IVP Charting Examples

By

Henry Herr
Office of Hydrologic Development
National Weather Service

1.0 Overview

This document provides examples for use with the IVP and IVP Batch Program. It should be used in conjunction with the user's manuals in order to understand how to use the batch language and GUI to generate plots.

> *NOTE: Though the location ids may be real within the examples of this document, the data is manufactured for testing. These examples should not be used to draw any conclusions pertaining to the real locations.*

1.1 Using This Manual

Refer to the examples herein, as needed, to understand how to generate graphics within the IVP software suite. The table provided in Section 4.0 summarizes the examples. Check the table to determine which example to examine and then go to the Section devoted to that example for more information.

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.
- 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 or in a batch file 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 Example Section Format

Each example section will provide the following:

- A description of the example and what the goal of the user may be in generating such a plot.
- Notes about the example.
- A listing of the batch file contents, as created by using the **IVP Batch File Creation Wizard** within the IVP.
- Screenshots of the **Verification Plot Definition Manager**, the **Verification Group Manager (Plot Definition)**, and the **Chosen Locations Table** within the **Verification Location Manager (Plot Definition)**.
- The produced chart image.

The batch files provided in each example section can be generalized to any locations at any RFCs by changing these sections:

- Change the "LOCATION DEFINITIONS" section appropriately for the locations used. Be sure to choose appropriate categories for analysis.
- Change the "GROUP PARAMETER DEFINITIONS" section to reflect the desired time frame. The lead time may also need to be changed if forecast lead times are longer or shorter than those in the example.
- Change the "GROUP DEFINITION(S)" section, if necessary. Specifically, the SHEF code commands and the DEF_GRP command may require changing in order to add the desired locations to the group.

4.0 Example Summary Table

#	Example Section Number and Name	Description
1	Errors vs. Lead Time	Create a chart of error statistics plotted against lead time, where the lead times are 0-24, 24-48, 48-72, 72-96, and 96-120 hours . Error statistics will be plotted as a line in order to see the trend.
2	Errors and Sample Size vs. Lead Time	Create a chart of error statistics and sample size plotted against lead time. Error statistics will be plotted as a line plot along the left-hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
3	RMSE and Sample Size vs. Lead Time Compared Over Forecast Type Sources	Create a chart of the RMSE and sample size against lead time and compared for different forecast type sources, including persistence. Error statistics will be plotted as a line plot along the left-hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
4	RMSE-SS and Sample Size vs. Lead Time Compared Over Forecast Type Source	Create a chart of the RMSE skill score vs. persistence and sample size against lead time and compared for different forecast type sources. RMSE-SS will be plotted as a line plot along the left hand y-axis. Sample size will be plotted as a bar plot along the right hand y-axis.
5	RMSE-SS and Sample Size vs. Lead Time	As above, but not compared over forecast type source. The two should plots should be visibly related to each other.
6	CDF Plots of Forecasts Compared Over Observed Categories	Create a CDF special plot comparing the cumulative distribution functions of the forecast values over different ranges of observed values. This can be used to see how well the forecast discriminates between observed values.
7	PDF Plots Corresponding to CDF plots above	Create a PDF special plot that corresponds to the CDF special plots, above.
8	Quantile Plot Corresponding to CDF plots above.	Create a plot of the quantiles that corresponds to the CDF special plots, above. The quantiles will be plotted as a line plot against the left hand y-axis.
9	Categorical Statistics vs. Yearly Analysis Interval	Create a chart of the POD, FAR, and ROC Areas and the average lead time to detection against the analysis interval. The analysis period will be the months of January, February, and March over the years 1997-2002, and the analysis interval will be yearly. Statistics will be plotted as a line plot along the left hand y-axis.
10	ROC Plot Compared over Analysis Interval	Generate the ROC plots that yielded the ROC Area statistics shown in the previous example.

5.0 Example 1

This example is designed to see how the forecast skill relates to lead time. The statistics displayed are error statistics, and each should tend to increase with lead time: as the lead time increases, the forecast skill decreases. However, the mean error may show no trend. This is because a consistent trend in the mean error implies bias in the forecast that becomes more significant with lead time. If the forecasts are unbiased, there should be no trend in the mean error, though the other errors should still increase.

5.1 Notes

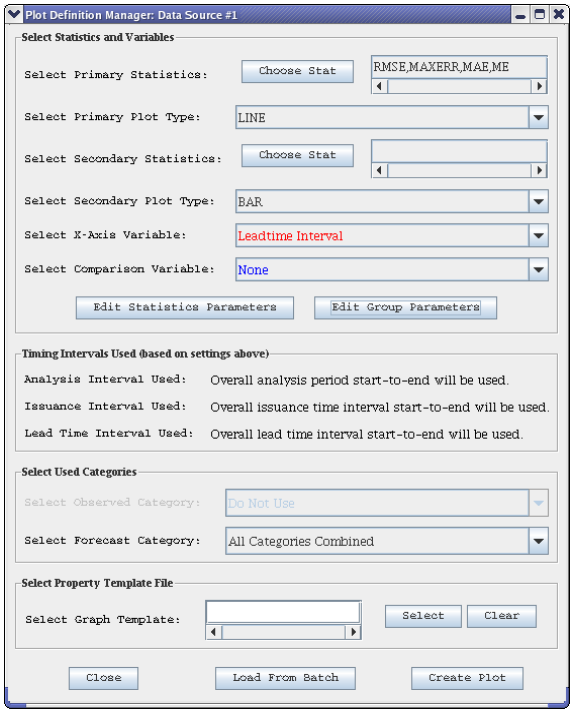
- This example shows that it is not a good idea to plot larger statistic values along the same y-axis as smaller statistic values. In this case, the maximum error (MAXERR) is so large it makes it very difficult to see the trends present in the other three statistics.
- Note the portion of the batch file devoted to resetting the SHEF code batch commands to default values, highlighted in the next section. These commands are used to define locations (DEF_LOC) and define groups (DEF_GRP). So, if you do not reset these values to their defaults after defining the locations, you may end up accidentally restricting the locations included in a group. See the *IVP Batch Program User's Manual for Verification* for more information. In batch files generated via the **IVP Batch File Creation Wizard** of the IVP, redundancy exists for these parameters, as they are reset after defining the locations and before defining the groups.
- When computing error statistics, and when the FCST_CAT_USED and OBS_CAT_USED commands are set as highlighted, the categories play no roll in computations. So the forecast category defining boundary of 6 ft (see the **Chosen Locations Table**) has no affect on the chart.

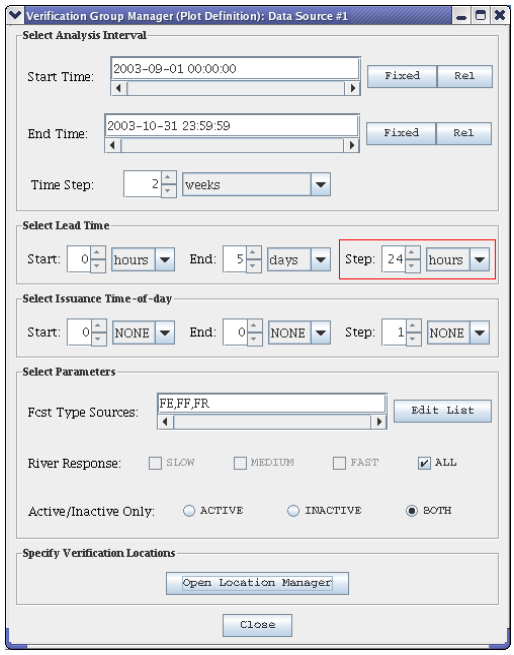
5.2 Batch File

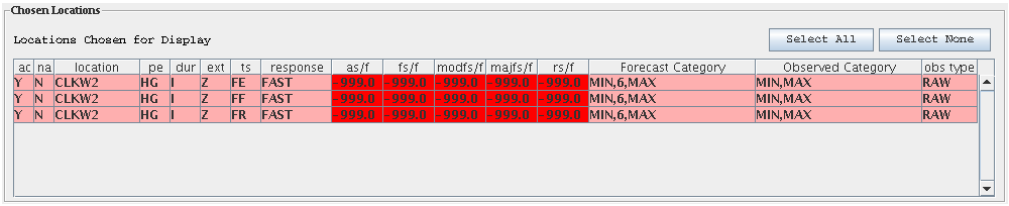
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,MAX
FCST_CAT = MIN,6,MAX
DEF_LOC = CLKW2

