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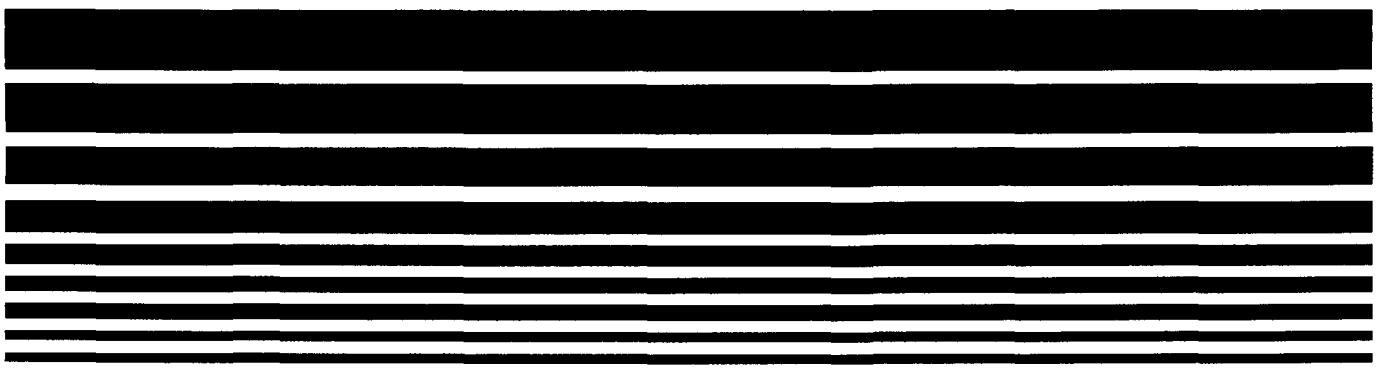
EPA USER'S GUIDE FOR THE URBAN AIRSHED MODEL

Volume VII: User's Manual for the Performance Evaluation System



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USER'S GUIDE FOR THE URBAN AIRSHED MODEL

Volume VII:
User's Manual for the Performance Evaluation System

OFFICE OF AIR QUALITY PLANNING AND STANDARDS
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

JUNE 1992

NOTICE

The information in this document has been funded wholly or in part by the U.S. Environmental Protection Agency (EPA) under contract 68-01-7365 to Computer Sciences Corporation. It has been subjected to the Agency's review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

This user's guide for the Urban Airshed Model (UAM) is divided into seven volumes as follows:

Volume I	User's Manual for UAM(CB-IV)
Volume II	User's Manual for the UAM(CB-IV) Modeling System (Preprocessors)
Volume III	User's Manual for the Diagnostic Wind Model
Volume IV	User's Manual for the Emissions Processor System
Volume V	Description and Operation of the ROM-UAM Interface Program System
Volume VI	User's Manual for the Postprocessing System
Volume VII	User's Manual for the Performance Evaluation System

Volume I provides historical background on the model and describes in general the scientific basis for the model. For those users that already possess a UAM modeling database or have prepared inputs without the use of the standard UAM preprocessors, this volume should serve as a self-sufficient guide to running the model.

Volume II describes the file formats and software for each of the standard UAM preprocessors that are part of the UAM modeling system. Included in this volume is an example problem that illustrates how inputs were created from measurement data for an application of the UAM in Atlanta.

Volume III is the user's manual for the Diagnostic Wind Model (DWM). This model is a stand-alone interpolative wind model that uses surface- and upper-level wind observations at selected sites within the modeling domain of interest to provide hourly, gridded, three-dimensional estimates of winds using objective techniques. It provides one means of formulating wind fields to the UAM.

Volume IV describes in detail the Emissions Processor System (EPS). This software package is used to process anthropogenic area and point source emissions for the UAM. An appendix to this volume describes the Biogenic Emissions Inventory System (BEIS), which can be used to generate gridded, speciated biogenic emissions. Software for merging the anthropogenic area, mobile, and biogenic emissions files into UAM input format is also described in this volume.

Volume V describes the ROM-UAM interface program system, a software package that can be used to generate UAM input files from inputs and outputs provided by the EPA Regional Oxidant Model (ROM).

Volume VI is the user's manual for the Postprocessing System (PPS). The UAM Postprocessing System (UAMPPS) is a data display and analysis tool for evaluating emission control strategies. After executing the UAM system, the results from one or more model runs may be graphically compared. The UAMPPS creates time-series plots, tile maps, gridded value maps, bar charts, box plots, scatter plots, and quantile plots. Through a series of menus, the user has a wide range of flexibility in scaling and labelling the graphs.

Volume VII is the user's manual for the Performance Evaluation System (PES). The UAM Performance Evaluation System (UAMPES) is a data display and analysis tool, which allows statistical and graphical comparisons between UAM predictions and actual observations contained in the Aerometric Information Retrieval System. These comparisons allow users to evaluate UAM performance. The variety of graphs and the system of menus used to create the graphs are similar to the UAMPPS. Experience acquired in using the UAMPPS should facilitate the use of the UAMPES.

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FIGURES (concluded)

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1. INTRODUCTION

This manual describes the procedures for using the Performance Evaluation System of the Urban Airshed Model (UAM). This section summarizes the purpose and features of the Performance Evaluation System and outlines the organization of the rest of the manual.

1.1 BACKGROUND

The 1990 Clean Air Act Amendments require all States with ozone nonattainment areas to submit a State Implementation Plan (SIP), which will explain the emissions control methods that each State plans to implement to achieve attainment. A concurrent requirement for some areas is to deliver a UAM modeling demonstration in support of the SIP.

The U.S. Environmental Protection Agency (EPA) issued guidance (EPA, 1991a) that provides recommendations and general procedures for exercising the UAM in regulatory applications. In particular, Chapter 5 of the UAM guideline document describes a set of performance statistics and graphical procedures that are useful to assess the accuracy of UAM in predicting ozone levels in specific applications areas.

The UAM Performance Evaluation System (UAMPES) was developed to provide assistance in implementation of the performance measures described in Chapter 5 of the UAM guideline document. The UAMPES enables users to compute and tabulate the seven specific statistical measures of model performance recommended in the UAM guideline document. In addition, the system enables users to graphically display comparisons between model predictions and measured concentrations using a variety of formats indicated in the UAM guideline document.

The UAMPES is designed to use two data sets.

- A data set of predicted concentrations is generated by the Extract module, which is common to both this system and the UAM Postprocessing System (UAMPPS). This data set contains data for a particular pollutant, geographical area, layer height, and time frame. A 3-dimensional Cartesian grid is laid over the geographical area. The data set contains predicted pollutant concentrations for each grid cell in the layer of cells nearest the earth's surface.

- A data set of observed concentrations is derived from the Aerometric Information Retrieval System (AIRS) AMP350 workfile, and contains observations for specific

monitoring stations. The monitoring stations are referred to as monitors in this manual and in the graphs and tables generated by the UAMPES.

By specifying the same geographical area for both data sets, users can make comparisons between the observed concentration levels recorded by the monitors and the concentration levels predicted by the UAM. These comparisons can then be used to evaluate model performance.

1.2 THE UAMPES

The UAMPES is available on the IBM computer systems at the EPA National Computer Center (NCC) and may be used by anyone with access to those systems. The UAMPES uses menus to elicit necessary information for producing the graphics. The menus enable even novice users to execute the UAMPES.

1.3 ORGANIZATION OF THIS MANUAL

The following sections of this manual provide the information necessary for using the UAMPES.

- Section 2 describes the features and characteristics of the UAMPES.
- Section 3 describes the equipment you need and how to start the UAMPES.
- Section 4 is a tutorial that illustrates a typical session.
- Section 5 describes each menu and how to use it.
- Section 6 describes the ways in which the output may be stored and/or printed.

1.4 FOR MORE INFORMATION

This manual provides complete instructions for using the UAMPES, but it does not attempt to cover other topics. For additional information contact the sources listed below.

More information about the data extraction is given in Appendix A; this appendix is identical in content to Section 4.1 of the user's manual for the UAM postprocessing system (EPA, 1990a).

For information about the AIRS AMP350 Work file, see the Aerometric Information Retrieval System (AIRS) user's guide, Volumes IV and V (EPA, 1991b). These user's guides are available from the meteorology/modeling contact for your EPA Region, or from the National Technical Information Services at:

National Technical Information Services
5285 Port Royal Rd.
Springfield, VA 22161
Telephone: (703) 487-4650

For more information about using the IBM computer system at the NCC, or for help with IBM computer-related problems, contact the EPA User Support Department. Specialists are on duty weekdays 8:00 a.m. through 7:00 p.m. eastern time to help solve problems and to answer questions. The mailing address and telephone numbers are:

User Support Department, MD-34
EPA National Computer Center
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711
Telephone: (919) 541-7862 or (800) 334-2405

1.5 CONVENTIONS USED IN THIS MANUAL

The conventions listed in Table 1-1 are used in this manual.

TABLE 1-1. CONVENTIONS USED IN THIS MANUAL

Convention	Description
UAMPES Main Menu	*Italics* indicate names of menus
Select	**Boldface** lowercase words indicate a menu field
<PF13>	< > characters indicate a terminal key.

2. OVERVIEW

The UAMPES combines predicted data generated by the UAM and observed data from monitor observations to generate statistical performance measures and supporting graphics that can be used to evaluate the accuracy of the model. This section discusses the statistical performance measures, the cell-aggregation methods, and the graphics that are available in the UAMPES.

2.1 INTRODUCTION

The UAMPES provides an automated method for calculating and displaying the performance statistics and graphic comparisons prescribed in the UAM guideline document (EPA, 1991a). Section 2.2 briefly discusses the seven statistical measures of model performance that are computed and tabulated by the UAMPES. Section 2.3 presents an overview of (a) the graphical components of the UAMPES and (b) the link that exists between the statistical performance measures and the graphical displays. Finally, Section 2.4 discusses methods for obtaining various spatial aggregates of model predictions used in the observed/predicted comparison process.

2.2 STATISTICAL PERFORMANCE MEASURES

The UAM guideline document (EPA, 1991a) prescribes seven statistical measures of model performance, which are to be applied in evaluating the performance of the UAM in a particular application. The UAMPES allows the user to extract model predictions along with appropriate ambient measurements of ozone for statistically based comparisons.

Figure 2-1 is an example output from the UAMPES, in tabular form, that summarizes the seven statistical performance measures. The summary statistics table is determined by: the monitors selected, the hours selected, and the aggregation method selected. This table is generated by the UAMPES every time the user selects a graph for which an aggregation method is specified (i.e., all graphics categories except the spatial graphics category). The spatial graphics category does not display cell aggregation and there is no opportunity for the user to specify a cell-aggregation method. The summary statistics are not affected by the "type" option. For example, the time-series plot, scatter plot, and quantile plot categories have three type options. The third option in all three categories generates a graph based on domain-wide maximum predicted values without regard to any aggregation method. The summary statistics table, which accompanies these graphs, uses predicted data values that are based on the aggregation method specified in Menu 2.1.*x*, but the graph displays domain-wide predictions. The aggregation method selected is the basis for the summary statistics. The summary statistics use the formulations prescribed in the UAM guideline document (EPA, 1991a).

As shown in Figure 2-1, the output displays notations, units, and the value of each performance measure. For each statistic, a value near zero is desirable. The reader is referred to Appendix B of this manual [which is identical to Appendix C of the UAM guideline document (EPA, 1991a)] for further details on notation and formulas and for explanations of the statistical terminology. Note that of the seven statistical performance measures, only fractional bias is appropriately displayed by the UAMPES in a graphical format (see discussion below).

Summary Statistics of UAM Recommended Performance Measures
for NEW YORK, 11JUL88, hours 1 through 24
using BILINEAR method and 9 monitors

Perf. Measure Description	Notation	Units	Value
Unpaired highest prediction accuracy (1)	Au	%	32.65
Normalized bias test (1)	D*	none	-0.91
Gross error for all pairs > 60 ppb	Ed*	none	0.26
Average station peak prediction accuracy	$\bar{A}$	%	28.17
Bias of all pairs > 60 ppb (1)	D60	ppb	10.80
Bias of all station peaks (1)	Dpeak	ppb	24.57
Fractional Bias for Peak Concentration			
Peak Monitor/Station Values			
Fractional bias of means (1)	Fm	none	0.32
Fractional bias of standard deviation (1)	Fs	none	0.26
Peak Hourly Values			
Fractional bias of means (1)	Fm	none	0.06
Fractional bias of standard deviation (1)	Fs	none	0.63

(1) Note: For these measures,
a positive value indicates UNDERprediction
and a negative value indicates OVERprediction.

Figure 2-1. Summary statistics table.

2.3 GRAPHICAL PERFORMANCE PROCEDURES

The UAMPES also enables users to create the graphical displays that directly compare observed and predicted concentrations. Table 2-1 provides a brief summary of the graphics categories, including: spatial graphics (maps) of observed and predicted values, time-series plots, bar charts, scatter plots, quantile plots, and fractional bias plots. Each of the graphic displays is described in more detail in the UAM guideline document and in Sections 3 and 4 of this document.

Each graphics category has two to four types (see Table 2-1), which produce similar graphs but display different aspects of the data. For example, for the spatial graphics category, four types are available. Each observed (monitor location) and predicted (grid cell location) concentration displayed on the map may represent (1) the average of the concentrations within the time period, (2) the maximum concentration occurring within the time period, (3) the hour that the maximum concentration occurred, or (4) the concentrations at a given hour. The "Number of possible plots" column in Table 2-1 highlights the fact that TIME1 and BAR1 options may generate multiple plots from a single request. The "Space and/or Time pairing" column indicates whether observed and predicted concentration levels are unpaired, paired in space, paired in time, or paired in both space and time. The "Number of data values per plot" column indicates how many data points will appear in each plot.

In the following subsections, we provide a description of the elements that are common to all of the graphs and a brief discussion of the different graphics with accompanying figures. Only a single example is illustrated for each graphics category, because the types are virtually identical in appearance except for appropriate changes in titles and labels. However, all of the graphics categories are described.

TABLE 2-1. GRAPHICS SUPPORTED BY THE PERFORMANCE EVALUATION SYSTEM

Graphic	Type	Number of possible plots	Space and/or Time pairing	Number of data values per plot
Spatial graphic	MAP1 (Average concentration)	1	Space & Time	Rows × Columns
	MAP2 (Maximum concentration)	1	Space	Rows × Columns
	MAP3 (Hour of maximum)	1	Space	Rows × Columns
	MAP4 (Concentration at hour)	1	Space & Time	Rows × Columns
Time Series (line graph)	TIME1 (Each monitor)	Monitors	Space & Time	2 × Hours
	TIME2 (Maximum monitor)	1	Time	2 × Hours
	TIME3 (Maximum domain)	1	Time	2 × Hours
Bar Chart	BAR1 (Each hour)	Hours	Space & Time	2 × Monitors
	BAR2 (Maximum hour)	1	Space	2 × Monitors
Scatter plot	SCAT1 (All monitors, hours)	1	Space & Time	Monitors × Hours
	SCAT2 (Maximum monitors)	1	Time	Hours
	SCAT3 (Maximum domain)	1	Time	Hours
Quantile plot	QQ1 (All monitors, hours)	1	Unpaired	Monitors × Hours
	QQ2 (Maximum monitors)	1	Unpaired	Hours
	QQ3 (Maximum domain)	1	Unpaired	Hours
Bias plot	BIAS1 (Maximum monitors)	1	Space	1
	BIAS2 (Maximum hour)	1	Time	1

2.3.1 Graphics Elements

The graphics produced by the UAMPES generally have five elements in common. These elements are titles, x and y axes, axis labels, legends, and graphics labels.

- Titles are located at the top of the graphic and provide general information about the data used. The title information includes, but is not limited to, the species of pollutant and the location and time frame of the study.
- The x (horizontal) and y (vertical) axes frame the bottom and left side of the plot and indicate the scale of the units being plotted.
- The axis labels are oriented along their respective axes and describe the units that are scaled along each axis.
- The legend is enclosed in a box located below the x-axis label. The legend provides a key to the symbols used in the plot.
- The graphics label is located in the lower right hand corner and provides a quick reference to tie together the graphics, the tables that accompany them, and their description in this manual.

2.3.2 Spatial Graphics

Spatial graphics present the grid cells associated with the predicted data overlaid on a map of the state and county lines of the geographical area. There are four types of spatial graphics, i.e., four ways of reporting predicted concentration levels: average concentration for a given time period, maximum concentration for a given time period, hour at which the maximum occurs during a given time period, and concentration at a given hour. The first three types (MAP1, MAP2, and MAP3) consider concentrations over a time period, or range of hours, specified in the *Data File Selection Menu*. If the user specifies a range of 24 hours, the first type of spatial graphic averages the 24 values for each grid cell and reports the result. Similarly, the second type locates and reports the maximum value over 24 hours for each grid cell. The third type reports the hour at which that maximum occurred, recognizing that the maximum may occur at different hours in different grid cells. The fourth type (MAP4) reports cell concentrations for a single hour specified by the user. Observed data are reported in the same manner, except monitor locations are used instead of grid cell locations.

There are two different display options for each of the four spatial graphic types. In the shaded tile map, in Figure 2-2, each grid cell (or tile) can be a different color or shade depending on the predicted concentration recorded in the extracted data set. In the gridded value map (not illustrated), the predicted numerical concentration value is plotted at each grid cell location. Observed concentrations are plotted at the location of the monitors.

