Calibration Reference Manual

Prepared by

Deltares and the National Water Center

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Revision History

Date	Version	Description	Author
11/18/13	1.0	First CHPS release	OHD and Deltares
03/18/15	2.0	Added STATQ module and used new FEWS PEAKFLOW transformation.	OHD
09/01/15	3.0	Added additional peakflow statistics	NWC

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Introduction

The goal of the Community Hydrologic Prediction System (CHPS) Calibration project was to provide calibration capabilities in a CHPS environment. As with the CHPS implementation itself, the vision for Calibration was to provide National Weather Service River Forecast System (NWSRFS)-based functionality within the new forecasting environment (CHPS), not to precisely replicate NWSRFS functionality.

An analysis of NWS requirements (StatQME, Interactive Calibration Program (ICP), etc.) revealed that existing Flood Early Warning System (FEWS) capabilities could meet many, but not all, of the CHPS basic calibration requirements through the use of existing FEWS transformations and configurations.

For the cases where calibration capabilities are not easily configurable (or not configurable at all), Deltares developed a mechanism to add custom software to FEWS without the need to change the FEWS software itself. This mechanism, referred to as custom transformations, forms part of a new FEWS Application Programming Interface (API) designed to allow a broad range of user provided software add-ons to FEWS. Refer to the Deltares public wiki (https://publicwiki.deltares.nl/display/FEWSDOC/Custom+Transformations) for more information on the FEWS API and custom transformations.

The CHPS Calibration Team also identified the need to replace the ICP Statistical Summary which provides information in a text-based tabular format within a single window. Rather than duplicating the report via source code, the team elected to use the existing FEWS Report Module to generate an HTML-based report. FEWS HTML Reports do not require special software but do require special configurations. This feature is referred to as the HTML Report within this document. Refer to http://publicwiki.deltares.nl/display/FEWSDOC/09+Report+Module for more information on the FEWS report module.

The purpose of this document is to provide instructions for the use of calibration tools in CHPS. A separate document, Calibration Configuration Guide, provides instructions to configure all features described in this document.

1 Description of the Calibration Workflow

A typical calibration workflow will be described using the Middle Fork of the Flathead River near West Glacier, MT (WGCM8) in the NWRFC domain. WGCM8 has two elevation zones: WGCM8U and WGCM8L. The structure of the calibration workflow WGCM8_Stats_Calibration is shown in Figure1.

The first two sub workflows are the current Flathead preprocessor workflow and the WGCM8 basin models. The only adjustment compared to the operational basin modules is commenting out the "looptimestep" in the UpdateStates General Adapter modules. This ensures the model does not loop every day and will only write a state at the end of the run.

The WATERBAL, STATQME (or STATQ) and PEAKFLOW modules calculate the water balance, discharge statistics and peak flow statistics.

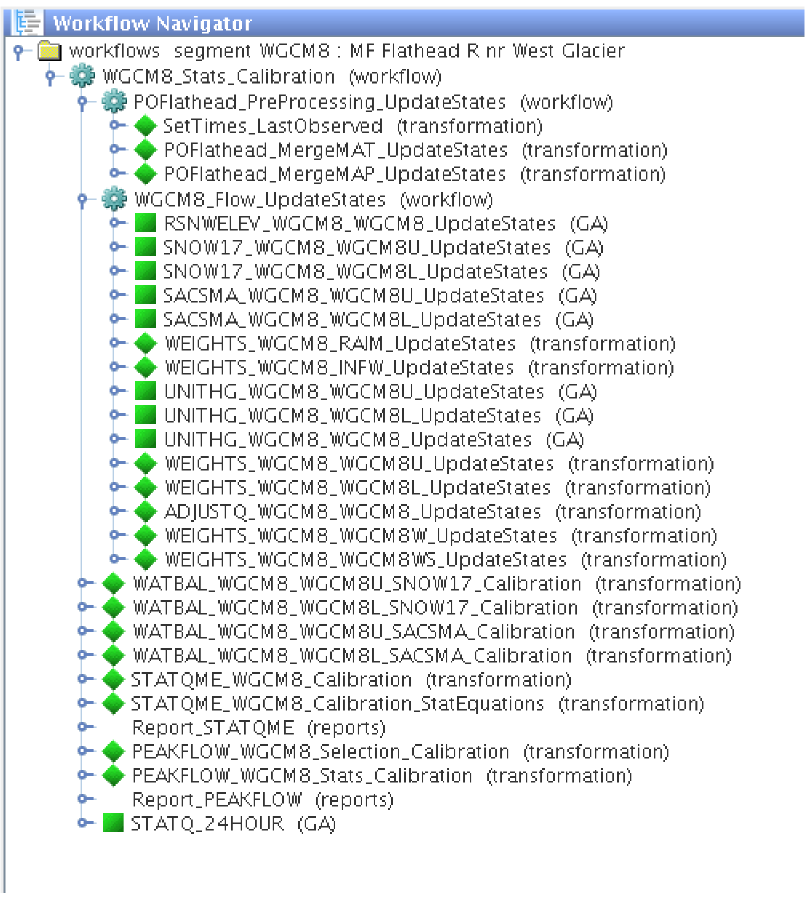


Figure 1: Calibration workflow for segment WGCM8

1.1 Water Balance

The calculations are similar to the WATERBAL operation in NWSRFS. The modules are separated per upper and lower sub-basins. Calculations are configured for monthly, seasonal, and annual time steps, both for multi-year aggregations and for yearly aggregations by water year.

1.2 StatQME

The CHPS StatQME module calculates most of the equations from the Stat-QME operation in the legacy system. The following table summarizes the equations provided in CHPS. (Reference: https://vlab.ncep.noaa.gov/documents/207461/1893022/533statqme.pdf)

StatQME Equation	CHPS Calibration
1. Simulated Mean	✓
2. Observed Mean	✓
3. Percent Bias	✓
4. Monthly Bias	✓
5. Maximum Error	✓
6. Percent average absolute error	✓
7. Percent RMS error	✓
8. Daily RMS error	✓
9. Daily average absolute error	✓
10. Correlation coefficient for daily flows	✓
11. Line of best fit	✓
12. Maximum monthly volume error	✗
13. Percent average absolute monthly volume error	✗
14. Percent monthly volume RMS error	✗
15. 25 largest daily error values	✗
16. 12 monthly volume errors	✗
17. Accumulated flow	✓
18. Cumulative frequency table percent error for each case	✗
19. Discharge exceedence plot	✗

Table 1: List of StatQME equations in CHPS

Flow Interval Biases for equations 1 through 7 are calculated for the statistical summary report.

Calculations are configured for daily, monthly, seasonal, and annual time steps, both for multi-year aggregations and yearly aggregations by water year.

1.3 StatQ

The CHPS StatQ module has similar capabilities as to StatQME module with several expanded options. It can compute statistics on specific events. This module also has a limited analysis of Peakflows (the @H analysis). The primary difference being STATQ module calculates statistical comparison between simulated and observed hourly discharge time series.

Refer to https://vlab.ncep.noaa.gov/documents/207461/1893006/StatQ_Users_Manual.pdf for more information on the StatQ User's Manual document.

StatQ Equation	CHPS Calibration
1. Percent Bias	✓
2. Absolute Percent Bias	✓
3. Simulated Mean	✓
4. Observed Mean	✓
5. RMS, or Percent RMS Error	✓
6. Correlation Coefficient	✓
7. Nash-Sutcliffe Coefficient	✓
8. Line of Best Fit	✓
9. Standard Deviation	✓
10. Coefficient of Variation	✓
11. Modified Correlation Coefficient	✓
12. Overall Statistic Equations for Flood Events	✓

Table 2: List of StatQ equations in CHPS

1.4 Peakflow

The Peakflow modules select observed peak values in the relative view period. The biases for these peaks are calculated afterwards. The two steps are described below.

The ***PEAKFLOW_WGCM8_Convert_Peak*** module allows the user to import a USGS peakflow file into the Fews database. The downloaded peakflow files should be placed into the Import/peakflow directory.

The ***PEAKFLOW_WGCM8_Selection_Calibration*** module selects a threshold (in metric units) for the peaks and copies all QME values above these thresholds to another time series. See Figure 2a.

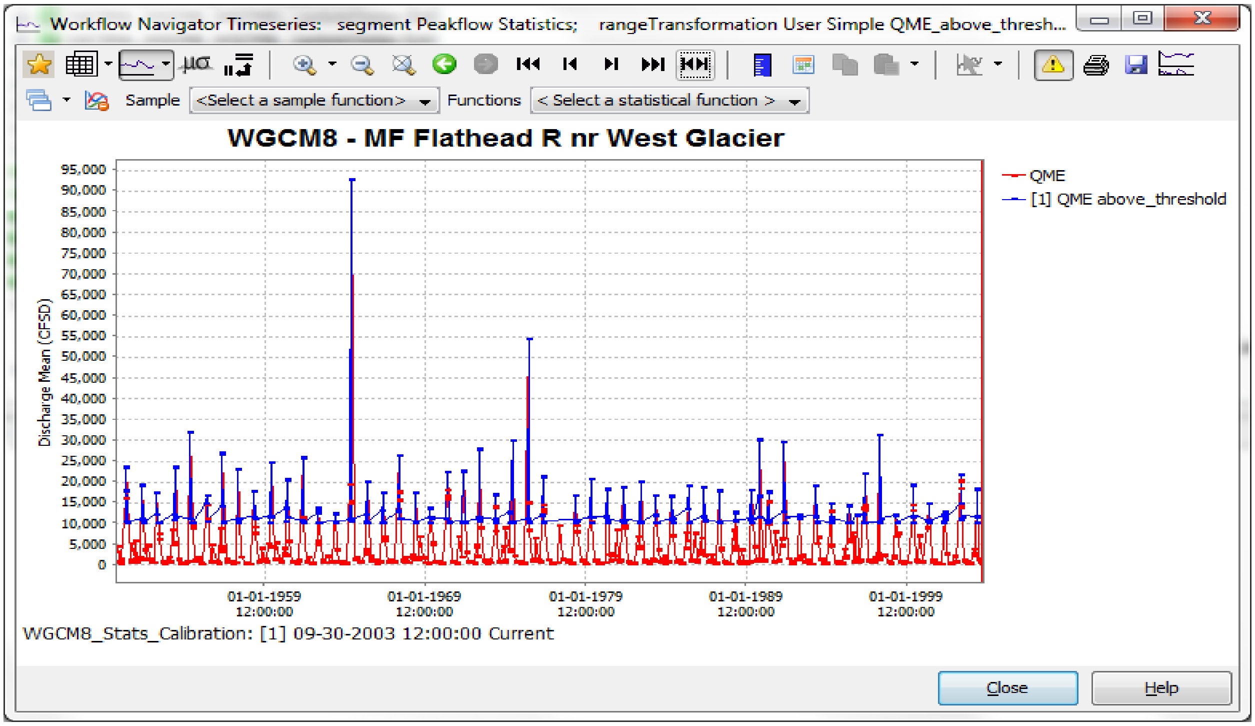


Figure 2a: Creation of time series above threshold

The module then selects the number of independent peaks having a certain gap length between the peaks. The output is written as a non-equidistant time series of QME_peaks (see Figure 2b).

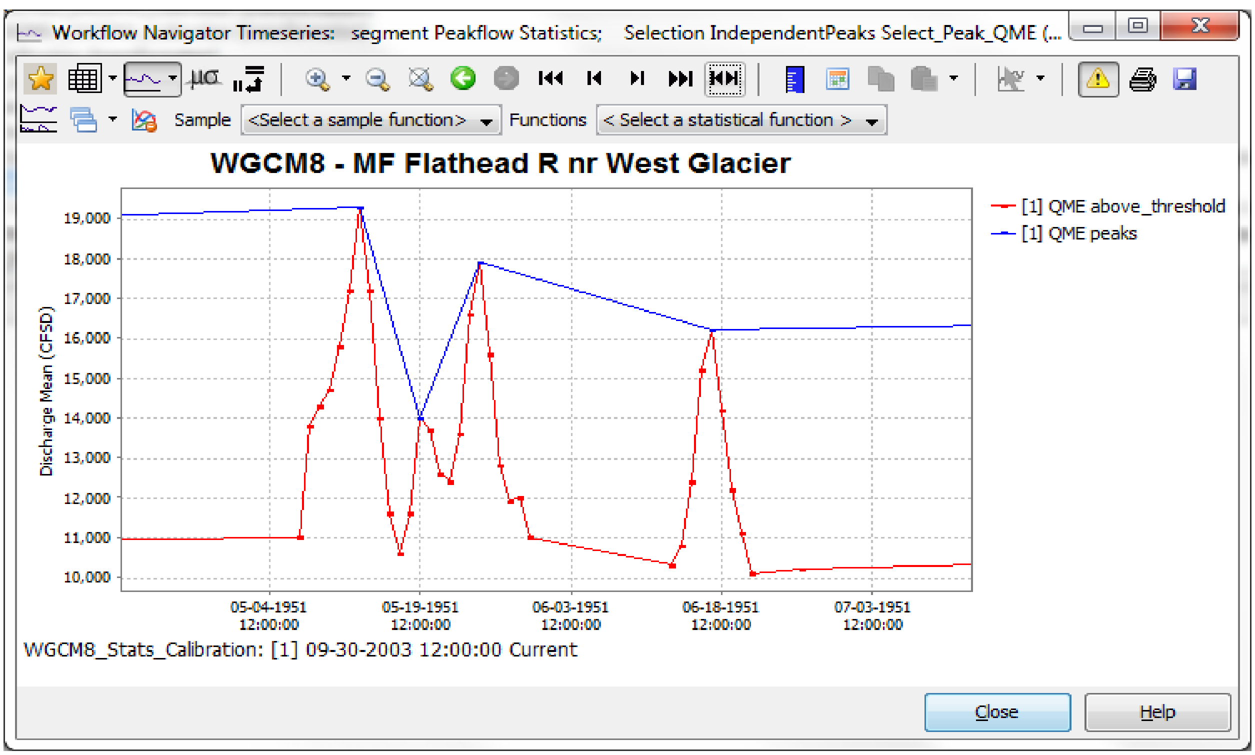


Figure 2b: Selection of Peaks

The ***PEAKFLOW_WGCM8_Stats_Calibration*** uses FEWS transformation *"maxAroundPeakTime"* to search for the maximum value for SQIN within the defined search window (in days), and calculates differences (i.e. discharge Error and Timing Errors in days). Using the output variables of the *"maxAroundPeakTime"* transformation then calculates various statistics (see ***Table 3*** below for a complete list). The Peak statistics are displayed as an HTML report or time series plots (see Figure 2c).

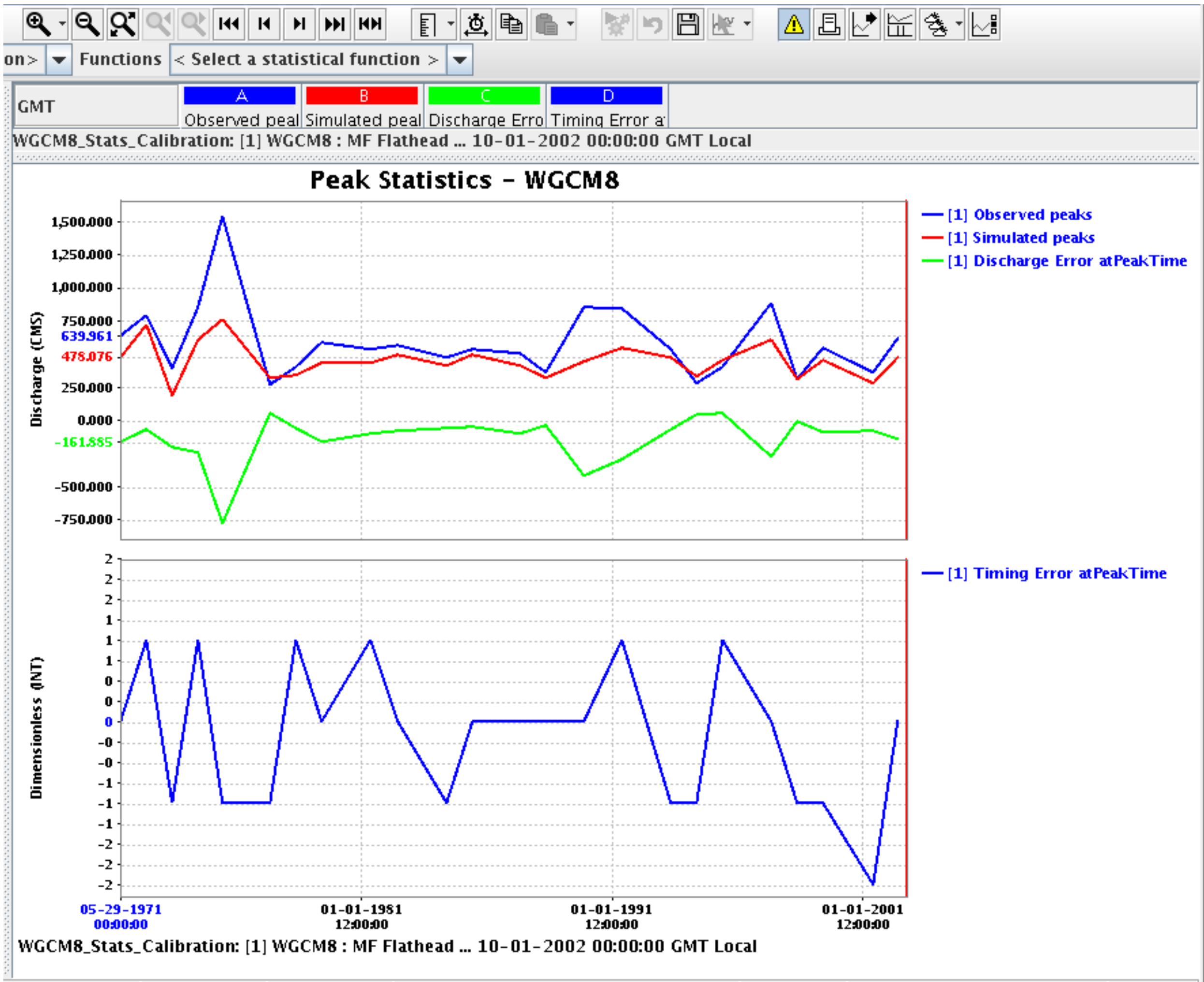


Figure 2c: Peaks statistics plots

The ***PEAKFLOW_WGCM8_Calibration_StatEquations*** module uses the FEWS api to calculate the following statistics given the observed (either calculated or imported) and simulated peaks:

1. Average Percent Error
2. Correlation Coefficient
3. Timing RMS Error
4. Timing Errors
5. Best Fit Line
6. Discharge Ratio

The CHPS PEAKFLOW module calculates all of the equations from the PEAKFLOW operation in the legacy system. The following table summarizes the equations provided in CHPS.

