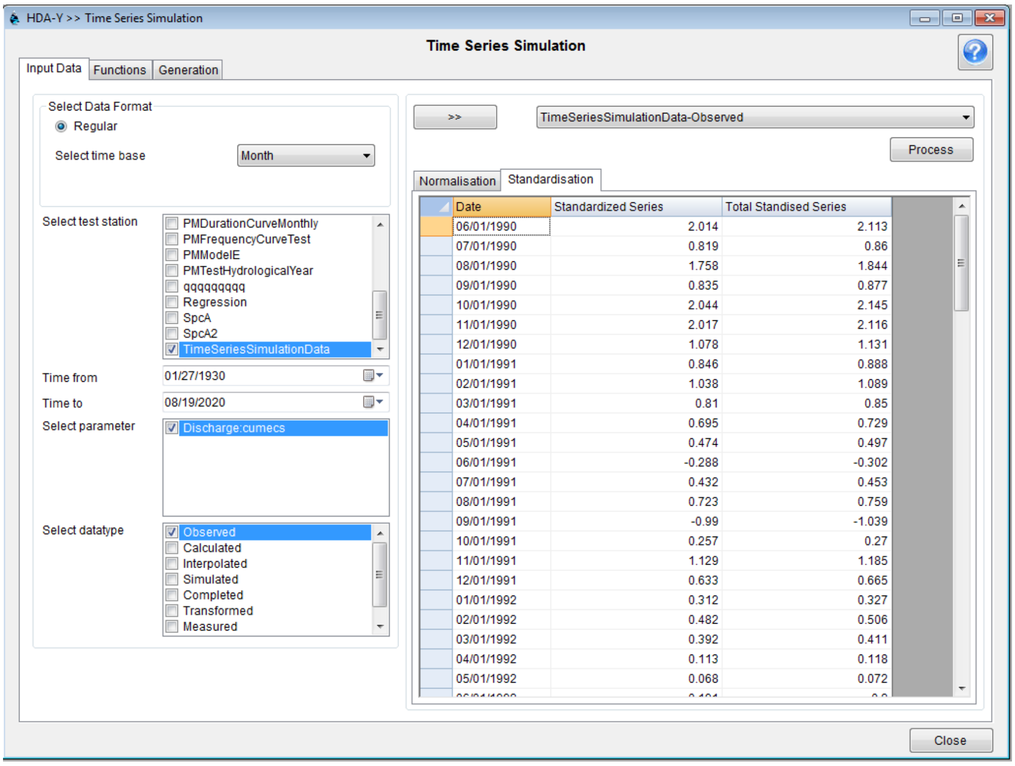


Operations

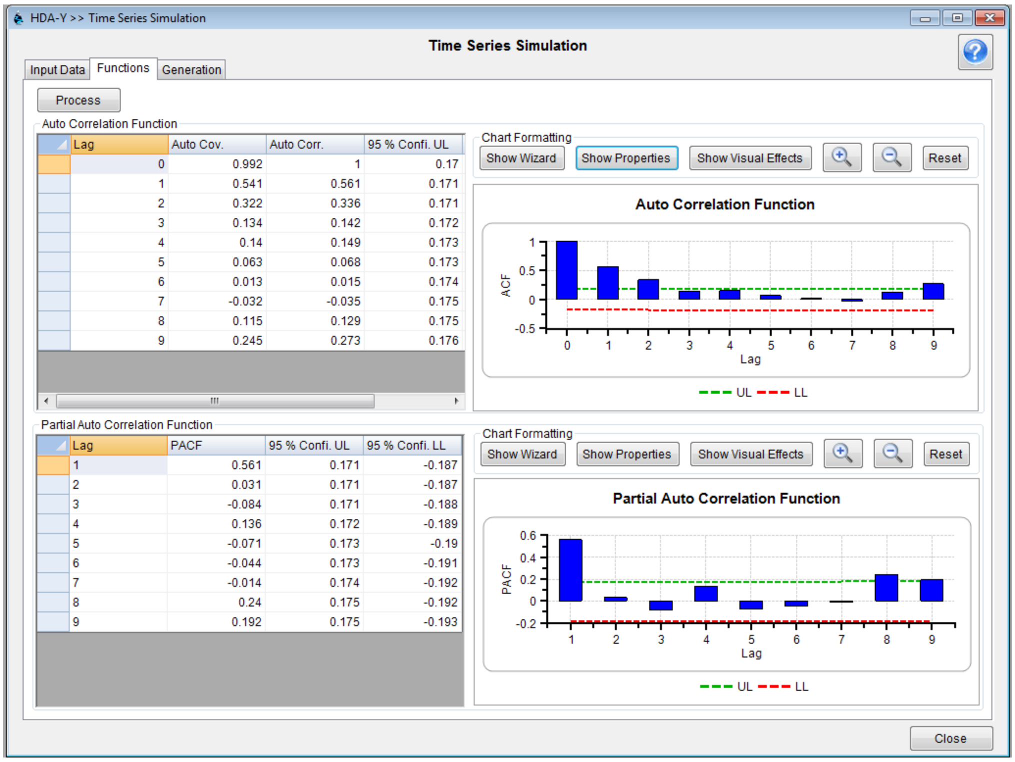
Use the menu path defined above to open the Rating Curve Transformation and Extrapolation

1. In the ***"Select Data Format"*** section:
   a) Select Data Format.
   b) The time base associated with the selected data format is displayed in the "Select Time Base" section. Select appropriate time base from dropdown.
   c) The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
2. Click on 

button, Discharge station time series descriptor will be filled in the Dropdown for which Time Series Simulation has to be performed.
3. Click on ***"Process"*** button will calculate the Normalisation and Standardisation respective to the selected discharge data, which is displayed in Normalisation and Standardisation tab respectively.

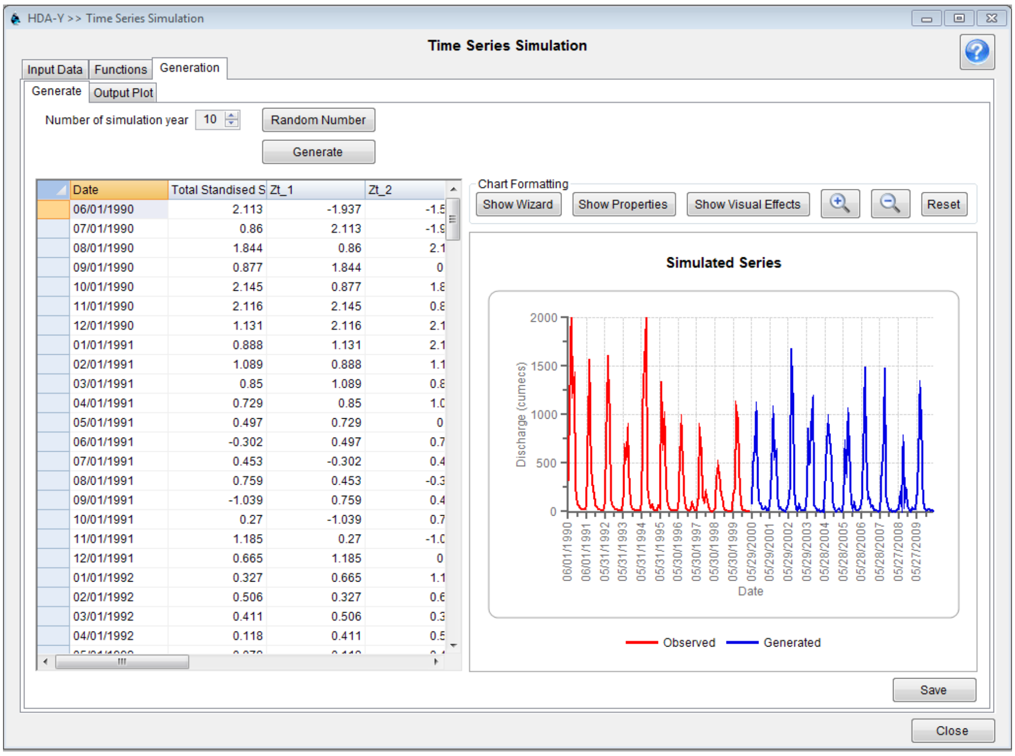


4. In the Functions tab, on click of "Process" button Auto Correlation and Partial Auto Correlation are calculated, which showed in their respective plots.

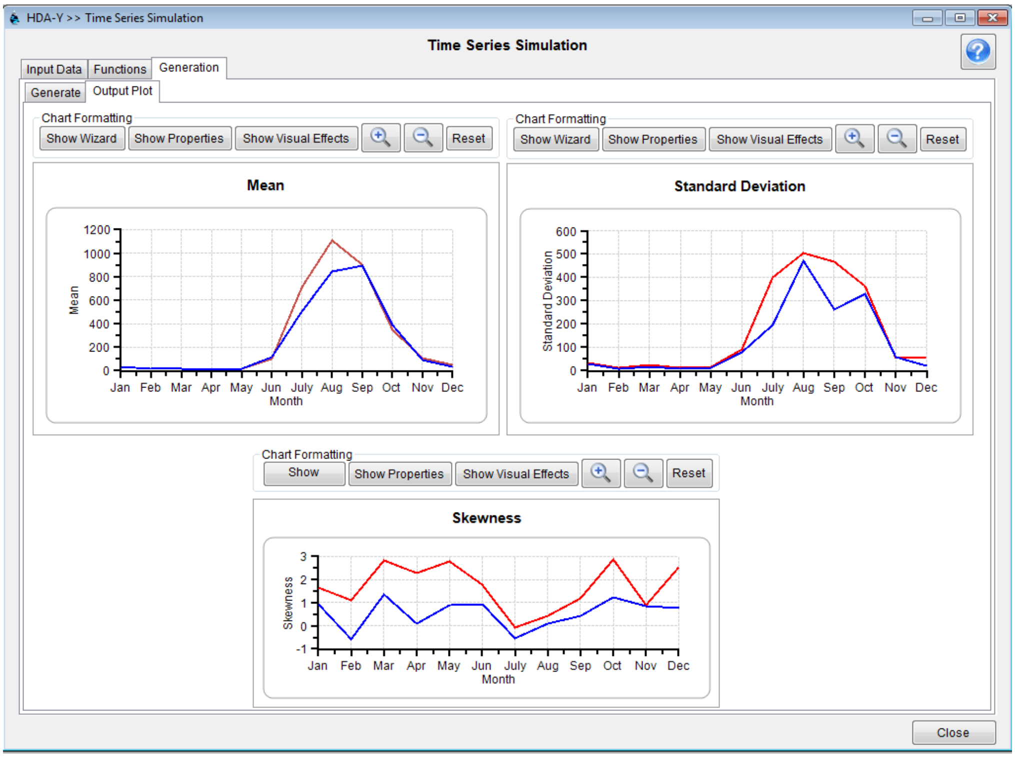


5. In the Genaration tab:
   a. Provide the Number of Simulation Years for which simulation has to be performed.
   b. Click on ***"Random Number"*** will generate the random numbers.

c. Click on ***"Generate"*** button will calculated the simulated discharge and showed their respective plot.



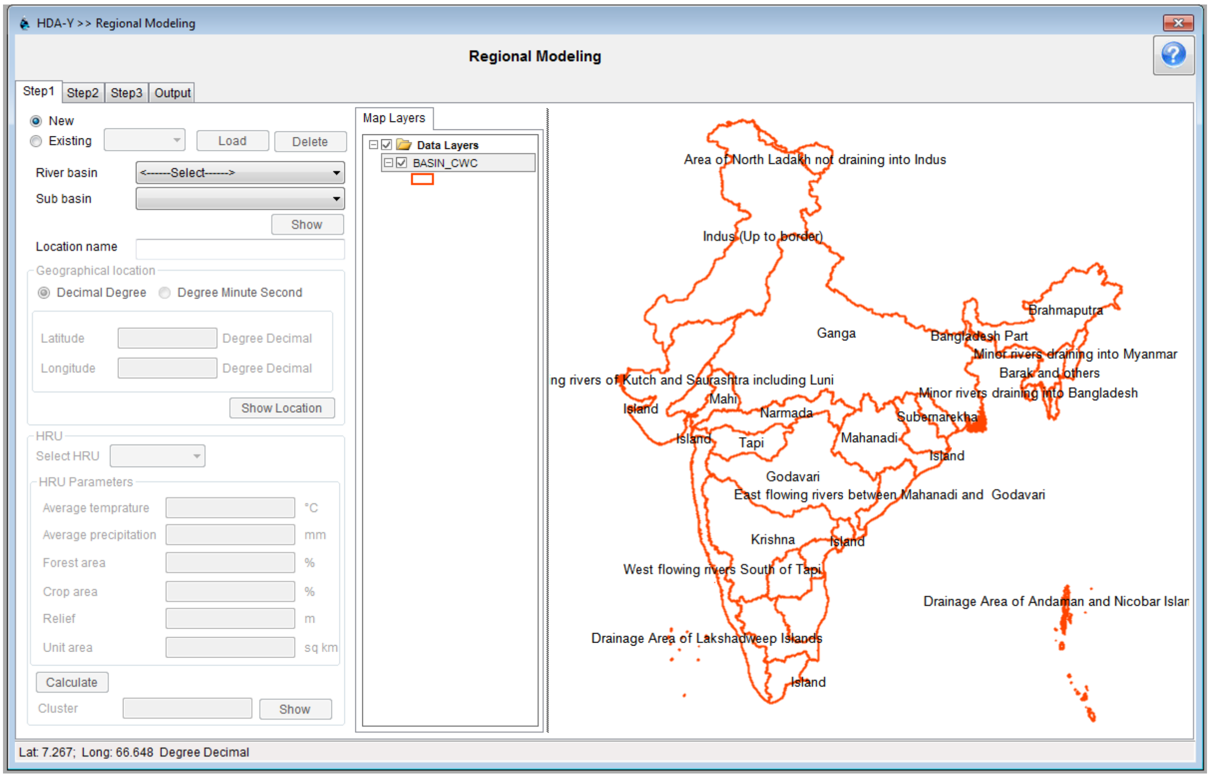
6. On click of ***"Save"*** button dischage series will be saved in the database with the same station name as that of the selected observed data discharge series.
7. Mean, Standard Deviation and Skewness plots will be displayed in the "Output Plot" sub-tab of "Generation" tab.



9. Regional Modeling

How to Access

HDA-Y >> Regional Modeling



Operations

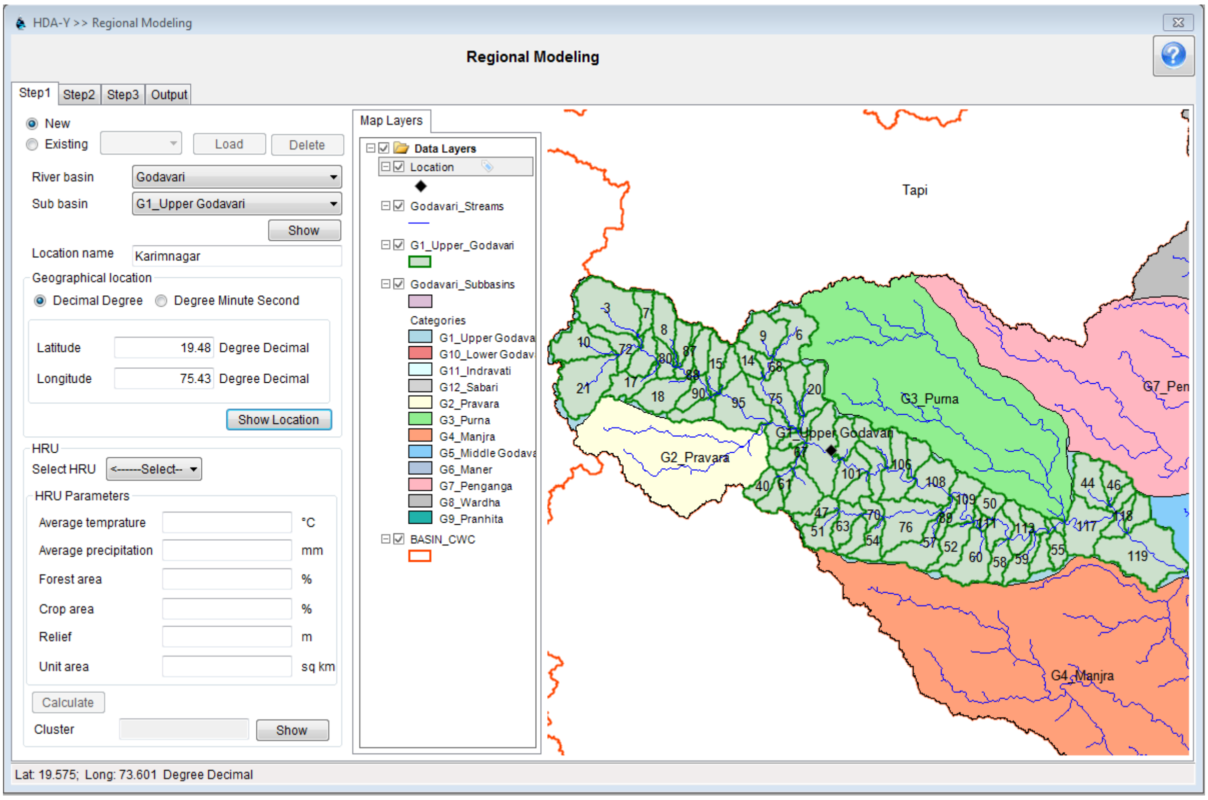
Use the menu path defined above to open Regional Modeling.

1. Step1

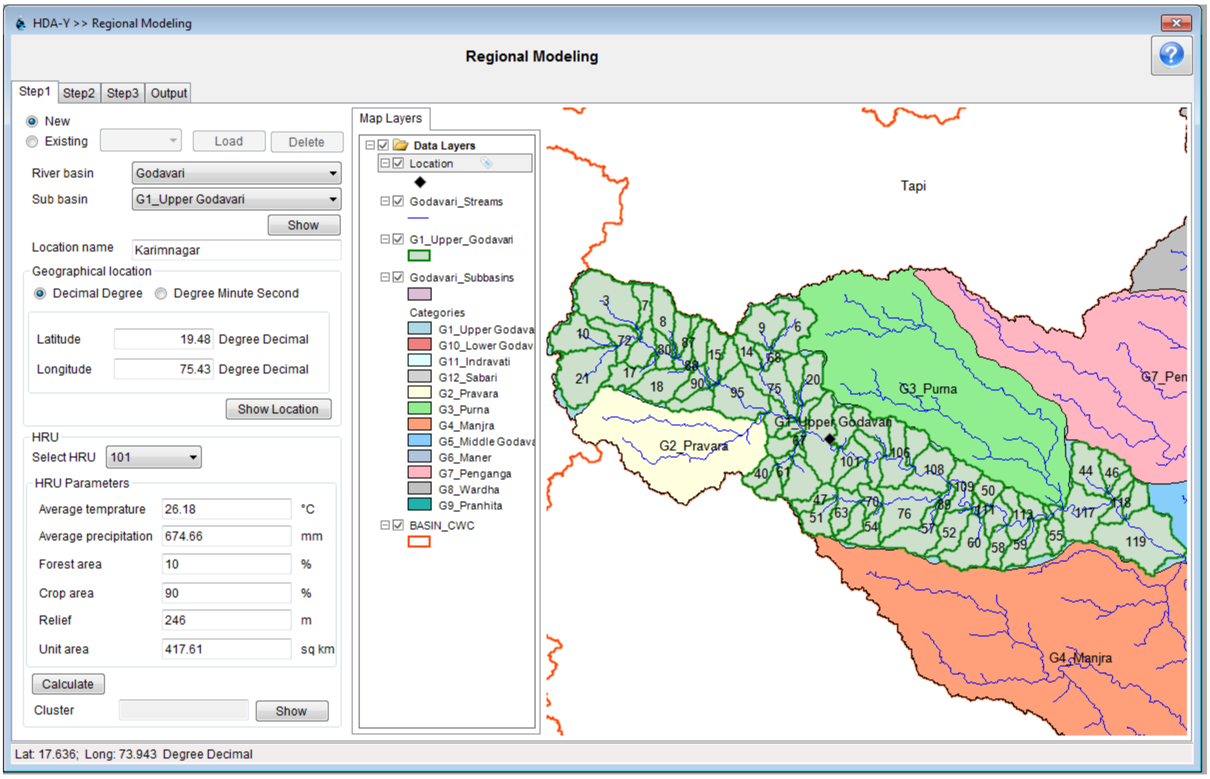
a. Select New. [for existing radio button explanation is ahead]

a. From the river basin dropdown select any river, if any sub basin available then that will be populate in the corresponding dropdown. Select your desired input, after that click on show button.

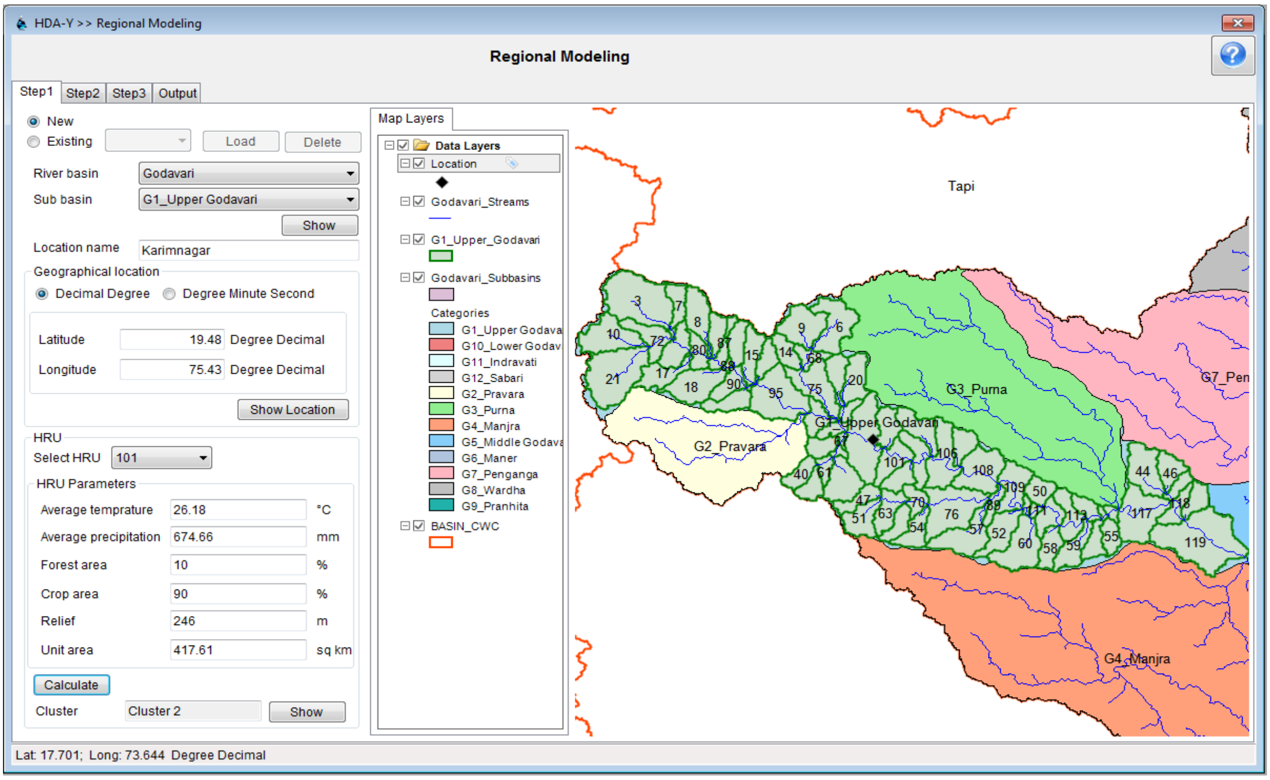
b. Now fill the location name and its latitude, longitude and click on ***"Show location"*** button. Figure given below



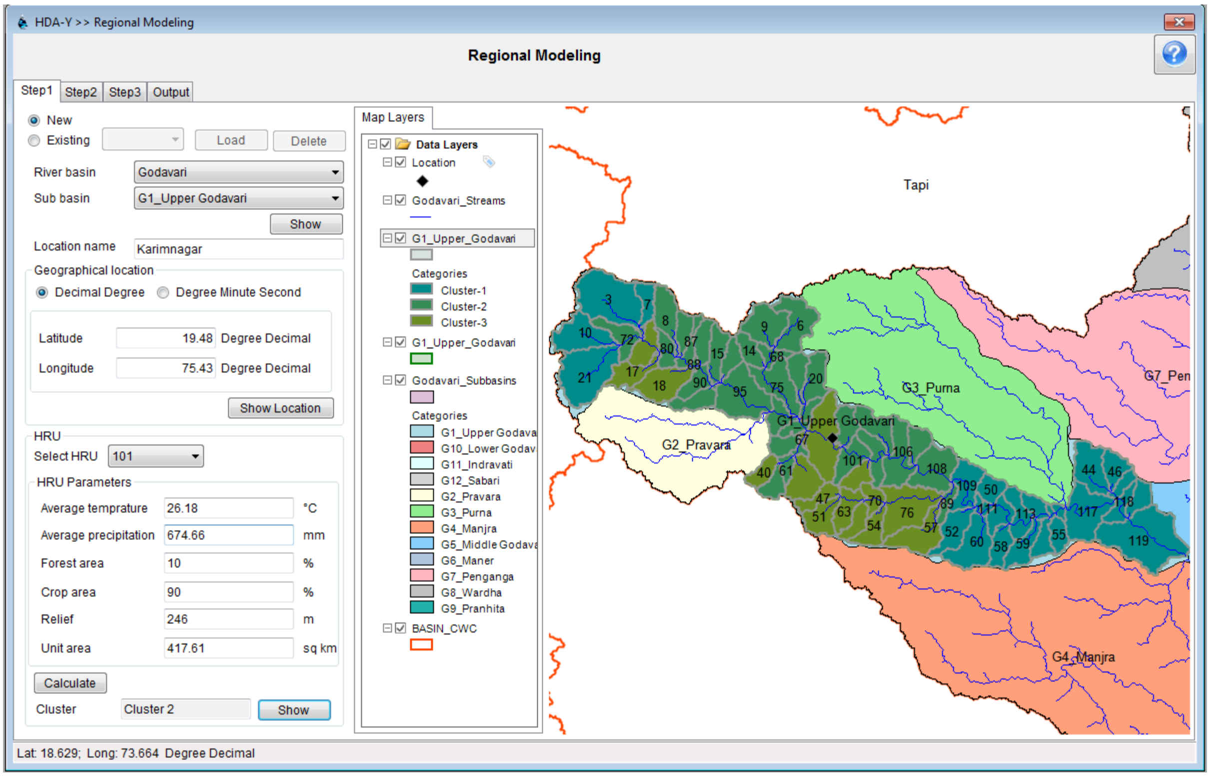
c. Select you desired HRU from hru dropdown, Its corressponding parameter will display automatically.



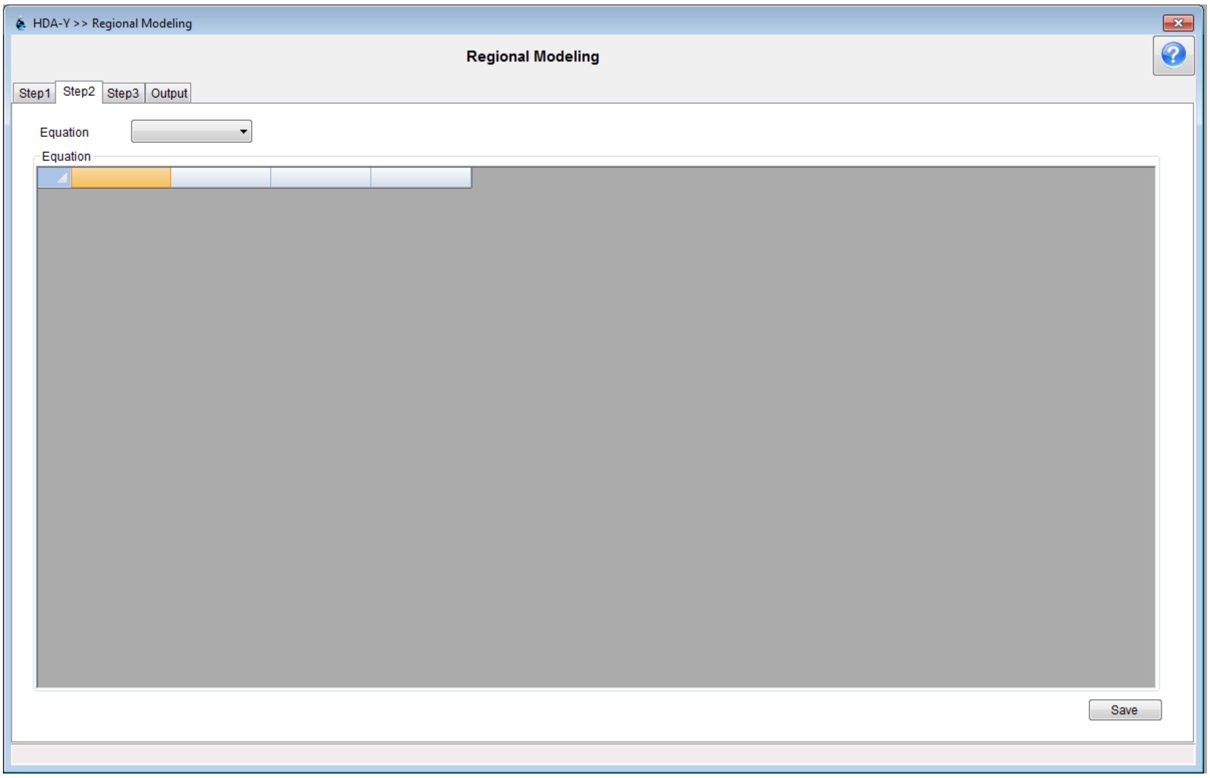
d. Now Click on “***Calculate”*** button. the calculated cluster will display in that textbox.



e. Now click on "***Show button***" map will filled with corresponding colors.

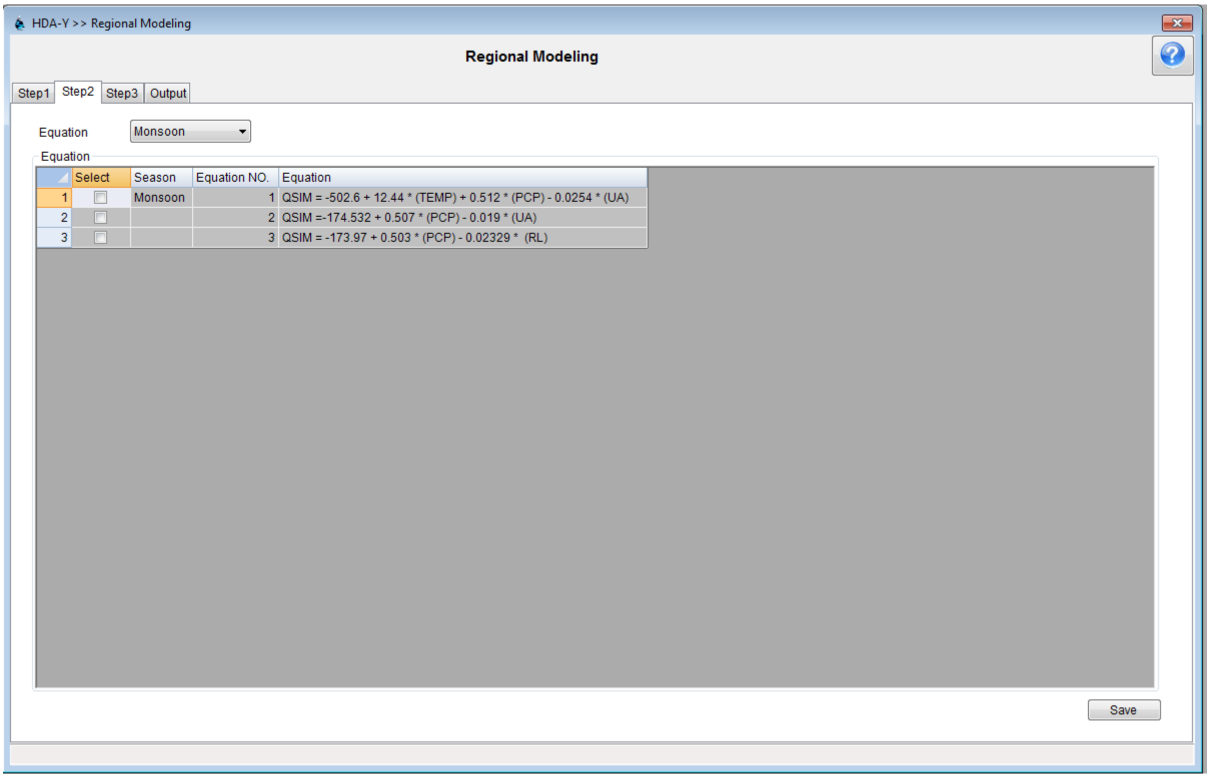


f. After completing the above Step click on Step2 tab.