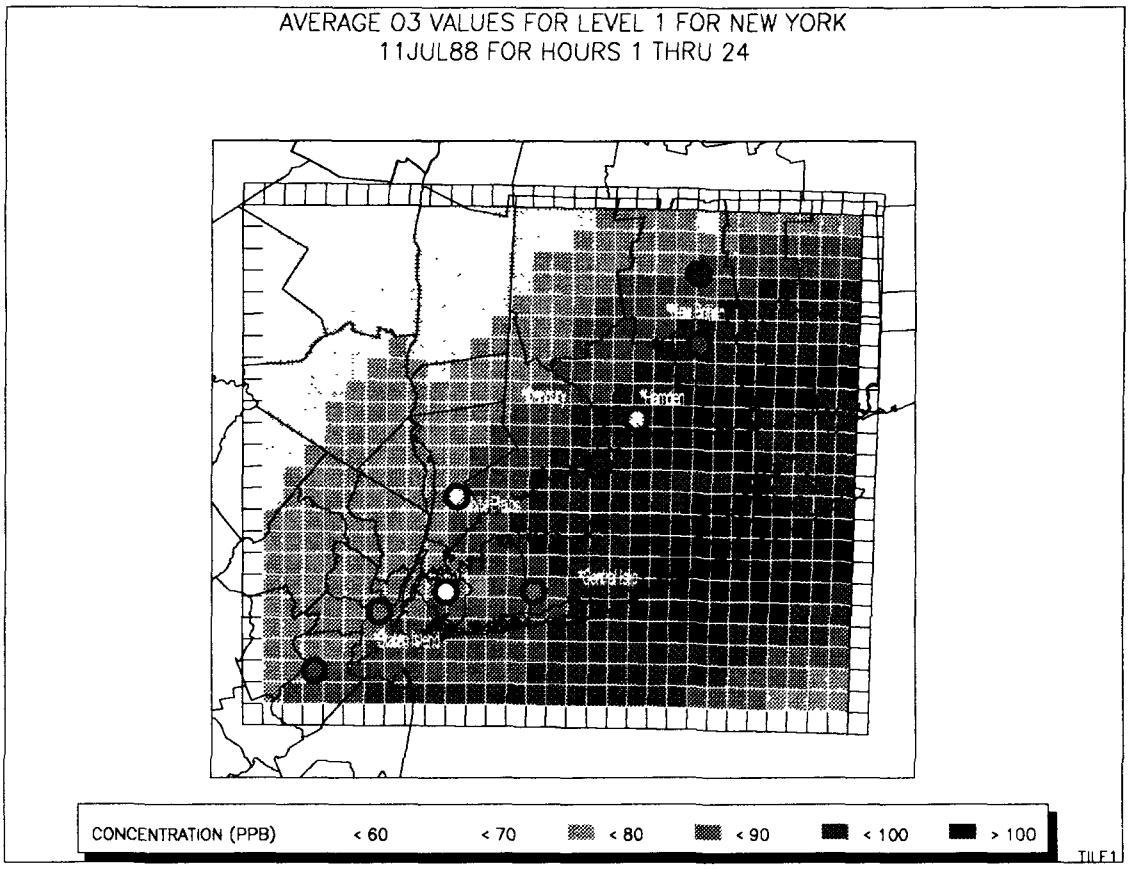


Figure 2-2. Shaded tile map (MAP1) of New York domain with cities and monitors annotated.

There are four general ways to vary the two different display options for spatial graphics:

(1) You may select either a color or monochrome plot.

(2) You may annotate the grid divisions with either column and row numbers derived from the UTM coordinate system or latitude and longitude values. You may also choose to have no grid division annotation.

(3) You may choose to annotate city names and locations. If you decide to annotate cities, you may choose all the cities in the SAS map database or you may select a subset of those cities to annotate. If you have already selected a subset of cities you may also choose to simply repeat the previously selected subset.

(4) The concentrations at the monitors listed in the AIRS AMP350 workfile may also be plotted on the map. The options for the monitors are similar to the options for the cities. You may choose to plot all or only a subset of the monitors.

2.3.3 Time-Series Line Graphs

The time-series line graph has three types:

1. observed and predicted concentrations, by monitor (multiple plots, one for each monitor location);

2. maximum observed and predicted concentrations across all monitor locations, and;

3. domain maximum observed and predicted concentrations.

For types 1 and 2, the predicted concentrations are derived by the user-specified, cell-aggregation method discussed in Section 2.4. For type 3, the predicted concentrations are the highest predicted concentrations occurring throughout the domain (i.e., cell aggregation does not occur). All three types plot two lines: one for observed concentrations and one for predicted concentrations, over the hours requested by the user. The hours requested must be part of the UAM extracted and AMP350 data sets.

The first type (TIME1), illustrated in Figure 2-3, plots values obtained by selecting the observed and predicted concentrations (paired in space and time). Observed values are compared to the predicted values obtained by the selected cell-aggregation method (as discussed in Section 2.4). TIME1 produces a separate graph for each monitor in the AMP350 workfile unless you specify fewer monitors. The procedure for specifying fewer monitors is discussed in Sections 5.4.2 and 5.6 of this manual.

The second type (TIME2) selects the maximum observed and predicted concentrations (paired in time, not space) over all monitors for each hour. TIME2 also uses predicted values generated by one of the six cell-aggregation methods. TIME2 creates a single graph with two lines: one for maximum observed concentrations and one for maximum predicted concentrations over the hours requested.

The third type (TIME3) selects the maximum observed and predicted concentrations (paired in time, not space) over all monitors for each hour, and predicted values from all of the grid cells in the domain (i.e., cell aggregation does not occur). Again, separate lines are plotted for maximum observed concentrations and maximum predicted concentrations.

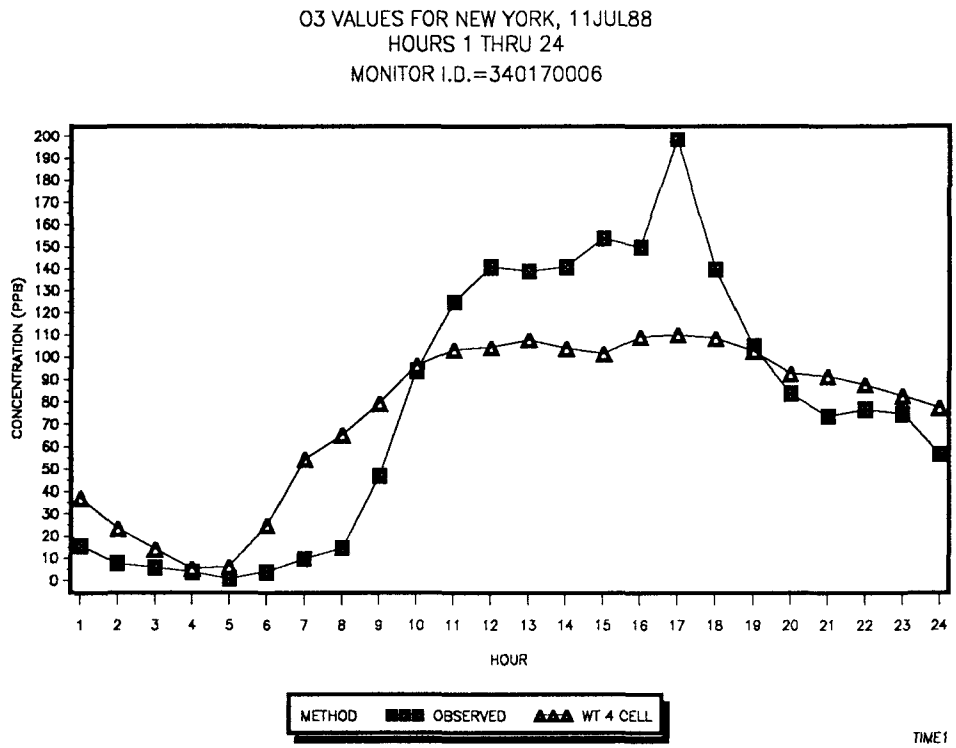


Figure 2-3. Time-series line graph (TIME1).

2.3.4 Bar Charts

There are two possible types of bar charts: observed and predicted concentrations at each hour, and maximum observed and predicted concentrations occurring within a user-specified time period. Both types display a pair of bars (one for observed concentrations and one for predicted concentrations) for each monitor location in the domain. The height of each bar is proportional to the concentration level. The percent difference between the two bars [i.e., {(observed - predicted) / observed} × 100] is displayed numerically above the bar for the predicted concentration level. Predicted concentrations are generated by the user-specified, cell-aggregation method.

The first type (BAR1), illustrated in Figure 2-4, displays observed and predicted concentrations (paired in space and time). Each graph displays a pair of bars (representing observed and predicted concentrations) for each monitor selected by the user. Note that a separate graph is produced for each hour requested. To prevent multiple graphs, specify a single hour in the *Data File Selection* menu.

The second type (BAR2) displays the maximum observed and predicted concentrations (paired in space, not time) for each observed and predicted pair over all hours requested. Again, multiple pairs of bars are shown on the graph, but only one graph is produced for this graph type. A monitor label is used to identify the spatial location of each pair of concentrations.

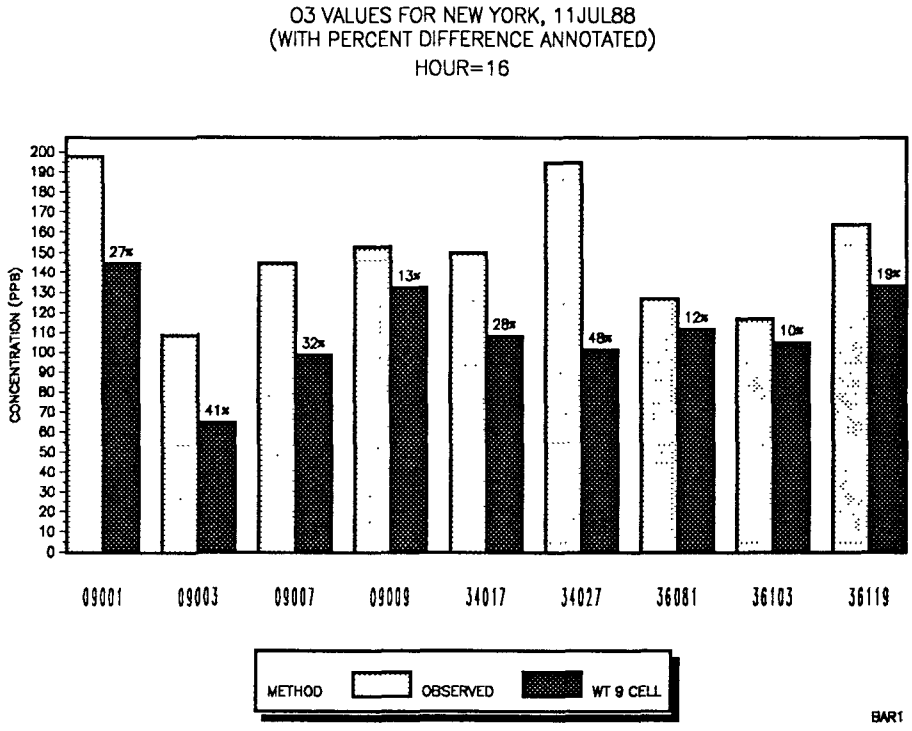


Figure 2-4. Bar chart (BAR1).

2.3.5 Scatter Plots

There are three types of scatter plots: observed and predicted, maximum observed and predicted, and domain maximum observed and predicted. For each type, predicted concentrations are plotted on the ordinate [vertical (y) axis] against observed concentrations on the abscissa [horizontal (x) axis]. Figure 2-5 presents an example scatter plot.

Each scatter plot type displays five reference lines to aid in gauging the fit between observed and predicted concentrations. The x:y (observed:predicted) ratios of the reference lines are 1:2, 1:1.3, 1:1, 1.3:1, and 2:1. The 1:1 line is a solid line; the others are dashed. The 1:1 line indicates that the predicted value is exactly equal to the observed value. This line is annotated as 0%, i.e., no difference between the observed and predicted values. The 1:2 line indicates that the predicted value is two times or 100% larger than the observed value and is annotated as -100%. The 1:1.3 line indicates that the predicted value is 1.3 times or 30% larger than the observed value and is annotated as -30%. Conversely, the 1.3:1 line indicates that the predicted value is 30% smaller than the observed value, and the 2:1 line indicates that the predicted value is 100% smaller than the observed value. The x:y ratios and the corresponding location of the reference lines can be changed (see Section 5.7.5).

In the first type (SCAT1), illustrated in Figure 2-5, observed concentrations are plotted against predicted concentrations generated by the selected cell-aggregation method (i.e., paired in space and time). The number of points on the graph are equal to the number of hours requested times the number of monitors in the requested domain.

The second type (SCAT2, not illustrated) selects the maximum observed and predicted concentrations of all monitors for a selected cell-aggregation method and for the requested hours (paired in time, not space). There is one point for each hour requested.

The third type (SCAT3, also not illustrated) is similar to the second type (SCAT2), except the maximum predicted values come from all of the grid cells in the domain of the extracted data set. Again, there is one point for each hour requested.

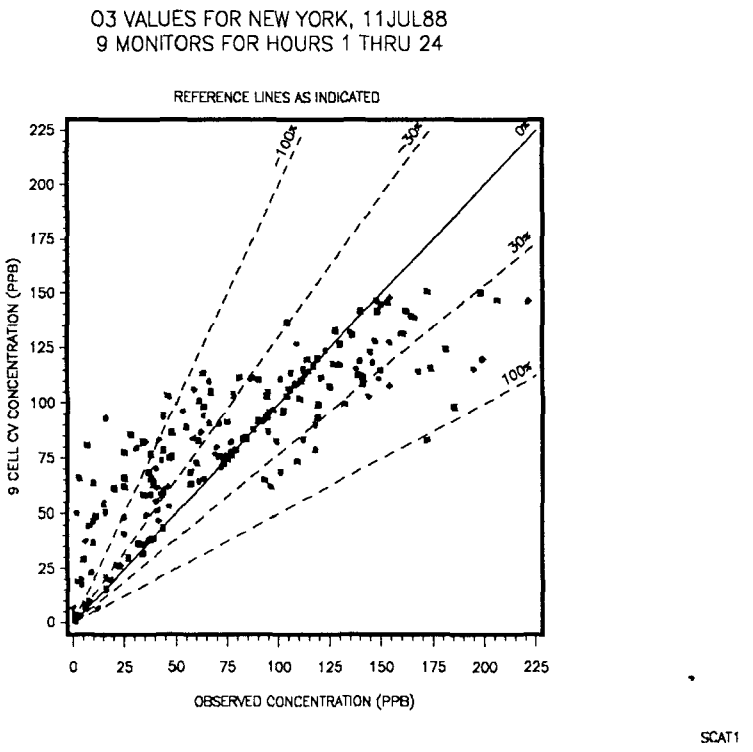


Figure 2-5. Scatter plot (SCAT1).

2.3.6 Quantile Plots

Quantile plots are scatter plots using ranked data with the deciles annotated. The data are identical to the data for scatter plots discussed above and the types (QQ1, QQ2, and QQ3) correspond to the scatter plots types. In QQ1, predicted concentrations generated by the selected cell-aggregation method are plotted against observed concentrations. QQ2 selects the maximum observed and predicted concentrations of all monitors for a selected aggregating method and for the requested hours. QQ3 is similar to QQ2 except that the maximum predicted values come from all of the grid cells in the domain of the extracted data set.

For each of these three types of quantile plots, the data are first scanned for any missing values in either the observed or predicted concentrations. If a missing value is detected, the whole observation (including both observed and predicted concentrations) is discarded. Thus, the data set will have the same the number of observed concentration values as predicted concentration values.

Observed and predicted concentrations are then independently ranked from highest to lowest values. The highest observed concentration may occur at hour 16 in monitor A. The highest predicted concentration may occur at hour 9 in monitor E. Whether or not the highest observed and predicted concentrations occur at the same time or in the same place is of no consequence in this plot. Figure 2-6 shows an example quantile plot, for the first type, QQ1 (observed and predicted from aggregate).

As is the case with the scatter plots, the predicted values are plotted on the ordinate and observed values are plotted on the abscissa. The label for the ordinate indicates the cell-aggregation method used. Minimum, maximum, and decile values are annotated and plotted as filled circles. Intermediate values are plotted as empty circles.

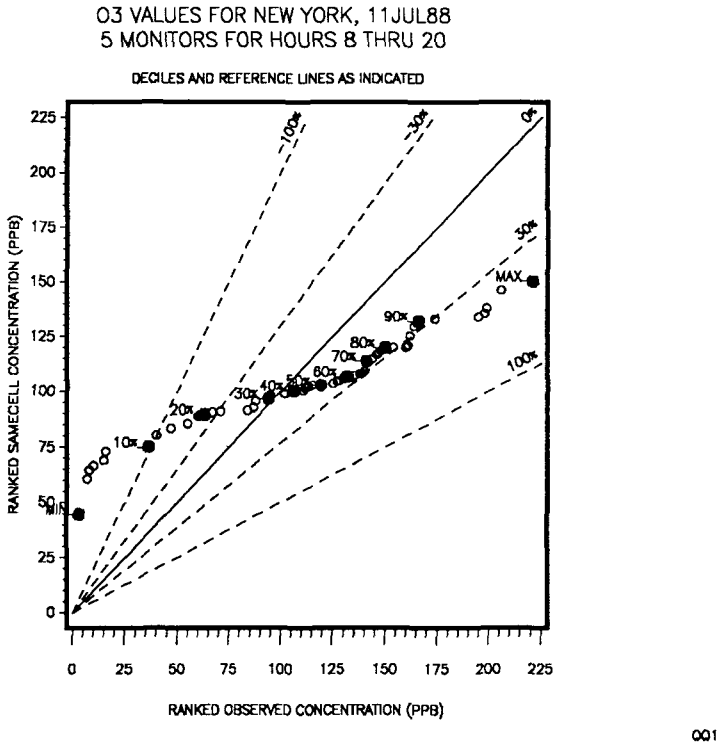


Figure 2-6. Quantile plot (QQ1).