Peakflow Equation	CHPS Calibration
1. Simulated Peak Discharge	✓
2. Observed Peak Discharge	✓
3. Discharge Errors	✓
4. Timing Errors	✓
5. Discharge Ratio	✓
6. Observed Peak Mean	✓
7. Simulated Peak Mean	✓
8. Discharge Error Mean	✓
9. Discharge Ratio Mean	✓
10. Discharge RMS Error	✓
11. Timing RMS Error	✓
12. Average Percent Error	✓
13. Correlation Coefficient	✓
14. Best Fit Line	✓

Table 3: List of PEAKFLOW equations in CHPS

1.5 Percolation Analysis

The CHPS Percolation Analysis Function is limited compared to the original ICP.

In ICP, users could click on the WY-PLOT at any point on the hydrograph (usually the beginning of the runoff event). A vertical line would be plotted on the Percolation Demand Curve. The plotting position on the x-axis was determined by the value of the Lower Zone Deficiency Ratio (LZDEFR) for the day selected in the WY-PLOT. Users would then click on the Percolation Curve plot at the vertical line, adding a point to indicate if more or less percolation was needed for the runoff event. The user would build up a cloud of points to assess the given Percolation Demand Curve.

At this time, CHPS cannot completely support this functionality. As a manual work-around, the user can start the Percolation Analysis shown in Figure 3. This plot links the SQME and QME time series to the daily time series of LZDEFR. Just like in ICP, the user can click on the linked plots at the beginning of a runoff event. Cross-hairs will appear in the bottom pane, showing the value of the LZDEFR for that day. Users can then add a point on a paper copy of the Percolation Demand Curve (see example in Figure 9) at the x-axis value of LZDEFR to indicate if more or less percolation is needed. Users can then specify new values of the percolation parameters and generate a new curve using the Modifiers functionality. This is discussed in more detail in Section 4.2.

The requirement to more faithfully implement the original ICP functionality in CHPS will be reviewed at a later date.

The LZDEFR time series is needed by the Percolation Analysis. The LZDEFR will be an additional output time series for the SAC-SMA model. The generation of the LZDEFR time series is discussed in section 3.1.12 of the Calibration Configuration Guide.

LZDEFR is computed using the following equation:

$$LZDEFR = 1.0 - \frac{LZTWC + LZFSC + LZFPC}{LZTWM + LZFSM + LZFPM}$$

Where LZTWC, LZFSC, LZFPC are states and LZTWM, LZFSM, and LZFPM are parameters of the SAC-SMA model. For the Percolation Analysis, LZDEFR is computed for each major time step (e.g., at hours 6, 12, 18, and 24 for a 6 hour run). One value is selected for each day to create a time series of daily LZDEFR values to use in the Percolation Analysis. The selected LZDEFR value corresponds to the multiplier (number of time step). For example, if the multiplier value is 6, then the 6Z value of LZDEFR from each day in the computational period is selected to create a daily time series of LZDEFR. In ICP, the LZDEFR value for the last time interval of each day was used.

To display the CHPS Percolation Analysis function, the following steps are used.

- Select **Plots** display tab, click on icon (Short cuts)
- Select WGCM8 Calibration → PERCOLATION ANALYSIS
- Click on icon (Table) and icon to see time and values

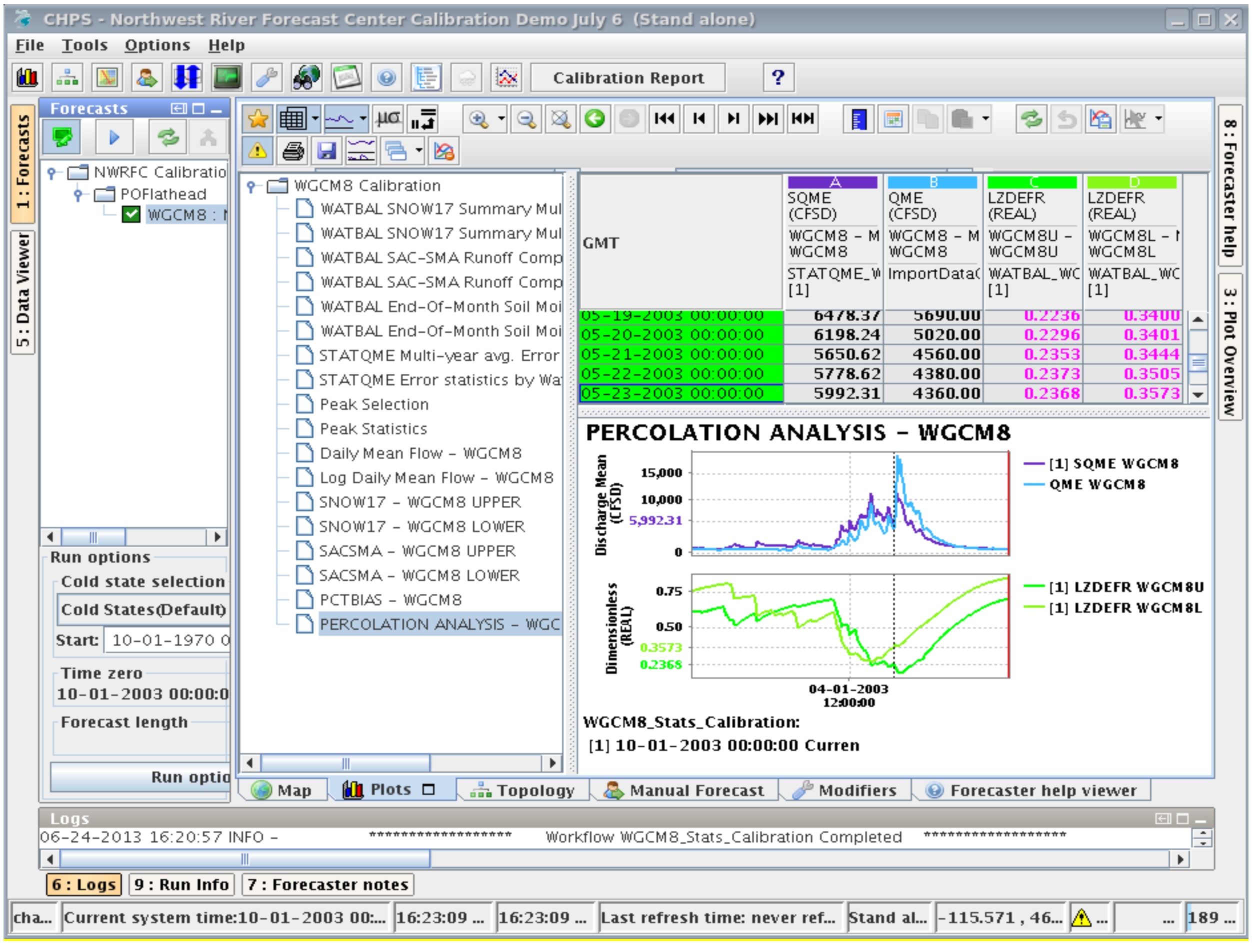


Figure 3: Percolation Analysis display showing the tabular and plotted values of the hydrographs and Lower Zone Deficiency Ratio.

2 Run Import Workflow

To illustrate the Run Import Workflow, we will use the example of WGCM8 in NWRFC. Before running the workflow with QME, MAP, and MAT data, you need to copy the external files from the /xxrfc_calb/Import/backup directory to the /xxrfc_calb/Import/cardfiles directory.

Open the Manual Forecast Display and select workflow Import Data Cards to run the import workflow. Set the cold state run start time to the start of your calibration period, e.g. 10/01/1949. In our example, the River, Reservoir and Snow (RRS) pre-processor needs to be run first for the observations to be available. If you do not provide a date, it will only run for 10 days. After this selection, press Run to submit the workflow. Users may already have time series of discharge, reservoir outflow, etc and may not need to run the RRS preprocessor.

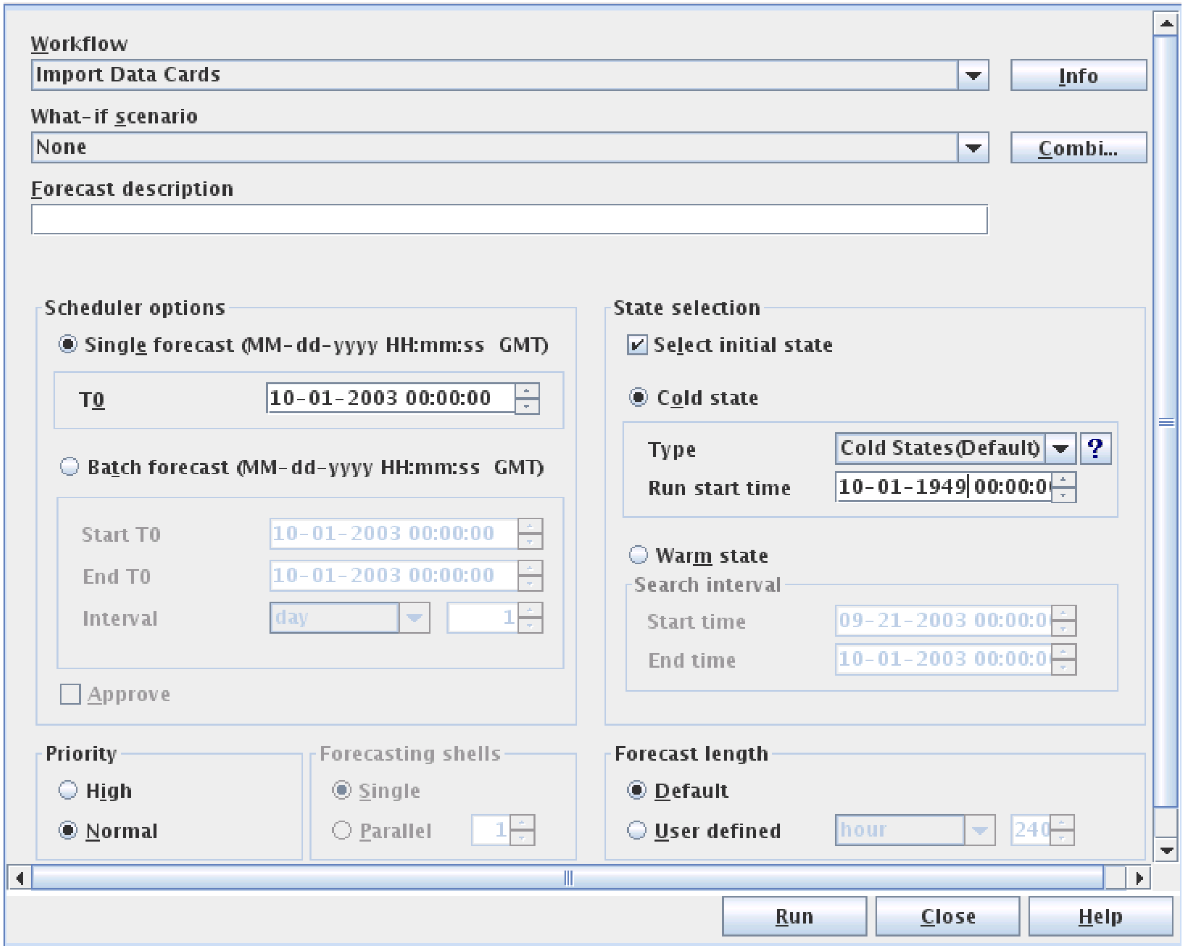


Figure 4: Run Import Workflow

3 How to Run a Calibration Workflow

The calibration workflow can be executed from the Manual Forecast Display, or from the Forecast tab of the Interactive Forecast Displays (IFD). The user may decide which is more convenient. The latter has additional functionalities for modifiers, as described in Section 4.

To set the end of the calibration run period, set the current system time to the end date of your desired calibration, as shown in Figure 5. The beginning of the run period is set differently depending on whether the Manual or Interactive Forecast Display is used to execute the calibration workflow.

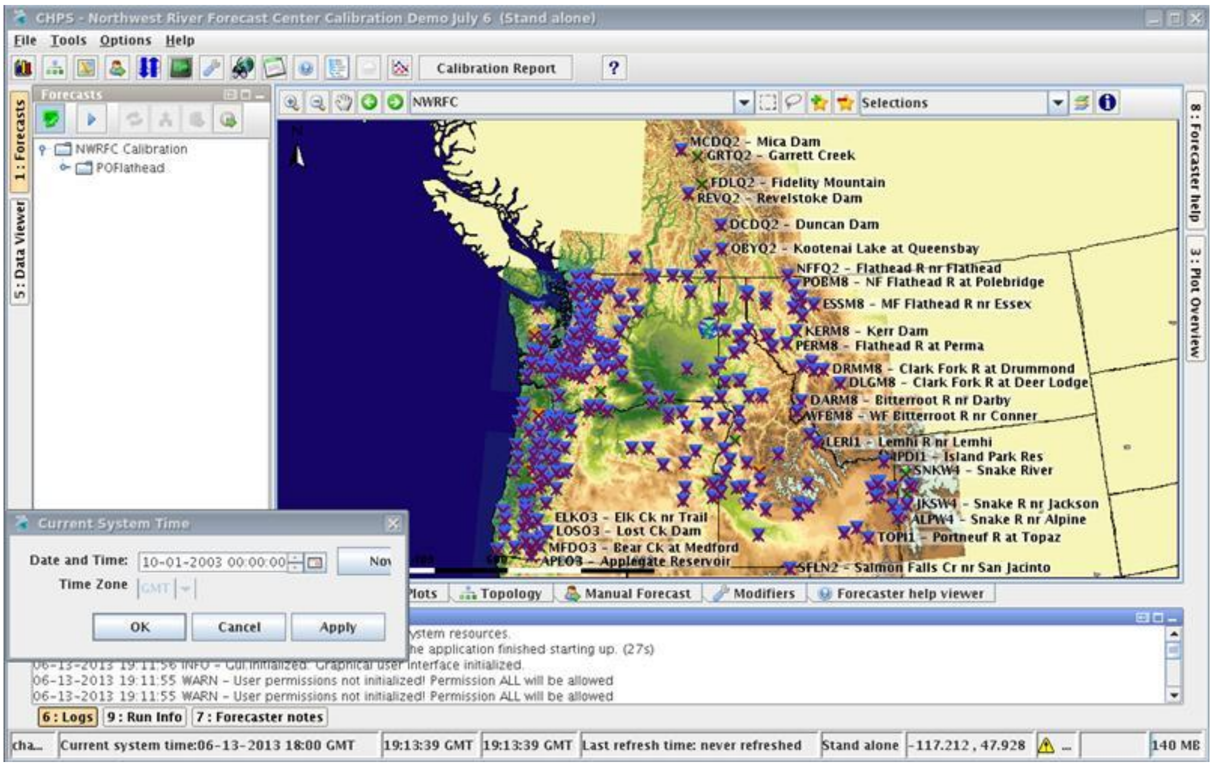


Figure 5: Current system time set to end of calibration run

3.1 Run from Manual Forecast Display

- Click on the  icon.
- Select your basin calibration workflow (e.g WGCM8_Stats_Calibration).
- Change the Cold states run start time to the start date of your calibration run. In Figure 6, the start of the calibration period is October 1, 1970.
- Press **Run.**

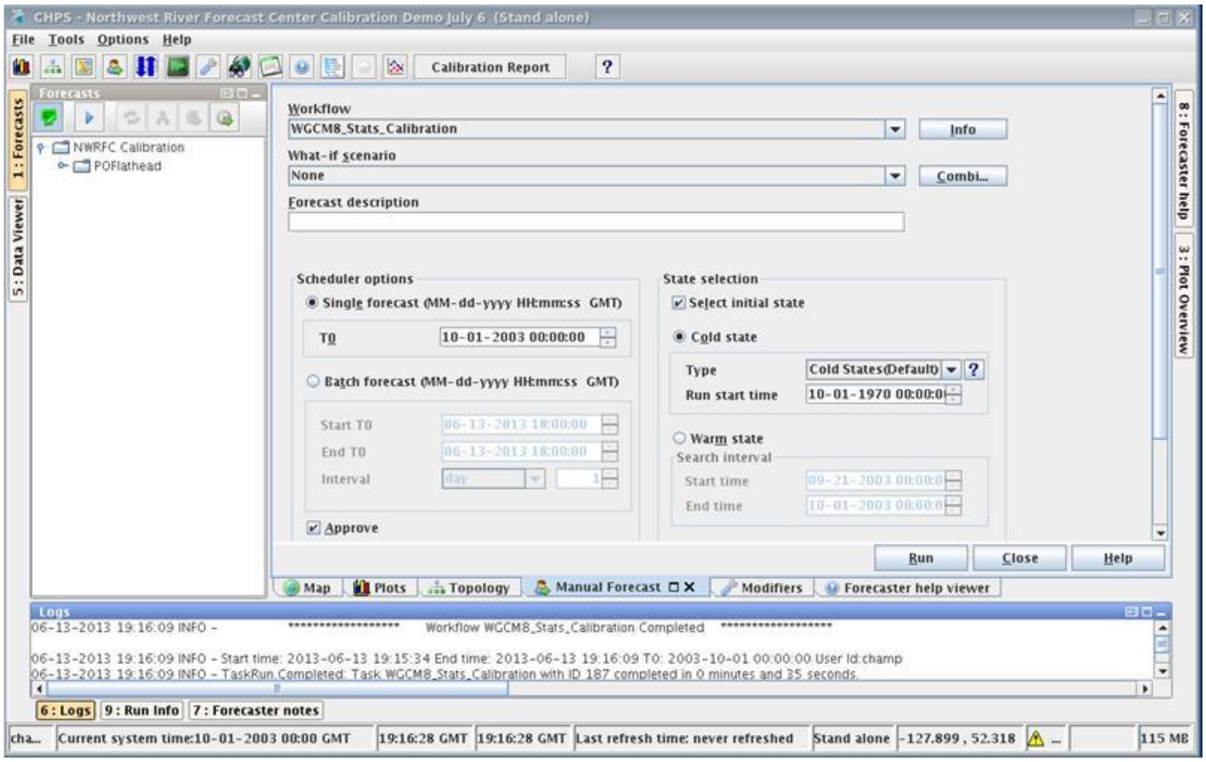


Figure 6: Cold states run start time set to start date of calibration run

By setting the cold state two years back, the calibration statistics are based on two years of data. The user can adjust this time as desired.

