

# *Interactive Verification Program User's Manual*

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## 1.0 Overview

The Interactive Verification Program (IVP) is a tool for verifying hydrologic forecasts. It provides the ability to do the following:

- Define and view forecast-observed data pairs for use in verification according to the location, physical element, forecast valid time, forecast issuance time-of-day, forecast lead time, forecast value, observed value, and forecast type source. Data can be viewed graphically in a scatter plot or time series plot, or in a table format.
- Quality control data pairs graphically. Pairs can be marked as bad, so that verification computations are performed without those pairs. The forecast and observed values of the data pairs can be modified to account for measurement or reporting errors.
- Save the forecast-observed data pairs to a properly formatted pairs file.
- Define and view verification statistics, including moments, error statistics, categorical statistics, quantiles, extremes, sample sizes, bias, correlation, and skill scores. Statistics can be viewed in a table and in a plot. More than one statistic can be displayed against a single y-axis if those statistics have the same scale, and two y-axes can be included in the plot. Statistics can be plotted against location, analysis (or validtime) interval, lead time interval, issuance time-of-day interval, forecast type source, forecast category, and observed category. This variable determines the x-axis. Those statistics can be compared over one of the variables, as well, as long as the comparison variable is not the same as the x-axis variable. The statistics and comparison variable determine the legend.
- Define and view special plots, including plots of the cumulative distribution functions, probability density functions, and relative operating characteristic curves. These can be compared over one of the variables above.
- Adjust plot properties (labels, fonts, colors, etc.) via the GUI or via the batch language.
- Save a plot to an image file (jpg or png).
- Save table containing the statistics to a file.
- Create a batch file that can be processed by the IVP Batch Program in order to regenerate graphics visible in the IVP, including changes made to the plot properties by the user.

This manual provides instructions on how to use the IVP.

### 1.1 Using This Manual

Section 8.0 provides instructions on how to use this software to generate verification graphics and quality control forecast-observed data pairs. Sections 9.0-24.0 provide information on each window of the IVP. It is recommended that the user read the instructions in Section 8.0 before first using this software, and, as the user interacts with the IVP, refer to the Section pertaining to a window if he or she has a question about it (see the Table of Contents for the page number).

Screenshots for each window are usually included at the end of the section pertaining to the window.

## 2.0 Notation

The following notational conventions are used in this document:

- A GUI component, including a window, panel, text field, menu, menu item, or button, is displayed in **bold**.
- A menu item within a menu is displayed as **[menu name] >> [menu item name]**. For example, **Actions >> Close** is the **Close** menu item within the **Actions** menu.
- IVP Batch Program commands and choices that can be made from the GUI are in `this font`.
- Terms to remember and *NOTES* will be denoted in *italics*.
- <key> indicates a keyboard key. For example <shift> means the shift key.
- Text to be entered at a command line is displayed in `this font`.
- Directories and file names are in `this font`.
- A directory corresponding to an apps-defaults token is denoted `$(token)`.

### 3.0 Execution

To execute the IVP, enter:

```
cd $(get_apps_defaults vsys_dir)/scripts
ivp
```

Upon execution, the **Verification Group Manager** window will open up.

### 4.0 Apps-defaults Tokens

The following apps-defaults tokens are used by the IVP:

- `adb_name` : <depends upon RFC>
- `util_rls` : `$(util_dir)/bin/RELEASE`
- `verify_dir` : `/rfc_arc/verify`
- `vsys_dir` : `$(verify_dir)`
- `vsys_input` : `$(vsys_dir)/input`
- `vsys_output` : `$(vsys_dir)/output`
- `vsys_files` : `$(vsys_dir)/files`
- `rax_pghost` : `ax` <optional; if not present, it uses the PGHOST environment variable>
- `pguser` : `pguser` <optional; if not present, it uses the PGUSER environment variable>
- `pgport` : `5432` <optional; if not present, it uses the PGPORT environment variable>

Each of the above directories must exist for the IVP to run properly. It is also recommended that the following directory be created for each user:

```
$(vsys_input)/$LOGNAME
```

If this recommendation is followed, then the apps-defaults site file should override the setting of `vsys_input` as follows:

- `vsys_input` : `$(vsys_dir)/input/$(LOGNAME)`

All of these directories should be constructed prior to running IVP.

## 5.0 Files and Directory Structure

All of the directories corresponding to apps-defaults tokens in Section 4.0 must exist. In addition, the following files must be in place for the IVP to execute properly:

```
$(util_rls)/rfc.ohd.jar
$(sys_java_dir)/lib/ChartDirector.jar
/usr/share/java/pg74.215.jdbc3.jar
$(vsys_dir)/scripts/ivp
```

## 6.0 File Types

The following types of files are used within the IVP (recommended file extensions, if any, are given in parentheses; for the output image files, the extensions are required)

- **Batch Input Files (.bat):** These files are input files to the IVP Batch Program, and can be loaded by the GUI in order to specify parameters of the data used and plots generated. These files are, by default, assumed to be in the `$(vsys_input)` directory.
- **Graph Template Files:** These files specify properties of the charts to create, including labels, fonts, colors, sizes, axis limits, and others. These files are, by default, assumed to be in the `$(vsys_files)/$(LOGNAME)/templates` directory.
- **Image Data Files (.dat):** These files are ASCII format files that provide the data plotted within a chart in a pipe-delimited tabular format. These files are, by default, assumed to be in the `$(vsys_output)/$(LOGNAME)` directory.
- **Output Image Files (.png, .jpg, .jpeg):** These files are images of the charts generated by the IVP or IVP Batch Program. These files are, by default, assumed to be in the `$(vsys_output)/$(LOGNAME)` directory. Any such file must have one of the extensions listed.
- **System Settings File:** This file is an ASCII format file used to specify defaults for the appearance of the IVP and its charts. The file must be in the directory `$(vsys_dir)/app-defaults` and have the name `IVP_SYSTEM_FILE.txt`. See Appendix A for more details.

`$(LOGNAME)` is the user name for the user on the system. Any batch file created by the IVP will have the `.bat` extension appended to its name.

## 7.0 Terminology

The following terms are used within this document and are important to understand before reading the remainder of this manual:

- *analysis interval:* The interval of time used to breakdown the *analysis time period* evenly into subintervals (possibly with one subinterval at the end that is not of equal size).
- *analysis time period:* The time period, start date/time to end date/time, for which the verification analysis is to be performed.
- *basis time (or issuance time):* The time at which a forecast was issued.



- *category*: With this software, categories are defined by a sequence numbers, where the first and last numbers define overall bounds, and the other numbers break down the overall bounds into contiguous regions.
- *forecast-observed data pair*: A forecast value paired with a corresponding observed value.
- *issuance time-of-day*: The hour of the day (0-23) during which a forecast was issued.
- *lead time*: The lead time of a forecast is computed as (*valid time* – *basis time*).
- *observation type (obs type)*: The type of observation required for pairs to be used in verification. The observation type can be “raw” or “processed” (“proc”). See the *IVP Batch Program User's Manual for Pairing* for more information about raw and processed data, and the archive database in general.
- *persistence forecast*: A forecast generated by taking the most recent observed value (prior to a forecast's *basis time*) and extending it out into the future. The persistence forecast type source is 'FR'.
- *verification location*: A location id and SHEF code that defines one forecast point and data type that is to be verified.
- *verification group*: A collection of verification locations that are to be verified as a whole, combined with parameters defining how the verification is to be performed.
- *valid time*: The time for which a forecast is targeted.

Additional terms are defined within the manual as needed, and will be denoted in *italics*.

## 8.0 *Instructions*

This section provides general instructions for generating graphical statistic products and quality controlling forecast-observed data pairs, in order to identify outliers and bad data.

### 8.1 *Performing a Verification Analysis*

Prior to using the IVP to perform a verification analysis, the user should know the following information about the pairs data to verify:

- Which locations and data types are to be included in the verification analysis? What are the location ids and SHEF codes? What are the observation types (raw or processed) for the locations?
- For what overall analysis time period is the verification analysis to be performed?
- Are persistence forecasts to be included in the analysis?

After loading the data, for each verification product to generate, the user should know the following information:

- For which of the locations for which pairs were loaded is the product to be generated? Are persistence forecasts to be part of the analysis?
- Is performance relative to categories (e.g. above flood stage, below flood stage) to be analyzed? If so, what categories are to be used? If not, then are the pairs included to be restricted to a particular category (i.e. only verify stages above flood stage)?
- For what subset of the overall analysis time period is the verification product to be generated? Is it to be broken down into smaller intervals? If so, what is the width of the intervals?
- Over what issuance time period is the product to be generated? Is it to be broken down into smaller intervals? If so, what is the width of the intervals?
- Over what forecast lead time period is the product to be generated? Is it to be broken down into smaller intervals? If so, what is the width of the intervals?
- Is the product to be generated only for points that are currently active? Inactive? Both?
- For stage or flow data, is the product to be generated only for points that have a response time that is slow? Medium? Fast?
- What are the statistics, x-axis variable, and comparison variable for which the product is to be generated?

The following sections describe how to use the IVP to load data and to generate products for the verification analysis to be performed. All windows described below are described in Section 9.0-24.0.

#### 8.1.1 *Loading the Data*

When loading pairs for verification analysis, try to load however many pairs are necessary in order to conduct a complete analysis. The more pairs that are loaded into memory, the less often the user will need to reload data from the archive database, which is the slowest aspect of the IVP. See Section 25.4 for recommended and maximum number of pairs that can be loaded into memory for AWIPS OB8.2.

To load pairs data for verification analysis, do the following:

1. Start the IVP (see Section 3.0).

2. Enter the overall analysis time period into the **Verification Group Manager** window.
3. Click on **Open Location Manager** to open up the **Verification Location Manager** window.
4. Select the desired verification locations from the **Available Locations** table and choose them to be displayed.
5. Set the observation type by clicking on **Edit Obs Type**.
6. Click on **Create Display** in the **Verification Group Manager**.
7. Examine the scatter and time series views of the **IVP Data Display** for a general feeling about the skill of the forecasts and to identify any potential erroneous pairs or outliers. If bad pairs or outliers appear to be present, see Section 8.2 on quality controlling pairs data for how to deal with them.

### 8.1.2 *Generating the Products*

When generating products, remember that the pairs used in the analysis have already been loaded. So, generating multiple products should be relatively quick. Fee free to generate as many products as desired by repeating the steps below (after Step 3.0).

To generate products, do the following:

1. Click on **Actions >> Show Plot Mgr** to open up the **Verification Plot Definition Manager**.
2. Click on **Edit Group Parameters** to open the **Verification Group Manager (Plot Definition)** window.
3. Specify the analysis interval, lead time information, issuance time information, and other information needed to generate the desired verification product in the **Verification Group Manager**.
4. Click on **Open Location Manager** to open up the **Verification Location Manager (Plot Definition)** window, which is identical to a default **Verification Location Manager**.
5. Set the categories using the **Observed Category Editor** and **Forecast Category Editor**, by clicking on the appropriate **Edit Category** button.
6. Choose only those locations that are to be included in the verification product; unchoose all others.
7. Close the **Verification Location Manager**, if desired.
8. Specify the graphic parameters for the desired verification product by changing the settings in the **Verification Plot Definition Manager**. Statistics are chosen via the **IVP Statistic Chooser Manager**.
9. Click on **Create Plot** to create an **IVP Statistics Display**.
10. If the user would like to save the chart image to a file, click on **Actions >> Save Image File**.
11. If the user would like to produce this particular graphic on a regular basis, the user should save a batch file by clicking on **Actions >> Save Batch File** and fill out the fields in the **IVP Batch File Creation Wizard** as desired.

*NOTE: If the PERSISTSS statistic is to be part of the product,, then be sure to include persistence forecasts in the data loaded via Section 8.1.1.*

## 8.2 *Quality Controlling Pairs Data*

Prior to quality-controlling forecast-observed pairs, the user should know the following:

- Which locations and data types are to be quality controlled? What are the location ids and SHEF codes? What are the categories for the locations? What are the observation types (raw or processed) for the locations?
- Over what analysis time period (start to end) is the examination to be done?

### 8.2.1 *Loading the Data*

Perform these steps to load data for quality control:

1. Start the IVP (see Section 3.0).
2. Enter the analysis time period information into the **Verification Group Manager** window.
3. Click on **Open Location Manager** to open up the **Verification Location Manager** window.
4. Select the desired verification locations from the **Available Locations** table and choose them to be displayed.
5. Set the categories using the **Observed Category Editor** and **Forecast Category Editor**, by clicking on the appropriate **Edit Category** button. This is only needed if you want to see the category values while performing quality control.
6. Set the observation type by clicking on **Edit Obs Type**.
7. Click on **Create Display** in the **Verification Group Manager** to create the **IVP Data Display**.

When loading data, be sure to keep the number of pairs relatively small, compared with product generation. The smaller the number of pairs, the quicker the chart rendering, and the easier it will be use the **IVP Data Display**. See Section 25.4 for the recommended number of pairs.

### 8.2.2 *Identifying Locations With Potential Outliers or Bad Pairs*

To identify locations that may include outliers or bad data, create plots of error statistics, especially maximum error, or skill scores, such as the RMSE-SS vs. Persistence, with the x-axis being location. Follow these steps:

1. In the **IVP Data Display**, click on **Actions >> Show Plot Mgr** to open up the **Verification Plot Definition Manager**.
2. Select the primary statistics to be MAXERR, and optionally the other error statistics. Or, select as the primary statistic the PERSISTSS (the RMSE-SS vs. Persistence statistics). Select the primary plot type to be SCATTER.
3. Optionally, select SAMPLE SIZE as the secondary statistic, with a plot type of BAR.
4. Select Location as the x-axis variable.
5. Click on **Create Plot** to create an **IVP Statistics Display**.
6. Examine the plot to determine if any locations have unreasonably large error statistic values or low skill score values (the more negative the skill score, the worse the performance). Record these locations for use in Section 8.2.3.

### 8.2.3 *Identifying the Outliers and Bad Pairs Using the IVP Data Display*

The two views of the **IVP Data Display** provide the primary means by which bad data can be identified. The initial **Scatter View** can be used to spot outlying forecast or observed values in the pairing process: just look for points that are well away from the line  $y = x$ . Outliers can also be spotted via the **Time Series View**, but the time series view is best used for spotting stage and flow forecasts that may have been generated using bad input data. For these errors, look for time series in which the forecast values are increasing but the observations are decreasing, or vice versa, or in which the forecast and observed time

series significantly diverge. These may be indicative of bad input for the models that generated the forecasts.

#### 8.2.4 *What to Do With Outliers and Bad Data*

Once an outlier or bad pair is identified, the user must decide how to deal with it. The options are as follows:

- *Mark the Pair as 'BAD'*: Use the **IVP Data Display** menu options, toolbar items, or the **Verification Pairs Data Editor** to mark the pair as bad, so that it is not used in statistic computations.
- *Fix the bad forecast or observed value via the IVP*: If the user knows why the pair is bad and how to fix it (i.e. what the forecast or observed value should be), the user can change the forecast or observed value via the **Verification Pairs Data Editor**. If the problem is a bad observed value, be sure to change all pairs that use that observed value.
- *Manually change the forecast or observed value in the data tables of the archive database*: If the user knows why the pair is bad and how to fix it, the user can make the change to the forecast or observed value, itself, within the appropriate table of the archive database that stores the forecast or observed value. After making the change, the user should re-run the pairing algorithm to generate good pairs using the fixed data. The good pairs will overwrite the bad pairs as long as the location, SHEF code, or validtime of the forecast value was not changed.
- *Do nothing*: If the outlier is actually a valid pair, the user should leave it as is. The point of verification is to determine the performance of the models and the forecasters. If the pair represents a poor, but valid, forecast, it should be left in the analysis.

If either of the first two bullets is followed, then be sure to save the changes to the archive database before quitting IVP, so that other sessions of the IVP or IVP Batch Program will pick up the change. Use the **Verification Pairs Data Editor** to save changed pairs to the database, or close the window without saving and, when the window titled "Save changed pairs?" opens up, click **Yes** to save the changed pairs to the database.

## 9.0 Verification Group Manager

The **Verification Group Manager** window provides tools to manage and edit parameters of a verification group. A verification group is a collection of verification locations for which one set of verification statistics is to be calculated, and parameters that define how to load pairs for statistic calculations. Parameters of a verification group managed via this window include:

- analysis period and interval: start time and end time defining the analysis period, and an analysis interval time step breaking down the period into subintervals
- issuance time-of-day period and interval: the start and end hours defining a range that restricts the forecast basis time hour-of-day, and a time step breaking down the range into subintervals
- lead time period and interval: start lead time and end lead time defining a range that restricts the lead time of the forecast, and a time step breaking down the range into subintervals
- forecast type sources: a list of type sources of forecasts to include in the calculations
- response time: a list of response times, restricting data to include in verification by the corresponding verification location's response time

Each parameter is managed graphically, using components of the **Verification Group Manager**.

*NOTE: It is recommended that, if an appropriate batch file already exists that defines the group for which statistics are to be computed, then use the **Load From Batch** button to load the parameters from the file. This is easier than specifying each field manually.*

### 9.1 Versions of the Verification Group Manager

There are two version of the **Verification Group Manager**. The default version is the initial window of the IVP and is used to specify pairs to load for the **IVP Data Display**. Within this version, it is recommended that the user only select the analysis period start and end time, and the locations to include in order to load all the need pairs for the verification analysis.

The "Plot Definition" version, is spawned from the **Verification Plot Definition Manager**, and allows for setting group parameters that are used to build the verification product. It does not include the **Load From Batch** or **Create Display** buttons. Additionally, borders are placed around the components of the **Verification Group Manager (Plot Definition)** that directly affect variable values for the graphic: red if the x-axis variable is affect, blue for the comparison variable, and purple for both variables.

### 9.2 Start Time and End Time

The screenshot shows a graphical user interface for selecting time intervals. It consists of two main sections, one for 'Start Time' and one for 'End Time'. Each section includes a text input field containing a date and time (e.g., '2003-09-01 00:00:00'), a scrollable range selector below it, and two buttons labeled 'Fixed' and 'Rel' to the right of the input field.

The start time and end time of the analysis interval specify a range within which the forecast valid time of a forecast-observed data pair must exist in order to be included in the verification computations. In the **Verification Group Manager**, the start time is given in the **Start Time** text field and the end time is given in the **End Time** text field. Both can be specified manually or via a **Choose Date/Time Window** opened by clicking on **Fixed**, or a **Choose Relative Date/Time Window** opened by clicking on **Rel**. See

the START\_TIME and END\_TIME commands within the *IVP Batch Program User's Manual for Verification* for acceptable formats for the text field.

### 9.3 Time Step

The time step specifies a time interval that breaks down the overall analysis interval (start to end) into equal sized subintervals. In the **Verification Group Manager**, the time step is given by the **Time Step Quantity** spinner and **Time Step Unit** choice box. The former specifies an integer value greater than 0, and the latter specifies a unit of time (“weeks”, “days”, “hours”), “MONTHLY”, “YEARLY”, or “NONE”. A unit of “NONE” implies that no subintervals are to be used and the **Time Step Quantity** is to be ignored. Combined, the quantity and unit define an interval of time. See the ANALYSIS\_INTERVAL command described within the *IVP Batch Program User's Manual for Verification* for more details.

### 9.4 Lead Time Start, Lead Time End, and Lead Time Step

The lead time start, lead time end, and lead time step specify a range within which the forecast lead time of a forecast-observed data pair must exist in order to be included in the verification computations, and further breaks down that interval into equal sized subintervals. In the **Verification Group Manager**, each is specified using a text field spinner and choice box: **Lead Time Start Quantity** spinner, **Lead Time Start Unit** choice box, etc.

### 9.5 Issuance Time Start, Issuance Time End, and Issuance Time Step

The issuance time start, issuance time end, and issuance time step specify a range within which the time-of-day (0-23 hours) of a basis time of a forecast-observed data pair must exist in order to be included in the verification computations, and further breaks down that interval into equal sized subintervals. In the **Verification Group Manager**, each is specified using a text field spinner and choice box: **Issuance Time Start Quantity** spinner, **Issuance Time Start Unit** choice box, etc.

### 9.6 Fcst Type Sources

The forecast type sources define a list of type sources within which the forecast-observed data pair's forecast type source must exist in order to be included in the verification computations. It is specified as a

comma delimited list in the **Fcst Type Sources** text field. It can be edited manually or via a **Select FCST\_TS Window**, opened by clicking on **Edit List**.

Alternatively, the forecast type sources can be defined by choosing verification locations within the **Verification Location Manager** for which the type source is one of the desired type sources. Then the **Forecast Type Sources** text field should be set to 'ALL'.

A setting of "ALL\_BUT\_PERSISTENCE" will include all type sources except persistence, 'FR'.

*NOTE: To include persistence forecasts in your analysis, the type source 'FR' must be included in the Forecast Type Sources text field. This can be added manually or via the Select FCST\_TS Window.*

### 9.7 River Response



The river response defines a list of response times within which a verification location's response time must be in order for that location to be included in the verification computations. In the **Verification Group Manager**, it is specified using **Response Time** checkboxes that allow for a setting of "ALL" (default) or a setting that can include any combination of "SLOW", "MEDIUM", and "FAST".

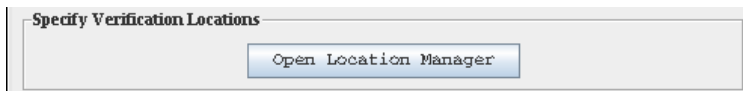
*NOTE: If the current river response setting is "ALL", then the other three radio buttons will be deactivated and cannot be selected. To make them active, first deselect "ALL".*

### 9.8 Active Status



The active status defines the active state that a location must have in order for that verification location to be included in verification computations. In the **Verification Group Manager**, it is specified using **Active/Inactive Only** radio buttons that allow for a setting of "BOTH" (default), "ACTIVE" or "INACTIVE". Only one radio button can be selected at a time.

### 9.9 Verification Locations



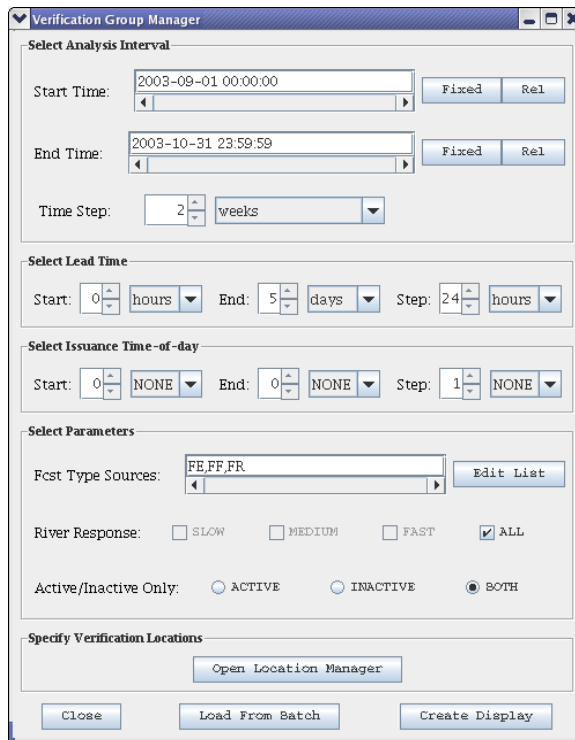
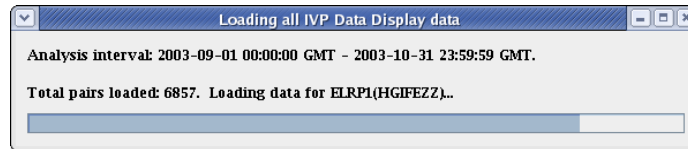
Before the data for verification can be loaded and an **IVP Data Display** can be created, verification locations must be specified. Click on the **Open Locations Manager** to open up a **Verification Location Manager** window and specify locations for verification.

### 9.10 Buttons

- **Start (End) Time Fixed** button: Opens up a **Choose Date/Time Window** for editing the **Start (End) Time** text field.



- **Start (End) Time Rel** button: Opens up a **Choose Relative Date/Time Window** for editing the **Start (End) Time** text field.
- **Fcst Type Sources Edit List** button: Opens up a **Select FCST\_TS Window** for editing the **Forecast Type Sources** text field.
- **Open Locations Manager** button: Opens up the **Verification Location Manager** to allow for changing categories for locations and choosing locations to be displayed in the **IVP Data Display**.
- **Close** button: Closes the **Verification Group Manager**. If no other **Verification Group Manager** window or **IVP Data Display** window is currently open, this will exit the program.
- **Load From Batch** button: Opens up a file browser that can be used to find a previously created batch file for the IVP Batch Program and set the parameters within this **Verification Group Manager** according to that file. It will read parameters until the first verification group is defined (via a DEF\_GRP batch file action; see the *IVP Batch Program User's Manual*) and sets the parameters herein according to those read in. Location information within the **Verification Location Manager** will also be changed based upon the batch file.
- **Create Display** button: Creates a new **IVP Data Display**, showing forecast-observed data pairs specified by this **Verification Group Manager** and the **Verification Location Manager**. To destroy all existing IVP Data Display windows when creating a new one, edit the System Settings File command `DestroyOldDisplayUponCreate` (see Appendix A). Upon clicking **Create Display**, a **Loading all IVP Data Display data** progress window will pop up. Shown below, it provides the status of loading forecast-observed pairs from the archive database. Progress is made when each verification location's pairs are loaded.