2.3.7 Bias Plots

Bias plots in the UAMPES are specifically designed to plot fractional biases. Fractional biases generally provide a way of comparing two values and indicating how closely one matches the other. In the context of the UAMPES, positive values of the fractional bias indicate that the observed concentration statistic (mean or standard deviation) is larger than the predicted concentration statistic (i.e., underprediction). Negative values indicate that the observed concentration statistic is smaller than the predicted statistic (i.e., overprediction). Calculation of fractional bias is described in Appendix C. For a discussion of its use as a measure of discrepancy, refer to Cox and Tikvart (1990).

The bias plot, illustrated in Figure 2-7, plots the fractional bias of the standard deviation on the vertical (y) axis against the fractional bias of the mean on the horizontal (x) axis. The plot displays cross hairs corresponding to the centers of the x and y axes and a pair of boxes or squares around the center of the plot. Values on both axes range from negative 2.0 to positive 2.0, with a cross hair at zero. The inner box indicates the point at which the observed concentration statistic is 30% larger or smaller than the predicted concentration statistic. The outer box indicates the point at which the observed concentration statistic is two times larger or smaller than the predicted statistic. The size of the boxes is determined by factor values of 1.3 and 2.0. For reference purposes, fractional bias values of -0.67 and -0.26 correspond to overprediction of 100% (factor of 2) and 30% (factor of 1.3), respectively. If you wish, these factor values and the corresponding size of the boxes can be changed. The procedure for changing these values is discussed in Sections 5.7.5 and 5.7.7 of this manual.

The first type of bias plot (BIAS1) finds the maximum observed and predicted concentration values (across hours for each monitor requested by the user), and calculates the means and standard deviations for both observed and predicted concentrations based on the number (N) of monitors specified by the user. Thus, these data are paired in space, but not time.

The second type (BIAS2) finds the maximum observed and predicted concentration values (across monitors for each hour requested by the user) and calculates means and standard deviations based on the number (N) of hours specified by the user. These data are paired in time, but not space.

Appendix C contains a detailed description of the methods and calculations used for both types of bias plots.

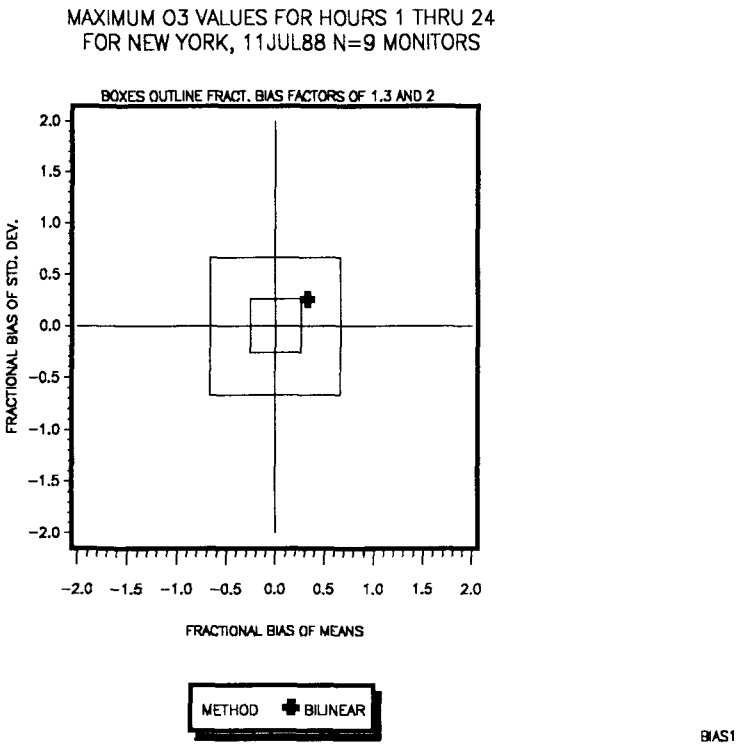


Figure 2-7. Bias plot (BIAS1).

2.4 CELL-AGGREGATION METHODS

Cell aggregation addresses the problem of comparing estimates derived from the UAM (i.e., predicted data) with observed concentration data for monitoring sites within the model domain (i.e., observed data). UAM grid cells are no smaller than 2 x 2 km and can be as large as 8 x 8 km. In contrast, the air quality data provided by monitors are for specific point locations, which may not be representative of a single cell or of area-wide concentrations. Cell aggregation provides a means of comparing estimates from one or more cells for an area including or close to a monitor location.

The UAMPES offers six cell-aggregation methods. Table 2-2 lists the methods and the number of cells that each method aggregates. The methods assume an orientation illustrated in Figure 2-8. For each monitor in the domain, UAMPES determines which grid cell contains the monitor. The UAMPES selects that cell and the eight cells that surround it (i.e., a square of nine cells, with the monitor located in the center cell of the square). In the discussion that follows, each cell is numbered according to the system shown in Figure 2-8. That is, the cells are numbered 1 through 9 (left to right, from bottom to top). The bottom row cells are numbered 1, 2, and 3; the middle row cells, 4-6; and the top row cells, 7-9. The monitor (M) will always be in the center cell (cell 5).

TABLE 2-2. THE SIX CELL-AGGREGATION METHODS

Cell-aggregation method	Number of cells
Same cell	1
Nine-cell closest value	9
Distance-weighted nine cell	9
Four-cell closest value	4
Distance-weighted four cell	4
Bilinear interpolation (four cell)	4

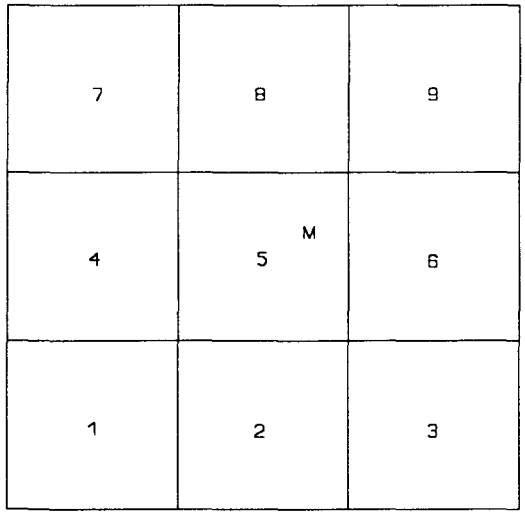


Figure 2-8. Square of nine cells.
(*M* represents the monitor location.)

The following paragraphs describe the six cell-aggregation methods.

- Same Cell The same-cell method is not an aggregation method in the strictest sense; it only considers a single cell. However, the same-cell method may be the most obvious comparison to make, because it selects the predicted value for the cell in which the monitor is actually located (i.e., cell 5 in Figure 2-8). The predicted value is recorded without weighting and without any calculations other than those performed by the model.

- Nine-Cell Closest Value The nine-cell, closest-value method checks the predicted concentrations of all nine cells and selects the predicted value that most closely matches the magnitude of the observed concentration.

- Distance-Weighted Nine Cell The distance-weighted, nine-cell method uses an algorithm to combine all of the predicted concentrations of all nine cells into a single-weighted average. This average is weighted by the squared inverse of the distance from the monitor to the center of each cell. Thus, the predicted concentrations of the cell centers that are closer to the monitor are given more weight than the values of the cell centers that are farther from the monitor. The formula for the distance-weighted algorithm is given in Appendix C.

The three remaining cell-aggregation methods use a common algorithm: the four-cell algorithm. First, the algorithm selects a square of four cells closest to the monitor. Then, the individual cell-aggregation methods are applied. Refer to Appendix C for details of the operation of the four-cell algorithm.

- Four-Cell Closest Value The four-cell, closest-value method checks the predicted concentrations of the four cells selected by the four-cell algorithm and selects the predicted value that most closely matches the magnitude of the observed concentration. This method is the same as the nine-cell closest value method (described above), except that four cells are checked instead of nine.

- Distance-Weighted Four Cell The distance-weighted, four-cell method considers the four cells selected by the four-cell algorithm and applies the same algorithm as the distance-weighted nine-cell method (described above).

- Bilinear Interpolation The bilinear interpolation method also arrives at a weighted average of the four predicted concentrations, but uses bilinear interpolation instead of the distance-weighting formula. Refer to Appendix C for details on this algorithm.

3. PROCEDURES

The UAMPES runs on the IBM computer system at the EPA National Computer Center (NCC, Research Triangle Park, NC). This section explains what authorization you need, what equipment is required and/or supported, how to start, and how to use system menus.

3.1 AUTHORIZATION

There are no restrictions on the use of the UAMPES on the EPA's IBM computer system at the NCC. You will need access to the standard facilities of the IBM computer system and the Time-Sharing Option (TSO). The TSO (the interactive part of the IBM computer operating system) is the environment in which the UAMPES menus operate. If you are not a registered user of EPA's IBM computer system, States may get information about registration procedures from the modeling contact for their EPA Region. Others may contact the EPA's NCC User Support Department identified in Section 1.4 of this manual.

3.2 EQUIPMENT

The UAMPES uses full-screen menus (i.e., the computer system and the terminal exchange data in screen-sized segments, rather than a line at a time or character-by-character). You must use a terminal that supports this full-screen protocol, or use equipment that emulates such a terminal. Also, your terminal must support full-screen graphics to display the graphics produced by the UAMPES. If your terminal does not support full-screen graphics, you will need to save the graphics in a catalog (explained in Section 6) and send the graphics from the catalog to a printer or other hard-copy device.

The UAMPES is designed to support, or produce, graphics on a variety of graphics terminals and hard-copy devices. If you do not have a full-screen terminal, you can emulate one using an asynchronous terminal or its equivalent [e.g., a personal computer (PC) equipped with a modem and appropriate communications software]. The computer system on which the UAMPES is installed must have a protocol converter (i.e., equipment that converts the character-by-character communications protocol of an asynchronous terminal to the full-screen protocol required for the UAMPES menus). For a PC/modem emulation to work acceptably, the PC communications software must provide a way to make some keys on the PC keyboard equivalent to the program function (PF) keys on full-screen terminals. Your terminal must be able to emulate PF keys to use the UAMPES menus.

For more information about terminals or terminal emulations, get in touch with the modeling contact for your EPA Region or the user support department of the computer system on which the UAMPES is installed.

3.3 GETTING STARTED

Before you use the UAMPES, you must log on to the TSO of the IBM computer system in full-screen mode. If you need help doing this, read the *Getting Started* chapter of the *Guide to NCC Services* (EPA, 1990b). This guide is distributed to new users of the NCC when they register, and current users can request a copy from the EPA User Support Department. Unfortunately, if you are using an asynchronous terminal or a PC with a modem, the guide is not very clear about the procedure for connecting to the system in the full-screen emulation mode. If you need help, get in touch with the modeling contact for your EPA Region, or call the EPA User Support Department of the NCC (see Section 1 in this manual).

After you have completed the log-on and the TSO has displayed its READY prompt, you are ready to invoke the UAMPES by entering "UAMPES" (in lowercase or uppercase letters). Press <Enter> to transmit the command to the computer and start the UAMPES. There will be a short pause while the software is loaded and initialized. When the *UAMPES Main Menu* emerges (Figure 3-1), the UAMPES is active.

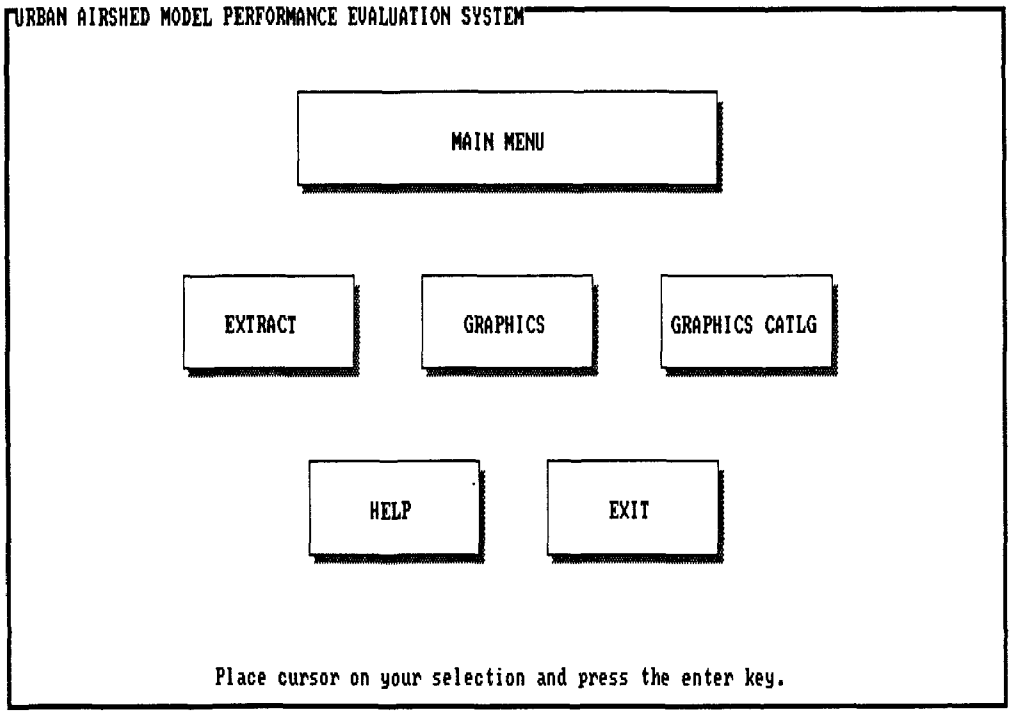


Figure 3-1. *UAMPES Main Menu.*

In Section 3.4, we describe general procedures for using all UAMPES menus. Section 4 uses an example to illustrate the procedures and menus that you can use to produce a graph. Section 5 describes the sequence of menus and provides details for each menu.

3.4 USING MENUS

The UAMPES menus make it easy to produce graphics for evaluating the UAM. The procedure is described in the steps below.

(1) A menu appears on your screen and prompts you for certain information. You need to supply the requested information and press <Enter>.

(2) Press <Enter>. This keystroke will tell the menu program, "I'm done here. Go on to the next operation." The menu program then checks the information for errors, omissions, or inconsistencies and reports any problems it finds.

(3) You need to fix the problems, press <Enter>, and the next menu will appear.

Steps 1 through 3 are repeated for each menu that is required to define your graphic. After all the specifications are assembled, the last menu program produces a graphic which will be displayed on your terminal and/or saved in a graphics catalog.

Figure 3-2 shows an example menu that illustrates many of the features of the UAMPES menus.

```
2.2
                        UAMPES: Data File Selection

   Please enter the Fully Qualified Data Set Names for the Extracted
   UAM (predicted) data set and the AIRS AMP350 (observed) Workfile
   to be used in this graphic.

   Do not enclose the Data Set Name in quotes.

   Extracted Data Set: _____________________________________________

AIRS AMP350 Workfile: _____________________________________________

   Period of Interest:  Date _______  Start Hour __
                                        End Hour __
                             (DDMMMYY)          (1-24)


   PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

Figure 3-2. Example UAMPES menu.

The following paragraphs describe the menu features and how to use them.

- Identification Every UAMPES menu has a number in the top left corner that uniquely identifies it, and one or two title lines at the top of the screen that summarize the menu's purpose or function. In Figure 3-2, the identifying number is 2.2. The method for assigning menu numbers is discussed in Section 5 (Menu Reference). The title line, *Data File Selection,* identifies the general function and purpose.

- Instructions Not all menus contain instructions. In the menus that contain instructions, the lines of text below the menu title explain what you are expected to do (see Figure 3-2). In the menus that do not contain instructions, the required action should be self-evident (see Figure 3-3). The specific instructions vary from one menu to another, but there are two general actions: fill in a blank or select from a list. In Figure 3-2, the instructions describe filling in blanks. However, in Figure 3-3, you are expected to select from the list presented and enter the number of your selection in the accompanying blank.

- Selection/Specification Fields and Cursor Movement The middle or bottom of a menu displays a list of values for you to choose from or has spaces (fields) for you to enter values. The menu in Figure 3-3 has both. The fields (beside the words **Type:**, **Aggregate Method:**, and **Monitor Selection:**) will accept values that you enter to fill in the blank field or replace the initial values. (These fields will be blank the first time that you run the system, or will contain initial values from the previous run.) When a menu is first displayed on your terminal, the cursor will appear at the beginning of the first selection/specification field. Pressing the <Tab> key moves the cursor from one field to the next. The cursor will automatically move to the next field if your entry in the previous field completely fills the space allotted to that field. If your terminal has a <Reverse-tab> or <Back-tab> key, pressing it moves the cursor to the previous field. You can also use the terminal's cursor movement (arrow) keys to move the cursor to a field, but using the <Tab> key is quicker.

- Protected Fields The areas of the screen that are skipped over when you press <Tab> are protected; you cannot alter them. If you move the cursor with cursor--movement keys to a protected part of the screen and try to alter it, the terminal keyboard locks and you must press the <Reset> key to regain use of it. If your keyboard does not have a <Reset> key, contact the EPA User Support Department (see Section 1).

  Menu titles, instructions, "white space", etc. are protected areas. Sometimes an area of a menu that looks like a fill-in-the-blank field with an initial value is a protected field. The menu program determines that only one value is valid for the

field, inserts that value for you, and makes the field protected. In general, if you can tab the cursor to a field, it has an initial value that can be changed. If you cannot tab to it, the field is protected.

- PF Keys Table 3-1 (on the next page) lists the standard PF-key functions. The CANCEL function, <PF3> or <PF15>, is available on every menu. It lets you return to a previous menu or exit from the UAMPES without producing a graph. The ABORT function, <PF4> or <PF16>, is available on every menu except the *UAMPES Main Menu*. It is a quick way to abandon a graphics request and return to the *UAMPES Main Menu*, but your menu choices are not saved. Some warning messages may occur if you end a UAMPES session using the ABORT function. The SCROLL functions listed in Table 3-1 are meaningful only on menus that display an item list that does not completely fit on one screen.

- Error Messages Error messages will appear within a narrow horizontal window in the middle of the screen if something is wrong. On color terminals, the window will have a red, flashing border. If you make a mistake when using the UAMPES menus, this window will appear. If a menu program detects something wrong, it describes the problem in a one-line message that appears after you press <Enter> from your terminal. In Figure 3-4, a message appeared because the value "4" is entered in the **Type** field. Only the values "1", "2", or "3" are valid choices in this field.