3.2 Run from Forecast tab

To run from the Forecast tab, select one of the nodes in the calibration directory (last one) and press the Run button in the Forecast tab menu bar (third button). The workflow will use a default cold state from a day two years in the past. The default can be set in the Topology.xml file (e.g., <coldState unit="day" multiplier="730"/>). Also, the **Run options** can edit these settings.

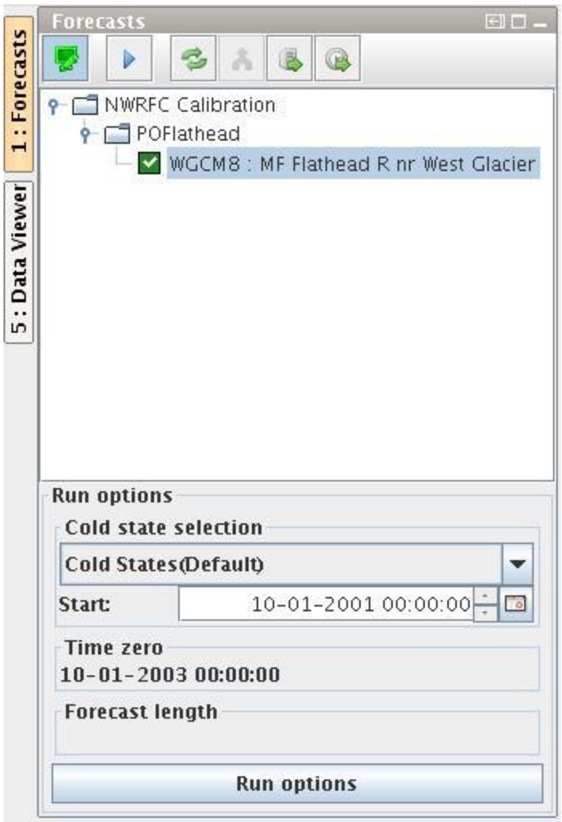
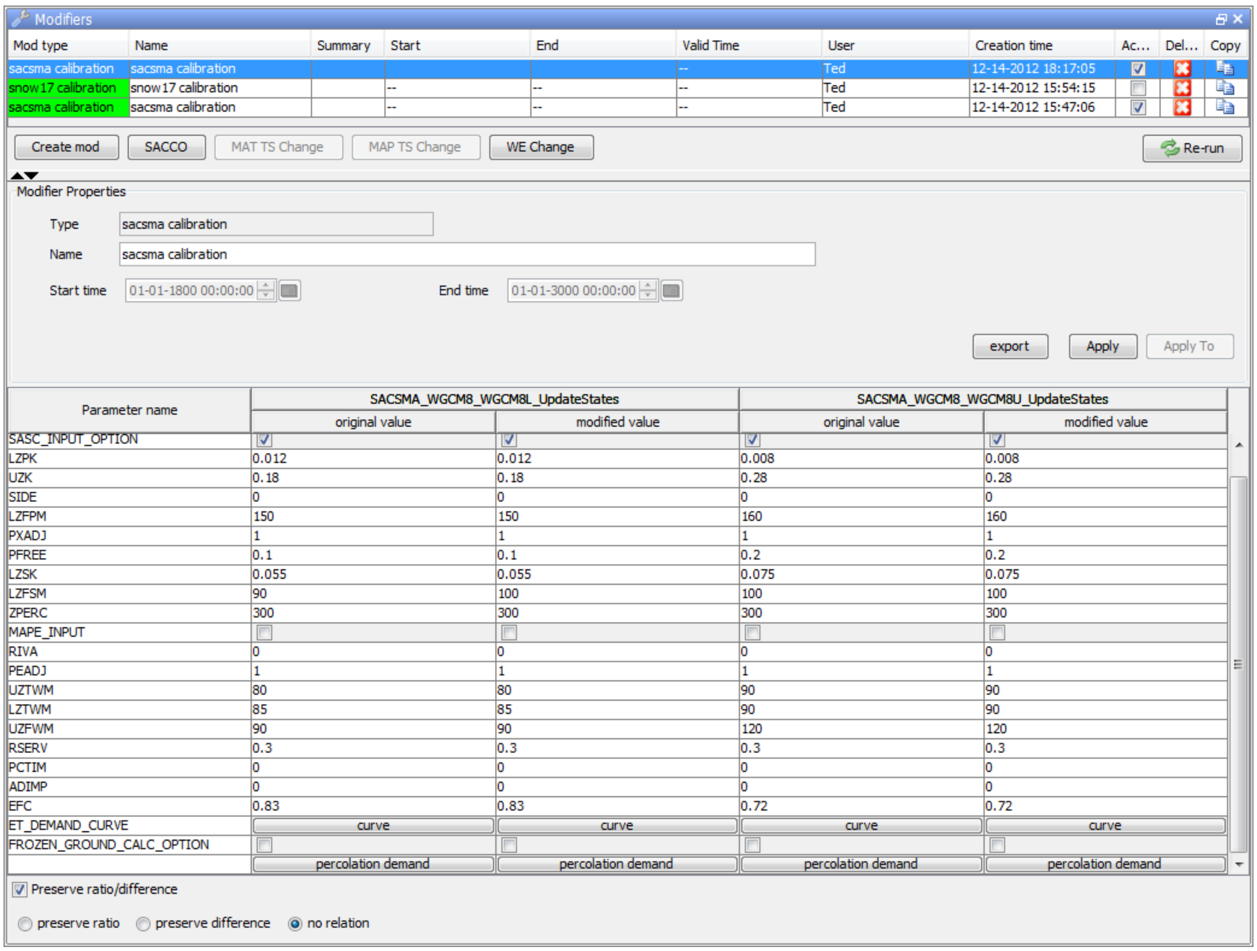


Figure 7: Run Calibration Workflow from Forecast tab

4 Run with Modifiers

Users can modify the parameters of the SAC-SMA, Snow-17, and Unit Hydrograph models to make manual calibration runs.

In addition to the modifiers available in the CHPS system, two extra parameter modifications are available for CHPS calibration: the so-called multipleModuleParameterModifier 'sacsma calibration' and 'snow17 calibration' (see Figure 8 for an example using SAC-SMA). The 'sacsma calibration' and 'snow17 calibration' modifiers should only be added to the calibration standalone and not to the live system. Parameters are shown for both the upper and lower elevation zones of WGCM8 basins. Please note that while not all parameters are configured in this example, the ET_DEMAND_CURVE and the Percolation Demand Curve are listed at the bottom of the window. The order of the parameters in this display is determined by the order of the parameters in the ModifierTypes.xml. If they are not defined there, the order is determined by the order in the parameter file. Several modifier functionalities are described in this section.



Parameter name	SACSMA_WGCM8_WGCM8L_UpdateStates original value	SACSMA_WGCM8_WGCM8L_UpdateStates modified value	SACSMA_WGCM8_WGCM8U_UpdateStates original value	SACSMA_WGCM8_WGCM8U_UpdateStates modified value
LZPK	0.012	0.012	0.008	0.008
UZK	0.18	0.18	0.28	0.28
SIDE	0	0	0	0
LZFPM	150	150	160	160
PXADJ	1	1	1	1
PFREE	0.1	0.1	0.2	0.2
LZSK	0.055	0.055	0.075	0.075
LZFSM	90	100	100	100
ZPERC	300	300	300	300
RIVA	0	0	0	0
PEADJ	1	1	1	1
UZTWM	80	80	90	90
LZTWM	85	85	90	90
UZFWM	90	90	120	120
RSERV	0.3	0.3	0.3	0.3
PCTIM	0	0	0	0
ADIMP	0	0	0	0
EFC	0.83	0.83	0.72	0.72

Figure 8: Example of a SAC-SMA Modifier Display

After adjusting the parameters in the Modifier Display, press **Re-Run** to rerun the workflow again on your standalone system. Section 5.6 presents steps for displaying the new simulations in a single plot.

4.1 Preserving the ratio and difference between parameters

Users can configure fixed ratios or differences for parameters in sub-basins or elevation zones. One example is the Snow-17 Snow Correction Factor (SCF). Min and max values can also be configured for each parameter.

The user can overrule the configured settings using the ratio/difference options at the bottom of the display.

4.2 Modifying the Percolation Demand Curve

Users access the Percolation Demand Curve for an area of interest by clicking on the "Modified Value" column. Curves corresponding to each parameter set are displayed as shown in Figure 9. Users can modify the parameters in the table to generate and display new curves.

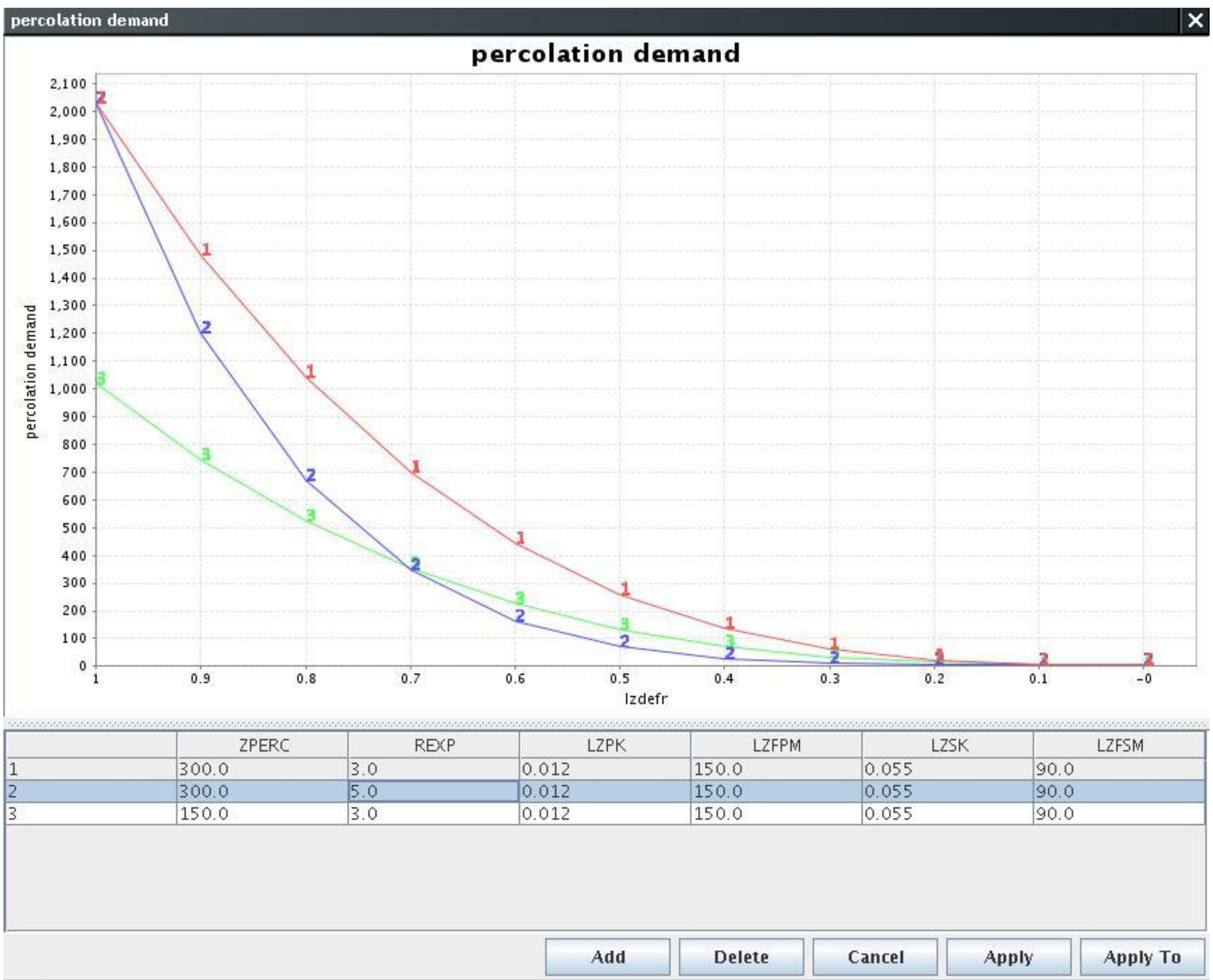


Figure 9: The SAC-SMA Percolation Demand Curve Modifier display. Parameters for each of the curves are listed in the table below the plot.

To use the Modifier user interface, you can add a new Percolation Demand Curve with the **Add** button and then edit the parameters in the corresponding line by double-clicking on a parameter. When you hit the **Enter** key, the new curve will be displayed and a new set of parameters will be listed in the table below the plot. You can edit several parameters that define the Percolation Demand Curve as shown in Figure 9. Unwanted curves can be removed by highlighting the parameters and then selecting the **Delete** button. When you have finished editing, highlight the desired curve in the table and press **OK**.

4.3 ET Demand Curve

The SAC-SMA ET Demand Curve can also be visualized graphically (see Figure 10) by clicking the curve button in the Modifier display. The user can edit the numbers either in the table or by clicking and dragging a point on the graph.

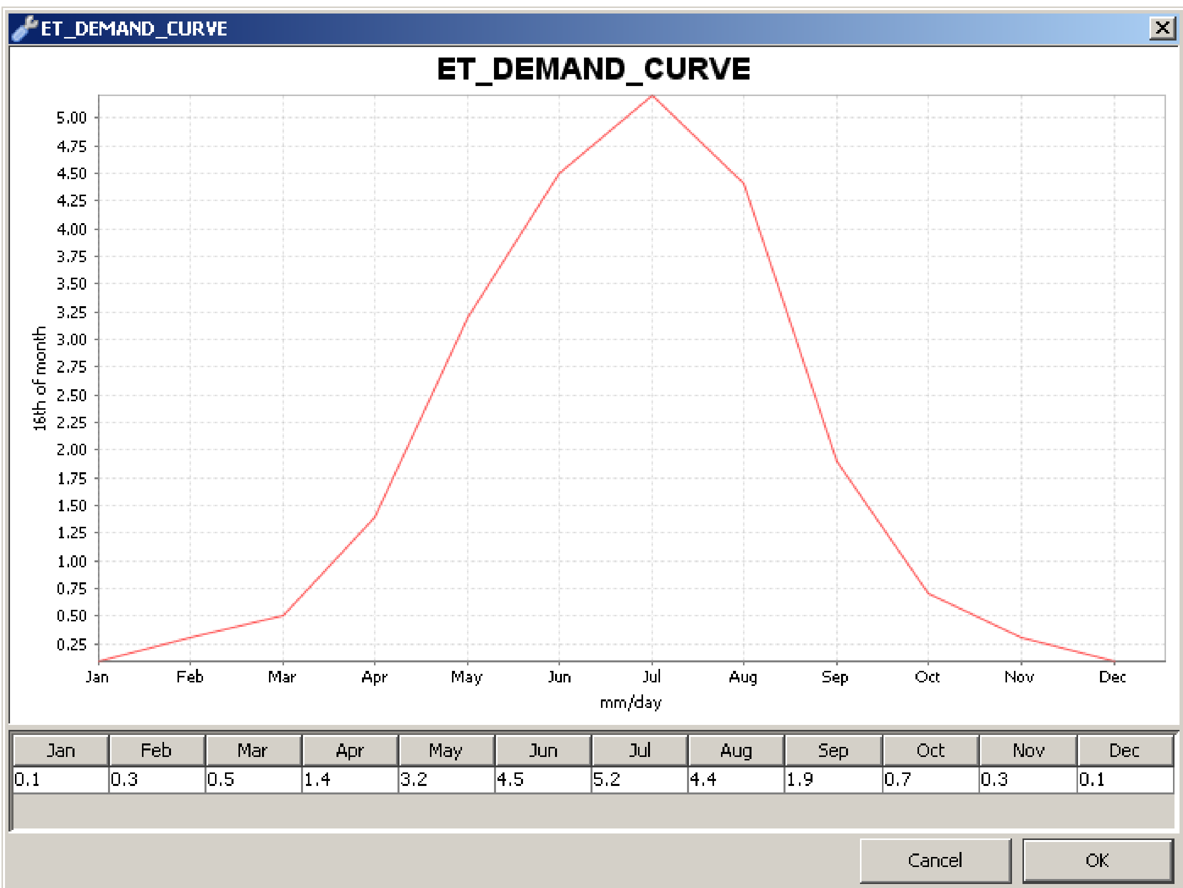


Figure 10: ET Demand Curve modifier

4.4 Keeping Track of Modifiers

Functionally is added to the system to keep track of which modifiers were used in which run. This is useful during the typical trial and error process of calibration. To view the modifiers that were applied, open the new tab Modifiers in the Forecast Management Display (see Figure 11).