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
ANALYSIS_INTERVAL = 2weeks
LEADTIME_START = 0hours
LEADTIME_END = 5days
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FE,FF,FR
RIVERRESPONSE = ALL
ACTIVE_STATUS = BOTH
DEF_GRP = CLKW2
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = RMSE,MAXERR,MAE,ME
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = NONE
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = LDTIME
COMP_VARIABLE = NONE
FCST_CAT_USED = ALL
OBS_CAT_USED = NONE
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example1.png,example1.dat"
```

5.3 Screenshots

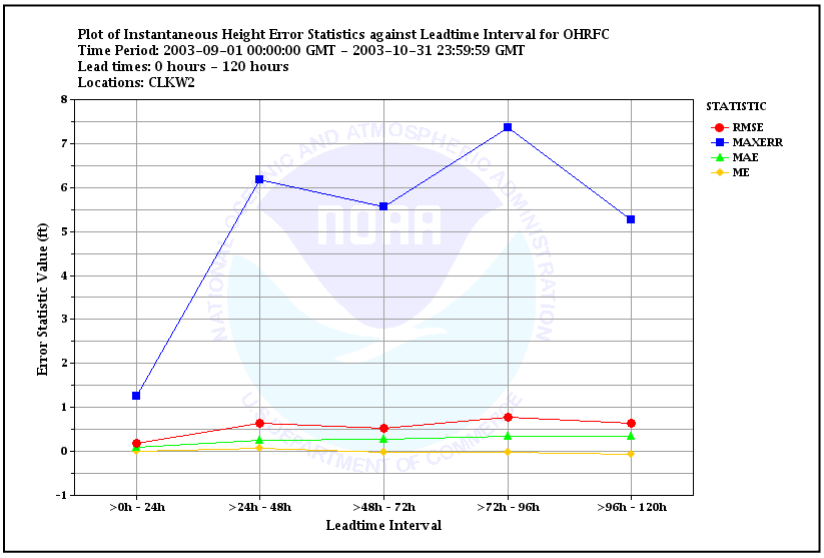






ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST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

5.4 Chart



6.0 Example 2

This is a continuation of example 1. In this case, we add the sample size plotted against the right-hand y-axis. Confidence intervals are not available in this version of the IVP. So, the best way to determine how much confidence to have in a plotted statistics is to examine the number of samples used to compute those statistics.

6.1 Notes

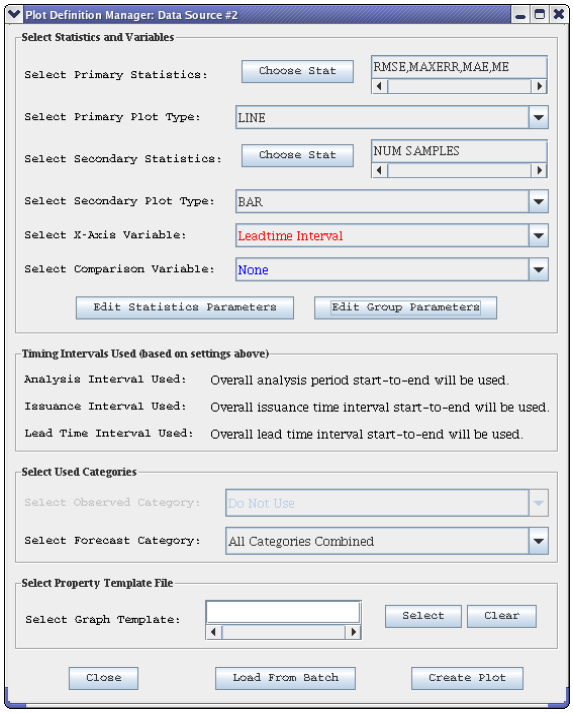
6.2 Batch File

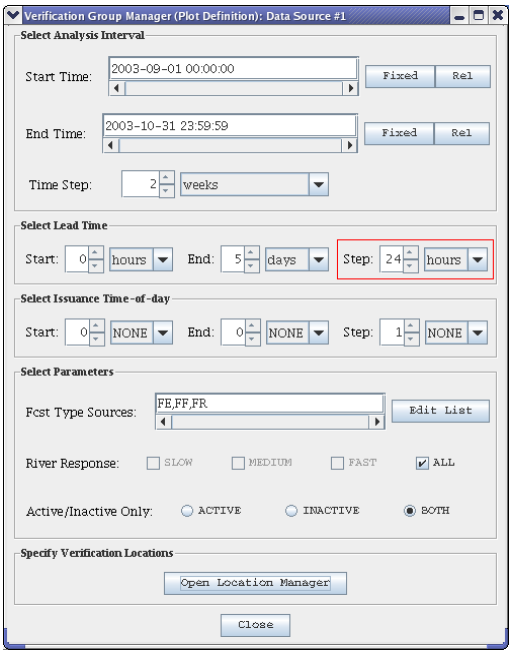
Differences between this batch file and that in Example 1 are highlighted.

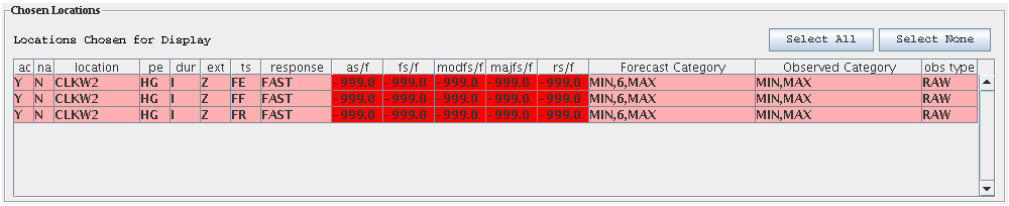
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,MAX
FCST_CAT = MIN,6,MAX
DEF_LOC = CLKW2

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
ANALYSIS_INTERVAL = 2weeks
LEADTIME_START = 0hours
LEADTIME_END = 5days
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FE,FF,FR
RIVERRESPONSE = ALL
ACTIVE_STATUS = BOTH
DEF_GRP = CLKW2
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = RMSE,MAXERR,MAE,ME
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = "NUM SAMPLES"
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = LDTIME
COMP_VARIABLE = NONE
FCST_CAT_USED = ALL
OBS_CAT_USED = NONE
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example2.png,example2.dat"
```

6.3 Screenshots

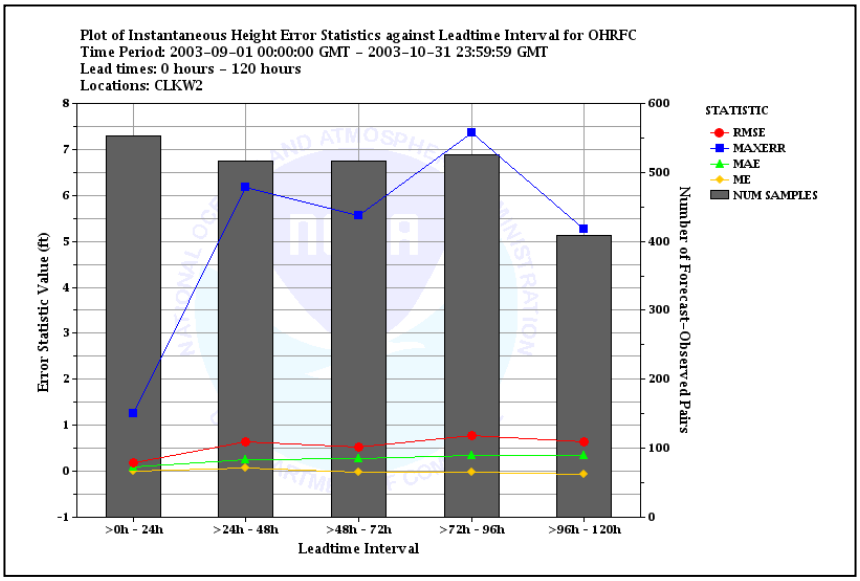






ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST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

6.4 Chart



7.0 Example 3

This is a continuation of example 2. In this case, we want to compare the statistics over three forecast type sources: FE, FF, and FR (persistence forecasts). However, with four statistics chosen and three type sources, there will be 12 lines produced in addition to three sample sizes. So, in this example we only examine the root-mean squared error statistic (RMSE).

7.1 Notes

- The comparison variable is reflected in the legend of the chart.
- The persistence forecast RMSE is consistently lower than the other two RMSEs. This is a sign that persistence may be outperforming the regular forecasts.