```
2.1.2
                    UAMPES: TIME-SERIES METHOD/TYPE SELECTION

          Type: _     1. Observed and Predicted (Select Aggregate)
                      2. Maximum Observed and Predicted (Select Aggregate)
                      3. Domain Maximum Observed and Predicted

    Aggregation Method: _    1. Samecell
                             2. 9 Cell Closest Value
                             3. Distance Weighted 9 Cell Average
                             4. 4 Cell Closest Value
                             5. Distance Weighted 4 Cell Average
                             6. Bilinear 4 Cell

     Monitor Selection: _    1. Use All Monitors
                             2. Subset Monitors
                             3. Use Previous Subset of Monitors


    PF/1/PF13=Help          PF3/PF15=Prev Menu          PF4/PF16=Main Menu
```

Figure 3-3. Example UAMPES menu without instructions.

TABLE 3-1. PF-KEY FUNCTIONS FOR UAMPES MENUS

PF Key	Command	Assigned Function
PF1 or PF13 [a]	**HELP**	Provides context-sensitive information on how to proceed or indicates what information is required.
PF3 or PF15 [a]	**CANCEL**	Terminates the current menu without taking any action and returns to the previous menu.
PF4 or PF16 [a]	**ABORT**	Terminates the current menu without taking any action and returns to the *UAMPES Main Menu*.
PF7 or PF19 [b]	**BACKWARD**	Scrolls toward the beginning of a list of items.
PF8 or PF20 [b]	**FORWARD**	Scrolls toward the end of a list of items.

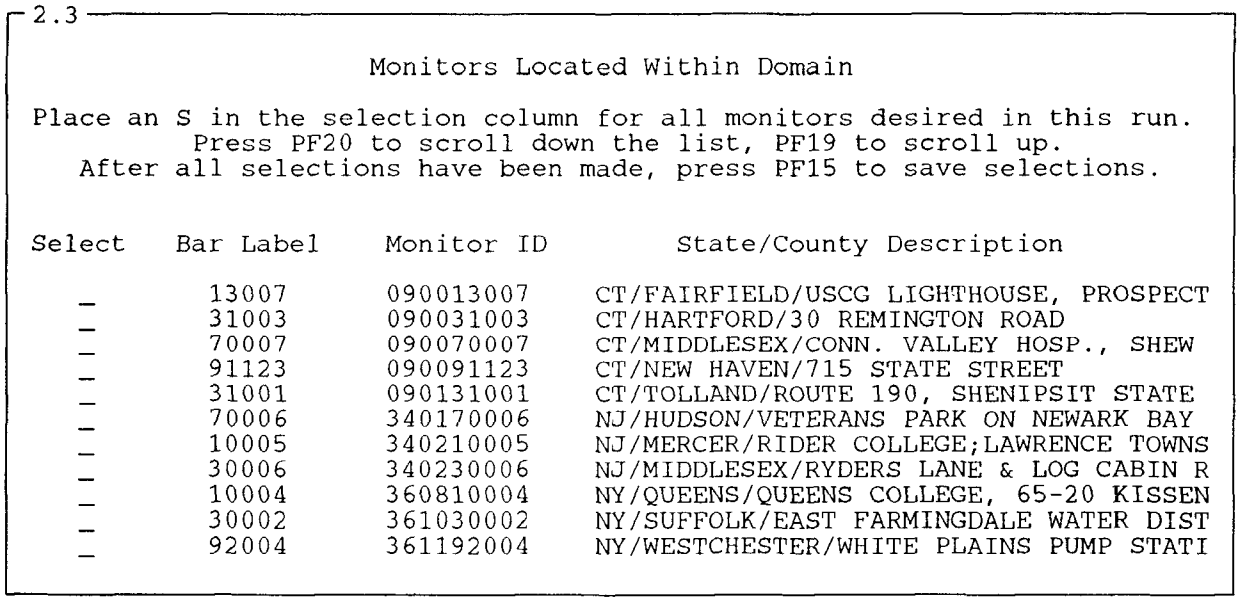
[a] These PF keys are available on all menus except the main menu.
[b] These PF keys are available on menus that contain a list that is too long to fit on one screen.

```
2.1.2

                UAMPES: TIME-SERIES METHOD/TYPE SELECTION

        Type: _     1. Observed and Predicted (Select Aggregate)
                    2. Maximum Observed and Predicted (Select Aggregate)
                    3. Domain Maximum Observed and Predicted

      Press Enter to continue
      PLEASE ENTER A 1, 2 OR 3 -OR- PRESS PF13 FOR HELP

                          4. 4 Cell Average
                          5. Distance Weighted 4 Cell Average
                          6. Bilinear 4 Cell

    Monitor Selection: _  1. Use All Monitors
                          2. Subset Monitors
                          3. Use Previous Subset of Monitors


    PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

Figure 3-4. Example UAMPES menu with error message.

- Error Correction First, press <Enter> to remove the error message from the screen. Fill-in-the-blank fields associated with an error are highlighted. If there are multiple errors, the error message describes only the first one and highlights the field associated with that error. You should change that field to eliminate the error. Then, press <Enter>. If there is more than one error, another error message will appear indicating what else needs to be done. In some instances an error condition involves two or more fields, and you may need to decide which of them is the real culprit, that is, the one causing the error. Press <Enter> after each correction. After no more corrections are needed, press <Enter> to move on to the next step in the program.

- Scrolling Some menus have a list of items to choose from. The menu shown in Figure 3-5 below displays a list of monitors which may be selected by entering an "S" in the **Select** field. If the entire list does not fit on the screen, you can scroll to see more items. Imagine that part of the menu is a window through which you see the list of items. Scrolling forward is like sliding the window down, toward the end of the list. Scrolling backward is like sliding the window up, toward the beginning of the list. Scrolling backward at the beginning of a list has no effect, nor does scrolling forward at the end of a list.



```
2.3

                    Monitors Located Within Domain

Place an S in the selection column for all monitors desired in this run.
         Press PF20 to scroll down the list, PF19 to scroll up.
   After all selections have been made, press PF15 to save selections.


Select   Bar Label    Monitor ID        State/County Description

  _        13007      090013007    CT/FAIRFIELD/USCG LIGHTHOUSE, PROSPECT
  _        31003      090031003    CT/HARTFORD/30 REMINGTON ROAD
  _        70007      090070007    CT/MIDDLESEX/CONN. VALLEY HOSP., SHEW
  _        91123      090091123    CT/NEW HAVEN/715 STATE STREET
  _        31001      090131001    CT/TOLLAND/ROUTE 190, SHENIPSIT STATE
  _        70006      340170006    NJ/HUDSON/VETERANS PARK ON NEWARK BAY
  _        10005      340210005    NJ/MERCER/RIDER COLLEGE;LAWRENCE TOWNS
  _        30006      340230006    NJ/MIDDLESEX/RYDERS LANE & LOG CABIN R
  _        10004      360810004    NY/QUEENS/QUEENS COLLEGE, 65-20 KISSEN
  _        30002      361030002    NY/SUFFOLK/EAST FARMINGDALE WATER DIST
  _        92004      361192004    NY/WESTCHESTER/WHITE PLAINS PUMP STATI
```

Figure 3-5. Example UAMPES menu with a scrollable list.

- Field Values Saved and Recalled The first time you use a menu, the fields in which you can enter values are blank. Underlines indicate the locations and sizes of blank fields. When you leave a particular menu, the UAMPES saves the values of all fill-in-the-blank fields, but not the selections you make from a scrollable list. The next time you use the same menu, the values you entered are displayed as the initial values. If you want to use the same values again, you do not have to reenter them. To override any defaults, type over the field and eliminate any extraneous characters using either the <Space bar> or the <Erase EOF> or <Del> keys.

- On-line Help On-line help is available from most screen fields. To access on-line help, simply place the cursor on the field for which help is desired and press <PF1> or <PF13>. A window with an explanation and additional information on the field will open on top of the menu. The help window may be one screen or multiple screens, depending on the field and the complexity of the related information. From the help window, press <PF3> or <PF15> to return to the application screen and continue your data entry.

- Colors on Menus If you are using a terminal that supports color graphics, you may notice that different types of information are displayed in different colors. The text describing a given field is displayed in cyan. If the field is protected, the color of the field will be pink. Fields that require a response from you are displayed in green; system errors or informational messages are displayed in red. If the system detects that an invalid value has been entered in a field, that field will be displayed in white and reverse video. If a monochrome terminal is used, no colors will be displayed; however, if an error is detected, the terminal will most likely display the field in reverse video.

4. TUTORIAL

This section illustrates a typical UAMPES session. It shows how the menus will look when you use the UAMPES, and how the menus respond to common mistakes. You can run this tutorial on your own terminal by entering the values and commands given in the text.

4.1 STARTING THE UAMPES

Suppose you want to compare concentrations predicted by the UAM with observed concentrations for the New York City metropolitan area. To get started, you will need to have an extracted data set (described in Appendix A of this manual, from the UAM Postprocessing System user's guide) and an AIRS AMP350 workfile (described in Volumes IV and V of the *Aerometric Information Retrieval System User's Guide*; EPA, 1991b). After completing the log-on to the EPA's IBM computer system, you are ready to access the UAMPES. Follow the instructions given in the *Getting Started* section (Section 3.3), and type "UAMPES" after the TSO READY prompt. Your terminal screen at this point will look like Figure 4-1.

```
92/05/19: NCC CUSTOMER SUPPORT HOURS EXTENDED          - SEE NEWS ALERT3
92/05/18: A LIST OF RECENTLY RELEASED EPA MEMOS        - SEE NEWS ALERT6
92/05/14: COBOL CONVERSION AID 1.6 AVAILABLE           - SEE NEWS ALERT9
92/05/14: ACCESS TO THE AIRS GRAPHICS SYSTEM           - SEE NEWS ALERT10
92/05/13: MEMORIAL DAY HOLIDAY SCHEDULE                - SEE NEWS ALERT2
92/05/11: MVS/ESA V4.2 OPERATING SYSTEM INSTALLED      - SEE NEWS ALERT1
92/05/11: PRIORITY BATCH JOB PROCESSING ON THE IBM     - SEE NEWS ALERT8
92/04/20: SUPERCALC 5.0 AVAILABLE FOR TESTING          _ SEE NEWS ALERT5
***

READY
UAMPES
```

Figure 4-1. Invoking the UAMPES from the TSO.

4.2 *UAMPES MAIN MENU*

Press <Enter> to submit the command and activate the UAMPES. Shortly after you press <Enter>, the *UAMPES Main Menu* appears. As you can see in Figure 4-2, the *UAMPES Main Menu* has five possible options from which you may choose. These are: the Extract module, the Graphics module, the Graphics Catalog module, Help, and Exit. These options are discussed in detail in Section 5 (Menu Reference).

You may move your cursor from one option to another using the <Tab> key. To choose an option, move the cursor to the desired option and press <Enter>. For this tutorial, move the cursor to the Graphics module option and press <Enter>.

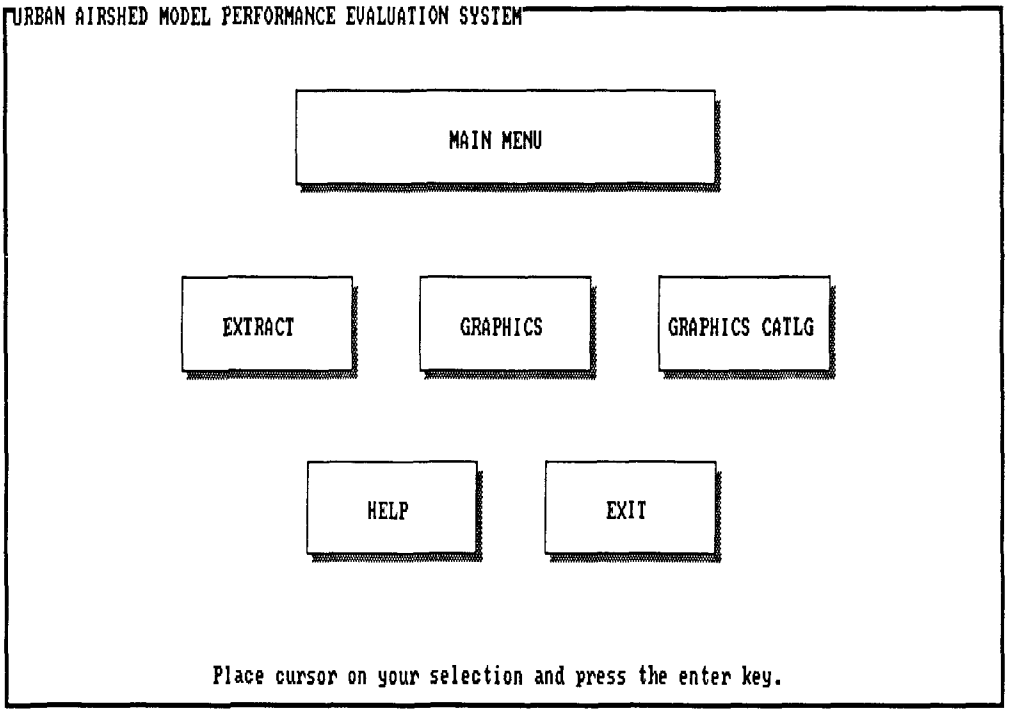


Figure 4-2. *UAMPES Main Menu.*

4.3 SELECTING A GRAPHIC

Selecting the Graphics module option from the *UAMPES Main Menu* will bring up the *Graphic Selection Menu* illustrated in Figure 4-3. This menu has one list and two selection fields. The list displays the different graphics available. The selection fields allow you to tell the system: (1) which type of graphic you wish to produce, and (2) the type of terminal or hard-copy device that you are using.

The cursor will appear in the first selection field, which is labeled **Graphic Selection.** Enter the number that appears beside the graphic you wish to produce. For illustrative purposes, "3" (Bar Chart) has been entered.

After entering the number in the first selection field, the cursor will automatically move to the **Device** field. In the example shown in Figure 4-3, "IBM3179" has been entered in the **Device** field. You must enter the appropriate device name for the equipment you are using. The UAMPES currently supports more than a dozen different devices (terminals, emulators, etc.). You may view the list of supported devices by typing a "?" in the **Device** field and pressing <Enter>. If you are not sure which name is appropriate for the equipment you are using, consult the user's manual supplied by the terminal manufacturer or contact the EPA User Support Department for help (see Section 1).

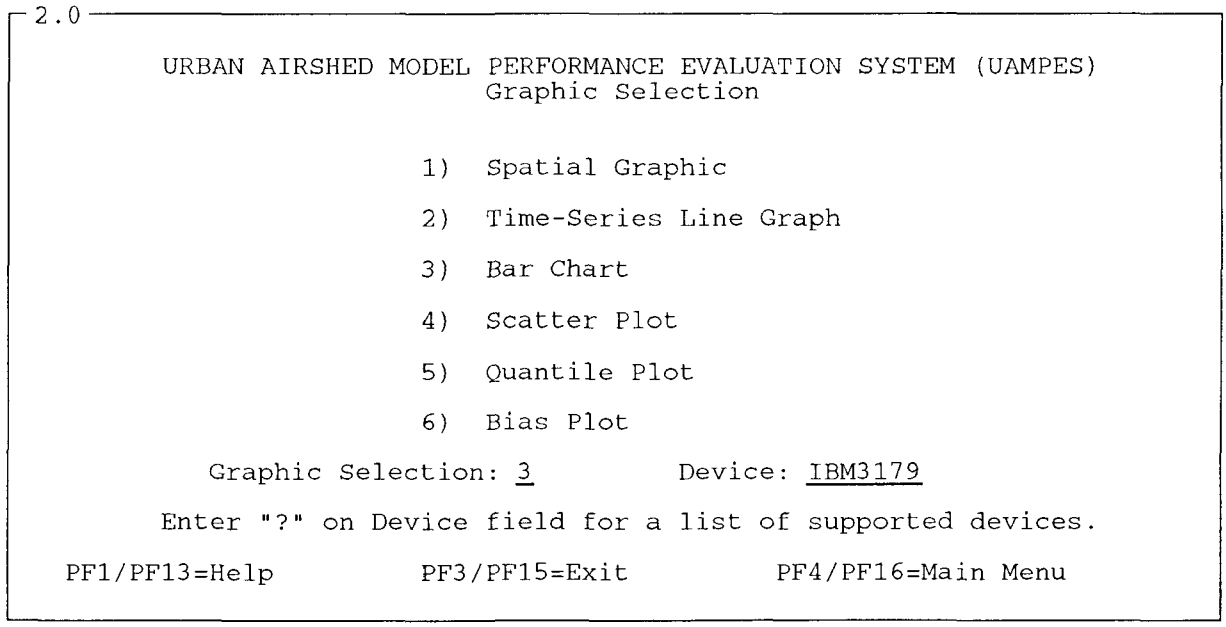


Figure 4-3. *Graphic Selection Menu.*

After filling in both fields in the *Graphic Selection Menu*, press <Enter>. You should then see the UAMPES menu illustrated in Figure 4-4. However, if the UAMPES detects a problem with either of the two fields in the *Graphic Selection Menu*, the menu will remain on your screen and an error message window containing a one-line description of the error will appear in the middle of the screen. On color monitors, this error window will be highlighted with a red, flashing border. On all monitors, there will be a note in the window border indicating that you first need to press <Enter> to continue.