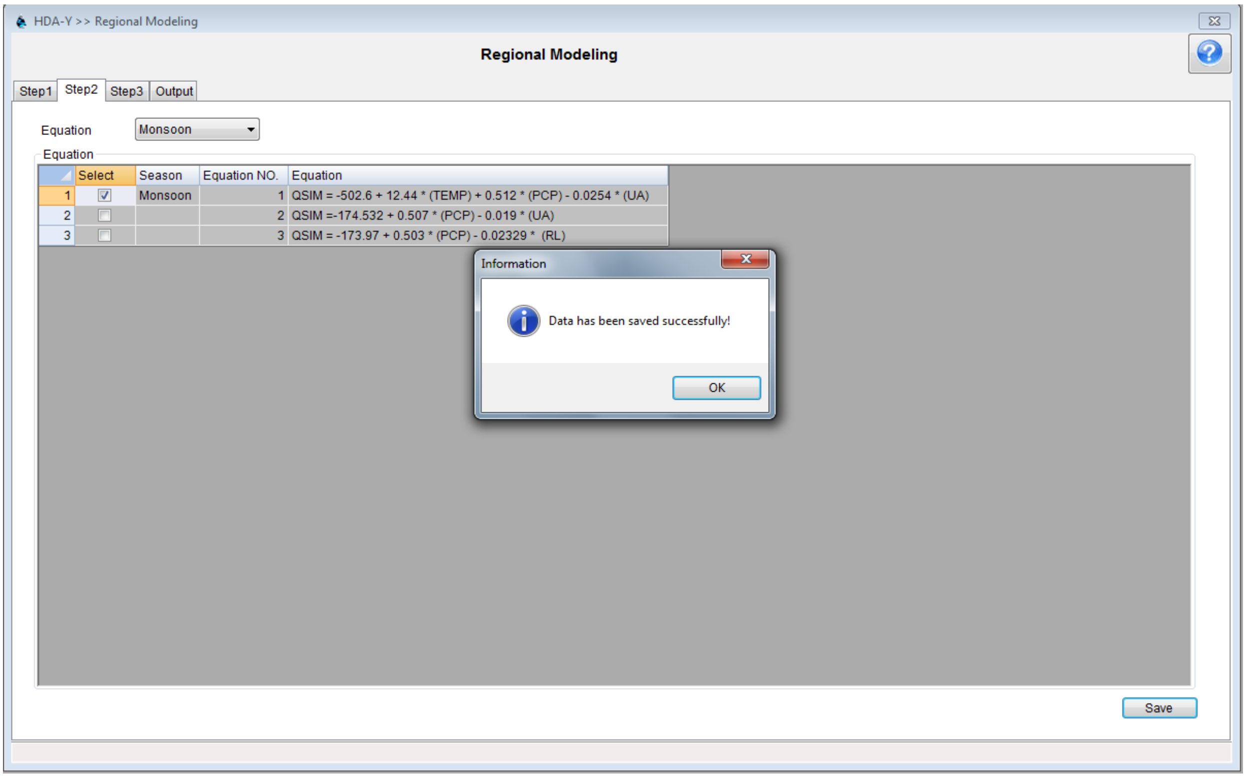
2. Step2

a. Select your equation monthwise or monsoon then equation will display as the given figure below.



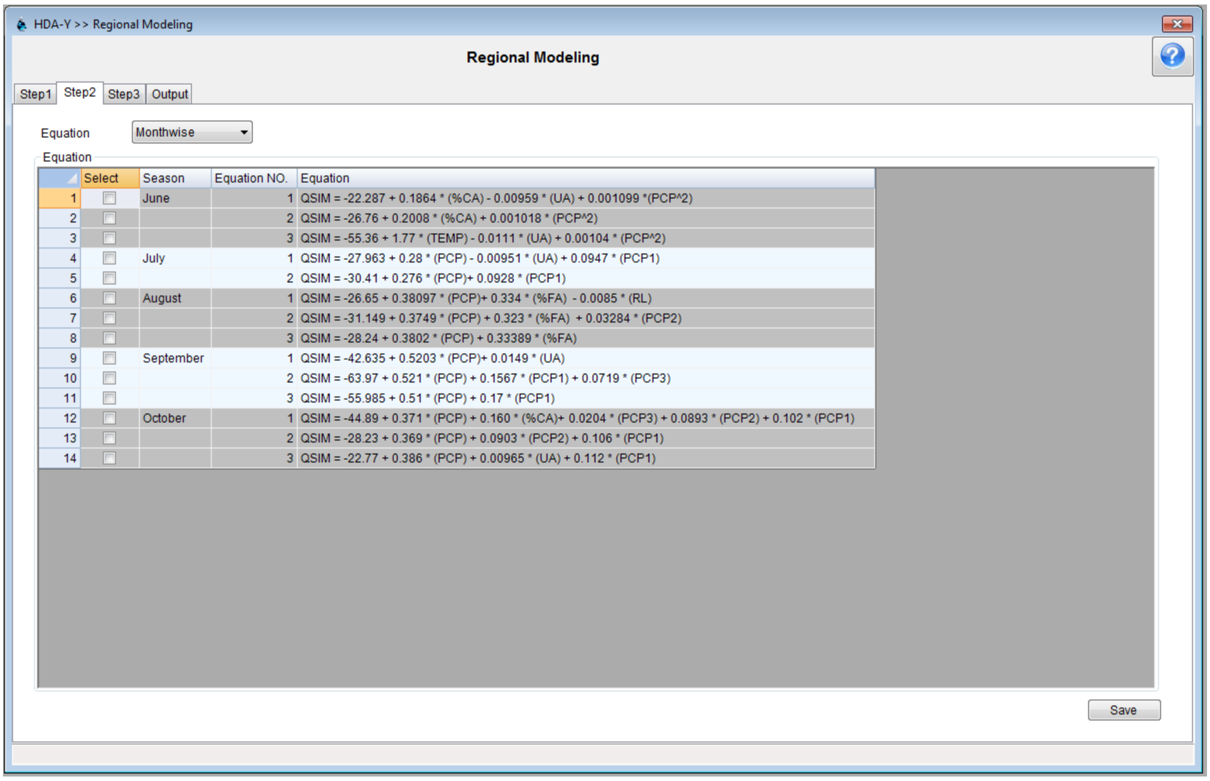
b. If you select monsoon equation then you can select only one equation at a time.

c. Select equation and after that click on ***"Save"*** button or click on Step3 tab.

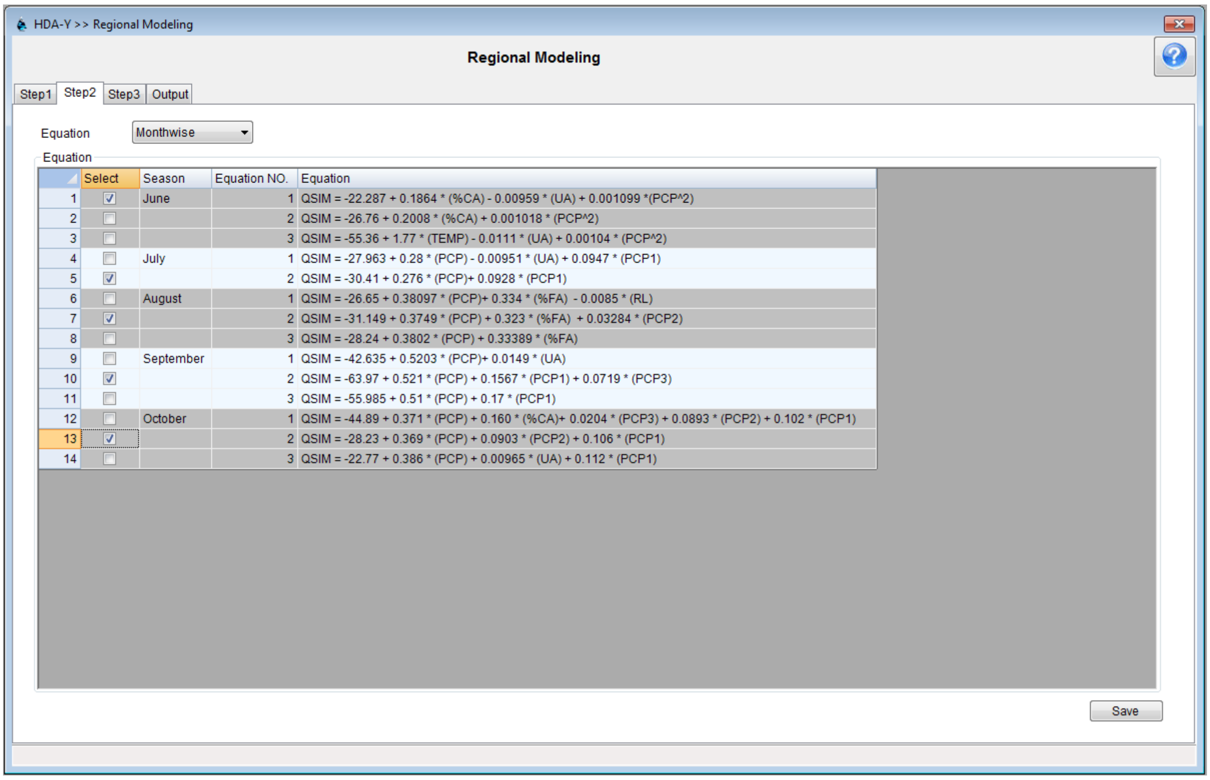


d. If you click on ***"Save"*** button, a message window will display, corresponding data saved successfully. You can go to Step3 without click on ***"Save"*** button. Save button is used to save data with previous operation.

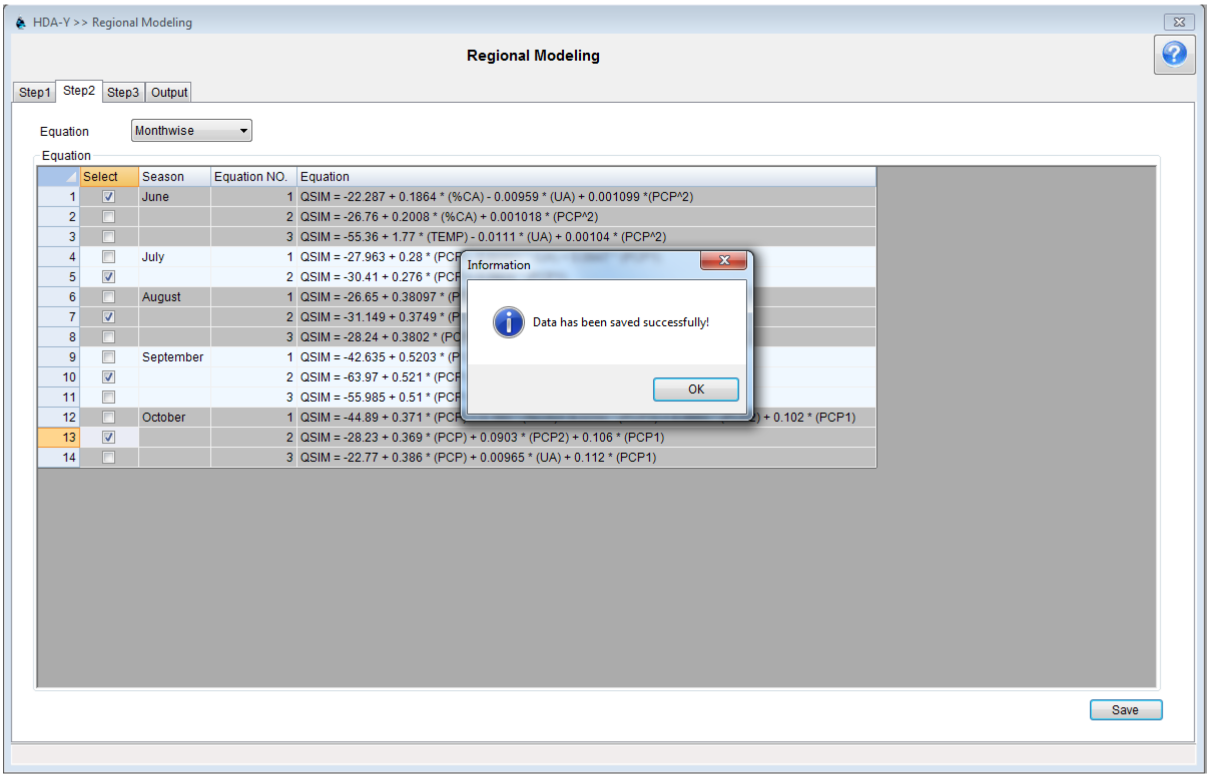
e. If you select monthwise then you can select one equation from every month

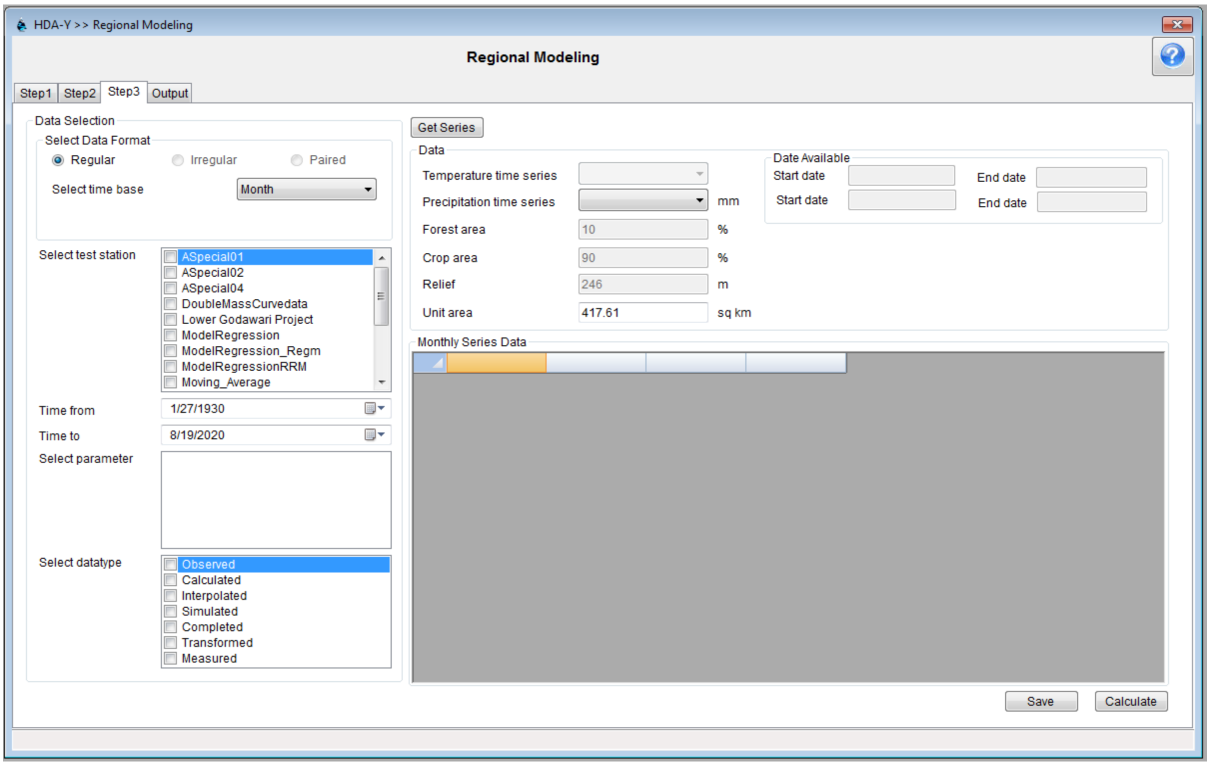


f. Please select only one equation from every month.



g. If you click on ***"Save"*** button, a message window will display, corresponding data saved successfully. You can go to Step3 without click on ***"Save"*** button. Save button is used to save data with previous operation.



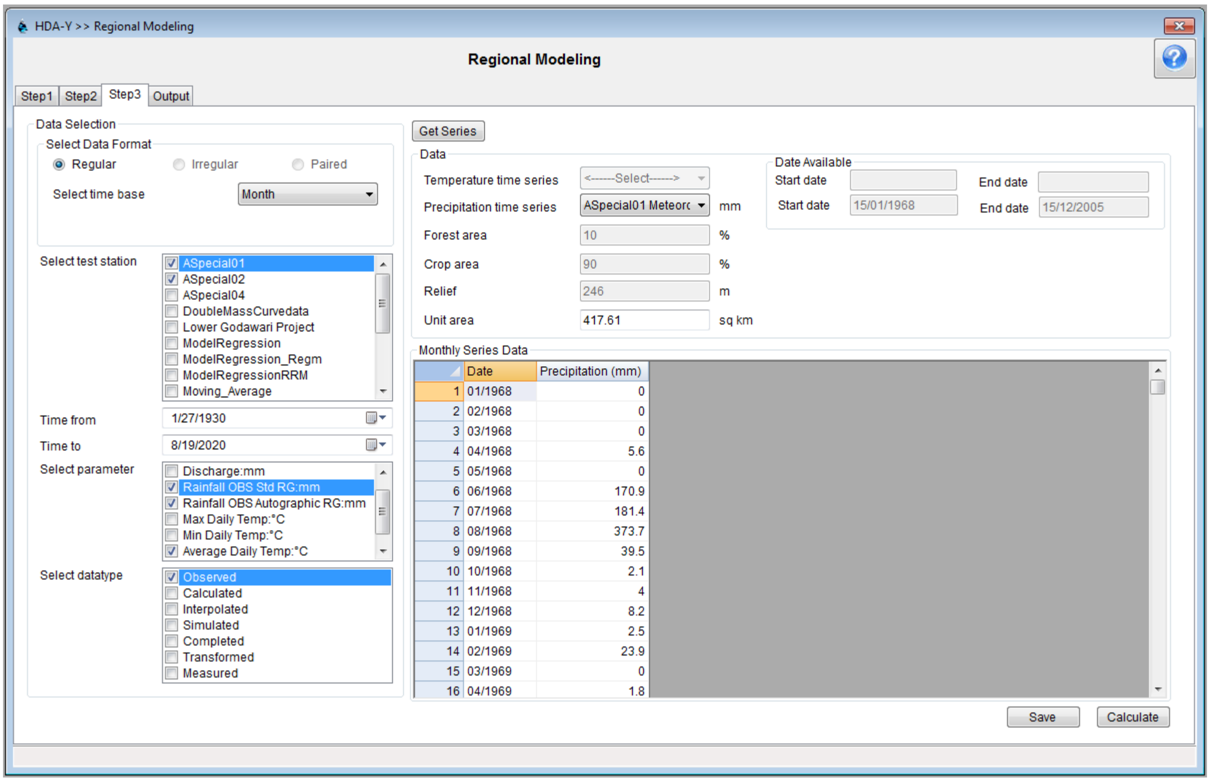


3. Step3

a. Now select data format, select station, its parameter and datatype.

b. Click on "***Get series***" button corresponding data will populate in the dropdown. And the corresponding dropdown and textbox will enable and disable on the basis of equation which you have select in the previous tab.

c. Select series from dropdown, corresponding data series will display in the grid and start, end date in the date available box.



d. Here have two buttons ***"Save"*** and ***"Calculate"***, if you click on save button data will save ("S***ave"*** button is used to save data with previous operation), and if you click on ***"Calculate"*** button, internal calculation will perform and output tab will open automatically.

e. In this output tab data with corresponding graph will shown

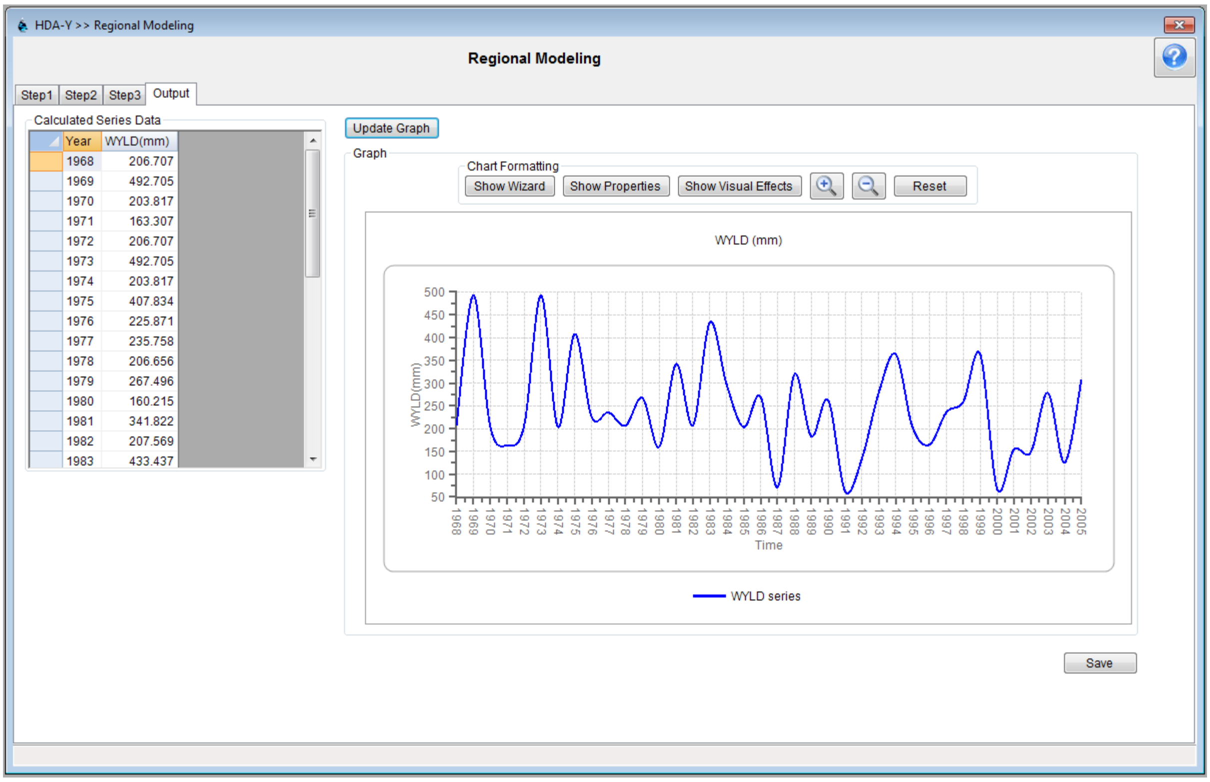


Fig-4 (a) - Monsoon

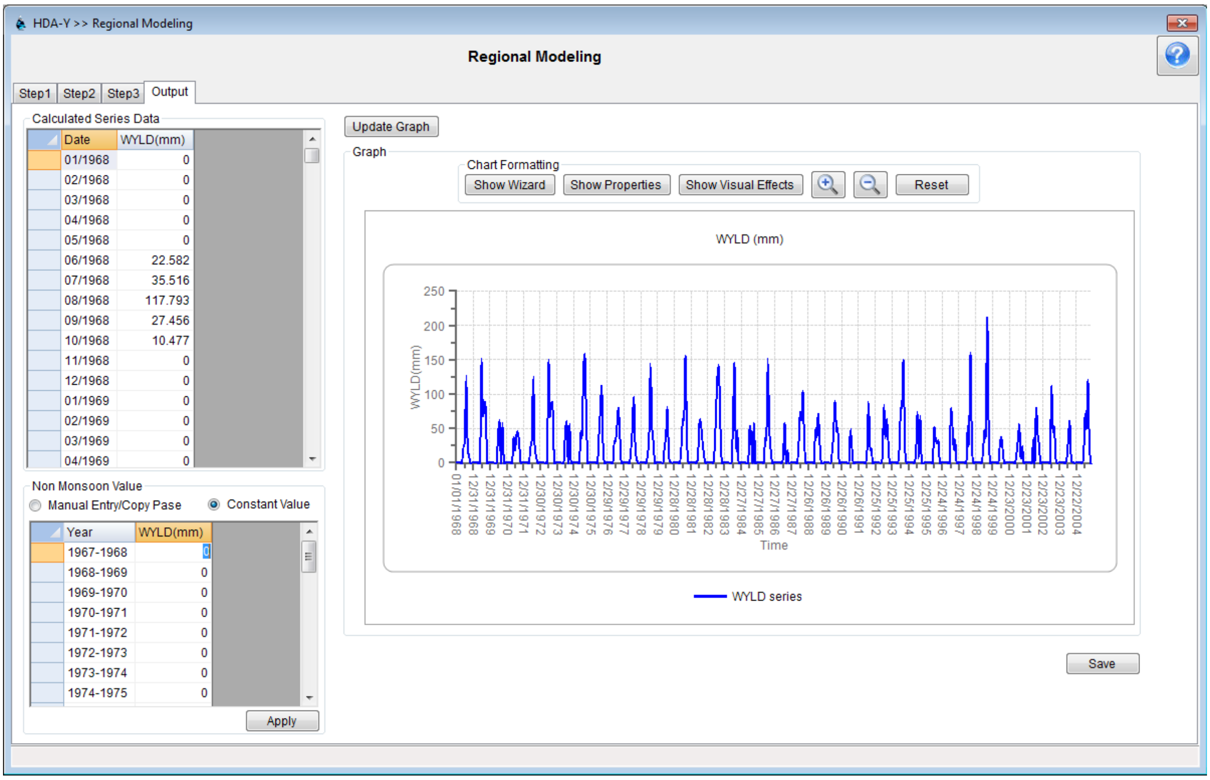
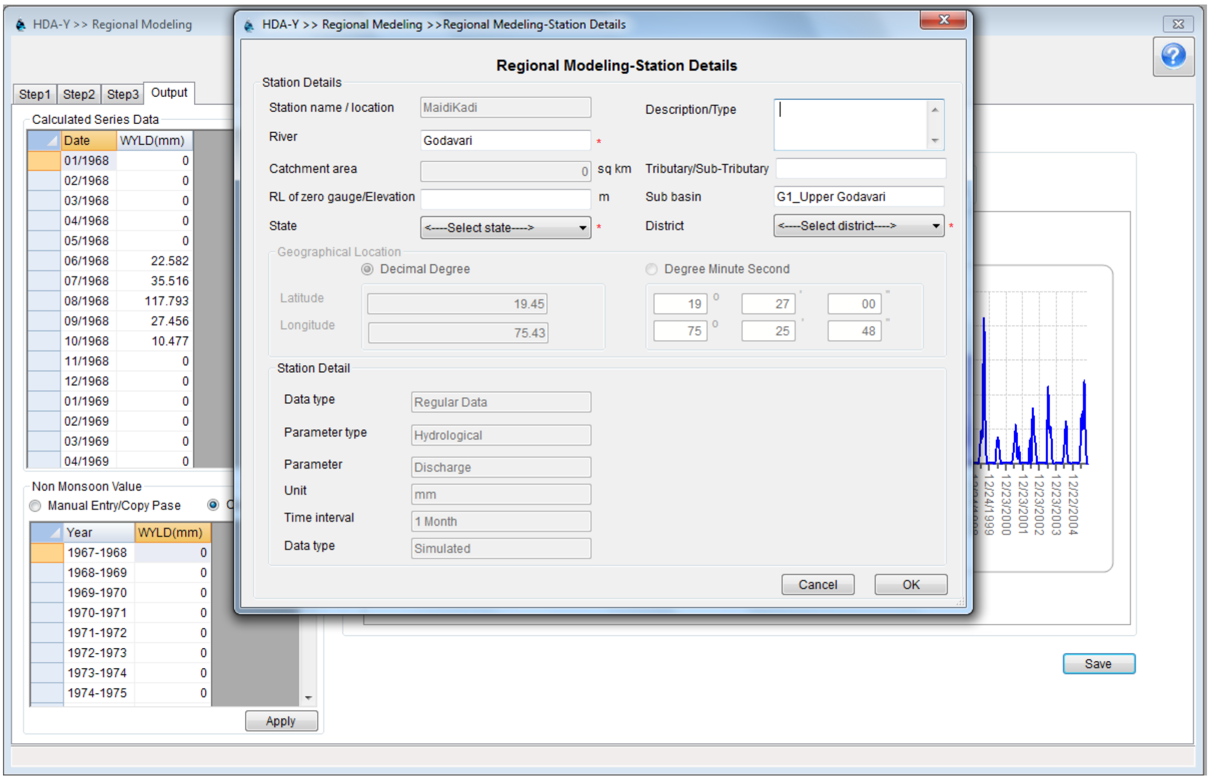
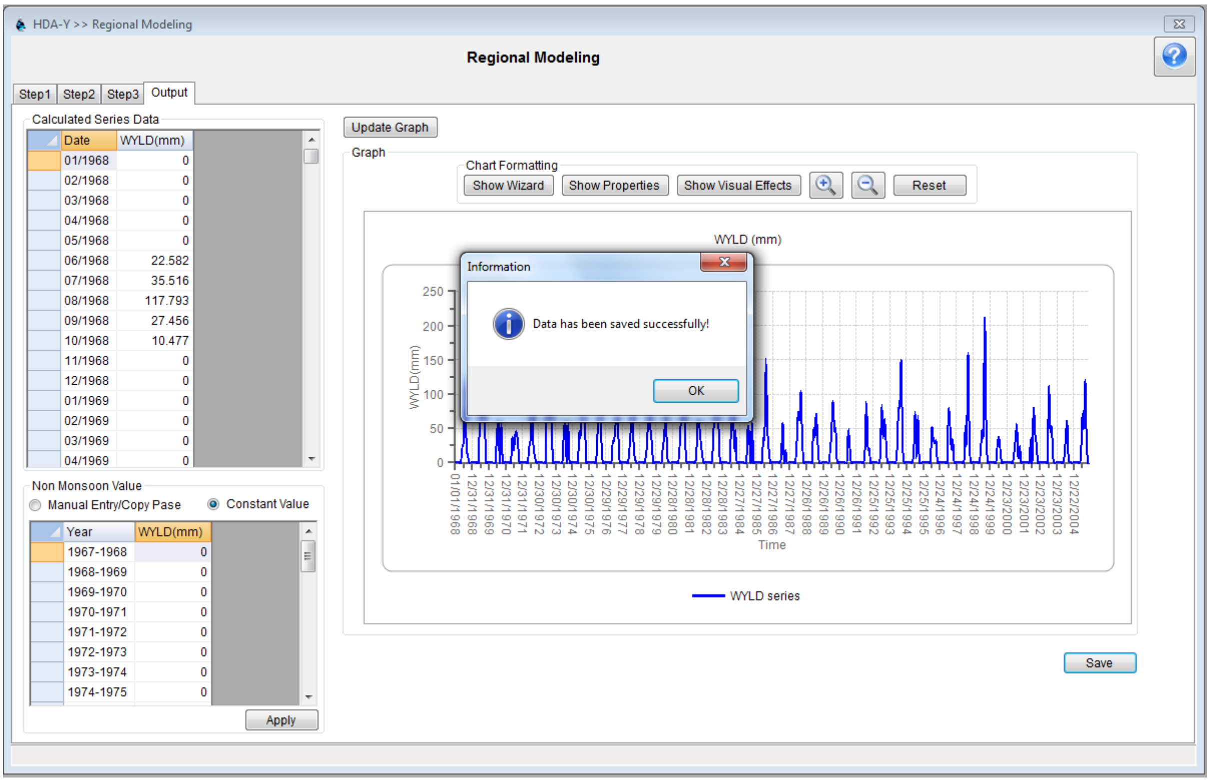


Fig-4 (b) Monthwise

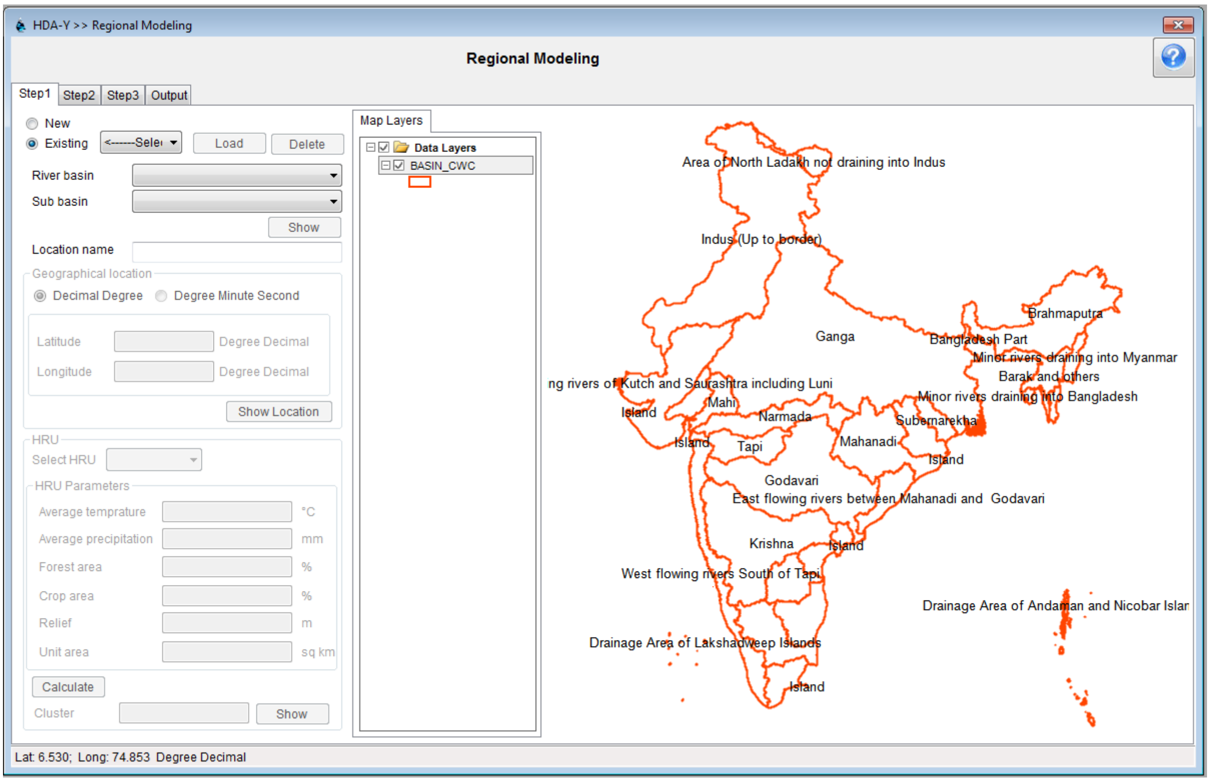
4. You can change value of non-monsoon value data grid, and after that you can update the graph on click on update graph button.
5. Finally you can save the data, click on ***"Save"*** button. When you click on ***"Save"*** button Regional Modeling station details window will open.