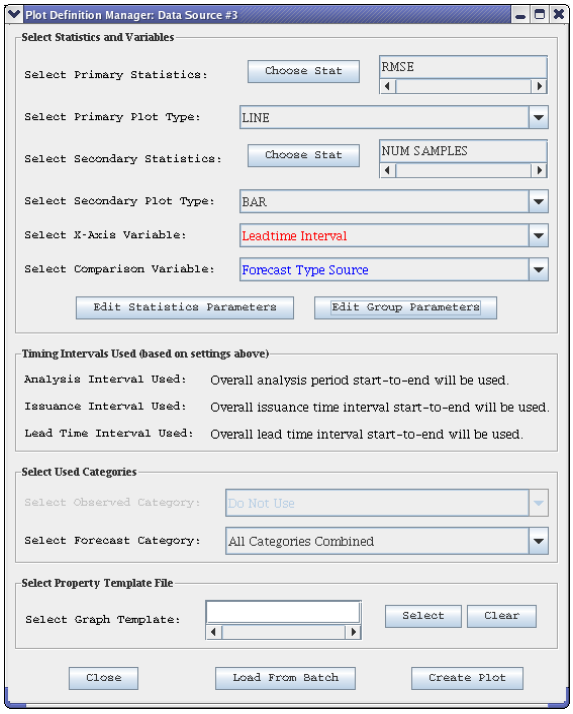
7.2 Batch File

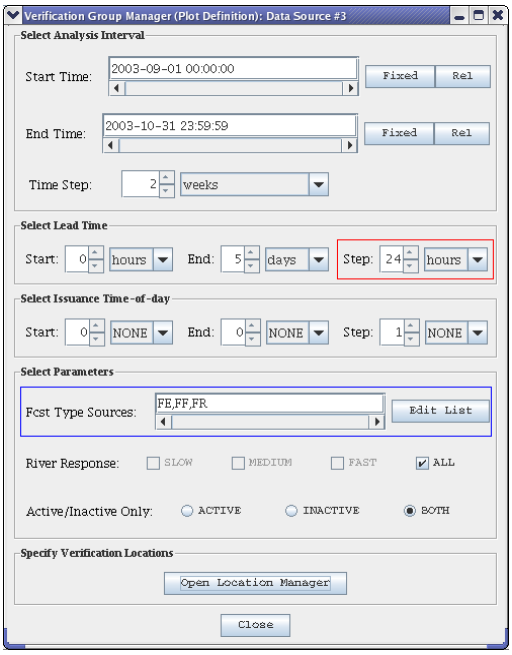
Differences between this batch file and that in Example 2 are highlighted.

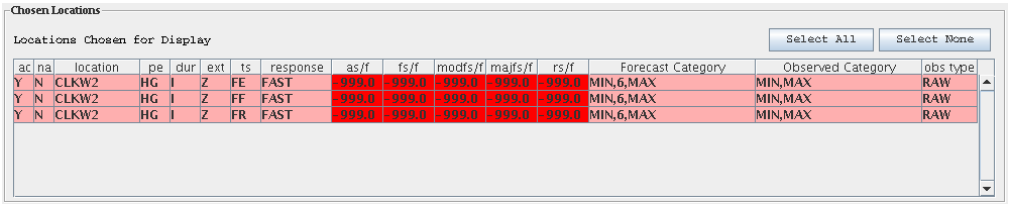
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,MAX
FCST_CAT = MIN,6,MAX
DEF_LOC = CLKW2

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
ANALYSIS_INTERVAL = 2weeks
LEADTIME_START = 0hours
LEADTIME_END = 5days
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FE,FF,FR
RIVERRESPONSE = ALL
ACTIVE_STATUS = BOTH
DEF_GRP = CLKW2
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = RMSE
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = "NUM SAMPLES"
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = LDTIME
COMP_VARIABLE = FCST_TS
FCST_CAT_USED = ALL
OBS_CAT_USED = NONE
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example3.png,example3.dat"
```

7.3 Screenshots

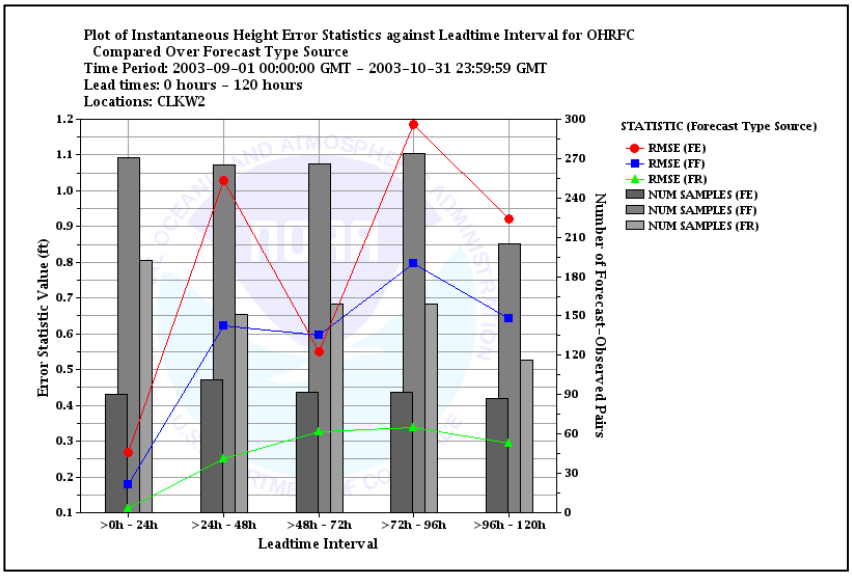






ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST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

7.4 Chart



8.0 Example 4

This is a continuation of example 3. Having seen that the persistence forecasts appear to outperform the regular forecasts, this example will display the RMSE skill score (RMSE-SS) vs. persistence (RMSESS_PER) for the different forecast type sources so that we can compare them.

8.1 Notes

- The 'FR' RMSE-SS vs. persistence is undefined, since 'FR' is the persistence forecast type source. However, the software will still see type source 'FR' as a forecast type source for which to produce a plot. Hence, the "RMSESS_PER(FR)" entry in the legend which has no corresponding data.
- Negative values for all of the skill scores confirm that persistence shows better skill than the regular forecasts relative to RMSE.
- The plot title and y-axis for this plot include the phrase "Correlation, Bias, and/or Skill". In this case, the plot is only for the skill score, so the chart properties should be adjusted to state "RMSE-SS vs. Persistence" instead via the **Chart Properties Manager** of the IVP. These changes could be saved to a template file and applied to the chart within the batch language by changing the line for GRAPH_TEMPLATE (highlighted) to specify the file location.

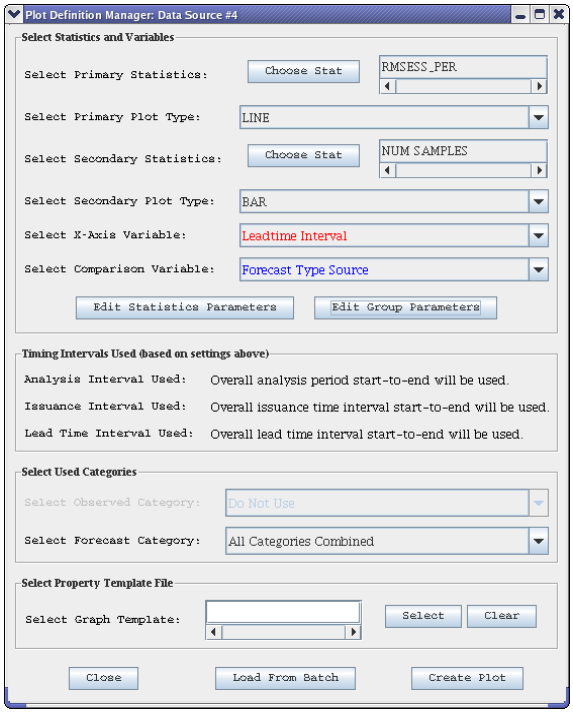
8.2 Batch File

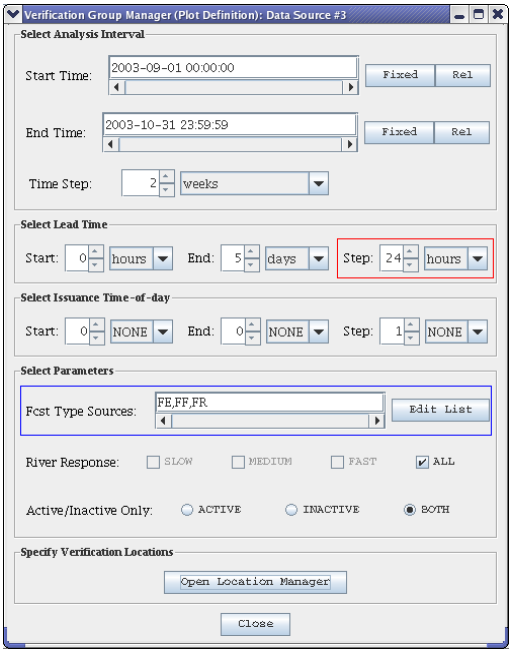
Differences between this batch file and that in Example 3 are highlighted.

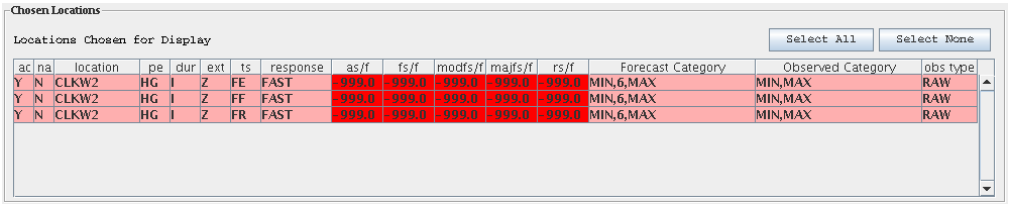
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,MAX
FCST_CAT = MIN,6,MAX
DEF_LOC = CLKW2

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
ANALYSIS_INTERVAL = 2weeks
LEADTIME_START = 0hours
LEADTIME_END = 5days
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FE,FF,FR
RIVERRESPONSE = ALL
ACTIVE_STATUS = BOTH
DEF_GRP = CLKW2
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = RMSESS_PER
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = "NUM SAMPLES"
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = LDTIME
COMP_VARIABLE = FCST_TS
FCST_CAT_USED = ALL
OBS_CAT_USED = NONE
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example4.png,example4.dat"
```