## 10.0 Choose Date/Time Window

The **Choose Date/Time Window** is used to specify a date in the format

yyyy-mm-dd hh:mm:ss TZC

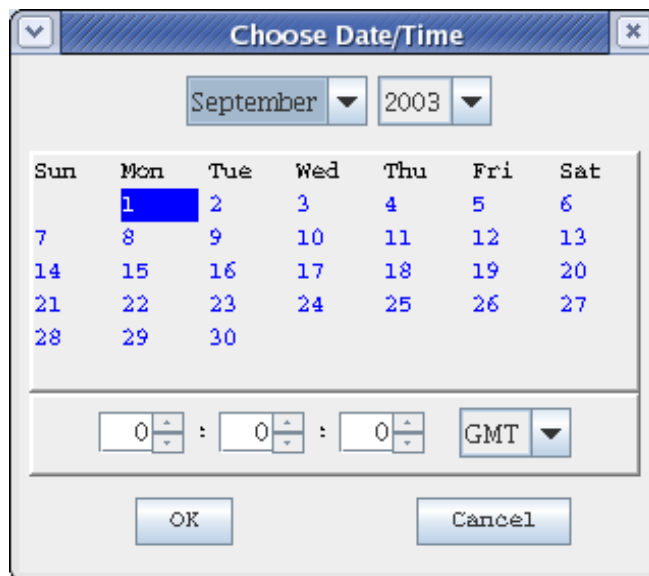
### 10.1 Specifying a Date

The date is chosen as follows:

1. Select a month from the **Month** choice box.
2. Select a year from the **Year** choice box.
3. Click on the desired day of the month.
4. Specify the hour in the **Hour** spinner either manually or by using the up and down arrows.
5. Specify the minute in the **Minute** spinner.
6. Specify the second in the **Second** spinner.
7. Select a time zone in the **Time Zone** choice box.
8. Click **OK**.

### 10.2 Buttons

- **OK** button: Closes the window and updates the corresponding date text field in the **Verification Group Manager**.
- **Cancel** button: Closes the window with no change in the **Verification Group Manager**.



## 11.0 Choose Relative Date/Time Window

The **Choose Relative Data/Time Window** is used to specify a date relative to the current time. It is a string of this format:

\* <+/-> <quantity> <unit> <quantity> <unit>...

where <quantity> is a positive integer and <unit> is “weeks”, “days”, or “hours”. For example, “\* - 2weeks” is valid, and is equal to “\* - 14 days” or “\* - 1 weeks 7 days” or “\* - 1weeks 6 days 24 hours”.

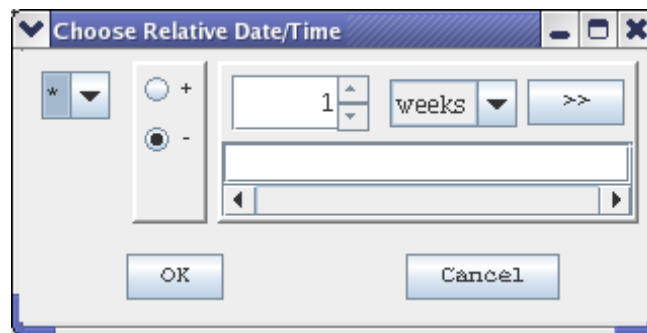
### 11.1 Specifying a Relative Date

A relative date is chosen as follows:

1. Select either the **Plus (+) Radio** button or the **Minus (-) Radio** button.
2. Enter the quantity to use into the **Quantity Text Field** either manually or by using the spinner arrows (up to increase, down to decrease).
3. From the **Unit** choice box, select the unit to use.
4. Click on the >> button. The quantity and unit will enter into the **Value** text field.
5. Repeat steps 2 and 3 until the relative date/time is completely specified.
6. Click on **OK**.

### 11.2 Buttons

- **OK** button: Closes the window and updates the corresponding date text field in the **Verification Group Manager**.
- **Cancel** button: Closes the window with no change in the **Verification Group Manager**.



## 12.0 Select FCST\_TS Window

The **Select FCST\_TS Window** allows the user to select type sources to include from a list of type sources, or select "ALL" if all items are to be used or "ALL\_BUT\_PERSIST" if all type sources are to be included except persistence forecasts, "FR". To select a type source for use, click on the desired type source in the list. To deselect the item, click on the selected item again. When finished, the user must click **OK** to accept the list or **Cancel** to return without accepting the list.

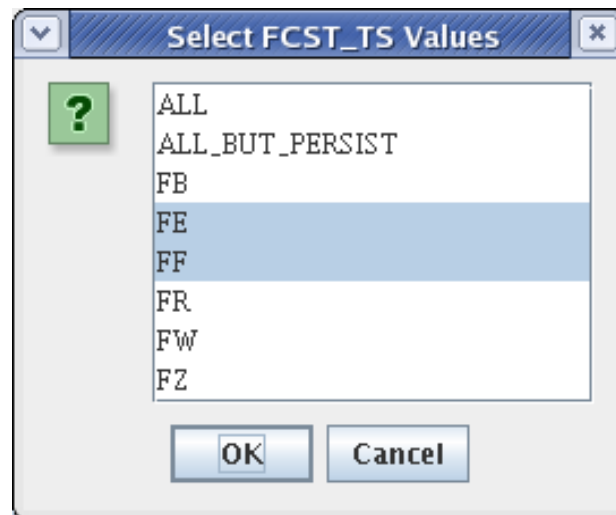
*NOTE: The type source 'FR' is for persistence forecasts, and must be selected for persistence forecasts to be included in the analysis.*

### 12.1 Similar Windows

Other windows within the IVP software use the same basic frame work as the **Select FCST\_TS Window**, but the list varies. These include the following windows that can be spawned from the **Verification Location Manager** and the **IVP Batch Creation Wizard's Location Restriction Window**: the **Select PE Window**, **Select DUR Window**, **Select EXTREMUM Window**, **Select FCST\_TS Window**, and **Select Missing Window (Verification Location Manager, only)**. See Sections 13.0 and 23.3.2 for more details.

### 12.2 Buttons

- **OK** button: Closes the window and updates the corresponding date text field in the **Verification Group Manager**.
- **Cancel** button: Closes the window with no change in the **Verification Group Manager**.



## 13.0 Verification Location Manager

The **Verification Location Manager** provides tools to manage the list of verification locations that are to be included in the verification group. A verification location is uniquely identified by a location id (lid from the IHFS and archive databases) and the SHEF code components: physical element, duration, extremum, and forecast type source. A verification location also has the following components:

- Response time (“SLOW”, “MEDIUM”, or “FAST”): specifies the river response time.
- Active flag (“Y” or “N”): specifies if the location is active.
- National flag (“Y” or “N”): specifies if the location is part of the national program.
- Observation type (“RAW” or “PROC”): specifies the table accessed to acquire pairs for verification: vfyppairs or vfyprocpairs, respectively.
- Critical stages and flows: values found in the rivercrit table of the archive data.
- Categories for both the observed and forecast value: used to compute statistics conditional on the category into which the pairs belong.

The active flag and national flag are defined in the vfyruninfo table by using the Vfyruninfo Editor (see the *Vfyruninfo Editor User's Manual*). There are three components of the **Verification Location Manager**:

- **Filter Panel**
- **Available Locations Table**
- **Chosen Locations Table**

Each of these components is described below.

### 13.1 Terminology

These terms must be defined in order to describe the **Verification Location Manager**:

- *selected location*: a selected location is a verification location that is currently selected from a table by clicking on the location's row. Selected locations are highlighted in blue.
- *chosen location*: A chosen location is a verification location that is chosen to be displayed in the **IVP Data Display**. A location is chosen by first selecting the row from the **Available Locations Table** and then clicking on **Choose**. Chosen locations are displayed in the **Chosen Locations Table** and are highlighted in pink and red.

*NOTE: Verification locations must be chosen in order for the **Create Display** button of the **Verification Group Manager** to build the **IVP Data Display**. All chosen locations **MUST** have the same number of observed categories and the same number of forecast categories. Furthermore, each must be of the same data type: height, discharge, temperature, or precipitation. If either of these conditions is not satisfied, the display will not be created.*

### 13.2 The Available Locations Table

The **Available Locations Table**, the upper table in the window, provides the verification locations defined in the vfyruninfo table that have not yet been chosen for display. By default, the rows have gray and white backgrounds, though this can be changed via the System Settings File (see Appendix A). Each row of the table lists the following attributes of a verification location:

Locations Available for Display														Reset Filter	Select All	Select None
ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type	
Y	N	ABR	TA	I	N	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ABR	TA	I	N	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ABR	TA	I	N	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ABR	TA	I	X	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ABR	TA	I	X	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ABR	TA	I	X	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	ACMP1	HP	I	Z	FF	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,MAX	MIN,MAX	RAW	
Y	N	ACMP1	HP	I	Z	FR	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,MAX	MIN,MAX	RAW	
Y	N	ALNP1	HG	I	Z	FE	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW	
Y	N	ALNP1	HG	I	Z	FF	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW	
Y	N	ALNP1	HG	I	Z	FR	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW	
Y	N	AROC2	TA	I	N	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	AROC2	TA	I	N	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	
Y	N	AROC2	TA	I	N	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW	

- ac: ‘Y’ if the verification location is active, ‘N’ if not.
- na: ‘Y’ if the location is part of the national program, ‘N’ if not.
- location: The 8-character (maximum) identifier for a location. Often called the lid in the IHFS and archive databases.
- pe: The 2-character SHEF physical element code.
- dur: The 1-character SHEF duration code.
- ext: The 1-character SHEF extremum code.
- ts: The 2-character SHEF forecast type source code.
- response: The river response time.
- as/f: The action stage (for height data) or flow (for discharge data) critical value, defined for this location in the rivercrit table. If the data type is stage or discharge but this critical value is not defined, it will be -999.0. If the data type is neither stage nor discharge, then it will be “-”.
- fs/f: The flood stage (for height data) or flow (for discharge data) critical value, defined for this location in the rivercrit table. See “as/f”.
- modfs/f: The moderate flood stage (for height data) or flow (for discharge data) critical value, defined for this location in the rivercrit table. See “as/f”.
- majfs/f: The major flood stage (for height data) or flow (for discharge data) critical value, defined for this location in the rivercrit table. See “as/f”.
- rs/f: The record stage (for height data) or flow (for discharge data) critical value, defined for this location in the rivercrit table. See “as/f”.
- Forecast Category: The string defining the categories for the forecast value. This field can be edited via the **Forecast Category Editor** window.
- Observed Category: The string defining the categories for the observed value. This field can be edited via the **Observed Category Editor** window.
- obs type: The table from which pairs are drawn for the location: “RAW” implies the vfypairs table; “PROC” implies the vfyprocpairs table. This field can be specified by clicking on the **Edit Obs Type** button.

Within the table, locations are selected by clicking on the corresponding row. Multiple locations can be selected by clicking and dragging, or by using the <ctrl> and <shift> buttons while clicking. A selected location can be deselected by pressing <ctrl> while clicking on its corresponding row. The **Reset Filter**, **Select All**, and **Select None** buttons associated with this table only affect this table (and the filter).

### 13.3 Filter Panel

Filter

PE:   Dur:   Ext:   TS:   Crit Vals:

The **Filter Panel** is located above the **Available Locations Table** and provides tools for removing locations from that table based on the pe, dur, ext, and ts columns, and based on if the critical values for a row are missing (-999.0 or '-'). There are five text fields in the panel: **PE**, **Dur**, **Ext**, **TS**, and **Critical Values**. Rows are filtered out from the table by doing one of the following:

- Enter text into the text field and press <Enter>. No rows will be removed until <Enter> is pressed. The text fields must be comma delimited lists of acceptable values.
- Click on the corresponding **Select** button, which spawns a window similar to the **Select FCST\_TS Window** (see Section 12.0), select items from the list, and click **OK**.

Whenever either method above is used to change the text field values for any of the four text fields, only those rows matching the conditions set in *all* of the text fields will be included in the display.

*NOTE: The Filter Panel only applies to the Available Locations Table.*

### 13.4 The Chosen Locations Table

ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FR	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	JHNP1	HG	I	Z	FE	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	JHNP1	HG	I	Z	FF	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,8,MAX	MIN,MAX	RAW

The **Chosen Locations Table**, the lower table in the window, displays the verification locations chosen for display in the **IVP Data Display**. Each row of the table lists the same attributes of a verification location as are listed in the **Available Locations Table**. By default, the rows have background colors of pink and red, though this can be changed via the System Settings File (see Appendix A). The **Select All** and **Select None** buttons associated with this table only affect this table.

### 13.5 Sorting the Rows

To sort the rows of a table by a given column, just click on the header for that column. For example, to sort alphabetically by location id, click on the “location” column header. The first time the table is sorted by a particular column, the sort will be in ascending order. The second time, it will be in descending order. After that, the sort order will continue to alternate between ascending and descending.

### 13.6 Buttons

- **PE Select** button: Opens up a **Select PE Window** to allow selecting acceptable values for the pe column of the table. Clicking on **OK** within the window will result the corresponding text field being updated and rows being selected based on the **Filter Panel**.
- **Dur Select** button: Opens up a **Select DUR Window** to allow selecting acceptable values for the dur column of the table.
- **Ext Select** button: Opens up a **Select EXTREMUM Window** to allow selecting acceptable values for the ext column of the table.

- **TS Select** button: Opens up a **Select FCST\_TS Window** to allow selecting acceptable values for the ts column of the table.
- **Critical Values Select** button: Opens up a **Select Missing Window** to allow selecting whether to include only rows with non-missing critical values.
- **Reset Filter** button: Reset the components of the **Filter Panel** to include all rows of the vfyruninfo table.
- **Select All** buttons: Selects all rows in the corresponding table.
- **Select None** buttons: Deselects all rows in the corresponding table.
- **Edit Obs Type** button: Opens up a dialog that allows the user to select an observation type for the selected rows within both tables. Upon clicking **OK** within the dialog, the obs type columns for all selected rows will be set, accordingly.
- **Edit Fcst Cat** button: Opens the **Forecast Category Editor** to allow for editing forecast categories for the selected locations in both tables.
- **Edit Obs Cat** button: Opens the **Observed Category Editor** to allow for editing forecast categories for the selected locations in both tables.
- **Choose** button: Chooses all currently selected locations in the **Available Locations Table** for display. After clicking, the selected rows will be removed from that table and inserted into the **Chosen Locations Table**, and all rows will be deselected.
- **Unchoose** button: Unchooses all currently selected rows in the **Chosen Locations Table**. After clicking, the selected rows will be removed from that table and inserted into the **Available Locations Table**, and all rows will be deselected.
- **Unchoose All** button: Unchooses all rows in the **Chosen Locations Table**. After clicking, the rows will be removed from that table and inserted into the **Available Locations Table**.
- **Close** button: Closes the **Verification Location Manager** window.

**Verification Location Manager**

Available Locations

Filter

PE: ALL Select Dur: ALL Select Ext: ALL Select TS: ALL Select Crit Vals: Any Select

Locations Available for Display

ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	ABR	TA	I	N	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ABR	TA	I	N	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ABR	TA	I	N	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ABR	TA	I	X	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ABR	TA	I	X	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ABR	TA	I	X	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	ACMP1	HP	I	Z	FF	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,MAX	MIN,MAX	RAW
Y	N	ACMP1	HP	I	Z	FR	MEDIUM	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,MAX	MIN,MAX	RAW
Y	N	ALNP1	HG	I	Z	FE	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW
Y	N	ALNP1	HG	I	Z	FF	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW
Y	N	ALNP1	HG	I	Z	FR	MEDIUM	0.0	8.0	10.0	12.0	11.6	MIN,MAX	MIN,MAX	RAW
Y	N	AROC2	TA	I	N	FB	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	AROC2	TA	I	N	FR	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW
Y	N	AROC2	TA	I	N	FZ	MEDIUM	-	-	-	-	-	MIN,MAX	MIN,MAX	RAW

Reset Filter Select All Select None

▼ Choose ▲ Unchoose ▲▲ Unchoose All ▲▲ Edit Obs Type Edit Fcst Category Edit Obs Category

Chosen Locations

Locations Chosen for Display

ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FE	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FF	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	ELRP1	HG	I	Z	FR	FAST	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	JHNP1	HG	I	Z	FE	MEDIUM	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW
Y	N	JHNP1	HG	I	Z	FF	MEDIUM	999.0	999.0	999.0	999.0	999.0	MIN,6,8,MAX	MIN,MAX	RAW

Select All Select None

Close



## 14.0 Observed and Forecast Category Editor

The **Observed Category Editor** and **Forecast Category Editor** are used to specify categories for verification locations. The categories are defined by a comma delimited list, where each delimited item is a boundary string specifying a boundary of a category. A boundary string must one of the following:

- MIN: -INFINITY (no lower bound)
- MAX: INFINITY (no upper bound)
- <absolute number>: Any fixed number (i.e. for stage data, 6 means 6 feet)
- <scalar>\*<stage/flow>: A multiple of one of the critical stages/flows associated with a verification location. The scalar can be any fixed number. The stage must be one of AS (AF) for the action stage (flow); FS (FF) for the flood stage (flow); ModFS (ModFF) for the moderate flood stage (flow); MaJFS (MaJFF) for the major flood stage (flow); and RS (RF) for the record stage (flow).

For example, the following string defines two categories: above flood stage and below flood stage:

```
"MIN, 1*FS, MAX"
```

The following defines three categories: below flood stage, between flood stage and 12 ft (assuming the data's units is in feet), and above 12 ft:

```
"MIN, 1*FS, 12, MAX"
```

*NOTE: The category boundaries are sorted into ascending order when determining the categories, implying that the order of boundary strings within the category string does not matter. So, in the second example above, if 12 were less than the flood stage for a location, the middle category would include stages larger than 12 ft and less than the flood stage.*

### 14.1 Boundary List

The **Boundary List** lists the currently specified boundary strings defining the category string. It is a list of strings on the right-hand side of the window above the **Delete** button with one boundary string per line. List items can be selected by clicking on them and deselected by clicking on them a second time.

### 14.2 Specifying a Boundary String

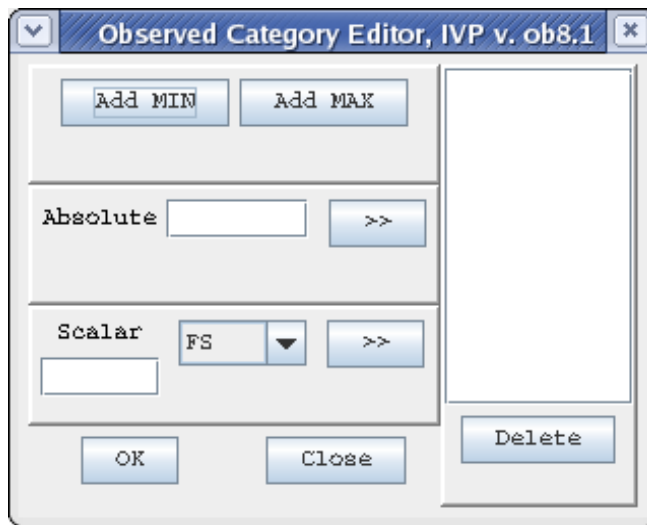
A boundary string is constructed by doing the following:

1. Select the locations to which you wish to apply these categories.
2. Click on the **MIN** button if one of the categories is to have no lower bound.
3. Click on the **MAX** button if one of the categories is to have no upper bound.
4. For each absolute number that defines a boundary, type the number into the **Absolute** text field and click on the **Absolute >>** button (the >> button next to the **Absolute** text field).
5. For each multiple of a stage that defines a boundary, type the scalar into the **Scalar** text field, select the stage from the **Stage** choice box, and click on the **Scalar >>** button (the >> button next to the **Stage** choice box).
6. Click on **OK** to make the changes to the **Verification Location Manager**.

After clicking on the **OK** button, the **Boundary List** will be turned into a comma delimited string and displayed in the appropriate column of the **Location Table**. The **Category Editor** window will also close.

### 14.3 Buttons

- **Add MIN** button: Adds the MIN string to **Boundary List**.
- **Add MAX** button: Adds the MAX string to the **Boundary List**.
- **Absolute >>** button: Adds an <absolute number> to the **Boundary List**. This is the >> button next to the **Absolute** text field.
- **Scalar >>** button: Adds a <scalar>\*<stage/flow> to the **Boundary List**. This is the >> button next to the **Scalar** choice box.
- **Delete** button: Removes the currently selected boundary strings from the **Boundary List**.
- **OK** button: Converts the **Boundary List** into a comma delimited category string and inserts the category string into the appropriate column within the **Location Table** for the currently selected locations. Also closes the window.
- **Close** button: Closes the window. Upon opening the window again, the **Boundary List** displayed upon last closing the window will again be visible.



## 15.0 IVP Data Display

The **IVP Data Display** graphically displays the forecast-observed data pairs specified by the parameters in the **Verification Group Manager** and locations chosen in the **Verification Location Manager**. Two views are available within the IVP Data Display:

- **Scatter View:** A plot of the forecast on the y-axis against the observation on the x-axis.
- **Time Series View:** A plot of the forecast on the y-axis against the forecast valid time on the x-axis. The points that make up a single time series (i.e. where all the points are for the same verification location and have the same basis or issuance time) are connected by a line.

Any data pair that will be included in the verification computations are shown in a plot. Additionally, any data pair that would have been used but cannot because it is considered 'bad' are also shown.

In either view, provided to the right of the plot is the **List Panel**, which enables the user to interact with the plot. The **List Panels** will be described in the sections pertaining to each view.

Also provided in either view is a **Navigator Panel**, which is a miniaturized version of the chart that displays the portion of the overall chart that is currently being viewed within the plot. The **Navigator Panel** is described below.

By default, the title of the plot provides the RFC name associated with the locations, the overall analysis interval, the overall lead time interval, and the currently selected location name and identifier. Also, by default, a faded NOAA logo watermark will be displayed as the background of the chart.

Associated with each view of the **IVP Data Display** chart are chart properties, which include the title, axis labels, legend, fonts, etc. These properties can be customized independently for each view via the **Chart Properties Manager**.

### 15.1 Scatter View

The **Scatter View** displays a plot of the forecast value on the y-axis against the observation on the x-axis. The scatter points are broken down into four types in the display:

1. Selected Pairs: The 'good' pairs for the location selected from the **Locations Lists Panel**. These are shown as blue dots.
2. Selected Bad Pairs: The 'bad' pairs for the location selected from the **Locations List Panel**. These are shown as dark gray x's.
3. All Pairs: All good pairs for locations not selected. These are shown as red dots.
4. Bad Pairs: All bad pairs for locations not selected. These are shown as light gray x's.

#### LOCATIONS

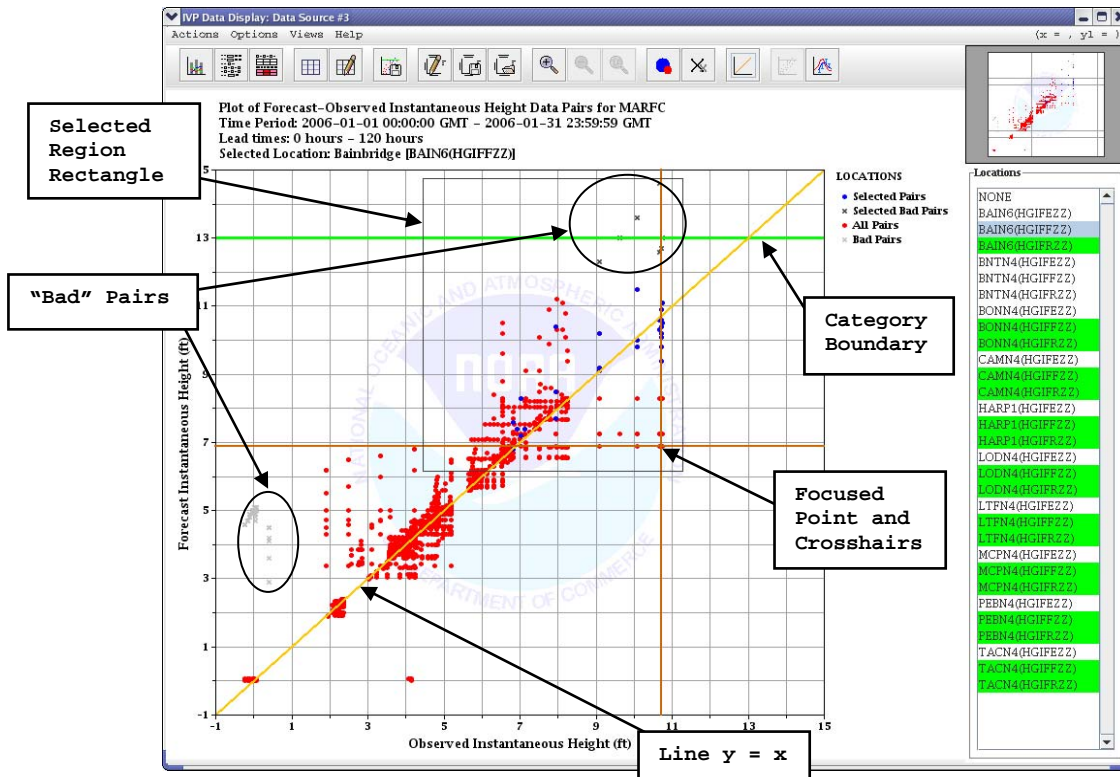
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs

All colors can be adjusted in the **Chart Property Manager**. The default colors, pixel sizes, and symbols for the points can be set in the System Settings File (see Appendix A).

#### 15.1.1 Locations List Panel

The **Locations List Panel** (see the screenshot) is displayed to the right of the scatter plot and lists all verification locations in the group, with each identified by its location id and SHEF code. By left-clicking

to select one location in the list, that location will be highlighted and its categories will be drawn as green lines. The color of the categories can be changed in the System Settings File (see Appendix A).



## 15.2 Time Series View

The **Time Series View** displays a plot of the forecast or observed value on the y-axis against the forecast valid time or observation observed time on the x-axis. The points that make up a single forecast time series are connected by a line, and the colors used for the time series rotate among the default colors. Optionally, the time series plot can also include a plot of the observed values for the selected location and observation SHEF type source code. The observed points will not be connected by a line.