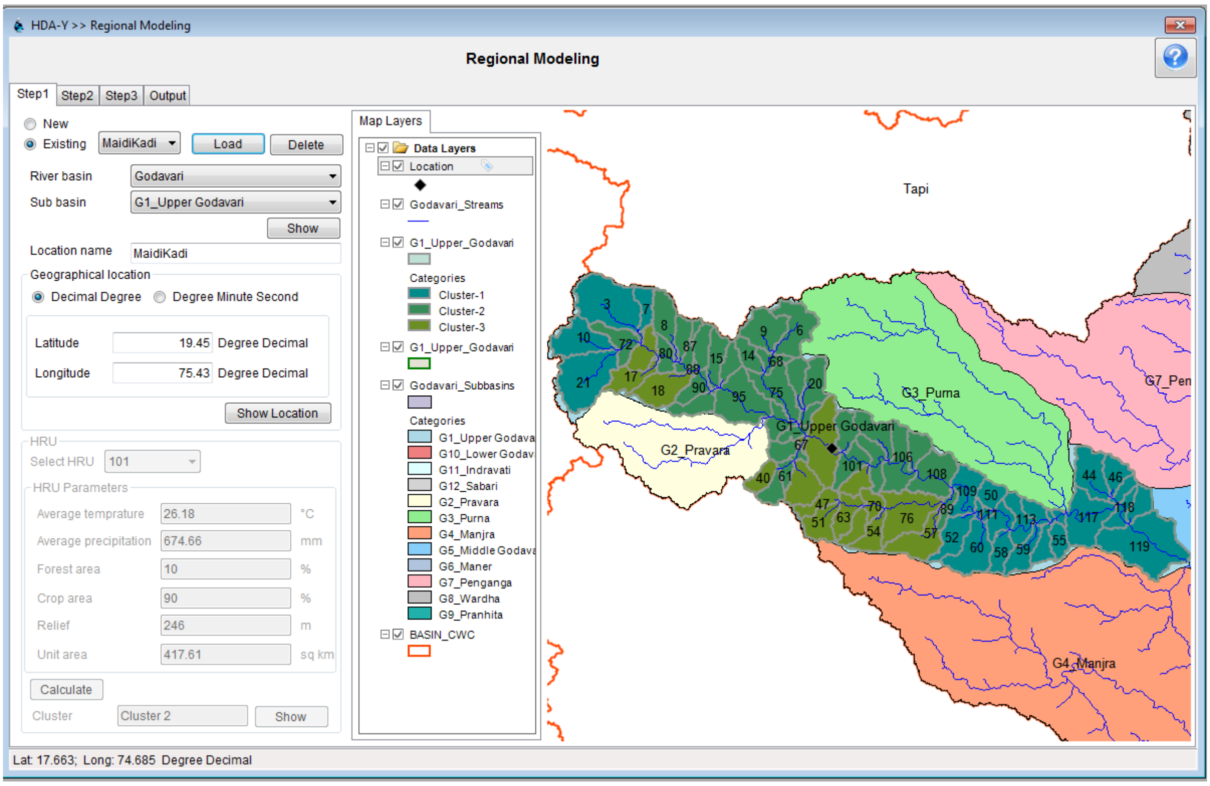
6. Here in this window fill your desired input and click on ***"Ok"*** button. When you click on ***"Ok"*** button final data will saved in your data base.



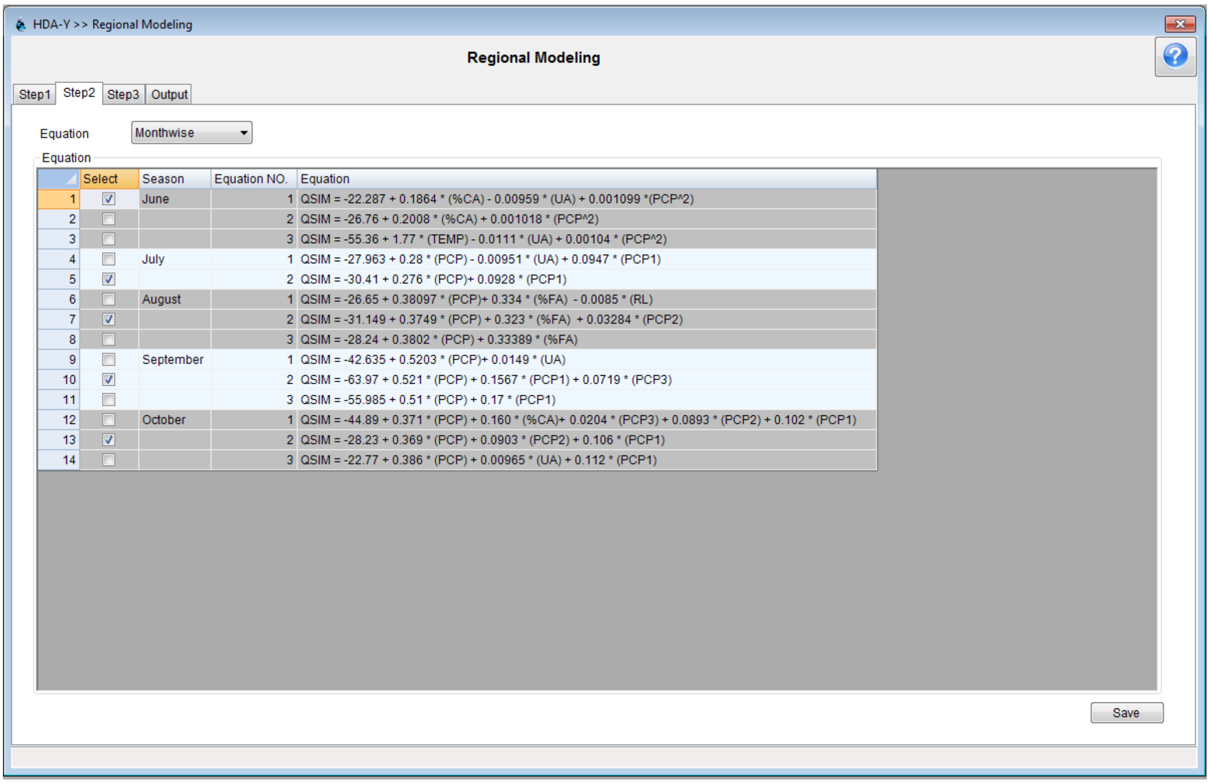
7. Now go to Step1 for existing radio button click on existing radio button.

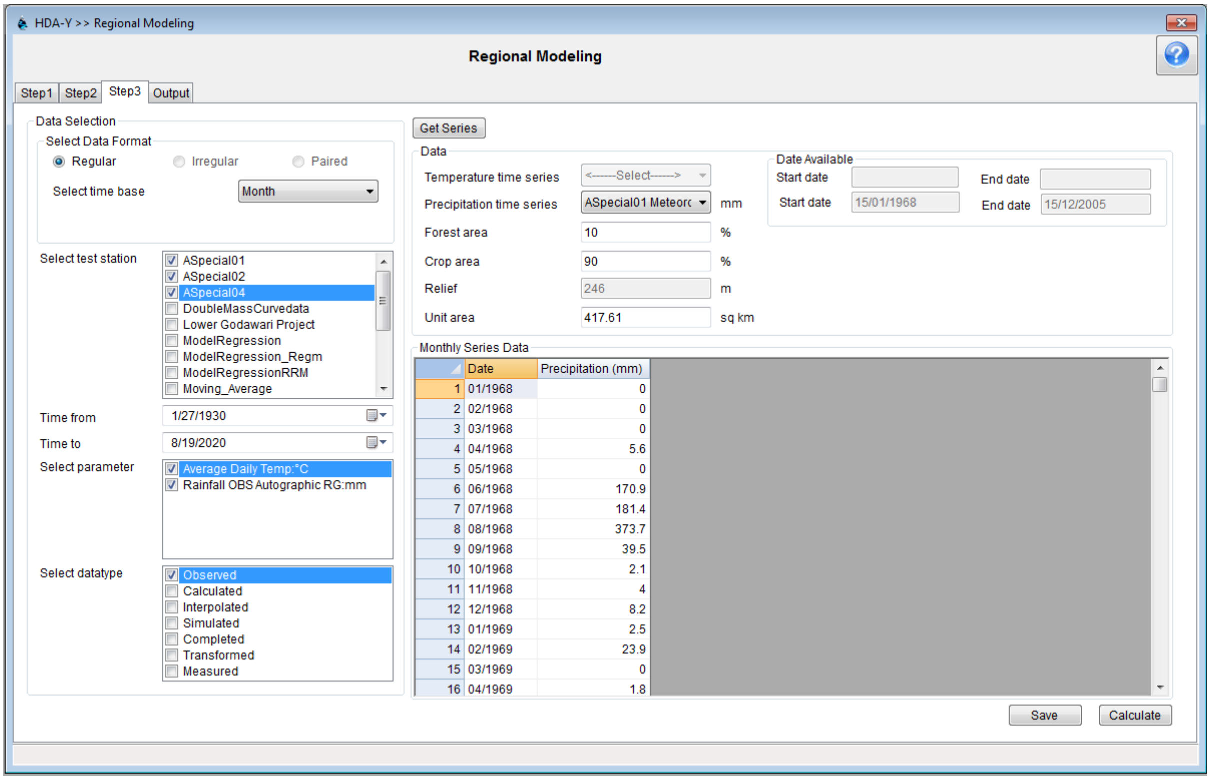


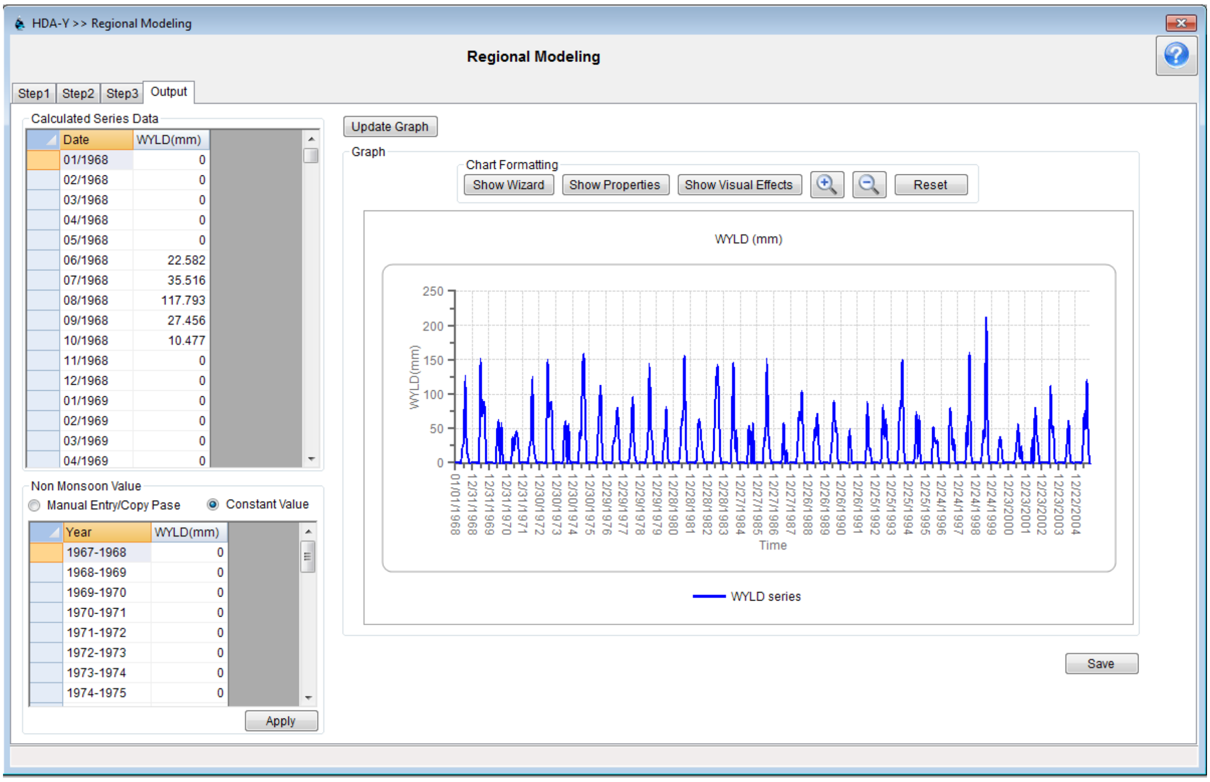
8. Now select the existing location name so you can delete it or load, when you click on ***"Delete"*** button, this existing location will be delete permanently, if you click on ***"Load"*** button, saved data will be loaded and filled in the corresponding control as given figure below.



9. You can open all tab and show the saved data. And further you can change as according to your need.




HDA-Y >> Regional Modeling
Regional Modeling
Step1 Step2 Step3 Output
Data Selection
Select Data Format
Regular Irregular Paired
Select time base Month
Select test station
ASpecial01
ASpecial02
ASpecial04
Time from 1/27/1930
Time to 8/19/2020
Select parameter
Average Daily Temp:°C
Rainfall OBS Autographic RG:mm
Select datatype
Observed
Get Series
Temperature time series
Precipitation time series
Forest area 10 %
Crop area 90 %
Relief 246 m
Unit area 417.61 sq km
Date Available
Start date 15/01/1968 End date 15/12/2005
Monthly Series Data
Save Calculate


HDA-Y >> Regional Modeling
Regional Modeling
Step1 Step2 Step3 Output
Calculated Series Data
Update Graph
Graph
Chart Formatting
Show Wizard Show Properties Show Visual Effects Reset
WYLD (mm)
WYLD(mm)
Time
WYLD series
Non Monsoon Value
Manual Entry/Copy Pase Constant Value
Apply
Save

10. Interface

10.1. WinWRAP

About WinWRAP

The Water Rights Analysis Package, or WRAP, is a package for analyzing water rights. This package is a collection or suite of programs that work together with the end goal of producing useful output. The path from initial data to the end result output is followed as each of WRAP's programs is examined.

The Water Rights Analysis Package (WRAP) modeling system simulates management of the water resources of a river basin or multiple-basin region under priority-based water allocation systems. In WRAP terminology, river/reservoir system water management requirements and capabilities are called water rights. The model facilitates assessments of hydrologic and institutional water availability/reliability in satisfying requirements for instream flows, water supply diversions, hydroelectric energy generation, and reservoir storage. Reservoir system operations for flood control can be simulated. Capabilities are also provided for tracking salinity loads and concentrations. Basin-wide impacts of water resources development projects and management practices are modeled. The modeling system is generalized for application anywhere, with input datasets being developed for the particular river basins of concern.

Appropriate of Usage

WRAP simulation studies combine a specified scenario of river/reservoir system management and water use with river basin hydrology represented by sequences of naturalized stream flows and reservoir evaporation-precipitation rates at pertinent locations for each monthly or sub-monthly interval of a hydrologic period-of-analysis. Model application consists of:

- Compiling water management and hydrology input data for the river system
- Simulating alternative water resources development, management, and use scenarios
- Developing water supply reliability and stream flow and storage volume frequency relationships and otherwise organizing and analyzing simulation results

Key Input

The modular programs of WRAP employ command line interfaces (similar to DOS) that many elementary computer programs use. WRAP utilizes an organizational style that is reliant on ASCII text files. These files are rigidly organized, delimited by spaces, and require that the data be exactly placed—a deviation by a single space wreaks havoc on the programs' processing capabilities. Nevertheless, despite these files' rigid requirements, experienced users are able to navigate the tedious waters of input file manipulation.

Key Output
WRAP-HYD

WRAP-HYD provides an environment for developing necessary input files for WRAP-SIM, namely the file of monthly naturalized flows (FLO) and the file for net evaporation-precipitation depths (EVA). These files are of a hydrological nature, thus the "HYD" in WRAP-HYD.

Because WRAP-HYD is solely used to produce the input files for the subsequent program, its use can be skipped entirely if the FLO and EVA files are already available (e.g. TCEQ has naturalized flows for given times for Texas). As shown in Figure 1, the EVA file is both an input and output file for WRAP-HYD; therefore, the unique output is the naturalized flow file. While naturalized flows will be discussed at length in the Naturalized Flows section, it will suffice to say that the FLO file is used as a base case of flow, from which specific anthropogenic effects are added or subtracted therefrom (e.g. diversions, reservoir effects) in the process of modeling available flows for water rights (for more information, see the Naturalized Flows section of this report).

In the WRAP path, the user feeds historical flow and evaporation-precipitation data files to WRAP-HYD and obtains the FLO and EVA files as output. These files are then used in WRAP-SIM.

WRAP-SIM

The "SIM" in WRAP-SIM stands for simulation. This is where the main simulation of WRAP takes place. Water balances for each month of the simulation period are performed, using the FLO and EVA files, along with information for specific reservoir information, channel losses, specified diversions, instream flow requirements (amounts of flow that are required to be in the stream), and hydroelectric power requirements.

HDA Interface

WinWRAP is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Key input time series data of flow and evapoaration.HDA generates respective ASCISS text files which area compatible with WinWRAP application. After creating all the required WinWRAP input files, HDA lauches pre-installed WinWRAP from HDA interface. Following this user has to perform simulation and analysis in WinWRAP outside of HDA.

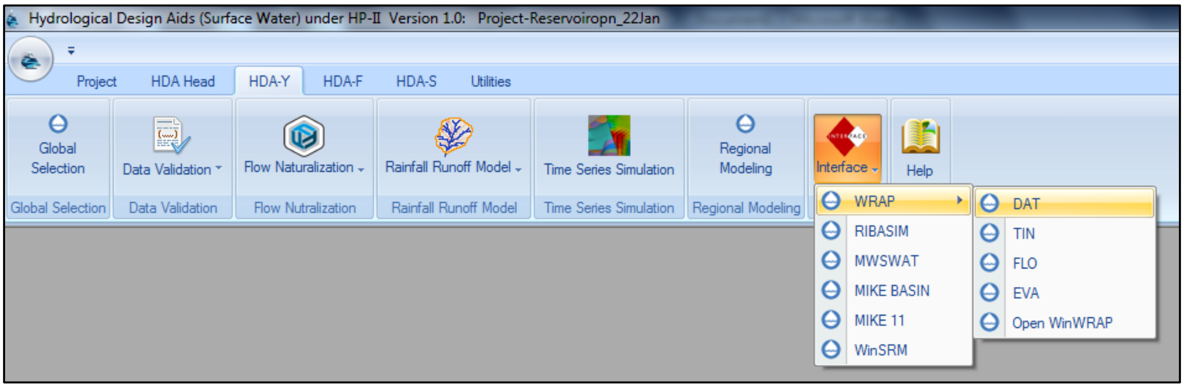
After performing analysis in WinWRAP (outside HDA), if user saves WinWRAP output time series(s), in *.xlsx or *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA WinWRAP Interface
How to Access

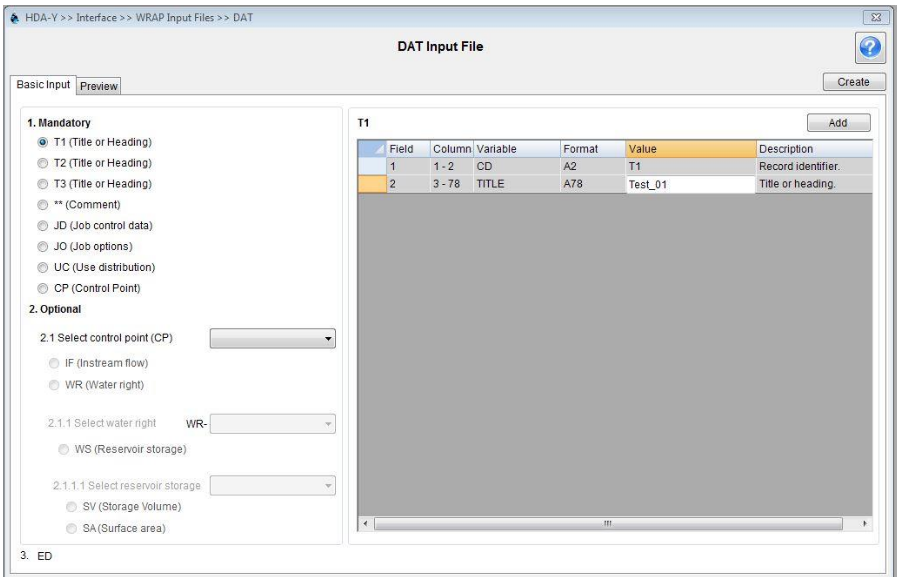
Steps for WRAP interface

Create *.DAT File
Steps-

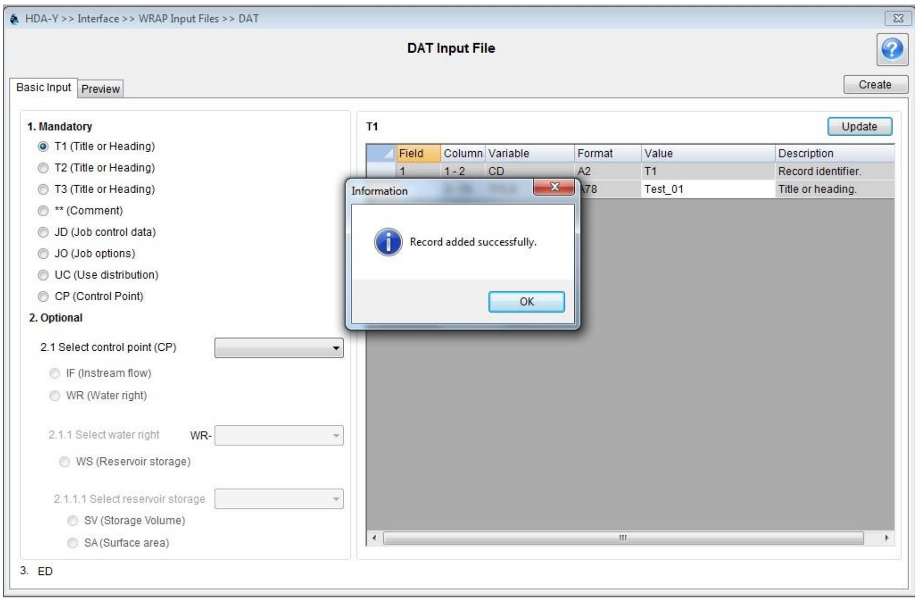
1. Go to- HDA – Y >> Interface >> WRAP >> DAT



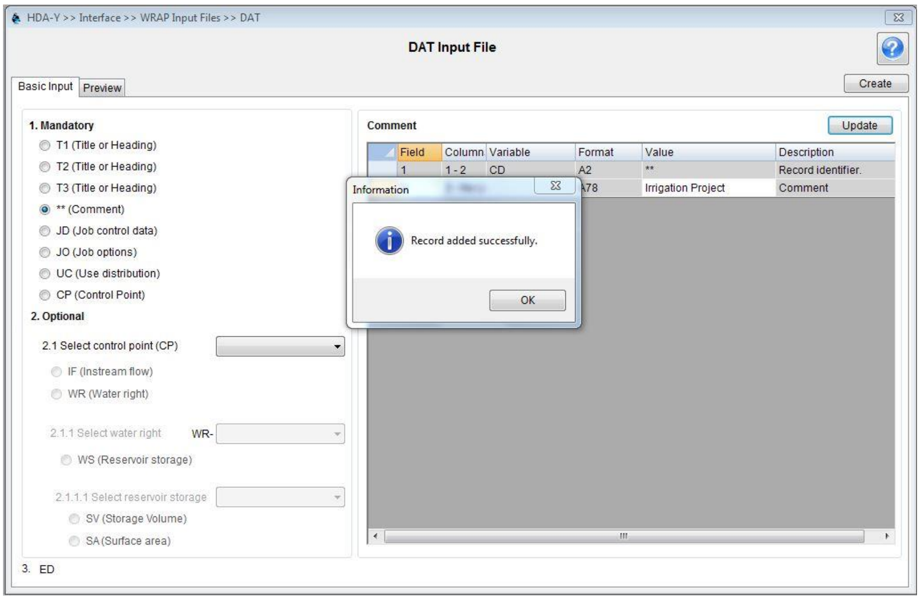
2. Under 'Basic Input' tab
   a. Mandatory
      i. T1, T2 or T3 (Title or Heading)



Under mandatory section select "T1, T2 or T3", find description regarding T1, T2, or T3 at right side of the window. Write title of heading form the file. Here it is mentioned as "Test_01".
Click on "Add" button to add title for the file.



ii. ** (Comments)



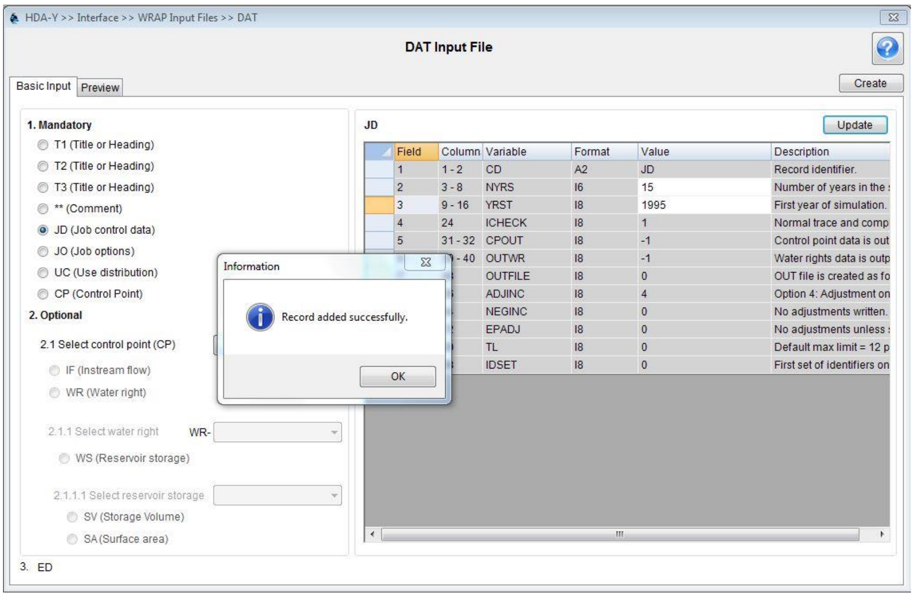
Under mandatory section select "**", find description regarding ** at right side of the window. Write title of heading form the file. Here it is mentioned as "Irrigation Project".

Click on "Add" button to add title for the file.

iii. JD (Job Control Data)

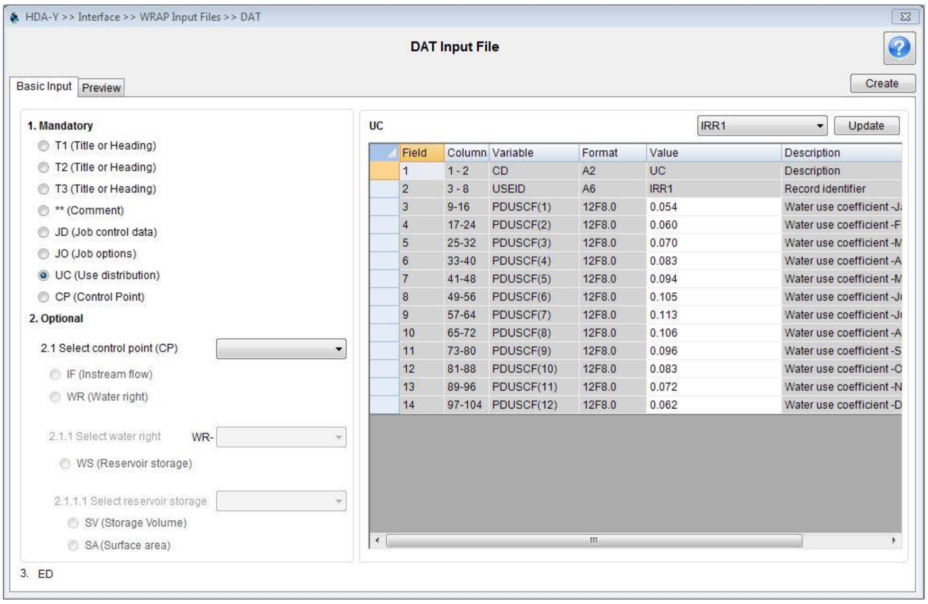
To enter job control data select "JD" from mandatory section and enter required information under column 'value' (number of years in the simulation and first year of the simulation).

