LESSON 1 CALIBRATION CONCEPTS

Learn more about the CHPS calibration feature and how it improves forecasts.

This lesson describes the CHPS calibration component – the software, its purpose, and some terms you need to know.

By the end of this lesson, you should be able to:

- Describe the purpose of calibration.
- List the requirements for calibration.
- Describe any special skills the calibration user needs.

1.2 PURPOSE

Well-calibrated river segments yield better simulations than non- or poorly-calibrated segments.

Calibration Definition

Calibrate: verb – to adjust….so it can be used in an accurate and exact way. Source: Merriam-Webster Dictionary

RFCs define calibration as adjusting the parameters applied to simulated time series so it more closely matches the observed time series.

Example: RFC calibration focal points typically calibrate headwater points with historical observed data.

All other points are calibrated by comparing a simulated historical run (typically averaged over a day) to the observed time series.

Importance of Calibration
An uncalibrated or poorly calibrated model could give inaccurate model output.

Output from poorly calibrated models could lead to inaccurate hydrologic forecasts and potentially threats to life and property or a high number of false alarms.

History
CHPS did not contain a calibration component until November 2013. Only legacy applications could be used for calibration.

The Hydrologic Software Engineering Branch in the Office of Hydrologic Development and Deltares developed the calibration functionality.

The CHPS calibration application functions comparably to the legacy application, the Interactive Calibration Program (ICP).

Note: The CHPS calibration component does **not** completely replicate ICP.

1.3 REQUIREMENTS

Recall from the course overview, the CHPS calibration component **must** be configured for segments in your RFC's area of responsibility.

Configuration Changes
The configuration file templates and samples required for setting up the calibration component were included in the November 2013 CHPS release.

New files or edits to existing files are required in nearly every Config subdirectory.

The Configuration Focal Point at your office should have completed the steps outlined in the Calibration Configuration Guide. Please check with the focal point at your office to ensure the configuration process is complete.

Calibration Stand Alone Instance

Part of the configuration process includes setting up one or more Stand Alone (SA) instances used exclusively for calibration. The calibration SAs differ from the Operator Client and other SAs in a couple of ways:

- topology typically contains only calibration points instead of all an RFC's forecast points.
- IFD includes the Calibration Report button for creating statistical summaries.

Reference: *Calibration Configuration Guide*

1.4 USER SKILLS

Your task is manipulating hydrologic and soil moisture parameters to make the simulation more closely match the observed data. Make sure you have the necessary skills to perform this task more easily.

Experience with CHPS

The experience you have creating forecasts helps you calibrate hydrologic models.

The interface for the CHPS calibration component is the Interactive Forecast Display (IFD).

Your knowledge of the interface features functions makes calibration easier.

Knowledge of Hydrology and Modeling

Understanding rainfall-runoff relationships, snowmelt processes, and other hydrologic science topics are necessary when calibrating.

Log into the NWS Learning Management System (LMS) and peruse the courses in the Basic Hydrology section.

Read through available documentation on the model you are calibrating. You can calibrate the model more effectively if you know model sensitivities and state variables.

Forecaster Experience

Forecasting for a basin on a regular basis provides insight into how the segments react to rainfall and runoff.

Use information from **Forecaster Notes** in CHPS and any personal documentation you have to assist in model calibration.

Still have questions? Ask the DOH or a forecaster experienced with calibration for help.

LESSON 2 GETTING STARTED

You calibrate models using the CHPS IFD, the same interface used for running models.

This familiarity allows you to concentrate on calibrating the model rather than learning new software.

This lesson describes the process of calibrating a model and how to open a CHPS calibration session.

By the end of this lesson, you should be able to:

- List calibration steps.
- Open CHPS for calibrating.

2.2 CALIBRATION PROCESS

The calibration application utilizes existing CHPS interfaces. You use familiar interfaces to complete calibration tasks.

Calibration Mechanism

Calibrating in the CHPS framework is possible because of edits to the CHPS configuration and additional FEWS transformations.

A custom transformation allows the addition of new software without changing the software.