### 15.2.1 Time Series List Panel

The **Time Series List Panel** (see the screenshot on the next page) is displayed to the right of the time series plot and provides the following selectable lists:

- **Location List:** List of locations, similar to what is displayed in the **Locations List Panel** for the **Scatter View**. Only one location can be selected at a time.
- **Issuance Times List:** List of available issuance, or basis, times for the currently selected location in the format “CCYY-MM-DD hh:mm:ss” (GMT is assumed). Each combination of location and basis time identifies one specific forecast time series. Multiple selections can be made.
- **Observed Type Source List:** List of available observation type sources. Each combination of location and type source defines one observed time series. The observed values are loaded based on the forecast time series available to display for the selected location, and include data from 24 hours before the overall earliest basis time to 24 hours after the overall latest valid time.

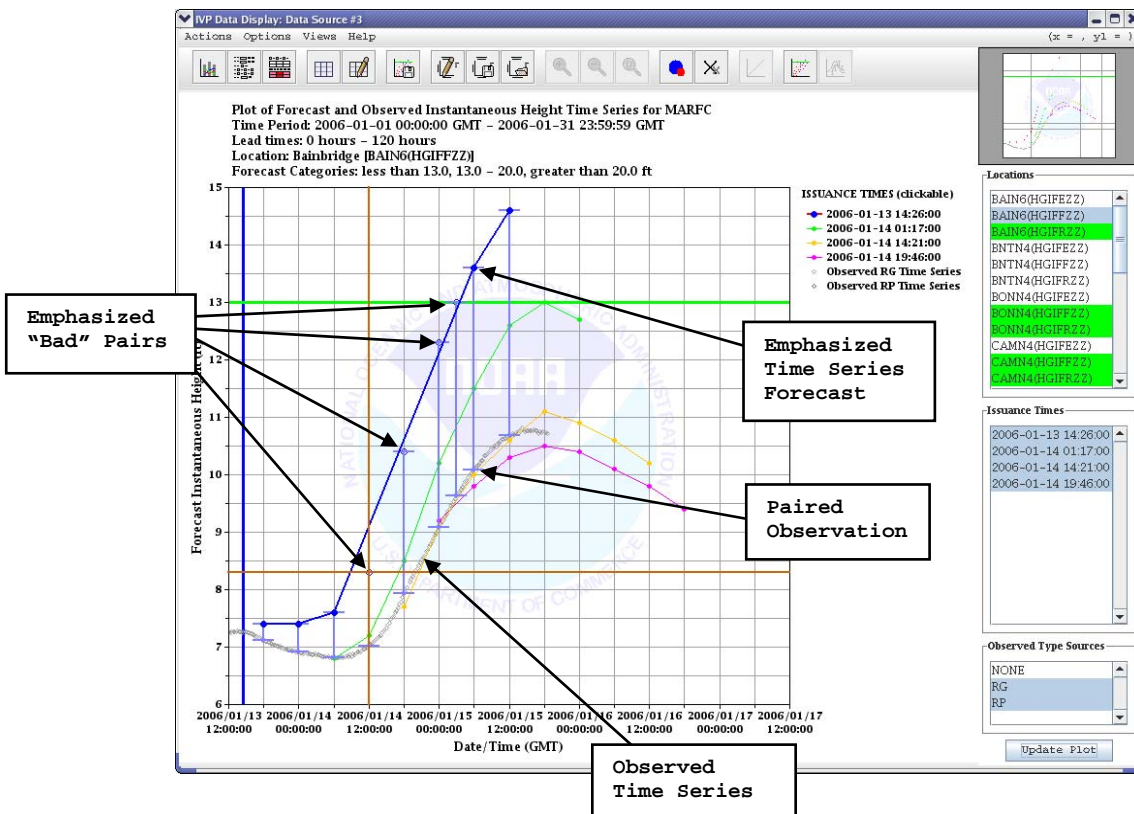
When a location, issuance time, and observed type source are chosen, and the **Update Plot** button is clicked, the **Time Series View** will change to display the chosen forecast and observed time series. Furthermore, the forecast categories for the selected location will be drawn as horizontal green lines. Any 'bad' pairs available for each time series will be displayed as an unfilled circle (unfilled diamond for observations) in the same color as the associated time series and will not be connected to the rest of the time series via a line. The default color of the category lines and the width of the **Time Series List Panel** can be set in the System Settings File (see Appendix A).

### 15.2.2 Emphasized Time Series

A time series can be emphasized, or focused on, by left-clicking on the corresponding entry in the plot legend. When emphasized, the following happens:

- The time series scatter point and line colors change to dark blue.
- The symbol size doubles.
- The observed value paired with each forecast value in the time series is drawn as a light blue diamond and connected to the forecast via light blue whiskers (of a Box-Whisker diagram).
- The basis time for the emphasized time series is shown as a vertical blue line.

Use the mouse wheel, or the number pad +/- keys, to move up or down within the legend. To deemphasize all layers, right click anywhere within the legend. If the observed values for the emphasized layer do not appear to match those displayed via the **Observed Type Sources** list, then view the location information (see Section 15.8) to see if the vaddadjust table adjustment factors are affecting the pairs' observed values. The observed time series data displayed are directly drawn from the database; no adjustment factors are applied to the observed data. The default colors, above, can be set in the System Settings File (see Appendix A).

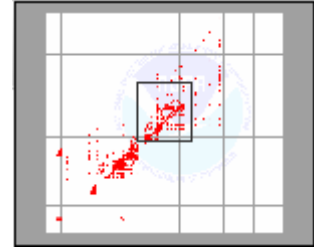


### 15.3 Data Tracker

The **Data Tracker** displays the coordinates in the right side of the window menu bar. When the mouse pointer passes over the plot and the mouse pointer changes to crosshairs, the **Data Tracker** displays the values currently pointed to by the mouse pointer.

### 15.4 Navigator Panel

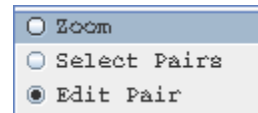
The **Navigator Panel** is provided in the upper right corner of the window and displays a miniature version of the original plot; i.e. the plot as it would be viewed before zooming, emphasizing time series, or chart property changes. Drawn on the miniature image is a black rectangle that shows the currently viewed portion of the plot. If the whole plot is being viewed, then the black rectangle will be the size of the entire miniature chart. When zoomed in, the **Navigator Panel** can be used to move the zoomed region as follows:



- Click or click-and-drag in the miniature chart to move the box. When the mouse button is released, the chart will re-center based on the new box drawn within the miniature chart.
- Click within the **Navigator Panel** but outside of the miniature chart (i.e. in the gray region) to shift the zoomed region. Click to the right of the miniature chart to shift the region to the right; click above to shift the region up, etc.

### 15.5 Mouse Mode Pop-up Menu

The **Mouse Mode Pop-up Menu** can be opened by right clicking within the plot area bounded by the axes. It displays the current mouse mode and allows the user to switch modes. The default is **Zoom** mode, and when selected, the user can zoom as per Section 15.7 (below). **Select Pairs** mode can only be chosen while either the **Verification Pairs Data Viewer** or **Verification Pairs Data Editor** is open, and allows for selecting pairs to be viewed or edited (see Sections 16.0 and 17.0). **Edit Pair** mode can only be chosen while the **Verification Pairs Data Editor** is open and one of the two checkboxes within that window are checked (see Section 17.0), and allows for graphically editing a pair.



### 15.6 Drawing a Selected Region Rectangle

When the **Verification Pairs Data Editor** is not in graphical editing mode, signified when the mouse cursor is crosshairs, a rectangle can be drawn on the **IVP Data Display** plot by placing the mouse cursor at one corner of the rectangle, pressing and holding the mouse button, moving the mouse to the opposite corner, and releasing the button. The rectangle will be redrawn as the region changes while the mouse is moving. Also, the **Data Tracker** will change format to show the two defining corners of the rectangle being drawn. Left click within the plot area to clear the selected region rectangle.

### 15.7 Zooming In and Out

This can only be done when the mouse is in **Zoom** mode (Section 15.5). To zoom in on a region, select a region (Section 15.6) and click on **Options >> Zoom In**. The plot will be redrawn to show only the selected region. Draw a rectangle and click on **Options >> Zoom In**, again, if you want to zoom in further on the plot. Click on **Options >> Zoom Out** to zoom out to the previous zoom level. Click on **Options >> Zoom Out** repeatedly to zoom all the way out to the original view of the plot, or click on

**Options >> No Zoom.** The **Options >> Zoom Out** and **Options >> No Zoom** menu items will be enabled whenever the current zoom level is not the original zoom level. Right click on a point in the plot area if you want to re-center the zoomed region about that point. Use the keyboard number pad to shift the zoomed region (e.g. press 1 to shift down and left, 2 to shift down, etc).

*NOTE: Zooming in and out can also be done by changing the axis limits in the **Chart Properties Manager**.*

*NOTE: The **Navigator Panel** is updated whenever a zoomed region is updated.*

## ***15.8 Displaying Information About A Location***

By right clicking in the **Locations List** of either view and clicking on **View Selected Location Info** in the menu that pops up, a window will pop-up displaying information about the currently selected location, including vfyruninfo table settings, the location table record of the archive database, and, for the time series view, the corresponding adjustment factors found in the vaddadjust table of the archive database for all currently selected observation type sources in the **Observed Type Sources** list.

## ***15.9 Focus Point Crosshairs***

Whenever one row is selected within the active table of the **Verification Pairs Data Editor** window, it is pinpointed in either view of **IVP Data Display** by brown crosshairs. The color of the cross hairs can be controlled via the System Settings File (see Appendix A).

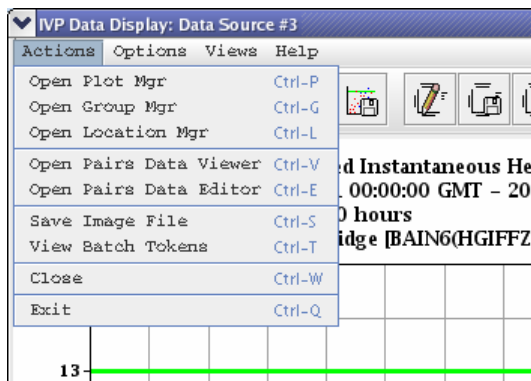
## ***15.10 Editing Point Crosshairs***

Whenever the mouse is in **Edit Pair** mode (Section 15.5), signified when the mouse cursor is a hand, editing crosshairs are drawn on the plot by pressing and holding the left mouse button when the pointer is over the plot. Black thin crosshairs and a small circle will be drawn that pinpoint where the new value will be placed on the plot once the mouse button is released. Also, the **Data Tracker** will change format to show the original point value and the new point value as the editing point crosshairs move. When the mouse button is released, the plot will be updated and the focus point crosshairs will change to the new point.

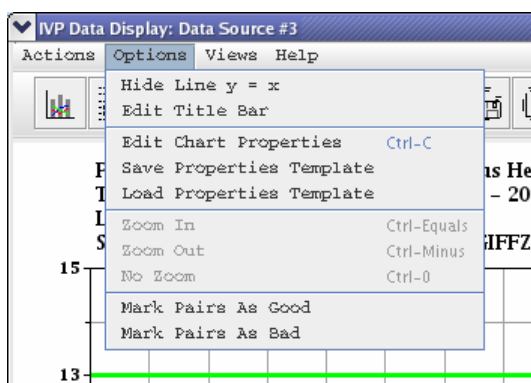
See Section 17.0 for more information about the **Verification Pairs Data Editor**.

## ***15.11 Menu Items and Toolbar Tools***

Most menu items within the menus of the **IVP Data Display** have corresponding toolbar tool that, when clicked, results in the same action as when the menu item is selected. For each menu item below, a picture of its corresponding toolbar tool is provided to the right.



- **Actions >> Open Plot Mgr** menu item: Opens up the **Verification Plot Definition Manager**.
- **Actions >> Open Group Mgr** menu item: Opens up the **Verification Group Manager**.
- **Actions >> Open Location Mgr** menu item: Opens up the **Verification Location Manager**.
- **Actions >> Open Pairs Data Viewer** menu item: Opens up the **Verification Pairs Data Viewer** and switches the mouse to **Select Pairs** mode.
- **Actions >> Open Pairs Data Editor** menu item: Opens up the **Verification Pairs Data Editor** and switches the mouse to **Select Pairs** mode.
- **Actions >> View Batch Tokens** menu item: Opens up a dialog which displays the batch tokens which would define the locations and group for which data is being displayed in this window within the IVP Batch Program.
- **Actions >> Save Image File** menu item: Open up a file browser to allow the user to select a jpeg or png file name to which to save the image. If the file name does not end in either a “.jpg” or “.jpeg” extension for JPEG images, or a “.png” extension for PNG images, then the file type will be unrecognized and no image will be saved.
- **Actions >> Close** menu item: Close the **IVP Data Display** window.
- **Actions >> Exit** menu item: Exit the IVP program.

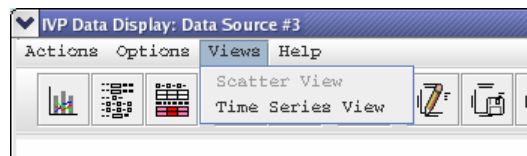


- **Options >> Show line y=x (Hide line y=x)** menu item: Draws the line  $y = x$  (i.e. forecast = observation) on the plot. The line will be orange.
- **Options >> Edit Chart Properties** menu item: Opens up the **Chart Properties Manager** for this chart and makes it active, enabling a user to change the properties of this chart. It can also be opened by clicking on the component of the plot to be edited. See Section 24.0 for more information on the **Chart Properties Manager**.

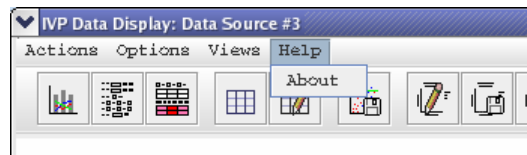




- **Options >> Save Properties Template** menu item: Opens up a file browser to save the current chart properties for this chart to a template file.
- **Options >> Load Properties Template** menu item: Opens up a file browser to select a template file and apply the settings to the chart properties for this chart.
- **Options >> Zoom In** menu item: Zooms in on a selected region of the plot. See Section 15.7, above.
- **Options >> Zoom Out** menu item: Zooms out to the previous zoom level. See Section 15.7, above.
- **Options >> No Zoom** menu item: Zooms out to the original view of the plot. See Section 15.7, above.
- **Options >> Mark Pairs As Good** menu item: Marks all pairs within the selected region of the plot as good. This will perform exactly as if the **Mark As Good** button of the **Verification Pairs Data Editor** had been clicked for all pairs within the selected region.
- **Options >> Mark Pairs As Bad** menu item: Marks all pairs within the selected region of the plot as bad. This will perform exactly as if the **Mark As Bad** button of the **Verification Pairs Data Editor** had been clicked for all pairs within the selected region.



- **Views >> Scatter View** menu item: Switches from the **Time Series View** to the **Scatter View**.
- **Views >> Time Series View** menu item: Switches from the **Scatter View** to the **Time Series View**. The first time this is clicked, a **Loading Observed Data for Time Series View** progress window will pop up, showing the progress of the software as it loads the observations for each location from the archive database.



- **Help >> About** menu item: Opens up a dialog summarizing version information.

## 16.0 Verification Pairs Data Viewer

The **Verification Pairs Data Viewer** shows the forecast-observed pairs currently displayed and visible in the **IVP Data Display** within a table. All rows that can be viewed in the current **IVP Data Display** view, if the zoom is out far enough, are shown.

Each row corresponds to a record of the `vfypairs` table in the archive database. Each field of the record is displayed as a column of the table in the **Verification Pairs Data Viewer**. The columns are:

- Index: The original row number. After sorting the table, the original ordering of the rows can be reacquired by sorting by the index column.
- Vis: If the point displayed on the row is currently visible in the **IVP Data Display** plot and within any drawn rectangle, then this column value will be 'Y'. Otherwise, the value will be 'N'.
- location: 8-character location id
- pe: physical element (SHEF `PEdtsep`)
- dur: duration (SHEF `peDtsep`)
- idur: integer representation of the duration
- fts: forecast type source (SHEF `pedTSep`)
- e: extremum (SHEF `pedtsEp`)
- p: probability (SHEF `pedtseP`)
- validtime: forecast valid time
- basistime: forecast basis time
- ots: observation type source (SHEF `pedTSep`)
- obstime: observed time
- fcst: forecast value (for stage data, the unit is feet)
- obs: observed value
- quality code: the integer quality code stored with the forecast value

*NOTE: The **Verification Pairs Data Viewer** table can be slow to update and draw for large sample sizes. If this window is slow, then do not use it. Instead use the **Verification Pairs Data Editor** to view selected pairs.*

### 16.1 Sorting the Rows

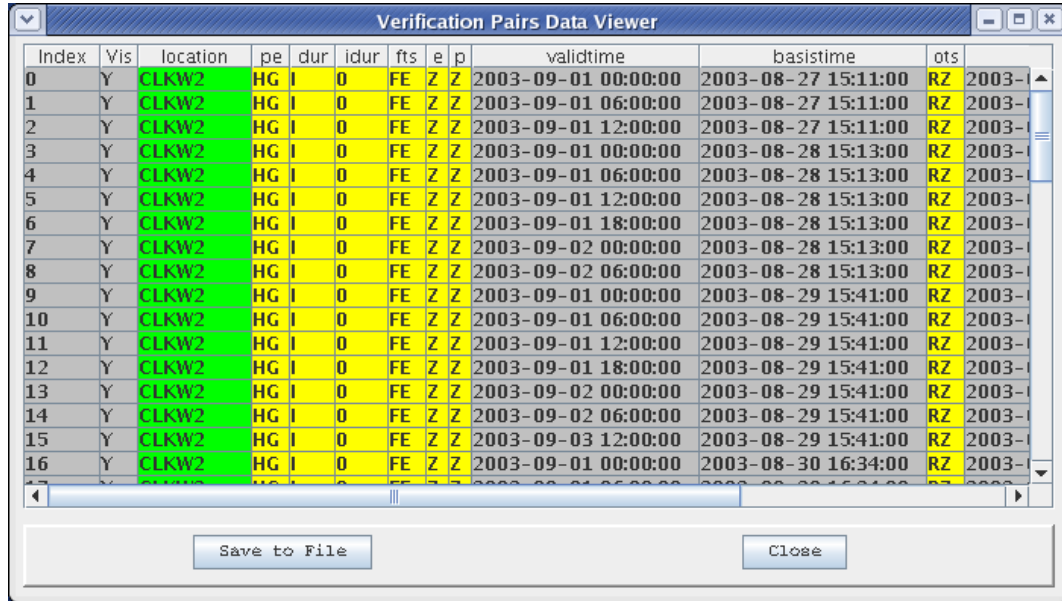
To sort the table by a given column, just click on the header for that column. For example, to sort alphabetically by location, click on the "location" column header. By default, the columns are sorted into ascending order. The first time the table is sorted by a particular column, the sort will be in descending order. The second time, it will be in ascending order. After that, the sort order will continue to alternate between descending and ascending. To retrieve the original order of the rows, sort the rows by the "Index" column.

### 16.2 Visible and Selected Rows

Rows that are displayed in colors, including yellow, green, and gray, correspond to rows that are (1) visible in the current plot of the **IVP Data Display**, and (2) if a rectangle is drawn on the plot, are within the rectangle. All visible rows that are in color have a Vis column value of 'Y', while all rows that are not in color have an 'N'. To focus on visible or non-visible rows, sort the table by the Vis column. Whenever the user draws a rectangle on the plot or zooms-in/out, the visible status of the rows are recalculated.

### 16.3 Buttons

- **Save to File** button: Opens up a file browser to allow the user to select the file to which to save the data within this table. The format of the file will be that of a pairs file (see the *IVP Batch Program User's Manual for Verification*).
- **Close** button: Close the **Verification Pairs Data Manager**.



## 17.0 Verification Pairs Data Editor

The **Verification Pairs Data Editor** allows for editing the forecast value, observed value, or quality for selected pairs of the **IVP Data Display**. The window displays two tables, a **Quality Panel**, a **Values Panel**, and buttons that allow for updating the plot and/or database.

*NOTE: The data visible in the **IVP Data Display** are used to compute statistics for any **IVP Statistics Display** generated using the same data source. So, for any changes made to data via the **Verification Pairs Data Editor** to affect computed statistics, they must be updated to the plot. Other sessions of IVP or the IVP Batch Program will not see the changes until the changes are saved to the database by clicking on **Update Database** and the other session's data is reloaded to acquire the changes.*

### 17.1 The Tables

Selected Data		Changed and Unsaved Data													
in plot	in db	location	pe	dur	idur	fts	e	p	validtime	basistime	ots	obstime	fcst	obs	quality
Y	Y	CLKW2	HG	I	0	FE	Z	Z	2003-09-03 18:00:00	2003-09-02 17:17:00	RZ	2003-09-04 11:00:00	8.1	5.25	good
Y	N	CLKW2	HG	I	0	FE	Z	Z	2003-09-04 00:00:00	2003-09-02 17:17:00	RZ	2003-09-04 11:00:00	9.4	5.25	SAD
Y	N	CLKW2	HG	I	0	FE	Z	Z	2003-09-04 06:00:00	2003-09-02 17:17:00	RZ	2003-09-04 11:00:00	2.7	19.95	good
Y	N	CLKW2	HG	I	0	FE	Z	Z	2003-09-04 12:00:00	2003-09-02 17:17:00	RZ	2003-09-04 11:00:00	6.68	5.25	good
Y	Y	CLKW2	HG	I	0	FE	Z	Z	2003-09-04 18:00:00	2003-09-02 17:17:00	RZ	2003-09-04 11:00:00	7.3	5.25	good

Two tables are displayed in the **Verification Pairs Data Editor**: The **Selected Data** table and **Changed and Unsaved Data** table. Both tables are of the same format as the **Verification Pairs Data Viewer**, except that cell background colors differ and the Index and Vis columns are replaced by the following:

- in plot: If 'Y' (and with a yellow background), then the corresponding pair displayed in the table matches that currently shown within the **IVP Data Display** plot. If 'N' (and with a red background), then it does not match. Click on **Update Plot** to update the plot for any changes made.
- in db: If 'Y' (and with a yellow background), then the pair matches the pair stored in the archive database. If 'N' (and with a red background), then any modifications to the pair have not yet been saved to the database. The column values that differ from those in the database will have a red background. Click on **Update Database** to update the pair within the database to match that shown in the table.

Only one of these two tables can be active at a time; click on the tabs to change the active table. The rows of the tables can be sorted by clicking on the column headers.

The **Selected Data** table displays pairs currently selected for editing. See Section 17.2 for how to select pairs for editing. The **Changed and Unsaved Data** table displays pairs that have been modified, but have either not been saved to the database or updated to the plot, and are not currently selected for editing. This table updates whenever new pairs are selected for editing.

### 17.2 Selecting Pairs for Editing

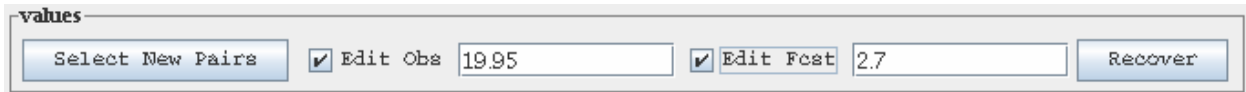
Pairs are selected by drawing a selected region rectangle on the plot within the **IVP Data Display** that includes the pairs while the mouse is in **Select Pairs** mode. See Sections 15.5 and 15.6.

### 17.3 Quality Panel



Pairs' quality codes can be changed by selecting (i.e., clicking on) the row(s) corresponding to the pairs and pressing either the **Mark as Good** or **Mark as Bad** buttons of the **Quality Panel**. When a pair's quality is changed, it will be immediately reflected in the table and in the plot (see Sections 15.1 and 15.2).

### 17.4 Values Panel



The **Edit Obs** and **Edit Fcst** checkboxes within the **Values Panel** control whether or not the corresponding pair's value can be modified. When checked, the corresponding text field is enabled and the user is able to modify the values. When unchecked, the corresponding text field is disabled and the value cannot be modified. The values in the text fields are changed whenever rows are selected from either of the two tables.

*NOTE: If the **Time Series View** is active in the **IVP Data Display**, then only one of the two checkboxes can be checked at any one time.*

*NOTE: When either checkbox is checked and one row in the active table is selected, the mouse in the will switch to **Edit Pair** mode within the **IVP Data Display**.*

### 17.5 Modifying the Forecast or Observed Value

There are two ways to modify the forecast and observed values:

- **Manual Editing:** If one or more rows are selected from the active table, the values can be modified manually by checking the corresponding checkbox and typing the value into the enabled text field. Press <Enter> after typing in the value or click on **Update Plot** to update the **IVP Data Display** to display the changed values.
- **Graphical Editing:** If one row is selected from the active table, the values can be modified graphically. Check on the checkbox for the data value to change and click or press-and-drag the new value in the plot of the **IVP Data Display**. This will result in editing point crosshairs being drawn in the plot of the **IVP Data Display** (see Section 15.9).