8.3 Screenshots

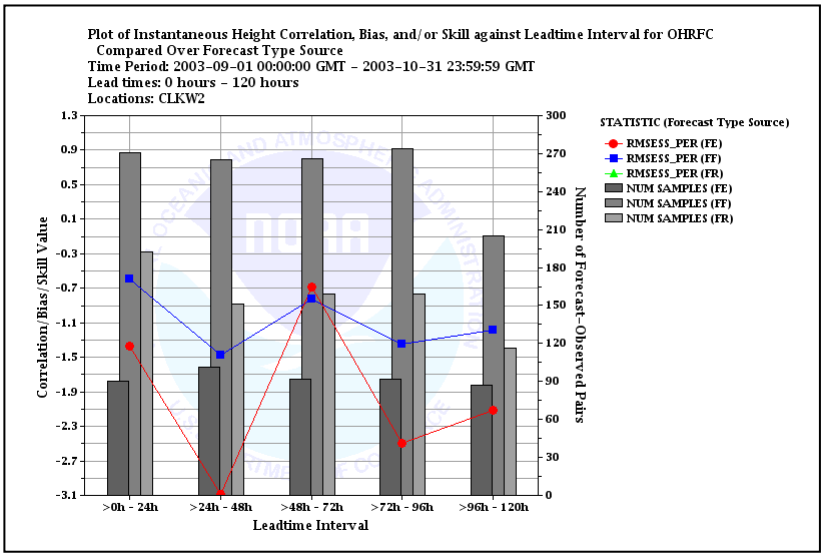






ac	na	location	pe	dur	ext	ts	response	as/f	fs/f	modfs/f	majfs/f	rs/f	Forecast Category	Observed Category	obs type
Y	N	CLKW2	HG	I	Z	FE	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FF	FAST	-999.0	-999.0	-999.0	-999.0	-999.0	MIN,6,MAX	MIN,MAX	RAW
Y	N	CLKW2	HG	I	Z	FR	FAST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

8.4 Chart



9.0 Example 5

This is a continuation of example 4. This example is only used to show the relationship between the skill scores computed independently for each forecast type source, and those that would result from computing for both forecast type sources lumped together.

9.1 Notes

- The overall RMSE-SS vs. persistence is between the two scores shown in example 4. It is closer to the skill score that has a greater number of samples associated with it; that for the forecast type source FF for each lead time.

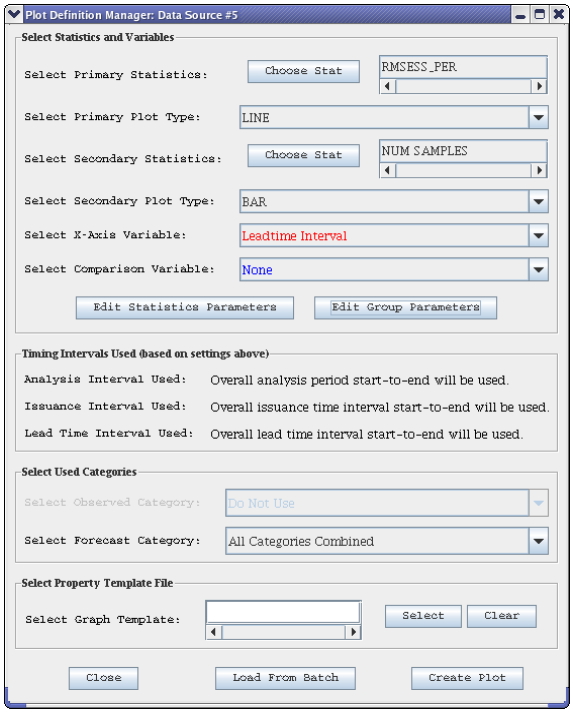
9.2 Batch File

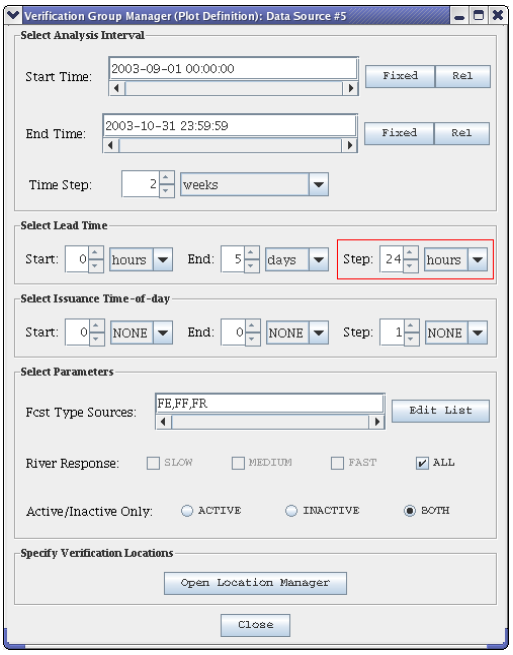
Differences between this batch file and that in Example 4 are highlighted.

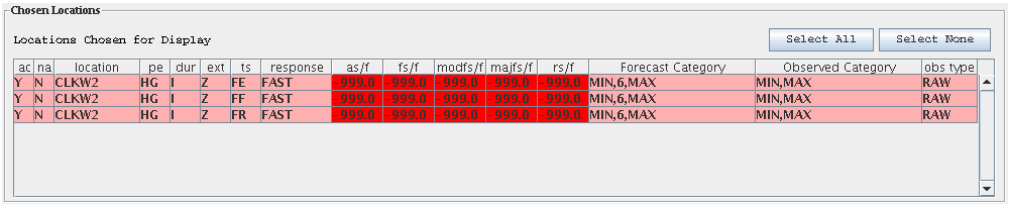
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FE,FF,FR
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,MAX
FCST_CAT = MIN,6,MAX
DEF_LOC = CLKW2