After pressing <Enter>, the error window will disappear and the field containing the error will be highlighted. Only numbers 1 through 6 are valid in the **Graphic Selection** field. Other values will result in an error message. Specifying a device in the **Device** field that is not supported will also result in an error message. Note that the entry in the **Device** field must exactly match one of the devices in the list of supported devices.

If an error message appears, the cursor will be positioned in the field in which the error occurs. Simply type over the existing entry to make the correction and press <Enter>. If there is more than one error, another error window will appear describing the nature of the error. Repeat the above sequence, i.e., press <Enter> key, type over the error to make the correction, and press <Enter>.

After you press <Enter> on the *Graphic Selection Menu* and the system does not detect any errors, the system will move on to the next menu.

4.4 GENERATING A BAR CHART

4.4.1 Selecting Type, Method, and Monitor Options

Selecting "3" (Bar Chart) from the *UAMPES Graphic Selection Menu* will bring up the menu shown in Figure 4-4. The *Bar Chart Method/Type Selection Menu* contains three lists and three corresponding selection fields.

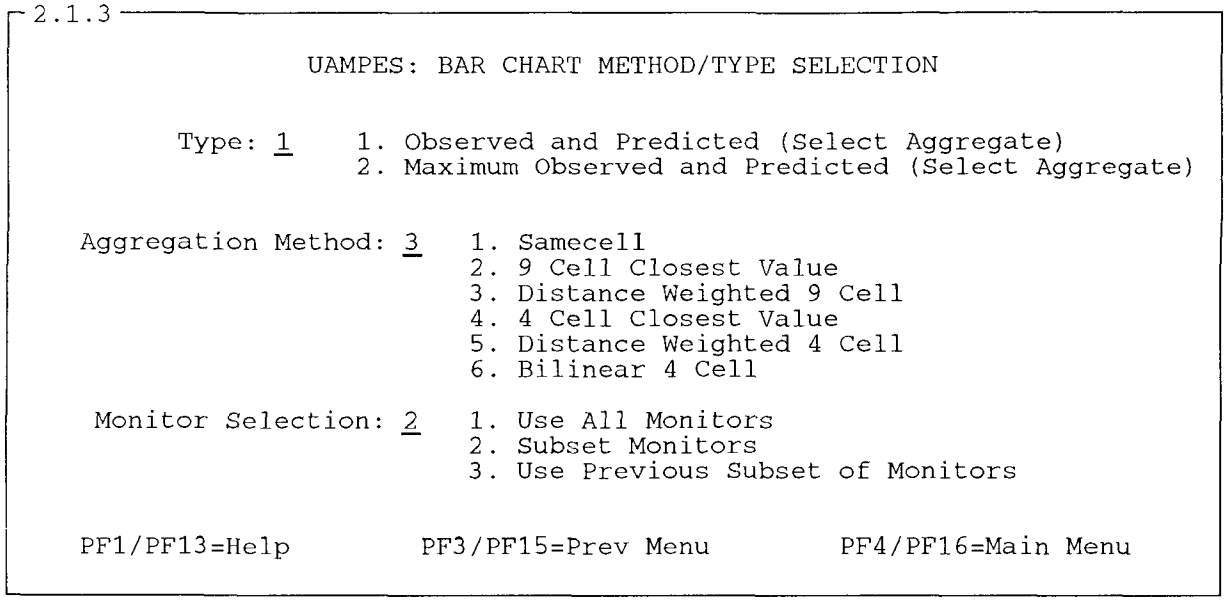


Figure 4-4. *Bar Chart Method/Type Selection Menu.*

The first list describes the two bar chart types, the second describes the aggregation methods, and the third describes the monitor options. Refer to Section 2.4 (Cell-Aggregation Methods) and Appendix C for a complete discussion of aggregation methods. Refer to Section 2.3 (Graphical Performance Procedures) and Section 5.4 (Method/Type Selection Menus) for a complete discussion of graphic types and monitor options. For the purposes of this tutorial, simply select the first graphic type, the third aggregation method, and the second monitor option. These selections are illustrated in Figure 4-4 by the numbers 1, 3, and 2 respectively.

The first graphic type, "Observed and Predicted (Select Aggregate)", will produce a bar chart with a pair of bars for each monitor you choose to include in the analysis. For each pair of bars, one bar will indicate the concentration level actually observed by that monitor at that hour. The other bar will indicate the concentration level predicted by the model after applying the aggregation method that you choose from the second list in this menu.

Choosing "Distance Weighted 9 Cell" in this example will display the weighted-average concentration of the nine cells closest to the monitor (weighted by the squared inverse of the distance from the monitor to the center of each grid cell). Selecting the second monitor option, "Subset monitors", will bring up a monitor selection menu following the *Data File Selection Menu.* In this example, the number of monitors chosen only affects the appearance of the graph. In the quantile plots and bias plots, the number of monitors chosen will also affect subsequent calculations. Refer to Section 5 (Menu Reference) for a complete discussion of the considerations pertaining to these options.

4.4.2 Data File Selection

The menu shown in Figure 4-4 works the same way as the UAMPES *Graphic Selection Menu.* After you have made your selections by entering the appropriate number in each field, press <Enter>. The selections illustrated will bring up the *Data File Selection Menu* shown in Figure 4-5 below.

At this point you may tell the UAMPES exactly what data to analyze and graph. The *Data File Selection Menu* contains five selection fields that must be completed before moving on to the next menu. There are two long fields for entering data set names. These long fields are followed by three shorter fields for entering the date, and start and end hours.

The first long field calls for the name of a data set created by the Extract module included in both this system and the UAMPPS (EPA, 1990a). Enter the fully qualified data set name of the extracted data set in the space provided. The second long field calls for the name of an AIRS AMP350 workfile. Enter the fully qualified data set name of the workfile data set in the space provided. Do not enclose the data set names in quotation marks.

```
2.2
                        UAMPES: Data File Selection

   Please enter the Fully Qualified Data Set Names for the Extracted
   UAM (predicted) data set and the AIRS AMP350 (observed) Workfile
   to be used in this graphic.

   Do not enclose the Data Set Name in quotes.

   Extracted Data Set:  uidacct.UAM.SASD.EXT.O3.X11JUL88.L1B88

 AIRS AMP350 Workfile:  uidacct.AMP350

   Period of Interest:  Date 11JUL88   Start Hour 16
                                         End Hour 16
                             (DDMMMYY)          (1-24)

   NOTE:  This chart type will generate a graphic for each hour
          from start hour through end hour.  This could be lots of plots!


   PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

Figure 4-5. *Data File Selection Menu.*

The three short selection fields define the period of interest and consist of the date and starting and ending hours. The period of interest must be a time frame contained in the two data sets. The **Date** should contain seven characters of the form *ddmmmyy* where *dd* is the day, *mmm* is the month, and *yy* is the year. For example, if the extracted and workfile data sets contain data for hours 1 to 24 on August 1, 1991, then you must enter "01AUG91" in the **Date** field. You may choose any range of hours between 1 and 24 for the **Start** and **End Hour** fields. The only restriction is that the starting hour must be earlier than the ending hour.

For this example, notice that the bar chart type, Observed and Predicted (Select Aggregate), will produce a separate graph for each hour requested. The note at the bottom of the *Data File Selection Menu* serves as a reminder of this feature. If you select a **Start Hour** of "1" and **End Hour** of "24", then 24 graphs will be produced. Producing this number of graphs may be a waste of your time and/or resources. To produce a single graph, select the same hour for **Start Hour** and **End Hour** (as shown in the example in Figure 4-5).

Only one other graphic type produces multiple graphs: the Observed and Predicted (Select Aggregate) type of Time-Series Line Graph. All the other types of graphics produce only a single graph (see Table 2-1).

4.4.3 Print File Selection

For each graph produced by the UAMPES, there will be a corresponding text file produced that records the exact values or data points plotted in each graph and contains the summary statistics table (Figure 2-1, Section 2.2). The summary statistics table is generated every time the user selects a graph for which an aggregation method is specified. The text file will duplicate the titles and label of the graph it accompanies. The Print File Selection window, shown in Figure 4-6, allows you to tell the system where to put this text file. The *Print File Selection* window will appear on top of the *Data File Selection Menu.* Refer to Section 5 (Menu Reference) for details of the operation of the Print File Selection window. For the purposes of this tutorial, enter a three-level file name beginning with your user ID/account number. The file name should be a name that you are not already using. The UAMPES will allocate the file for you. In the example shown in Figure 4-6, the name "uidacct.PRINT.-LISTING" has been entered.

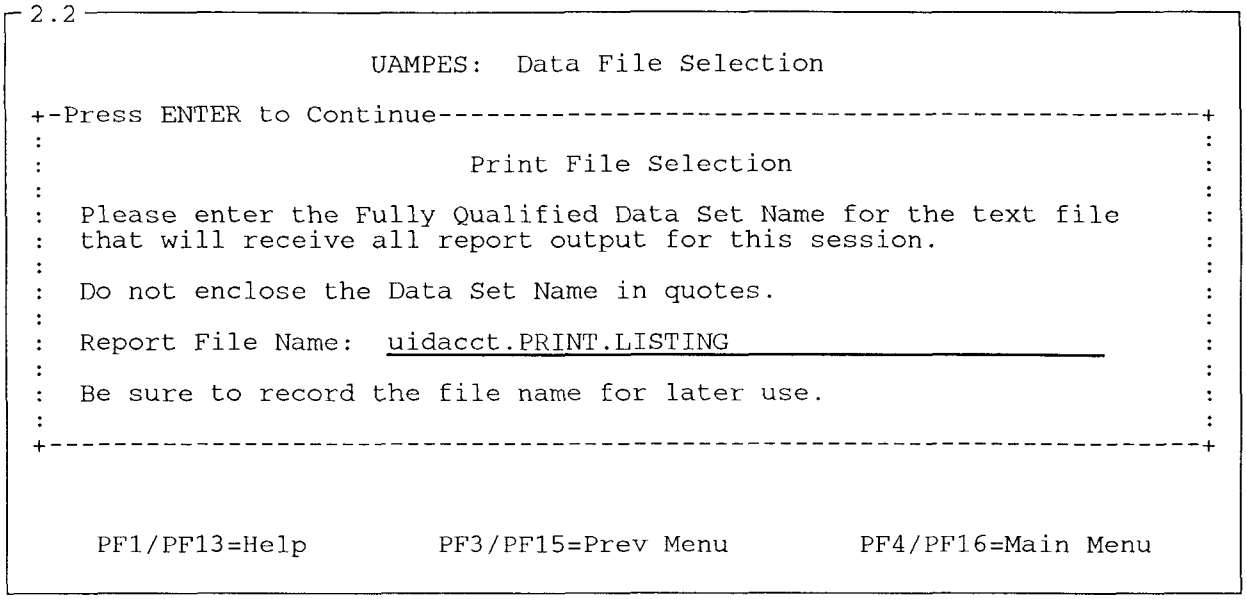


Figure 4-6. *Data File Selection Menu* with Print File Selection window.

4.4.4 Selecting a Subset of Monitors

After you have filled in all of the selection fields of the *Data File Selection Menu*, press <Enter> to move on to the *Monitors Located Within Domain Menu*, as shown in Figure 4-7. This menu appears because the option to subset monitors was selected in the *Bar Chart Method/Type Selection Menu* (Figure 4-4).

Before presenting the list that appears in this menu, the UAMPES compares the two data sets entered in the *Data File Selection Menu*, and matches the monitors and their locations that are in the AIRS AMP350 workfile with the geographical area described by the domain in the extracted data set. Only the monitors that are located within the domain of the extracted data set are included in the UAMPES analysis. The monitors that do fit this criteria are then listed in the *Monitors Located Within Domain Menu*.

The *Monitors Located Within Domain Menu* allows you to preview the group of monitors that will be used in the model performance analysis. You may then select all of the monitors, a single monitor, or any subset of monitors you wish. The number of monitors selected is an important consideration in producing bar charts.

The two types of bar charts are the only graphics in the UAMPES that display a monitor identification (ID) for every monitor in the domain in a single graph. The monitor ID in the AIRS AMP350 workfile is nine characters long.

```
2.3

                    Monitors Located Within Domain

Place an S in the selection column for all monitors desired in this run.
          Press PF20 to scroll down the list, PF19 to scroll up.
   After all selections have been made, press PF15 to save selections.