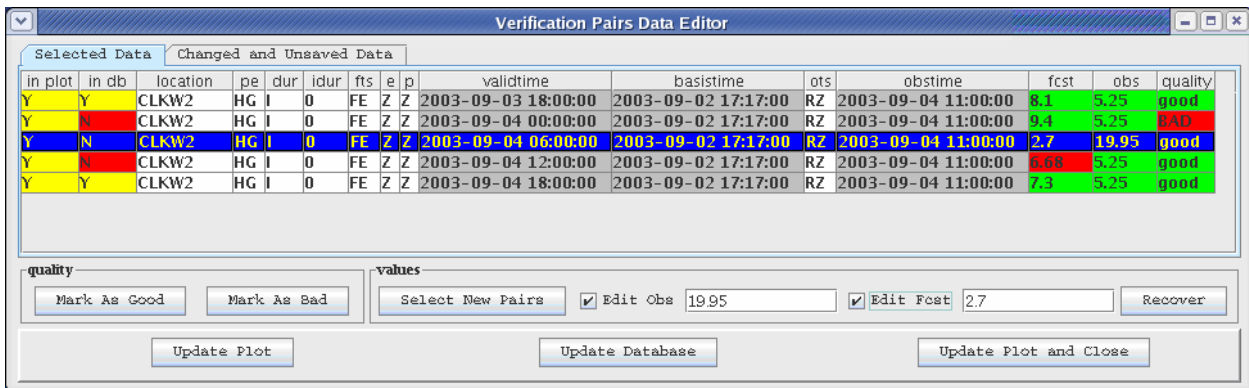
If only one row is selected from the active table, the **IVP Data Display** will be updated to show focus point crosshairs (see Section 15.9) that intersect at the point on the plot corresponding to the selected row. When the row's values are changed, the crosshairs will be updated accordingly.

While in graphical editing mode, the mouse cursor, when over the plot area, will be a hand. Otherwise, it will be crosshairs.

*NOTE: Values can only be edited graphically if the changed value can be seen within the current plot, given the view and zoom level. For example, in a **Time Series View**, if the valid time for the pair being edited is not within the x-axis limits, then the pair cannot be edited graphically since no matter what changes are made to the pair's observed and forecast values it will never be visible in the plot (the valid time will always be outside the x-axis limits).*

## 17.6 Buttons

- **Mark as Good** button: Makes the quality for all highlighted pairs (row) within the currently active table 'good' and updates the plot.
- **Mark as Bad** button: Makes the quality for all highlighted pairs (row) within the currently active table 'BAD' and updates the plot.
- **Select New Pairs** button: Unchecks the two **Edit Obs** and **Edit Fcst** checkboxes, allowing the user to draw a rectangle on the plot in the **IVP Data Display**, and select new pairs to edit.
- **Recover** button: Sets the obs, fcst, and quality column values to match those that were loaded from the database or most recently saved to the database.
- **Update Plot** button: Redraws the plot to reflect the pairs currently within the **Selected Data** and **Changed and Unsaved Data** tables that may have been updated manually.
- **Update Database** button: As **Update Plot**, but it also saves any changes within the **Selected Data** and **Changed and Unsaved Data** tables to the archive database, making the changes permanent, unless changed again.
- **Update Plot and Close** button: Updates the plot and closes the window. This will not save changes to the database!



## 18.0 Verification Plot Definition Manager

The **Verification Plot Definition Manager** provides tools to manage parameters defining a verification product displayed in an **IVP Statistic Display**. Parameters defining the plot include the following:

- *primary statistics*: statistics displayed against the left hand y-axis of the generated plot.
- *primary plot type*: the plot type of the primary statistics (line, scatter, or bar plot).
- *secondary statistics*: statistics displayed against the right hand y-axis of the generated plot.
- *secondary plot type*: the plot type of the secondary statistics.
- *x-axis variable*: the variable to display along the x-axis (location, analysis interval, lead time interval, issuance time interval, observed category, forecast category, and forecast type source).
- *comparison variable*: The variable over which statistics are compared, and which is reflected in the legend of the plot. The variable choices are the same as those for the x-axis, but the two variables cannot be identical.
- *analysis interval used*: the analysis interval used in the plot.
- *leadtime interval used*: the lead time interval used in the plot.
- *observed category*: the observed category used to restrict what pairs are included in the analysis.
- *forecast category*: the forecast category used to restrict what pairs are included in the analysis.

Each parameter is managed graphically, using components of the **Verification Plot Definition Manager**.

*NOTE: It is recommended that, if you have an appropriate batch file already constructed that defines the parameters of the graphic you wish to produce, then you should use the **Load From Batch** button to load the parameters from that file. This is easier than specifying each field manually.*

*NOTE: If **Load From Batch** was used to load a batch file in the Verification Group Definition Manager, the parameters herein will be initialized to the values in that batch file.*

### 18.1 Primary and Secondary Statistics

The screenshot shows two sections of the interface. The top section is labeled 'Select Primary Statistics:' and contains a 'Choose Stat' button and a text field with the value 'POD,HFAR,TFAR,CSI'. The bottom section is labeled 'Select Secondary Statistics:' and contains a 'Choose Stat' button and a text field with the value 'AVGLDTM'. Both text fields have left and right arrow buttons for navigation.

The *primary statistics* and *secondary statistics* define the statistics displayed on the left-hand and right-hand y-axes, respectively. All of the statistics displayed against a single axis must have the same scale. For example, the mean absolute error and mean error can be displayed against the same y-axis, because both have the same units (feet, in the case of stage data). However, mean absolute error and probability of detection cannot be displayed against the same y-axis, because the probability of detection is a probability, between 0 and 1.

Selecting primary and secondary statistics is done through an **IVP Statistic Chooser Manager**, which ensures only statistics with the same scale can be displayed against a single axis. The **IVP Statistic Chooser Manager** is opened by clicking on the corresponding **Choose Stat** button. The **Primary Statistics** text field displays the currently selected primary statistics, and the **Secondary Statistics** text field displays the secondary statistics.

## 18.2 Primary and Secondary Statistic Plot Types

Select Primary Plot Type: LINE

Select Secondary Plot Type: BAR

The *plot type* for a statistic can be one of the following:

- **Scatter:** Statistic values are plotted as points. A scatter plot is good when the x-axis does not show trends (i.e. location).
- **Line:** statistic values are plotted as points and are connected by lines. A line plot is good when the plot is intended to reveal trends (for example, when the x-axis is lead time interval).
- **Bar:** statistic values are plots as vertical bars rising to the statistic value from the bottom of the plot. A bar plot is good when the y-axis value is a count, such as the statistic sample size.

The primary and secondary statistic plot types are chosen from the corresponding **Plot Type** choice box.

## 18.3 X-Axis Variable

Select X-Axis Variable: Forecast Category

The *x-axis variable* for a plot can be one of the following:

- **Location:** Statistic values are plotted for each location independently in the order in which the locations appear within the **Chosen Locations Table** of the **Verification Location Manager**.
- **Analysis Interval:** Statistic values are plotted against each interval defined by the start time, end time, and time step of the **Verification Group Manager**.
- **Issuance Time Interval:** Statistic values are plotted against each interval defined by the issuance time start, issuance time end, and issuance time step of the **Verification Group Manager**.
- **Lead Time Interval:** Statistic values are plotted against each interval defined by the lead time start, lead time end, and lead time step of the **Verification Group Manager**.
- **Observed Category:** Statistic values are plotted against each category defined for the observed value in the **Verification Location Manager**.
- **Forecast Category:** Statistic values are plotted against each category defined for the forecast value in the **Verification Location Manager**.
- **Forecast Type Source:** Statistics values are plotted against the forecast type sources of the pairs used in the computations.
- **<Special Plot>:** When a special plot is chosen within the **IVP Statistic Chooser Manager**, this is automatically selected, since x-axis is pre-determined by the special plot.

## 18.4 Comparison Variable

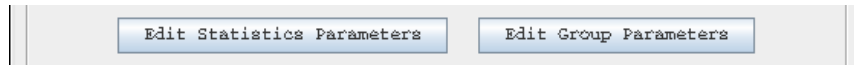
Select Comparison Variable: None



The *comparison variable* for a plot can be any one of the variables available for the x-axis variable, except for <Special Plot>, as long as it is not identical to the x-axis variable. The breakdown for different variable values is reflected in the shapes and colors of the points, lines, and bars, and this information is provided in the legend. There is one additional variable choice that can be made:

- None: No comparison variable will be used. The legend will be determined by statistics only.

### 18.5 Edit Statistics and Group Parameters

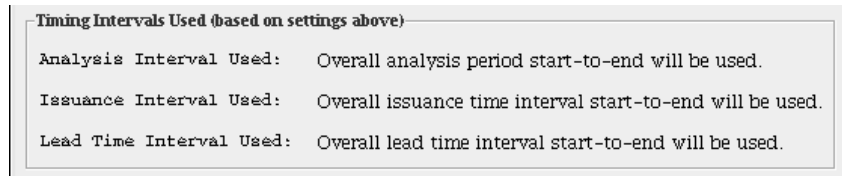


Click on **Edit Statistics Parameters** to open up a **View/Change Statistics Parameters** window, which allows for editing parameters of some of the statistics.

Click on **Edit Group Parameters** to open up a **Verification Group Manager (Plot Definition)** window, which allows for editing the parameters of the group that will be used to build the verification product when **Create Plot** is clicked within the **Verification Plot Definition Manager**. See Section 9.0 for a description of the window, and, specifically, Section 9.1 for a description of the Plot Definition version. When opened, colored borders will be drawn around the components that define the x-axis and comparison variable values that will be shown in the verification product: red for x-axis, blue for comparison, purple for both. Click on **Close** when done changing the parameters.

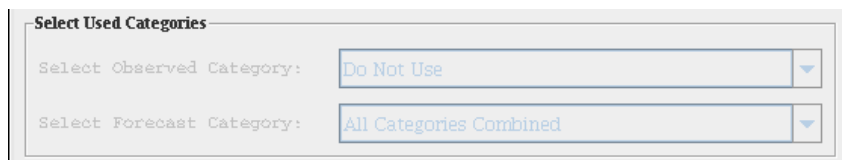
*NOTE: The plot generated when **Create Plot** is clicked is always generated using pairs loaded when the **IVP Data Display** was created. Overriding the group parameters can limit the data available for computations, but will never result in additional pairs being available.*

### 18.6 Analysis Interval, Issuance Time Interval, and Lead Time Interval Used



The *analysis interval used*, *issuance time interval used*, and the *lead time interval used* inform the user what intervals are being used to compute the statistics. If the x-axis and comparison variable are none, location, observed category, or forecast category, then the all three intervals will be the overall interval, from start to end (ignoring the step values). If the x-axis variable or comparison variable is analysis interval, then the analysis interval used will be “All user-defined intervals will be used”, implying that the time step will affect the statistics. Similarly for the lead time interval and issuance time interval.

### 18.7 Observed Category and Forecast Category



The *observed category* and *forecast category* define any restrictions on the data to use in verification based on the observed or forecast value. These also specify what categories are used for categorical statistic calculations. The choice is made by selecting an item from the **Observed Category** choice box or **Forecast Category** choice box. The choices are as follows:

- **Do Not Use**: Do not use this category as a restriction to the data. If chosen, then the corresponding choice box will be disabled and the other category choice box will become enabled, allowing a selection to be made. For some statistics, the category chosen to not be used specifies the variable used in computations for the statistics (see Appendix B).
- **All Categories Combined** or **Use Only Category**: If only one category is defined (usually "MIN, MAX"), then data pairs must be in that category for the corresponding data value (i.e. observed or forecast) in order to be used in the computations. If multiple categories are defined, then the data pairs must be in any one of the categories in order to be used in the computations.
- **Category #**: The data pair must be in the category chosen for the corresponding data value (i.e. observed or forecast) in order to be used in the computations.

If either the x-axis or comparison variable is a category (Observed Category or Forecast Category), then the two choice boxes are disabled, since the x-axis variable or comparison variable would dictate how the categories are used.

Only one of the two category choice boxes can be active at a time. If the observed category is set to not be used, then the forecast category must be chosen as something else, and vice versa.

*NOTE: To make it so that all data pairs are used in computing statistics regardless of category, one of the two choice boxes must be "Do Not Use" and the other must be "All Categories Combined" or "Use Only Category". Also, the categories must include boundary strings MIN and MAX.*

### 18.7.1 Resulting Adjustments to Categories

During statistical computation, adjustments are made (described below) to the observed or forecast categories for all locations based on the corresponding choice box selection. However, adjustments are not made if the x-axis or comparison variable is set to Forecast Category or Observed Category. In such cases, the user defined categories are used as is.

If adjustments are to be made, then the forecast (or observed) categories will be set to have only one category as follows:

- For selections **Do Not Use**, **All Categories Combined**, or **Use Only Category**: The one category will have a lower bound set to the smallest overall user-defined category boundary, and an upper bound set to the largest such boundary. This will allow for all user-defined pairs for all locations to be used regardless of the forecast (or observed) value.
- For selection **Category #**: The user defined category corresponding to # will be used, restricting the pairs used in computations to those that have a forecast (or observed) value within this category.

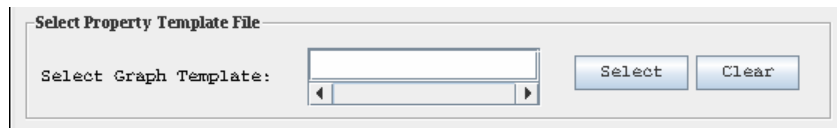
This adjustment will affect computations of categorical statistics. So, if you chose a categorical statistic for either the primary or secondary statistics, then you should set either the x-axis variable or comparison

variable to be `Observed Category` or `Forecast Category`. Otherwise, the resulting plot could display nonsensical results created by the adjustments above.

### 18.7.2 ROC Plots

If the ROC Plot is chosen as the primary statistic, then the **Observed Category** and **Forecast Category** choice boxes determine the observation threshold used in computing the ROC plot (see Appendix B). The threshold value is the lower bound defining the category chosen from whichever choice box is not set to "Do Not Use". Since "MIN" is not a valid threshold but is usually used to define the smallest overall category boundary, whichever category is chosen typically should not be "All Categories Combined", "Use Only Category", or "Category 1".

## 18.8 Graph Template File



The *graph template file* specifies properties (that are not default) of the chart to create, including labels, fonts, colors, sizes, axis mins and maxes, and others. For more information on the graph template file, see the section on the **Chart Properties Manager** (Section 24.0) and Appendix D. The text field specifies the template file to use when the **IVP Statistic Display** is first created. If the text field is empty or "NONE", then default chart properties will be used to construct the display.

## 18.9 Special Plots

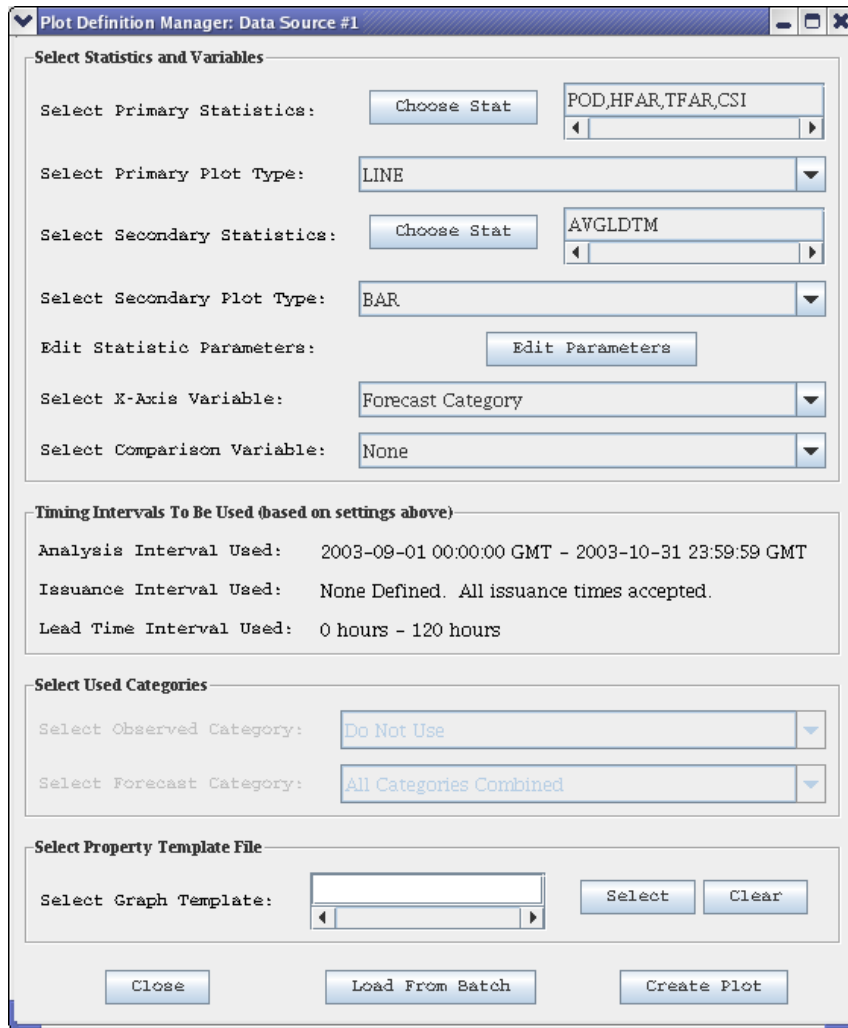
Special plots are plots for which the plot parameters are almost completely determined by the special plot type. Whenever the primary statistic is a special plot, the secondary statistics text field is set to "NONE", both plot type choice boxes are set to a fixed selection and disabled, and the x-axis choice box is set to '<Special Plot>' and disabled. Only the comparison variable and category choice boxes are still enabled. A special plot cannot be set as the secondary statistic.

### 18.10 Buttons

- **Primary Statistic Choose Stat** button: Opens up the **IVP Statistic Chooser Manager** for selecting the primary statistics. This must be chosen in order for a plot to be constructed.
- **Secondary Statistic Choose Stat** button: Opens up the **IVP Statistic Chooser Manager** for selecting the secondary statistics.
- **Edit Statistics Parameters** button: Opens a **View/Change Statistics Parameters** window. See Section 18.5.
- **Edit Group Paarameters** button: Opens a **Verification Group Manager (Plot Definition)** window. See Section 18.5.
- **Graph Template Select** button: Opens up a file browser for selecting the template file.
- **Close** button: Closes the **Verification Plot Definition Manager**.
- **Load From Batch** button: Opens up a file browser that can be used to find a previously created batch file for the IVP Batch Program and set the parameters within this **Verification Plot Definition Manager** according to that file. It will read parameters until the first graphic is generated (via a `GEN_GRAPH` batch file action; see the *IVP Batch Program User's Manual*) and

sets the parameters herein according to those read in. It will also update the Plot Definition versions of the **Verification Group Manager** and the **Verification Location Manager**, but only those locations for which pairs have already been loaded can be altered or chosen based on the batch file.

- **Create Plot** button: Creates the **IVP Statistic Display** showing the plot specified by this **Verification Plot Definition Manager**.



## ***19.0 IVP Statistic Chooser Manager***

The **IVP Statistic Chooser Manager** is used to select primary or secondary statistics for the IVP statistic plot. The statistics are placed in groups, so that all of the statistics in a group have the same scale or unit. Each group is given a master check box, with an appropriate name, so that if that checkbox is checked, then all statistics within the group will be checked. The statistics are described in Appendix B.

The statistic groups are as follows:

- Error Statistics: root mean squared error, maximum error, mean absolute error, and mean error
- Categorical Statistics: probability of detection, hydrologic false alarm ratio, traditional false alarm ratio, over forecast rate, under forecast rate, critical success index, Gilbert score, and ROC area.
- Quantiles and Extremes: minimum, quantiles, and maximum
- Moments: observed mean, forecast mean, observed standard deviation, and forecast standard deviation.
- Lead Time Statistics: average lead time of detection
- Sample Size: statistic sample size
- Correlation, Bias, and Skill: Pearson's correlation coefficient, bias (%), and the RMSE skill score relative to persistence forecasts.
- Special Plots: cumulative distribution function plot, probability density function plot, and relative operating characteristic plot.

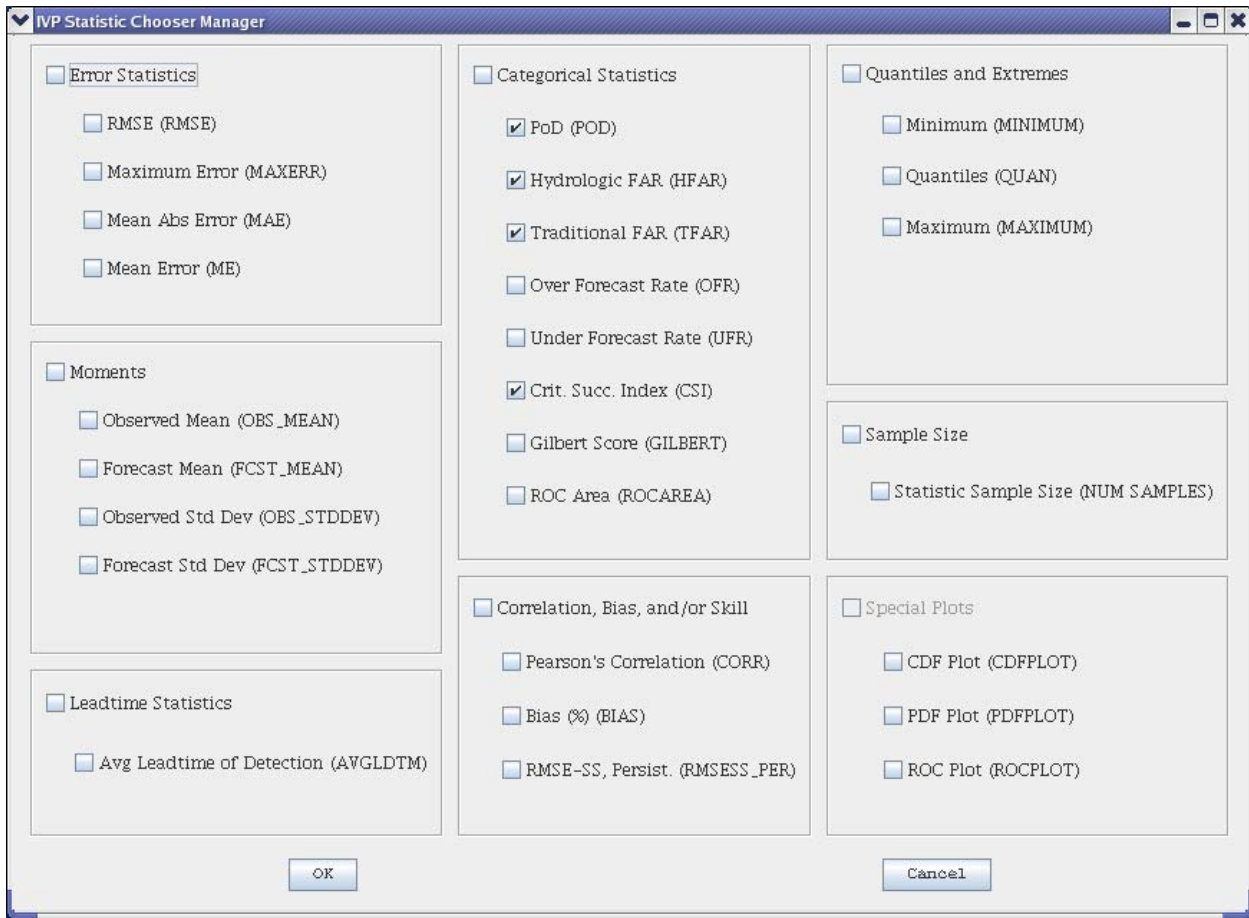
Statistics are chosen by clicking on checkboxes. If a statistic of one group is checked, then all statistics of all other groups will be unchecked. Multiple statistics can be checked only if they are in the same group.

### ***19.1 Special Plots***

Special plots are plots for which the plot parameters are almost completely determined by the special plot type. When a special plot is selected, all other check boxes are turned off, meaning that only one special plot can be selected at a time.

### ***19.2 Buttons***

- **OK** button: Close the window and update the corresponding text field of the **Verification Plot Definition Manager** to list the chosen statistics.
- **Cancel** button: Close the window and do nothing else.



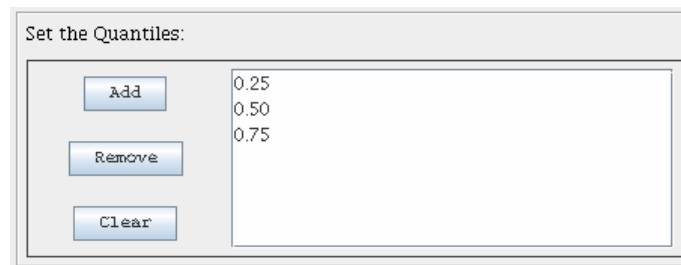
## 20.0 View/Change Statistics Parameters Window

The **View/Change Statistics Parameters** window is used to view and set the verification statistics parameters that can be modified by the user:

- **Quantiles:** The quantiles computed when the `Quantile` statistic is chosen for display on the primary or secondary y-axis.
- **Number of PDF Bins:** The number of bins used to compute the `PDFPLOT` special plot. See Appendix B for more details.
- **Number of ROC Points:** The number of points computed on the curve for the `ROCPLLOT` special plot. See Appendix B for more details.

Each of these parameters is specified in its own panel within this window. The panels are described below.

### 20.1 Quantiles Panel



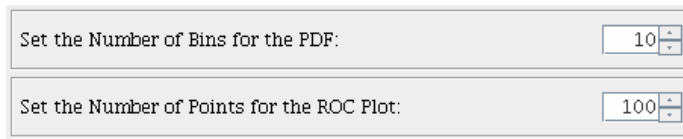
The **Set the Quantiles** panel is used to specify a list of numbers between 0 and 1 (not inclusive) that correspond to the probabilities for which quantiles are to be computed. The current list is provided in the **Probabilities List** in ascending order. Click on **Add** to add a probability to the list, **Remove** to remove selected probabilities from the list, and **Clear** to clear the list. The default probabilities are 0.25, 0.50, and 0.75.