Calibration Steps

1. **Check for required data –** Check the Import directory to make sure all necessary data is available. Reimport the data if necessary.
2. **Open the calibration SA –** Open a CHPS instance configured for calibration. Use the command line to open the instance.
3. **Set dates for the calibration period –** Set the start and end dates of the calibration run. The run defaults to 10 days unless these dates are set. Setting the date tells the software how many years of data to use in calibration calculations.
4. **Run calibration workflows –** Run workflows to import historical data and generate calibration statistics. The workflow translates the imported data from datacard to XML. For more information on datacard format, click the link at the bottom of the page.
5. **Edit model parameters –** View the output graphics and make adjustments. This process differs, depending on which model you are calibrating. Use the Modifiers tab to adjust parameters for SACSMA, UNIT-HG, and SNOW-17. For all other models, edit the **UpdateStates.xml** file. Save the file and reload the configuration. Repeat this step using the appropriate method until the observed and simulated values more closely match. See several previous calibration time series at once by clicking the “Multiple Forecast” button and selecting “Include Historical Run”.
6. **Save updated parameters –** Save the updated parameters to an office-designated location.
7. **Share calibrated parameters –** Share the updated calibration parameters with other users in your office. Methods of sharing vary by office. Ask the DOH about the way calibration changes are shared at your office.

2.3 INITIAL STEPS

Slide	Text
Preparation	**Step 1:** Ensure the required data is available. QME, MAP, and MAT data **must** be in the Import directory for the calibration workflows to work properly **Error!** QME, MAT, or MAPX data could not be found! **Solution:** Try reimporting the data. See the job sheet for detailed instructions on importing data.
Open CHPS	**Step 2:** Use the command line method for opening the calibration Stand Alone (SA). Use the SA. This is **testing** and the OC does not include calibration workflows.
3	The calibration SA opens to the familiar Interactive Forecast Display (IFD).
Calibration Period	**Step 3:** Specify an **end date** for the calibration period. Otherwise, the model run will be limited to 10 days. Left or right click the system time to change this date.
Calibration Period	**Step 4:** Specify a **start date** for the calibration period in the "Run Options" section of the Forecasts tab. Start date = Beginning of Period of Record
Calibration Workflow	**Step 5:** Click a segment in the **Forecasts** window to run calibration workflows.
End	The next step is analyzing the statistics you generated by running the workflows. Please use your regular course navigation to continue.

Use the job sheet below to open a CHPS calibration Stand Alone.

Job Sheet: Open a CHPS Calibration Session

LESSON 3 CALIBRATING

Calibrating hydrologic models yields more accurate forecasts with fewer daily model modifications.

This lesson provides details on using modifiers and editing XML to calibrate hydrologic models.

By the end of this lesson, you should be able to:

- Describe the plots used for calibration.
- Match the model to the appropriate calibration parameter editing technique.
- Manage edits to calibration parameters.
- Access reports and tables.

3.2 CALIBRATION PLOTS

You opened the calibration Stand Alone and ran workflows to import historical data and generate calibration statistics. Now familiarize yourself with the various statistical, model parameter, and time series plots available on the Plots Tab.

Slide	Text
1	The calibration focal point set up these plots by editing the **DisplayGroups.xml** configuration file, located in the **SystemConfigFiles** directory. Suggestion for addition plots or changes to existing ones? Ask the configuration focal point.
Behavior	The behavior of these plots is the same as the time series used for forecasting For instance, switching panes (clicking the thumbnail image swaps it with the large pane) is the same.
3	Note any discrepancies in the plots. Use this information when you are creating modifiers or editing parameters in the XML.
WATBAL	The WATBAL plot depicts how the runoff is distributed among various forms of runoff (i.e., direct, surface, etc.).
STATQME	The STATQME module produces graphical output from 12 equations. These equations calculate mean, bias, and error statistics.
Peakflow	This plot shows the **observed** peaks analyzed for the QME peak statistics. The calibration module uses the peaks in the calculation of biases.
QME Peak Statistics	Calibration focal points use this plot to evaluate the peak. In other words, a graphical depiction of biases in high flow simulations. This graph is helpful because it shows **when** the peaks occurred.
Percolation Analysis	Percolation analysis requires manually plotting the lower zone deficit ration (LZDEFR) on a percolation demand curve (outside of CHPS). Determine whether more or less percolation is required. Enter the proposed percolation values in the Modifiers tab or edit the appropriate XML file.
SACSMA Analysis	Use this plot to see: • How simulated soil moisture changes in time • What sort of runoff is generated in individual events • What runoff is contributing to errors in a particular event This frequently used plot depicts trends in daily water balance.
End	The next step is modifying parameters. Please use your regular course navigation to continue to information on calibration methods.

3.3 CALIBRATION METHODS

The method used for calibrating a model depends on the model itself.

Learn which method is used for the model you are calibrating **and** the parameter requiring adjustment.

Two Possibilities

Segments are calibrated using one of two methods - by editing XML files or by using the Modifiers tab.

Modifiers Tab

Calibrate most SACSMA, SNOW-17, and UNIT-HG by manipulating parameters in the Modifiers tab.

Click here for a list of the default modifiers available.