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2003-09-01 00:00:00"
END_TIME = "2003-10-31 23:59:59"
ANALYSIS_INTERVAL = 2weeks
LEADTIME_START = 0hours
LEADTIME_END = 5days
LEADTIME_STEP = 24hours
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FE,FF,FR
ACTIVE_STATUS = BOTH
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FE,FF,FR
RIVERRESPONSE = ALL
ACTIVE_STATUS = BOTH
DEF_GRP = CLKW2
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = RMSESS_PER
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = "NUM SAMPLES"
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = LDTIME
COMP_VARIABLE = NONE
FCST_CAT_USED = ALL
OBS_CAT_USED = NONE
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example5.png,example5.dat"
```

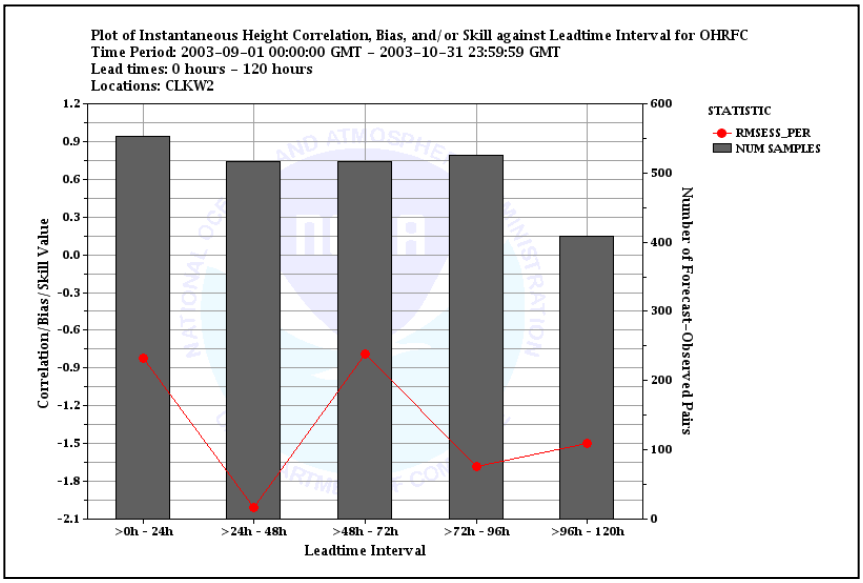
9.3 Screenshots







9.4 Chart



10.0 Example 6

This example looks at the cumulative distribution functions (CDFs) for the forecast value compared over observed categories. This is one of several tools that can be used to determine if the forecasts are distinguishing between different observed categories. The CDFs are estimated empirically from the forecast-observed pairs data.

In this specific case, precipitation is being analyzed. We want to examine how well the forecast distinguishes between zero precipitation and non-zero precipitation (defined as >0.001 inches).

10.1 Notes

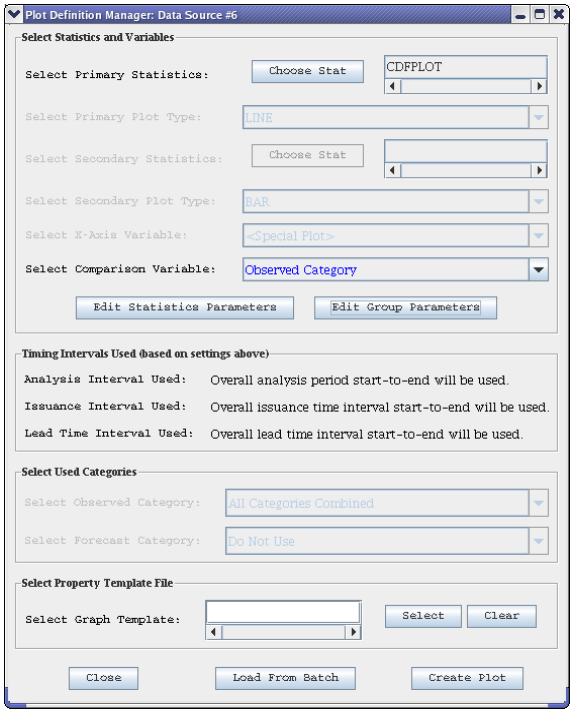
- There is a noticeable difference between the two CDFs. This implies the forecast may be distinguishing fairly well between zero and non-zero precipitation events.
- The legend entries are “Cat 1” and “Cat 2”, which do not state how the categories are defined. In this case, the categories are “No Precipitation” and “Precipitation”. The legend component of the chart properties could be changed via the **Chart Properties Manager** of the IVP to reflect this. These changes could be saved to a template file and applied to the chart within the batch language by changing the line for GRAPH_TEMPLATE (highlighted) to specify the file location.

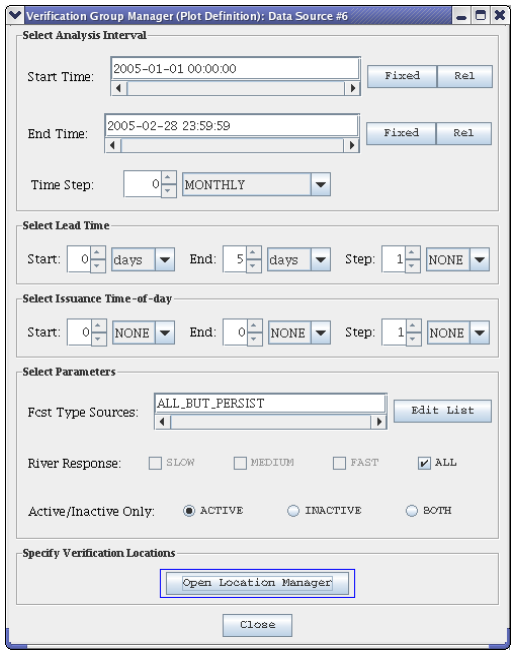
10.2 Batch File

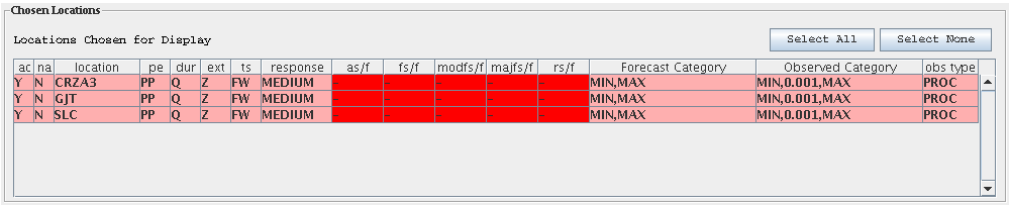
```
#======== LOCATION DEFINTIONS
PE = PP
DUR = Q
FCST_TS = FW
EXTREMUM = Z
OBS_TYPE = PROCESSED
OBS_CAT = MIN,0.001,MAX
FCST_CAT = MIN,MAX
DEF_LOC = CRZA3,GJT,SLC