Select   Bar Label    Monitor ID        State/County/Site Address

  _         13007      090013007    CT/FAIRFIELD/USCG LIGHTHOUSE, PROSPECT
  _         31003      090031003    CT/HARTFORD/30 REMINGTON ROAD
  _         70007      090070007    CT/MIDDLESEX/CONN. VALLEY HOSP., SHEW
  _         91123      090091123    CT/NEW HAVEN/715 STATE STREET
  _         70006      340170006    NJ/HUDSON/VETERANS PARK ON NEWARK BAY
  _         70006      340270006    NJ/MIDDLESEX/RYDERS LANE & LOG CABIN R
  _         10004      360810004    NY/QUEENS/QUEENS COLLEGE, 65-20 KISSEN
  _         30002      361030002    NY/SUFFOLK/EAST FARMINGDALE WATER DIST
  _         92004      361192004    NY/WESTCHESTER/WHITE PLAINS PUMP STATI
  _         _____      _________    ____________________________________
  _         _____      _________    ____________________________________
```

Figure 4-7. *Monitors Located Within Domain Menu.*

If there are more than four or five monitors in the domain, these ID numbers will start to run into each other. For this reason, the UAMPES will, by default, truncate the monitor ID numbers to the last five digits of each number. These five digits are placed in the **Bar Label** column of this menu.

As long as there are no duplicate entries in the **Bar Label** column, this system will uniquely identify each monitor, and as many as 15 monitors can fit on a single graph. However, if you have any duplicate labels or more than 15 monitors in the requested domain, you will have to make adjustments in the **Select** field and/or the **Bar Label** field.

First, let's deal with the possibility of having more than one monitor with the same value in the **Bar Label** field. If there are two or more monitors with the same **Bar Label** field, the UAMPES will treat them as multiple observations from a single monitor, add their concentration levels together, and display the resulting sum. Thus, if levels are running around 100 parts-per-billion (ppb) and there are three monitors with the same **Bar Label**, the graph will indicate a monitor with concentration levels around 300 ppb! To prevent this from happening, be sure that each monitor listed in Figure 4-7 has a unique **Bar Label**. In Figure 4-7, note that there are two monitors with the same value ("70006") in the **Bar Label** column. Type over the characters in the **Bar Label** field with any identification that will work for you (Figure 4-8 shows one possibility). Note: you may enter any combination of alphabetical or numerical characters. In the example shown in Figure 4-8, the monitors are now labeled with the first five digits of the **Monitor ID**, which correspond to the state and county codes. This strategy will work as long as there is only one monitor in each county. The entries that appear in the **Bar Label** field are the ones that will identify each monitor in the bar chart. Note also in Figure 4-8 that selected monitors are indicated by an "S" in the **Select** field.

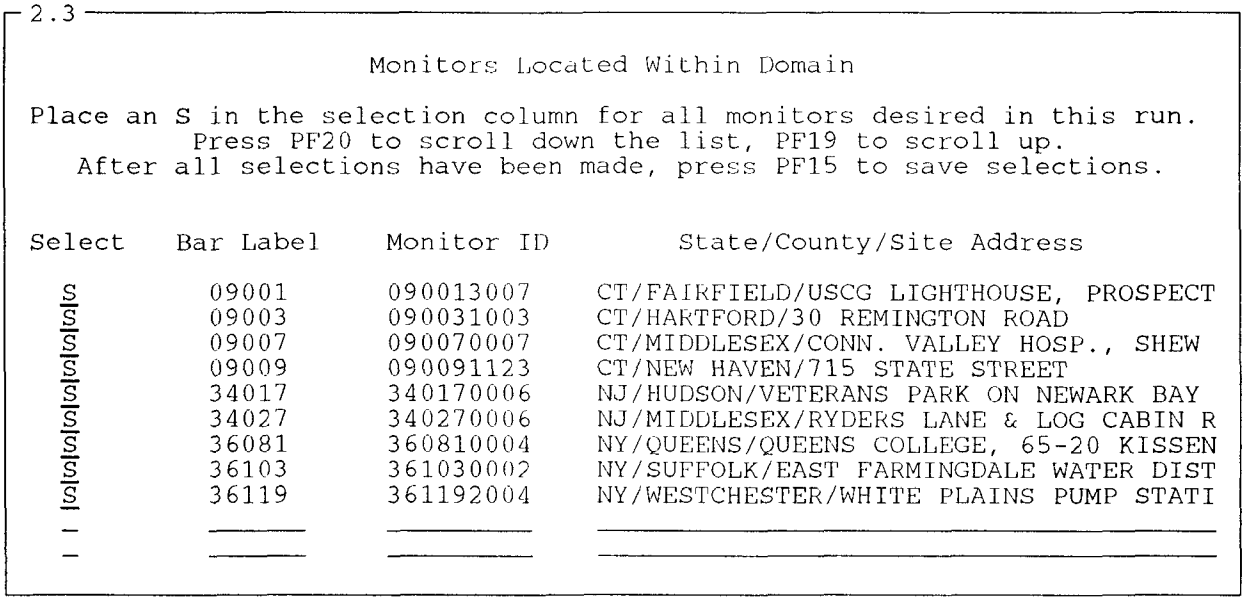


Figure 4-8. *Monitors Located Within Domain Menu* with modified labels.

Now let's look at the possibility of having more than 15 monitors. The primary limiting factor on the number of monitors that can be plotted on a single graph is the size of the **Bar Label**. If the **Bar Label** is too large, no graph will be produced. With sufficiently small **Bar Label**, more than 80 monitors have been plotted on a single graph in simulation trials. The size of **Bar Label** may be reduced by giving each monitor only a two or three character identifier in the current menu. The size may also be reduced by specifying a smaller size of print in the **Size** field of the *Graphic Title/Description Specification Menu.*

Although more than 15 monitors can be plotted, certain problems arise as the number of monitors increases. Specifically, the size of the print of the **Bar Label** may be reduced to the point of illegibility; percent difference annotations start to overlap and also become illegible; and the bars themselves begin to resemble lines rather than bars.

To prevent these problems, you may wish to subset the monitors into two or more groups. For example, if you are considering 20 monitors, you may wish to generate two graphs with 10 monitors on each graph rather than a single graph with all 20 monitors crowded onto it. To accomplish this, enter an "S" in the **Select** field that precedes the **Bar Label** for the first group of monitors, continue through the UAMPES to produce a graph, and return to this point to select the next group of monitors.

Only 11 monitors can be listed on the screen at one time, so if there are more than 11 monitors to choose from, you will need to use the <PF7> or <PF19> key and the <PF8> or <PF20> key to scroll through the list. Use <Tab> to move the cursor to the **Select** field for

each monitor you wish to include in this graph. Type an "S" to indicate that this monitor is to be included. If you type an "S" and then decide that you do not want this monitor included in this graph, return the cursor to the **Select** field (using <Tab>) and press <Space bar> to delete the "S". After you have determined that each monitor has a unique description and you have indicated the monitors that you wish to select for this graphic, press the <PF3> or <PF15> key to save the selections and move on to the next menu. The <PF3> or <PF15> key takes the place of <Enter> in this menu, because the selections to be saved may include selections that have been scrolled off of the screen.

4.4.5 Selecting Bar Chart Attributes

The next menu is the *Bar Chart Attribute Selection Menu* shown in Figure 4-9. Each of the six different graphics has a corresponding *Attribute Selection Menu* that determines the appearance attributes for that particular graphic.

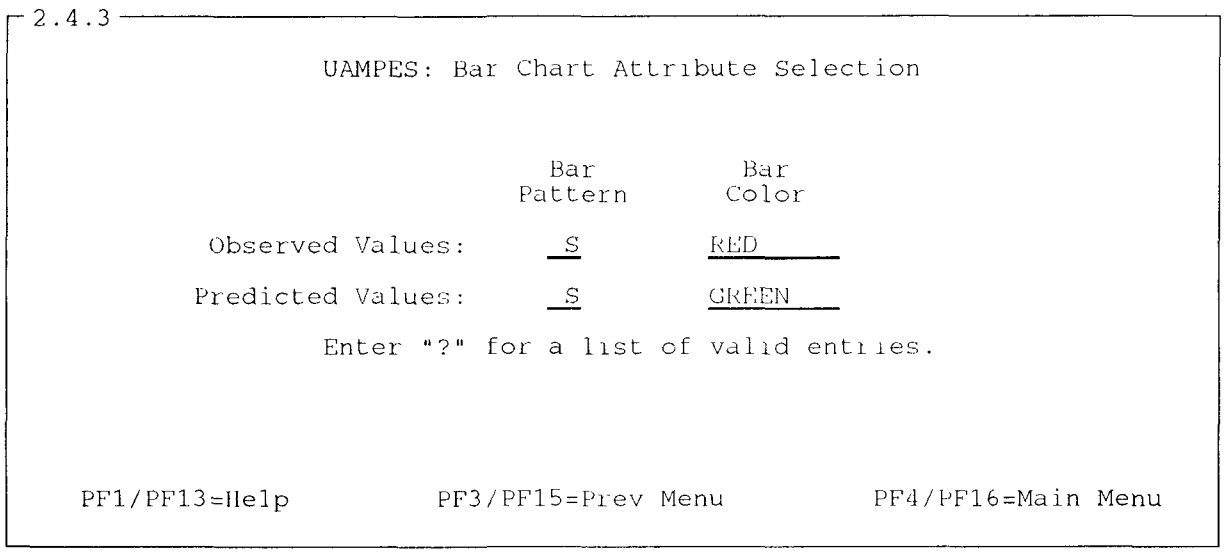


Figure 4-9. *Bar Chart Attribute Selection Menu.*

The *Bar Chart Attribute Selection Menu* allows you to select the pattern and color of the bars in the bar chart. The values shown in Figure 4-9 (S, RED and S, GREEN) will result in a solid red bar for the observed concentrations and a solid green bar for the predicted concentrations. This illustrates the point that, by changing colors from one bar to the next, you may want to specify the same pattern for both bars. On the other hand, you may on occasion wish to change the pattern from one bar to the next while specifying the same color for both bars. You may also change both the pattern and the color for both bars. The choice is yours to make.

You will notice that the *Bar Chart Attribute Selection Menu* (Figure 4-9) presents fields without presenting lists to accompany them. You may view the list that is available for a particular field by typing a question mark (?) in the field of interest and then pressing <Enter>. A window with a list of possible choices will appear. Figure 4-10 illustrates this window as it will appear in the menu.

The cursor will be on the first item in the list. To make a selection from the list, use the <Tab> or cursor movement keys to move the cursor to the item of your choice and press <Enter>. The window will disappear and the item you have chosen will appear in the selection list. Any field may be changed at any time as long as the menu is displayed on your screen. You may also return to any selection list as many times as you wish by using the <?> <Enter> sequence.

The Select Data window only displays the most popular options for each field. For a complete list of options for each field, refer to the SAS documentation discussed in Section 5.7 of this manual.

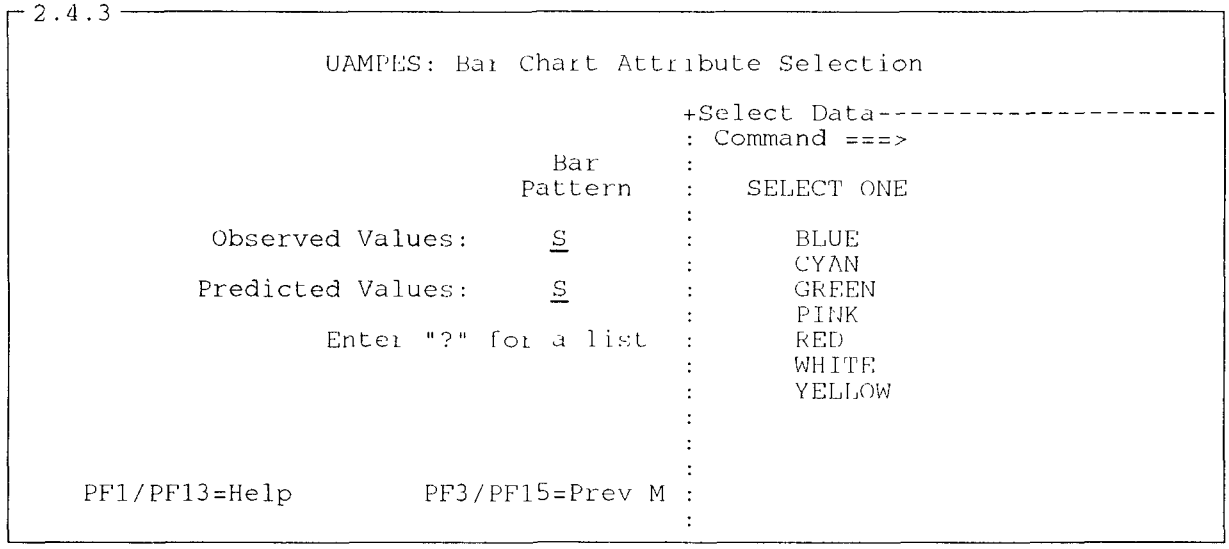


Figure 4-10. *Bar Chart Attribute Selection Menu* with a Select Data window.

4.4.6 Selecting Titles and Descriptions

After making entries in the *Bar Chart Attribute Selection Menu*, press <Enter> to bring up the *Graphic Title/Description Specification Menu* shown in Figure 4-11. This menu presents a table of the text information that will accompany the graphic. Unlike most UAMPES fields, the fields for title text and axis label text will not be saved. This menu will appear with default titles and axis labels that accurately describe the graph based on information in the data sets you specified earlier in the *Data File Selection Menu* and previous menu fields. The UAMPES automatically searches the specified data sets and inserts the species, study (defined by the user when running the Extract module), date, and hours of the data being analyzed. You may change the wording of these descriptions, but your choices are not saved and will not reappear in subsequent iterations of this menu.

You may also change the color, font, and size of the lines of text. Colors may be any that are supported by the device you are using. Fonts may be any of those listed in Chapter 6 of SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990). Be aware that as the size of text increases, the size of the graph decreases; and as the size of text decreases, the text becomes less legible. Until you have run the UAMPES once or twice, we recommend that you use a value of "3" in the title **Size** fields and a value of "2" in the axis label **Size** fields. Similar to most other fields, the **Color**, **Font**, and **Size** fields will be saved and recalled in subsequent iterations.

Note that the **Color**, **Font**, and **Size** specified for the **Horizontal Axis** label control the color, font, and size of the bar labels. You may increase the number of bar labels that can fit on a single graph by specifying a smaller **Horizontal Axis** label **Size** in this menu. The **Color** specified for **Title #1** will also be used to color the boxes that surround the graph and the legend, as well as the reference lines and other annotations that appear in the graph. The **Color** specified for **Title #2** will also be used to color the text that appears in the legend.

```
2.5
                UAMPES: Graphic Title/Description Specification

Enter Requested information. Skip any fields not desired. Do not use quote

                TEXT                                    COLOR     FONT      SIZE
Title #1
O3 VALUES FOR NEW YORK, 11JUL88                         WHITE     SIMPLEX   3.00

Title #2
(WITH PERCENT DIFFERENCE ANNOTATED)                     WHITE     SIMPLEX   3.00

Vertical Axis
CONCENTRATION (PPB)                                     WHITE     SIMPLEX   2.00

Horizontal Axis
                                                        WHITE     SIMPLEX   2.00

                    Enter "?" for a list of valid entries.

    PF1/PF13=Help          PF3/PF15=Prev Menu          PF4/PF16=Main Menu
```

Figure 4-11. *Graphic Title/Description Specification Menu.*

4.4.7 Axis Scaling Menu

After you are satisfied with the *Graphic Title/Description Specification Menu* and press <Enter>, the *Axis Scaling Menu* will appear. This menu allows you to select maximum and minimum scale values for the vertical axis. If all the graphed values range between 500 and 600, it may be desirable to specify a minimum scale value of 400 in order to take a closer look at the details of the graph. Also, if you are creating several graphs to be compared with each other, this menu allows you to ensure that all the graphs use the same scale.

The system checks the data about to be plotted and reports the maximum and minimum **Data Values** in the first column of this menu. The second column provides selection fields for you to specify the maximum and minimum axis values (which should always encompass the full range of the data values) and the interval to be indicated along the length of the scale line. In the example shown in Figure 4-12, a **Maximum** axis value of "200", a **Minimum** axis value of "0", and an **Interval** of "10" have been entered. This interval will result in about 20 labeled tic marks along the scale line. The first time you run the system these selection fields will be blank. In subsequent runs, these fields will hold the values used on the previous run. Always check the new data values against the previous axis values to be sure that the axis values encompass the full range of data values. If the data values fall outside (either above or below) the range of axis values, an error message to that effect will be displayed and no graph will be produced.

```
2.6
                UAMPES: BAR CHART AXIS SCALING MENU

                                          Selected
                            Data Values   Axis Values

                Maximum         199           200

                Minimum         66.26         0

                Interval                      10


  PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

Figure 4-12. *Bar Chart Axis Scaling Menu.*

At this point, you have given the UAMPES all the information necessary to produce a table of summary statistics and a graph. When you press <Enter>, a one or two minute pause will occur while the UAMPES generates the graph. After the graph has been generated, it will be displayed on your screen. Now, it is time to check the graph to see if it plots the information in which you are interested, and to check the text describing the graph to see if the default description is adequate. The table of summary statistics has been placed in your user-specified output listing file. You may exit the system (UAMPES) and view or print the table using standard IBM utilities or TSO commands.

If you have faithfully and successfully followed this tutorial, you should see a graph similar to the one in Figure 4-13 below. The graph displays a pair of bars (one for observed concentration and one for predicted concentration) for each monitor. The height of each bar is proportional to the concentration level. The percent difference between the observed and predicted concentrations is calculated as: [(observed - predicted) / (observed)] × 100, and is displayed above the bar for the predicted concentration level.

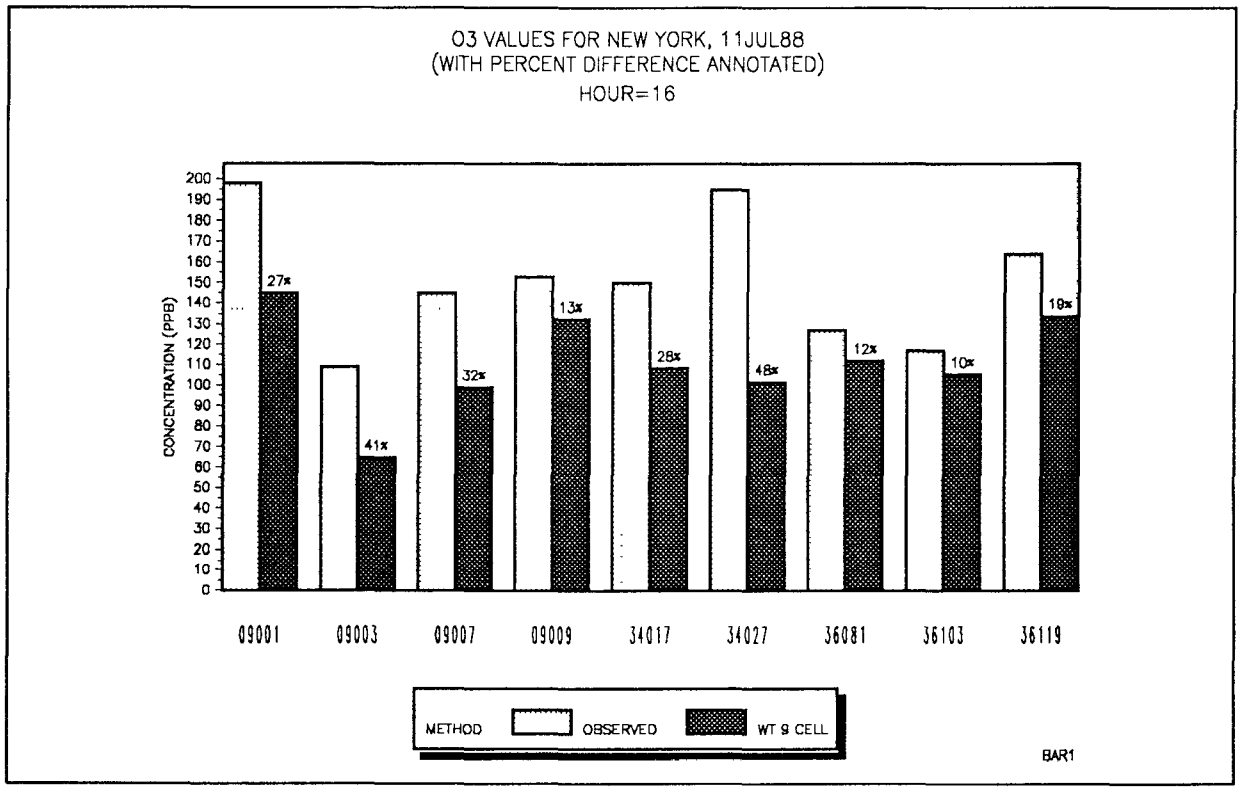


Figure 4-13. Bar chart (BAR1) from the tutorial.

4.4.8 Termination Options

After you have checked the graph to be sure it is what you had in mind, you must choose whether or not to save the graph to a graphics catalog. If the graph is just for your information or is not exactly what you had in mind, you may be satisfied with simply viewing the graph on your screen and not saving it. However, if the graph presents information you wish to share with others, you will probably want to save it to a graphics catalog. Graphs saved to a graphics catalog can then be displayed on a variety of devices other than the one used to generate the original graph. Reproducing the graph on a screen or hard-copy device will also take less time than generating the original graph.

Press <Enter> to move on to the next menu, the *Termination Selection Menu*, shown in Figure 4-14 below. This menu presents five options for the disposition of the graph you have just viewed. These options will:

(1) return you to the *Graphic Selection Menu*,
(2) return you to the *Data File Selection Menu*,
(3) return you to the *Graphic Title/Description Menu*,
(4) bring up the *Graphics Catalog Generation Menu*, or
(5) end your current session with the Graphics module option and return to the *UAMPES Main Menu*.

For any option, type the corresponding option number in the **Selection** field and press <Enter>. For the purposes of this tutorial, assume that we want to save the graphic. Type "4" in the **Selection** field and press <Enter>.