Note: The modifier names correspond to the parameter names defined in the SACSMA module parameter file.

Ask the focal point if the modifier you need does not appear in the Modifiers tab.

Rerun the segment after modifying parameters to refresh the calibration graphic.

Edit XML

Calibrate other models, such as APICONT and LAG/K, but editing the model's **UpdateStates** file, located in the **ModuleParFiles** directory.

Ask the Configuration Focal Point if you need help with this task.

3.4 MANAGING XML EDITS

Recall, you must edit the XML configuration files for all non-SACSMA model parameters **and** several of the SACSMA parameters.

General Information You need to edit several **UpdateStates.xml** files for hydrologic models. The number and name of the files varies depending on which model. Editing the files associated with hydraulic models is more complex, depending on how it was integrated into CHPS. Use XML editing software. The editing software provides schema validation and color-coding to locate errors.
Editing The first step in editing parameters is making a copy of the existing file. You have the option of reverting to the original file if the edits are unacceptable. Locate the parameter in the XML file you wish to change and type in the new value. **Note:** Include a reason for the change in a comment. **Job Sheet:** Manage XML Parameters
Saving Click the “save” icon or select “Save” from the menu in the editor you are using. The local datastore contains the output of the CHPS calibration runs.
Deleting Do not "delete" the changes using the XML editing method. Instead, if you are dissatisfied with the changes, revert to the saved copy of the file.
Viewing Return to the plots described in Lesson 3.2 and view the results of the edits. Return to the file for additional XML edits if needed. Refresh the plot following an edit to an XML file by reloading the configuration.
Sharing Once you are satisfied with the edits, upload the changes to the Central Server using the Configuration Manager. Other users download the files to their system. You also have the option of exporting the calibration parameters. Export the data in any of the formats available for other CHPS time series, such as Pi-Service, XML, and netCDF. Click here for more information on all available CHPS data types.
Best Practice: Several people at your office could be calibrating at one time, each having his or her own calibration Stand Alone. Designate a "keeper of the files" who compiles individual calibration files. This "keeper" uploads the new files to the shared office Stand Alone **and** the operational system.

3.6 STATISTICS AND REPORTS

Output statistics and create reports using the updated calibration parameters.

Statistics

Calibration workflows calculate various statistics using **daily mean** model states and observed data.

Further configuration of the calibration Stand Alone or use of an external statistics program, such as statq, are necessary to perform these functions on **instantaneous** model states and observed data.

Reports

The calibration application uses the Report Module to generate yearly or multiyear reports.

This makes it possible to review all statistical information in tabular format in one window.

The reports replace the function of the ICP Statistical Summary.

Access these tables by clicking the "Calibration Report" button on the IFD tool bar.

The image on the right depicts a typical summary report.

Hint: Click the image to enlarge/shrink.

References: *Calibration Configuration Guide, Deltares Documentation on the Report Module*

LESSON 4 TROUBLESHOOTING

A basic understanding of troubleshooting techniques helps you narrow down possible issues, leading with a quicker resolution of CHPS calibration issues.

This lesson describes best practices, common issues, and solutions to problems with calibration.

By the end of this lesson, you should be able to:

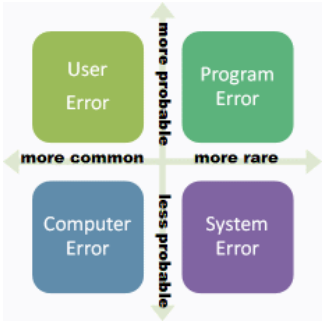
- List basic troubleshooting steps.
- Identify problems with calibration.
- Identify sources of help for calibration issues.

4.2 BASIC TROUBLESHOOTING

Troubleshooting is a logical and systematic search for the source of a problem. Following the steps helps ensure you approach all problems with clear logic, eliminating more common errors before beginning more complex investigations. A timely diagnosis and a thorough write up of the issues generally leads to a quicker resolution of the problem.

Note: In most cases, you will not be asked to resolve any of these problems by yourself. Knowing about different types of errors will help with the troubleshooting process.

Working from Common to Rare Possibilities



Identify and isolate the issue as a first step. Start with the most probable and common issue, and progress to the least probable and uncommon issue. Consider the chart on the right.

If you have not seen this type of behavior previously, you should move from left to right and then top to bottom when searching for errors (User, Program, Computer, and System).

Types of Errors

You may need to troubleshoot several types of errors - **user**, **computer**, **system**, and **program** errors. Here are some tips for identifying various types of errors.

User errors are the most common and probable issues. Typical user errors include incorrectly typing commands or not clicking the right part of a menu.