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2005-01-01 00:00:00"
END_TIME = "2005-02-28 23:59:59"
ANALYSIS_INTERVAL = MONTHLY
LEADTIME_START = 0days
LEADTIME_END = 5days
LEADTIME_STEP = NONE
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = ALL_BUT_PERSIST
ACTIVE_STATUS = ACTIVE
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = ALL_BUT_PERSIST
RIVERRESPONSE = ALL
ACTIVE_STATUS = ACTIVE
DEF_GRP = CRZA3,GJT,SLC
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = CDFPLOT
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = NONE
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = NONE
COMP_VARIABLE = OBS_CAT
FCST_CAT_USED = NONE
OBS_CAT_USED = ALL
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example6.png,example6.dat"
```

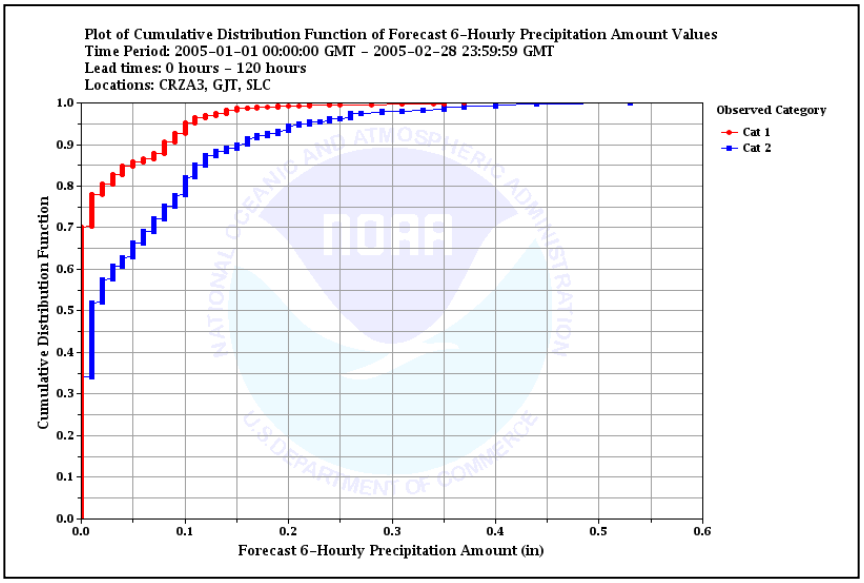
10.3 Screenshots







10.4 Chart



11.0 Example 7

This is a continuation of example 6. This example looks at the probability density functions (PDFs) for the forecast value compared over observed categories. This is another tool that can be used to determine if the forecasts are distinguishing between different observed categories well. The PDFs are, theoretically, mathematically related to the CDFs. However, within the IVP, the PDFs are estimated independently using a histogram approach. The points in the estimate are connected via lines.

11.1 Notes

- There is a noticeable difference between the two PDFs. This further implies the forecast may be distinguishing fairly well between zero and non-zero precipitation events.
- By default, 10 "bins" are used to estimate the points of the histogram. If it is decided that more bins should be used, that change can be made in the system settings file of the IVP. See Appendix A in the *IVP User's Manual*. To see the changes, IVP would need to be restarted or the plot regenerated via the IVP Batch Program. Currently, there is no way to change the number of bins via the IVP GUI, itself.

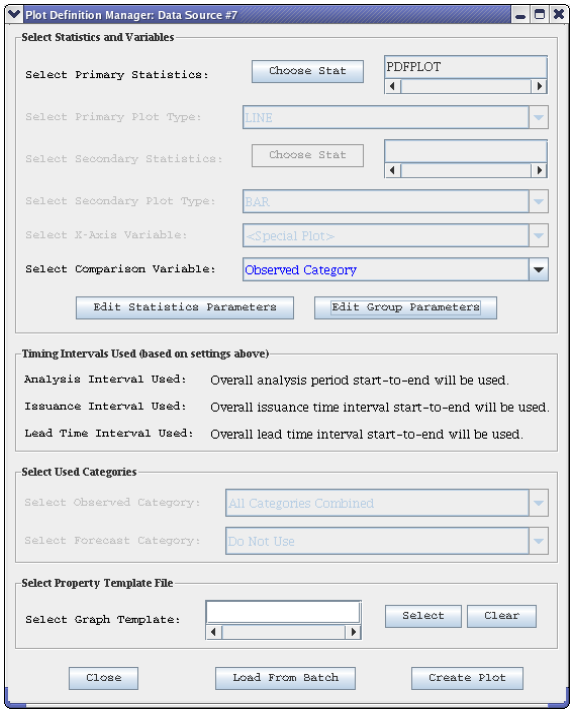
11.2 Batch File

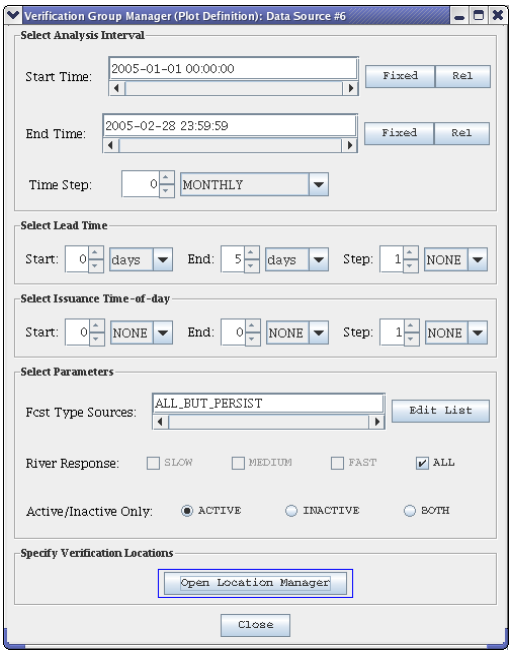
Differences between this batch file and that in Example 6 are highlighted.

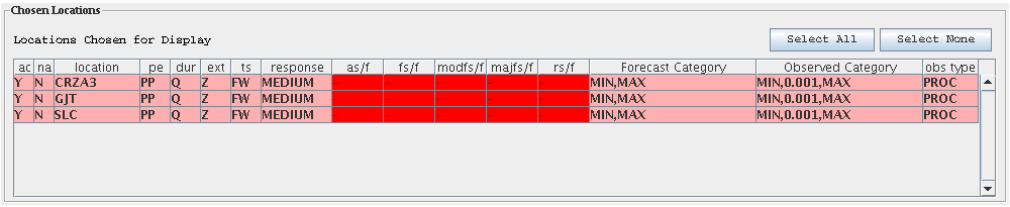
```
#======== LOCATION DEFINTIONS
PE = PP
DUR = Q
FCST_TS = FW
EXTREMUM = Z
OBS_TYPE = PROCESSED
OBS_CAT = MIN,0.001,MAX
FCST_CAT = MIN,MAX
DEF_LOC = CRZA3,GJT,SLC

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2005-01-01 00:00:00"
END_TIME = "2005-02-28 23:59:59"
ANALYSIS_INTERVAL = MONTHLY
LEADTIME_START = 0days
LEADTIME_END = 5days
LEADTIME_STEP = NONE
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = ALL_BUT_PERSIST
ACTIVE_STATUS = ACTIVE
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = ALL_BUT_PERSIST
RIVERRESPONSE = ALL
ACTIVE_STATUS = ACTIVE
DEF_GRP = CRZA3,GJT,SLC
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = PDFPLOT
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = NONE
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = NONE
COMP_VARIABLE = OBS_CAT
FCST_CAT_USED = NONE
OBS_CAT_USED = ALL
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example7.png,example7.dat"
```

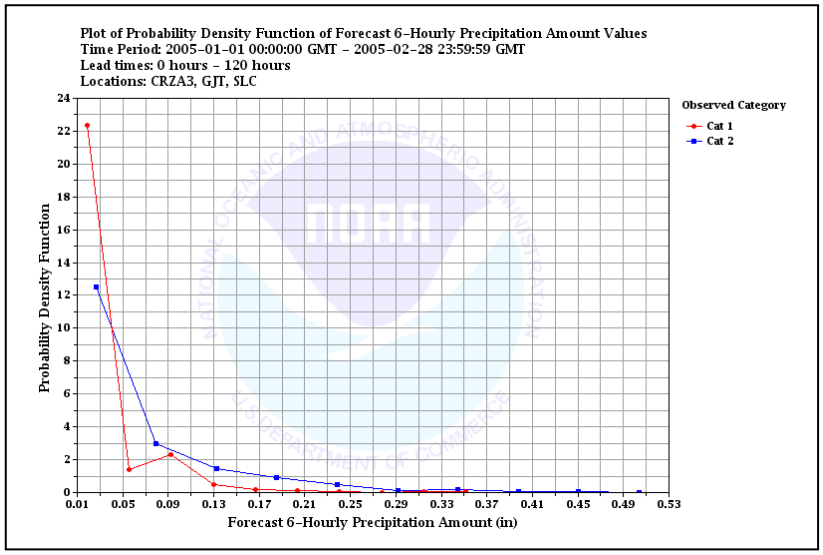
11.3 Screenshots







11.4 Chart



12.0 Example 8

This is a continuation of example 6. This example computes the minimum, 25% non-exceedance quantile, 50% quantile, 75% quantile, and the maximum for each of the cumulative distributions in example 6. The observed category is displayed along the x-axis instead of as a comparison variable in order to make the plot easier to read.

12.1 Notes

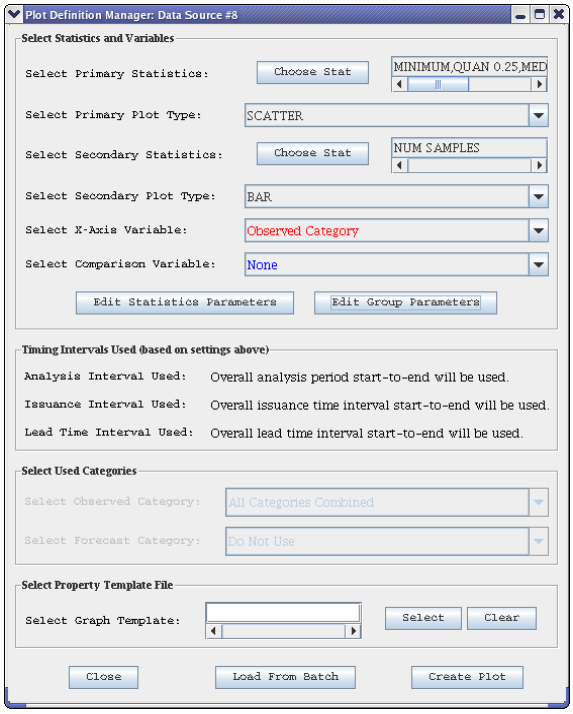
- The quantiles here do correctly correspond to the CDFs shown in the chart of example 6.
- Note the use of the special command token "@+". This token will never be used in an IVP generated batch file. It was added to the batch file in this example so that the line widths are not too long, and to show how a line continuation is done using "@+" in the IVP's batch language. See Section 12.0 of the *IVP Batch Program User's Manual for Verification* for more details.

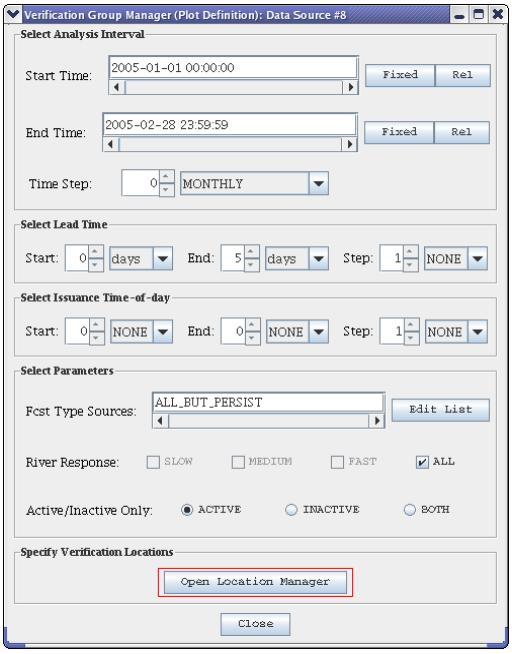
12.2 Batch File

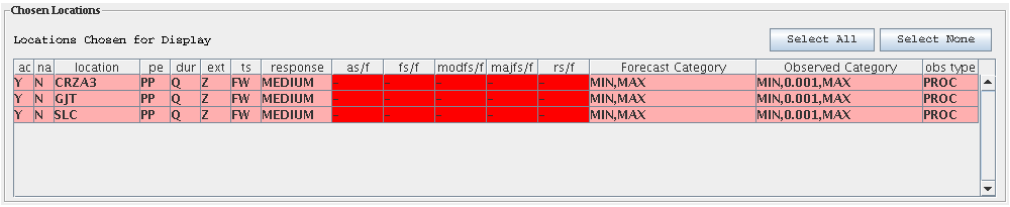
Differences between this batch file and that in Example 6 are highlighted.