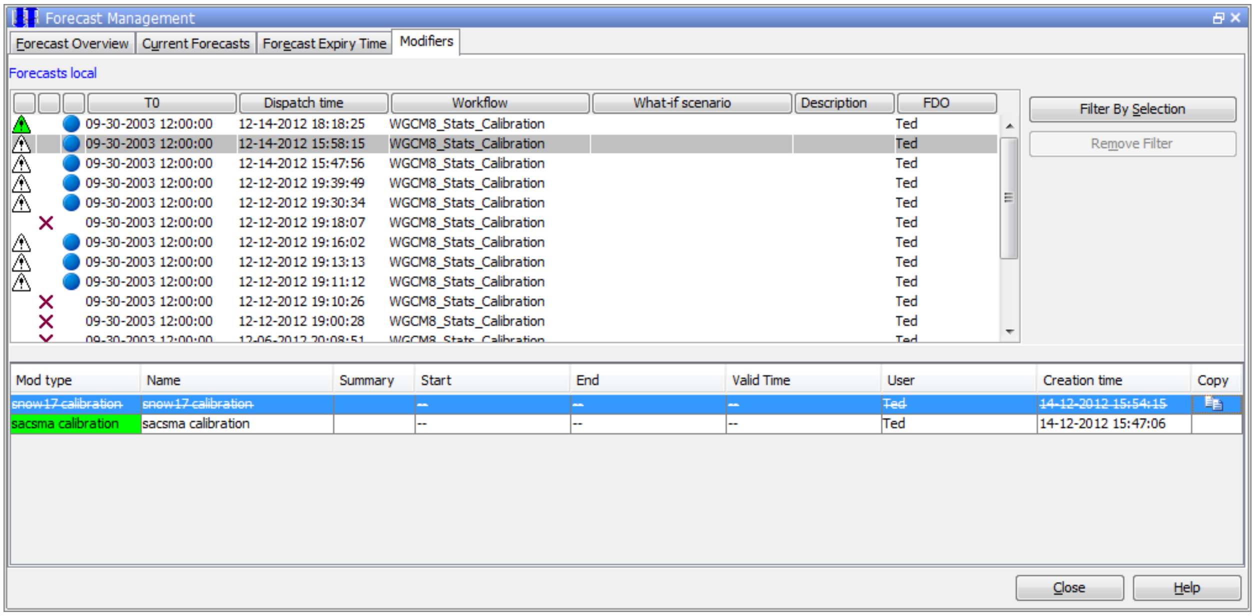


Figure 11: Modifier tab in Forecast Management Display

Selection of the forecast in the upper box shows the applied modifiers in the lower box. This process is also the case for non-current forecasts.

Please note that the system only saves a mod and the associated forecast when the forecast was generated in a server run. Local runs are not saved. The system will save the applied mods for a forecast with the **Run Approved Forecast** button (in the toolbar of the Forecast tab) instead of the **Re-Run** button when running the forecast on a standalone system. The Run Approved Forecast button is usually disabled during segment runs. An edit made to the Topology.xml will enable this button in the toolbar.

4.5 Restore Deleted Modifiers from Previous Forecasts

Another new feature is the ability to restore deleted modifiers from previous forecasts. For example, when a modifier from a previous forecast was deleted, it can still be used in a new run when the deleted modifier is copied from the Modifier tab in the Forecast Management Display to the Modifier Display. Therefore, the expiryTimeDeletedModifiers should be configured for the relevant modifier type in the ModifierTypes.xml.

Deleted modifiers, used in previous runs, are shown as grey crossed-out lines in the Modifier tab (see the selected line in Figure 11 above). To restore this modifier, click on the **Copy** icon on the right and click **Yes** in the pop-up window as shown in Figure 12. Once restored, the modifier is visible in the Modifier Display.

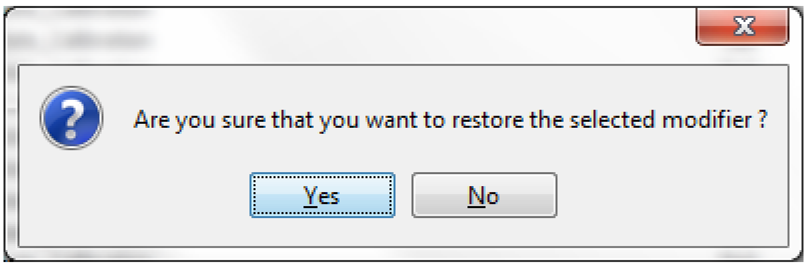


Figure 12: Confirmation for restoring the selected modifier

4.6 Export of Modified Model Parameters to ModuleParameterFile

When the user is satisfied with the calibration results, he or she can export the adjusted model parameters as an xml file to a user-defined directory. This file can directly be used in the operational system by uploading the file to the associated sub-directory in the ModuleParFiles directory. To export the modifiers, just press the **Export** button in the Modifier Display, and browse to a user-defined directory. The same functionality is available for the UNITHG coordinates in the UNITHG modifier display. Note, the UNITHG modifier display for calibration is the same as for the live system, so the Export button will exist on the live system and can be ignored though it should be harmless if pressed.

5 Viewing Data within FEWS

The input and output time series of the calibration workflow can be viewed in the Data Viewer and/or in the Plots linked to the Forecast tab. The user may decide which is more convenient. The Data Viewer allows a more flexible approach, whereas the Plots are linked to the Modifier Display.

5.1 Data Viewer

After running a calibration workflow in the Forecast tab, the mean daily discharge statistical summary can be viewed in the Data Viewer tab as follows:

- Select **Data Viewer** tab
- Select Calibration node in Data Viewer window
- Select one of the following:
  - “Mean Daily Discharge Statistical Summary”, “Multi-year avg.”, and “Daily Flows Multi-Year Summary”
  - “By Wateryear”, and “Daily Flows Annual Summary”
- Select basin name (e.g WGCM8) and select all SQME output
- Click on **Plots** display; click the table icon ; and  icon (zoom out to show entire timeseries).

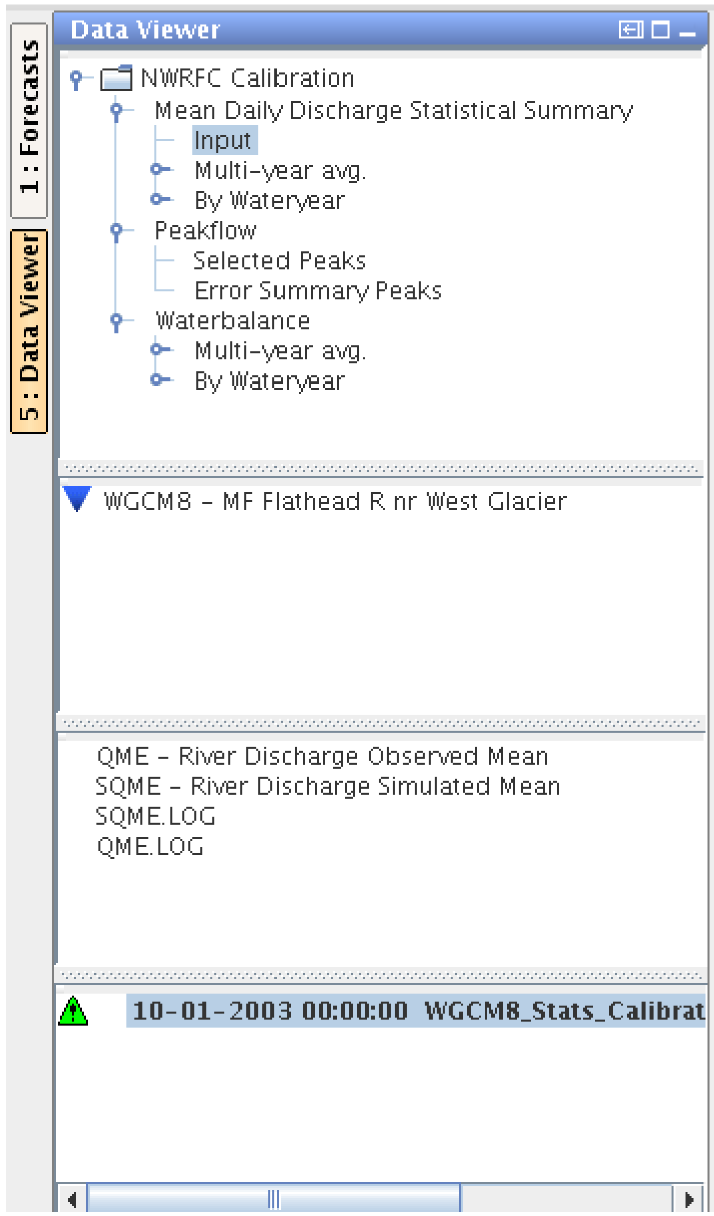


Figure 13: Calibration data in Data Viewer

5.2 Water Balance Output

Figure 14 and Figure 15 show two of the water balance quantities. Note: the multi-year averaged values are visible before and after the water year. If necessary, these time series can be trimmed to one water year.

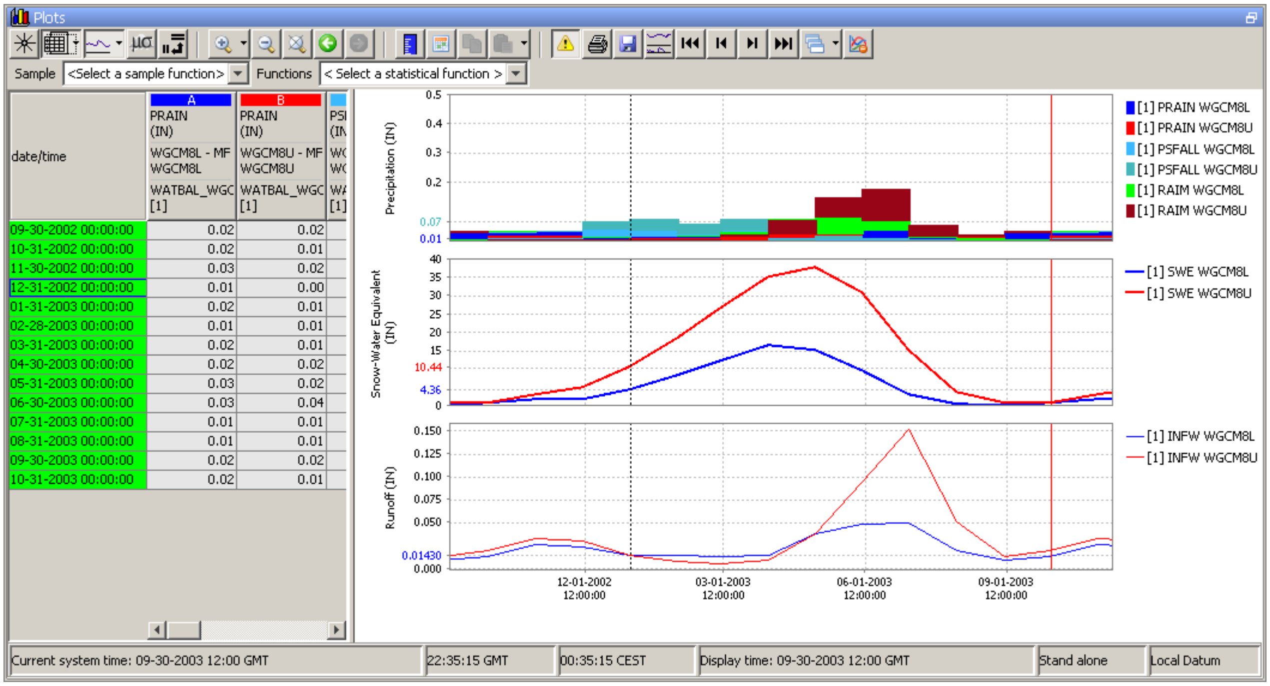


Figure 14: Monthly multi-year average water balance

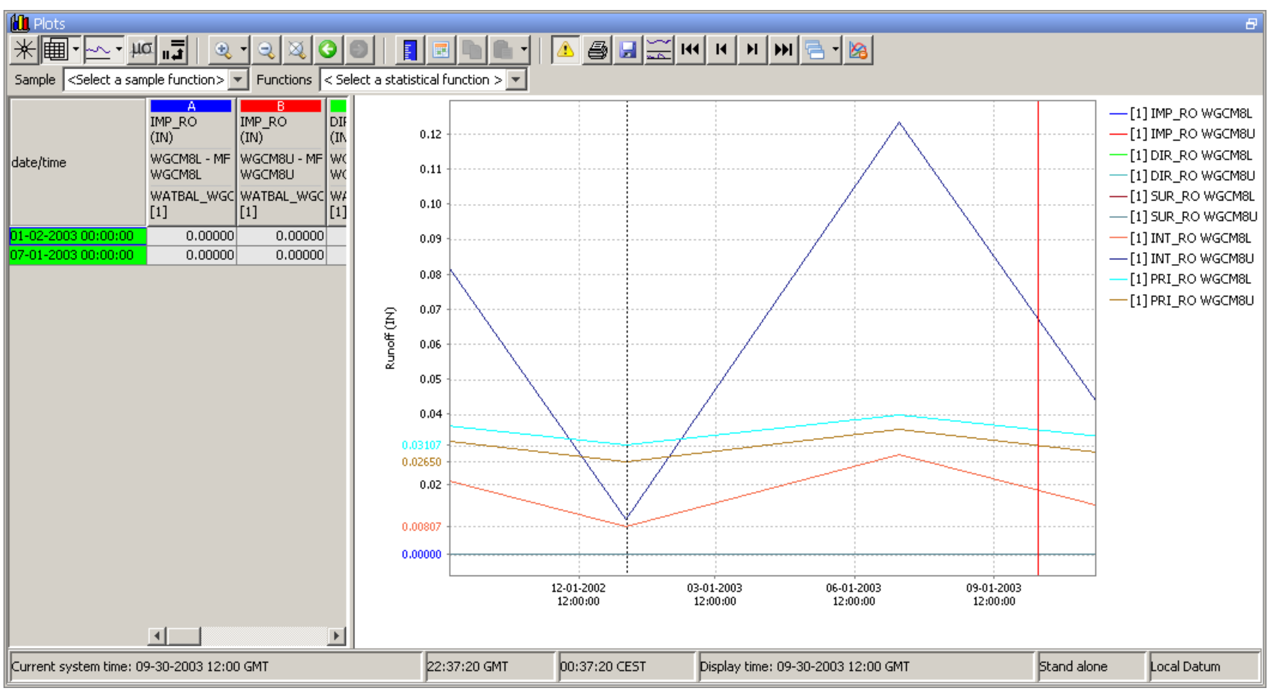


Figure 15: Seasonal multi-year average SAC-SMA accounting volumes

5.3 StatQME

5.3.1 Discharge Error

Figure 16 and Figure 18 show two outputs from StatQME. Note: the multi-year averaged monthly values are visible for only one water year.