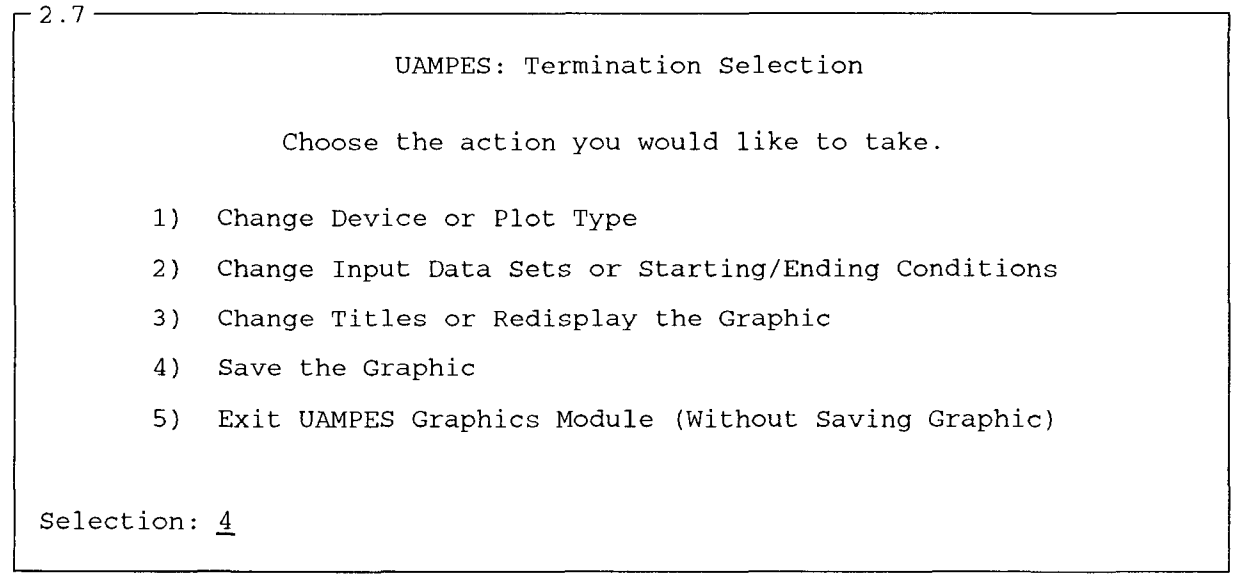


Figure 4-14. *Termination Selection Menu.*

4.5 SAVING THE GRAPHIC IN A GRAPHICS CATALOG

The *Graphics Catalog Generation Menu* shown in Figure 4-15 contains brief instructions for providing a name for the catalog as well as a name and brief description of the graph that you have just produced. A single catalog may contain any number of graphics, so you may only need a single catalog for all the graphics you produce. On the other hand, you may wish to have more than one catalog for organizational purposes.

The **Graphics Catalog DSN** should be any valid file name for the computer system that you are using. On the EPA's IBM system you may wish to use a three-level name beginning with your user ID/account number (uidacct). Each level must be separated by a period (.) and should be no more than eight characters in length. Any combination of alphabetical and numerical characters can be used, but you must start with an alphabetical character (e.g., "uidacct.GRAPHICS.CATALOG"). Refer to the Guide to NCC Services (EPA, 1990b) for further naming conventions.

The graphic **Name** should be no more than eight alphanumeric characters containing no blanks, for example, "FIRSTBAR". The graphic **Description** may be up to 40 characters long and may contain blanks (e.g., "NEW YORK, 11JUL88, 9 MONITORS, HOUR 16".

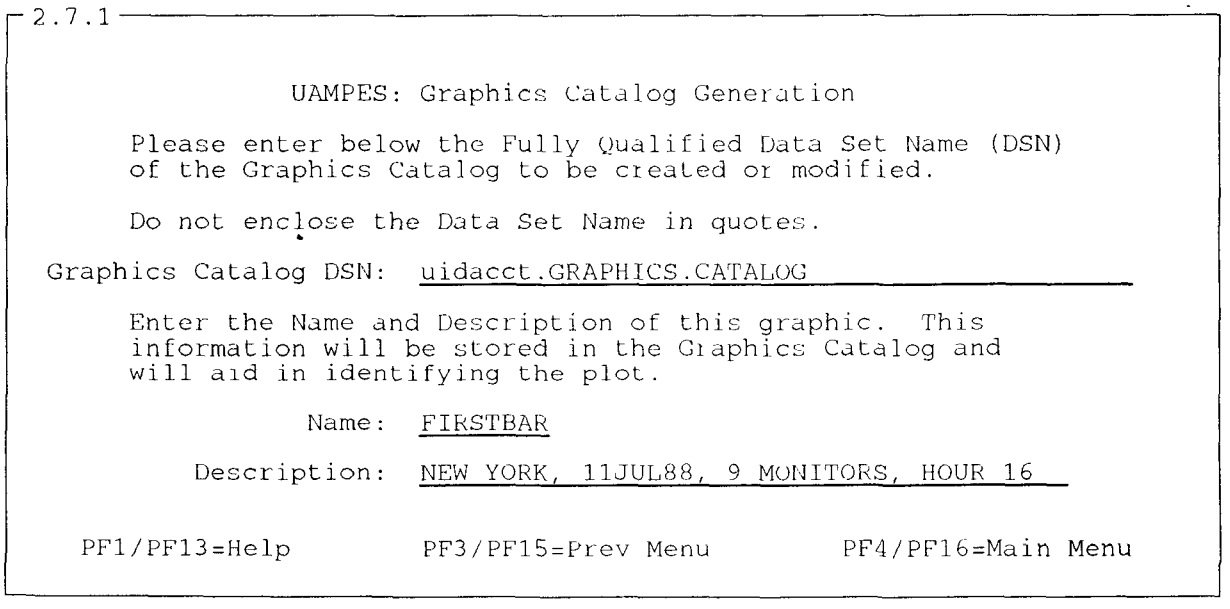


Figure 4-15. *Graphics Catalog Generation Menu.*

After you have provided names and a description in the appropriate fields, press <Enter>.

The PROC GREPLAY window shown in Figure 4-16 will appear to allow you to verify that the graphic has been placed in the graphics catalog. Press <PF3> or <PF15> to return to the *Termination Selection Menu*, shown in Figure 4-14.

Then, you have several choices: produce a different graphic by selecting options 1 or 2; take another look at the current graphic by selecting option 3; save another copy of the current graph (possibly to a second catalog) by selecting option 4 again; or end the session by selecting option 5.

At this point, you should have successfully produced a bar chart and saved it in a graphics catalog. Refer to Appendix D of this manual for more detailed instructions on using the "Graphics Catalog" option in the *UAMPES Main Menu* to view or print graphics stored in a graphics catalog; this appendix is identical in content to Section 4.3 of the user's manual for the UAMPPS (EPA, 1990a).

Section 5 (Menu Reference) provides a complete discussion of all UAMPES menus. Section 6 (Files) presents a description of the tables that support the graphics.

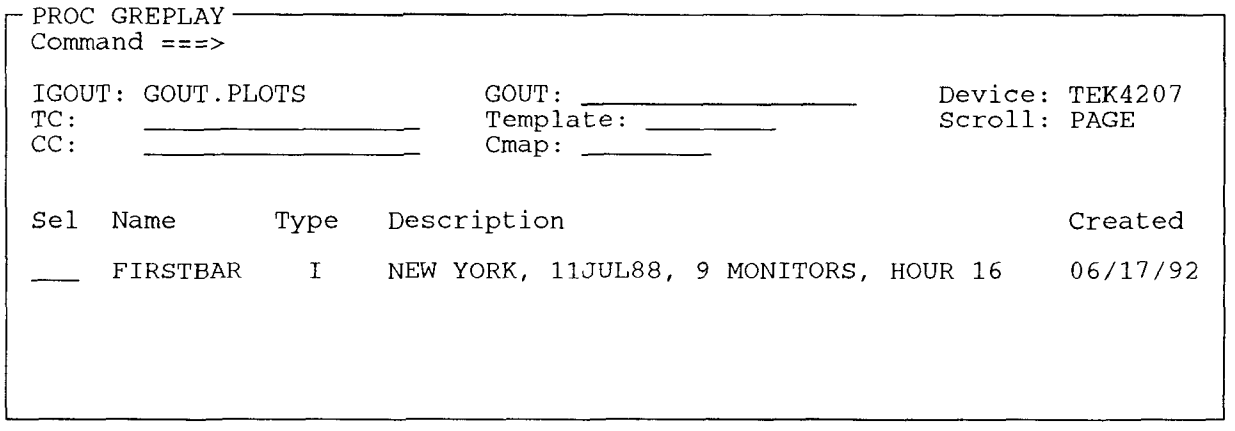


Figure 4-16. PROC GREPLAY window.

5. MENU REFERENCE

This section describes the UAMPES graphics menus. It begins with an outline of the menu structure, illustrating how menus are related to each other and the order in which they occur as you use the UAMPES. The remainder of the section gives detailed descriptions of the menus. Each description explains a menu's purpose, tells how to use it, and lists error messages and tells what causes them.

5.1 MENU OUTLINE

The UAMPES menus are numbered in the upper-left corner to give you an idea of where you are in the system. There are three menu groups that may be chosen from the *UAMPES Main Menu*: Extract, Graphics, and Graphics Catalog. All menu numbers associated with Extract begin with a "1", all menus associated with Graphics begin with a "2", and all menus associated with the Graphics Catalog begin with a "3".

The following subsections provide information on Graphics menus (i.e., menus starting with "2"). As noted earlier in this manual, Appendices A and C present information on the Extract and Graphics Catalog menus, respectively. These appendices are identical in content to Sections 4.1 and 4.3 of the user's manual for the UAM postprocessing system (EPA, 1990a) and are provided herein for easy reference.

The second digit in the menu number indicates the level of the menu. These levels correspond to the levels indicated in Figure 5-1. If there is more than one menu in a given level, the menus in that level are numbered consecutively with a third digit. For example, using Figure 5-1, the *Bar Chart Attribute Selection Menu* will be numbered 2.4.3 (i.e., Graphics group, level 4, menu 3).

The UAMPES graphics menus allow you to build a variety of graphs using data specified by you. Figure 5-1 illustrates how the graphics menus are related to each other and the order in which they appear on your screen.

The *Graphic Selection Menu* is the starting point for building any type of graph. After specifying the graphic you want from the *Graphic Selection Menu*, a menu unique to the type of graph specified, will come on screen (e.g., *Bar Chart Method/Type Selection Menu*). This menu will allow you to further define the type of graph to be produced.

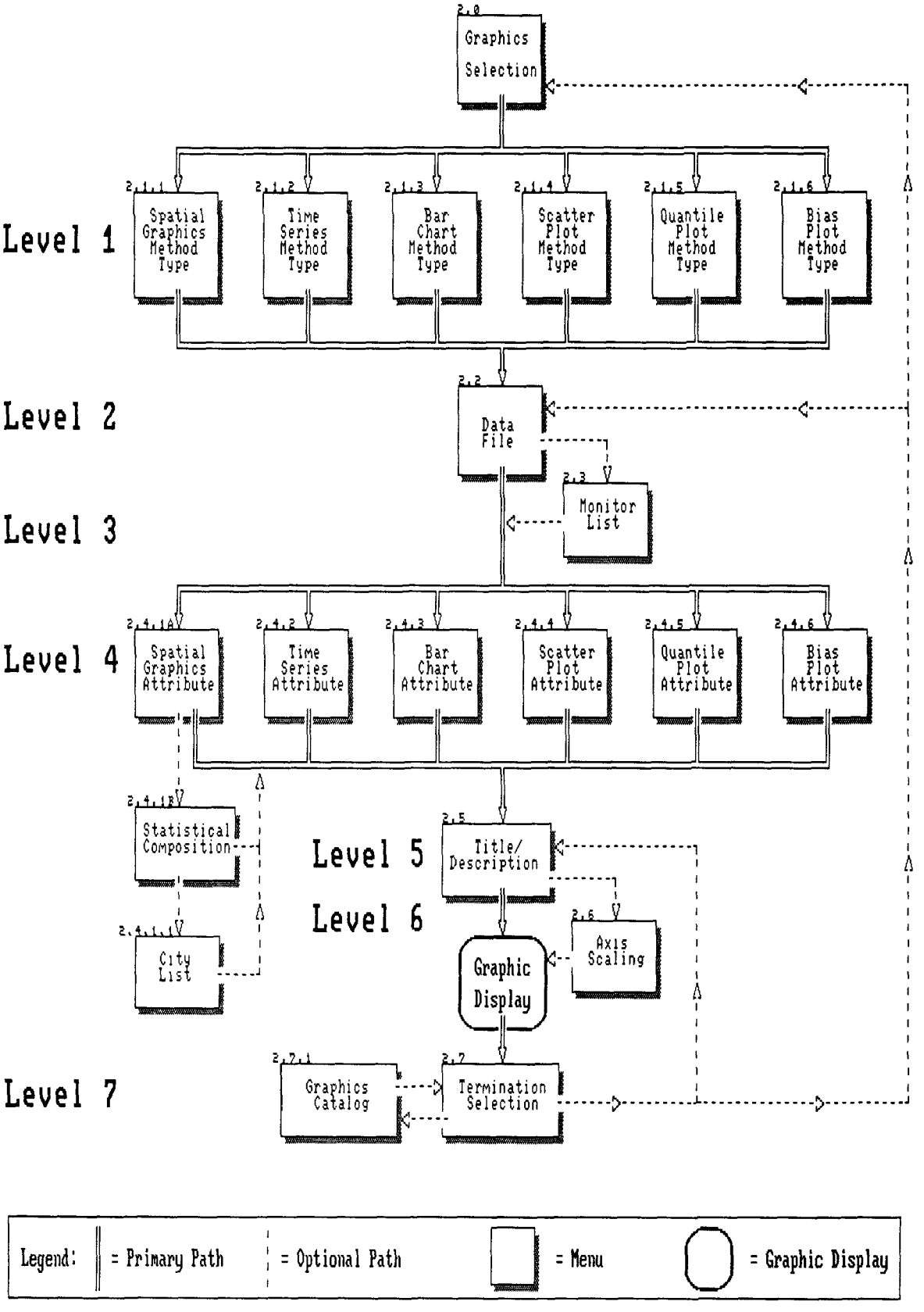


Figure 5-1. The UAMPES menu structure.

Next, the *Data File Selection Menu* and the Print File Selection window, which are common to all the graphs, will be displayed. These screens let you tell the UAMPES exactly what data you wish to analyze and where to place the table of summary statistics. If you ask for a subset of monitors, these screens will be followed by a *Monitors Located Within Domain Menu* which is also common to all the graphs. If you ask to use all the monitors or a previous subset of monitors, you will skip the *Monitors Located Within Domain Menu* and proceed directly to the *Attribute Selection Menu(s)* unique to the type of graph selected. Then you can select specific attributes for the graph you are creating.

The *Graphic Title/Description Specification Menu* follows the specific *Attribute Selection Menu*; this menu is common to all the graphs. It lets you specify the text that describes the graph. In the case of the spatial and the bias plot graphics, when this menu is completed, the table of summary statistics and the graph are completely defined and will be generated. The table of summary statistics is placed in the print file and the graph is displayed on your screen. For the other four graphics (time series, bar chart, scatter plot, and quantile plot), the *Axis Scaling Menu* will be presented before the graph is displayed. The *Axis Scaling Menu* allows you to specify the upper and lower limits and the interval for the scaled axis or axes.

After the table of summary statistics is placed in the print file and the graph is displayed, the *Termination Selection Menu* presents several options for what to do next. If you choose to save the graphic, the *Graphics Catalog Generation Menu* will prompt you for the name of the catalog, and a name and description for the graph to be saved. After saving the graphic, the *Termination Selection Menu* will reappear. At this point, you may generate another graphic or end the session. After ending the session, you may use standard IBM or TSO commands to view or print the print file.

The remainder of this section describes each of the UAMPES graphics menus in detail.

5.2 UAMPES MAIN MENU

The *UAMPES Main Menu* (Figure 5-2) presents five possible options: the Extract module, the Graphics module, the Graphics Catalog module, Help, and Exit. The Extract and Graphics Catalog options are identical to the Extract and Graphics Catalog options in the UAMPPS. Briefly, the Extract option allows users to extract data for a single species at a single level from a much larger data set generated by running the Urban Airshed Model. The Graphics Catalog option allows users to view or produce hard-copy output of graphs that have been saved in a graphics catalog. Please refer to Appendices A and D for details of the operation of these options. The Graphics option is the focus of this section. The Help option provides general information about the system and the other options available in the *UAMPES Main Menu.* The Exit option will end the current session and return you to the TSO READY prompt.

When you first start the system, your cursor will appear on the Extract option. Press the <Tab> key to move the cursor from one option to another. To select a particular option, move the cursor to the desired option and press <Enter>. To view and work with the menus discussed in this section, move the cursor to the Graphics option and press <Enter>.