Here, starting year enters as 1995 and total years in the simulation are 15.



iv. JO (Job Options)

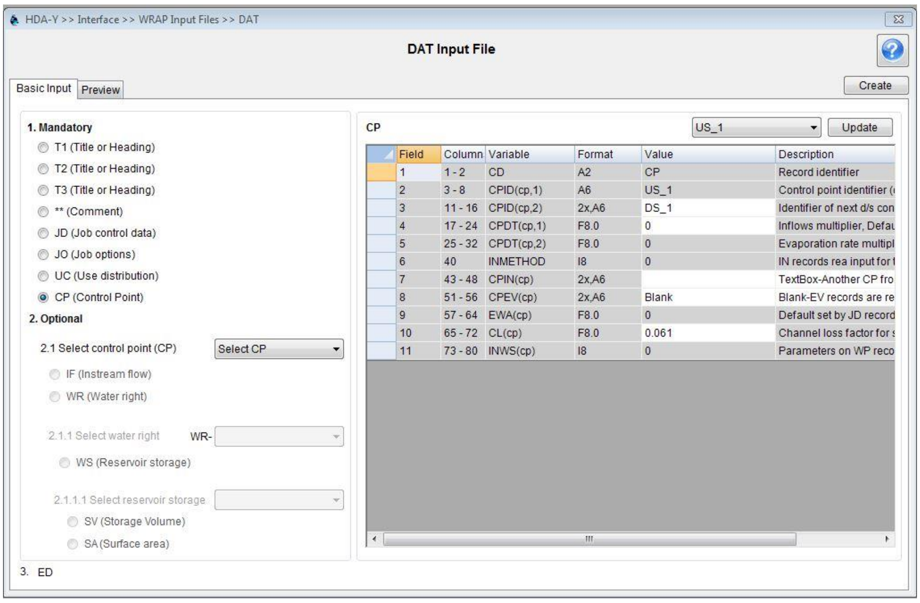
v. UC (Use distribution)



Select "UC" from the mandatory section. Enter water use coefficients month wise under column Value.

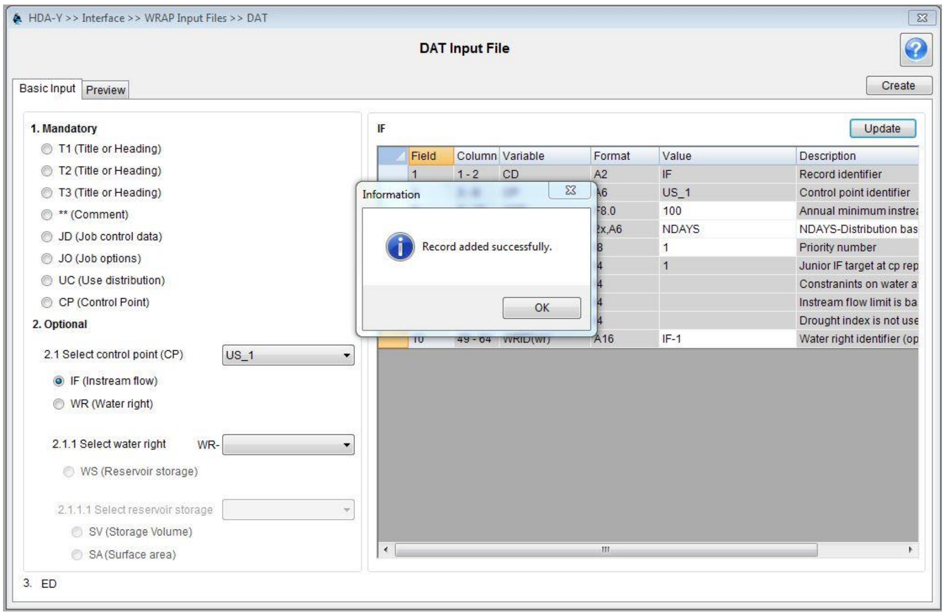
vi. CP (Control Point)

Select "CP" from mandatory section to define control points of the project. Define control point details under column Value.



b. Optional

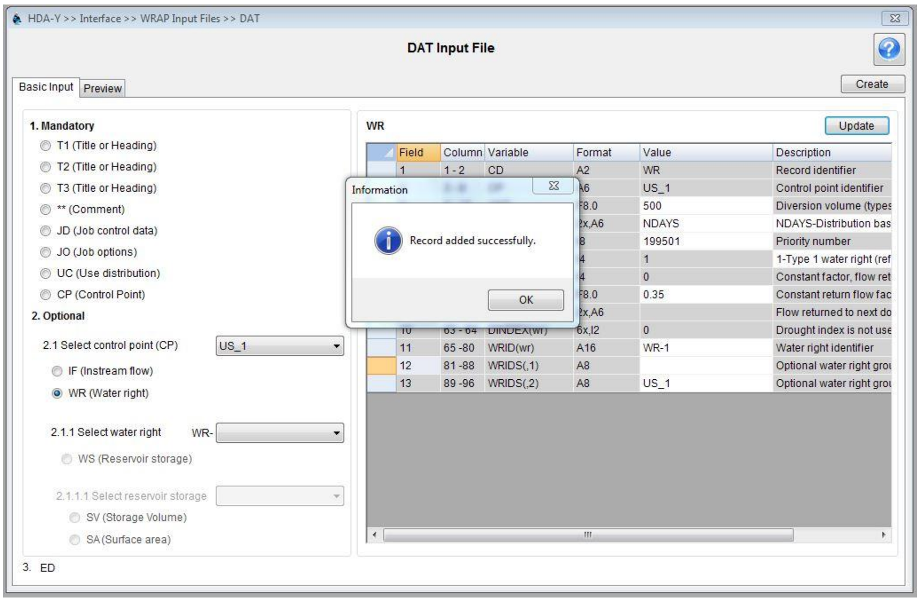
i. IF (Instream Flow)



Select control point for which instream flow information need to enter. Then select IF and enter necessary information and details under the column value. After entering the all details click on the Add button.

ii. WR (Water Right)

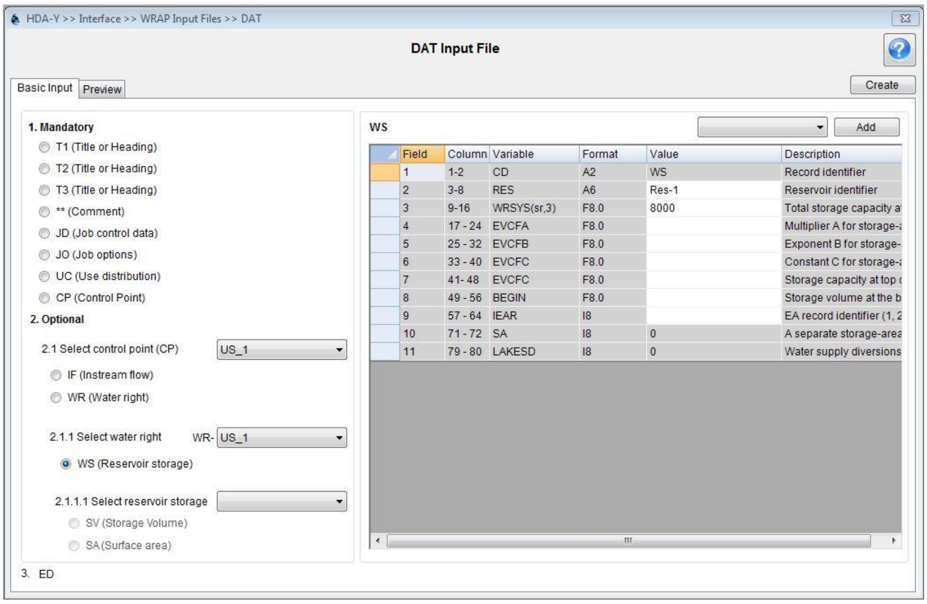
As mention for the IF (instream flow) carry out the same procedure to WR.



iii. WS (Reservoir Storage)

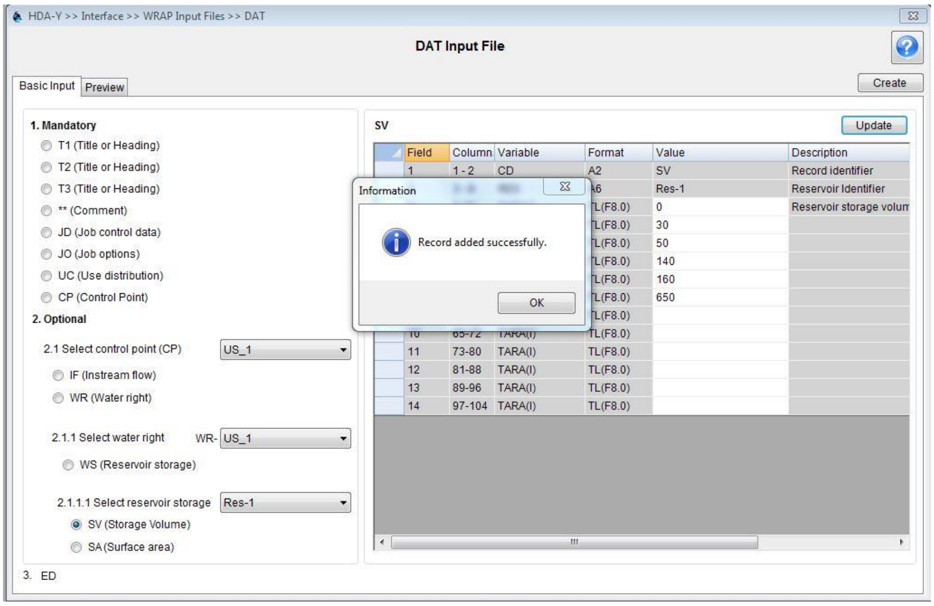
Select "WS" under optional section.

Enter water storage / reservoir storage under column Value.

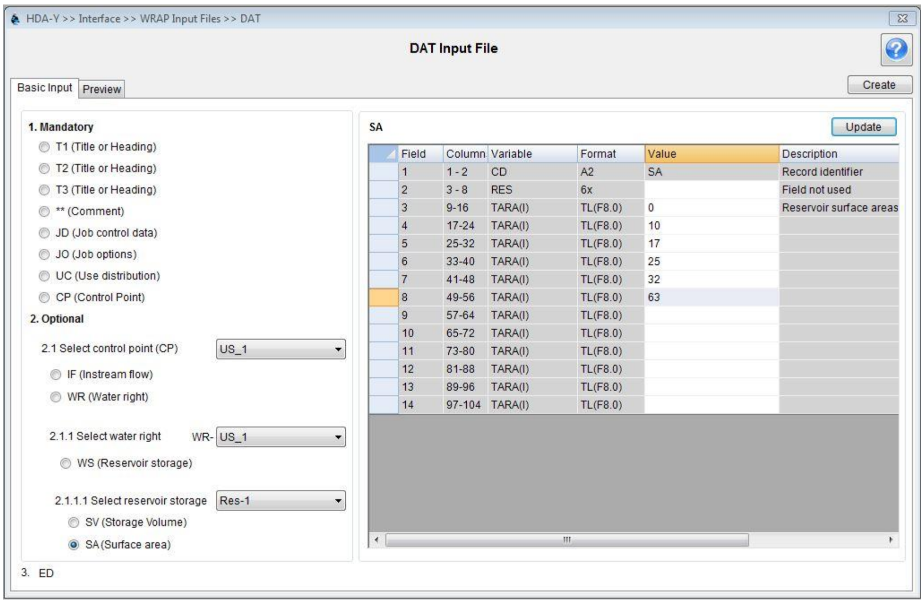


iv. SV (Surface Volume)

Enter surface area and surface volume of the reservoir defined under WS by selecting SA and SV under column Value.

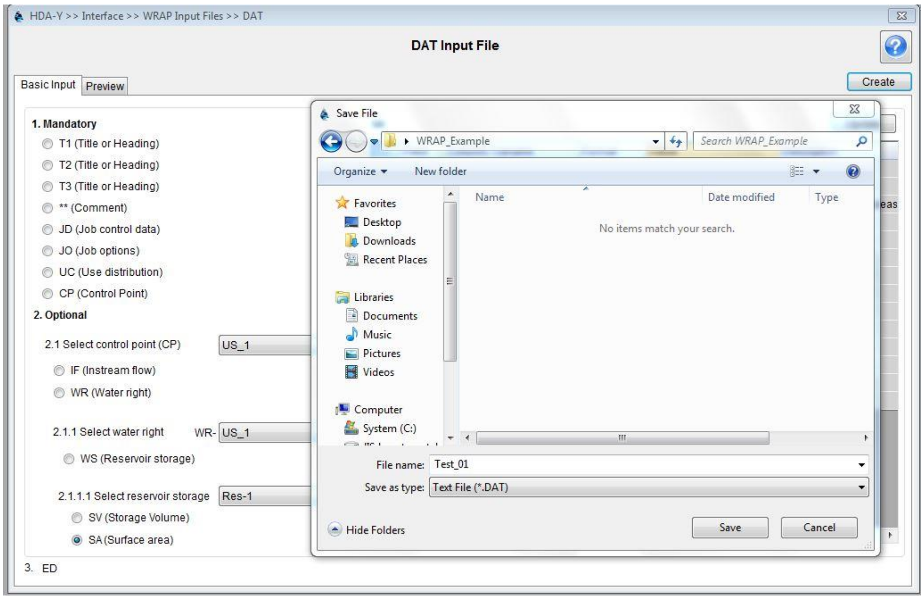


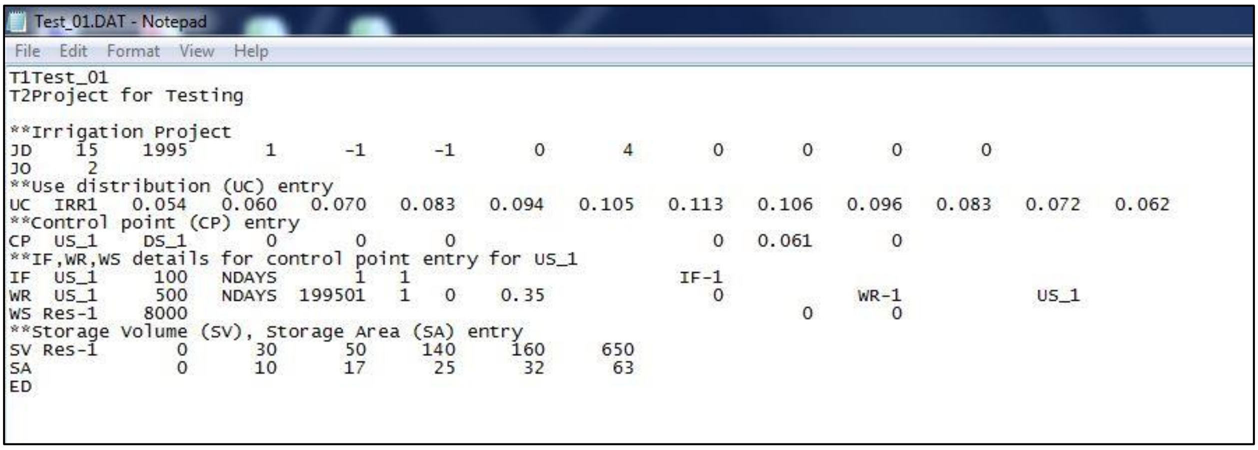
v. SA (Surface Area)



3. Create “DAT”

Click on “Create” button and save the DAT file.




Test_01.DAT - Notepad

File Edit Format View Help

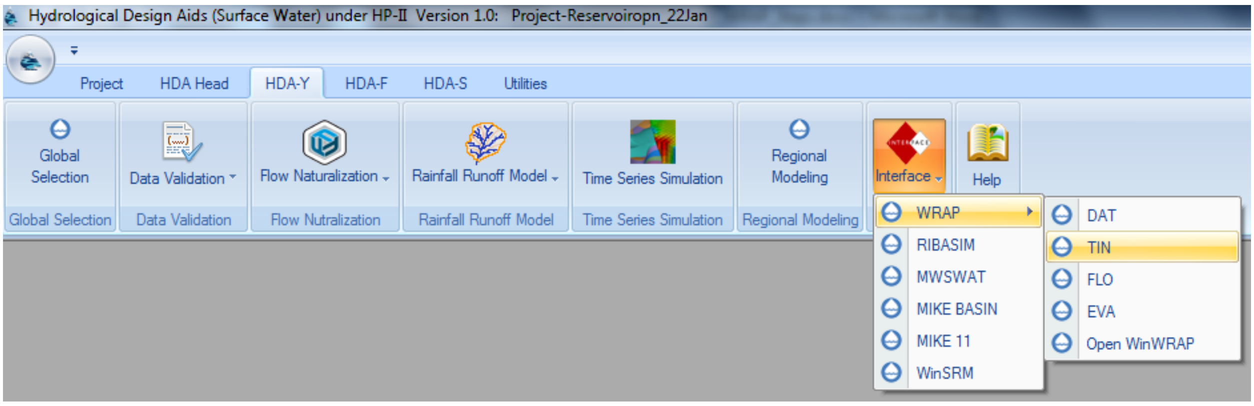
```
T1Test_01
T2Project for Testing

**Irrigation Project
JD    15    1995      1     -1     -1      0      4      0      0      0      0
JO     2
**Use distribution (UC) entry
UC  IRR1   0.054  0.060  0.070  0.083  0.094  0.105  0.113  0.106  0.096  0.083  0.072  0.062
**Control point (CP) entry
CP  US_1    DS_1       0      0      0                     0  0.061      0
**IF,WR,WS details for control point entry for US_1
IF  US_1     100   NDAYS      1      1                 IF-1
WR  US_1     500   NDAYS  199501     1     0   0.35        0                 WR-1           US_1
WS  Res-1   8000                                                   0      0
**Storage Volume (SV), Storage Area (SA) entry
SV  Res-1      0     30     50    140    160    650
SA             0     10     17     25     32     63
ED
```

Create *.TIN File

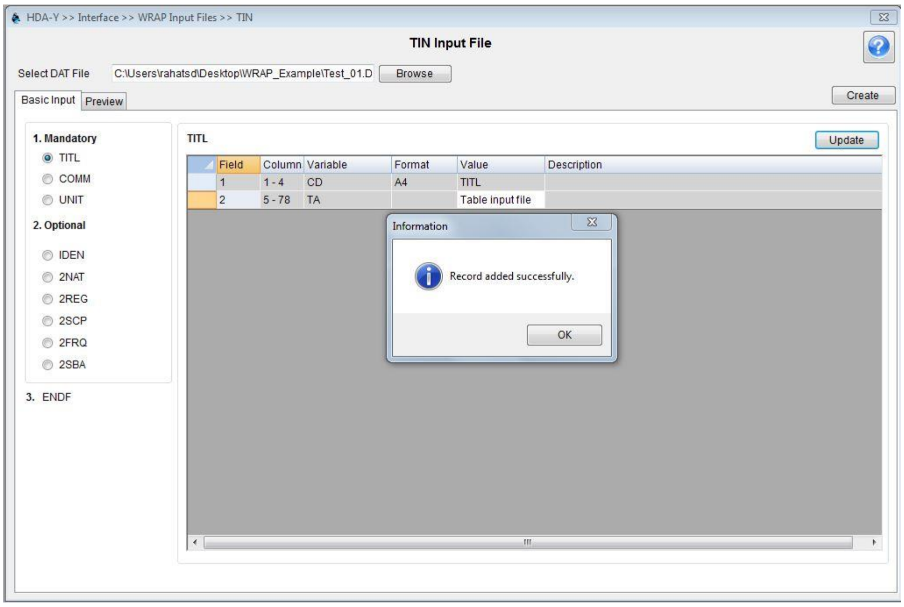
Steps-

1. Go to- HDA – Y >> Interface >> WRAP >> TIN



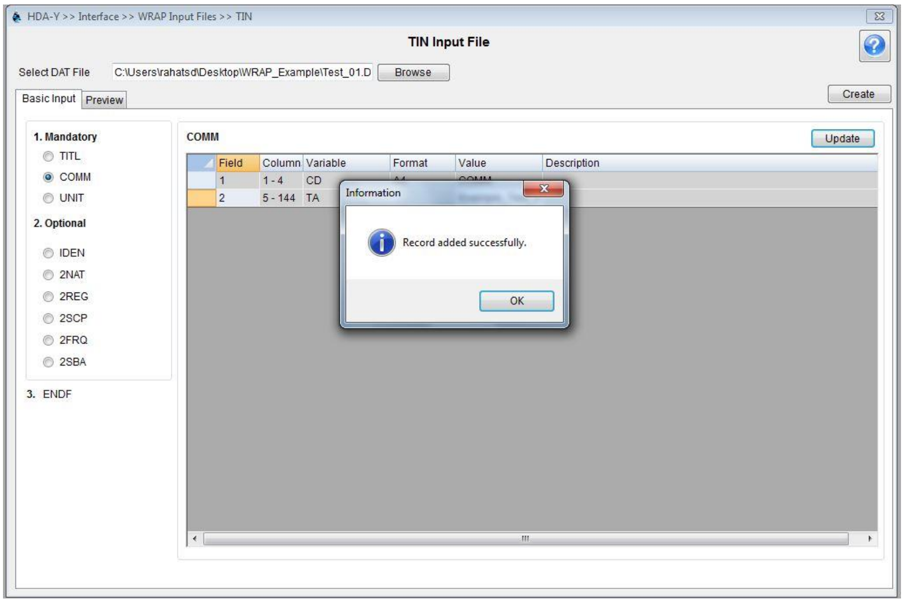
2. Under ‘Basic Input’ tab
    a. Mandatory
        i. TITL (Heading)

Define title or heading for the Table INput file by selecting TITL under mandatory section.



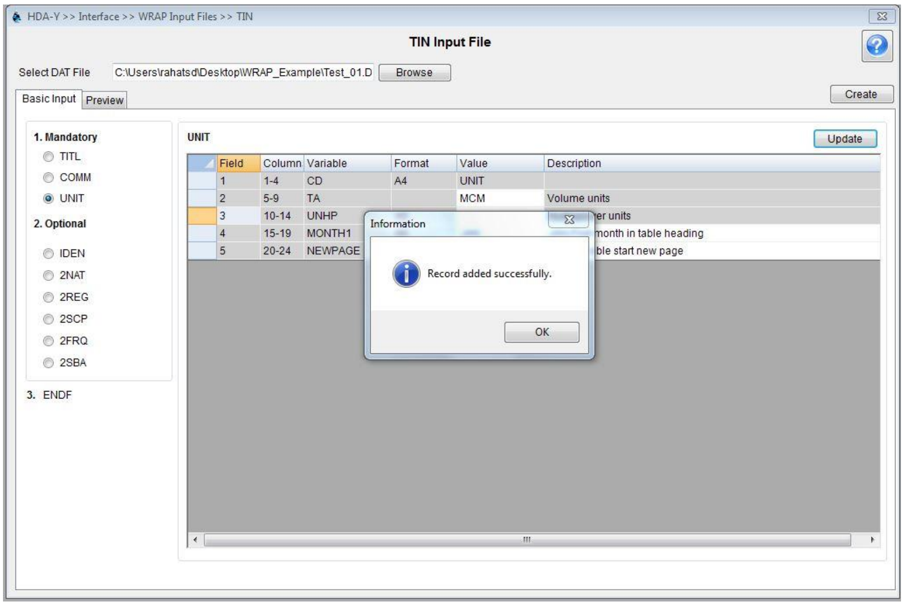
ii. COMM (Comment)

Enter comment for the TIN file by selecting COMM under mandatory section. Write under column Value



iii. UNIT

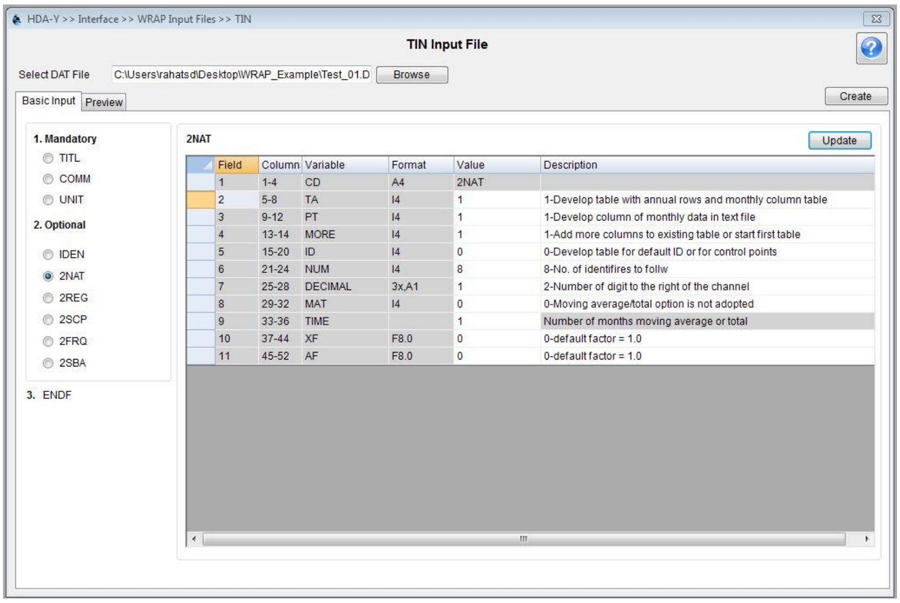
Define unit by selecting UNIT from the mandatory section.



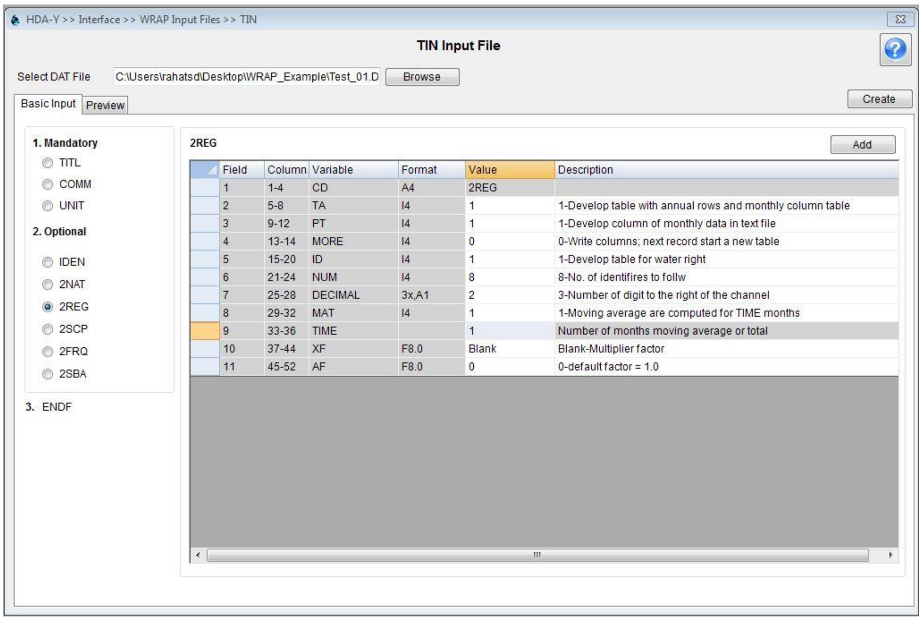
b. Optional

Under optional select 2NAT, 2RG, 2SCP , 2FRQ or 2SBA one by one and enter desire output format from Value column (right side).