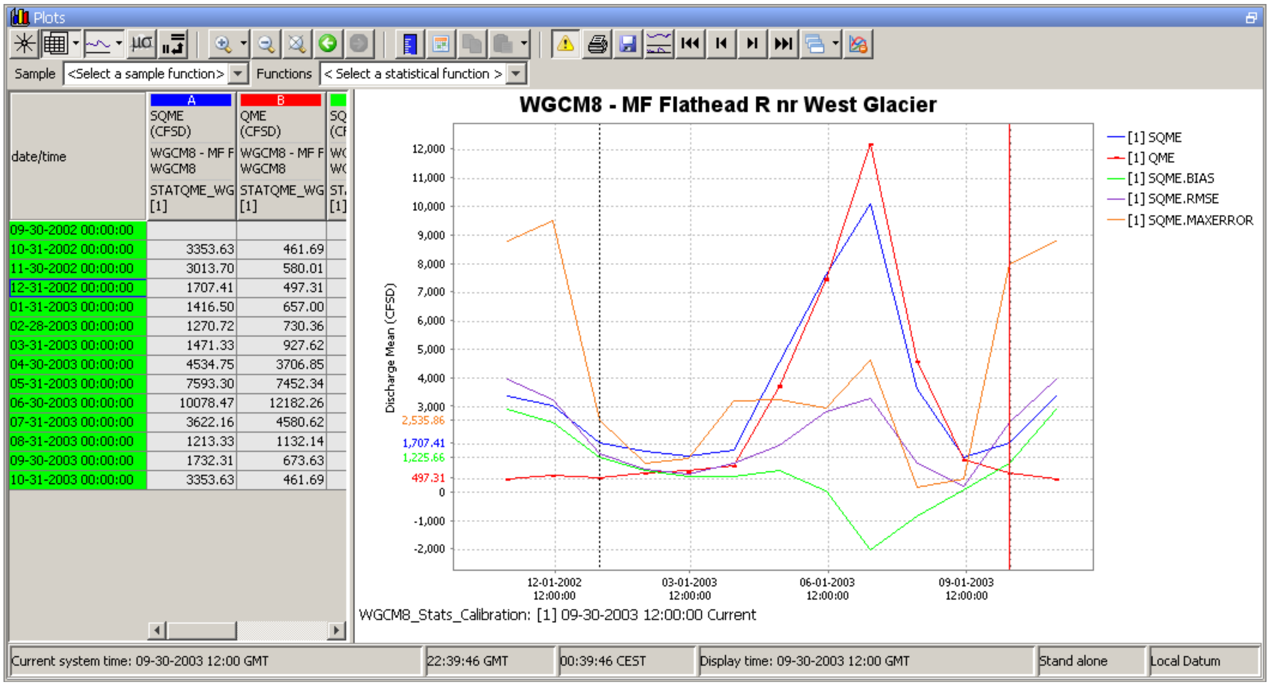


Figure 16: Discharge statistics for multi-year averaged monthly values

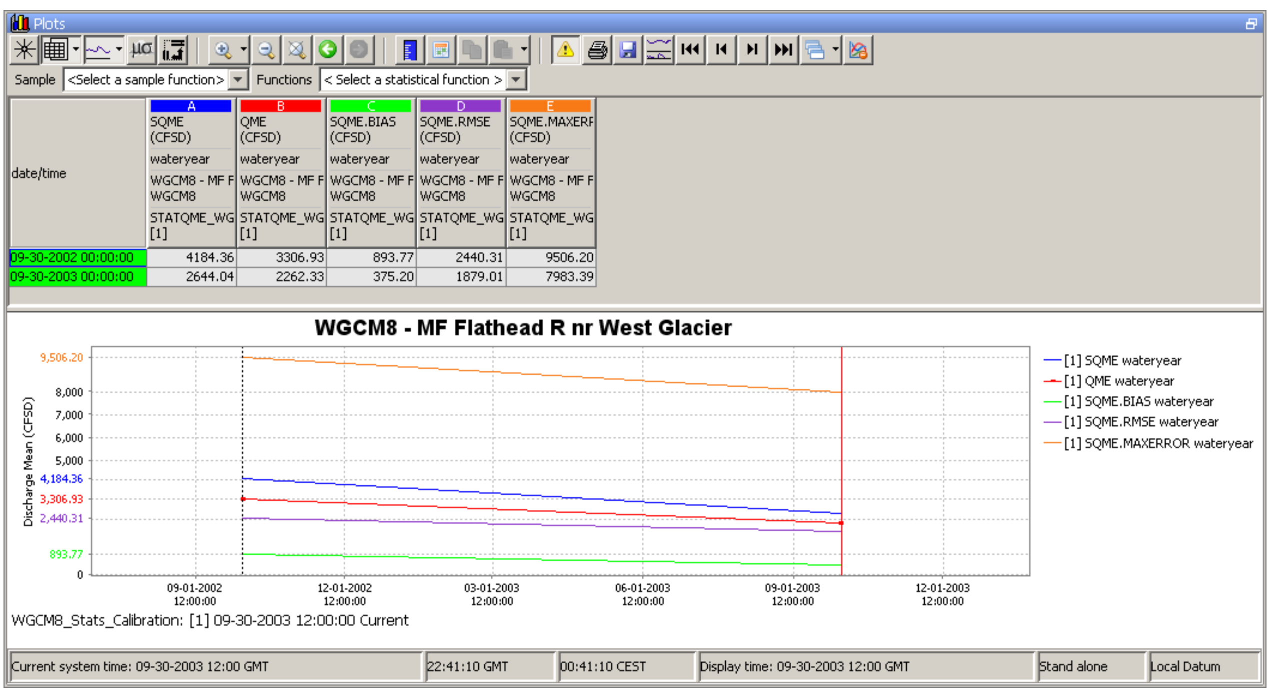


Figure 17: Discharge statistics for annual averaged values, aggregated by water year

5.3.2 Multi-year statistical summary

Figure 18 is an example of the multi-year statistical summary. The output will show only one row and the date indicates the end date of the calibration period.

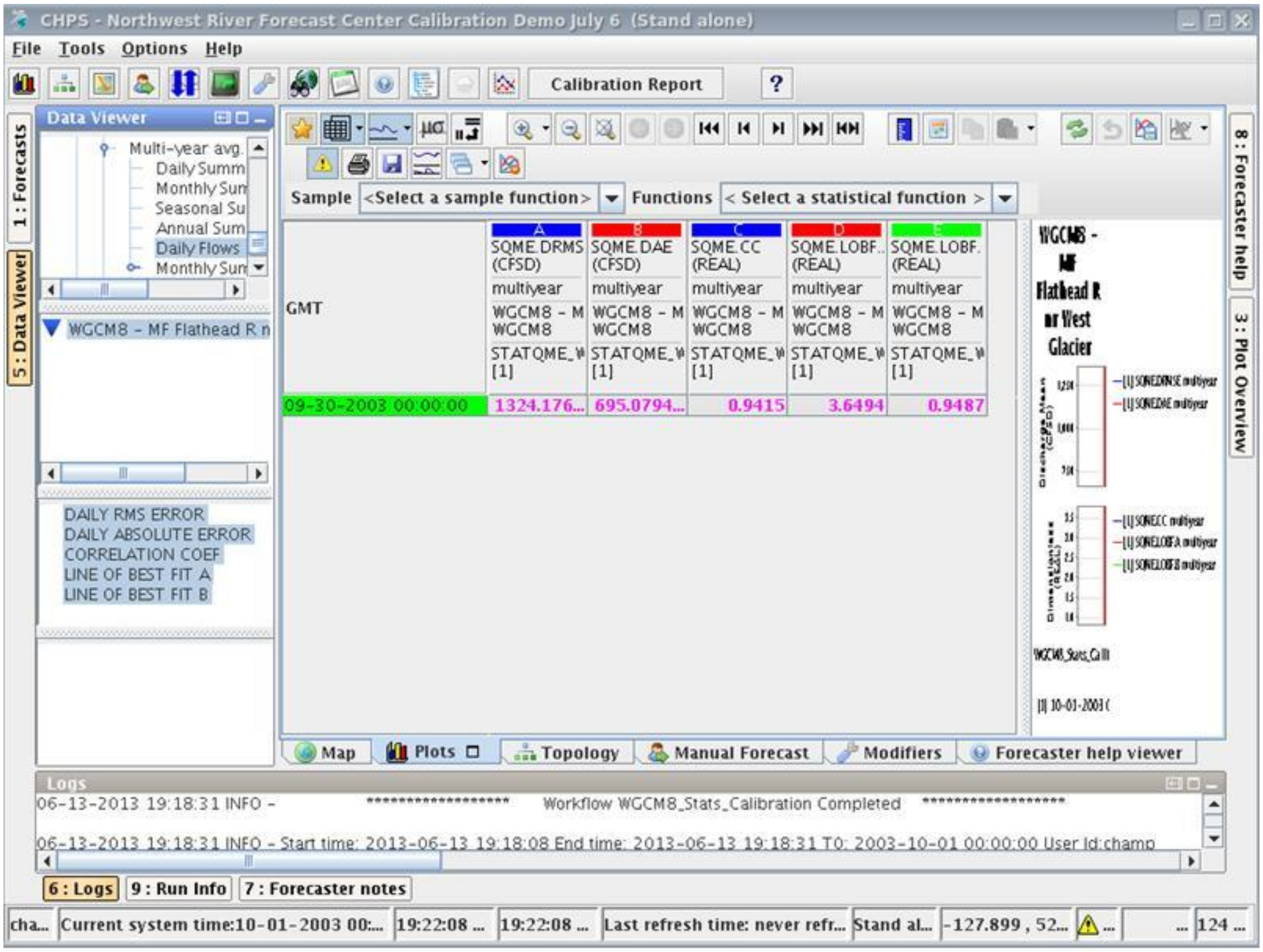


Figure 18: Display of the multi-year statistical summary in FEWS

5.3.3 ***Yearly statistical summary***

The output (Figure 19) will show multiple rows which indicate yearly statistics.

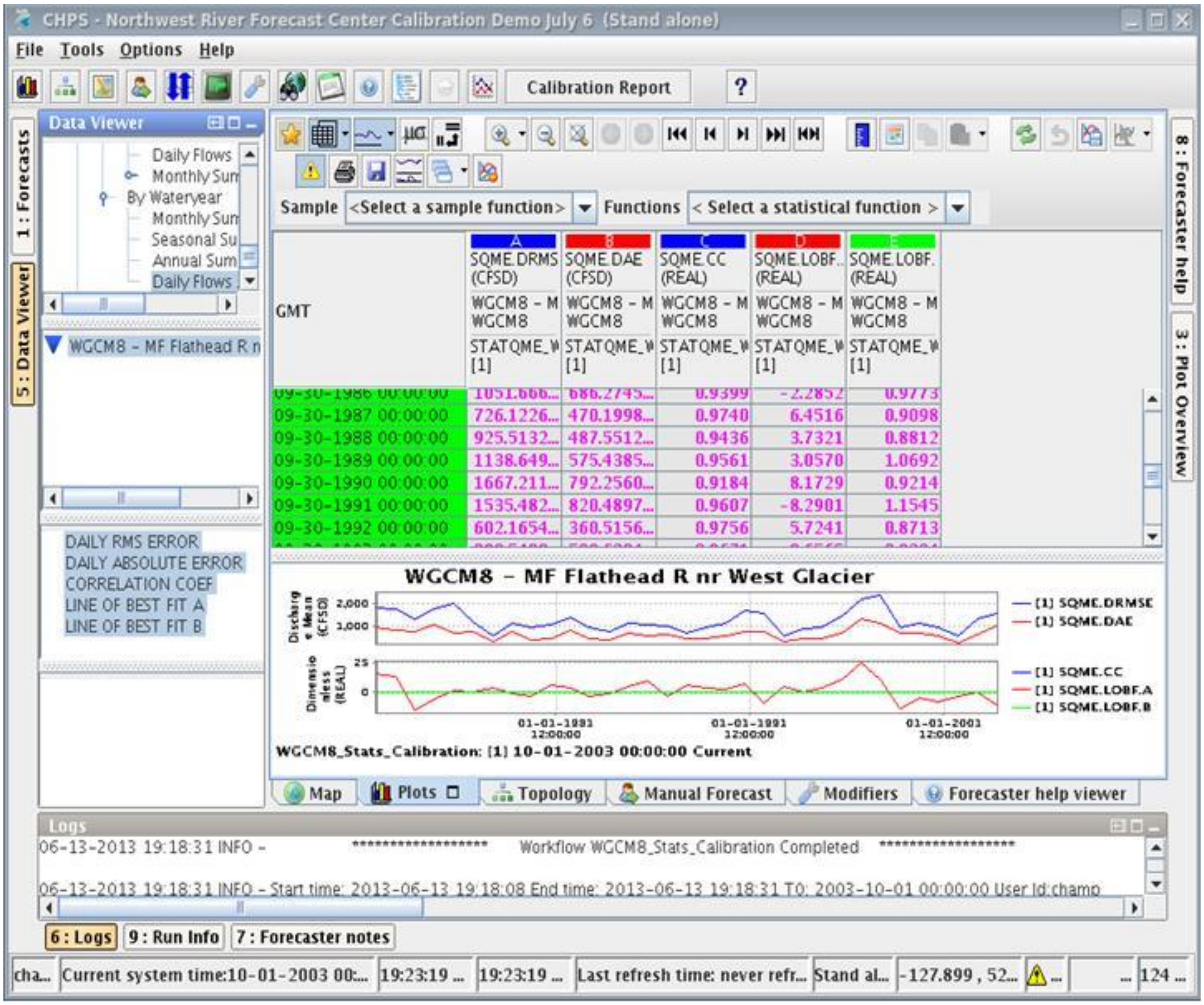


Figure 19: Display of yearly statistical summary in FEWS

5.4 Peakflow

Below are plots generated as part of executing PEAKFLOW in CHPS. Figure 20 shows selected peaks and Figure 21 shows computed statistics.

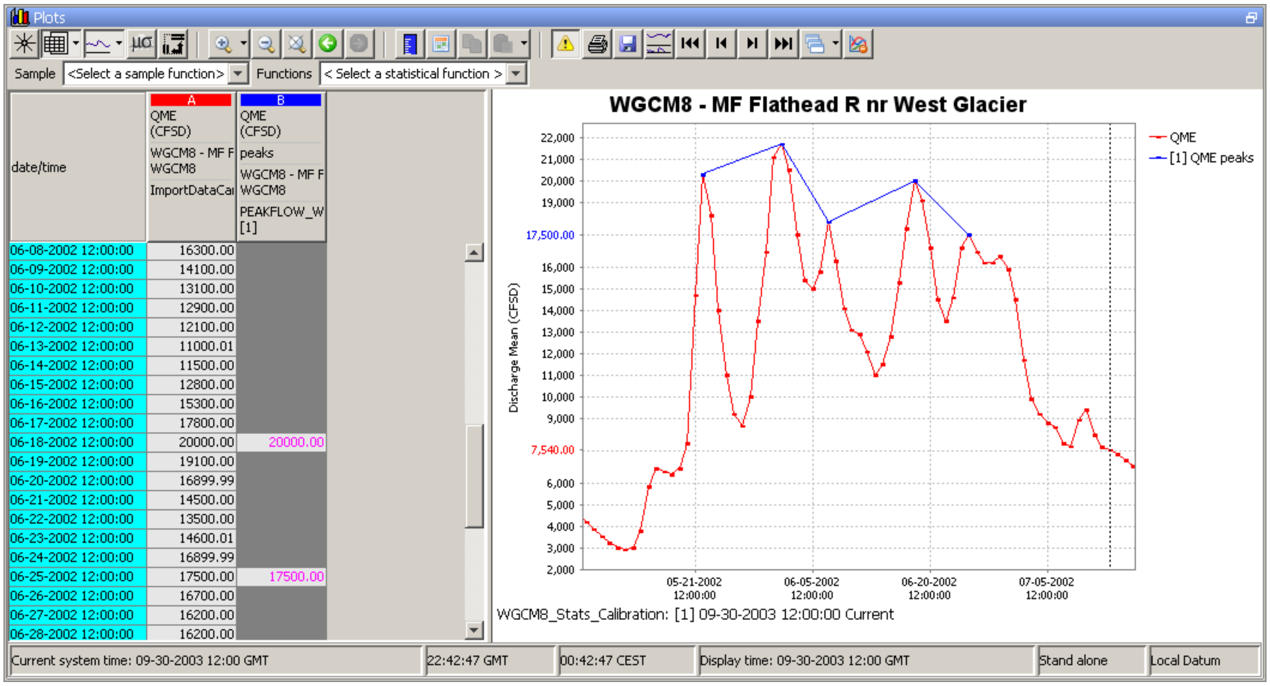


Figure 20: Selection of peaks for calculation

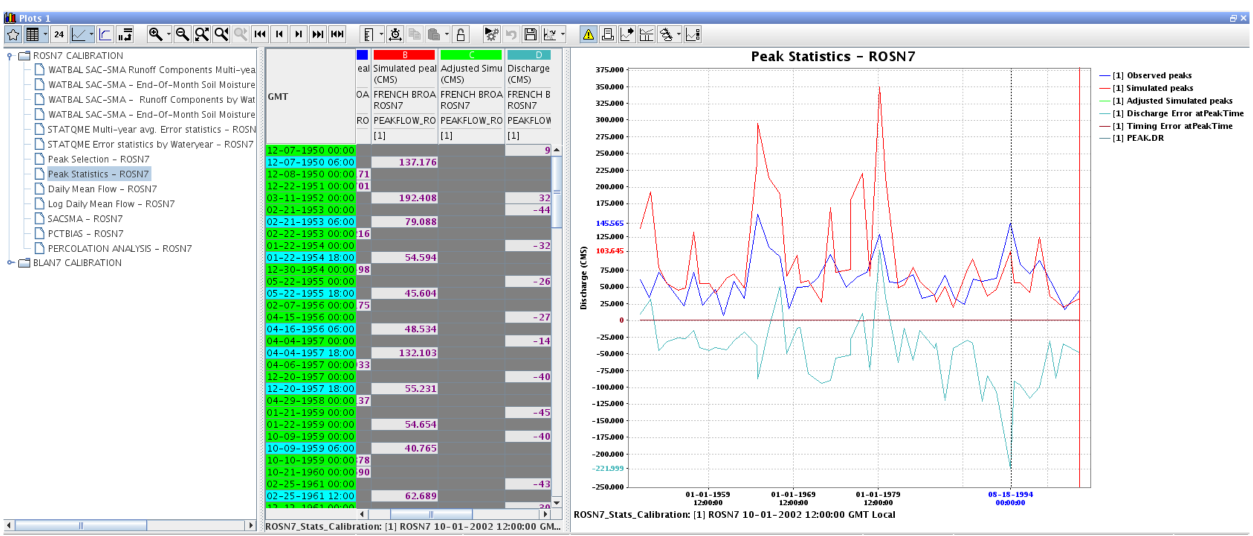


Figure 21: Calculated Peakflow statistics

5.5 Forecast tab in Plot Overview

Below (Figure 22 and Figure 23) are some screenshots for the Plot Overview filters. Note: the multi-year averaged monthly values are visible for one water year. If necessary, we can average other time steps.