*NOTE: If there are no probabilities in the list and **OK** is clicked, the changes to the quantiles will be discarded. An empty list is invalid.*

#### 20.1.1 Buttons

- **Add** button: Opens up a **Add Probability Level** dialog in which the user specifies the probability to add. Click on **OK** to try to add the probability or **Cancel** to not add it. The probability will only be added if it is between 0 and 1 (not inclusive) and if the probability does not yet exist in the list.
- **Remove** button: Removes any selected probabilities from the **Probabilities List**. Multiple selections can be made from this list using the <shift> and <ctrl> keys.
- **Clear** button: Clears the **Probabilities List**.

## 20.2 *Number of PDF Bins and Number Of ROC Points Panels*

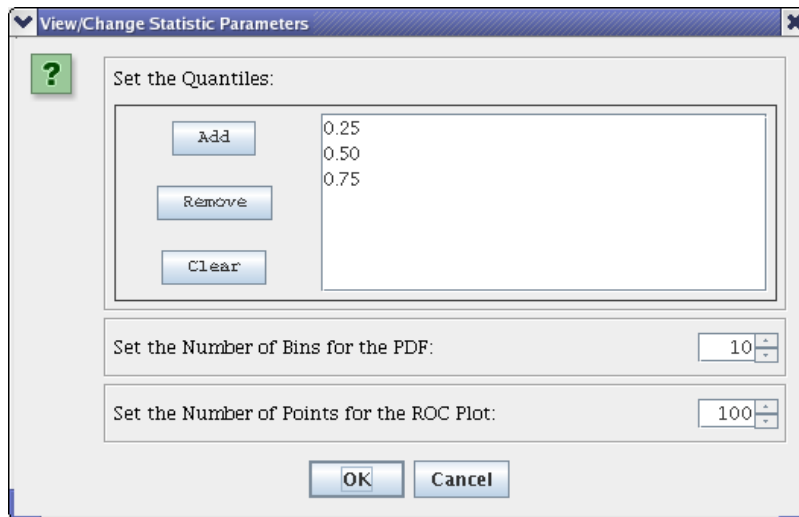


Two separate panels are shown. The top panel has the label "Set the Number of Bins for the PDF:" followed by a text box containing "10" and up/down arrows. The bottom panel has the label "Set the Number of Points for the ROC Plot:" followed by a text box containing "100" and up/down arrows.

Both of these panels specify positive integer values. The numbers can be changed by manually entering them into the text fields or by clicking on the up or down arrows. The defaults are 10 and 100, respectively.

## 20.3 *Buttons*

- **OK** button: Accept the changes and close the window. If any change is invalid, it will be discarded.
- **Cancel** button: Discard the changes and close the window.



The screenshot shows a dialog box titled "View/Change Statistic Parameters". It features a green question mark icon in the top-left corner. The main area is titled "Set the Quantiles:" and contains a list box with the values "0.25", "0.50", and "0.75". To the left of the list box are three buttons: "Add", "Remove", and "Clear". Below the list box are two more panels: "Set the Number of Bins for the PDF:" with a text box containing "10" and up/down arrows, and "Set the Number of Points for the ROC Plot:" with a text box containing "100" and up/down arrows. At the bottom of the dialog are "OK" and "Cancel" buttons.



## 21.0 IVP Statistic Display

The **IVP Statistic Display** graphically displays statistics calculated by the IVP software according to parameters of the **Verification Plot Definition Manager**, **Verification Group Manager**, and **Verification Location Manager**. The legend defines what statistics are displayed, with statistics displayed along the primary y-axis preceding those displayed along the secondary y-axis.

Associated with the chart in the **IVP Statistic Display** window are chart properties, including the chart title, axis labels, legend title, fonts, colors, etc. Default values for the chart properties are constructed based on the data and user settings. These properties can be customized via the **Chart Property Manager**. They can also be loaded from an existing template file via **Actions >> Load Chart Properties**.

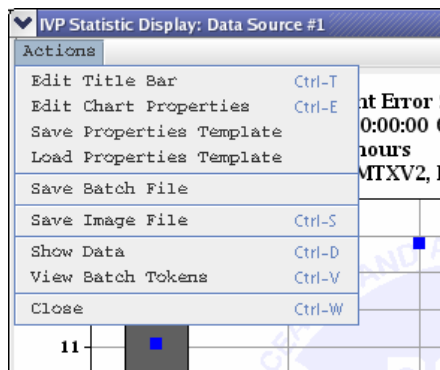
The following features are the same as those in the **IVP Data Display** (see Section 15.0):

- **Data Tracker** (Section 15.3)
- **Actions >> Edit Chart Properties** (Section 15.11)
- **Actions >> Save Properties Template** (Section 15.11)
- **Actions >> Load Properties Template** (Section 15.11)
- **Actions >> Save Image File** (Section 15.11)
- **Actions >> Close** (Section 15.11)

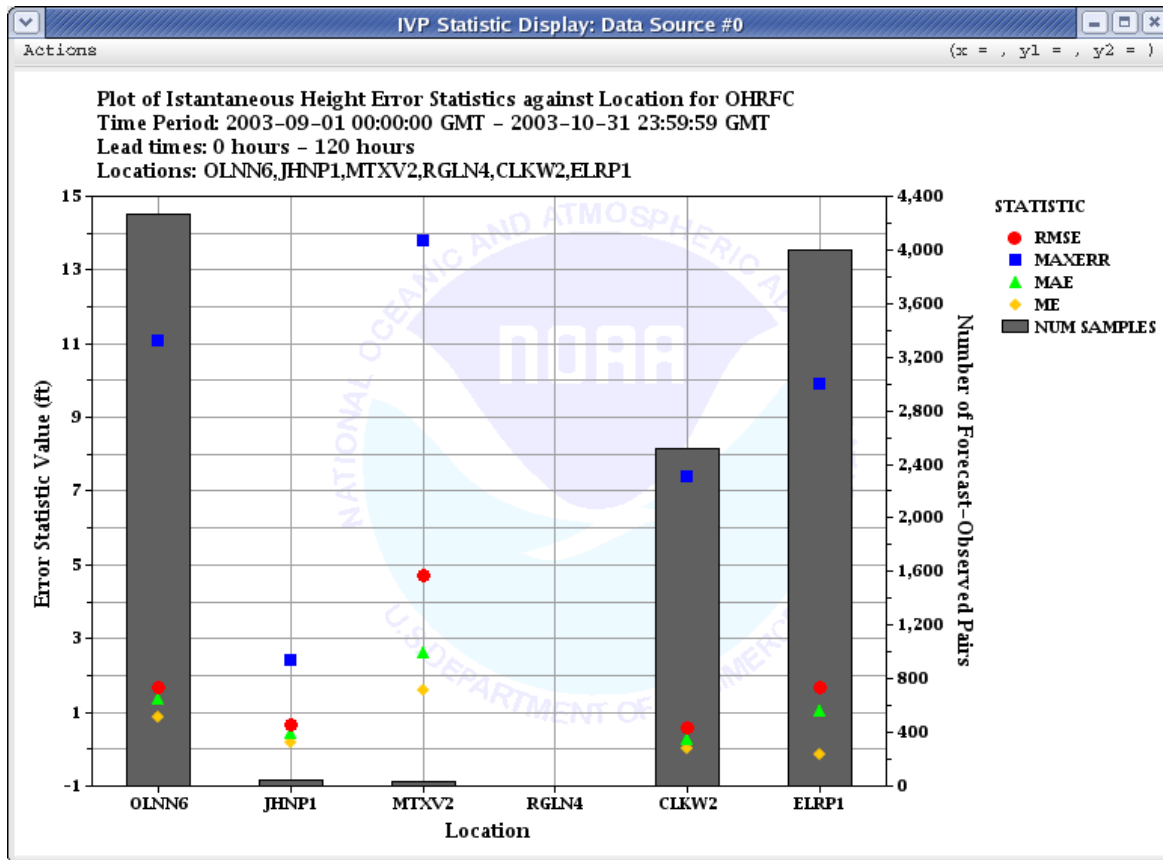
Additional features are given below.

### 21.1 Menu Items

In addition to the menu items identical to those in the **IVP Data Display**, the following menu items are available:



- **Actions >> Save Batch File** menu item: Opens up an **IVP Batch File Creation Wizard** for saving a batch file to reconstruct the image within the **IVP Statistic Display**.
- **Actions >> Show Data** menu item: Opens up **IVP Statistics Data Viewer** for this plot.
- **Actions >> View Batch Tokens** menu item: Opens up a dialog which displays the batch tokens which could be used to produce the graphic displayed in this window via the IVP Batch Program.



## 22.0 IVP Statistics Data Viewer

The **IVP Statistics Data Viewer** shows in a table the statistics currently displayed in the **IVP Statistic Display**. The columns of the table are as follows:

- **Index:** An indexing number shows the order in which the rows were initially given in the table.
- **X-axis Variable:** The value of the variable displayed along the x-axis. This column has a pink background.
- **Statistic and comparison variable value:** One column per statistic and comparison variable value combination displayed on the plot. These columns have a gray background.

### 22.1 Buttons

- **Save to File** button: Opens up a file browser to allow the user to select the file to which to save the data within this table. The image data file produced will contain the contents of the table delimited by pipes, '|', and a header section providing information about the parameters used to generate to the output.
- **Close** button: Closes the **IVP Statistics Data Viewer**.

Index	Location	RMSE	MAXERR	MAE	ME	NI
0	OLNN6	1.662185	11.090000	1.332605	0.867803	4
1	JHNP1	0.648386	2.410000	0.397500	0.168000	40
2	MTXV2	4.711076	13.770000	2.591875	1.593125	32
3	RGLN4	-999.000...	-999.000...	-999.000...	-999.000...	0
4	CLKW2	0.586161	7.370000	0.255690	-0.005540	2

## 23.0 IVP Batch File Creation Wizard

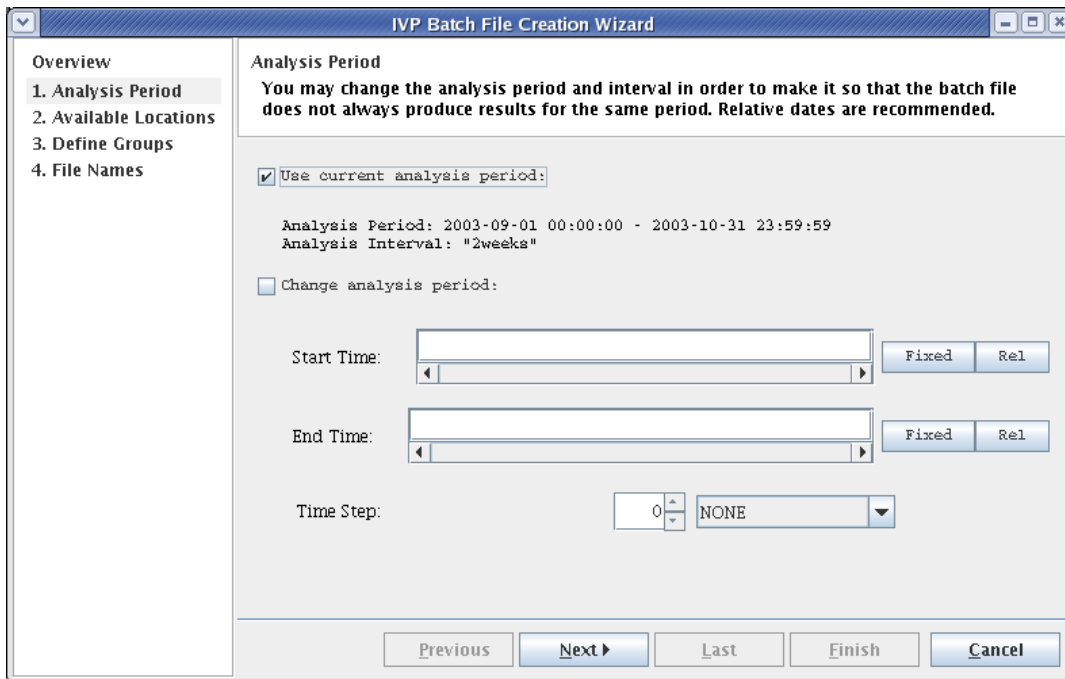
The **IVP Batch File Creation Wizard** is used to complete specification of the batch file to construct that will allow for the IVP Batch Program to reconstruct the image in the corresponding **IVP Statistic Display**. The wizard allows for the following flexibility in building the batch files:

- The analysis period and interval can be different from that in the **Verification Group Manager**. If the graphic is to be produced regularly (for example, once per month), then using relative dating to specify the analysis period is recommended.
- Verification locations can be defined that are different from those in the **Verification Location Manager**.
- The locations can be combined in various ways to produce different verification groups, each requiring a graphic to be produced.
- The batch output files can be specified using replacement strings. This is recommended if the batch file is to generate graphics for multiple groups. If replacement strings are not used, then each group's graphic will overwrite the previous group's graphic.

To build the batch file, the names of the image file and data file to create, the template file (if used), and the batch file name must all be specified. The *image file* is the file to contain the image in the **IVP Data Display**, being either a PNG or JPEG file. The *data file* is the text file to contain the contents of the **IVP Statistics Data Viewer**. The *template file* is the file containing information about the chart properties to use when constructing the chart. The *batch file* is the batch file produced by the wizard.

Each wizard step is described below with the associated screenshot provided. The buttons at the bottom of the wizard, which are common to all steps, are described at the end of this section.

### 23.1 Analysis Period Wizard Step



The first step in the wizard allows for specifying an analysis period that is different from that currently specified in the **Verification Group Manager**, if needed. If the currently defined analysis period is acceptable, make sure the **Use Current Analysis Period** checkbox is checked. To change the analysis period, check the **Change Analysis Period** checkbox and specify the dates accordingly. This uses the same mechanisms in the **Verification Group Manager**; see Sections 9.1 and 9.2.

### 23.1.1 Buttons

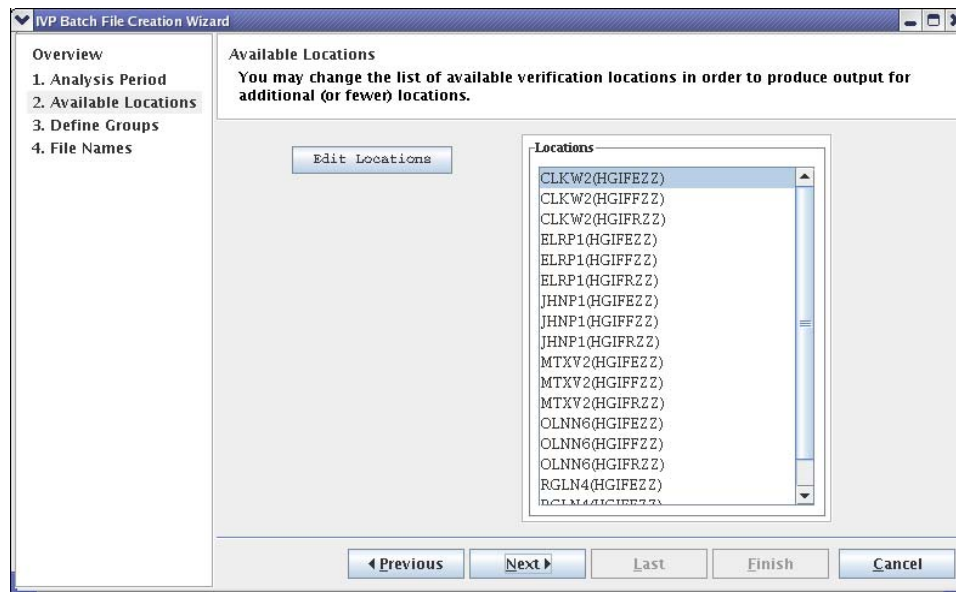
- **Start (End) Time Fixed** button: Opens up a **Choose Date/Time Window** for editing the **Start (End) Time** text field.
- **Start (End) Time Rel** button: Opens up a **Choose Relative Date/Time Window** for editing the **Start (End) Time** text field.

## 23.2 Available Locations Wizard Step

This wizard step involves defining the verification locations that are available for analysis within the batch job to execute. By default, the list of locations, provided in the **Locations List**, matches those selected in the **Verification Location Manager**. Each location is specified by its location id and SHEF pedtsep code. To change the list, click on **Edit Locations** and modify the locations within the **Verification Location Manager** window that pops up. When done, click on **OK** to accept the changes or **Cancel** to cancel them.

### 23.2.1 Buttons

- **Edit Locations** button: Opens up a **Verification Location Manager** to allow for defining a different set of locations for the batch file.



## 23.3 Define Groups Wizard Step

During this wizard step, multiple groups can be defined such that a graphic is generated for each group. The scrolled panel in this step contains one **Group Definition Panel** per group defined. To add a new

group, click on **Add Group**. To add one new group per location id defined in the **Available Locations Wizard Step**, click on **Add One Per Location ID**. To remove groups, click on the checkbox associated with each **Group Definition Panel** to remove and click **Remove**.

### 23.3.1 Group Definition Panel

The **Group Definition Panel** contains a checkbox, an **Edit List** button, an **Edit Parameters** button, and a text field listing every location id in the group. Check the checkbox if the group is to be removed the next time **Remove** is clicked. Click on **Edit List** to change the list of location ids, or enter the ids by hand in the text field. Click on **Edit Parameters** to open up a **Location Restrictions Window** that allows for restricting locations included in the group.

### 23.3.2 Location Restrictions Window

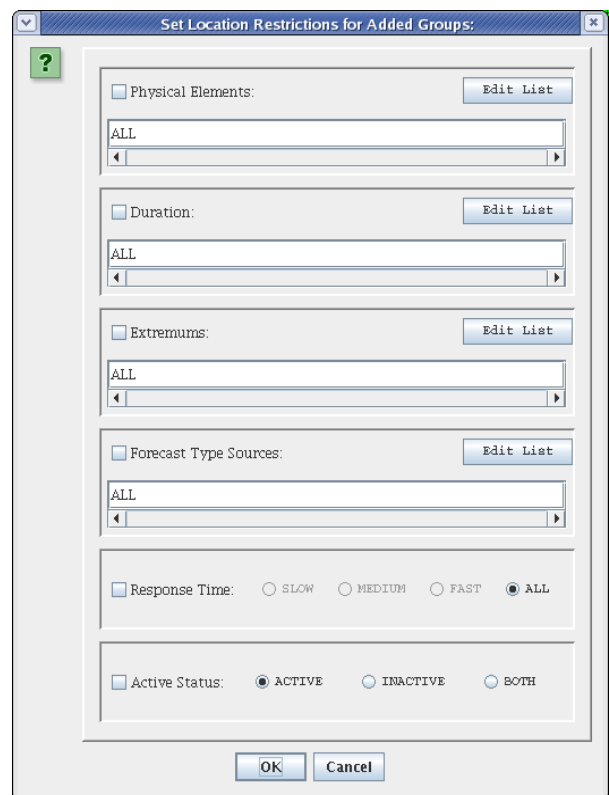
The **Location Restrictions Window** specifies restrictions on what verification locations to include in the group. Specifically, verification locations can be restricted based on the following attributes:

- SHEF physical element code
- SHEF duration code
- SHEF extremum code
- SHEF forecast type source code
- Verification location response time
- Verification location active status

To include a restriction, check the corresponding checkbox, and click on the corresponding **Edit List** button if it is a SHEF code, or the corresponding radio buttons if it is the response time or active status. It is also possible to edit the text fields associated with SHEF codes manually.

Once the parameters are set, click on **OK** to accept the changes, or **Cancel** to discard them.

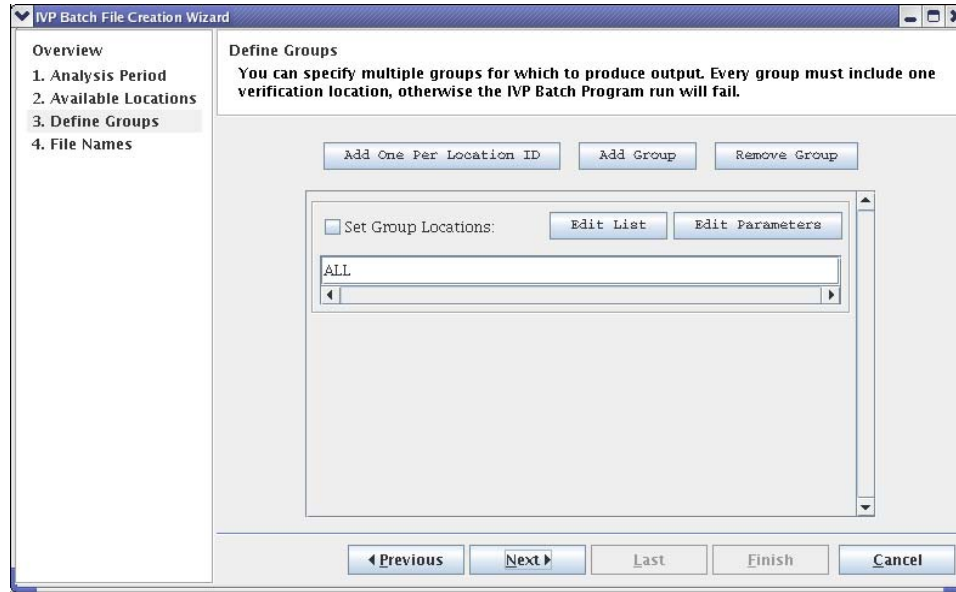
*NOTE: Since the list of location id's specified in the **Group Definition Panel** does not include the SHEF codes, it is important to specify any restrictions to SHEF codes within this window.*



### 23.3.3 Buttons

- **Add One Per Location ID** button: Opens a **Location Restrictions Window**. Once the user clicks on **OK**, one group per location id among the list of available locations specified in the **Available Locations Wizard Step** will be added to the scrolled panel. Each group will use the restrictions specified in the **Location Restrictions Window**.
- **Add Group** button: Adds a single group with a default location id list of 'ALL'.
- **Remove Group** button: Removes all groups in the scrolled panel for which the checkbox is checked.

- **Edit List** button: Within the **Group Definition Panel** and **Location Restrictions Window**, this spawns a GUI very similar to the **Select FCST\_TS Window** described in Section 12.0. The list of choices within the windows is generated based on the list of available locations.
- **Edit Parameters** button: Spawns a **Location Restrictions Window** allowing for restrictions to be placed on what verification locations are included in a group.



### 23.4 File Names Wizard Step

There are four file names that may be specified:

- **Image file:** The name of the image file the IVP Batch Program is to construct using this batch file. Unless specified, this file is assumed to be in the directory  $\$(vsys\_output)/\$LOGNAME$ . This file is required. The file must have a .png, .jpg, or .jpeg extension. If it has none of these, .png will be automatically appended to the file name within the batch file.
- **Data file:** The name of the data file the IVP Batch Program is to construct using this batch file. Unless specified, this file is assumed to be in the directory  $\$(vsys\_output)/\$LOGNAME$ . This file is optional. If it is not used, the data file should be left blank or set to “NONE”. If specified, the file must have a .dat extension. If it does not, .dat will be automatically appended to the file name within the batch file.
- **Template file:** The name of the graph template file the IVP Batch Program is to use when constructing the chart. Unless otherwise specified, this file is assumed to be in the directory  $\$(vsys\_files)/\$LOGNAME/templates$ . This file is optional. If it is not to be used, then the radio button **Use Defaults** should be selected, or the template file should be left blank or set to “NONE”. If the template file needs to be created, the button **Create New Template** should be selected. If the template file already exists, the button **Use Existing Template** should be selected.
- **Batch File Name:** The name of the batch file, itself. Unless specified, it is assumed the batch file will be generated in the  $\$(vsys\_input)$  directory. The file must have a .bat extension. If it does not, .bat will be automatically appended to the file name when the batch file is created.

### 23.4.1 Replacement Strings

If there are multiple groups for image files or image data files are to be produced, it is important that the image file and data file names incorporate replacement strings. The replacement strings should refer to something that is different between the groups. For example, if one group is generated for each location id, then @LOCATIONS should be used, which will be replaced by the location id. If the restrictions placed on locations within the groups is based on the forecast type source involved, the @FCSTTSS should be used, which will be replaced by the forecast type source.

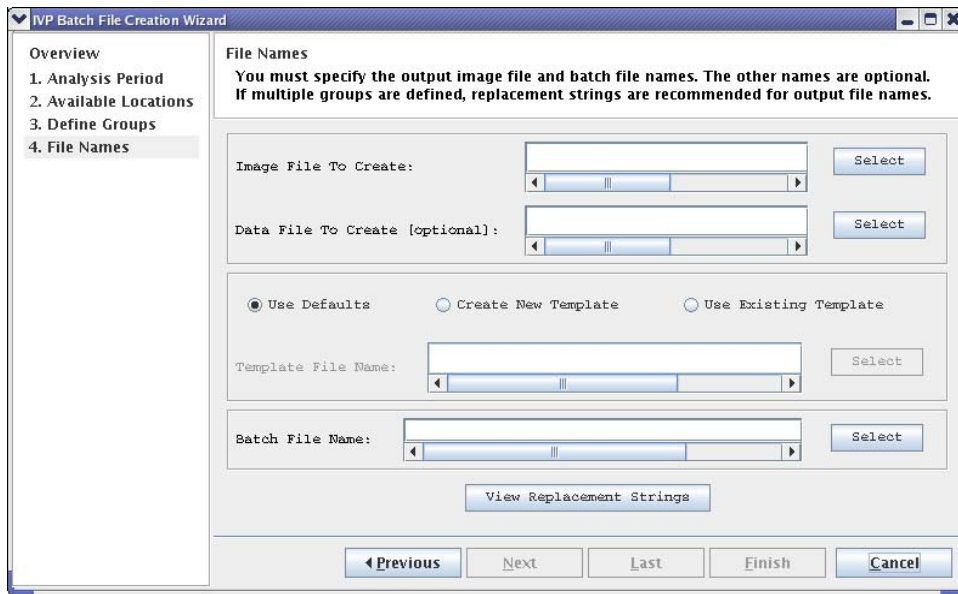
Optionally, if there is one template file to use for each group, replacement strings should be used in the template file names. Note, however, that if the template file is to be generated (i.e. **Create New Template** is selected), only one such file will be generated. It is best to save each of the needed template files via the IVP Statistics Display if replacement strings are to be used for the template file names.