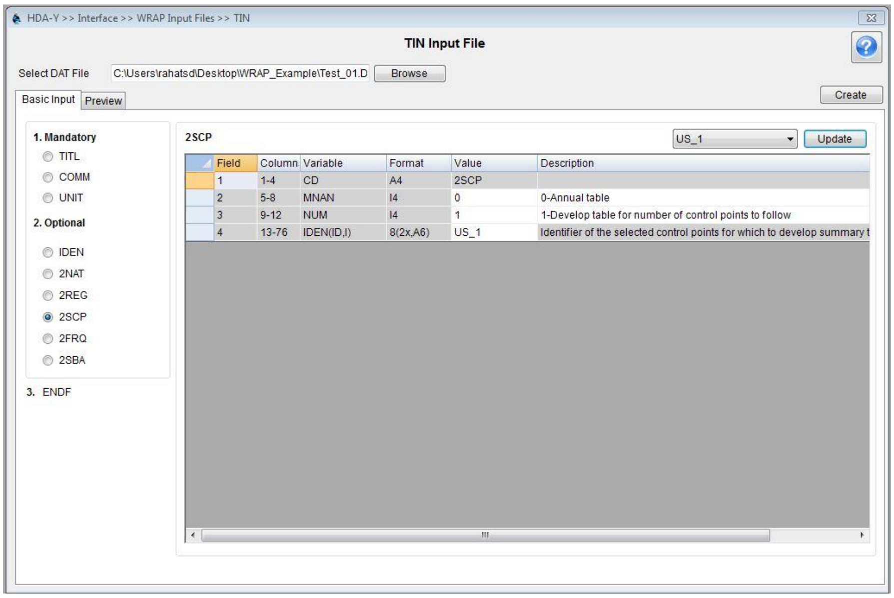
i. 2NAT



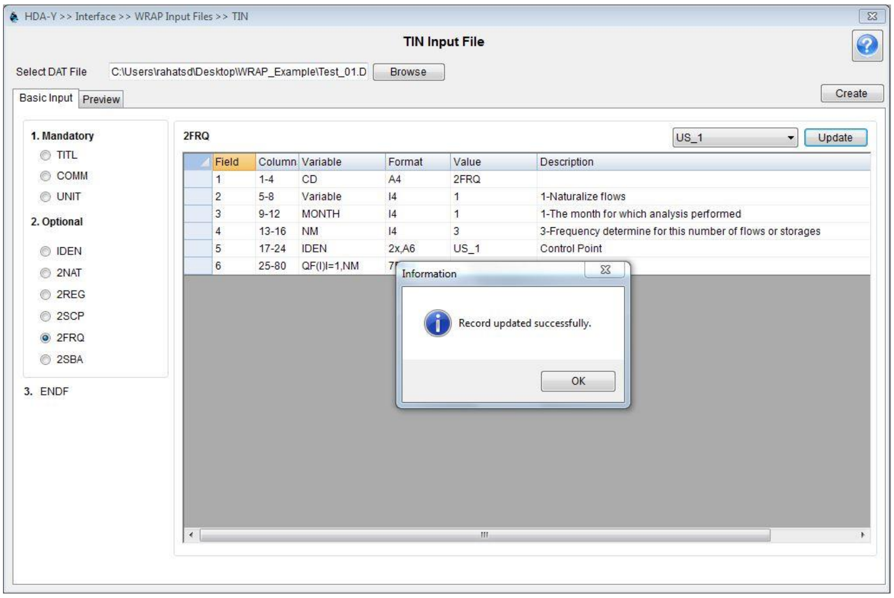
ii. 2REG



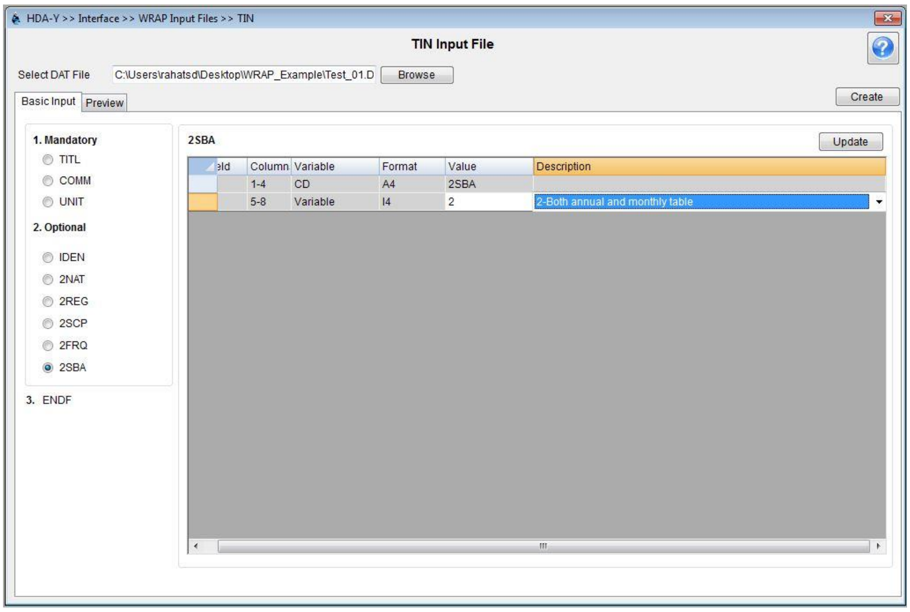
iii. 2SCP



iv. 2FRQ

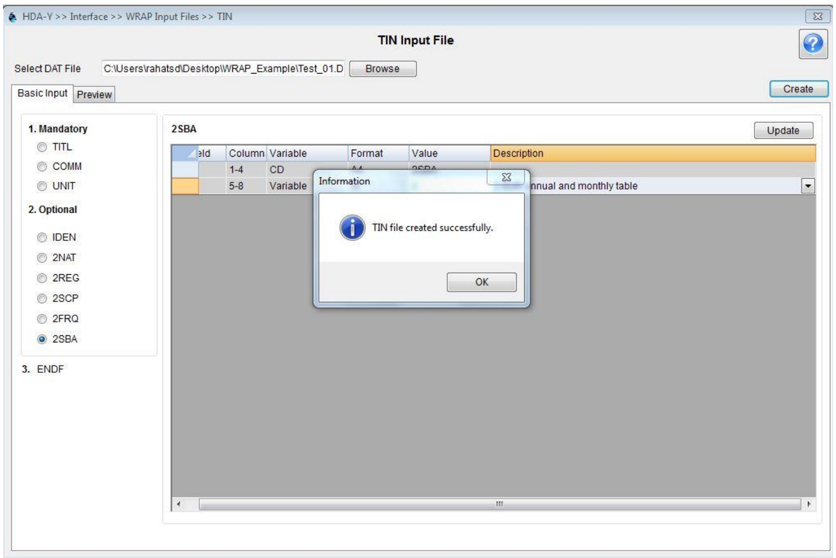


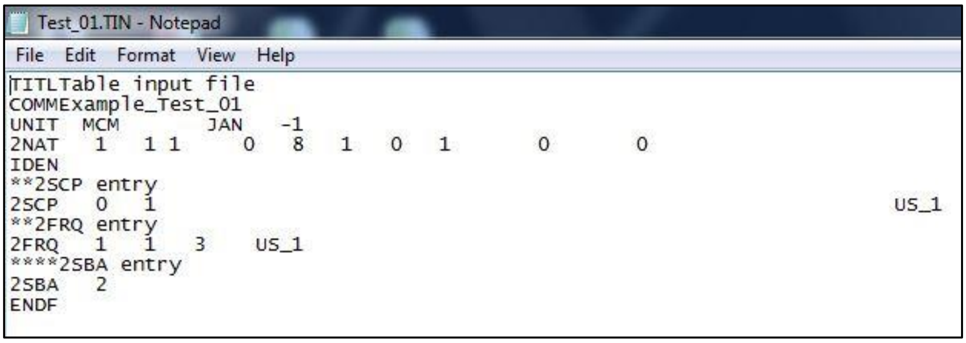
v. 2SBA



3. Create “TIN”

After entering all information click on Create button to create TIN file. Example of TIN file is as follows-



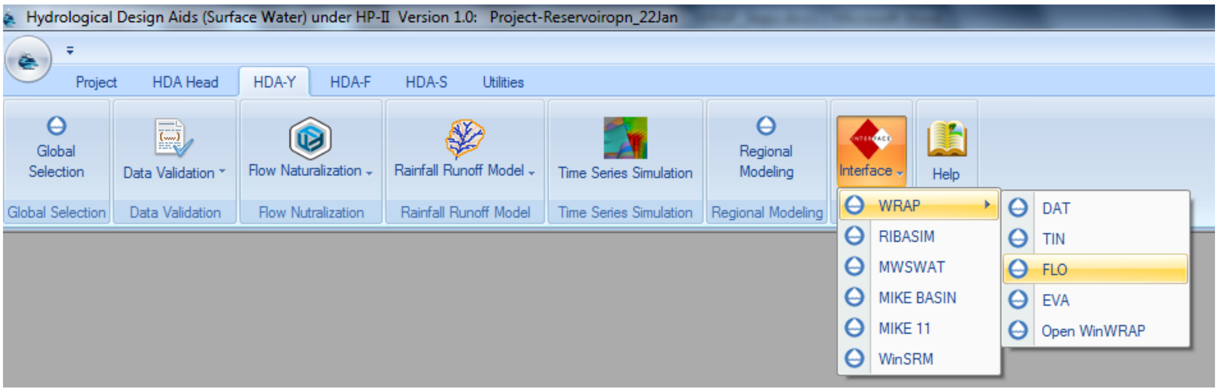



```
TITLTable input file
COMMExample_Test_01
UNIT  MCM      JAN   -1
2NAT   1   1 1     0   8   1   0   1       0       0
IDEN
**2SCP entry
2SCP   0   1                                                 US_1
**2FRQ entry
2FRQ   1   1   3    US_1
****2SBA entry
2SBA   2
ENDF
```

Create *.FLO file

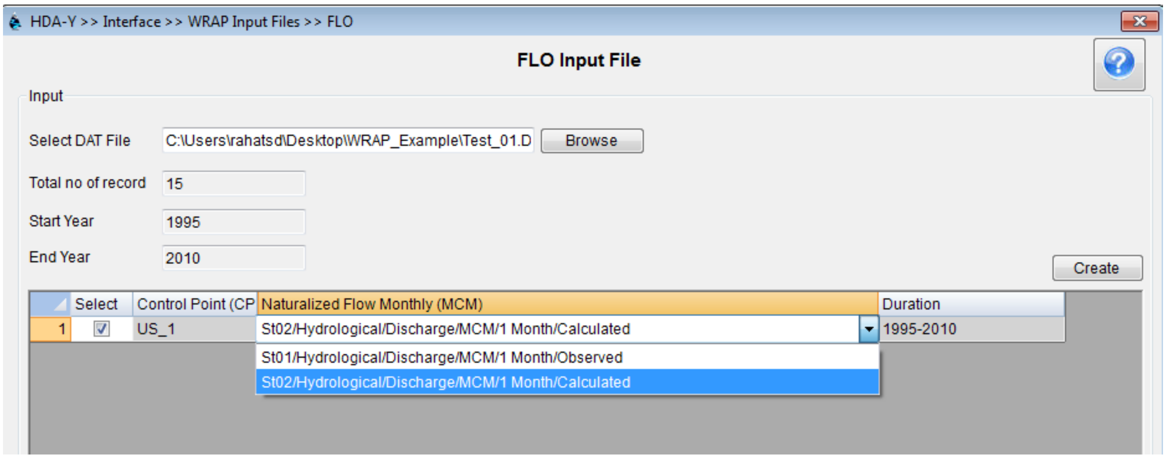
Steps-

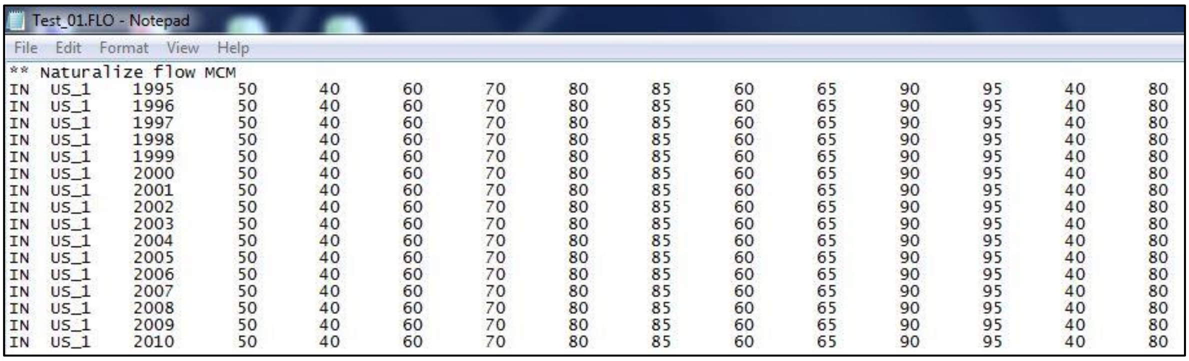
1. Go to- HDA – Y >> Interface >> WRAP >> FLO



Select DAT file.

From dropdown select flow time series and click on the Create button to create FLO file.




Test_01.FLO - Notepad
File Edit Format View Help

```
** Naturalize flow MCM
IN  US_1  1995  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  1996  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  1997  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  1998  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  1999  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2000  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2001  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2002  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2003  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2004  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2005  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2006  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2007  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2008  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2009  50  40  60  70  80  85  60  65  90  95  40  80
IN  US_1  2010  50  40  60  70  80  85  60  65  90  95  40  80
```

Like FLO file create *.EVA file.

WRAP example (SIM Example)

The Pranhita river is part of Godavari river basin, its lies between East longitudes 75^0 55' to 80^0 55' and North Latitudes 18^0 45' to 22^0 50'. The Pranhita River System consists of mainly four major tributaries namely a) Wainganga b) Wardha c) Penganga d) Peddavagua.

Projects under Pranhita river basin

Major projects –

1 Dhuti Weir
2 Bagh Project
3 Itiadoh
4 Pench

Medium Projects –

1 Sagar nadi
2 Bori tank
3 Chichbund
4 Ari tank
5 Roomal tank
6 Mooram tank
7 Sarthi
8 Waramain
9 Gangulpura
11 Jamunia
12 Karadi
13 Waghyanalla
14 Binja
15 Chandrabagha
16 Saikimardokala
17 Managad
18 Chulbund
19 Kahairbandha
21 Chorkamara
22 Bodalkasa
23 Ghorazhari tank
24 Asolmandha tank
25 Dina Nadi
26 Umari
27 Kesarnalla
28 Pandarabodi
29 Mordham
31 Kekranala
32 Bagheda
33 Betekarbothali
34 Sangrampur
35 Sorna
36 Rengpar
37 Nahleshwar (MH)

10	Nahleshwar (MP)	20	Chandpur	30	Kolar

Water allocation in WRAP is controlled by control points (CP). There are eight CPs in Pranhita basin defined based on the outlet stations.

Control Points	
CP1	Keolari
CP2	Kumhari
CP3	Rajegaon
CP4	Satarpur
CP5	Salebandi
CP6	Pauni
CP7	Rajoli
CP8	Ashti

Based on the above CPs input files are prepared for the water right analysis package (WRAP). The mentions CPs are the discharge sites. Under each CP there are irrigation projects which may major or medium projects. The schematic diagram of the Pranhita basin is as follows:

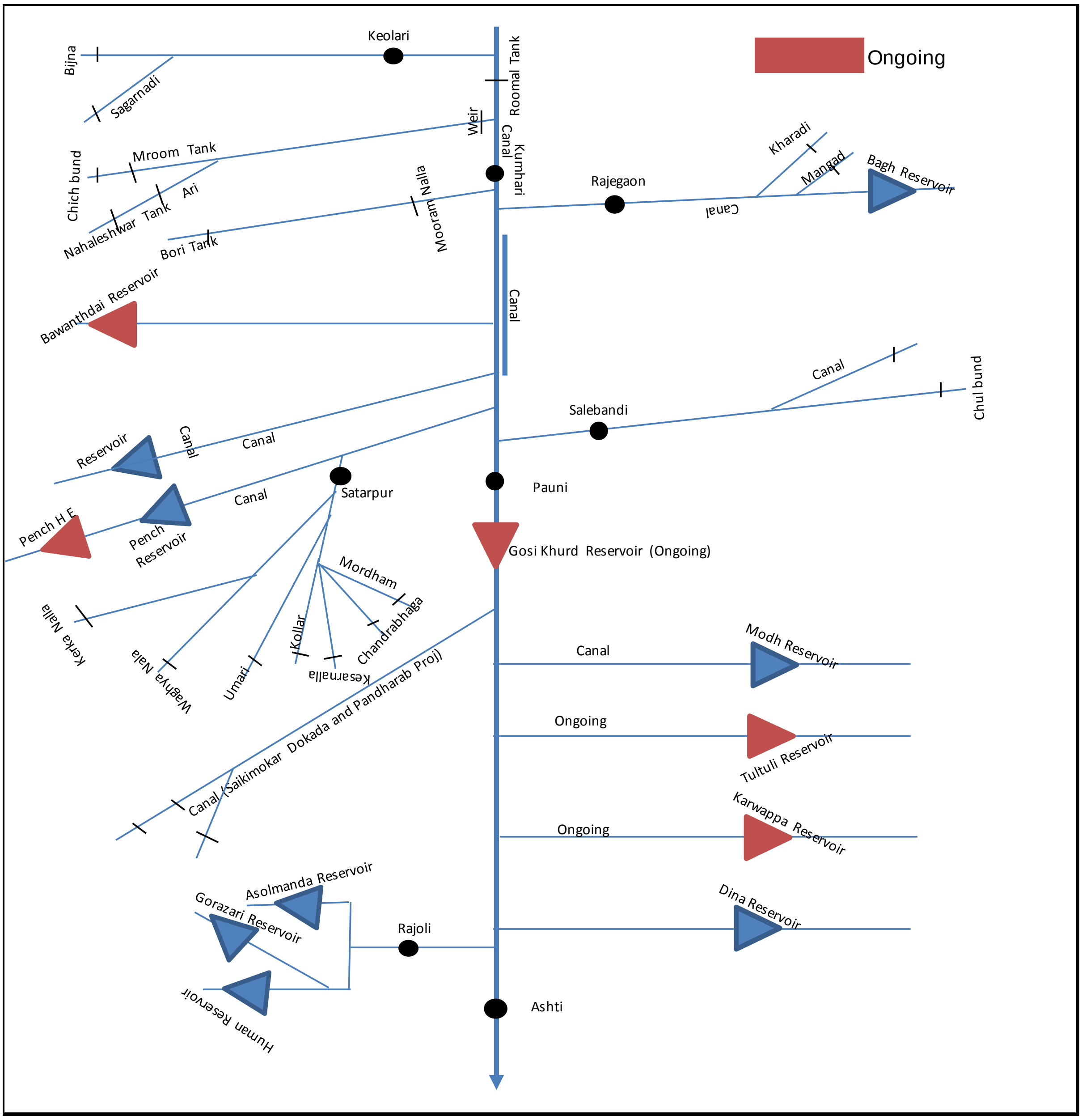


Figure -1 Schematic diagram of Pranhita Basin

Data availability

Sixteen years of naturalize flow available for all CPs starting 1990 to 2005. Water right for all projects under each CP is estimated from design annual utilization per year. Input and output files required for WRAP are listed as below:

Input Files-

1. DAT File
2. FLO File
3. EVA File
4. TIN File

Output Files-

1. MSS File
2. OUT File
3. TMS File
4. TOU File

.DAT file preparation

This is input file for the WRAP. This file contains the water allocation, distributions information as well as reservoir water storage. The file format is shown below.

Table 1- .DAT File Structure

SN	Record Name	Description
1	T1	Title or headings at the beginning of the file and reproduced in the output files
2	T2	
3	T3	
4	** Comment	Comment
5	JD record	Job control data
6	JO record	Simulation job options
7	OF record	Optional output file
8	RO record	Reservoir/Hydropower output records to be included in output file
9	UC record	Water use coefficients
10	CP record	Control point information
11	CI record	Constant inflows and/or outflows
12	WR record	Water right
13	IF record	Instream flow requirement
14	WS record	Reservoir storage associated with water right
15	SV record	Storage volumes for reservoirs storage versus area table
16	SA record	Surface areas for reservoirs storage versus area table
17	ED record	End of data

Record details-

T1, T2 and T3:

The DAT input file begins with optional *T1*, *T2* and *T3* records. The titles or headings provided on the title records are reproduced at the beginning of the main output file created by *SIM* and on the cover page created by *TABLES*. The title records may contain any descriptive information.

Table 2- T1, T2, and T3 Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	T1	Record identifier
2	3 - 78	TITLE	A78		Title or heading

** Comment Record

*Comment ** Record* - Comment records beginning with a double asterisk may be entered almost anywhere within the input data. The comments are notes written by the model-user for information only and are not read (other than the ** identifier) or used in any way by the program. Notes are very useful in documenting a dataset. The ** is also routinely used to deactivate records without actually deleting them. Various records may be activated or deactivated in alternative simulation runs by adding or deleting the **.

Table 3- ** /Comment Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	**	Record identifier
2	3 - No limit		A78		Comments

A record beginning with two asterisks ** is not read by the program, except for the ** identifier. Comment ** records are used to insert notes in the input dataset or to temporarily deactivate selected records.

JD Record and JO Record:

Table 4- JD Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	JD	Record identifier
2	3 - 8	NYRS	I6		Number of years in the simulation period-of-analysis
3	9 - 16	YRST	I8		First year of simulation
4	24	ICHECK	I8	1	Normal trace and complete error and warning checks
5	31 - 32	CPOUT	I8	-1	Control point data is output for all control points
6	39 - 40	OUTWR	I8	-1	Water rights data is output for all WR and IF record rights except hydropower rights
7	48	OUTFILE	I8	0	OUT file is created as formatted text file
8	56	ADJINC	I8	4	Option 4: Adjustment only at downstream CP's.
9	64	NEGINC	I8	0	No adjustments written
10	72	EPADJ	I8	0	No adjustments unless specified on CP record
11	80	TL	I8	0	Default max limit = 12 pairs in tables
12	88	IDSET	I8	0	First set of identifiers on WR input records are used.

JD (Job control Data) and JO (Job Control Option) - General information controlling the simulation includes the hydrologic period-of-analysis and parameters for several *SIM* computational features including options associated with negative incremental flows, system reservoir release decisions, beginning-ending storage, priority system, input and output, and input error checking.

Total numbers of years for the simulation are 16, starting from 1990.

JO Record

Table 5- JO Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	JO	Record identifier
2	8	INEV	I6	2	Grouped by control points in FLO and EVA files
3	16	FAD	I8		Flow adjustment (FAD) input file
4	24	SYSOUT	I8		HRR output file is not created
5	32	BES	I8		Feature is not used and BES file is not created
6	40	BRS	I8		
7	48	STOFLG	I8		End-of-period storage used for system release rules
8	56	STODI	I8		Beginning-of-period storage used for drought index

9	64	NPOPT	I8		
10	72	PASS2	I8		
11	80	DUALD	I8		
12	84	RUFIN	I4		Options for applying RU record adjustments
13	88	RUFIN	I4		RU record regulated flow adjustments

UC Record:

Use Coefficient **UC** Record **-** Sets of 12 factors associated with water use types are used to distribute annual diversion, energy generation, or instream flow requirements over the 12 months of the year. The types of water use may be associated with particular uses, such as irrigation, municipal, and industrial water supply, or hydroelectric energy, or otherwise represent different distributions of annual requirements over the year. SIM sums the 12 factors and divides each by the total to transform them to decimal fractions summing to unity.

Table 6- UC Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	UC	Record identifier
2	3 - 8	USEID	A6		Identifier relates sets of use factors to the use type in field 4 of WR and IF records
3	9-16	PDUSCF(1)	12F8.0		Monthly water use coefficients for the 12 months
4	17-24	PDUSCF(2)	12F8.0		
5	25-32	PDUSCF(3)	12F8.0		
6	33-40	PDUSCF(4)	12F8.0		
7	41-48	PDUSCF(5)	12F8.0		
8	49-56	PDUSCF(6)	12F8.0		
9	57-64	PDUSCF(7)	12F8.0		
10	65-72	PDUSCF(8)	12F8.0		
11	73-80	PDUSCF(9)	12F8.0		
12	81-88	PDUSCF(10)	12F8.0		
13	89-96	PDUSCF(11)	12F8.0		
14	97-104	PDUSCF(12)	12F8.0		

IRR1, IRR2, IRR3, IRR4, IRR5, IRR6, IRR7, IRR8 are water use type for eight different locations. UC record example is given for one type of water use as follows

UC IRR1 0.059 0.030 0.016 0.019 0.028 0.042 0.220 0.157 0.156 0.146 0.045 0.082

CP Record

*Control Point **CP** Record* - A *CP* record is required for each control point. This record contains the six-character alpha-numeric identifier of the control point, the identifier of the next control point located immediately downstream, information related to sources of naturalized stream flow and net evaporation-precipitation rate data for the control point, and the channel loss factor for the river reach below the control point. The location of all system components is based on entering control point identifiers on various records that reference back to the spatial configuration defined by the control points and next downstream control points listed on the *CP* records.

Table 7-CP Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	CP	Record identifier
2	3 - 8	CPID(cp,1)	A6		Control point identifier (cp = 1, NCPTS)
3	11 - 16	CPID(cp,2)	2x,A6		Identifier of next d/s control point
				OUT	Outlet, there is no control point downstream
4	17 - 24	CPDT(cp,1)	F8.0	0	Inflows multiplier, Default factor = 1
5	25 - 32	CPDT(cp,2)	F8.0	0	Evaporation rate multiplier, Default factor = 1
6	40	INMETHOD	I8	0	IN records are input for this control point
7	43 - 48	CPIN(cp)	2x,A6		Another CP from which IN records are repeated
8	51 - 56	CPEV(cp)	2x,A6		Control point from which EV records are repeated
9	57 - 64	EWA(cp)	F8.0	0	Default set by JD record field 10 is used
10	65 - 72	CL(cp)	F8.0		Channel loss factor for stream reach below cp
11	73 - 80	INWS(cp)	I8	0	Parameters on WP record are for the total watershed

```
**CONTROL POINTS INFORMATION AND DETAILS
** CPID1   CPID2    CPDT1    CPDT2   INMETH    CPIN     CPEV      EWA      CL
**-----!--------!--------!--------!--------!--------!--------!--------!--------!
**
CPKEOLAR  KUMHAR
CPKUMHAR   PAUNI
CPRAJEGA   PAUNI
CPSALEBA   PAUNI
CPSATARP   PAUNI
CP PAUNI   ASHTI
CPRAJOLI   ASHTI
CP ASHTI
**
```

WR Record

Water Right **WR** Record - In SIM, a water right is defined as a WR or IF record with associated attached records with supplemental information. Although an actual water right permit may be represented by a set of several WR records, in WRAP nomenclature, each WR or IF record is a water right and each right has one WR record or IF record. The WR record contains the water right identification, control point location, annual permitted diversion or energy generation amount, use type (connection to UC records) for distributing the annual target over 12 months, priority number, type of right (connection to rules for meeting targets), drought index identifier (connection to DI record), and return flow specifications. WS, HP, and other records attached to a WR or IF record provide optional additional information regarding the right.

Table 8 WR record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	WR	Record identifier
2	3 - 8	CP	A6		Control point identifier
3	9 - 16	AMT	F8.0		Diversion volume (types 1-3 in field 6), inflow (type 4), hydropower (types 5-6), or storage (type 7) target
4	19 - 24	USE	2x,A6		Use type identifier to UC and CP records
5	25 -32	WRNUM(wr,7)	I8		Priority number
6	36	WRNUM(wr,5)	I4	2	Type 2 water right (no refilling storage)
7	40	RFMETH(wr)	I4	0	Constant factor, flow returned same month

8	41 - 48	RFAC	F8.0		Constant return flow factor
9	51 - 56	RCP	2x,A6	Blank	Flow returned to next downstream control point
10	63 - 64	DINDEX(wr)	6x,I2	0	Drought index is not used for this water right
11	65 -80	WRID(wr)	A16		Water right identifier
12	81 -88	WRIDS(,1)	A8		Optional water right group identifier
13	89 -96	WRIDS(,2)	A8		Optional water right group identifier

Water right for different CPs mentioned above is estimated based on the irrigation water requirement under each project. Water right used in the WRAP is in volume per year, 'Mm^3 per year'.

Table 9 Water right for CPs under Pranhita Basin

CPs	Kumhari	Keolari	Rajegaon	Salebandi	Pauni	Satarpur	Rajoli	Ashti
Mm^3/year	341	20	394	298	1033	86	106	100

```
** Bijna, Sagarnadi at Control Point KEOLAR
WRKEOLAR      20     IRR1  199101    0   2     0.15                           WR-1   KEOLAR
WSBIJANA     8.5                               0.96
WSSAGARN     4.7                               0.40
**
** Dhuti weir, Chich bund, Nahaleshwar, Mooram Tank, Bori Tank, Ari Tank, Sarthi and Jamunia at Control Point KUMHAR
WRKUMHAR     341     IRR2  199302    0   2     0.35                           WR-2   KUMHAR
WS DHUTI   14.86                               7.08
WS  BORI    11.2                               1.23
WS   ARI   15.30                               2.41
WSCHICHB   7.760                               0.82
WSMOORUM     5.9                               0.33
WSSARATH   17.05                               0.88
WSJAMUNI   9.209                              0.018
**
** Bagh Project, Karadi, Mangaad, Waramain, Khailbhanda at Control Point| RAJEGA
WRRAJEGA     394     IRR3  199503    0   2     0.35                           WR-3   RAJEGA
WSSIRPUR   203.8                              11.32
WSPUJARI   65.11                              18.42
WSBAGHNA    2.32                              0.173
WSMANAGA    15.7                              2.201
WSKHAIRB   18.16                              0.845
**
** Chul Bund, Rangepar, Ithedoh at Control Point SALEBA
WRSALEBA     298     IRR4  199104    0   2     0.30                           WR-4   SALEBA
WSCHULBA   21.45                               4.98
WSRENGEP    3.76                               0.42
WSITIADO   288.8                              63.71
```

WS Record:

Water Right Reservoir Storage **WS** Record - Reservoir data on a WS record include active and inactive storage capacity and storage-area information. WS records are associated with specific water right WR records. One primary and multiple secondary reservoirs can be associated with a water right, with a WS record for each reservoir following the WR record. The right refills storage in the one primary reservoir as well as using it to supply water. Secondary reservoirs associated with a right meet water use requirements but are not refilled by that particular water right.

Table 10 WS Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	WS	Record identifier
2	3 - 8	RES	A6		Reservoir identifier
3	9 - 16	WRSYS(sr,3)	F8.0		Total storage capacity at top of the conservation pool
4	17 - 24	EVCFA	F8.0		Multiplier A for storage-area equation
5	25 - 32	EVCFB	F8.0		Exponent B for storage-area equation
6	33 - 40	EVCFC	F8.0		Constant C for storage-area equation
7	41- 48	EVCFC	F8.0		Storage capacity at top of the inactive pool

8	49 - 56	BEGIN	F8.0		Storage volume at the beginning of the simulation or Put 0 reservoir full capacity at the beginning
9	57 - 64	IEAR	I8		EA record identifier (1, 2, 3, ….). 1 for first EA record or put 0 Option not used.
10	71 - 72	SA	I8	0	A separate storage-area relationship is provided
11	79 - 80	LAKESD	I8	0	Water supply diversions are accessible to hydropower

SV and SA Record

Storage **SV** versus Area **SA** Records.- A pair of SV and SA records provides a table of storage volume versus surface area for a reservoir. Each volume on the SV record corresponds to a surface area on the SA record. The SV/SA records represent one of two optional methods for providing reservoir storage versus area relationships. The alternative option involves use of a regression equation with coefficients entered on a WS record. Reservoir storage-area relationships are used within SIM for computing net evaporation-precipitation amounts. For a simulated storage volume, the reservoir surface area is determined by linear interpolation of the SV/SA table.

Table 11 SV and SA Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	SV	Record identifier
2	3 - 8	RES	A6		Reservoir Identifier
3	9-16	TARA(I)	TL(F8.0)		Reservoir storage volumes corresponding to surface areas in same fields of the SA record
4	17-24	TARA(I)	TL(F8.0)		
5	25-32	TARA(I)	TL(F8.0)		
6	33-40	TARA(I)	TL(F8.0)		
7	41-48	TARA(I)	TL(F8.0)		
8	49-56	TARA(I)	TL(F8.0)		
9	57-64	TARA(I)	TL(F8.0)		
10	65-72	TARA(I)	TL(F8.0)		
11	73-80	TARA(I)	TL(F8.0)		
12	81-88	TARA(I)	TL(F8.0)		
13	89-96	TARA(I)	TL(F8.0)		
14	97-104	TARA(I)	TL(F8.0)		

ED Record:

End-of-Data **ED** Record - The ED record is placed at the end of the series of records discussed above in the DAT input file. The ED record has no input fields and simply indicates the end of the data file.

Table 12 ED Record

Field	Columns	Variable	Format	Value	Description
1	1 - 2	CD	A2	ED	Record identifier

The ED record ends the DAT file.

Hydrology Files (filenames root.FLO and root.EVA)

IN INflows to the river/reservoir system (monthly naturalized stream flows)
EV EVvaporation (monthly reservoir net evaporation less precipitation depths)

Inflow **IN** and Evaporation **EV** Records **-** Naturalized stream flow sequences for the hydrologic period-of-analysis for each control point are either entered on inflow IN records or computed from naturalized flows entered on IN records at one or more other control points. Reservoir net evaporation-precipitation depths for each control point with a reservoir are entered on EV records in the same format as IN records. IN and EV records are stored in various optional alternative record and file formats. IN and EV records are normally stored in FLO and EVA files.

FLO file - default format is to group IN records together by year. The set of IN records for all control points for a particular year is followed by the set for the next year. Parameter INEV in JO record field 2 provides other options for group IN records. INEV option 2 groups IN records together by control point. The set of IN records for all control points for the first year is followed by the set of IN records for all control points for the second year.
EV records in the EVA file are organized the same as the FLO file IN records.