Computer errors typically occur on only one workstation. Make sure you are on a workstation configured with a calibration Stand Alone instance.

System errors are more widespread than user and computer errors, occurring on more than one calibration-configured workstation.

Program errors tend to occur after software upgrades. Like most software, CHPS is updated periodically.

4.3 COMMON ISSUES

Offices already utilizing the calibration application noted two common issues. Try these suggestions if you have failed calibration runs at your office.

Symptom: Missing MAPE, temperature, or RAIM data
Potential Causes:
Did you run the preprocessing steps for the forecast group or segment?
Is the imported data expired?
Solution

- Run the preprocessing workflow.
- Re-import the historical data.
- Before the newly imported historical data expires, start CHPS **without** the Rolling Barrel. This prevents the system from deleting expired data.

Best Practices

Troubleshoot run errors using the Manual Forecasts tab.

Run hydrologic models in debug mode to write cold state files to the **/tmp** directory.

Symptom: Simulation runs failing
Cause: Memory limits exceeded
Solutions

- Delete the local data store, and re-import historical data.
- Ask the CHPS System Manager guidance on running CHPS with more memory.
- Tell the Configuration Focal Point about the issues. The preprocessing steps and simulation steps may need to be separated.
- Consider running large forecast groups on different calibration Stand Alones.

4.4 IDENTIFYING SOLUTIONS

The scenarios in the previous section are some of the more common issues. You have ways of finding help if you are dealing with other problems.

Identifying the Source of the Problem

The first step in identifying a solution to calibration issues is gathering information about the problem.

Consider the following questions before e-mailing a question to the list_serv or submitting a FogBugz ticket:

- Is this happening to everyone, or just on one workstation/CHPS instance?
- Is this an intermittent or constant problem?
- Were there any changes to the system recently?
- Do the log files indicate any specific errors?

Finding answers to calibration questions is easier if you know where to look. Check out these resources for calibration information.

Searching for Similar Cases

Search for similar cases and ask RFC colleagues for help on the chps_ops listserv. Use the information you gathered in the section above. Write a concise e-mail, but do not leave out important details, such as if the problem appears to be workstation-specific. Click here to sign up for the chps_ops list.

Reporting Problems

The NWS has two methods of reporting RFC-related problems. The group to contact depends on

Severity	System	Business Hours Contact	After Hours Contact
Urgent	CHPS	FogBugz; contact HSD as necessary	NCF; NCF contacts HDS, uses FogBugz for details
	AWIPS	NCF; HSD may assist via FogBugz	
Routine	CHPS	FogBugz; contact HSD as necessary	
	AWIPS	NCF; HSD may assist via FogBugz	

time of day, the severity of the problem, and the affected system.

The Network Control Facility (NCF) manages the AWIPS Wide Area Network (WAN), Satellite Broadcast Network (SBN), and provides AWIPS support to field offices.

Call the NCF at 301.713.9344 and request a trouble ticket for the problem.

FogBugz provides a platform to report RFC-specific problems. You can also browse the cases to see if another RFC had a similar problem.

For more information on how to report a problem using FogBugz, use the instructions in the job sheet below.

Job Sheet: Reporting Problems on FogBugz

COURSE SUMMARY

Purpose: simulated more representative of observed
Lesson 1.2

Requirement: Update Config files
Lesson 1.3

Action: Take LMS hydro science courses
Lesson 1.4

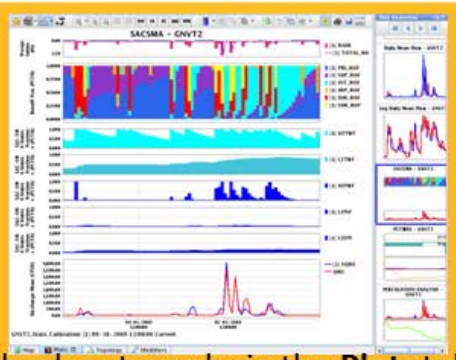
Calibration Steps

1. Open the calb SA
2. Set the run end date
3. Import historical data
4. Edit model parameters
5. Save updated parameters
6. Share calibrated parameters

Lesson 2.2

Use **Modifiers** for:
SNOW-17
SACSMA
UNIT-HG
Lesson 3.3

Edit **XML** for all other models
Lesson 3.3



Check out graphs in the **Plots** tab
Lesson 3.2

Recall **basic troubleshooting** techniques
Lesson 4.2

NCF
301.713.9344
Lesson 4.4

FogBugz
schuylkill.nws.noaa.gov:7069
Lesson 4.4

Reminder: Complete the assessment and survey in the LMS!