A list of replacement strings can be seen in Appendix C or by clicking on **View Replacement Strings**.

*NOTE: Do not use replacement strings in the batch file name.*

### 23.4.2 Buttons

- **Select** buttons: Each select button opens up a file browser to choose the name of the file. Clicking on the **Open** or **Save** button of the browser will close the window and update the corresponding text field. Clicking on **Cancel** will close the window, with no updates.
- **View Replacement Strings** button: Opens up a window displaying the replacement strings defined in Appendix C.



## 23.5 Buttons

- **Previous** button: Moves to the previous wizard step.
- **Next** button: Moves to the next wizard step. This is enabled once fields that are required at the step are specified.



- **Last** button: Moves to the last wizard step.
- **Finish** button: Generates the batch file using the specified parameters and closes the wizard. This is enabled once all required fields are specified.
- **Cancel** button: Closes the wizard and does not generate a batch file.

## 24.0 IVP Chart Properties Manager

The **IVP Chart Properties Manager** window is used to customize the appearance of a displayed chart. It allows for customizing the following *chart components*:

- Chart Title: The text, font, and color of the chart title can be changed.
- X-Axis Title: The text, font, and color of the x-axis title can be changed.
- Primary Y-Axis Title: The text, font, and color of the primary (left-hand) y-axis title can be changed.
- Secondary Y-Axis Title: The text, font, and color of the secondary (right-hand) y-axis title can be changed.
- Legend Title: The text and font of the legend title can be changed.
- Legend Components: The text and color of the legend components can be changed. The font is always equal to the legend title font.
- Tick Mark Font: The fonts of the tick marks used for all of the axes can be changed. All three axis tick mark labels are in the same font.
- X-Axis Limits or Labels: If the x-axis is numerical (as with the **IVP Data Display**), then the minimum and maximum values of the axes can be changed. If the x-axis is by label (as with the **IVP Statistics Display**), then the labels along the x-axis can be changed.
- X-Axis Annotation: The direction of printing for the x-axis labels can be changed.
- Primary Y-Axis Limits: The minimum and maximum for the primary y-axis can be changed.
- Secondary Y-Axis Limits: The minimum and maximum for the secondary y-axis can be changed.
- Chart Dimensions: The dimensions (height and width) of the chart displayed within the window can be changed.

The **IVP Chart Properties Manager** window is organized into two panels, each of which has a tab on it: **Chart Titles** and **Chart Others**. These two panels further contain other tabbed panels. The organization of these other tabbed panels, and the chart component each panel is associated with, is as follows:

**Chart Title (Chart Titles):** Chart Title  
**Y-Axis 1 Title (Chart Titles):** Primary Y-Axis Title  
**Y-Axis 2 Title (Chart Titles):** Secondary Y-Axis Title  
**X-Axis Title (Chart Titles):** X-Axis Title  
**Legend Title (Chart Titles):** Legend Title  
**Legend (Chart Titles):** Legend Components  
**Tick Mark Font (Chart Titles):** Tick Mark Font  
**Chart Dimension (Chart Others):** Chart Dimensions  
**Primary Y-Axis (Chart Others):** Primary Y-Axis Limits  
**Secondary Y-Axis (Chart Others):** Secondary Y-Axis Limits  
**X-Axis (Chart Others):** X-Axis Limits or Labels  
**X-Axis Annotation (Chart Others):** X-Axis Annotation

Each tabbed panel provides tools to edit the corresponding chart component of the chart. The tabbed panels are described below, with a small screenshot of the appearance of the panel within the **Chart Property Manager** window.

*NOTE: In any chart, either within the IVP Data Display window or the IVP Statistics Display window, if you click on a component of the chart, it will open up the **IVP Chart Properties Manager** window and make the corresponding tabbed panel the active panel.*

## 24.1 *Template Files*

A *template file* is a file that records the properties corresponding to the **Chart Property Manager**. Specifically, it records the properties of a graphic that differ from the default properties. Template files allow for a user to customize the appearance of a graphic, save the chart properties, and then apply those properties when generating other images, both in the IVP and IVP Batch Program. The format of a template file is described in Appendix D.

This file can be created by clicking on **Options >> Save Properties Template** in the **IVP Data Display**, clicking on **Actions >> Save Properties Template** in the **IVP Statistics Display**, or by choosing to create a new template within the **IVP Batch File Save Manager**. The settings within a template file can be applied to a chart by clicking on **Options >> Load Properties Template** in the **IVP Data Display**, clicking on **Actions >> Load Properties Template** in the **IVP Statistics Display**, or by specifying the template file in the **Verification Plot Definition Manager**.

## 24.2 *Default Values*

Every property of a chart has a default value associated with it. Initially, all chart properties are assumed to be their default. For all tabbed panels except for those associated with labels, the radio button **Default** specifies if a default value is being used. For those associated with labels, the radio button **Default (Text & Font)** specifies if both the text and font of the label are default, and **Default (Text Only)** specifies if the text is default but the font is not.

In any case, if a change is made in a panel, the corresponding **Default** radio button will be deselected. To reacquire the default value, the user may click on the corresponding **Default** radio button. Note that, for labels, clicking on **Default (Text Only)** will only recover the default label text. Clicking on **Default (Text & Font)** will recover both the default label text and font.

## 24.3 *All Titles (Chart Titles)*

The **Chart Title**, **X-Axis Title**, **Y-Axis 1 Title**, **Y-Axis 2 Title**, and **Legend Title** panels, as well as the **Tick Mark Font** panel, all have the same basic appearance, so only the **Chart Title** panel is shown here. The exceptions are that neither the **Legend Title** panel nor the **Tick Mark Font** panel has a **Text Color** button. Also, the text within the **Tick Mark Font** panel is ignored; it is only there to show what the font looks like for numbers.

The Font is specified by choosing a font name from the **Font** choice box, a size from the **Font Size** choice box, and selecting bold or italics using the **Bold** and **Italics** buttons. The text color is chosen by clicking on the **Text Color** button and selecting a color from the **Choose Color** window that pops up. The **Choose Color** window allows for specifying a color by appearance, HSB code, or RGB code.

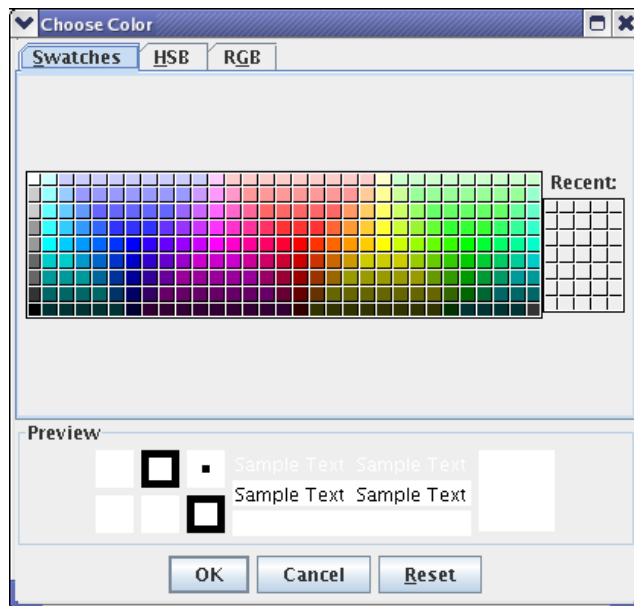
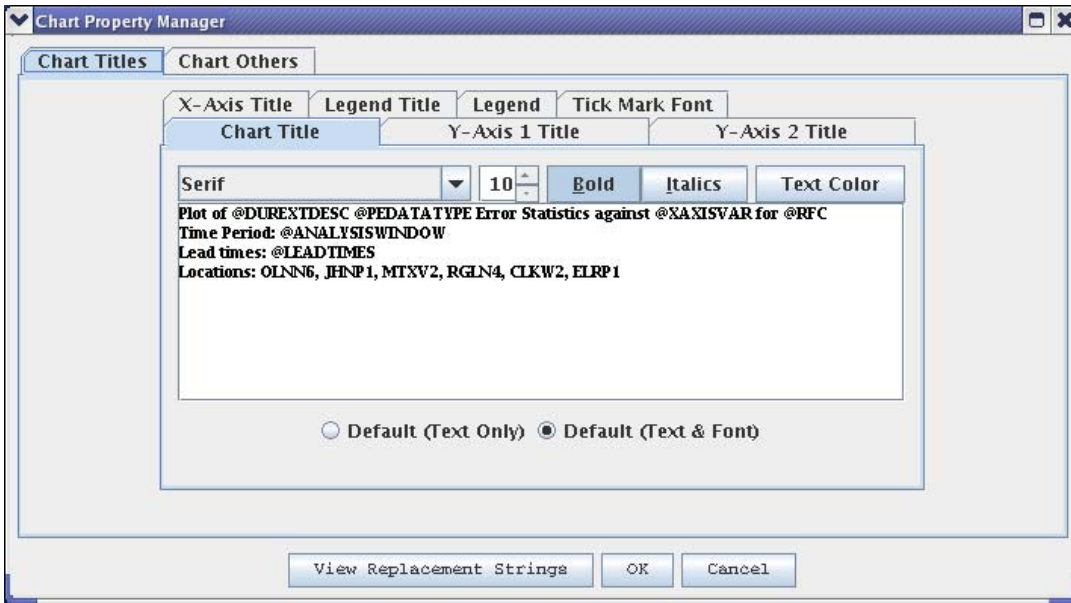
The text area will display the text as it will be seen on the chart, except that the font size will not match that which will be displayed and any replacement strings will not be replaced. The font size is a product of the charting tool used, ChartDirector. The font on the chart will be slightly larger than that displayed in the **IVP Chart Properties Manager**. All titles can have multiple lines.

A replacement string can be part of the text of a label, allowing for more generic and robust labels. See Appendix C for a description.

*NOTE: A ‘;’ must not be used within the text of any title.*

### 24.3.1 Buttons

- **Bold** button: Selects the font to be bold, if toggled (i.e. shaded).
- **Italics** button: Selects the font to be italics, if toggled.
- **Text Color** button: Opens up a **Choose Color** window for selecting the color of the text.



## 24.4 All Numerical Axis Limits (Chart Others)

The **X-Axis** limits (for the **IVP Data Display**), **Primary Y-Axis** limits, **Secondary Y-Axis** limits, and **Chart Dimensions** panels all have the same basic appearance, so only the **Primary Y-Axis** limits panel is shown here. Each contains two sliders: one for the upper limit (or chart height) and one for the lower limit (or chart width). A limit (or dimension) can be changed by using the slider (click on it and drag, or click to either side of it) or by typing the desired number into the text field and pressing <Enter>.

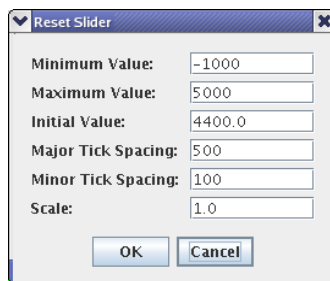
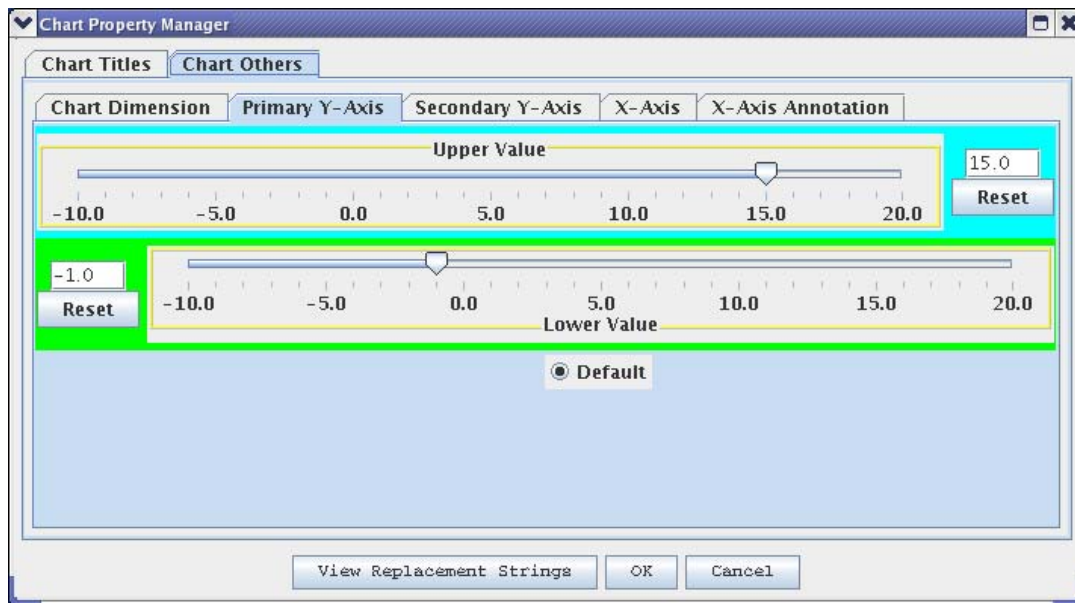
The slider itself can also be customized by clicking on **Reset**, which will pop up a **Reset Slider** window. This window allows for setting the slider's minimum value, maximum value, initial value, major tick spacing, minor tick spacing, and scale.

*NOTE: To specify a limit outside the slider's minimum and maximum range, type the limit value into the text field and press <Enter>. Do not use the slider in these cases.*

*NOTE: Any customization of the sliders will be lost when the window closes.*

### 24.4.1 Buttons

- **Reset** button: Opens up the Reset Slider window, allowing for customizing the slider.



## 24.5 Legend (Chart Titles)

The Legend panel is used to change the color and text of legend components. Each component is provided in a **Legend Component List**, with the background color being the color used within the legend. To change a legend component, do the following:

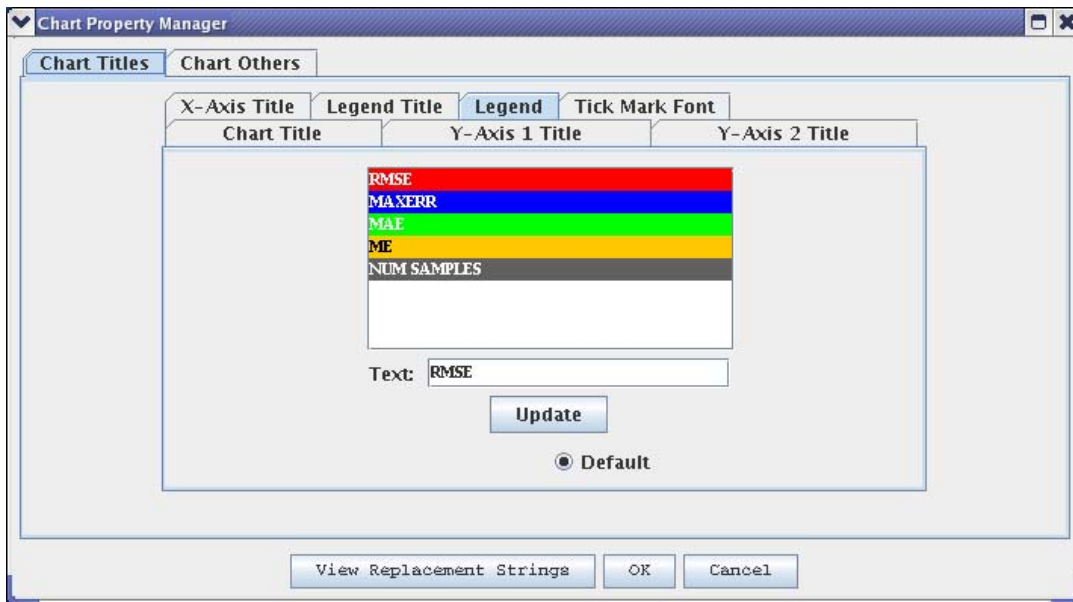
1. Click on the corresponding item in the **List**.
2. Type the name of the legend component into the text field. Do NOT use a replacement string (see Appendix C).
3. Click on **Update**. A **Choose Color** window will pop up.
4. Select the desired color and click on **OK**.

After completing the last step, the **Legend Component List** should change to reflect the new component.

*NOTE: The shapes used in the charts cannot be edited via the **Chart Property Manager**. However, they can be edited via the \*Symbol settings of the System Settings File (see Section A.3).*

### 24.5.1 Buttons

- **Update** button: Opens up a **Choose Color** window for choosing the legend component color.



## 24.6 X-Axis Labels (Chart Others)

The **X-Axis (Chart Others)** panel is used to change the x-axis tick mark labels for the **IVP Statistics Display**. The current x-axis labels are provided in an **X-Axis Label List**. To change an x-axis label, do the following:

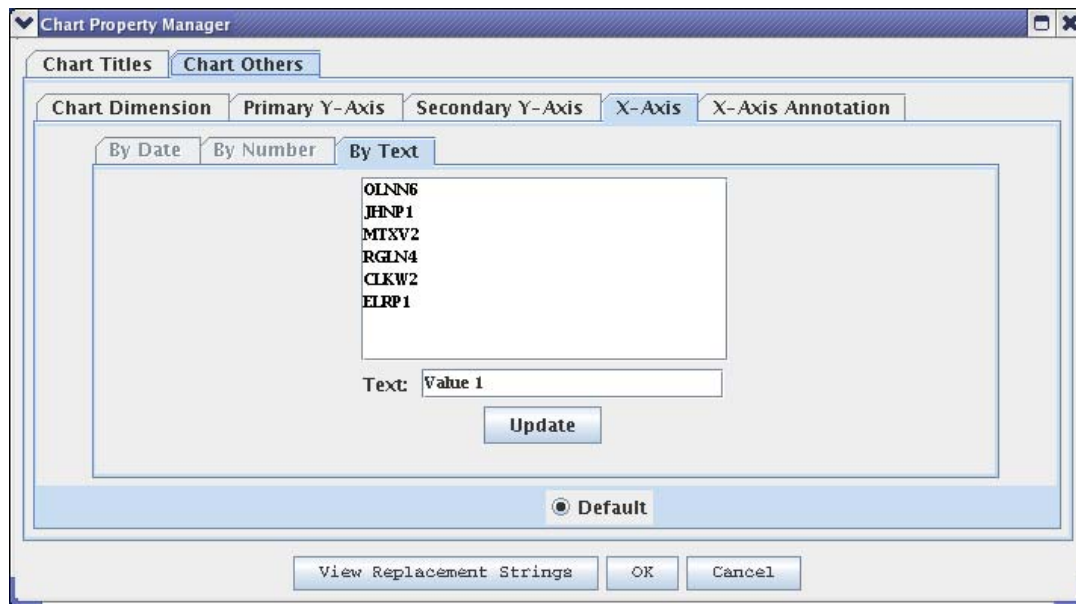
1. Click on the corresponding item in the **List**.

2. Type in the desired label in the text field. Do NOT include a replacement string (see Appendix C).
3. Click on **Update**.

After completing the last step, the **X-Axis Label List** should be updated to display the new label.

### 24.6.1 Buttons

- **Update** button: Updates the selected x-axis label in the **X-Axis Label List** to be the text currently in the text field.



### 24.7 Buttons

- **View Replacement Strings** button: Opens up a window displaying the replacement strings defined in Appendix C.
- **OK** button: Accepts the changes and closes the window.
- **Cancel** button: Closes the window without making any changes to the chart properties.

## 25.0 Tips and Information

This section provides tips about how to operate the IVP and how the windows interact.

### 25.1 System Settings File

An IVP System Settings File exists allowing for customization of the various windows and plots. It is described in Appendix A. If you need to change the size of windows, fonts used, column names in tables, or other items, check the appendix to see if it can be done and edit the System Settings File appropriately. The System Settings File is located at the following directory:

```
$(vsys_dir)/app-defaults/IVP_SYSTEM_FILE.txt
```

where `$(vsys_dir)` is the directory corresponding to `apps-defaults` token `vsys_dir`.

### 25.2 NOAA Logo Watermark

The NOAA logo is displayed as a watermark in the background of all charts. This image is drawn from this PNG file:

```
$(vsys_dir)/app-defaults/ivp_chart_bg.png
```

If you need to change the watermark, then just edit this file. If you need to remove the watermark, then just remove this file or change its name.

### 25.3 Replacement Strings

Replacement strings can be used for all titles, excluding legend entries and tick mark labels, within **IVP Data Display** and **IVP Statistic Display** charts. They can also be used for any output file name generated by the software (except for national statistics output). These strings allow for flexible labeling and file naming, based on parameters of the verification locations, verification groups, or plot definition. Replacement strings are described within Appendix C.

### 25.4 Performance

For large scale (tens or hundreds of thousands of pairs) verification products, the IVP can be a slow, memory intensive program. Two factors control the performance of the IVP: (1) system memory and (2) database usage. The following sections describe general solutions for performance issues, and then speed and memory specific solutions.

#### 25.4.1 General Solutions

For both speed and memory problems, the most basic solution is to reduce the number of pairs being analyzed by doing one of the following:

- Decrease the number of locations included in the **Verification Location Manager**.
- Decrease the size of the analysis interval in the **Verification Group Manager** in order to lessen the number of forecast-observed pairs included in the analysis.



If the products must be generated for the original set of pairs, then generate the product in the IVP by using one of the two methods above to reduce the number of pairs. After opening up the **IVP Statistic Display**, create a batch file via the **IVP Batch File Creation Wizard** and set the locations to use and the overall analysis interval to the required values for the larger product within the wizard. Then, run the IVP Batch Program with the created batch file to acquire the desired product. The IVP Batch Program is capable of producing products that involve more pairs than the IVP can handle.

### 25.4.2 Speed Solutions

If the IVP performs slowly, then you should take the following actions, in order, until the problem is resolved:

- If the slowness is in the rendering speed for the chart in the **IVP Data Display**, then zoom in on a subset of the chart. The IVP will render only the data in needs to render to generate a plot. So, by zooming in, the amount of data to render decreases and performance should improve.
- If the slowness is in querying the database, then turn off the SHEF decoders and any other programs that are accessing the archive database, if possible.
- Run IVP on a computer with better hardware (i.e. more memory and faster processor) that can see the archive database (with the `rax_pghost` and `pguser` apps-defaults tokens being changed appropriately). See the next Section for how to setup IVP to run on an AWIPS LX machine.

### 25.4.3 Memory Solutions

Based on experiments, the following table summarizes limitations on the number of pairs to analyze using the default memory settings of the IVP GUI for an AWIPS OB8.2 release:

System	Recommendation		Approx. Maximum
	pairs QC	product generation	
AX	20,000	20,000	40-60,000
LX*	100,000	400,000	600-800,000

\*See the next section for how to setup IVP to run on an LX box.

If the IVP runs out of memory, then use the `-m` and `-s` options of the `ivp` script to increase the amount of memory in the Java heap space. Run "`ivp -hh`" to see how to use these options.

## 25.5 Running IVP on AWIPS LX Machines

Generally, the AWIPS lx machines have greater resources than the archive machines and can access the archive database. To run the IVP software on an AWIPS lx machine, do the following:

1. Log-in to the ax machine.
2. Tar up the entire directory structure under the directory corresponding to apps-defaults token `vsys_dir`:

```
tar -cvf ivp.tar $(get_apps_defaults vsys_dir)/*
```

3. Put the tar file on the system where the IVP software is to run.

4. Select the directory where the software is to be located. The directory `/awips/hydroapps/lx/rfc/verify` may be a good choice. This directory will be denoted `<basedir>` below.
5. Untar the tar file into that directory:

```
cd <basedir>
tar -xvf ivp.tar
```

6. In your apps-defaults site file, change the token `verify_dir` to point to the directory `<basedir>`, or do the following:

```
export verify_dir=<basedir>
```

7. Set the `rax_pghost` apps-defaults token to be your archive (ax) machine. This may already be set correctly. This usually works:

```
export rax_pghost=ax
```

8. Set the `pguser` apps-defaults token to be a valid user.
9. Make sure all apps-defaults tokens needed by the software are present on the AWIPS LX system.

At this point the software should login to an lx machine and execute IVP using the command given in Section 3.0.

## 25.6 Debugging

The apps-defaults token `vsys_debug` can be used to acquire debugging output from all of the verification software (IVP, IVP Batch Builder, IVP Batch Program, Vfyruinfo Editor, etc.). To set it, export it as follows:

```
export vsys_debug=40
```

As the value of the `vsys_debug` goes up, the amount of output increases. Here are some common settings and some of what they will include in the screen output:

- |    |   |
|----|---|
| 0  | No screen output, except what is output from the wrapper scripts.   |
| 1  | Standard (default).   |
| 20 | Additional progress info, including locations as they are being processed and timing results for creating plotted data sets and rendering the plots.  |
| 40 | Database queries and number of records found will be output to the screen, except for queries involving the location, rivercrit, sensok, and vaddadjust tables; more detailed information about chart construction; additional output file information  |
| 60 | Database queries and results for the location, rivercrit, sensok, and vaddadjust tables; locations and time series identified for the IVP Data Display; x-axis and y-axis values for the IVP Statistics Display charts except for special plots; additional information about parsing batch tokens. |
| 80 | X-axis and y-axis values for the IVP Statistics Display charts for special plots; pair-by-pair building status updates and information about rejected observed data due to the sensok table (for the IVP Batch Program).  |

- 100 Status of computational subsets, output line generation, and location-by-location pair loading results within the verification computations; boundary computations based on category defining strings for verification locations; counts of number of observed candidates found in pairing for a forecast (for the IVP Batch Program); reasons for failing to load data from a pairs file (for the Pairs Ingestor software).
- 128 All output will be given, including every individual database record (observation, forecast, or pair) used, created, or compared (not recommended).