Month wise inflow data in MCM

**FLow data at different discharge station in Pranhita Basin
**This data is in MCM per month.

INKEOLAR	1990	0.00	0.00	0.00	0.00	1.22	165.20	402.88	330.03	333.71	131.72	37.42	0.55
INKEOLAR	1991	0.00	0.00	4.74	0.00	0.00	3.61	127.46	265.34	14.25	0.00	0.00	0.00
INKEOLAR	1992	0.00	0.00	0.00	0.00	0.00	12.33	301.37	551.19	97.77	0.00	0.00	0.00
INKEOLAR	1993	0.00	0.00	0.00	0.00	0.00	50.83	487.55	280.33	204.75	34.77	3.62	0.00
INKEOLAR	1994	0.00	0.00	0.00	0.00	0.00	76.50	888.85	586.70	347.13	103.61	2.92	0.00
INKEOLAR	1995	1.70	0.00	3.47	0.00	0.00	26.85	367.90	152.84	87.91	18.71	0.79	0.00
INKEOLAR	1996	1.00	4.00	0.00	0.00	0.00	28.22	130.38	209.70	221.45	49.68	3.09	0.00
INKEOLAR	1997	0.00	0.00	0.00	0.00	0.00	1.37	501.23	176.64	153.95	8.54	120.21	168.62
INKEOLAR	1998	21.00	12.40	11.14	0.00	0.00	13.64	168.75	201.78	320.57	21.68	74.26	0.00
INKEOLAR	1999	0.00	1.76	0.00	0.00	0.00	7.31	71.90	257.16	967.48	160.18	15.62	2.47
INKEOLAR	2000	0.00	0.00	0.00	0.00	0.00	3.20	421.28	142.06	1.20	0.00	0.00	0.00
INKEOLAR	2001	0.00	0.00	0.00	2.20	0.00	26.46	213.51	152.24	23.32	128.09	0.00	0.00
INKEOLAR	2002	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	[illegible]	208.85	22.11	0.00	0.00

Month wise Evaporation in m

**Evaporation minus precipitation depth

EVKEOLAR	1990	0.022	0.001	0.053	0.039	-0.002	-0.278	-0.264	-0.261	-0.188	0.023	0.038	0.012
EVKEOLAR	1991	0.018	0.010	0.023	0.060	0.000	-0.044	-0.238	-0.194	0.047	0.036	0.020	0.012
EVKEOLAR	1992	0.010	0.009	0.030	0.028	0.000	-0.069	-0.282	-0.367	-0.029	0.042	0.024	0.016
EVKEOLAR	1993	0.010	-0.006	0.039	0.036	0.000	-0.177	-0.332	-0.191	-0.152	0.042	0.035	0.022
EVKEOLAR	1994	0.013	0.012	0.043	0.031	0.000	-0.242	-0.519	-0.375	-0.109	0.009	0.032	0.019
EVKEOLAR	1995	-0.007	0.014	-0.014	0.095	0.000	-0.144	-0.328	-0.133	-0.026	0.049	0.017	0.007
EVKEOLAR	1996	-0.009	0.007	0.067	0.032	0.000	-0.046	-0.269	-0.176	-0.149	0.000	0.049	0.024
EVKEOLAR	1997	0.016	0.019	0.026	0.046	0.000	-0.049	-0.454	-0.126	-0.062	0.007	-0.104	-0.108
EVKEOLAR	1998	0.012	0.045	0.027	0.106	0.001	-0.135	-0.188	-0.129	-0.221	0.041	-0.040	0.035
EVKEOLAR	1999	0.025	-0.004	0.053	0.052	0.000	-0.074	-0.179	-0.133	-0.509	-0.065	0.036	0.021
EVKEOLAR	2000	0.018	0.012	0.026	0.044	0.000	-0.125	-0.350	-0.106	0.051	0.043	0.022	0.013
EVKEOLAR	2001	0.009	0.009	0.034	0.021	0.000	-0.160	-0.197	-0.106	0.016	-0.068	0.035	0.022
EVKEOLAR	2002	0.017	0.003	0.039	0.037	-0.008	-0.194	0.008	-0.570	-0.087	-0.002	0.033	0.021
EVKEOLAR	2003	0.018	-0.045	0.060	0.055	0.001	-0.098	-0.407	-0.249	-0.289	0.046	0.033	0.015

For Pranhita basin example, total flow and evaporation data for eight CPs is starting from 1990 to 2005.
.DAT file structure is shown below

Fields											
1	2	3	4	5	6	7	8	9	10	11	
Columns											
2	8	16	24	32	40	48	56	64	72	80	page
Basic Input Data File (filename root.DAT)											
T1											41
T2											41
T3											41
**											41
JD	NYRS	YRST	ICHECK	CPOUT	OUTWR	OUTFILE	ADJINC	NEGINC	EPADJ	TL	42
JO	INEV	FAD	SYSOUT	BES	BRS	STOFLG	STODI	NPOPT	PASS2	DUALD	44
CR	CR1	CR2	CR3	CR4	CR5						46
FY	FYIN1	FYIN2	FYIN3	FYIN4	FYIN5	FYWRID	FYGROUP	MFY	SIM3		47
XL	STX	INX	EVX	CIX	SAX	POWFCT	DEPTHX	CNLN	CNUB	MPLB	48
CO	NCPOUT	CPOUID	CPOUID	CPOUID	CPOUID	CPOUID					54
RO	NREOUT	REOUID	REOUID	REOUID	REOUID	REOUID					54
WO	NWOUT		WROUT		WROUT		WROUT		WROUT		55
GO	NGOUT	GROUP	GROUP	GROUP	GROUP	GROUP					55
UC	USEID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	60
UP	USEID	USEP	USEM	USEADD	USEMUL	USEFAC					61
RF	RFID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	62
CI	CIID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	63
CP	CPID1	CPID2	CPDT1	CPDT2	INMETHOD	CPIN	CPEV	EWA	CL	L, INWS	64
WR	CP	AMT	USE	priority	Type RFM	RFAC	RCP	DINDEX		WRID	66
IF	CP	AMT	USE	priority	IFMETH	DINDEX		WRID	CP2		68
SO	WSHED	MONDEP	ANNDEP	ACPID	BACKUP	MRW	ARW	ISHT	ADL	LM1	74
TO	TARGET	FACT	TOCOMB	TOLIM	TOLIM	TOFLOW	TORES	TOWR	TOCONT		78
ML	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	81
FS	FSV	FSCP	FSX(1)	FSX(2)	FSX(3)	FSX(4)	FSI,FSI	FSI,FSI	FSI,FSI	FSI,FSI	86
BU	BU	BUX	BUWRID	BUG							89
TS	TSL	TSYR	QTS	QTS	QTS	QTS	QTS	QTS	QTS	QTS	90
WS	RES	capacity	A	B	C	INACT	BEGIN	IEAR	SA	LAKESD	92
HP	WRSYS	WRSYS(2)	TELEV	TQCAP	TPCAP						94
OR	CP	WRSYS(2)	WRSYS(5)	WRSYS(4)	SN2	WRSYS(6)	WRSYS(7)	WRSYS(8)	FSOR,J		95
PX	DUAL	XAX	XCP	XCPID	XP	XPR	XPRIOR	XPOUT		WRID1	98
SV	RES	TARA	TARA	TARA	TARA	TARA	TARA	TARA	TARA	TARA	103
SA		TARB	TARB	TARB	TARB	TARB	TARB	TARB	TARB	TARB	103
PV	RES	TARA	TARA	TARA	TARA	TARA	TARA	TARA	TARA	TARA	103
PE		TARB	TARB	TARB	TARB	TARB	TARB	TARB	TARB	TARB	103
MS	RES	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	105
DI	NDI	NR	DIRES	DIRES	DIRES	DIRES	DIRES	DIRES	DIRES	DIRES	106
IS	NS	DISTO	DISTO	DISTO	DISTO	DISTO	DISTO	DISTO	DISTO	DISTO	106
IP		DIPER	DISPER	DISPER	DISPER	DISPER	DISPER	DISPER	DISPER	DISPER	106
IM	Jan	Feb Mar	Apr May	Jun Jul	Aug Sep	Oct Nov	Dec				107
ED											41
Flow File (filename root.FLO)											
IN	ID	NYR PYR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	111
Net Evaporation-Precipitation File (filename root.EVA)											
EV	ID	NYR PYR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	111
Flow Distribution File (filename root.DIS)											
FD	ID	DSG	NG	UGID(1)	UGID(2)	UGID(3)	UGID(4)	UGID(5)	UGID(6)	UGID(7)	115
FC	COEF1	COEF2	COEF3								115
WP	ID	DA	CN	MP	DAF						115
ED											41
Flow Adjustment File (filename root.FAD)											
FA	ID	PYR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	117

.TIN File preparation

Tabular output can be read through TIN input file (.TIN extension) by defining require outputs. Output tables are stored in TOU file (.TOU extension).

Miscellaneous Records

TITL records provide titles or headings to be reproduced on the cover page and at the top of each type 2 or 3 table. Zero to five TITL records are placed at the beginning of the TIN file. COMM or **** records provide a means to insert comments or notes at any location in the input file. Comment records are not read or used in any way by the program.

```
TITLPranhita Project output tables
COMMTables with unit MCM
UNIT MCM
PAGE
```

Time Series Table

The following types of input records build tables in the same optional formats, with the only difference being the selection of variable to be tabulated.
2NAT – Naturalized stream flow
2UNA – Unappropriated stream flow
2REG – Regulated stream flow
Time series output data can be view in tabular form as well as in HEC-DSSVue (The USACE Hydrologic Engineering Center Data Storage System uses binary files with the filename extension DSS.).

Table 13 Time Series Record for TIN File

Column	Variable	Format	Value	Description
1-4	CD	A4	2NAT	
5-8	TA	I4	1	Develop table with annual rows and monthly column table
9-12	PT	I4	1	Develop column of monthly data in text file
13-16	MORE	I4	1	Add more columns to existing table or start first table
15-20	ID	I4	0	Develop table for default ID or for control points
21-24	NUM	I4	8	No. of identifiers to follow
25-28	DECIMAL	3x,A1		Standard number of digits
29-32	MAT	I4	0	Moving average/total option is not adopted
33-36	TIME	I4		Number of months moving average or total
37-44	XF	F8.0	0	default factor = 1.0
45-52	AF	F8.0	0	default factor = 1.0

Time series tables for the Pranhita basin (1. Tabular form, 2. HEC-DSSVue)

1.

Pranhita Project output tables

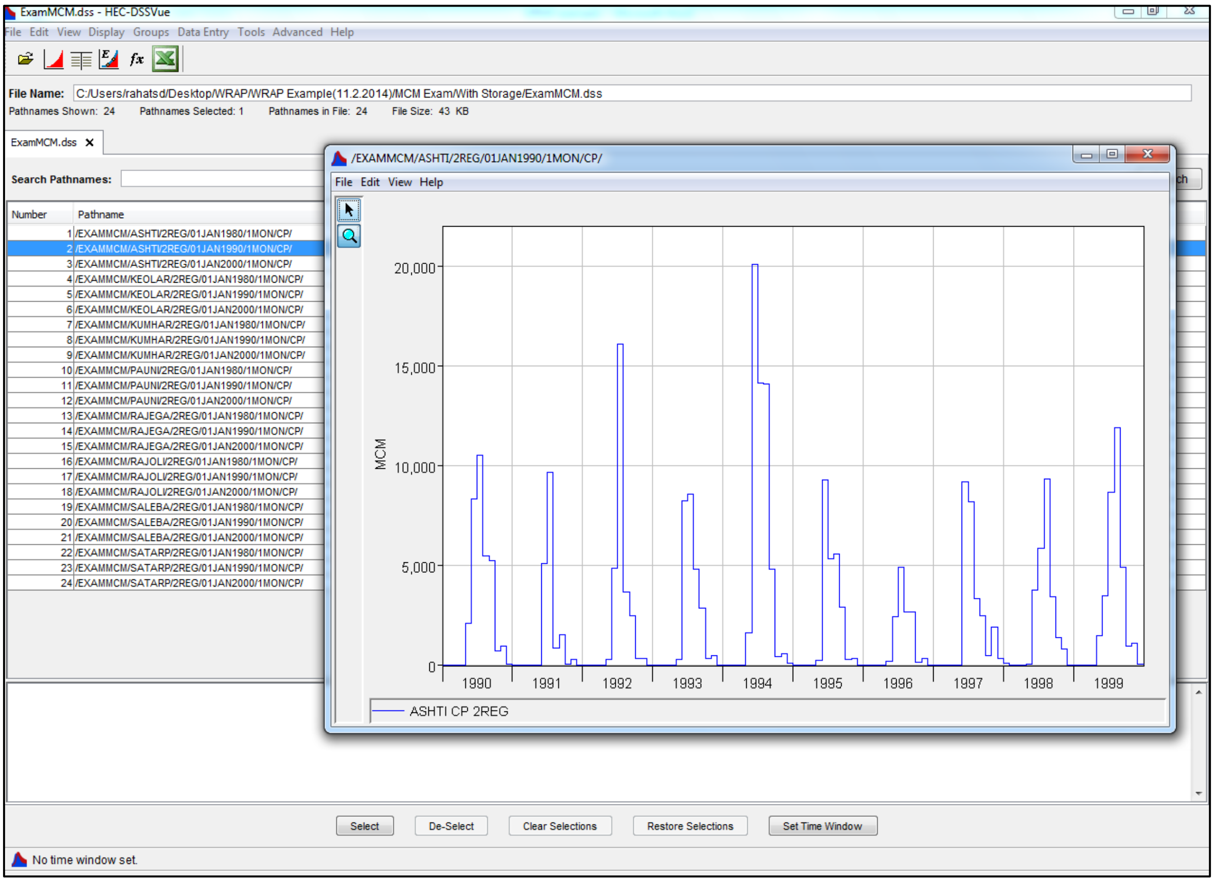
NATURALIZED STREAMFLOWS (MCM) AT CONTROL POINT KEOLAR

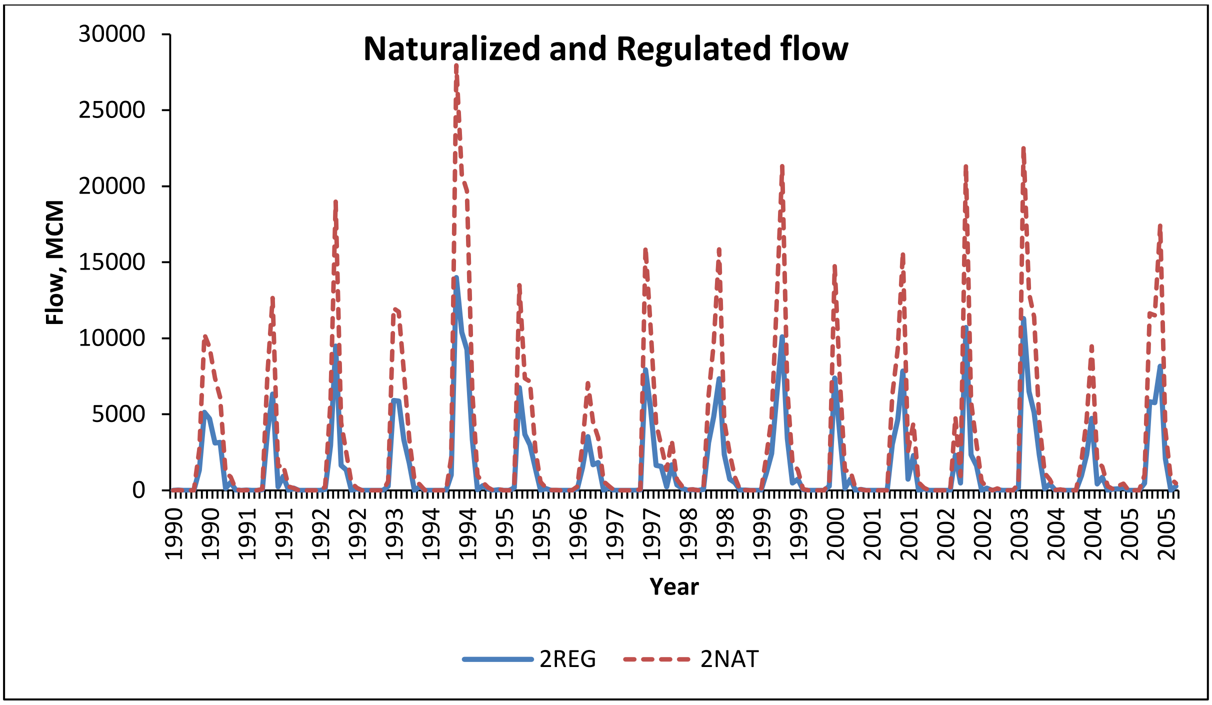
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1990	0.	0.	0.	0.	1.	165.	403.	330.	334.	132.	37.	1.	1403.
1991	0.	0.	5.	0.	0.	4.	127.	265.	14.	0.	0.	0.	415.
1992	0.	0.	0.	0.	0.	12.	301.	551.	98.	0.	0.	0.	963.
1993	0.	0.	0.	0.	0.	51.	488.	280.	205.	35.	4.	0.	1062.
1994	0.	0.	0.	0.	0.	76.	889.	587.	347.	104.	3.	0.	2006.
1995	2.	0.	3.	0.	0.	27.	368.	153.	88.	19.	1.	0.	660.
1996	1.	4.	0.	0.	0.	28.	130.	210.	221.	50.	3.	0.	648.
1997	0.	0.	0.	0.	0.	1.	501.	177.	154.	9.	120.	169.	1131.
1998	21.	12.	11.	0.	0.	14.	169.	202.	321.	22.	74.	0.	845.
1999	0.	2.	0.	0.	0.	7.	72.	257.	967.	160.	16.	2.	1484.
2000	0.	0.	0.	0.	0.	3.	421.	142.	1.	0.	0.	0.	568.
2001	0.	0.	0.	2.	0.	26.	214.	152.	23.	128.	0.	0.	546.
2002	0.	0.	0.	0.	0.	49.	20.	944.	209.	22.	0.	0.	1244.
2003	0.	10.	0.	0.	0.	2.	470.	318.	481.	108.	45.	1.	1435.
2004	4.	0.	0.	0.	0.	69.	103.	270.	16.	1.	0.	0.	464.
2005	0.	0.	0.	0.	0.	16.	568.	359.	380.	57.	3.	0.	1383.
MEAN	2.	2.	1.	0.	0.	34.	328.	325.	241.	53.	19.	11.	1016.

Pranhita Project output tables

		2NAT KEOLAR	2NAT KUMHAR	2NAT RAJEGA	2NAT SALEBA	2NAT SATARP	2NAT PAUNI	2NAT RAJOLI	2NAT ASHTI
1990	1	0.00	0.15	0.13	0.03	0.00	0.34	0.34	5.60
1990	2	0.00	0.65	10.69	0.00	0.00	12.58	0.00	6.35
1990	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
1990	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	5	1.22	1.22	4.10	0.07	0.00	0.42	1.78	23.38
1990	6	165.20	367.90	427.33	32.50	30.22	1326.44	50.04	2083.55
1990	7	402.88	1532.35	1136.05	252.61	421.28	5125.37	516.74	8344.18
1990	8	330.03	1140.26	619.04	376.32	1020.08	4704.61	797.60	10503.20
1990	9	333.71	1195.48	708.45	291.38	618.52	4275.96	346.07	6742.66
1990	10	131.72	595.64	516.48	185.29	441.80	2961.09	391.83	4867.66
1990	11	37.42	261.19	196.44	86.39	171.22	1061.10	83.39	1753.78
1990	12	0.55	97.04	87.75	38.84	45.47	352.65	27.88	631.93

2.





IDEN Record

Identifiers of control point, water right, water right groups or reservoirs. This is to be used for defining CP or reservoir or water right for which output table need to generate.

Table 14 IDEN Record

Field	Column	Variable	Format	Value	Description
1	1-4	CD	A4	IDEN	Record Identifier
2-9	5-68	IDCP(I)	8(2x,A6)	AN	Identifiers of control point (ID=ID=0), reservoirs (ID=TID=2), water right (ID=TID=1), water right group (ID=TID=3). Used for for positive NUM=NID.
		IDRES(I)	8(2x,A6)		
		IDEN8(I)	8A8		
	5-132	IDEN16(I)	8A16		Eight identifiers per record on up to ten records for a total of up to 80 identifiers.
		I=1, NUM			

2FRE Record – Flow - Frequency or Storage - Frequency Relationships

Any number of control points, water rights, or reservoirs may be included in a frequency table. Storage frequency tables also include the total storage associated with each frequency for all the control points, rights, or reservoir.

Table 15 2FRE Record

Field	Column	Variable	Format	Value	Description
1	1-4	CD	A4	2FRE	Record identifier

2	7-8	Variable	I4	1	Naturalize flows
3	11-12	MON	I4	blank, 0	All months are included in the computations
4	15-16	NUM	I4	0	Include all control points, reservoirs in table
5	20	TABLE	I4	blank, 0, 1	Frequency table is created in standard row format
6	24	Method	I4	blank, 0, 1	Relative frequency p=(n/N) 100%
7	28	MAT	I4	blank, 0	Moving average/total option is not adopted
8	32	TIME	I4	+	Number of months for moving average or total
9	33-40	XF	F8.0	blank, - , +	Multiplier factor. Default multiplier factor = 1.0
10	41-48	AF	F8.0	blank, - , +	Addition factor. Default multiplier factor = 1.1

2FRQ Record – Frequency for specified flow storage

Table 16 2FRQ Record

Field	Column	Variable	Format	Value	Description
1	1-4	CD	A4	2FRQ	Record identifier
2	5-8	Variable	I4	4	Reservoir storage associated with a control point
3	9-12	MONTH	I4	1	The month for which analysis performed
4	13-16	NM	I4	3	Frequency determine for this number of flows or storages
5	17-24	IDEN	2x,A6	AN	Identifier of control point (field 2 variable 1,−4), water right (variable 5, 8), or reservoir (variable 6, 7)
6	25-80	QF(I) I=1,NM	7F8.0	+	Streamflow (variable 1, 2, 3), storage (variable 4, 5, 6), reservoir elevation (7), or instream flow shortage (8)

```
   Pranhita Project output tables

FLOW-FREQUENCY FOR NATURALIZED STREAMFLOWS

----------------------------------------------------------------------------------------------------------------------------
CONTROL         STANDARD      PERCENTAGE OF MONTHS WITH FLOWS EQUALING OR EXCEEDING VALUES SHOWN IN THE TABLE
 POINT      MEAN DEVIATION  100%       99%       98%       95%       90%       75%       60%       50%       40%       25%       10%     MAXIMUM
----------------------------------------------------------------------------------------------------------------------------
KEOLAR      84.7     170.    0.0       0.0       0.0       0.0       0.0       0.0        0.        2.       12.      103.      320.      967.
KUMHAR     338.7     580.    0.0       0.0       0.0       0.0       0.0       0.0        7.       46.      120.      437.     1163.     3377.
RAJEGA     346.6     597.    0.0       0.0       0.0       0.0       0.0       0.0       11.       51.      134.      472.     1221.     3003.
SALEBA     101.1     174.    0.0       0.0       0.0       0.0       0.0       0.0        0.       12.       42.      137.      338.      820.
SATARP     231.9     412.    0.0       0.0       0.0       0.0       0.0       0.0        0.       21.       96.      297.      872.     2245.
PAUNI     1665.0    2755.    0.0       0.0       0.0       0.0       0.0       0.0       42.      238.      693.     2160.     5857.    13972.
RAJOLI      91.2     167.    0.0       0.0       0.0       0.0       0.0       0.0        0.       12.       35.      124.      270.     1067.
ASHTI     2394.1    3870.    0.0       0.0       0.0       0.0       0.0       0.0       50.      335.     1019.     3135.     8409.    20044.
----------------------------------------------------------------------------------------------------------------------------
```

Summary table for control points

2SCP Record: monthly or annual summary table for a control point

Table 17 2SCP Record

Field	Column	Variable	Format	Value	Description
1	1-4	CD	A4	2SCP	Record identifier
2	5-8	MNAN	I4	2	Both annual and monthly table
3	9-12	NUM	I4	1	Develop table for number of control points to follow
4-11	13-76	IDEN(ID,I)	8(2x,A6)		Identifier of the selected control points for which

					to develop summary tables

2SBA **–** monthly or annual summary table for the entire river basin

Table 18 2SBA Record

Field	Column	Variable	Format	Value	Description
1	1-4	CD	A4	2SBA	
2	5-8	Variable	I4	2	Both annual and monthly table

ANNUAL SUMMARY TABLE FOR THE RIVER BASIN

Note: For naturalized streamflow and unappropriated flow, the quantities shown represent the maximum flow at any control point in a given month, based on comparing all control points. All other quantities shown are the sum of the values for all the control points.

YEAR	NATURALIZED STREAMFLOW (MCM)	RETURN FLOW (MCM)	STREAMFLOW DEPLETION (MCM)	UNAPPROPRIATED FLOW (MCM)	EOP STORAGE (MCM)	EVAPORATION (MCM)	TARGET DIVERSION (MCM)	ACTUAL DIVERSION (MCM)	DIVERSION SHORTAGE (MCM)
1990	34968.7	716.7	2294.0	33391.2	1255.5	-13.7	2378.0	2378.0	0.0
1991	18595.8	685.4	1519.5	17761.0	501.1	10.4	2378.0	2287.1	90.9
1992	29551.2	639.0	2022.4	28167.8	406.6	-10.6	2378.0	2141.4	236.6
1993	27284.7	691.6	2299.7	25676.6	430.4	-13.5	2378.0	2298.5	79.5
1994	57478.6	703.6	2435.1	55747.6	582.6	-41.8	2378.0	2333.0	45.0
1995	25554.6	638.1	1933.2	24259.2	402.5	-15.9	2378.0	2138.7	239.3
1996	15014.3	650.5	2144.7	13520.4	386.1	-7.0	2378.0	2176.2	201.8
1997	27515.5	698.2	2478.9	25735.2	578.7	-19.3	2378.0	2314.8	63.2
1998	26896.0	708.3	2320.3	25284.6	579.6	-19.5	2378.0	2348.7	29.3
1999	34131.7	698.6	2285.9	32544.3	578.5	-20.2	2378.0	2316.2	61.8
2000	20352.7	495.3	1376.5	19471.6	317.1	-11.9	2378.0	1657.6	720.4
2001	29422.2	622.8	2102.2	27943.2	360.1	-22.4	2378.0	2087.9	290.1
2002	26035.0	653.1	2162.1	24526.0	363.1	-18.5	2378.0	2183.8	194.2
2003	37406.9	704.8	2477.7	35633.8	542.3	-31.8	2378.0	2336.7	41.3
2004	14584.3	545.9	1581.4	13548.7	308.9	-9.9	2378.0	1830.9	547.1
2005	35002.4	698.6	2460.8	33240.2	478.8	-20.6	2378.0	2318.2	59.8
MEAN	28737.2	659.4	2118.4	27278.2	504.5	-16.6	2378.0	2196.7	181.3

Message file (file run message, warining message etc.)

Program SIM automatically create the message files MSS and TMS.

In a MSS file error message are written and program excutation is terminated if detectable programs are encountered in reading input data or performing the simulation. Warning message are recorded in the message file without terminating program excutation to alert the model-user to possible irregularities in the input data. Most of the messages are generated by problems detected by the program while reading input data files, though various checks incorporated in the simulation computation routines also may generate error and warning messages.

Message files generated by *SIM* programs should be routinely reviewed to trace the simulation and view warning messages even if the program executes normally without premature termination.

```
 WRAP-SIM MESSAGE FILE

*** Starting to read file ExamMCM.DAT
*** JD record was read.
*** JO record was read.
*** Starting to read UC records.
*** Finished reading UC records.
*** Starting to read CP records.
*** Finished reading CP records.
*** Starting to read IF/WR records.
*** Finished reading IF/WR records.
*** Starting to read SV/SA records.
*** Finished reading SV/SA records.
*** Finished reading file ExamMCM.DAT
*** Starting to open remaining files.
*** Opened file ExamMCM.FLO
*** Opened file ExamMCM.EVA
*** Opened file ExamMCM.OUT
*** Finished opening text files.
*** Starting to read IN and EV records.
*** Finished reading IN and EV records.
*** Finished ranking water rights in priority order.

*******************************************************
 System components counted from input file:
      8 control points (CP records)
      8 primary control points (INMETHOD=1)
      8 control points with evap input (CPEV=blank)
     37 reservoirs
      0 instream flow rights (IF records)
      8 all water rights except IF rights (WR records)
      8 system water rights
      8 sets of water use coefficients (UC records)
     37 storage-area tables (SV/SA records)
*******************************************************

*** Beginning annual loop.
```

MSS file defines the warning or error messages regarding DAT file records. TMS file defines the waring or messages regarding table input file.(TIN) records.

```
 TABLES MESSAGE FILE

*** File was opened: ExamMCM.TIN
*** File was opened: ExamMCM.TOU
*** Identifiers for the 25 records in the TIN file were checked.
*** File was opened: ExamMCM.OUT
*** Tables are being developed as specified by a PAGE record.
*** Tables are being developed as specified by a 2NAT record.
*** Tables are being developed as specified by a 2REG record.
*** Tables are being developed as specified by a 2UNA record.
*** Tables are being developed as specified by a 2FRE record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SCP record.
*** Tables are being developed as specified by a 2SBA record.

    Program TABLES output is in file ExamMCM.TOU

Date: 03/13/2014
Time: 16:06:23

  ***** Normal Completion of Program TABLES *****
```

```
TITLPranhita Project output tables
COMMTables with unit MCM
UNIT MCM
PAGE
****5678901234567890123456789012345678901234567890123456789012345678901234567890123456789
****
2NAT   1   1   0   0   8
IDEN   KEOLAR   KUMHAR   RAJEGA   SALEBA   SATARP   PAUNI   RAJOLI   ASHTI
2REG   1   4   0   0   8
IDEN   KEOLAR   KUMHAR   RAJEGA   SALEBA   SATARP   PAUNI   RAJOLI   ASHTI
2UNA   1   1   0   0   8
IDEN   KEOLAR   KUMHAR   RAJEGA   SALEBA   SATARP   PAUNI   RAJOLI   ASHTI
****
2FRE   1   0
2SCP   0   1   KEOLAR
2SCP   0   1   KUMHAR
2SCP   0   1   RAJEGA
2SCP   0   1   SALEBA
2SCP   0   1   SATARP
2SCP   0   1    PAUNI
2SCP   0   1   RAJOLI
2SCP   0   1    ASHTI
2SBA   2
****
ENDF
```

WinWRAP Output – Import in HDA

After performing analysis in WinWRAP (outside HDA), if user saves WinWRAP output time series(s), in *.xlsx or *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.

10.2. RIBASIM

About RIBASIM

RIBASIM (River Basin Simulation Model) is a generic model package for analyzing the behavior of river basins under various hydrological conditions. The model package is a comprehensive and flexible tool which links the hydrological water inputs at various locations with the specific water-users in the basin. RIBASIM is designed for river basin planning and management.

RIBASIM follows a structured approach to river basin planning and management. RIBASIM enables the user to evaluate a variety of measures related to infrastructure, operational and demand management and the results in terms of water quantity and water quality. RIBASIM generates water distribution patterns and provides a basis for detailed water quality and sedimentation analyses in river reaches and reservoirs. It provides a source analysis, giving insight in the water's origin at any location of the basin.

RIBASIM contains a reservoir operation simulation component used to model single and multi-purpose reservoirs, lakes and storage basins.

Appropriate of Usage

RIBASIM can be used for basin planning and management:

- Long-term basin planning: the preparation of long and mid-term basin plans e.g. with a time horizon of 10 to 25 years. All kind of measures (technical, operational and institutional) can be analyzed with RIBASIM.

- Short term (half or one year) water allocation scheduling: preparation of a seasonal operation plan for the basin. RIBASIM can be used to determine e.g. a crop plan based on reservoir storage and expected inflows.
- In-season operation scheduling: during the season based on the actual situation in the field, the actual rainfall and the updated forecasts an updated water allocation schedule can be determined for the coming weeks or months.
- Flow forecasting systems. At any time the flow at various locations along the river is predicted based on forecasts of the catchment runoff and hydrologic routing of river flow.

Key Input

The structure of RIBASIM is based on an integrated framework with a user-friendly, graphically, GIS-oriented interface. Working with RIBASIM forces a structured approach to river basin planning and management. RIBASIM is map oriented. A flexible modelling environment has been designed in which the modelling system is made independent of the user's choice of Geographic Information Systems (GIS). Some of the key parameters for RIBASIM model are flow, rainfall, evaporation.

Key Output

Using a set of simulations, usually made for a range of alternative development or management strategies, the performance of the basin is evaluated in terms of water allocation, water shortages, firm and secondary hydropower production, overall river basin water balance (water accounting), flow composition, crop production, flood control, water supply reliability, groundwater use, and others, or combinations of these.

The user can select the format in which the results will be shown or exported, including graphs, thematic maps, animation, tables, and transferred to spreadsheets.