```
#======== LOCATION DEFINTIONS
PE = PP
DUR = Q
FCST_TS = FW
EXTREMUM = Z
OBS_TYPE = PROCESSED
OBS_CAT = MIN,0.001,MAX
FCST_CAT = MIN,MAX
DEF_LOC = CRZA3,GJT,SLC

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = "2005-01-01 00:00:00"
END_TIME = "2005-02-28 23:59:59"
ANALYSIS_INTERVAL = MONTHLY
LEADTIME_START = 0days
LEADTIME_END = 5days
LEADTIME_STEP = NONE
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = ALL_BUT_PERSIST
ACTIVE_STATUS = ACTIVE
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS


#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = ALL_BUT_PERSIST
RIVERRESPONSE = ALL
ACTIVE_STATUS = ACTIVE
DEF_GRP = CRZA3,GJT,SLC
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = "MINIMUM,QUAN 0.25,MEDIAN,"
@+ = "QUAN 0.75,MAXIMUM"
PRIMARY_PLOT_TYPE = SCATTER
SECONDARY_STATS = "NUM SAMPLES"
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = OBS_CAT
COMP_VARIABLE = NONE
FCST_CAT_USED = NONE
OBS_CAT_USED = ALL
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example8.png,example8.dat"
```

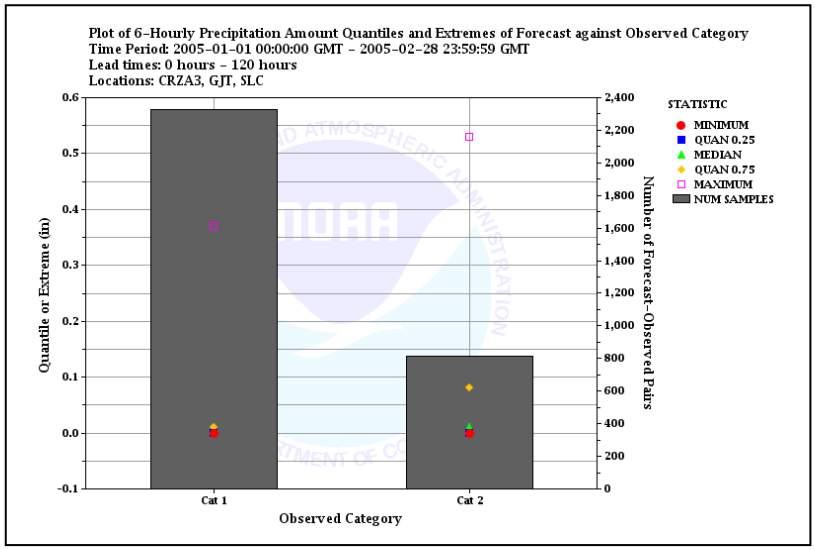
12.3 Screenshots







12.4 Chart



13.0 Example 9

This example is designed to show how the skill of the forecast relative to categorical statistics probably of detection (POD), false alarm ratio (HFAR), and ROC plot area (ROCAREA) has changed over the years. Hopefully over time our forecasts will improve: the POD will approach 1, the HFAR will approach 0, and the ROC area will approach 1.

13.1 Notes

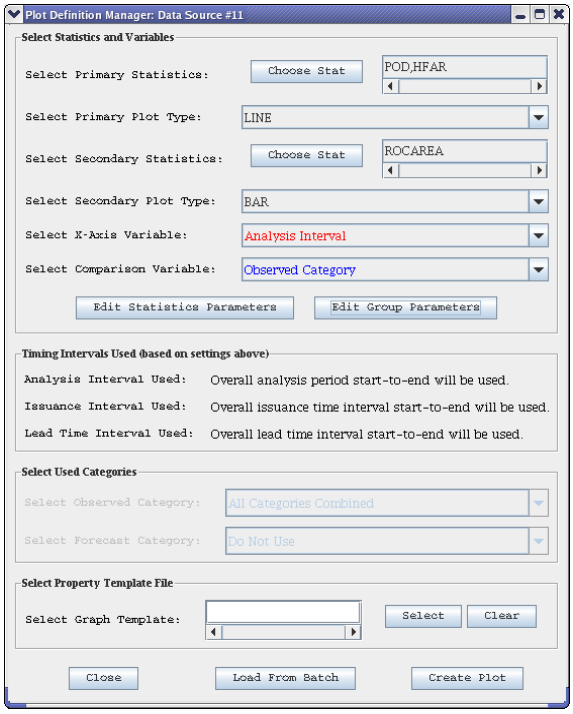
- As with previous examples, the chart properties should be changed for this plot. Specifically, the secondary y-axis title should be changed to be "ROC Area". The primary y-axis title can be left the same.
- The ROC Area computed for the years 1999 and 2000 is 0. This is likely a product of insufficient data for those years, since it is indicative of no observed values exceeding the observed threshold; in this case, 20 ft. See Appendix B.7 of the *IVP User's Manual*. This was verified by examining the pairs used in the computations via the **Verification Pairs Data Viewer** of the IVP. The x-axis (observed value axis) was changed so that its lower bound was 20 ft. Examination of the pairs showed that all pairs exceeding that threshold were in 1997 and 1998. None were in 1999 or 2000.
- There is also no ROC Area computed for the first category ("`Cat 1`", in the legend). This is because that categories lower bound is "`MIN`" or –INFINITY. This is not a valid threshold for compute the ROC plot, so no plot is produced and the ROC Area is set to -999.0.

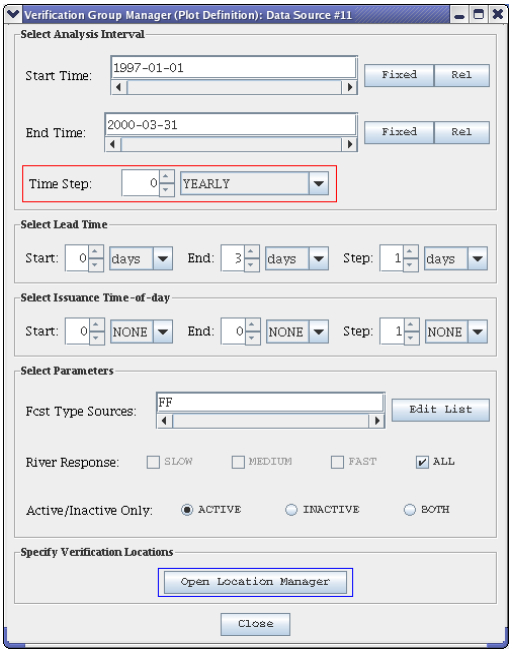
13.2 Batch File

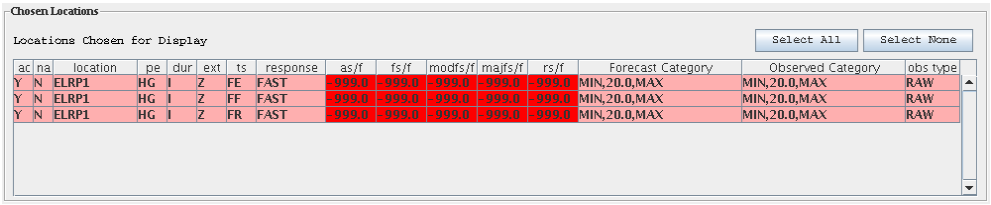
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FF
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,20.0,MAX
FCST_CAT = MIN,20.0,MAX
DEF_LOC = ELRP1

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = 1997-01-01
END_TIME = 2000-03-31
ANALYSIS_INTERVAL = YEARLY
LEADTIME_START = 0days
LEADTIME_END = 3days
LEADTIME_STEP = 1days
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FF
ACTIVE_STATUS = ACTIVE
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FF
RIVERRESPONSE = ALL
ACTIVE_STATUS = ACTIVE
DEF_GRP = ELRP1
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = POD,HFAR
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = ROCAREA
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = ANAL_INT
COMP_VARIABLE = OBS_CAT
FCST_CAT_USED = NONE
OBS_CAT_USED = ALL
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example9.png,example9.dat"
```