## ***25.7 Software Specifications***

The IVP has the following software specifications:

- Code written in Java 1.5
- Charting tool is ChartDirector Ver 4.1 (<http://www.advsofteng.com/>)

## Appendix A: System Settings File

### A.1 Overview

The IVP windows appear different on different operating systems. Therefore, it is necessary to allow for user to adjust the default display to accommodate multiple operating systems. The System Settings File allows the user to change the appearance of the windows. This appendix describes that file.

### A.2 Location

The following apps-defaults token must be set in order for the System Settings File to be found:

```
vsys_dir
```

The file is assumed to exist in the directory `$(vsys_dir)/app-defaults` with the name "IVP\_SYSTEM\_FILE.txt".

### A.3 System Settings File

The System Settings File uses the same file format as an IVP Batch Program batch file. However, rather than being read in sequentially, it is processed and stored at run-time so that each GUI component can extract the settings that pertain to it. If a command is given more than once within the System Settings File, the last instance will over-ride the earlier instances.

The following two sections provide a list of the commands ordered by the name of the affected components and a description of all of the commands ordered alphabetically.

#### A.3.1 Commands Listed by Affected Components

System Settings Token	Affected Components
ChartBGColor	All Charts
ChartExteriorBGColor	All Charts
ChartFGColor	All Charts
ChartGridColor	All Charts
ChartZLineColor	All Charts
LegendFont	All Charts
TickLabelFont	All Charts
TitleFont	All Charts
XAxisLabelFont	All Charts
YAxis2LabelFont	All Charts
YAxisLabelFont	All Charts
BorderFont	All Windows
ButtonFont	All Windows
LabelFont	All Windows
ListFont	All Windows
MenuFont	All Windows
TableFont	All Windows

<b>TextFieldFont</b>	All Windows
<b>CategoryEditorWindowHeight</b>	<b>Category Editor Manager</b>
<b>CategoryEditorWindowWidth</b>	<b>Category Editor Manager</b>
<b>DateChooserWindowHeight</b>	<b>Choose Date/Time Window</b>
<b>DateChooserWindowWidth</b>	<b>Choose Date/Time Window</b>
<b>RelDateChooserWindowHeight</b>	<b>Choose Relative Date/Time Window</b>
<b>RelDateChooserWindowWidth</b>	<b>Choose Relative Date/Time Window</b>
<b>BatchSaveWindowHeight</b>	<b>IVP Batch File Creation Wizard</b>
<b>BatchSaveWindowWidth</b>	<b>IVP Batch File Creation Wizard</b>
<b>ChartCatLineColor</b>	<b>IVP Data Display</b>
<b>ChartCrossHairLineColor</b>	<b>IVP Data Display</b>
<b>DestroyOldDisplayUponCreate</b>	<b>IVP Data Display</b>
<b>IVPDataCatLineWidth</b>	<b>IVP Data Display</b>
<b>IVPDataChartHeight</b>	<b>IVP Data Display</b>
<b>IVPDataChartWidth</b>	<b>IVP Data Display</b>
<b>IVPDataLocListWidth</b>	<b>IVP Data Display</b>
<b>ToolTipMode</b>	<b>IVP Data Display</b>
<b>IVPDataNavigatorMaxHeight</b>	<b>IVP Data Display (chart navigator panel)</b>
<b>ChartBadPairsColor</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartBadShownLocationColor</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartBadSymbol</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartGoodSymbol</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartPairsColor</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartShownLocationColor</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartXYLineColor</b>	<b>IVP Data Display (scatter view)</b>
<b>IVPDataXYLineWidth</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartYAxis1LineWidth</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartYAxis1SymbolSize</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartYAxis2LineWidth</b>	<b>IVP Data Display (scatter view)</b>
<b>ChartYAxis2SymbolSize</b>	<b>IVP Data Display (scatter view)</b>
<b>IVPDataChartTSColors</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSEmphasisColor</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSEmphasizedObservedSymbol</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSFcstLineWidth</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSForecastSymbol</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSObservedSymbol</b>	<b>IVP Data Display (time series view)</b>
<b>IVPDataChartTSWhiskerColor</b>	<b>IVP Data Display (time series view)</b>
<b>CommandListFont</b>	<b>Batch Token Viewer</b>
<b>IVPStatChooserWindowHeight</b>	<b>IVP Statistics Chooser Mgr</b>
<b>IVPStatChooserWindowWidth</b>	<b>IVP Statistics Chooser Mgr</b>
<b>IVPStatTableMgrWindowHeight</b>	<b>IVP Statistics Data Viewer</b>
<b>IVPStatTableMgrWindowWidth</b>	<b>IVP Statistics Data Viewer</b>
<b>IVPStatChartHeight</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartPrimaryColors</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartPrimaryLineSize</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartPrimarySymbols</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartPrimarySymbolSize</b>	<b>IVP Statistics Display</b>

<b>IVPStatChartSecondaryColors</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartSecondaryLineSize</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartSecondarySymbols</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartSecondarySymbolSize</b>	<b>IVP Statistics Display</b>
<b>IVPStatChartWidth</b>	<b>IVP Statistics Display</b>
<b>IVPSpecialChartPrimaryLineWidth</b>	<b>IVP Statistics Display</b> (special plot)
<b>IVPSpecialChartPrimarySymbolSize</b>	<b>IVP Statistics Display</b> (special plot)
<b>IVPSpecialChartSecondaryLineWidth</b>	<b>IVP Statistics Display</b> (special plot)
<b>IVPSpecialChartSecondarySymbolSize</b>	<b>IVP Statistics Display</b> (special plot)
<b>ROCXYLineColor</b>	<b>IVP Statistics Display</b> (ROC special plot)
<b>ROCXYLineWidth</b>	<b>IVP Statistics Display</b> (ROC special plot)
<b>ProgressWindowHeight</b>	<b>Progress Windows</b>
<b>ProgressWindowLabelFont</b>	<b>Progress Windows</b>
<b>ProgressWindowWidth</b>	<b>Progress Windows</b>
<b>DestroyOldDisplayUponCreate</b>	<b>Verification Group Manager</b>
<b>TextAreaWidth</b>	Replacement Strings Windows
<b>TextAreaHeight</b>	Replacement Strings Windows
<b>VfyGrpMgrSectionLabelFont</b>	<b>Verification Group Manager</b>
<b>VfyGrpMgrWindowHeight</b>	<b>Verification Group Manager</b>
<b>VfyGrpMgrWindowWidth</b>	<b>Verification Group Manager</b>
<b>VfyLocMgrChosenColor</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrChosenStageColor</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrColumnName&lt;#&gt;</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrColumnWidth&lt;#&gt;</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrUnchosenColor</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrUnchosenStageColor</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrWindowHeight</b>	<b>Verification Location Manager</b>
<b>VfyLocMgrWindowWidth</b>	<b>Verification Location Manager</b>
<b>IVPDataEditorMgrWindowHeight</b>	<b>Verification Pairs Data Editor</b>
<b>IVPDataEditorMgrWindowWidth</b>	<b>Verification Pairs Data Editor</b>
<b>IVPDataTableMgrWindowHeight</b>	<b>Verification Pairs Data Viewer</b>
<b>IVPDataTableMgrWindowWidth</b>	<b>Verification Pairs Data Viewer</b>
<b>VfyPlotDefWindowHeight</b>	<b>Verification Plot Definition Manager</b>
<b>VfyPlotDefWindowWidth</b>	<b>Verification Plot Definition Manager</b>

### A.3.2 Command Descriptions

Commands, indicated in **bold**, set parameter values that control the appearance of various IVP windows. The <value> on the line of the System Settings File that contains the command is usually restricted, depending on that command. Acceptable Values are listed for each command. The default value shown is the value assumed if the system settings command is not found.

The following are IVP system settings commands:

**BatchSaveWindowHeight = <number>**

*Description:* Controls the pixel height of the **IVP Batch File Save Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 330

**BatchSaveWindowWidth = <number>**

*Description:* Controls the pixel width of the **IVP Batch File Save Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 600

**BorderFont = <font>**

*Description:* Controls the font used border labels.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif:bold;10"

**ButtonFont = <font>**

*Description:* Controls the font used on button labels in the windows.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Courier;plain;12"

**CategoryEditorWindowHeight = <number>**

*Description:* Controls the pixel height of the **Forecast Category Editor** and **Observed Category Editor**.

*Acceptable Values:* positive integer value.

*Default Value:* 250

**CategoryEditorWindowWidth = <number>**

*Description:* Controls the pixel width of the **Forecast Category Editor** and **Observed Category Editor**.

*Acceptable Values:* positive integer value.

*Default Value:* 320

**ChartBadPairsColor = <color>**

*Description:* Controls the scatter point color in the **IVP Data Display Scatter View** for bad pairs.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* light\_gray

**ChartBadShownLocationColor = <color>**

*Description:* Controls the scatter point color in the **IVP Data Display Scatter View** for a highlighted location and bad pairs.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* dark\_gray

**ChartBadSymbol = <symbol>**

*Description:* Controls the symbol for bad pairs in the **IVP Data Display Scatter View**.

*Acceptable Values:* See **IVPstatChartPrimarySymbols**.

*Default Value:* "X"

**ChartBGColor = <color>**

*Description:* Controls the background color of the plot area within the chart.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* white

**ChartCatLineColor = <color>**

*Description:* Controls the category line color of the **IVP Data Display**.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* green

**ChartCrossHairLineColor = <color>**

*Description:* Controls the line colors for cross hairs fixed on a point.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* "204,102,0"

**ChartExteriorBGColor = <color>**

*Description:* Controls the background color area around the plot area within the chart.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* white

**ChartFGColor = <color>**

*Description:* Controls the foreground color of the charts.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* black

**ChartGoodSymbol = <symbol>**

*Description:* Controls the symbol for good pairs in the **IVP Data Display Scatter View**.

*Acceptable Values:* See **IVPStatChartPrimarySymbols**.

*Default Value:* "CIRCLE\_FILL"

**ChartGridColor = <color>**

*Description:* Controls the grid color of the charts.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* "160,160,160"

**ChartPairsColor = <color>**

*Description:* Controls the scatter point color in the **IVP Data Display Scatter View** for good pairs.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* red

**ChartShownLocationColor = <color>**

*Description:* Controls the scatter point color in the **IVP Data Display Scatter View** for a highlighted location and good pairs.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* yellow

**ChartWindowHeight = <number>**

*Description:* Controls the default height of a **Chart** window.

*Acceptable Values:* positive integer value.

*Default Value:* 500



**ChartWindowWidth = <number>**

*Description:* Controls the default width of a **Chart** window.

*Acceptable Values:* positive integer value.

*Default Value:* 650

**ChartXYLineColor = <color>**

*Description:* Controls the line  $y = x$  color in the **IVP Data Display**.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* orange

**ChartYAxis1LineWidth = <number>**

*Description:* Controls the default line width for data plotted along the primary (left-hand) Y-axis of the chart in the **IVP Data Display** and **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 3

**ChartYAxis1SymbolSize = <number>**

*Description:* Controls the default symbol size for data plotted along the primary (left-hand) Y-axis of the chart in the **IVP Data Display** and **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 5

**ChartYAxis2LineWidth = <number>**

*Description:* Controls the default line width for data plotted along the secondary (right-hand) Y-axis of the chart in the **IVP Data Display** and **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 3

**ChartYAxis2SymbolSize = <number>**

*Description:* Controls the default symbol size for data plotted along the secondary (right-hand) Y-axis of the chart in the **IVP Data Display** and **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 5

**ChartZLineColor = <color>**

*Description:* Controls the zooming rectangle (selected rectangle) line color and moving point line color.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* dark\_gray

**CommandListFont = <font>**

*Description:* Controls the font used on list items within the **Location List Panel** and the window that pops-up as a result of clicking **Actions >> View Batch Tokens**.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "TimesRoman;plain;12"

**DateChooserWindowHeight = <number>**

*Description:* Controls the default height of the **Choose Date/Time** window.

*Acceptable Values:* positive integer value.

*Default Value:* 275

**DateChooserWindowWidth = <number>**

*Description:* Controls the default width of a **Choose Date/Time** window.

*Acceptable Values:* positive integer value.

*Default Value:* 320

**DestroyOldDisplayUponCreate = <ON/OFF>**

*Description:* If set to **ON**, the IVP will destroy the old **IVP Data Display** before creating a new one.

*Acceptable Values:* **ON** or **OFF**.

*Default Value:* **OFF**

**IVPDataCatLineWidth = <number>**

*Description:* Controls the default line width of the category lines in the **IVP Data Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 3

**IVPDataChartHeight = <number>**

*Description:* Controls the default height of the chart within the **IVP Data Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 700

**IVPDataChartTSColors = "<color>;<color>;..."**

*Description:* Controls the colors used for time series within the **IVP Data Display Time Series** view. If more time series are displayed than colors listed, they will be plotted by rotating through system defaults. If the **IVPDataChartTSEmphasisColor** is included in this list, it will be removed.

*Acceptable Values:* list of colors, each of which satisfies Appendix A.5 requirements

*Default Value:* "red;green;orange;magenta;0,128,0;cyan"

**IVPDataChartTSEmphasisColor = <color>**

*Description:* Controls the color of the emphasized time series scatter points and lines. Observed colors are forced to be shades of gray.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* "blue"

**IVPDataChartTSEmphasizedObservedSymbol = <symbol>**

*Description:* Controls the symbol for emphasized observations in the **IVP Data Display Time Series** view.

*Acceptable Values:* See **IVPStatChartPrimarySymbols**.

*Default Value:* "DIAMOND\_FILL"

**IVPDataChartTSForecastSymbol = <symbol>**

*Description:* Controls the symbol for forecasts in the **IVP Data Display Time Series** view.

*Acceptable Values:* See **IVPStatChartPrimarySymbols**. A forecast from a good pair has this symbol. A forecast from a bad pair uses this symbol, but will remove any "\_FILL", making it hollow.

*Default Value:* "CIRCLE\_FILL"

**IVPDataChartTSFcstLineWidth = <number>**

*Description:* Controls the default line width of the line connect forecast points in a time series within the **IVP Data Display Time Series** view.

*Acceptable Values:* positive integer value.

*Default Value:* 1

**IVPDataChartTSObservedSymbol = <symbol>**

*Description:* Controls the symbol for observations in the **IVP Data Display Time Series** view.

*Acceptable Values:* See **IVPStatChartPrimarySymbols**.

*Default Value:* "DIAMOND"

**IVPDataChartTSWhiskerColor = <color>**

*Description:* Controls the color of the emphasized time series whisker line and observed points.

*Acceptable Values:* Any color string (see Section A.5)

*Default Value:* "128,128,255" (light blue)

**IVPDataChartWidth = <number>**

*Description:* Controls the default width of the chart within the **IVP Data Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 825

**IVPDataEditorMgrWindowHeight = <number>**

*Description:* Controls the default height of the **Verification Pairs Data Editor**.

*Acceptable Values:* positive integer value.

*Default Value:* 300

**IVPDataEditorMgrWindowWidth = <number>**

*Description:* Controls the default width of the **Verification Pairs Data Editor**.

*Acceptable Values:* positive integer value.

*Default Value:* 963

**IVPDataLocListWidth = <number>**

*Description:* Controls the default width of the **Location List Panel** and **Time Series List Panel** within the **IVP Data Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 175

**IVPDataNavigatorMaxHeight= <number>**

*Description:* Controls the maximum allowed height for the **Navigator Panel** of the **IVP Data Display**.

The **IVPDataLocListWidth** controls the maximum allowed width. The panel is determined based on these dimensions and an internal buffer around the displayed miniature chart image.

*Acceptable Values:* positive integer value.

*Default Value:* 130

**IVPDataTableMgrWindowHeight = <number>**

*Description:* Controls the default height of the **Verification Pairs Data Viewer**.

*Acceptable Values:* positive integer value.

*Default Value:* 400

**IVPDataTableMgrWindowWidth = <number>**

*Description:* Controls the default width of the **Verification Pairs Data Viewer**.

*Acceptable Values:* positive integer value.

*Default Value:* 700

**IVPDataXYLineWidth = <number>**

*Description:* Controls the default line width of the line  $y=x$  in the **IVP Data Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 3

**IVPSpecialChartPrimaryLineWidth = <number>**

*Description:* Controls the default line width of lines draw for primary statistics in an **IVP Statistics**

**Display** displaying a special plot.

*Acceptable Values:* positive integer value.

*Default Value:* 1

**IVPSpecialChartPrimarySymbolSize = <number>**

*Description:* Controls the default line symbol size for primary statistics in an **IVP Statistics Display** displaying a special plot.

*Acceptable Values:* positive integer value.

*Default Value:* 5

**IVPSpecialChartSecondaryLineWidth = <number>**

*Description:* Controls the default line width of lines draw for secondary statistics in an **IVP Statistics**

**Display** displaying a special plot.

*Acceptable Values:* positive integer value.

*Default Value:* 1

**IVPSpecialChartSecondarySymbolSize = <number>**

*Description:* Controls the default line symbol size for secondary statistics in an **IVP Statistics Display** displaying a special plot.

*Acceptable Values:* positive integer value.

*Default Value:* 5

**IVPStatChartHeight = <number>**

*Description:* Controls the default height of the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 525

**IVPStatChartPrimaryColors = "<color>;<color>;..."**

*Description:* Controls the colors used for primary statistics within the **IVP Statistics Display**. If more statistics are displayed than colors listed, they will be plotted using system defaults.

*Acceptable Values:* list of colors, each of which satisfies Appendix A.5 requirements

*Default Value:* "red;blue;green;orange;magenta;0,128,0;cyan"

**IVPStatChartPrimaryLineSize = <number>**

*Description:* Controls the width of lines drawn for primary statistics in the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 1

**IVPStatChartPrimarySymbols = "<symbol>;<symbol>;..."**

*Description:* Controls the symbols used for primary statistics within the **IVP Statistics Display**. If more statistics are displayed than symbols listed, they will be plotted using system defaults.

*Acceptable Values:* list of symbols, each of which is one of the following: "none", "circle", "cross", "diamond", "square", "star5", "star6", "star8", "hex", "oct", "x", "up\_tri", "left\_tri", "right\_tri", "down\_tri", "pent". Additionally, if the string ends with "\_fill", then the shape will be filled in. For example "up\_tri" will yield the outline of an upward pointing triangle, while "up\_tri\_fill" will be the same, but filled in.

*Default Value:* "circle\_fill;square\_fill;up\_tri\_fill;diamond\_fill;square;star5;cross"

**IVPStatChartPrimarySymbolSize = <number>**

*Description:* Controls the size of symbols drawn for primary statistics in the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 8

**IVPStatChartSecondaryColors = "<color>;<color>;..."**

*Description:* Controls the colors used for secondary statistics within the **IVP Statistics Display**. If more statistics are displayed than colors listed, they will be plotted using system defaults.

*Acceptable Values:* list of colors, each of which satisfies Appendix A.5 requirements

*Default Value:* "96,96,96;128,128,128;160,160,160"

**IVPStatChartSecondaryLineSize = <number>**

*Description:* Controls the width of lines drawn for secondary statistics in the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 1

**IVPStatChartSecondarySymbols = "<symbol>;<symbol>;..."**

*Description:* Controls the symbols used for secondary statistics within the **IVP Statistics Display**. If more statistics are displayed than symbols listed, they will be plotted using system defaults.

*Acceptable Values:* list of symbols, each of which is one of the following: "none", "circle", "cross", "diamond", "square", "star5", "star6", "star8", "hex", "oct", "x", "up\_tri", "left\_tri", "right\_tri", "down\_tri", "pent". Additionally, if the string ends with "\_fill", then the shape will be filled in. For example "up\_tri" will yield the outline of an upward pointing triangle, while "up\_tri\_fill" will be the same, but filled in.

*Default Value:* "circle\_fill;square\_fill;up\_tri\_fill;diamond\_fill;square;star5;cross"

**IVPStatChartSecondarySymbolSize = <number>**

*Description:* Controls the size of symbol drawn for secondary statistics in the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 8

**IVPStatChartWidth = <number>**

*Description:* Controls the default width of the **IVP Statistics Display**.

*Acceptable Values:* positive integer value.

*Default Value:* 775

**IVPStatChooserWindowHeight = <number>**

*Description:* Controls the default height of the **IVP Statistics Chooser Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 640

**IVPStatChooserWindowWidth = <number>**

*Description:* Controls the default width of the **IVP Statistics Chooser Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 870

**IVPStatTableMgrWindowHeight = <number>**

*Description:* Controls the default height of the **IVP Statistics Data Viewer**.

*Acceptable Values:* positive integer value.

*Default Value:* 500

**IVPStatTableMgrWindowWidth = <number>**

*Description:* Controls the default width of the **IVP Statistics Data Viewer**.

*Acceptable Values:* positive integer value.

*Default Value:* 200

**LabelFont = <font>**

*Description:* Controls the default font used on labels within the various windows.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Courier;plain;12"

**LegendFont = <font>**

*Description:* Controls the default font used within the legend of the various **Chart** windows and **Data Source Display** window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif;bold;8"

**ListFont = <font>**

*Description:* Controls the font used within lists in the program, including the **Select FCST\_TS Window**, for example.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "TimesRoman;plain;12"

**MenuFont = <font>**

*Description:* Controls the font used in the menus of the various windows.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Courier;plain;12"

**ProgressWindowHeight = <number>**

*Description:* Controls the height of a progress window.

*Acceptable Values:* positive integer value.

*Default Value:* 125

**ProgressWindowLabelFont = <font>**

*Description:* Controls the label used in the progress window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "TimesRoman;Bold;12"

**ProgressWindowWidth = <number>**

*Description:* Controls the width of a progress window.

*Acceptable Values:* positive integer value.

*Default Value:* 600

**RelDateChooserWindowHeight = <number>**

*Description:* Controls the default height of the **Relative Choose Date/Time** window.

*Acceptable Values:* positive integer value.

*Default Value:* 160

**RelDateChooserWindowWidth = <number>**

*Description:* Controls the default width of a **Relative Choose Date/Time** window.

*Acceptable Values:* positive integer value.

*Default Value:* 320

**ROCXYLineColor = <font>**

*Description:* Controls the default color of the  $y=x$  line plotted within an ROC special plot.

*Acceptable Values:* A color string (see Section A.5)

*Default Value:* black

**ROCXYLineWidth = <number>**

*Description:* Controls the default line width of the  $y=x$  line plotted within the ROC special plot.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* 3

**TableFont = <font>**

*Description:* Controls the default font used for table data, including the tables in the **Verification Pairs Data Manager** and **IVP Statistics Data Viewer**.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Courier;plain;12"

**TextFieldFont = <font>**

*Description:* Controls the default font used for text fields within the software.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "TimesRoman;plain;12"

**TextAreaHeight = <number>**

*Description:* Controls the default height of text area window used to display replacement strings.

*Acceptable Values:* positive integer value.

*Default Value:* 400

**TextAreaWidth = <number>**

*Description:* Controls the default width of the text area window used to display replacement strings.

*Acceptable Values:* positive integer value.

*Default Value:* 400

**TickLabelFont = <font>**

*Description:* Controls the default font used for the tick mark labels along all axes.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif;bold;8"

**TitleFont = <font>**

*Description:* Controls the default font used for the title in the **Chart** windows and the **Data Source Display** window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif:bold;10"

**ToolTipMode = <ON/OFF>**

*Description:* If set to **ON**, tool tips will be turned on for all tool bar items. Currently, this only affects the **IVP Data Display** toolbar.

*Acceptable Values:* **ON** or **OFF**.

*Default Value:* **ON**.

**VfyGrpMgrWindowHeight = <number>**

*Description:* Controls the default height of the **Verification Group Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 640

**VfyGrpMgrWindowWidth = <number>**

*Description:* Controls the default width of the **Verification Group Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 500

**VfyLocMgrColumnName<#> = <string>**

*Description:* Sets the name of the <#>-th column of the tables within the **Verification Location Manager** to be the specified string.

*Acceptable Values:* a string, which must be in quotes if spaces are included

*Default Value:* depends upon <#>; see the default display of the **Verification Location Manager**

**VfyLocMgrColumnWidth<#> = <number>**

*Description:* Sets the width of the <#>-th column of the tables within the **Verification Location Manager** to be the specified number.

*Acceptable Values:* positive integer value

*Default Value:* depends upon <#>: {20,20,85,30,30,30,30,70,51,51,51,51,51,165,165,55}.

**VfyLocMgrChosenColor = <color>**

*Description:* Controls the background color of the non-stage columns when a location is chosen for display in the **Location Table** of the **Verification Location Manager**.

*Acceptable Values:* a color (see Section A.5)

*Default Value:* pink

**VfyLocMgrChosenStageColor = <color>**

*Description:* Controls the background color of the stage columns when a location is chosen for display in the **Location Table** of the **Verification Location Manager**.

*Acceptable Values:* a color (see Section A.5)

*Default Value:* red



**VfyLocMgrUnchosenColor = <color>**

*Description:* Controls the background color of the non-stage columns when a location is not chosen for display in the **Location Table** of the **Verification Location Manager**.

*Acceptable Values:* a color (see Section A.5)

*Default Value:* white

**VfyLocMgrUnchosenStageColor = <color>**

*Description:* Controls the background color of the stage columns when a location is not chosen for display in the **Location Table** of the **Verification Location Manager**.

*Acceptable Values:* a color (see Section A.5)

*Default Value:* light\_gray

**VfyLocMgrWindowHeight = <number>**

*Description:* Controls the default height of the **Verification Location Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 710

**VfyLocMgrWindowWidth = <number>**

*Description:* Controls the default width of the **Verification Location Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 1015

**VfyPlotDefWindowHeight = <number>**

*Description:* Controls the default height of the **Verification Plot Definition Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 700

**VfyPlotDefWindowWidth = <number>**

*Description:* Controls the default width of the **Verification Plot Definition Manager**.