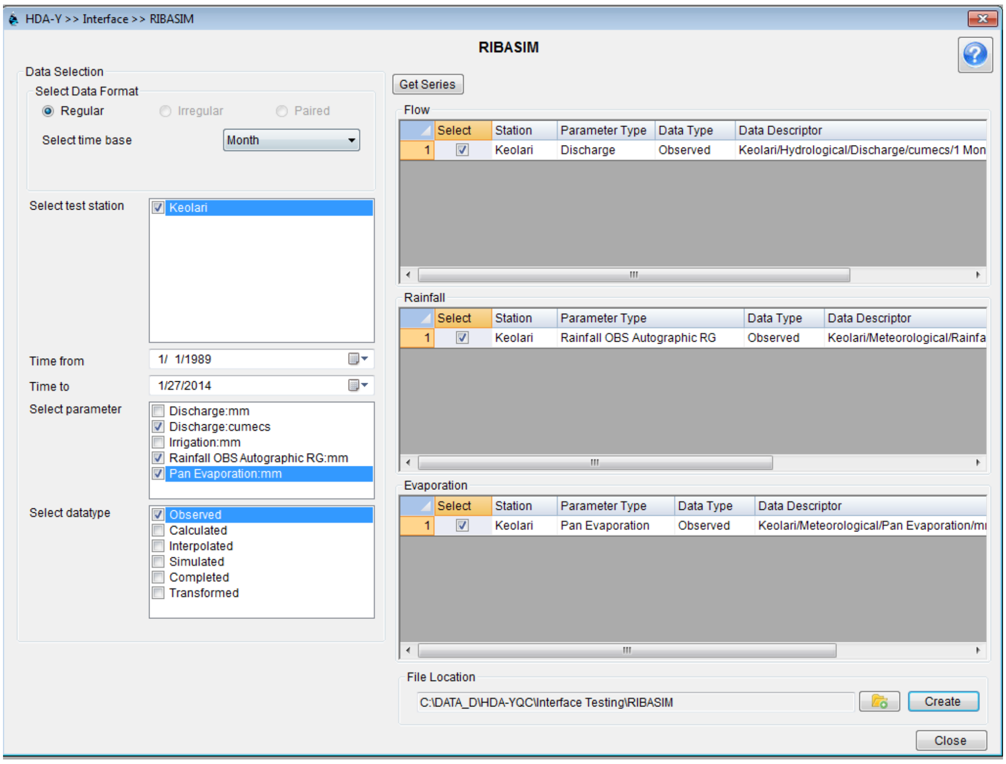
HDA Interface

RIBASIM is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Key input time series data of Discharge, Rainfall and Evaporation can be selected from HDA database and RIBASIM compatible input file (with correct properties) will be created to a user defined location.

After performing analysis in RIBASIM (outside HDA), if user saves RIBASIM output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA RIBASIM Interface
How to Access

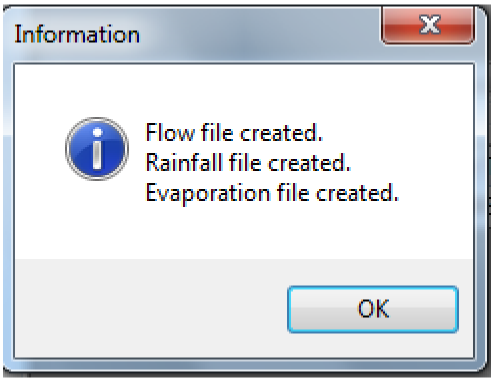
HDA-Y >> Interface >> RIBASIM



Operations

Operation of RIBASIM Interface

1. Use the menu path defined above to open the RIBASIM Interface form.
2. In the "***Select Data Format***" section:
   - 2.1. Regular data with 'Monthly' time base should be selected.
   - 2.2. Stations should be selected for which flow, rainfall and evaporation are available in the HDA project.
   - 2.3. Click on 'Get Series' and the rainfall, temperature and discharge section will be filled up the corresponding time series (s). Select the desired series.
   - 2.4. Define a desired location where RIBASIM compatible input files will be created from HDA interface. A confirmation message will be displayed after successful creation of the input files.



RIBASIM Output – Import in HDA
After performing analysis in RIBASIM (outside HDA), if user saves RIBASIM output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.

10.3. MWSWAT

About MWSWAT
SWAT is a river basin scale hydrologic public domain model actively supported by the USDA Agricultural Research Service at the Grassland, Soil and Water Research Laboratory in Temple, Texas, USA. SWAT is the acronym for Soil and Water Assessment Tool, developed by Dr. Jeff Arnold. SWAT was developed to predict the impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land use and management conditions over long periods of time. SWAT is a distributed parameter model designed for sub watersheds level of simulation.

Appropriate of Usage
To predict the effect of management decisions (climate and vegetative changes, reservoir management, groundwater withdrawals, water transfer) on water, sediment, nutrient and pesticide yields on large river basins.

Key Input
Following are the key input requirements to perform a study using MWSWAT.

Spatial Data

- Digital Elevation Model
- Land cover map
- soil map

Weather

- Rainfall
- air temperature (Min and max)
- solar radiation, wind speed
- relative humidity

Key Output
Following is the main output that MWSWAT calculates after successful running of the simulation.

a) Various hydrological parameters like ET, snowmelt, soil water content, percolation, groundwater recharge, irrigation, surface runoff generated, transmission loss, lateral flow, water yield, sediment yield etc.

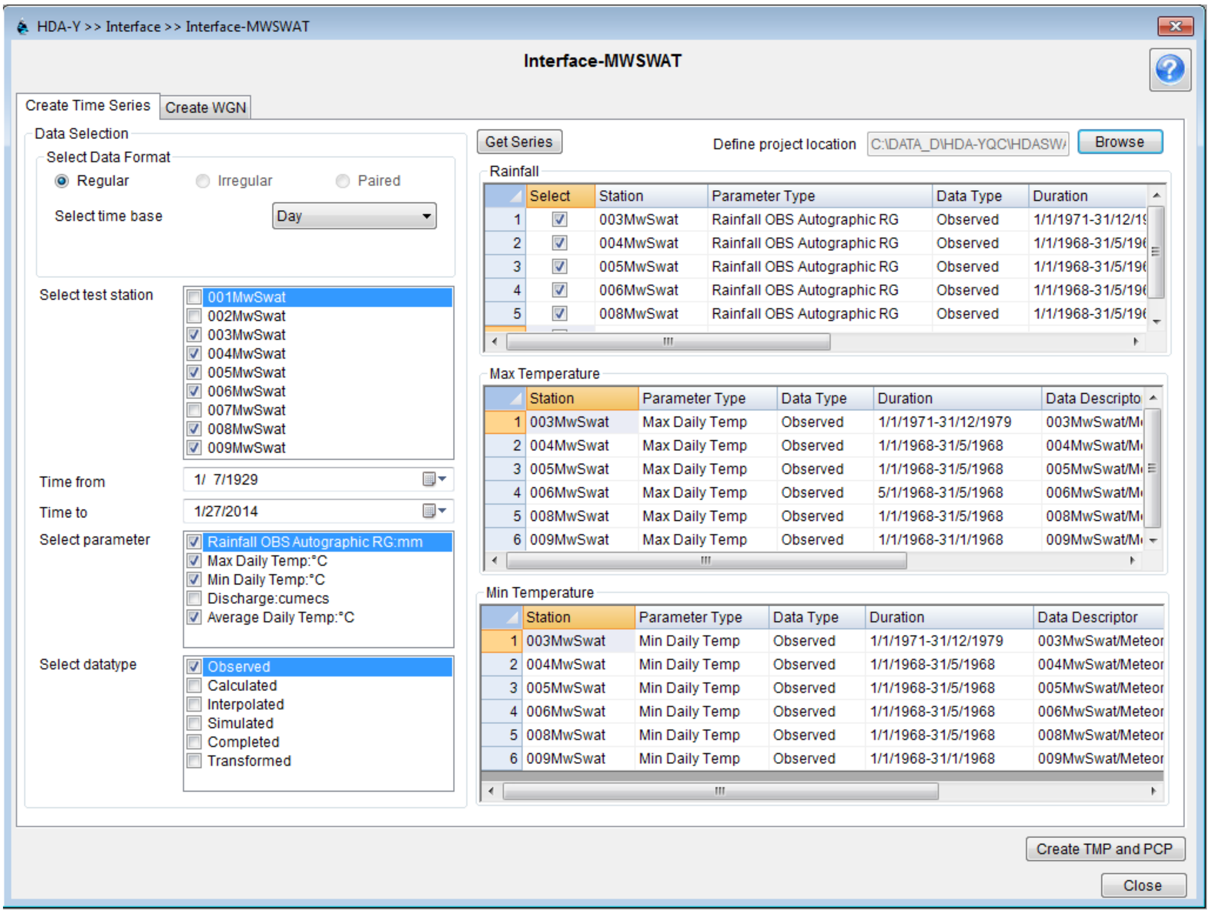
HDA Interface
MWSAT is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Key input time series data of Maximum Temperature, Minimum Temperature,

and Precipitation for the same station should be selected from HDA database and MWSWAT compatible input files (*PCP, *.TMP and *.WGN) files will be created to a user defined location.

After performing analysis in MWSWAT (outside HDA), if user saves MWSAT output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA MWSWAT Interface
How to Access

HDA-Y >> Interface >> MWSWAT

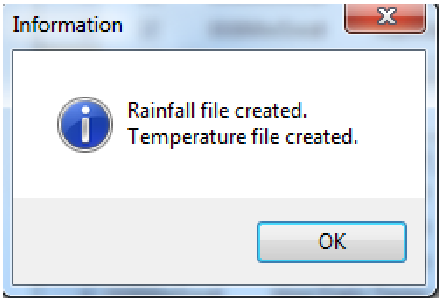


Operations

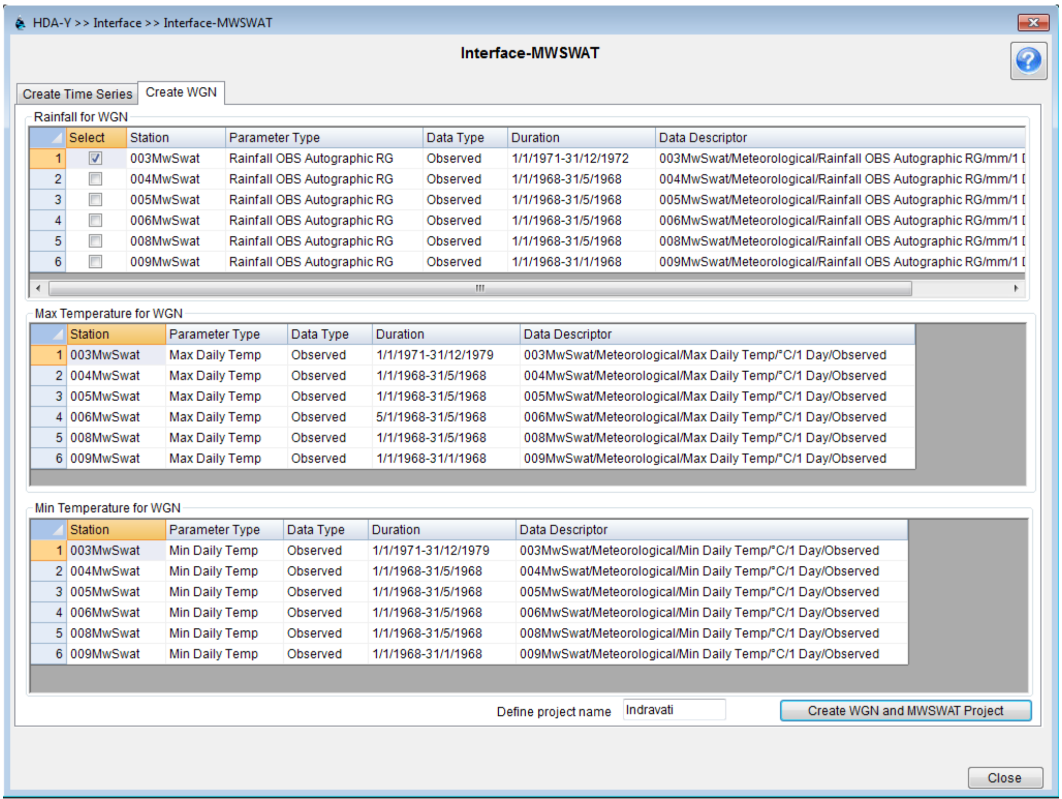
Operation of MWSWAT Interface

1. Use the menu path defined above to open the MWSWAT Interface form.
2. In the "***Select Data Format***" section:
   2.1. Regular data with 'Daily' time base should be selected.
   2.2. Stations should be selected for which precipitation, maximum & minimum temperature station data are available in the HDA project.
   2.3. Click on 'Get Series' and the rainfall, temperature sections will be filled up the corresponding time series (s). Select the desired series.
   2.4. Define a project location to create a MWSWAT file.

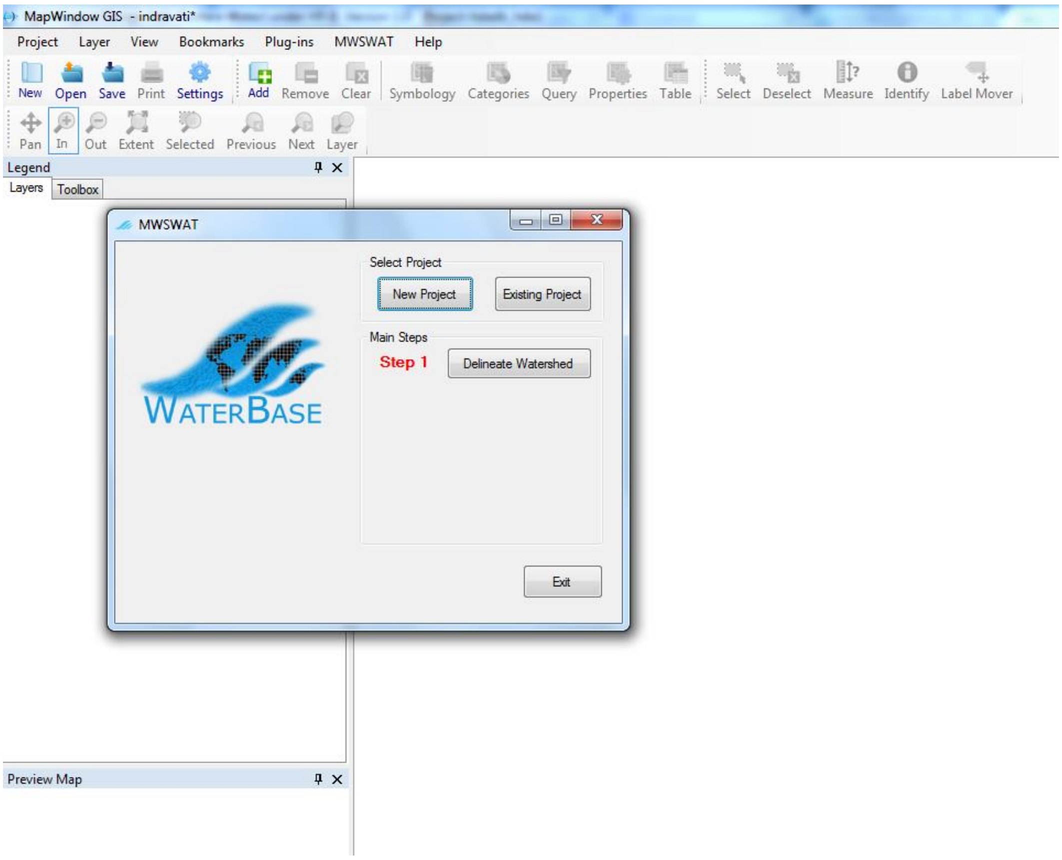
2.5. Click 'Create TMP and PCP' button to generate temperature and precipitation input files for MWSWAT simulation. After the files are created a confirmation message will be displayed.



2.6. In the 'Create WGN' tab select one station for WGN station and define MWSWAT project name.



2.7. Click on 'Create WGN and MWSWAT Project' button to create the WGN file and open the created MWSWAT project in pre-installed MWSWAT interface..



MWSWAT Output – Import in HDA

After performing analysis in MWSWAT (outside HDA), if user saves MWSWAT output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.

10.4. MIKE BASIN

About MIKE BASIN

The rationale of undertaking water resources studies on a basin scale instead of on a project by project basis is based on the recognition that the water and land resources of a basin forms a unity and hence must be treated as such if future conflicts over water utilization are to be avoided.

For addressing water allocation, conjunctive use, reservoir operation, or water quality issues, MIKE BASIN couples the power of ArcGIS with comprehensive hydrologic modeling to provide basin-scale solutions. The MIKE BASIN philosophy is to keep modeling simple and intuitive, yet provide in-depth insight for planning and management.

In MIKE BASIN, the emphasis is on powerful simulation result visualization in both space and time, making it the perfect tool for building understanding and consensus. For hydrologic simulations, MIKE BASIN builds on a network model in which branches represent individual stream sections and the nodes represent confluences, diversions, reservoirs, or water users. The ArcGIS interface has been expanded accordingly, e.g., such that the network elements can be edited by simple right-clicking.

Technically, MIKE BASIN is a quasi-steady-state mass balance model, however, allowing for routed river flows. The water quality solution assumes purely advective transport; decay during transport can be modeled. The groundwater description uses the linear reservoir equation.

MIKE BASIN is a generic network modeling system, representing rivers and their main tributaries in a network consisting of branches and calculation nodes. Branches represent individual river sections, while nodes represent a confluence or a location where certain water activities occur (for instance multipurpose reservoirs, withdrawal for water supply or irrigation, effluent discharge, diversion systems, gauging stations or low flow control points). MIKE BASIN is flexible and intuitive so it is easy for users to tailor model applications to their particular needs. MIKE BASIN provides a range of relevant components which allows construction of models of any complexity. Basic features include:

a) Watershed delineation tools
b) Ground water /river sources representation
c) River routing
d) Water supply and irrigation allocation
e) Multipurpose reservoir operation
f) Hydropower generation
g) Low flow controls
h) Priority-based allocation principles

Appropriate of Usage
Following are the few key study areas where MIKE BASIN could be used.

a) Water availability analysis: conjunctive surface and groundwater use, optimization thereof.
b) Infrastructure planning: irrigation potential, reservoir performance, water supply capacity, waste water treatment requirements.
c) Analysis of multi-sectoral demands: domestic, industry, agriculture, hydropower, navigation, recreation, ecological, finding equitable tradeoffs.
d) Ecosystem studies: water quality, minimum discharge requirements, sustainable yield, effects of global change. Regulation: water rights, priorities, water quality compliance.

Key Input
Following are the key input requirements to perform a study using MIKE BASIN.

a) Catchment Area
b) River Network
c) Time Series Parameters
   I. Discharge
   II. Water Level
   III. Rainfall
   IV. Temperature
   V. Irrigation
   VI. Evaporation
   VII. Sunshine
   VIII. Relative Humidity

IX. Evapo-transpiration
X. Accumulated Sediment Mass

Key Output
Following are the few key outputs that MIKE BASIN calculates after successful running of the simulation.

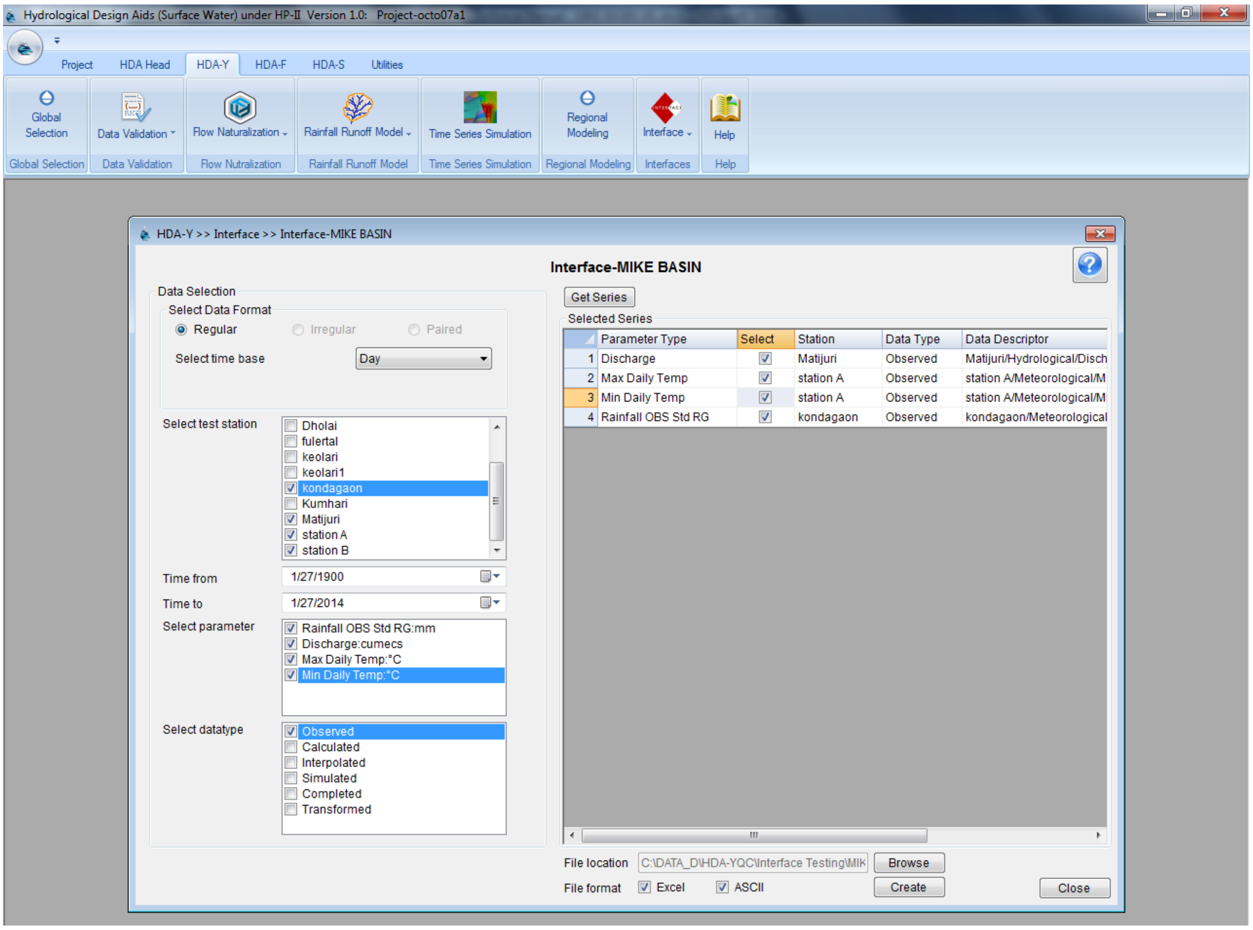
a) Mass balances
b) Detailed flow descriptions throughout the water system
c) Water diversions
d) Hydropower generation
e) Hydropower tradeoffs to other operating objectives
f) Water quality descriptions of dissolved solids
g) Water temperature

HDA Interface
MIKE BASIN is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Most of the key input time series data files of Discharge, Water Level, Maximum Temperature, Minimum Temperature, Average Temperature, Rainfall, Evaporation, Sunshine, Relative Humidity, Evapotranspiration, Accumulated Sediment Mass can be selected from HDA database and MIKE BASIN compatible data files (with correct properties) in *.xlsx and/or *.txt formats will be created/exported to a desired location. The exported files can be imported in MIKE BASIN to assign to the respective elements/nodes of the MIKE BASIN network.

After performing analysis in MIKE BASIN (outside HDA), if user saves MIKE BASIN output time series(s), either in *.xlsx or *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA MIKE BASIN Interface
How to Access

HDA-Y >> Interface >> MIKE BASIN



Operations

Operation of MIKE BASIN Interface

1. Use the menu path defined above to open the MIKE BASIN Interface form.
2. In the "***Select Data Format***" section:
   2.1. Select Data Format.
   2.2. The time base associated with the selected data format is displayed in the "Select Time Base" section.
   2.3. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
   2.4. Click on "Get Series" to display all the selected series(s) in the right panel.
   2.5. Define the file location where the MIKE BASIN compatible time series files (*xlsx and/or *.txt) formats will be saved.
   2.6. Click on Create to finish creating the files.
   2.7. The files exported by the HDA can be imported in MIKE BASIN nodes as described in the Section (8).
3. Catchment area and river network shapefiles required for MIKE BASIN study are created during Watershed Delineation performance while creating the project in HDA-Head. The shapefiles can be imported in MIKE BASIN.

Create River Network and Define Catchment

A river network can be created in three different ways:

a) Method 1: Importing a river network
The river network may be imported from an existing shapefile layer created by HDA-Head using the "Copy Branch Shapes" tool which is found in the MIKE BASIN dropdown menu.
b) Method 2: Digitizing a river network
For schematic models and small river networks, the network can be digitized directly on the screen. An aerial photograph or map is often used as background maps in such situations.
c) Method 3: Derive the network from a DEM
River can be derived automatically from a DEM using the "Trace River" tool which can be found in the MIKE BASIN toolbar.

Catchments provide inflow to the MIKE BASIN river network, and a MIKE BASIN model may contain any number of catchments. Catchments may be represented schematically, or by their delineated boundaries.

a) Schematic Catchments

Schematic catchments are added to the model by using the Add Catchments button in the MIKE BASIN toolbar. When the button has been pressed, catchments are added by clicking at a point along the river network. When a catchment is added it will by default be a schematic catchment that is represented by a green catchment node and a shape representing the catchment area.

b) Delineated Catchments
   i. Importing Catchment Shapes

   If you have catchment shapes in an existing shapefile, you can copy these shapes to your river network. First, add the shapefile to the ArcGIS Table of Content using the "Add Data…" command in the ArcGIS File menu, or use the corresponding button on the Standard toolbar ( ). Tip: Once you've added the layer, drag it below the MIKE BASIN catchments layer in the table of contents. This way, as the shapes are copied to the MIKE BASIN model, you will see the new MIKE BASIN catchments appearing over the shapes you are copying. Otherwise, the new catchments will be hidden by the original shapes.

   Select the layer with the catchment shapes you want to copy in the dropdown list. Then click on the Select catchment shape to copy from tool button. On the map, click on the catchment shape you want to copy. The dialog will now automatically switch to the second tool so you can assign the shape to a branch. Click on the reach you want to assign the catchment to. The downstream node of the selected branch will turn into a catchment node, and the selected catchment shape will be copied to the MIKE BASIN Catchments layer.

   ii. Delineating Catchments

   Catchment shapes may be delineated using elevation data. The most accurate, method is to derive the catchments from a detailed elevation model (DEM).

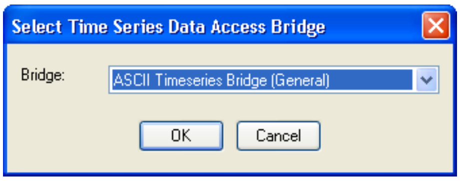
Import XLS and TXT files in MIKE BASIN Nodes
In the time series collection part of the Table of Content, it is possible to import time series. These time series can be in different formats e.g. **Excel, ASCII** and import through so-called data bridges. If

user selects, e.g. the Excel data bridge, user can keep the data in Excel and MIKE BASIN can read the time series directly, provided that the time series are specified with the correct properties.

If user needs to **import a large number of time series from EXCEL or TXT formats**, user can use the **Time Series Data Loader...**.

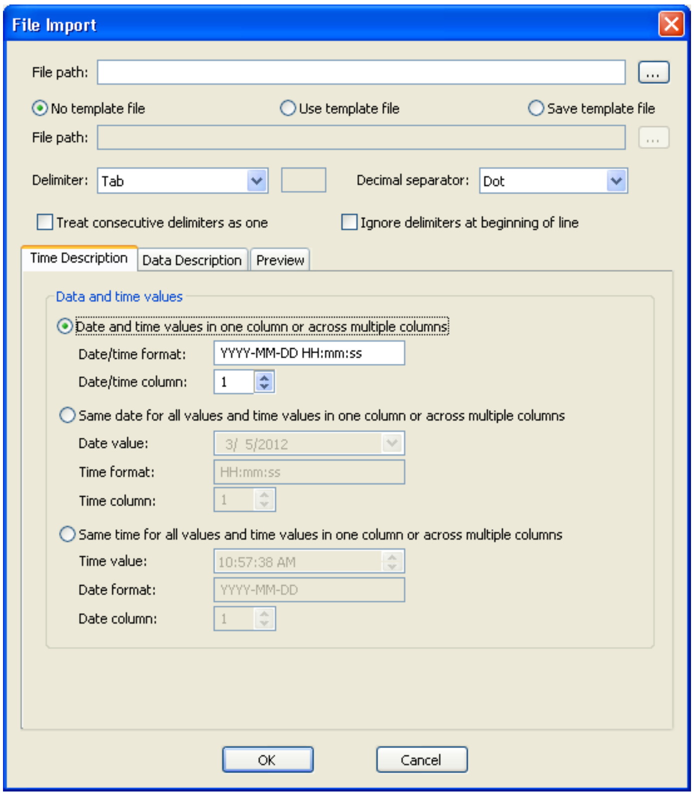
Import of ASCII time series

The ASCII time series Bridge (general) is selected from the list of bridges.



After the bridge is selected the "File import dialog" appears. The following dialog is used to specify all the parameters connected to the ASCII file import.

Time description tab



Date and time values in one column or across multiple columns:

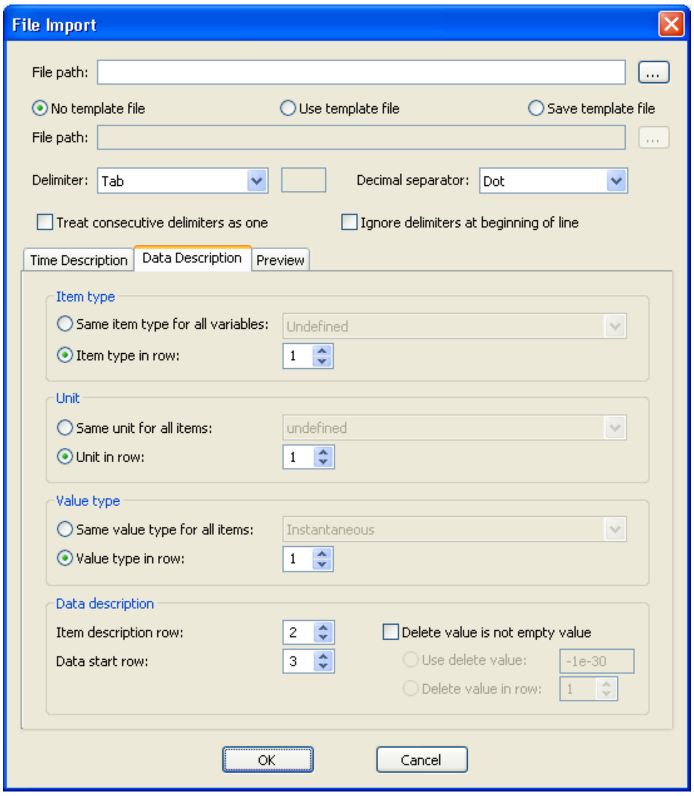
This option should be used if both date and time values are in the ASCII file.

Date/time format: Specify the date/time format used in the ASCII file as YYYY-MM-DD HH:mm:ss

Date/time column: This specifies the column containing date/time values. Select 1.

Data description tab

This dialog is used to describe how the data and the descriptors for the data are stored.



Item type:

Same type for all variables: If the item type is not specified in the ASCII file this option is used to give all the items the same item type.

Item type in row: If the item type is saved in the ASCII file, this specifies the row from where the item type should be read. If the item types are separated by the delimiter item types for several items would be identified. Note that the item type is case sensitive.

Unit:

Same unit for all items: If the unit is not specified in the ASCII file this option is used to give all the items the same unit.

Unit in row: If the unit is saved in the ASCII file, this specifies the row from where the unit should be read. If the units are separated by the delimiter units for several items would be identified. Note that the unit is case sensitive.

Value type:

Same value type for all items: If the value type is not specified in the ASCII file this option is used to give all the items the same value type.

Value type in row: If the value type is saved in the ASCII file, this specifies the row from where the value type should be read. If the value types are separated by the delimiter value types for several items would be identified. Note that the value type is case sensitive.

Data description:

Item description row: Specifies the row with the item description.

Data start row: Specifies the row in which the data starts (the first row after any header or comment information).