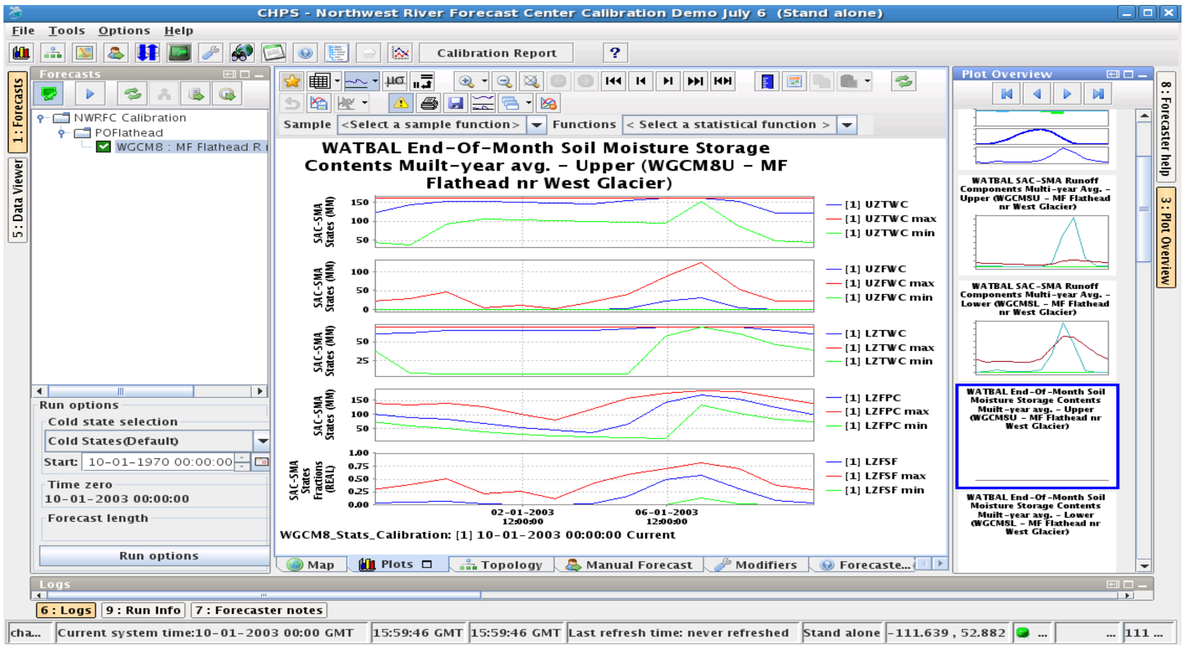


Figure 22: SACSMA results with multi-year averaged monthly, min and max values

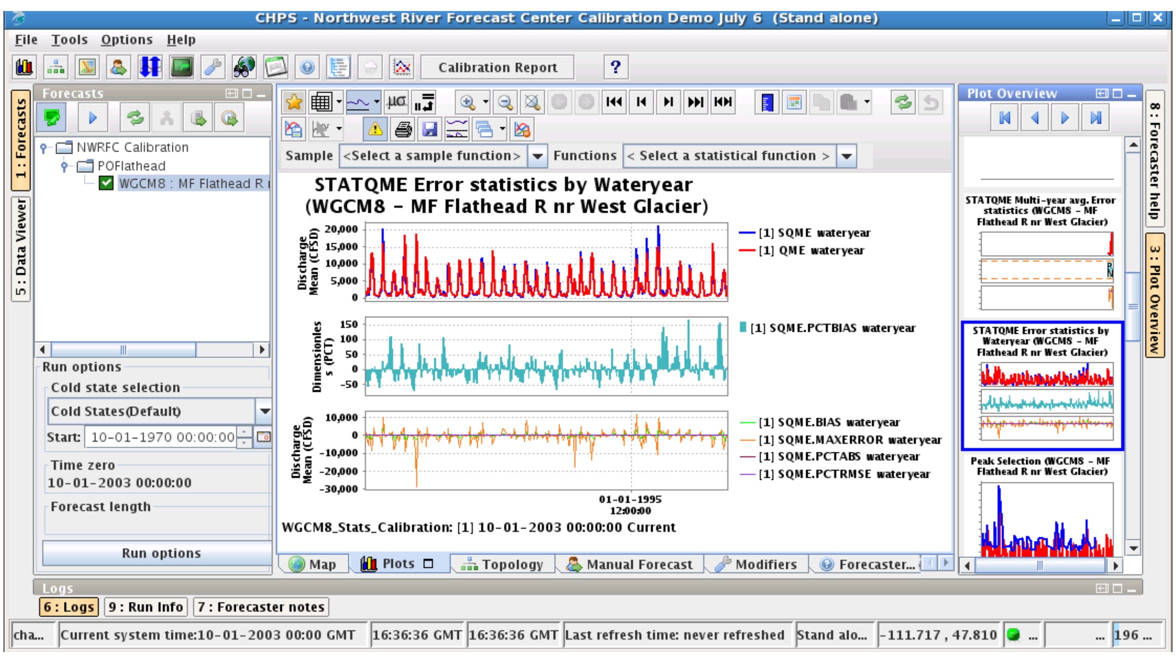


Figure 23: STATQME Error statistics, averaged by water year

5.6 Viewing Previous Simulations in One Graph

Previous simulation results can be shown in the time series display together with the current approved simulation. This can be done using the Forecast Management display, but a more convenient way is available via the **Multiple Forecast** button  in the toolbar of the time series display. Pressing this button returns a display shown in Figure 24.

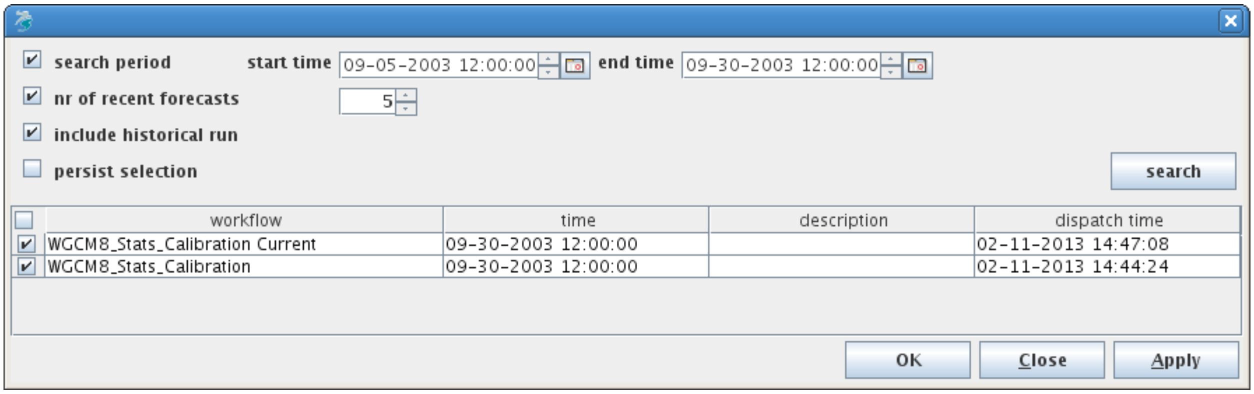


Figure 24: Multiple Forecast Display

By default, the display only lists forecasts. To view a certain number of recent historical simulations, like the UpdateStates workflows in the calibration environment, mark the **Include Historical Run**, and press **Search**. Then, select the specific workflow you want to see and press **OK**. The results of this simulation, according to the filter selection, are shown in the display together with the current simulation (see

Figure 25 for an example).

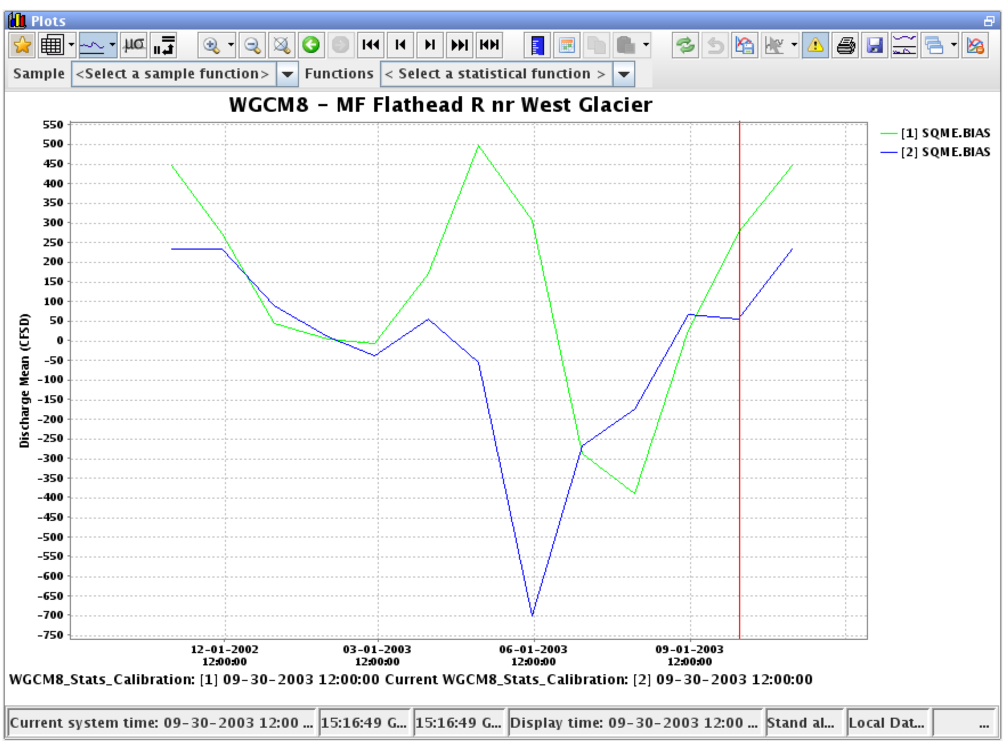


Figure 25: Viewing multiple forecasts in time series display

6 ICP-like Displays

The ICP-like display feature mimics the display capabilities of Interactive Calibration Program (ICP) to visualize and compare multiple stream flow or other hydrological time series on a single plot. The calibrator can also see linked displays of SAC-SMA and SNOW-17 states and outputs.

6.1 Summary of the ICP-like Displays Capabilities

- Add timeSeriesSets of certain parameters to the output section in the SNOW17_UpdateStates and SACSMA_UpdateStates General Adapter modules
- Make the ICP-like plots on a daily time step by adding some variables and using simple/aggregation transformations to convert the 6hr time series to daily time series in the STATQME and WATBAL Calibration modules
- Add the catchment SQINs and subsequent conversions to SQMEs in STATQME Calibration module if basin catchment SQIN time series exists
- Add new parameter Ids to Parameters.xml file
- Add the threshold level for percent bias and negative percent bias
- Use calibration plot templates in the DisplayGroups.xml file

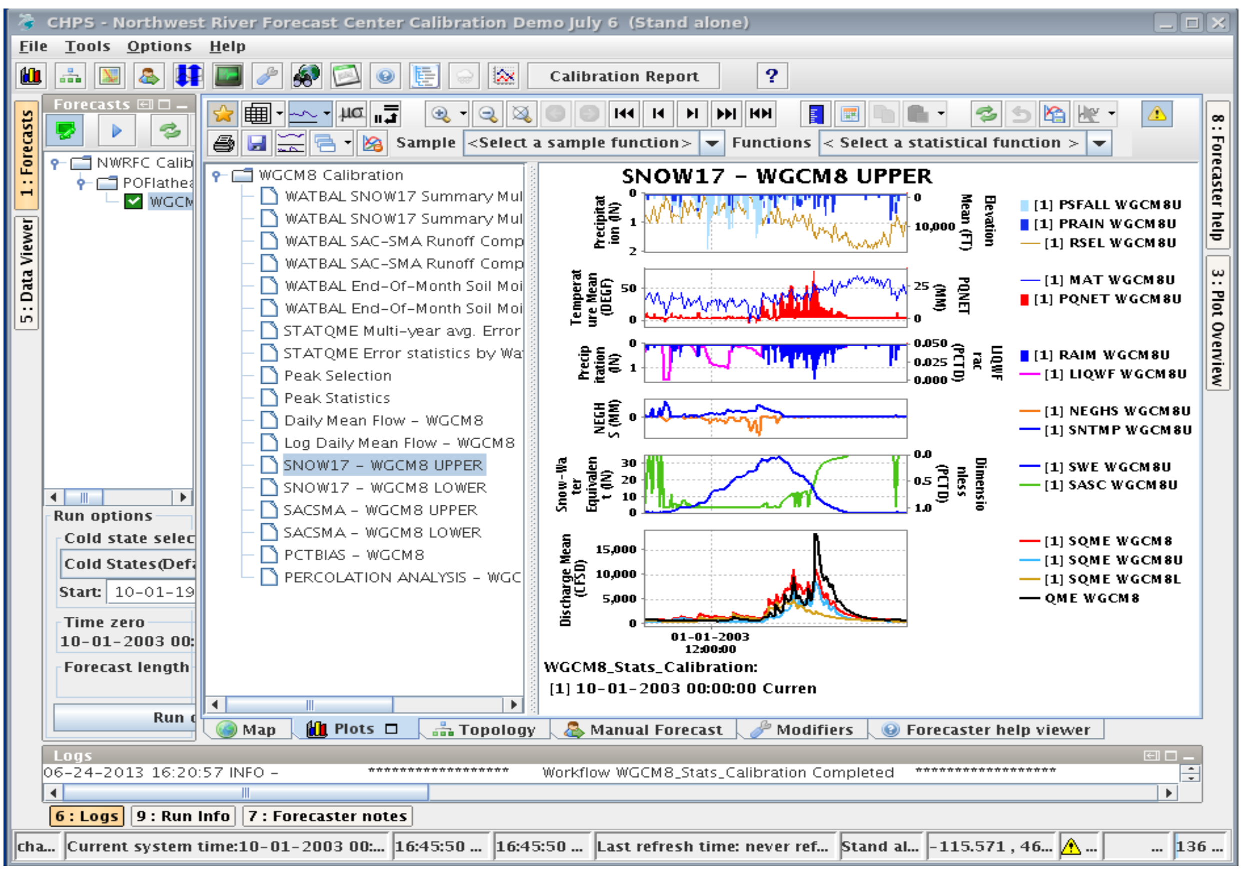


Figure 26: SNOW17 display

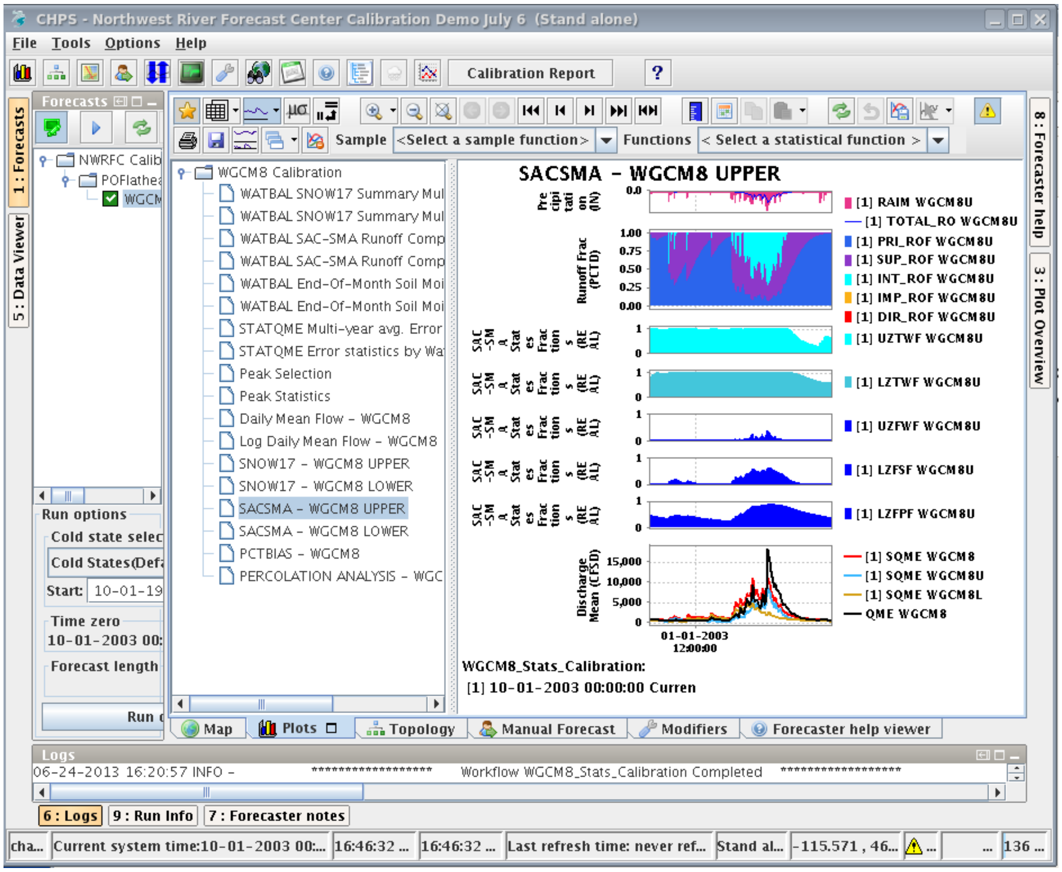


Figure 27: SAC-SMA display

7 Viewing Statistical summaries as HTML reports

7.1 StatQME report

Yearly and multi-year statistical summaries can be generated as HTML reports (shown for a single location) by clicking on the 

icon to display the following window:

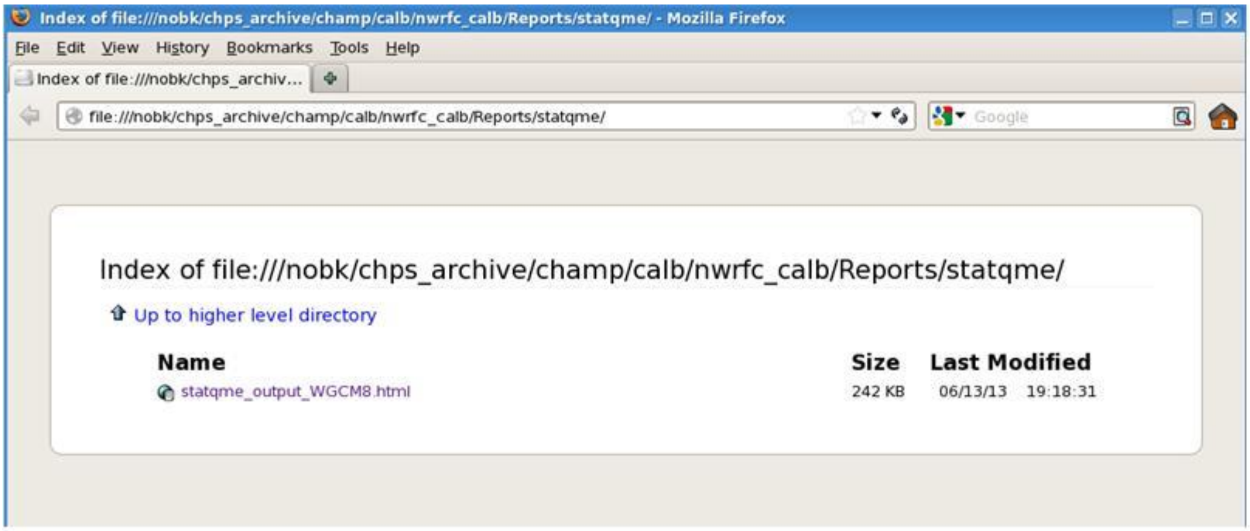


Figure 28: Locate HTML report file

Click on the HTML file you want to display. The report will show yearly and multi-year statistical summaries as shown in Figures 29 and 30.

file:///nobk/chps_archive/champ/CALIBRATION/rel050213/OHDCalibrationStatqme/nwrfc_calb/Reports/statqme

INITIAL DATE:
05/01/2013

STATISTICAL SUMMARY

WGCM8 - MF Flathead R nr West Glacier

MONTHLY	SQME - River Discharge Simulated Mean CMSD	QME - River Discharge Observed Mean CMSD	% BIAS PCT	MONTHLY BIAS CMSD	MAXIMUM ERROR CMSD	% AVERAGE ABSOLUTE ERROR PCT	% DAILY RMS ERROR PCT
10/1949		21.118			290.839	738.70	805.2
11/1949	115.907	38.237	203.10	77.67	131.131	196.10	205.7
12/1949	66.97	40.728	64.40	26.242	37.755	64.10	65.9
01/1950	29.575	19.597	50.90	9.978	23.52	61.70	67.8
02/1950	18.781	19.507	-3.70	-0.726	6.60	11.30	14.9
03/1950	20.379	27.939	-27.10	-7.561	-18.816	26.80	30.9
04/1950	44.105	67.971	-35.10	-23.865	-116.022	37.20	59.9
05/1950	170.389	256.185	-33.50	-85.796	-297.068	34.40	44.8
06/1950	435.373	456.779	-4.70	-21.407	-256.289	16.70	21.7
07/1950	237.676	232.60	2.20	5.076	43.795	4.50	6.5
08/1950	65.943	57.365	15.00	8.579	21.566	16.60	18.3
09/1950	35.534	26.875	32.20	8.659	21.955	32.40	36.1

WATER YEAR	SQME - River Discharge Simulated Mean CMSD	QME - River Discharge Observed Mean CMSD	% BIAS PCT	MONTHLY BIAS CMSD	MAXIMUM ERROR CMSD	% AVERAGE ABSOLUTE ERROR PCT	% DAILY RMS ERROR PCT
1950		105.653			-297.068	39.20	67.5
1951	111.036	108.364	2.50	2.672	263.517	24.60	41.1
1952	81.363	81.977	-0.70	-0.614	-318.997	25.90	53.5
1953	81.16	89.146	-9.00	-7.985	-195.321	28.00	46.8
1954	95.259	102.541	-7.10	-7.283	-513.143	26.90	65.3

WATER YEAR	DAILY RMS ERROR CMSD	DAILY ABSOLUTE ERROR CMSD	CORRELATION COEF REAL	LINE OF BEST FIT A REAL	LINE OF BEST FIT B REAL
1950	71.2711	41.4098	0.8825	-13.1997	1.008
1951	44.477	26.6901	0.9171	4.9449	0.931
1952	43.8299	21.2766	0.8978	1.8235	0.985
1953	41.6521	24.9485	0.9636	-7.9579	1.196
1954	66.8466	27.5652	0.9083	2.6508	1.048

Figure 29: HTML Statistical Summary report

MULTI-YEAR STATISTICAL SUMMARY

MONTHLY	SQME - River Discharge Simulated Mean CMSD	QME - River Discharge Observed Mean CMSD	% BIAS PCT	MONTHLY BIAS CMSD	MAXIMUM ERROR CMSD	% AVERAGE ABSOLUTE ERROR PCT	% DAILY RMS ERROR PCT
October	36.595	29.847	22.60	6.748	290.839	37.50	92.70
November	41.259	34.466	19.70	6.793	-427.642	38.90	75.00
December	28.967	26.256	10.30	2.712	-205.681	38.10	69.30
January	21.086	20.711	1.80	0.375	-88.84	34.80	51.50
February	20.064	21.227	-5.50	-1.163	-132.755	40.00	66.80
March	26.57	24.967	6.40	1.602	92.203	40.90	62.00
April	82.472	84.836	-2.80	-2.364	-318.997	37.80	53.30
May	242.954	264.739	-8.20	-21.785	-513.143	23.20	33.40
June	294.52	301.982	-2.50	-7.462	-1289.787	21.10	30.90
July	117.22	121.754	-3.70	-4.534	232.953	19.50	29.10
August	42.915	40.878	5.00	2.037	158.025	17.40	28.00
September	29.222	27.601	5.90	1.621	77.595	24.30	39.20
Year Avg.	82.28	83.583	-1.60	-1.304	-1289.787	25.50	51.80

	DAILY RMS ERROR CMSD	DAILY ABSOLUTE ERROR CMSD	CORRELATION COEF REAL	LINE OF BEST FIT A REAL	LINE OF BEST FIT B REAL
Year Avg	43.2179	21.2897	0.9291	-0.0203	1.016

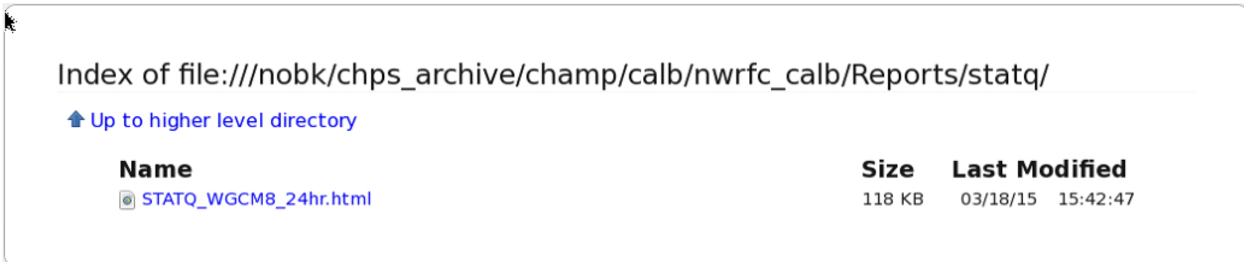
FLOW INTERVAL CMSD From	To	NUMBER OF CASES INT	SQME - River Discharge Simulated Mean CMSD	QME - River Discharge Observed Mean CMSD	% BIAS PCT	BIAS (SIM-OBS) MM	MAXIMUM ERROR CMSD	% AVERAGE ABSOLUTE ERROR PCT	% DAILY RMS ERROR PCT
0.00	25.00	7866	18.728	16.286	15.00	0.0722	290.839	36.70	78.10
25.00	50.00	4730	39.833	34.891	14.20	0.1462	271.722	32.90	49.80
50.00	100.00	2463	75.360	70.230	7.30	0.1518	161.883	28.90	39.40
100.00	200.00	2088	146.072	146.395	-0.20	-0.0095	232.953	24.90	31.90
200.00	350.00	1614	263.653	265.468	-0.70	-0.0537	308.569	21.40	27.80
350.00	600.00	889	371.733	439.306	-15.40	-1.9988	356.733	21.20	26.20
600.00	-	73	514.336	748.224	-31.30	-6.9182	-1289.787	33.60	41.80

QUARTERLY	OBSERVED MM	SIMULATED MM	ACC ERROR MM	ERROR THIS PERIOD MM
Dec 1949	90.17	319.03	228.85	228.8
Mar 1950	149.83	380.07	230.24	1.3
Jun 1950	856.41	967.95	111.54	-118.7
Sep 1950	1140.10	1271.84	131.74	20.2
Dec 1950	1309.38	1474.86	165.48	33.7

Figure 30: HTML Statistical Summary report

7.2 StatQ report

StatQ output is not saved to FEWS database, but stores in html format to display via a web browser. Yearly and multi-year statistical summaries can be generated as HTML reports (shown for a single location) by clicking on the STAT_Q Report icon to display the following window:

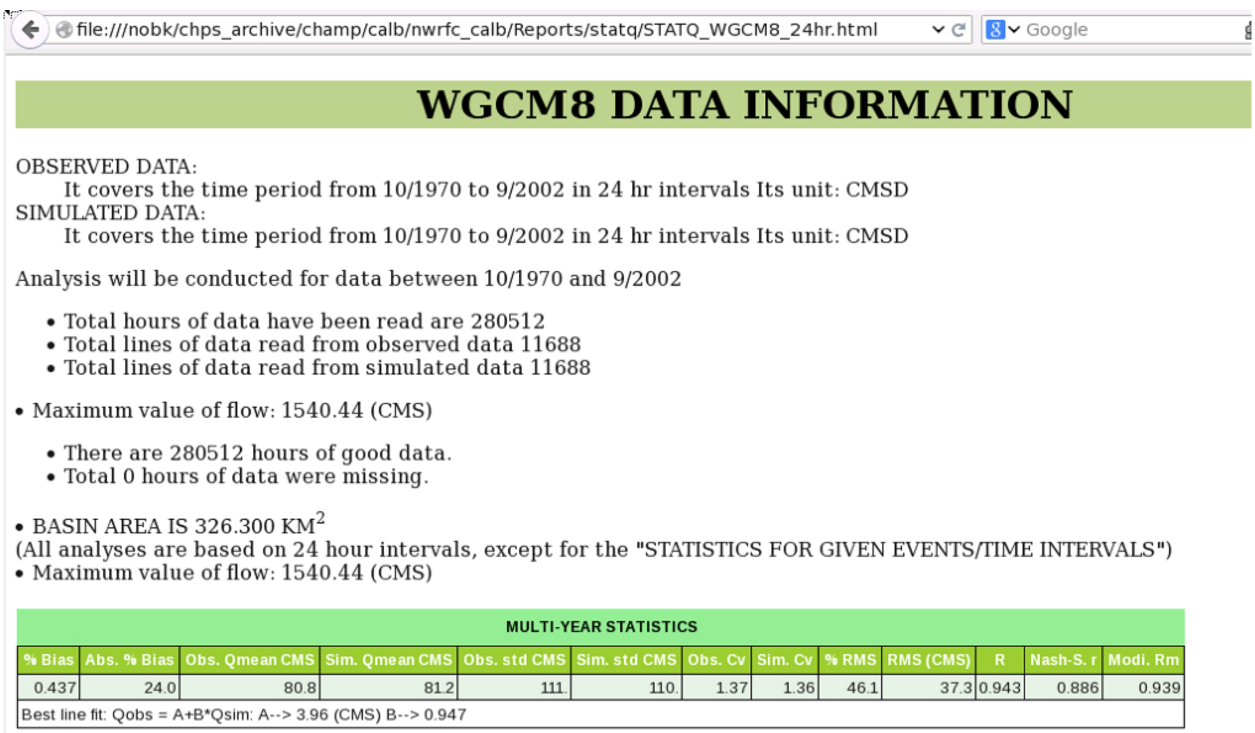

Index of file:///nobk/chps_archive/champ/calb/nwrfc_calb/Reports/statq/

Up to higher level directory

Name	Size	Last Modified
STATQ_WGCM8_24hr.html	118 KB	03/18/15 15:42:47

Figure 31: Locate HTML report file

Click on the HTML file you want to display. The report will show the results of analyzing StatQ observations and simulations including, multi-year and yearly statistical summaries as shown in Figures 32 and 33.


file:///nobk/chps_archive/champ/calb/nwrfc_calb/Reports/statq/STATQ_WGCM8_24hr.html

WGCM8 DATA INFORMATION

OBSERVED DATA:
It covers the time period from 10/1970 to 9/2002 in 24 hr intervals Its unit: CMSD
SIMULATED DATA:
It covers the time period from 10/1970 to 9/2002 in 24 hr intervals Its unit: CMSD

Analysis will be conducted for data between 10/1970 and 9/2002

- Total hours of data have been read are 280512
- Total lines of data read from observed data 11688
- Total lines of data read from simulated data 11688

- Maximum value of flow: 1540.44 (CMS)

- There are 280512 hours of good data.
- Total 0 hours of data were missing.

- BASIN AREA IS 326.300 KM^2

(All analyses are based on 24 hour intervals, except for the "STATISTICS FOR GIVEN EVENTS/TIME INTERVALS")
- Maximum value of flow: 1540.44 (CMS)

MULTI-YEAR STATISTICS

% Bias	Abs. % Bias	Obs. Qmean CMS	Sim. Qmean CMS	Obs. std CMS	Sim. std CMS	Obs. Cv	Sim. Cv	% RMS	RMS (CMS)	R	Nash-S. r	Modi. Rm
0.437	24.0	80.8	81.2	111.	110.	1.37	1.36	46.1	37.3	0.943	0.886	0.939

Best line fit: Qobs = A+B*Qsim: A--> 3.96 (CMS) B--> 0.947

Figure 32: HTML Multi-Year Statistical Summary report

YEARLY STATISTICS									
Year	Percent Bias	Absolute Percent Bias	Absolute Error (CMS)	Observed Qmean	Simulated Qmean	Percent RMS	RMS (CMS)	R	Nash-S. r
1970	-7.08	32.5	6.33	19.5	18.1	60.1	11.7	0.0126	-13.6
1971	-14.1	26.2	27.5	105.	90.4	48.5	51.0	0.934	0.860
1972	5.81	24.1	25.1	104.	110.	48.8	50.8	0.959	0.888
1973	-14.4	36.7	23.1	62.9	53.9	63.5	40.0	0.916	0.770
1974	-1.88	26.7	29.7	111.	109.	43.9	48.8	0.954	0.905
1975	-8.55	25.1	26.1	104.	95.0	56.7	58.9	0.940	0.869
1976	0.895	18.9	16.6	87.6	88.4	34.6	30.3	0.962	0.924
1977	-8.28	28.4	13.5	47.5	43.6	41.5	19.7	0.930	0.858
1978	-1.65	22.4	18.6	83.0	81.6	36.5	30.3	0.951	0.903
1979	-11.9	16.9	12.2	72.0	63.4	38.6	27.8	0.982	0.937
1980	-14.0	22.5	17.8	79.0	67.9	45.0	35.5	0.944	0.880
1981	15.7	25.8	20.9	81.1	93.8	44.1	35.7	0.957	0.887
1982	-6.59	14.9	13.4	90.2	84.3	30.4	27.4	0.983	0.957
1983	11.9	20.5	14.5	70.6	79.0	32.7	23.1	0.971	0.930
1984	5.18	29.8	20.4	68.5	72.1	46.3	31.7	0.945	0.845
1985	1.11	20.6	18.2	88.4	89.4	35.8	31.7	0.959	0.911
1986	-0.0655	26.5	18.9	71.3	71.3	40.8	29.1	0.943	0.886
1987	4.53	17.2	10.4	60.7	63.5	31.3	19.0	0.978	0.951
1988	2.49	27.3	15.0	55.0	56.4	49.4	27.1	0.936	0.857
1989	-9.75	20.4	19.7	96.4	87.0	46.8	45.1	0.928	0.844
1990	3.14	21.3	21.7	102.	105.	35.9	36.5	0.948	0.883
1991	-8.49	19.9	20.1	101.	92.1	41.4	41.7	0.966	0.916
1992	1.73	18.3	9.91	54.3	55.2	31.5	17.1	0.975	0.928
1993	7.72	19.9	14.0	70.2	75.6	36.1	25.4	0.968	0.927
1994	1.82	24.7	14.9	60.3	61.4	45.1	27.2	0.948	0.889
1995	2.86	29.0	29.2	101.	104.	50.8	51.1	0.893	0.700
1996	19.4	29.9	28.2	94.5	113.	56.0	52.9	0.971	0.793
1997	18.9	36.5	38.6	106.	126.	64.8	68.7	0.936	0.803
1998	10.3	23.1	14.7	63.7	70.2	35.8	22.8	0.963	0.922
1999	2.52	26.0	22.7	87.0	89.2	37.7	32.8	0.947	0.895
2000	8.55	21.6	15.0	69.1	75.0	36.4	25.1	0.961	0.919
2001	2.89	21.2	9.71	45.7	47.1	38.6	17.7	0.969	0.937
2002	-10.1	20.9	25.0	120.	108.	37.5	44.9	0.962	0.913

Figure* 33*: HTML Yearly Statistical Summary report

7.3 PEAKFLOW report

The PEAKFLOW module produces summary statistics of the observed and the corresponding simulated instantaneous peak discharges as HTML reports (shown for a single location) by clicking on the PEAKFLOW Report icon to display the following window:

Index of file:///awips/chpshome/champ/FBs/BETA_5.1.1/nwrfc_calb/Reports/peakflow/

Up to higher level directory

Name	Size	Last Modified
peakflow_report_WGCM8.html	7 KB	03/23/15 14:08:36

Figure* 34*: Locate HTML report file

Click on the HTML file you want to display. The report will show the results of analyzing observations and simulations peaks as shown in Figure 35.