*Acceptable Values:* positive integer value.

*Default Value:* 560

**XAxisLabelFont = <font>**

*Description:* Controls the default font used for the x-axis in the **Chart** windows and the **Data Source Display** window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif:bold;10"

**YAxisLabelFont = <font>**

*Description:* Controls the default font used for the left y-axis in the **Chart** windows and the **Data Source Display** window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif:bold;10"

**YAxis2LabelFont = <font>**

*Description:* Controls the default font used for the right y-axis in the **Chart** windows and the **Data Source Display** window.

*Acceptable Values:* Any font string (see Section A.4)

*Default Value:* "Serif:bold;10"

## ***A.4 Generic Font Format***

All font settings for the IVP must be entered in the System Settings File with the following value format:

```
<font name>;<font style>;<font size>
```

where each component can have the following values:

<font name>: "Serif", "SanSerif", "TimesRoman" or "Courier"

<font style>: "plain", "bold", "italics" or "bold-italics"

<font size>: any integer representing a valid size for that font. If invalid, the system determined default size is used.

## ***A.4 Generic Color Format***

All color settings for the IVP must be entered in the System Settings File with the following value format:

```
<color> -or- <red> , <green> , <blue>
```

where each component can have the following values:

<color>: black, blue, cyan, dark\_gray, gray, green, light\_gray, magenta, orange, pink, red, white, yellow to use Java default colors, or an X11 color string as found in /usr/lib/X11/rgb.txt (only use the color strings that do not contain spaces).

<red> , <green> , <blue>: The red, blue, and green numerical values for a color. Each component must be an integer between 1 and 255, inclusive.

## Appendix B: The Statistics

The statistics are computed numerically from a sample of forecast-observed data pairs. The sections below describe the statistics computed by the IVP software. For the equations below,  $N$  is the number of samples satisfying the restrictions for a particular x-axis value,  $f_i$  is the forecast value in the  $i$ -th data pair, and  $o_i$  is the observed value in the  $i$ -th data pair.

### B.1 Output Information

The following table provides a complete listing of all statistics output by the IVP and IVP Batch Program. The table shows the following:

- The statistic group description, used in the following sections, and CALCSTATS "<STATn>" batch identifier.
- The corresponding statistic choice in the **IVP Statistic Chooser Manager**.
- The column header for the statistic in the output statistics file (see the *IVP Batch Program Users Manual for Verification*). This is also given in the **IVP Statistic Chooser Mgr** of the IVP GUI after the name of each of the statistics that can be chosen.
- The name of the statistic.

Group Description (CALCSTATS Identifier)	IVP Statistic Chooser Manager Choice	Output Statistics Column Header	Statistic
categorical statistics (CATSTATS)	PoD	POD	probability of detection
	Traditional FAR	TFAR	traditional false alarm ratio
	Hydrologic FAR	HFAR	hydrologic false alarm ratio
	Under Forecast Rate	UFR	under forecast rate
	Over Forecast Rate	OFR	over forecast rate
	Crit. Succ. Index	CSI	critical success index
	Gilbert Score	GILBERT	Gilbert score
	ROC Area	ROCAREA	ROC area
	Avg Lead Time Of Detection	AVGLDTM	average lead time of detection
	<not available>	SAMPLESO	sample size, observed
	SAMPLESF	sample size, forecast	
Error statistics (ERRORS)	RMSE	RMSE	root mean-squared error
	Maximum Error	MAXERR	maximum error
	Mean Abs Error	MAE	mean absolute error
	Mean Error	ME	mean error
Moments (MOMENTS)	Pearson's Correlation	CORR	Pearson's correlation coefficient
	Observed Mean	OBS_MEAN	observed mean
	Forecast Mean	FCST_MEAN	forecast mean
	Observed Std Dev	OBS_STDDEV	observed standard deviation
	Forecast Std Dev	FCST_STDDEV	forecast standard deviation
	Bias (%)	BIAS	bias (%)
Quantiles and extremes (QUANTILES)	Minimum	MINIMUM	minimum
	0.## Quantile	QUAN 0.##	##% quantile

	Median	MEDIAN	median
	Maximum	MAXIMUM	maximum
Skill scores relative to persistence (PERSISTSS)	RMSE-SS, Persist.	RMSESS_PER	RMSE skill score relative to persistence
	<not available>	RMSE_NONPER	component RMSE for non-persistence pairs
	<not available>	RMSE_PER	component RMSE for persistence pairs
	<not available>	SIZE_NONPER	sample size for non-persistence pairs
	<not available>	SIZE_PER	sample size for persistence pairs
Probability density plot* (PDFPLOT)	PDF Plot	PDFPLOT*	probability density plot
Cumulative density plot* (CDFPLOT)	CDF Plot	CDFPLOT*	cumulative distribution plot
ROC plot* (ROCPLLOT)	ROC Plot	ROCPLLOT*	relative operating characteristic curve plot
ANY	Statistic Sample Size	SAMPLE SIZE	number of pairs used in computing statistics

\* This group of statistics can only be generated when producing graphics.

### B.2 Categorical Statistics

Categorical statistics are calculated relative to a particular category. Regardless of whether the user chooses to use forecast categories or observed categories, the equations used to compute categorical statistics are the same. This means that the user only controls the boundaries defining the categories. It is usually best to plot the categorical statistics with an x-axis of either forecast categories or observed categories. After creating the display, the x-axis label should be changed to “Categories”, and each of the x-axis tick marks should be given an appropriate label, such as “Below FS” (below flood stage).

The following table will be used to describe the computation of each categorical statistic:

	Observed was...		
Forecast was...	<u>below</u>	<u>within</u>	<u>above</u>
<u>below</u>	<b>A</b>	<b>B</b>	<b>C</b>
<u>within</u>	<b>D</b>	<b>E</b>	<b>F</b>
<u>above</u>	<b>G</b>	<b>H</b>	<b>I</b>

As an example, the above table can be read as: “B is the number of pairs for which the observed is within the interval and the forecast is above the interval”. The statistics plotted against the left y-axis are as follows:

- *Probability of Detection*: The probability that, given an observed value is within the category, the forecast value is also within the category, or  $E/(B+E+H)$ .

- *Traditional False Alarm Ratio*: The probability that, given a forecast value is within the category, the observed value is not within the category (either above or below), or  $(D+F)/(D+E+F)$ .
- *Hydrologic False Alarm Ratio*: The probability that, given a forecast value is within the category, the observed value is below the category (useful when categories represent flood levels), or  $D/(D+E+F)$ .
- *Under Forecast Rate*: The probability that, given an observed value is within the category, the forecast value is below the category, or  $B/(B+E+H)$ .
- *Over Forecast Rate*: The probability that, given an observed value is within the category, the forecast value is above the category, or  $H/(B+E+H)$ .
- *Sample Size, Observed*: The number of pairs for which the observed value is within the category.
- *Sample Size, Forecast*: The number of pairs for which the forecast value is within the category.

Define a 2x2 contingency table using the 3x3 table above in such a way that the line between “within” and “above” defines the break point in the 2x2 table. Then the following terms are defined:

$$\begin{aligned} \text{HITS} &= A+B+D+E \\ \text{MISSES} &= G+H \\ \text{FARS} &= C+F \\ \text{TOTAL} &= A+B+C+D+E+F+G+H+I \\ \text{HITS RANDOM} &= (\text{HITS}+\text{MISSES}) * (\text{HITS}+\text{FARS}) / \text{TOTAL} \end{aligned}$$

The following two statistics are also computed:

- *Critical Success Index*: Commonly used in verification, the CSI integrates information from the POD and FAR, and is calculated as  $(\text{HITS})/(\text{HITS}+\text{MISSES}+\text{FARS})$ . For the uppermost category, this value will be assigned -999.0, since it is guaranteed to be 1 (no pairs are loaded larger than the uppermost category boundary, so MISSES and FARS are 0).
- *Gilbert Score*: Same as the CSI, but it attempts to account for hits due to random chance. It is calculated as  $(\text{HITS} - \text{HITS RANDOM})/(\text{HITS}+\text{MISSES}+\text{FARS} - \text{HITS RANDOM})$ .

There are two final categorical statistics:

- *Average Lead Time of Detection*: Average lead time, in hours, of all pairs within category E in the table above.
- *ROC Area*: The area under the relative operating characteristic curve. See Section B.7 for a description.

### ***B.3 Error Statistics***

Error statistics are calculated by using the difference between the forecast and observed value for each data pair in a formula of some kind. The statistics are calculated as follows:

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^N (f_i - o_i)^2}{N}}$$

$$\text{MaxErr} = \text{MAX} \{ |f_i - o_i| : i = 1, \dots, N \}$$

$$\text{MAE} = \frac{\sum_{i=1}^N |f_i - o_i|}{N}$$

$$\text{ME} = \frac{\sum_{i=1}^N (f_i - o_i)}{N}$$

### B.4 Moments

Moments provide summary statistics about the forecast and observed data comprising the pairs used in verification. The moments are as follows:

- *Observed (Forecast) Mean*: The sample mean of the observed (forecast) values:

$$\text{sample mean} = \frac{\sum_{i=1}^N x_i}{N} .$$

- *Observed (Forecast) Standard Deviation*: The sample standard deviation of the observed (forecast) values:

$$\text{sample standard deviation} = \sqrt{\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N - 1}} .$$

This is the unbiased estimate of the sample standard deviation for the population of observed (forecast) values.

- *Pearson's Correlation Coefficient*: The covariance of the forecasts and observations divided by the product of their individual standard deviations.
- *Bias (%)*: forecast mean divided by the observed mean. In the output, it will not be expressed as a percentage, but as a decimal.

### B.5 Quantiles and Extremes

The quantiles and extremes are computed by, first, building a set of points, and then calculating empirical probabilities based on the set. Given a probability  $p$ , a *quantile* is that value,  $x_p$ , for which  $P(X \leq p) = x_p$ . The steps in computing the quantiles are as follows:

1. Define which x-axis variable you wish to use.
2. If you wish to calculate the forecast (observed) quantile, in the **Verification Plot Definition Manager**, select "Do Not Use" from the **Forecast Category (Observed Category)** choice box. In the batch language, specify the category of "OBS" ("FCST") as a CALCSTATS parameter. In other words, quantiles and extremes are computed relative to the variable NOT being used to categorize the data, according to the column "CAT VAR".
3. For each x-axis variable, a set is built which includes all pairs that satisfy the condition placed on the category NOT chosen in Step 2, above. For example, if you wish to compute the forecast

- (observed) quantile, then the pairs used in calculations must be in the selected observed (forecast) category in order to be used in the computation.
4. Estimate the quantiles by building an empirical cumulative distribution function using probability estimates based on Bayesian plotting positions (Krzysztofowicz, 1992) and using linear interpolation to find the forecast (or observed) value that satisfies the quantile definition.
  5. Calculate the minimum and maximum by finding the largest and smallest forecast (observed) value used in estimating the empirical cumulative distribution function.

The quantile probabilities,  $p$ , are user specified via the batch language command `QUANTILES` or via the IVP **View/Change Statistics Parameters** window.

## ***B.6 Skill Scores***

Skill scores are computed as a comparison of forecasts with a baseline some kind. Currently, only the RMSE skill score relative to persistence forecasts is computed:

$$\text{RMSESS\_PER} = 1 - \frac{\text{RMSE}_{\text{forecast}}}{\text{RMSE}_{\text{persistence}}}$$

In this case, a value of 1 implies perfect skill, a value of 0 implies the same skill relative to the reference, and a negative value implies worse skill relative to the reference. For each skill score, the component statistics and the number of pairs used in computing the component statistics will be output. For `RMSESS_PER`, the component statistics are  $\text{RMSE}_{\text{forecast}}$  and  $\text{RMSE}_{\text{persistence}}$ .

## ***B.7 Special Plots***

There are three special plots produced by the IVP. The following sections describe each.

### ***B.7.1 Cumulative Distribution Function***

The first special plot is an estimate of the cumulative distribution functions (CDFPLOT). This is calculated based upon the variable for which the category in the **Verification Plot Definition Manager** is chosen as "Do Not Use". For example, to use the forecast variable to compute the CDFs, select "Do Not Use" from the **Forecast Category** choice box. The empirical estimate is computed using Bayesian plotting positions (Krzysztofowicz, 1992).

### ***B.7.2 Probability Density Function***

The second special plot is an estimate of the probability density functions (PDFPLOT). This is calculated based upon the variable for which the category in the **Verification Plot Definition Manager** is chosen as "Do Not Use". The function is estimated using  $N$  intervals evenly spaced from the largest value to the smallest value of the variable. The number of instances of the variable value within each interval is counted, and that number is scaled such that the total area of the histogram would be 1. Though it is computed as a histogram, in the plot, in order to make it easier to view, the points on the probability density function are connected by lines, where the x-coordinate of each point is the midpoint of the corresponding interval.

The value of  $N$  is 10, by default, and is user specified via the batch language command `PDF_BINS` or via the IVP **View/Change Statistics Parameters** window.

### B.7.3 Relative Operating Characteristic (ROC) Plot

The third special plot is an estimate of the relative operating characteristic (ROC) curves (ROCPLOT). It is computed point-by-point by defining some threshold for the observed value such that if it is exceeded some event of interest occurs. For example, using flood stage as the threshold value implies that the event of interest is flooding. Next, a threshold for the forecast value is defined such that if the forecast exceeds the threshold, an action is taken; the action being appropriate for when the observed value is above its threshold. For example, if the forecast threshold is the action stage (corresponding to an observed threshold of flood stage) then the action taken may be preparing for a flood. Then, for the forecast threshold, two numbers are computed:

- Probability of Detection (POD): Given the observed threshold is exceeded, the probability that the forecast threshold is exceeded.
- Probability of False Detection (POFD): Given the observed threshold is not exceeded, the probability that the forecast threshold is exceeded.

The ROC is a plot of the POD against POFD for many possible forecast thresholds. In this case, 100 thresholds are used by default, being equally spaced from the smallest forecast or observed value to the largest forecast or observed value. It is user specified via the batch language command `ROC_PTS` or via the IVP **View/Change Statistics Parameters** window.

Related to the ROC plot is the ROC Area, a categorical statistic (see Section B.2) which is the area under the curve in the ROC plot. If the ROC area is 0, then the POD is 0, which likely means that either (1) for any forecast threshold, your forecasts never detect observations above the observed threshold (not likely), or (2) that there are either no observations above or no observations below the observed threshold in the pairs data (most likely). This likely means insufficient data is being used to compute the ROC curve for the given observed threshold. If the ROC Area is missing (-999.0), then the threshold was improperly defined; most likely the batch file or GUI indicates a threshold that is -INFINITY by specifying the first category or all categories be used to define the threshold.

### B.8 Sample Size

The statistic sample size is the number of samples used to calculate a statistic; i.e.  $N$ . In the IVP Batch Program output statistics file, it is the number of pairs used to compute the statistics on the line of output. Within the IVP GUI, with an x-axis of location, it is the number of forecast-observed data pairs found for each location. With an x-axis of analysis interval, issuance time-of-day interval, or lead time interval, it is the number of pairs found for the interval. With an x-axis of forecast type source, it is the number of pairs found for each type source. With an x-axis of observed category or forecast category, the sample size is not directly related to the categorical statistics, as it is the number of pairs found where the value of which ever variable's (forecast or observed) category used is chosen as "Do Not Use" in the **Verification Plot Definition Manager** (or set via the `*_CAT_USED` commands in the IVP Batch Program) is within the defined category. For example, when computing categorical statistics against observed categories, it is the number of pairs where the forecast value is within each of the categories.

### B.9 References

Krzysztofowicz, R., "A Bayesian Estimator of an Empirical Distribution," working paper, University of Virginia, 1992.





## Appendix C: Replacement Strings

Replacement strings enable labels and file names to be specified in such a way that the text is based upon parameters of the corresponding verification location(s), verification group, or plot definition, so that the labels and names reflect the pairs involved in the computations. Replacement strings can be used in pairs file names (PAIRS\_FILE of *IVP Batch Program User's Manual for Verification*), output file names (OUTPUT\_FILE), image file and image data file names (GEN\_GRAPH), and chart property template file names (GRAPH\_TEMPLATE). They can also be used within any label text for a chart (see Section 24.0 and Appendix D). Replacements are made when the strings are needed; in other words, when a file is opened or when label text is specified within the chart.

The replacement strings are as follows:

Replacement String	What Replaces It
@ALLLIDS	Comma separated list of location ids (lid in the archive database). Equivalent to @ONELID if there is only one verification location.
@ALLLIDSHEFS	Comma separated list of location full identifiers of the format <lid>(<SHEF code>). Be careful using this, as it may create long lists if there is more than one location. Equivalent to @ONELIDSHEF if there is only one verification location.
@ANALYSISINT	The analysis interval; either "MONTHLY", "YEARLY" or "# hours".*
@ANALYSISWINDOW	The analysis window; equivalent to "@STARTTIME - @ENDTIME".*
@CATVAR	Either "observed" or "forecast" depending on which variable is used to categorize pairs.
@COMPVAR	The variable used for comparison, based on the choices available in the <b>Verification Plot Definition Manager</b> choice box.*
@DUREXTDESC	Descriptor of the duration and extremum SHEF codes; for example "Daily Maximum" or "Instantaneous Daily".
@DURS	Comma separated list of duration SHEF codes within the pairs.
@ENLDLTIME	The last lead time in the format "# hours".*
@ENDTIME	The end time of the analysis window, by default in format "CCYY-MM-DD hh:mm:ss TZC". The user can set the format manually; see @STARTTIME for how to do this.
@EXTREMUMS	Comma separated list of extremum SHEF codes within the pairs.
@FCSTCAT	The forecast category in the format "Cat#", where # is the number of interval, starting from the smallest (# = 1).
@FCSTTSS	Comma separated list of forecast type source SHEF codes within the pairs.
@LDTIMEINT	The lead time interval in the format "# hours".*
@LEADTIMES	The lead time interval, equivalent to "@STARTLDTIME - @ENLDLTIME".*
@ONELID	The location id for the first displayed location.
@ONELIDSHEF	The location identifier, <lid>(<SHEF code>), for the first displayed location.
@ONELOCNAME	The full name of the first displayed location defined for the group, as acquired from the location table of the archive database. *
@OBSCAT	The observed category in the format "Cat#", where # is the number of the interval starting from the smallest (# = 1).
@PEDATATYPE	The data type: "precipitation", "temperature", "height", "discharge", or nothing ("") if unknown.
@PES	Comma separated list of physical elements SHEF codes within the pairs.
@RESPTIMES	The response time setting.*
@RFC	Three letter RFC id found for the first location in the working verification group.

@STARTLDTIME	The very first lead time in the format "# hours".*
@STARTTIME	The start time of the analysis window, by default in format "CCYY-MM-DD hh:mm:ss TZC". The user can set the format manually by passing in a format string within "{ [ " and " ] }" following the replacement string. For example, "@STARTTIME{ [MON DD, CCYY] }". Note that "MON" corresponds to the three letter month abbreviation. Do not use quotes within the within the "{ [ " and " ] }"!
@STATVAR	Either "observed" or "forecast" depending on the variable for which statistics are computed. This is the opposite of @CATVAR.
@UNIT	A unit identifying string (i.e. "ft").
@XAXISTITLE	The title displayed by default for the x-axis, based upon the x-axis variable.*
@XAXISVAR	The variable used for the x-axis, based on the choices available in the <b>Verification Plot Definition Manager</b> choice box.*
@YAXIS1TITLE	The title displayed by default for the primary y-axis, given the primary statistics.*
@YAXIS2TITLE	The title displayed by default for the secondary y-axis, given the secondary statistics.*

\* This replacement string cannot be used in file names.

*NOTE: File names will have all white space removed after replacing the replacement strings.*

## Appendix D: Graphical Template File

### D.1 Overview

A graphical template file specifies the differences between characteristics of a plot produced by the IVP software and the default values. See Section 23.0 for a complete listing of the characteristics of a plot that can be user specified. Any graphical characteristic not set in the template file has a default value automatically determined for it based on the System Settings File (see Appendix A), data, or plot definition parameters. The file follows the same standard syntax as a System Settings File.

*NOTE: The **Chart Property Manager** should always be used to modify this file. Manual modification is not recommended, unless absolutely necessary.*

### D.1 Location

Unless the path to the template file is fully specified, the following apps-defaults token must be set in order for a System Settings File to be found:

```
vsys_files
```

By default, the files are assumed to exist in directory `$(vsys_files)/$(LOGNAME)/templates`.

### D.2 Commands

Commands, indicated in **bold**, set parameter values that control the characteristics of a plot. The `<value>` on the line of the System Settings File that contains the command is usually restricted, depending on that command. Acceptable Values are listed for each command. The default value shown is the value assumed if the system settings command is not found.

The following are graphic template file commands:

**ChartLegendTitle** = "`<text>;<font name>;<size>;<style>;<color-rgb>`"

*Description:* Controls the title of the legend: the text, font, and color.

*Acceptable Values:* See **ChartTitle**.

*Default Value:* Specified by system settings and default text.

**ChartHeight** = "`<number>`"

*Description:* Controls the default height of the chart.

*Acceptable Values:* any positive integer.

*Default Value:* Specified by system settings.

**ChartMinXValue** = "`<number>`"

*Description:* Controls the lower limit on the x-axis if the chart has a numerical x-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartMaxXValue = "<number>"**

*Description:* Controls the upper limit on the x-axis if the chart has a numerical x-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartPYAxisLower = "<number>"**

*Description:* Controls the lower limit of the primary (left-hand) y-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartPYAxisUpper = "<number>"**

*Description:* Controls the upper limit of the primary (left-hand) y-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartSYAxis = "<true/false>"**

*Description:* If true, then there will be a secondary y-axis.

*Acceptable Values:* anything.

*Default Value:* Calculated based on plot definition parameters.

**ChartSYAxisLower = "<number>"**

*Description:* Controls the lower limit of the secondary (right-hand) y-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartSYAxisUpper = "<number>"**

*Description:* Controls the upper limit of the secondary (right-hand) y-axis.

*Acceptable Values:* any real number.

*Default Value:* Calculated based on data.

**ChartTitle = "<text>;<font name>;<size>;<style>;<color-rgb>"**

*Description:* Controls the title of the chart: the text, font, and color.

*Acceptable Values:* The components must be of this format:

- **<text>**: A string that cannot include carriage returns. To have a multi-line title, the text must use HTML tags: it must start with "<html>", end with "<\html>", and use "<br>" to represent carriage returns (new-lines) in the middle.
- **<font name>**: The name of the font to use.
- **<size>**: The size of the font (a positive integer).
- **<style>**: The style of the font: 0 for plain, 1 for bold, 2 for italic, 3 for bold and italic.
- **<color-rgb>**: The color must be specified in full RGB and must use semicolons instead of commas: "<red>;<green>;<blue>"

*Default Value:* Specified by system settings and default text.

**ChartWidth = "<number>"**

*Description:* Controls the default height of the chart.

*Acceptable Values:* any positive integer.

*Default Value:* Specified by system settings.

**ChartXAxis = "<label 1>;...;<label N>"**

*Description:* Provides the x-axis tick mark labels if the chart has a categorical x-axis.

*Acceptable Values:* A semicolon delimited list of strings.

*Default Value:* Specified by plot definition parameters (x-axis variable value).

**ChartXAxisMode = "<number>"**

*Description:* Controls the type of x-axis.

*Acceptable Values:* 1 for numerical x-axis (any special plot) or 2 for categorical x-axis (any other plot).

*Default Value:* Calculated based on statistics specified.

**ChartXTickRotate = "<number>"**

*Description:* Controls the rotation of the tick mark labels for the x-axis.

*Acceptable Values:* 0 for 0 degrees, 1 for 90 degrees, 2 for 180 degrees, 3 for 270 degrees.

*Default Value:* 0

**ChartXAxisTitle = "<text>;<font name>;<size>;<style>;<color-rgb>"**

*Description:* Controls the title of the x-axis: the text, font, and color.

*Acceptable Values:* See **ChartTitle**.

*Default Value:* Specified by system settings and default text.

**ChartYAxis1Title = "<text>;<font name>;<size>;<style>;<color-rgb>"**

*Description:* Controls the title of the primary (left-hand) y-axis: the text, font, and color.

*Acceptable Values:* See **ChartTitle**.

*Default Value:* Specified by system settings and default text.

**ChartYAxis2Title = "<text>;<font name>;<size>;<style>;<color-rgb>"**

*Description:* Controls the title of the secondary (right-hand) y-axis: the text, font, and color.

*Acceptable Values:* See **ChartTitle**.

*Default Value:* Specified by system settings and default text.

**ChartTickMarkFont = "<text>;<font name>;<size>;<style>;<color-rgb>"**

*Description:* Controls the title of the primary (left-hand) y-axis: the text, font, and color.

*Acceptable Values:* See **ChartTitle**, except the <text> is ignored.

*Default Value:* Specified by system settings and default text.

**Legends = "<legend item 1>;...;<legend item N>"**

*Description:* Provides legend items for the legend. Each item must then have a line in the file corresponding to <legend item #>.

*Acceptable Values:* A semicolon delimited list of strings.

*Default Value:* Specified by system settings and default text.

**<legend item #> = "<text>;<font name>;<size>;<style>;<color-rgb>;<symbol>"**

*Description:* Controls each of the components of the legend.

*Acceptable Values:* See **ChartTitle**, except the font parameters are ignored and <symbol> follows the same format as **IVPStatChartPrimarySymbols** in the System Settings File (Appendix A).

*Default Value:* Specified by system settings and default text.