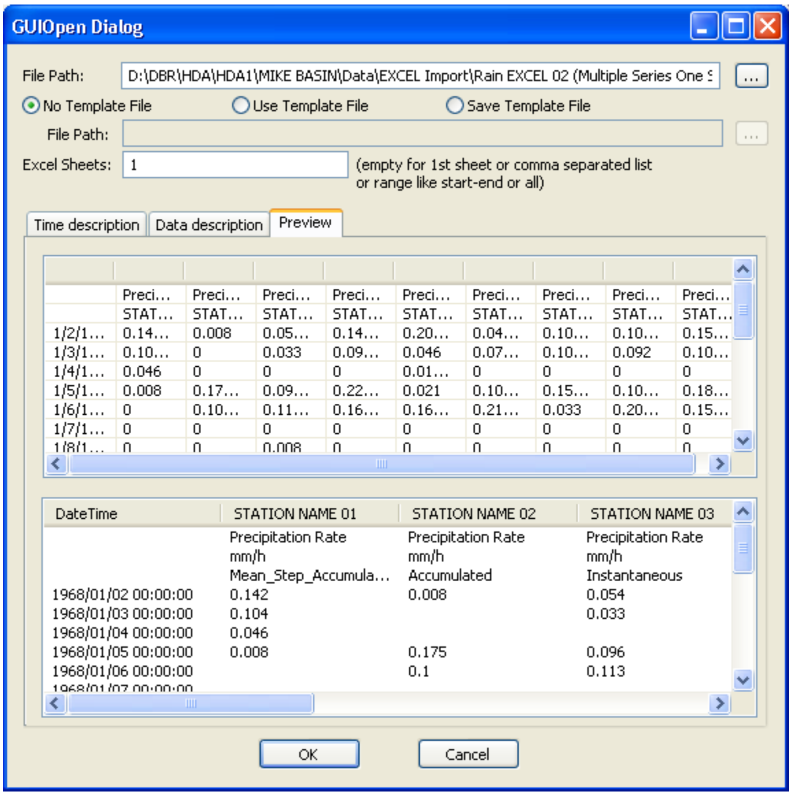
Delete values are not empty values: If this is checked on a delete value should be specified, otherwise all blank values will be treated as delete values.

Use delete value: Use the specified value as a delete value.

Delete values in row: Read the delete value from the specified row.

Preview dialog

The preview dialog shows the input file, and if all the parameters in the dialog are validated how the bridge understands the ASCII file. This dialog is very useful when defining the parameters for the ASCII import.

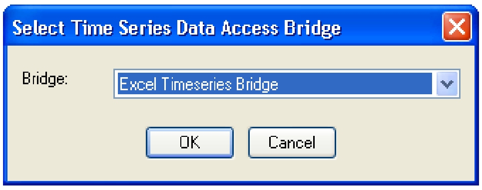


Import Excel Time Series

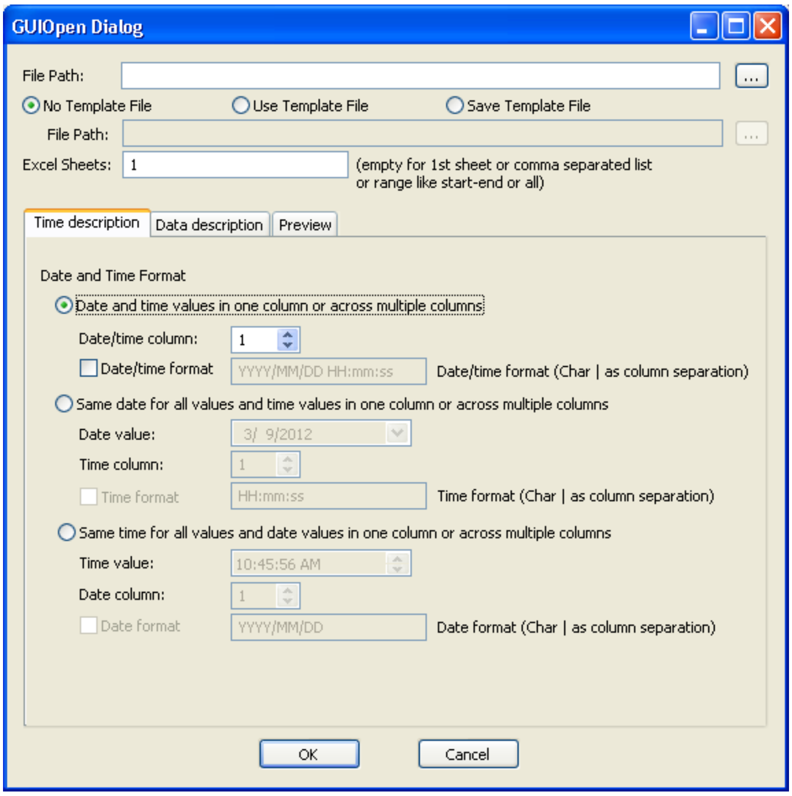
The Excel Time Series Bridge supports both the Import and Export commands, and is developed to support generic import and export of time series data in Excel format.

Import Excel TS

The Excel Time series Bridge (general) is selected from the list of bridges.



After the bridge is selected the "file import dialog" appears. This dialog is used to specify all the parameters connected to the Excel file import.



File Path: Specify the path to the Excel file No template file: The dialog setting will not be read from a template file, and the user will specify all the settings.

Excel sheets: Specify which Excel sheet to use in the import. If multiple sheet should be used specify the sheet number using comma as separator, or specify 1-3 (for selecting sheet 1 to sheet 3). If typing “all" all sheets will be used.

Time description dialog

Date and time values in one column or across multiple columns:

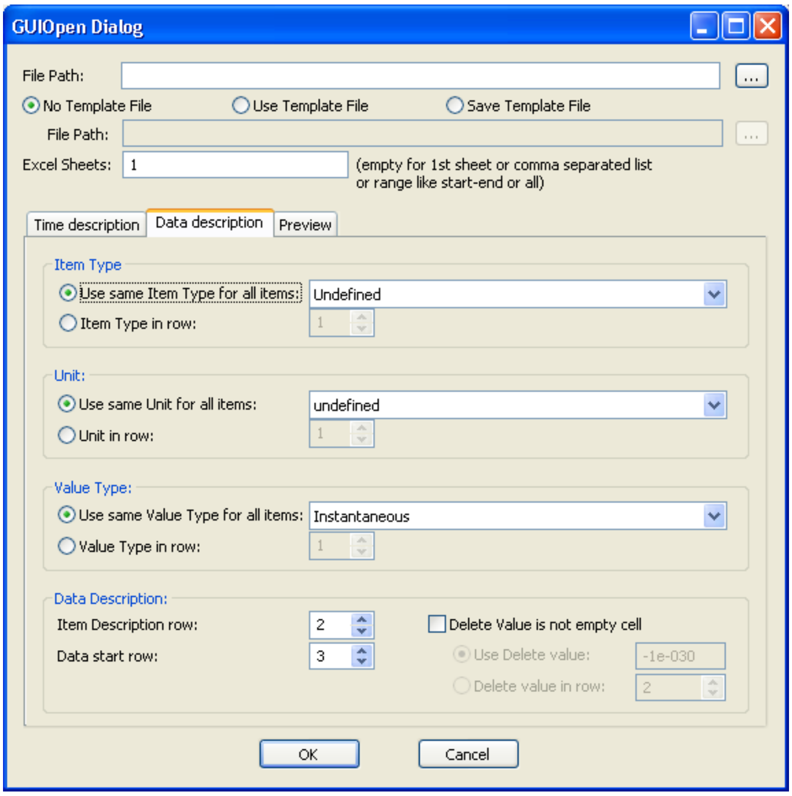
This option should be used if both date and time values are in the Excel file.

Date/time format: Specify the date/time format used in the ASCII file as YYYY-MM-DD HH:mm:ss

Date/time column: This specifies the column containing date/time values. Select 1.

Data description tab

This dialog is used to describe how the data and the descriptors for the data are stored.



Item type:

Same type for all variables: If the item type is not specified in the Excel file this option is used to give all the items the same item type.

Item type in row: If the item type is saved in the Excel file, this specifies the row from where the item type should be read. If the item types are separated by the delimiter item types for several items would be identified. Note that the item type is case sensitive.

Unit:

Same unit for all items: If the unit is not specified in the Excel file this option is used to give all the items the same unit.

Unit in row: If the unit is saved in the Excel file, this specifies the row from where the unit should be read. If the units are separated by the delimiter units for several items would be identified. Note that the unit is case sensitive.

Value type:

Same value type for all items: If the value type is not specified in the Excel file this option is used to give all the items the same value type.

Value type in row: If the value type is saved in the Excel file, this specifies the row from where the value type should be read. If the value types are separated by the delimiter value types for several items would be identified. Note that the value type is case sensitive.

Data description:

Item description row: Specifies the row with the item description.

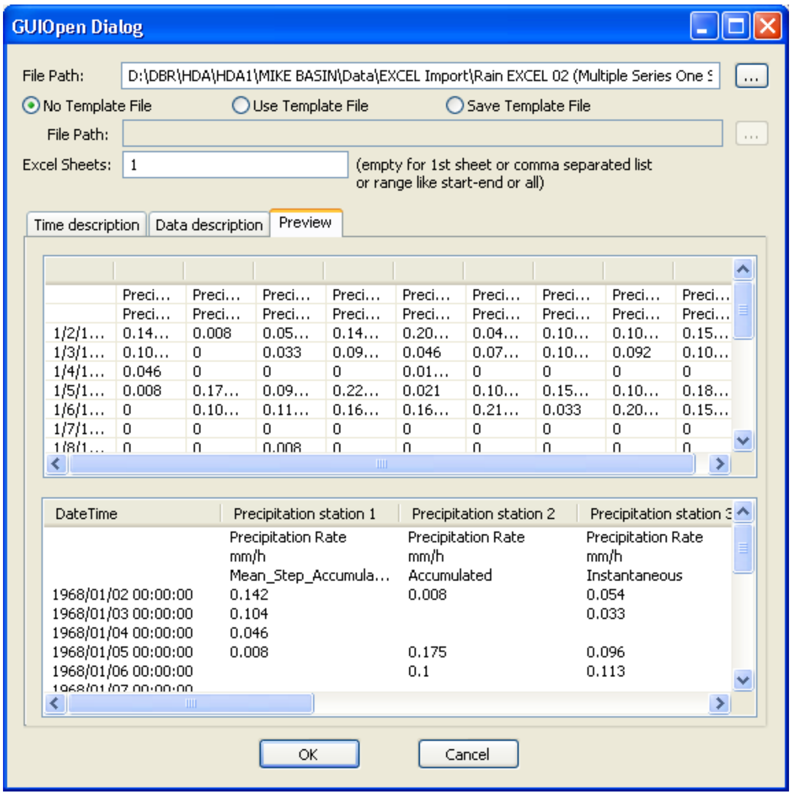
Data start row: Specifies the row in which the data starts (the first row after any header or comment information).

Delete values are not empty values: If this is checked on a delete value should be specified, otherwise all blank values will be treated as delete values.

Use delete value: Use the specified value as a delete value. Delete values in row: Read the delete value from the specified row.

Preview dialog

The preview dialog shows the input file, and if all the parameters in the dialog are validated how the bridge understands the Excel file. This dialog is very useful when defining the parameters for the Excel import.



MIKE BASIN Output – Import in HDA

After performing analysis in MIKE BASIN (outside HDA), if user saves MIKE BASIN output time series(s), either in *.xlsx or *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.

10.5. MIKE 11

About MIKE 11

MIKE 11, developed by DHI water & Environment is a hydrodynamic module (HD) uses an implicit, finite difference scheme for the computation of unsteady flows in rivers and estuaries, rivers irrigation and other water bodies. The module can describe sub-critical as well as supercritical flow conditions through a numerical scheme which adapts according to the local flow conditions (in time and space).

MIKE 11 is a user-friendly, fully dynamic, one-dimensional modeling tool for the detailed analysis, design, management and operation of both simple and complex river and channel systems. With its exceptional flexibility, speed and user friendly environment, MIKE 11 provides a complete and effective design environment for engineering, water resources, water quality management and planning applications.

The Hydrodynamic module is the nucleus of the MIKE 11 modeling system and forms the basis for most modules including Flood forecasting, advection-dispersion, water quality and non-cohesive sediment transport modules, This module solves the vertically integrated equations for the conservation of continuity and momentum, i.e. Saint Venant equations.

Appropriate of Usage

Following are the few key study areas where MIKE 11 could be used.

a) Flood forecasting and reservoir operation
b) Simulation and flood control measures
c) Operation of irrigation and surface drainage systems
d) Design of channel systems
e) Tidal and storm surge studies in rivers and estuaries

In addition to the hydrodynamic module described above, MIKE 11 includes add-on modules for 'Hydrology' as well.

Rainfall Runoff Model

The Rainfall Runoff Editor (RR-editor) provides the following facilities:

1. Input and editing of rainfall-runoff and computational parameters required for rainfall-runoff modeling.

2. Specification of time series. Time series are specified on the Timeseries page within the Rainfall Runoff Editor. In other MIKE 11 modules, the time series input are specified in the boundary file.

3. Calculation of weighted rainfall through a weighting of different rainfall stations to obtain catchment rainfall.

4. Digitizing of catchment boundaries and rainfall stations in a graphical display (Basin View) including automatic calculation of catchment areas and mean area rainfall weights.

5. Presentation of Results. Specification of discharge stations used for calibration and presentation of results.

Some of the features in the Rainfall Runoff package have been developed in cooperation with CTI Engineering, CO., Ltd., Japan. Amongst these are additional methods for Calculation of Runoff from catchments and Calculation of Mean Precipitation of basins (method of Thiessen polygons and Isohyetal Mapping).

Simulation

The Rainfall Runoff Editor builds a file containing all the specified data with extension .RR11. Once the catchments have been defined and the rainfall-runoff, and the model parameters specified in the rainfall-runoff editor, the Simulation is started from the MIKE 11 Run (or simulation) Editor. It should be noticed that:

1. Time Step: It is recommended to use a time Step not larger than the time Step in the rainfall series and not larger than the time constant for routing of overland flow.
2. Simulated catchment results can be linked with the River Network. Catchment runoff/discharges and be inputted as lateral inflows and summed to Normal and Routing river branch types.

Rainfall Runoff Model type

NAM: A lumped, conceptual rainfall-runoff model, simulating the overland-, inter- flow, and base-flow components of catchment runoffs as a function of the moisture contents in four storages. NAM includes a number of optional extensions, including an advanced snow-melt routine and a separate description of the hydrology within irrigated areas. Auto calibration is available for 9 important parameters.

UHM: The Unit Hydrograph Module includes different loss models (constant, proportional) and the SCS method for estimating storm runoff.

SMAP: A monthly soil moisture accounting model.

Urban: Two different model runoff computation concepts are available in the Rainfall Runoff Module for fast urban runoff:

A) Time/area Method
B) Non-linear Reservoir (Kinematic Wave) Method.

Combined: The runoff from a number of catchments, constituting parts of a larger catchment, can be combined into a single runoff series. Each of the sub- catchments must be specified separately by name, model type, parameters etc. The combined catchment can be defined only after the sub-catchments have been created. The combined catchment is defined in the group for combined catchments, which is activated when selecting combined catchment. The runoff from the combined catchment is found by simple addition of the simulated flow from the sub-catchments.

Catchment Area
Defined as the upstream area at the outflow point from a catchment.

The Calculated area shown in the Catchment Overview is based on the digitized catchment boundaries in the Graphical display. The calculated area is activated when the Basin View has been selected. The Catchment Area is shown in the edit fields for Area and Calculated Area, when transferring a catchment from the Basin View to the catchment page. The Area which is used in the model calculation can afterwards be modified manually.

Calibration plot
A calibration plot will automatically be prepared for catchments, where the time series for observed discharge have been specified on the Time series Page and the selection of calibration plot has been ticked off. The calibration can be loaded from the Plot composed and is saved in the subdirectory RRCalibration with the file name: Catchment-name.plc. The time series in these plots are also available in DFS0 format in the subdirectory RRcalibration with the file name: Catchmentname.dfs0.

Key Input
Following are the few key parameters that MIKE 11 takes as input to the model.

a) Rainfall time series
b) Temperature time series
c) Evaporation time series
d) Observed Discharge time series

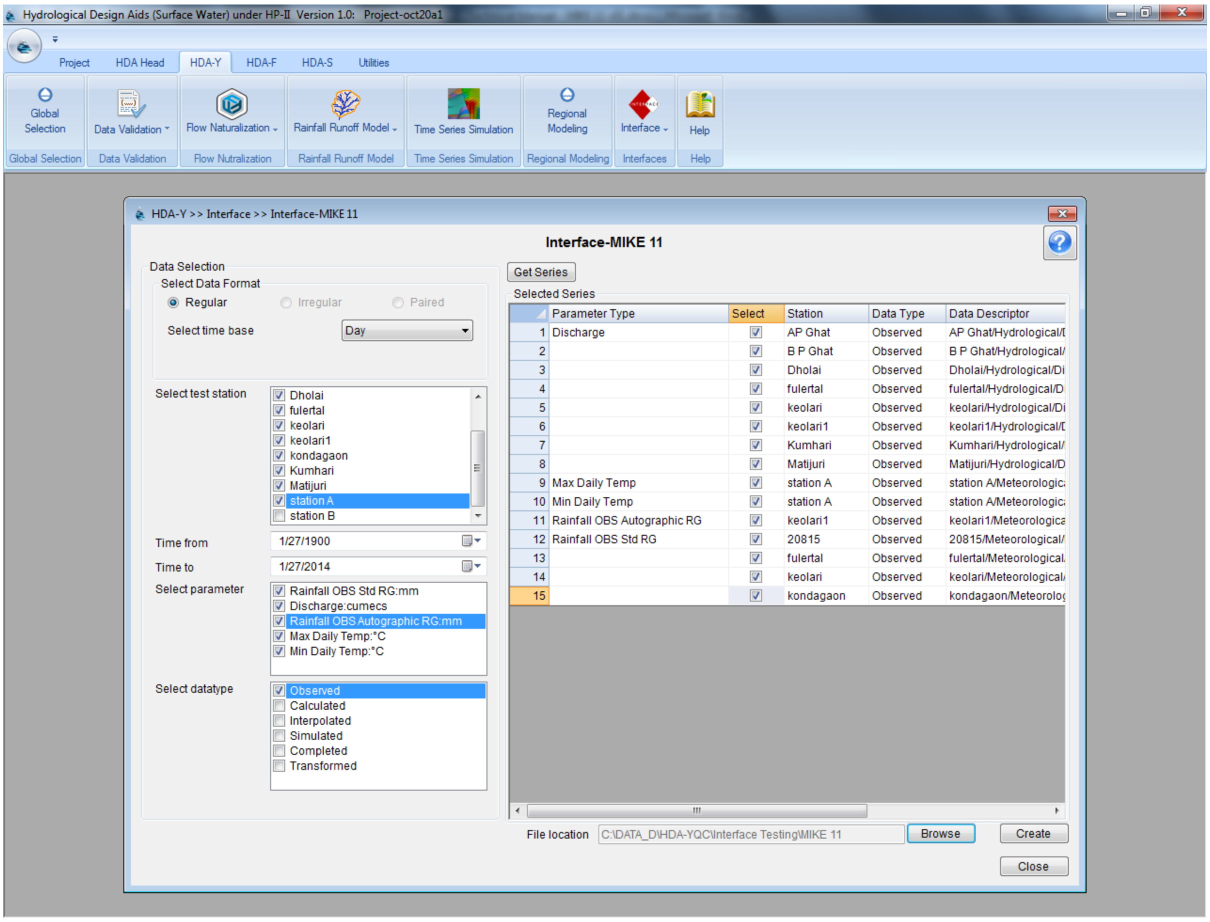
HDA Interface
MIKE 11 is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Most of the key input time series data files of Discharge, Maximum Temperature, Minimum Temperature, Average Temperature, Rainfall, Evaporation, be selected from HDA database and MIKE 11 compatible data files (with correct properties) in *.txt format will be created/exported to a desired location. The exported files can be imported in MIKE 11 to assign to the respective elements/nodes of the MIKE 11 network.

After performing analysis in MIKE 11 (outside HDA), if user saves MIKE 11 output time series(s), in *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA MIKE 11 Interface

How to Access

HDA-Y >> Interface >> MIKE 11



Operations

Operation of MIKE 11 Interface

1. Use the menu path defined above to open the MIKE 11 Interface form.
2. In the "***Select Data Format***" section:
   2.1. Select Data Format.
   2.2. The time base associated with the selected data format is displayed in the "Select Time Base" section.
   2.3. The stations associated with the time base is displayed in the "Select Station" and its corresponding parameters and data type are displayed in "Select Parameter" and "Select Data Type" section.
   2.4. Click on "Get Series" to display all the selected series(s) in the right panel.
   2.5. Define the file location where the MIKE 11 compatible time series files (*.txt) formats will be saved.
   2.6. Click on Create to finish creating the files.
   2.7. The files exported by the HDA can be imported in MIKE 11 nodes.

3. **ASCII File Format**
   This is a generic text format which can be produced by almost any spreadsheet or text editors. Only non-equidistant calendar axis data can be saved in this format. Files must have the following format:
   Title
   Time Itemname 1 Itemname 2
   Unit 100182 1003 2 100256 1800 1
   1996-12-24 18:00:00 1.23 2.34
   1996-12-24 18:30:00 1.44 3.38
   1996-12-24 19:00:00 2.12 4.63
   etc...
   a) The first line contains the title.
   b) The second line contains the string "Time" followed by the name of the items. The list is separated with tabs.
   c) The third line is optional. It contains the string "Unit"
   d) Each of the following lines contains data for one time Step. Each line consists of a date and time followed by one field for each of the data items.
4. Catchment area and river network shapefiles required for MIKE 11 study are created during Watershed Delineation performance while creating the project in HDA-Head. The shapefiles can be imported in MIKE 11.

Import XLS and TXT files in MIKE 11 Nodes

In the time series collection part of the Table of Content, it is possible to import time series. These time series can be in different formats e.g. ASCII (*.txt) and import through so-called data bridges. If user selects, user can keep the data in Excel and MIKE 11 can read the time series directly, provided that the time series are specified with the correct properties.

MIKE 11 Output – Import in HDA

After performing analysis in MIKE 11 (outside HDA), if user saves MIKE 11 output time series(s), either in *.xlsx or *.txt format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.

10.6. WinSRM

About WinSRM

The Snowmelt-Runoff Model (SRM) is designed to simulate and forecast daily stream flow in mountain basins where snowmelt is a major runoff factor. Most recently, it has also been applied to evaluate the effect of a changed climate on seasonal snow cover and runoff. SRM was developed by Martinec (1975) in small European basins. Recently, the runoff was modeled in the basin of the Ganges river, which has an area of 917,444 km^2 and an elevation range from 0 to 8,840 m a.s.l. Contrary to the original assumptions, there appear to be no limits for application with regard to the basin size and the elevation range.

SRM can be applied in mountain basins of almost any size (so far from 0.76 to 917,444 km^2) and any elevation range. A model run starts with a known or estimated discharge value and can proceed for an unlimited number of days, as long as the input variables - temperature, precipitation and snow covered area - are provided.

Appropriate of Usage

SRM can be applied in mountain basins of almost any size (so far from 0.76 to 917.444 km^2) and any elevation range. A model run starts with a known or estimated discharge value and can proceed for an unlimited number of days, as long as the input variables – temperature, precipitation and snow covered area – are provided (refer Section 3, WinSRM User Manual).

Key Input

Following are the key input requirements to perform a study using WinSRM.

a) Temperature
b) Precipitation
c) Discharge
d) Elevation zones and corresponding areas
e) Zone hypsometric mean elevation
f) Snow covered depletion curve

Key Output

Following is the main output that WinSRM calculates after successful running of the simulation.

a) Simulated Discharge

HDA Interface

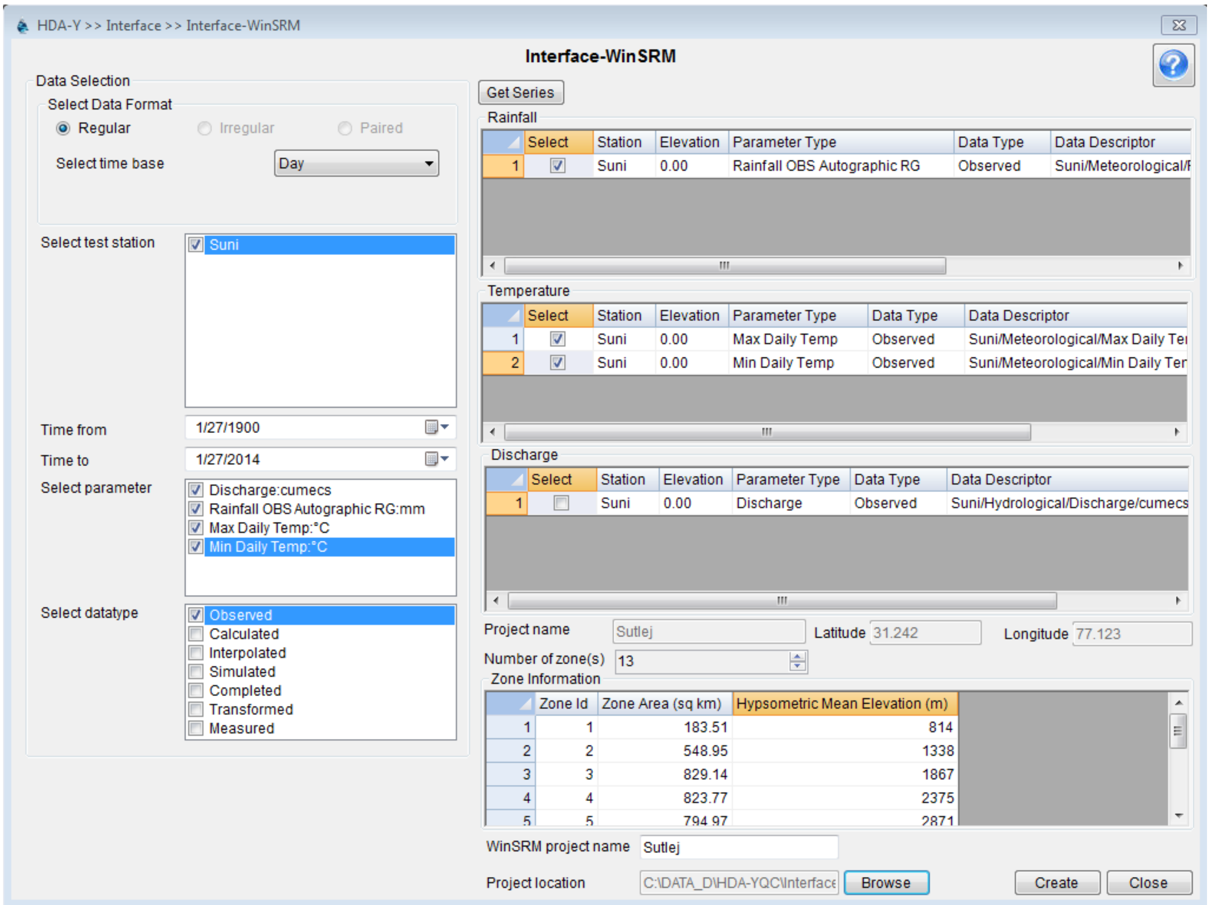
WinSRM is interfaced with Hydrological Design Aids (Surface Water) software under HDA-Y (Water Availability) module. Key input time series data of Discharge, Maximum Temperature, Minimum Temperature, Precipitation can be selected from HDA database and WinSRM model file (with correct properties) will be created to a desired location.

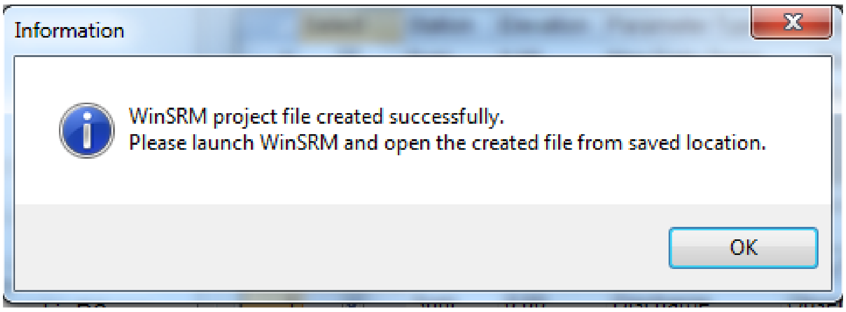
The created file WinSRM model file can be opened in WinSRM for further analysis and simulation.

After performing analysis in WinSRM (outside HDA), if user saves WinSRM output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section.

Create Input Files from HDA WinSRM Interface
How to Access

HDA-Y >> Interface >> WinSRM





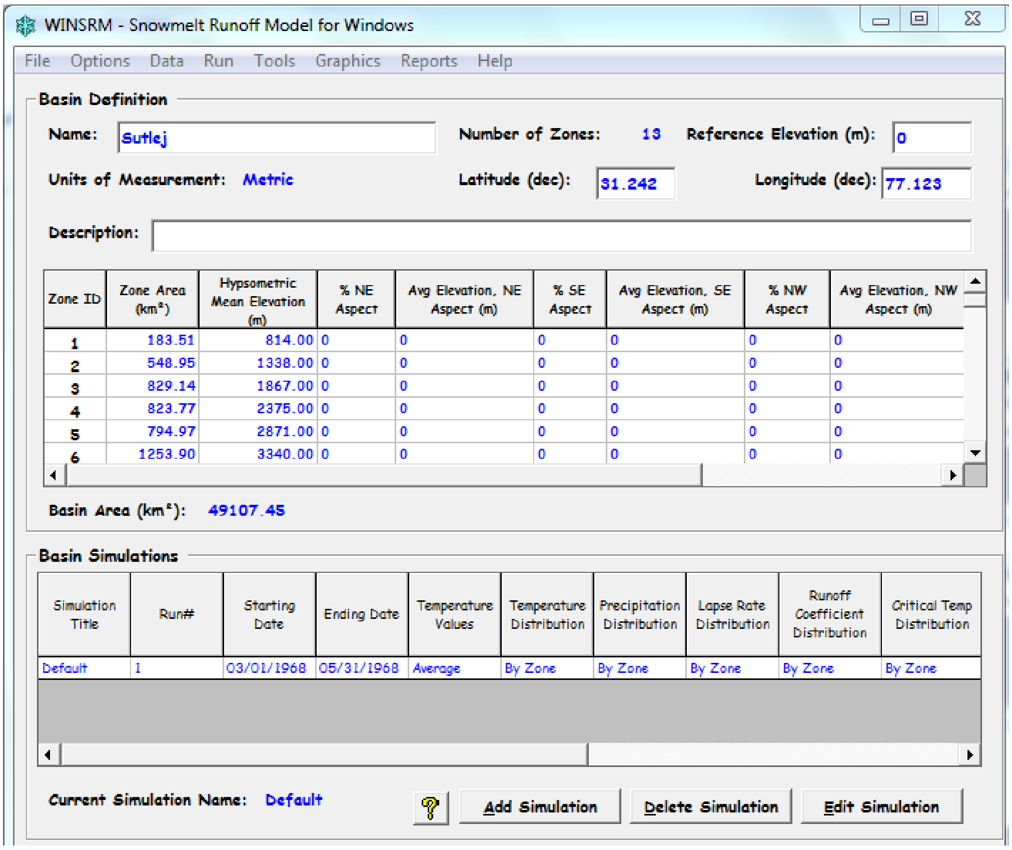
Operations

Operation of WinSRM Interface

1. Use the menu path defined above to open the WinSRM Interface form.
2. In the "***Select Data Format***" section:
   - 2.1. Regular data with 'Daily' time base should be selected.
   - 2.2. Stations should be selected for which precipitation, maximum & minimum temperature/average temperature, and discharge station data are available in the HDA project.
   - 2.3. Click on 'Get Series' and the rainfall, temperature and discharge section will be filled up the corresponding time series (s). Select the desired series.
   - 2.4. Define the number of elevation zones and their corresponding areas and hypsometric mean elevation.

2.5. Define a desired name for the WinSRM project and select the desired location where WinSRM model files will be created.

2.6. Launch WinSRM software and open the project created by HDA interface.



2.7. After opening the WinSRM model file, go to 'Data | Variables | Period of record' and define 'Snow cover depletion curve' (CDC) for all the respective elevation zones to run the simulation is WinSRM.

WinSRM Output – Import in HDA

After performing analysis in WinSRM (outside HDA), if user saves WinSRM output time series(s), in *.xlsx format, the same saved time series (s) can be imported in HDA through HDA-Head data entry section. Please refer Technical Manual and User Manual of HDA-Head Station and Data Entry sections.