INITIAL DATE:
09-01-2015 13:39

PEAKFLOW DISCHARGE AND TIMING ERROR SUMMARY

Location: **FRENCH BROAD/ROSMAN**

Date	Observed Peak (CMS)	Date	Simulated Peak (CMS)	Date	Discharge Error (CMS)	Date	Discharge Ratio (SIM/OBS)	Date	Timing Errors (DAYS)
12-07-1950	127.43	12-07-1950	137.18	12-07-1950	9.75	12-07-1950	1.08	12-07-1950	0.00
03-11-1952	160.27	03-11-1952	192.41	03-11-1952	32.13	03-11-1952	1.20	03-11-1952	0.00
02-21-1953	124.03	02-21-1953	79.09	02-21-1953	-44.94	02-21-1953	0.64	02-21-1953	0.00
01-22-1954	86.65	01-22-1954	54.59	01-22-1954	-32.06	01-22-1954	0.63	01-22-1954	0.00
05-22-1955	71.64	05-22-1955	45.60	05-22-1955	-26.04	05-22-1955	0.64	05-22-1955	0.00
04-15-1956	76.46	04-16-1956	48.53	04-15-1956	-27.92	04-15-1956	0.63	04-16-1956	-1.00
04-04-1957	146.68	04-04-1957	132.10	04-04-1957	-14.58	04-04-1957	0.90	04-04-1957	0.00
12-20-1957	95.71	12-20-1957	55.23	12-20-1957	-40.48	12-20-1957	0.58	12-20-1957	0.00
01-21-1959	99.96	01-22-1959	54.65	01-21-1959	-45.30	01-21-1959	0.55	01-22-1959	-1.00
10-09-1959	81.55	10-09-1959	40.76	10-09-1959	-40.79	10-09-1959	0.50	10-09-1959	0.00
02-25-1961	106.47	02-25-1961	62.69	02-25-1961	-43.78	02-25-1961	0.59	02-25-1961	0.00
12-12-1961	100.24	12-12-1961	69.49	12-12-1961	-30.75	12-12-1961	0.69	12-12-1961	0.00
03-06-1963	65.70	03-06-1963	48.37	03-06-1963	-17.33	03-06-1963	0.74	03-06-1963	0.00
09-29-1964	271.84	09-29-1964	234.34	09-29-1964	-37.50	09-29-1964	0.86	09-29-1964	0.00
10-04-1964	382.28	10-04-1964	294.87	10-04-1964	-87.41	10-04-1964	0.77	10-04-1964	0.00
02-13-1966	225.69	02-13-1966	213.76	02-13-1966	-11.92	02-13-1966	0.95	02-13-1966	0.00
06-04-1967	137.90	06-04-1967	188.73	06-04-1967	50.83	06-04-1967	1.37	06-04-1967	0.00
03-12-1968	115.53	03-12-1968	65.85	03-12-1968	-49.68	03-12-1968	0.57	03-12-1968	0.00
06-15-1969	108.45	06-15-1969	97.02	06-15-1969	-11.43	06-15-1969	0.89	06-15-1969	0.00
11-01-1969	66.26	11-01-1969	56.12	11-01-1969	-10.14	11-01-1969	0.85	11-01-1969	0.00
10-11-1970	139.89	10-11-1970	60.00	10-11-1970	-79.89	10-11-1970	0.43	10-11-1970	0.00
05-03-1972	121.20	05-03-1972	27.07	05-03-1972	-94.13	05-03-1972	0.22	05-03-1972	0.00
05-28-1973	258.82	05-28-1973	168.48	05-28-1973	-90.34	05-28-1973	0.65	05-28-1973	0.00
12-26-1973	127.99	12-26-1973	71.33	12-26-1973	-56.67	12-26-1973	0.56	12-26-1973	0.00
09-23-1975	128.56	09-24-1975	76.54	09-23-1975	-52.02	09-23-1975	0.60	09-24-1975	-1.00
10-17-1975	209.26	10-17-1975	180.36	10-17-1975	-28.90	10-17-1975	0.86	10-17-1975	0.00
03-13-1977	209.83	03-12-1977	220.08	03-13-1977	10.26	03-13-1977	1.05	03-12-1977	1.00
01-25-1978	139.60	01-26-1978	65.74	01-25-1978	-73.86	01-25-1978	0.47	01-26-1978	-1.00
03-04-1979	244.37	03-04-1979	349.57	03-04-1979	105.19	03-04-1979	1.43	03-04-1979	0.00
11-02-1979	179.53	11-02-1979	213.34	11-02-1979	33.81	11-02-1979	1.19	11-02-1979	0.00
05-27-1981	111.29	05-27-1981	48.31	05-27-1981	-62.98	05-27-1981	0.43	05-27-1981	0.00
02-03-1982	64.85	02-03-1982	53.29	02-03-1982	-11.56	02-03-1982	0.82	02-03-1982	0.00

02-02-1983	139.04	02-02-1983	79.17	02-02-1983	-59.87	02-02-1983	0.57	02-02-1983	0.00
12-11-1983	72.77	12-12-1983	58.04	12-11-1983	-14.73	12-11-1983	0.80	12-12-1983	-1.00
08-17-1985	80.14	08-17-1985	37.82	08-17-1985	-42.32	08-17-1985	0.47	08-17-1985	0.00
11-01-1985	60.60	11-01-1985	26.99	11-01-1985	-33.61	11-01-1985	0.45	11-01-1985	0.00
11-26-1986	170.47	11-26-1986	50.84	11-26-1986	-119.63	11-26-1986	0.30	11-26-1986	0.00
11-17-1987	62.30	11-17-1987	19.95	11-17-1987	-42.35	11-17-1987	0.32	11-17-1987	0.00
07-03-1989	105.62	07-04-1989	75.88	07-03-1989	-29.74	07-03-1989	0.72	07-04-1989	-1.00
02-16-1990	126.29	02-16-1990	91.78	02-16-1990	-34.51	02-16-1990	0.73	02-16-1990	0.00
03-29-1991	175.28	03-29-1991	54.33	03-29-1991	-120.95	03-29-1991	0.31	03-29-1991	0.00
11-22-1991	119.50	11-22-1991	36.13	11-22-1991	-83.37	11-22-1991	0.30	11-22-1991	0.00
11-22-1992	152.91	11-23-1992	45.98	11-22-1992	-106.93	11-22-1992	0.30	11-23-1992	-1.00
08-17-1994	325.64	08-17-1994	103.64	08-17-1994	-222.00	08-17-1994	0.32	08-17-1994	0.00
01-14-1995	147.81	01-15-1995	56.64	01-14-1995	-91.18	01-14-1995	0.38	01-15-1995	-1.00
10-05-1995	153.19	10-05-1995	56.10	10-05-1995	-97.10	10-05-1995	0.37	10-05-1995	0.00
11-08-1996	158.01	11-08-1996	41.67	11-08-1996	-116.34	11-08-1996	0.26	11-08-1996	0.00
01-07-1998	224.55	01-08-1998	124.47	01-07-1998	-100.08	01-07-1998	0.55	01-08-1998	-1.00
04-01-1999	66.83	04-01-1999	35.74	04-01-1999	-31.09	04-01-1999	0.53	04-01-1999	0.00
11-26-1999	116.10	11-26-1999	29.90	11-26-1999	-86.20	11-26-1999	0.26	11-26-1999	0.00
11-09-2000	53.80	11-10-2000	19.14	11-09-2000	-34.66	11-09-2000	0.36	11-10-2000	-1.00
09-27-2002	81.55	09-27-2002	32.99	09-27-2002	-48.56	09-27-2002	0.40	09-27-2002	0.00

Observed Peaks mean: 138.04 (CMS)
Simulated Peaks mean: 91.97 (CMS)
Discharge Error mean: -46.07 (CMS)
Discharge Ratio mean: 0.64

Discharge RMS Error: 68.12 (CMS)
Timing RMS Error: 0.46 (DAYS)
Average Percent Error: -33.37 %
Correlation Coefficient (Discharge): **R** = 0.75
Best Fit Line: OBSQ = A + B * SIMQ: **A** = 73.43 **B** = 0.70

Figure 35: HTML Peakflow Daily Statistical Summary report

INITIAL DATE:
09-04-2015 13:34

PEAKFLOW DISCHARGE AND TIMING ERROR SUMMARY

Location: **FRENCH BROAD/ROSMAN**

Date	Observed Peak (CMS)	Date	Simulated Peak (CMS)	Date	Timing Errors HOURLY	Date	Discharge Error (CMS)	Date	Discharge Ratio (SIM/OBS)
12-07-1950	127.43	12-07-1950	137.18	12-07-1950	-6	12-07-1950	9.75	12-07-1950	1.08
03-11-1952	160.27	03-11-1952	192.41	03-11-1952	0	03-11-1952	32.13	03-11-1952	1.20
02-21-1953	124.03	02-21-1953	79.09	02-21-1953	-6	02-21-1953	-44.94	02-21-1953	0.64
01-22-1954	86.65	01-22-1954	54.59	01-22-1954	-18	01-22-1954	-32.06	01-22-1954	0.63
05-22-1955	71.64	05-22-1955	45.60	05-22-1955	-18	05-22-1955	-26.04	05-22-1955	0.64
04-15-1956	76.46	04-16-1956	48.53	04-16-1956	-30	04-15-1956	-27.92	04-15-1956	0.63
04-04-1957	146.68	04-04-1957	132.10	04-04-1957	-18	04-04-1957	-14.58	04-04-1957	0.90
12-20-1957	95.71	12-20-1957	55.23	12-20-1957	-18	12-20-1957	-40.48	12-20-1957	0.58
01-21-1959	99.96	01-22-1959	54.65	01-22-1959	-24	01-21-1959	-45.30	01-21-1959	0.55
10-09-1959	81.55	10-09-1959	40.76	10-09-1959	-6	10-09-1959	-40.79	10-09-1959	0.50
02-25-1961	106.47	02-25-1961	62.69	02-25-1961	-12	02-25-1961	-43.78	02-25-1961	0.59
12-12-1961	100.24	12-12-1961	69.49	12-12-1961	-6	12-12-1961	-30.75	12-12-1961	0.69
03-06-1963	65.70	03-06-1963	48.37	03-06-1963	-6	03-06-1963	-17.33	03-06-1963	0.74
09-29-1964	271.84	09-29-1964	234.34	09-29-1964	-18	09-29-1964	-37.50	09-29-1964	0.86
10-04-1964	382.28	10-04-1964	294.87	10-04-1964	-12	10-04-1964	-87.41	10-04-1964	0.77
02-13-1966	225.69	02-13-1966	213.76	02-13-1966	-6	02-13-1966	-11.92	02-13-1966	0.95
06-04-1967	137.90	06-04-1967	188.73	06-04-1967	-6	06-04-1967	50.83	06-04-1967	1.37
03-12-1968	115.53	03-12-1968	65.85	03-12-1968	-18	03-12-1968	-49.68	03-12-1968	0.57
06-15-1969	108.45	06-15-1969	97.02	06-15-1969	-6	06-15-1969	-11.43	06-15-1969	0.89
11-01-1969	66.26	11-01-1969	56.12	11-01-1969	-18	11-01-1969	-10.14	11-01-1969	0.85
10-11-1970	139.89	10-11-1970	60.00	10-11-1970	-6	10-11-1970	-79.89	10-11-1970	0.43
05-03-1972	121.20	05-03-1972	27.07	05-03-1972	-12	05-03-1972	-94.13	05-03-1972	0.22
05-28-1973	258.82	05-28-1973	168.48	05-28-1973	-6	05-28-1973	-90.34	05-28-1973	0.65
12-26-1973	127.99	12-26-1973	71.33	12-26-1973	-18	12-26-1973	-56.67	12-26-1973	0.56
09-23-1975	128.56	09-24-1975	76.54	09-24-1975	-24	09-23-1975	-52.02	09-23-1975	0.60
10-17-1975	209.26	10-17-1975	180.36	10-17-1975	-12	10-17-1975	-28.90	10-17-1975	0.86
03-13-1977	209.83	03-12-1977	220.08	03-12-1977	6	03-13-1977	10.26	03-13-1977	1.05
01-25-1978	139.60	01-26-1978	65.74	01-26-1978	-24	01-25-1978	-73.86	01-25-1978	0.47
03-04-1979	244.37	03-04-1979	349.57	03-04-1979	-12	03-04-1979	105.19	03-04-1979	1.43
11-02-1979	179.53	11-02-1979	213.34	11-02-1979	-6	11-02-1979	33.81	11-02-1979	1.19
05-27-1981	111.29	05-27-1981	48.31	05-27-1981	-18	05-27-1981	-62.98	05-27-1981	0.43
02-03-1982	64.85	02-03-1982	53.29	02-03-1982	-12	02-03-1982	-11.56	02-03-1982	0.82

02-02-1983	139.04	02-02-1983	79.17	02-02-1983	-6	02-02-1983	-59.87	02-02-1983	0.57
12-11-1983	72.77	12-12-1983	58.04	12-12-1983	-24	12-11-1983	-14.73	12-11-1983	0.80
08-17-1985	80.14	08-17-1985	37.82	08-17-1985	-18	08-17-1985	-42.32	08-17-1985	0.47
11-01-1985	60.60	11-01-1985	26.99	11-01-1985	-12	11-01-1985	-33.61	11-01-1985	0.45
11-26-1986	170.47	11-26-1986	50.84	11-26-1986	-12	11-26-1986	-119.63	11-26-1986	0.30
11-17-1987	62.30	11-17-1987	19.95	11-17-1987	-12	11-17-1987	-42.35	11-17-1987	0.32
07-03-1989	105.62	07-04-1989	75.88	07-04-1989	-24	07-03-1989	-29.74	07-03-1989	0.72
02-16-1990	126.29	02-16-1990	91.78	02-16-1990	-12	02-16-1990	-34.51	02-16-1990	0.73
03-29-1991	175.28	03-29-1991	54.33	03-29-1991	-18	03-29-1991	-120.95	03-29-1991	0.31
11-22-1991	119.50	11-22-1991	36.13	11-22-1991	-6	11-22-1991	-83.37	11-22-1991	0.30
11-22-1992	152.91	11-23-1992	45.98	11-23-1992	-24	11-22-1992	-106.93	11-22-1992	0.30
08-17-1994	325.64	08-17-1994	103.64	08-17-1994	-6	08-17-1994	-222.00	08-17-1994	0.32
01-14-1995	147.81	01-15-1995	56.64	01-15-1995	-24	01-14-1995	-91.18	01-14-1995	0.38
10-05-1995	153.19	10-05-1995	56.10	10-05-1995	-12	10-05-1995	-97.10	10-05-1995	0.37
11-08-1996	158.01	11-08-1996	41.67	11-08-1996	-12	11-08-1996	-116.34	11-08-1996	0.26
01-07-1998	224.55	01-08-1998	124.47	01-08-1998	-24	01-07-1998	-100.08	01-07-1998	0.55
04-01-1999	66.83	04-01-1999	35.74	04-01-1999	-12	04-01-1999	-31.09	04-01-1999	0.53
11-26-1999	116.10	11-26-1999	29.90	11-26-1999	-6	11-26-1999	-86.20	11-26-1999	0.26
11-09-2000	53.80	11-10-2000	19.14	11-10-2000	-24	11-09-2000	-34.66	11-09-2000	0.36
09-27-2002	81.55	09-27-2002	32.99	09-27-2002	-6	09-27-2002	-48.56	09-27-2002	0.40

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Figure 36: HTML Peakflow Hourly Statistical Summary report