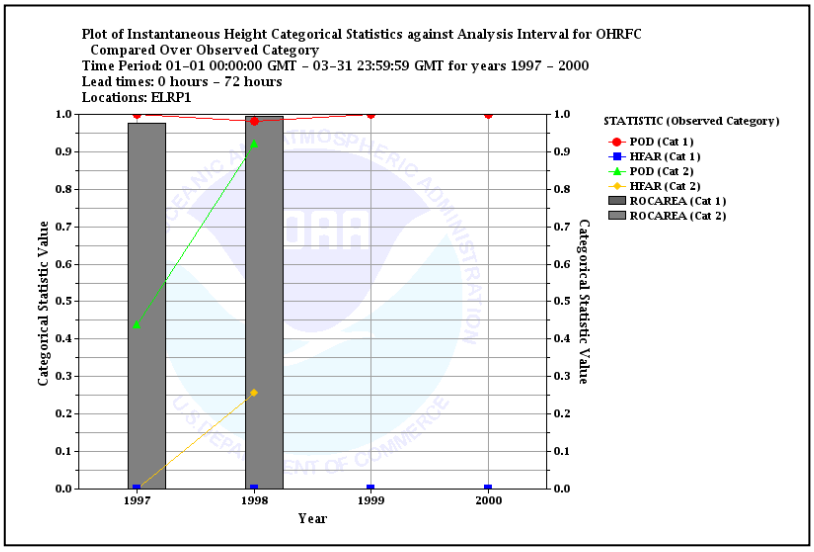
13.3 Screenshots







13.4 Chart



14.0 Example 10

This is a continuation of example 9. This example shows how to generate ROC plots corresponding to the ROC area computations of example 9.

14.1 Notes

- The `OBS_CAT_USED` command is being used to define the observed threshold for the computation of the ROC plots. The threshold is always the lower bound of the category specified by either `OBS_CAT_USED` or `FCST_CAT_USED`. In this case, the threshold is 20 ft. This will make the plots correspond to the "`Cat 2`" plots in example 9.
- This, combined with example 9, imply that the forecasts perform well relative to the two categories, below 20 ft and above 20 ft.

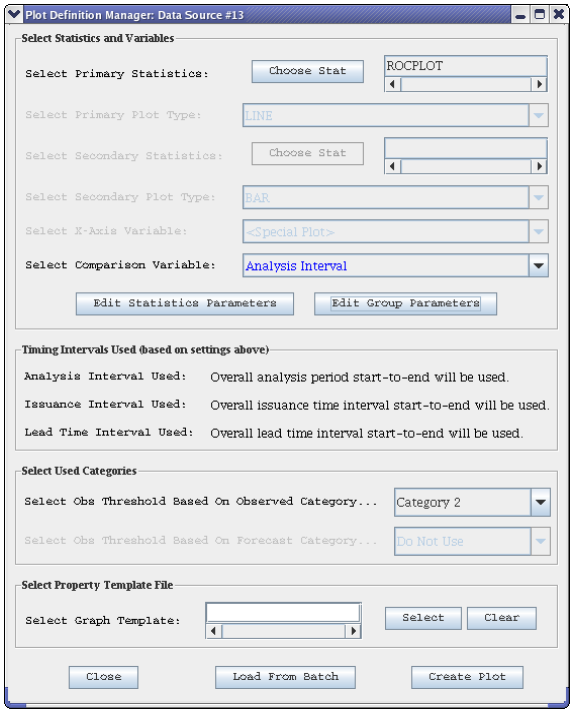
14.2 Batch File

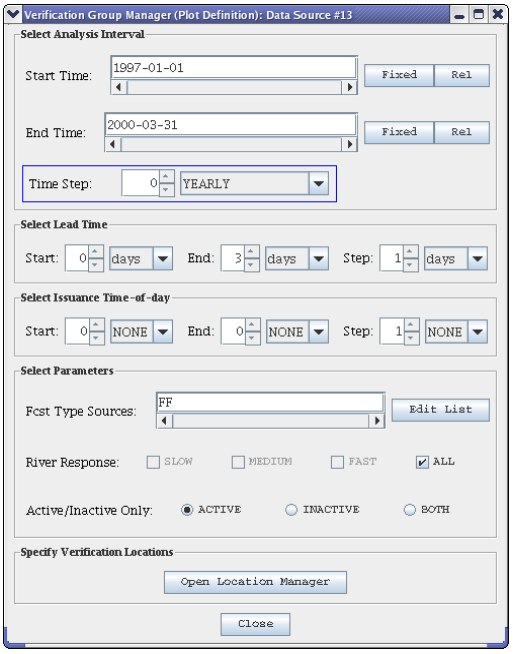
Differences between this batch file and that in Example 9 are highlighted.

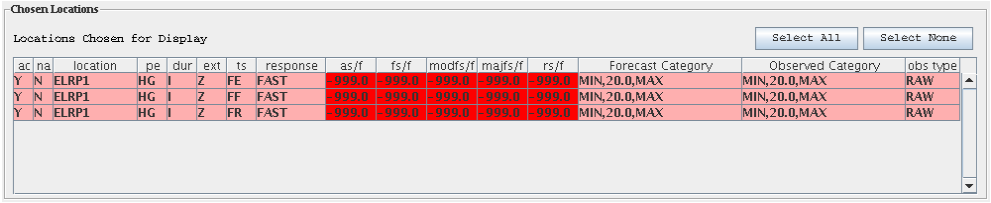
```
#======== LOCATION DEFINTIONS
PE = HG
DUR = I
FCST_TS = FF
EXTREMUM = Z
OBS_TYPE = RAW
OBS_CAT = MIN,20.0,MAX
FCST_CAT = MIN,20.0,MAX
DEF_LOC = ELRP1

DUR = <default>
EXTREMUM = <default>
PE = <default>
FCST_TS = <default>
#======== END OF LOCATION DEFINITIONS

#======== GROUP PARAMETER DEFINITIONS
START_TIME = 1997-01-01
END_TIME = 2000-03-31
ANALYSIS_INTERVAL = YEARLY
LEADTIME_START = 0days
LEADTIME_END = 3days
LEADTIME_STEP = 1days
ISSUANCE_START = NONE
ISSUANCE_END = NONE
ISSUANCE_STEP = NONE
FCST_TS = FF
ACTIVE_STATUS = ACTIVE
RIVERRESPONSE = ALL
BREAKDOWN_BY_LID = OFF
#======== END OF GROUP PARAMETER DEFINITIONS
```

```
#======== GROUP DEFINITION(S)
PE = <default>
DUR = <default>
EXTREMUM = <default>
FCST_TS = FF
RIVERRESPONSE = ALL
ACTIVE_STATUS = ACTIVE
DEF_GRP = ELRP1
#======== END OF GROUP DEFINITION(S)

#======== STATISTICS PARAMETERS
QUANTILES = 0.25,0.50,0.75
PDF_BINS = 10
ROC_PTS = 100
#======== END OF STATISTICS PARAMETERS

#======== GRAPHICS PARAMETER DEFINITIONS
PRIMARY_STATS = ROCPLOT
PRIMARY_PLOT_TYPE = LINE
SECONDARY_STATS = NONE
SECONDARY_PLOT_TYPE = BAR
XAXIS_VARIABLE = NONE
COMP_VARIABLE = ANAL_INT
FCST_CAT_USED = NONE
OBS_CAT_USED = CAT2
#======== END OF GRAPHICS PARAMETER DEFINITIONS

GRAPH_TEMPLATE = NONE
GEN_GRAPH = "example10.png,example10.dat"
```

14.3 Screenshots







14.4 Chart