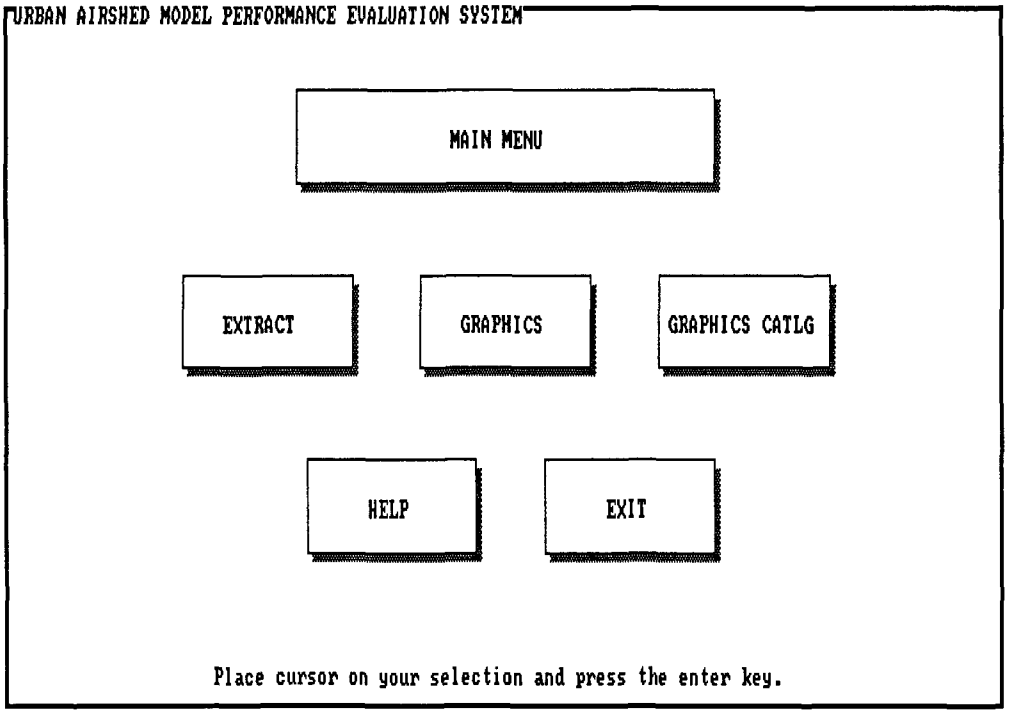


Figure 5-2. *UAMPES Main Menu.*

5.3 GRAPHIC SELECTION MENU

The *UAMPES Graphic Selection Menu* (2.0), shown in Figure 5-3, lets you select a graphic. In addition, the menu asks for the type of equipment you are using so that the system knows what language to "speak" when it sends the graph to your terminal.

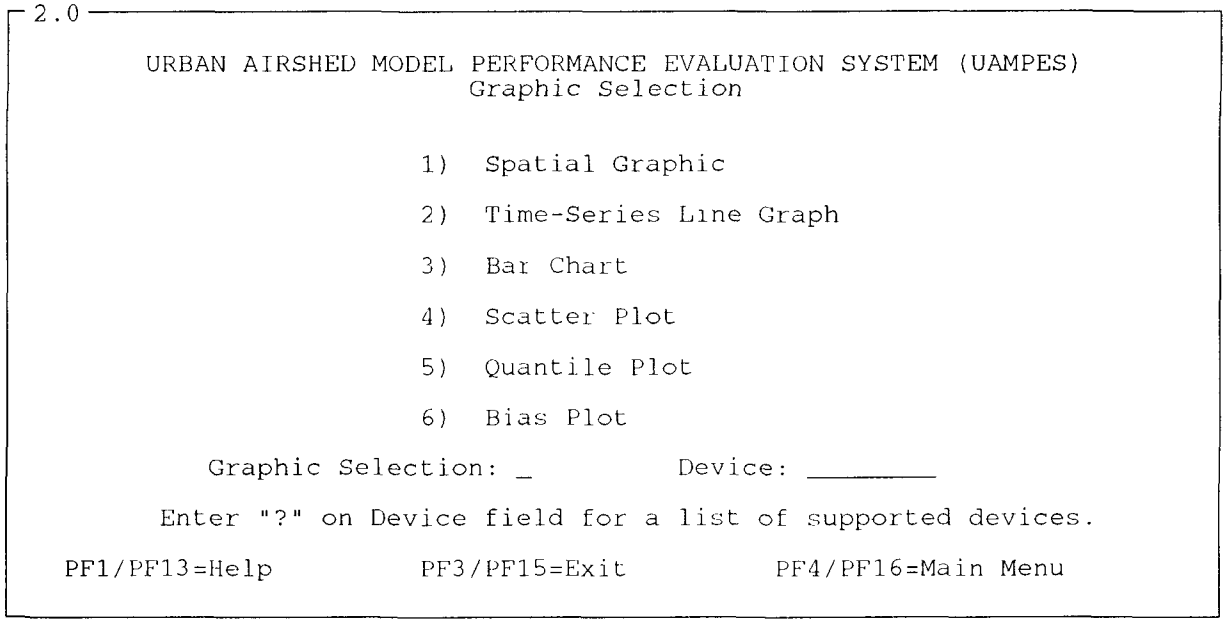


Figure 5-3. *Graphic Selection Menu.*

Instructions

Choose a graphic from the list and enter the number of that graphic in the **Graphic Selection** field. Samples of the available graphics can be found in Section 2 of this manual.

Next, enter the name of the terminal you are using or emulating in the **Device** field. Be sure to consult the user's manual supplied by the terminal manufacturer if you are not certain what type of graphics device you are using or emulating. For further help, call the EPA User Support Department (see Section 1).

Note that the UAMPES only checks the **Device** field for a supported device. There is no way for the UAMPES to know if the device you have entered accurately describes the one you are using so there will *NOT* be an error message if the entry is incorrect. There will ONLY be an error message if the entry does not match one of the supported devices. *Failure to enter the proper device name on this screen may result in unrecoverable errors when you attempt to display a graph.*

If you are using a Tektronix 4207, 4211, or 4224 connected via a coaxial adapter, enter "TCX4207". If you are using one of the above named devices but NOT with a coaxial connection, enter "TEK4207". Enter "IBM3179" or "GDDMPCG" if you are using or emulating an IBM 3179G terminal; "IBM3279" should be entered if you are using or emulating an IBM 3279G terminal. Enter "TEK4010" if you are using a version of Kermit that supports graphics. After you have made valid entries in the **Graphic Selection** and **Device** fields, press <Enter> to move on to the next menu.

Error Messages

```
A value is required at the cursor location.
```

Because both fields in this menu are required, leaving either of them blank will result in the above message appearing in the Error Message window. Press <Enter> to remove the error window from your screen. The cursor will be placed on the appropriate field to allow you to enter a valid value. Use the guidelines described above to supply the correct information.

```
You must enter a value between <valid range> to continue.
```

The above message will be displayed if any value other than "1" through "6" is entered in the **Graphic Selection** field. The cursor will be placed on the **Graphic Selection** field to allow you to enter a number within the range of 1 through 6.

Finally, if you specify a value in the **Device** field that is not in the list of supported terminal devices, a Device List Window will open and you may choose a device from the list.

5.4 METHOD/TYPE SELECTION MENUS

There is a *Method/Type Selection Menu* for each type of graph (UAMPES menus 2.1.1 through 2.1.6) that can be specified in the *UAMPES Graphic Selection Menu.* The menu for the spatial graphics has unique options because it draws a map of the geographical area in question. Menus for the other graphics are quite similar to each other. Each of the other five menus has three similar lists to choose from. Accordingly, the *Spatial Graphics Annotation Selection Menu* will be discussed separately followed by a collective discussion of the other *Method/Type Selection Menus.*

5.4.1 Spatial Graphics Annotation Selection Menu

The *Spatial Graphics Annotation Selection Menu* (2.1.1), shown in Figure 5-4 below, lets you select the type of spatial graphic that you would like to create. You can display either color or monochrome versions of a shaded-tile or gridded-value map, using one of the four **Analysis** types.

```
2.1.1
                UAMPES: Spatial Graphics Annotation Selection

           Map Type: _ 1) Shaded Tile   2) Gridded Value

       Pattern Type: _ 1) Color         2) Monochrome

    Grid Annotation: _ 1) None          2) Col/Row          3) Lat/Lon

    City Annotation: _ 1) None  2) All  3) Subset Cities    4) Prev Subset

  Monitor Selection: _ 1) All Monitors  2) Subset Monitors 3) Prev Subset

           Analysis: _ 1)  Average Concentration
                       2)  Maximum Concentration
                       3)  Hour of Maximum Concentration
                       4)  Concentration at a Given Hour

     PF1/PF13=Help         PF3/PF15=Prev Menu         PF4/PF16=Main Menu
```

Figure 5-4. *Spatial Graphics Annotation Selection Menu.*

Instructions

Choose either a shaded-tile or gridded-value map by specifying "1" or "2" in the **Map Type** field. After selecting the type of graphic that you would like to display, you may then choose to display either a color or monochrome plot. Inserting "1" in the **Pattern Type** field will yield a color plot; a value of "2" will generate a monochrome plot.

Next, you must decide the type of grid annotation that you want displayed on the chart. Entering "1" in the **Grid Annotation** field will display no annotation. Entering "2" will annotate row and column numbers. Entering "3" will display latitude/longitude annotation.

The **City Annotation** field lets you determine what cities, if any, will be marked on the map. A value of "1" displays no cities. A value of "2" displays all major cities within the domain. However, you may find that displaying all cities within the domain produces a cluttered map. If you enter "3", you will be able to select the cities that you would like displayed from the complete list. After you have decided on a subset of cities to display, you may repeat that subset of cities on subsequent runs by entering "4". Note that you MUST enter "3" before entering "4". Also, the subset is not retained at the end of a session: Specifically, if you change domains within a session, you must enter "3" to produce a valid subset for the new domain. For example, entering "4" to obtain a previous subset for New York would not overlay on a domain for Atlanta.

The **Monitor Selection** field is similar to the **City Annotation** field. It lets you determine which monitors to display on top of the grid cells. A value of "1" will display all the monitors in the selected domain. Again, displaying all the monitors may produce a cluttered map. If you enter "2", you will be able to select the monitors to display from the complete list. After selecting a subset of monitors, you may repeat that subset of monitors on subsequent runs by selecting "3". The same caveats that apply to selections "3" and "4" of the **City Annotation** field also apply to selections "2" and "3" of the **Monitor Selection** field (i.e., a value of "2" must be run before entering "3", and if you change domains, "3" is not available).

The **Analysis** field (chosen next) that is applied to the grid cells will also be applied to any monitors that are displayed. If you choose to display several monitors and select "1" for the average concentration analysis, then the average concentration of each monitor over the selected range of hours will be displayed at that monitor's location. If you have selected a shaded tile map (**Map Type** "1"), then the monitor location will be shaded accordingly. If you have selected a gridded value map (**Map Type** "2"), then the monitor value (average, maximum, etc.) will be displayed at the monitor location.

By filling out the **Analysis** field, you determine the type of statistic that is displayed in the graphic. The types of statistics and their corresponding options are explained below.

Option 1--Average Concentration
Computes the average concentration for each cell in the domain and the average concentration for each monitor. This average is based on the number of hours specified in the *Data File Selection Menu*. The range of hours specified is considered to be the period of interest.

Option 2--Maximum Concentration
Computes the maximum concentration for each cell in the domain and the maximum concentration for each monitor over the specified time period and displays the result in the graphic.

Option 3--Hour of Maximum Concentration
Determines the hour at which the maximum predicted concentration for each grid cell and maximum observed concentration for each monitor in the domain occurs over the period of interest, and displays the result in the graphic.

Option 4--Concentration at a Given Hour
Determines the concentration at the hour specified in the **Start Hour** field of the *Data File Selection Menu* and displays the result in the graphic.

After you have specified all information, press <Enter> to process your selections.

Error Messages

```
Enter a number between <valid range> -or- press PF1/PF13 for help.
```

The above message appears if the number in any field is not in the allowable range for that field. Type over the incorrect value with a valid value.

```
Selection 4 only valid after selection 3 has been run.
```

The above message results from typing a "4" in the **City Annotation** field, when there is no previously selected subset of cities. Always choose option 3 before choosing option 4. During a session, you must create a subset before you use it.

5.4.2 Other Method/Type Selection Menus

For the other five graphics (other than spatial graphics), the selection menus (2.1.2 through 2.1.6) display different selection lists for each of three fields: **Type**, **Aggregation Method,** and **Monitor Selection**. The *Time-Series Method/Type Selection Menu* (2.1.2), shown in Figure 5-5 below, is representative of these menus. The choices for graphic **Type** are listed first, followed by a list of **Aggregation Method** choices. The features and algorithms associated with each type and method are discussed in Section 2 and Appendix C. Then, the user chooses the **Monitor Selection** (all or a subset of monitors).

```
2.1.2
                UAMPES: TIME-SERIES METHOD/TYPE SELECTION

        Type: _     1. Observed and Predicted (Select Aggregate)
                    2. Maximum Observed and Predicted (Select Aggregate)
                    3. Domain Maximum Observed and Predicted

  Aggregation Method: _   1. Samecell
                          2. 9 Cell Closest Value
                          3. Distance Weighted 9 Cell Average
                          4. 4 Cell Closest Value
                          5. Distance Weighted 4 Cell Average
                          6. Bilinear 4 Cell

   Monitor Selection: _   1. Use All Monitors
                          2. Subset Monitors
                          3. Use Previous Subset of Monitors


  PF/1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

Figure 5-5. *Time-Series Method/Type Selection Menu.*

Instructions

Choose a graphic type from the list and enter its number in the **Type** field. Do the same for the aggregation method, entering the appropriate number in the **Aggregation Method** field. Choosing all or only a subset of monitors will have different effects depending on the type of graph that you desire. Both the **Aggregation Method** selected and the **Monitor Selection** will have a direct bearing on the table of summary statistics. The **Type** selected will have no effect on the table.

The first **Type** of time-series graphics, Observed and Predicted (Select Aggregate), will generate a separate graph for each monitor. You may wish to select only a single monitor and wait to see the corresponding graph before electing to generate multiple graphs which may or may not contain useful information.

Using a subset of monitors will primarily affect the appearance of the bar charts and scatter plots by plotting fewer bars and dots respectively. See the tutorial in Section 4 for a thorough discussion of other considerations affecting bar charts.

In addition, using a subset of monitors will affect the calculations of rank order in the quantile plots and fractional bias in the bias plots. Refer to Section 2 and Appendix C of this manual for a discussion of these calculations.

After you have made valid entries in all three fields, press <Enter> to move on to the next menu.

Error Messages

Error messages for these screens are the same as those for the *UAMPES Graphic Selection Menu.*

5.5 DATA FILE SELECTION MENU AND PRINT FILE SELECTION WINDOW

The *Data File Selection Menu* lets you specify exactly which data sets you want the UAMPES to compare. The Print File Selection window allows you to direct the text output that accompanies each graph produced by the UAMPES. The Print File Selection window will appear only once each time you run the UAMPES, and will appear on top of the *Data File Selection Menu* the first time that menu appears in a session.

5.5.1 Data File Selection Menu

The *Data File Selection Menu* (2.2), shown in Figure 5-6, contains five selection fields that must be completed before moving on to the next menu. There are two long fields for entering data set names. These long fields are followed by three shorter fields for entering the date, and start and end hours.

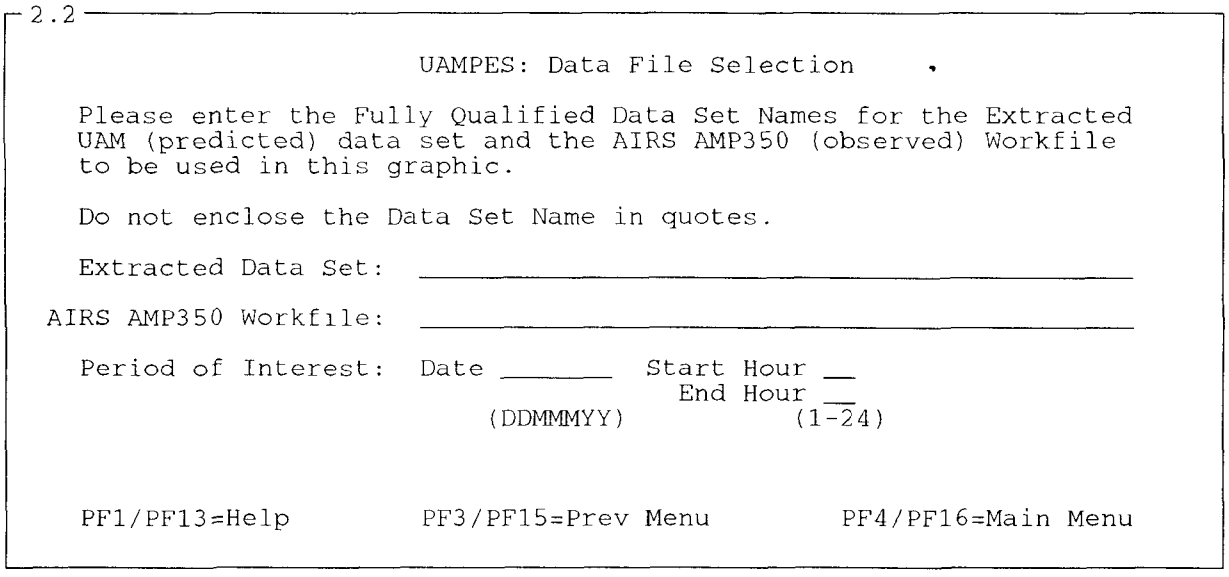


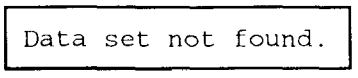
Figure 5-6. *Data File Selection Menu.*

Instructions

The first long field calls for the name of an extracted data set created by the Extract module. Enter the fully qualified data set name of the extracted data set in the space provided. The second long field calls for the name of an AIRS AMP350 Workfile. Enter the fully qualified data set name of the workfile data set in the space provided. Do not enclose the data set names in quotation marks.

The three short selection fields define the period of interest and consist of the date and starting and ending hours. The period of interest must be within the time frame contained in the two data sets. The **Date** should contain seven characters of the form *ddmmmyy* where *dd* is the day, *mmm* is the month, and *yy* is the year. For example, if the extracted and workfile data sets contain data for hours 1 to 24 on August 1, 1991, then you must enter "01AUG91" in the **Date** field and may choose any range of hours between 1 and 24 for the **Start** and **End Hour** fields. The only restriction is that the starting hour must be earlier than the ending hour.

Error Messages



The UAMPES will search for data sets with the names that you have specified. If they are not found, the message above will appear. Press <Enter> to remove the Error Message window from the screen. The data set that was not found will be highlighted. If neither data set was found, both will be highlighted. You should first check the entries you have made in this menu for accuracy. If you do not find any errors, end the current session and review the list of data sets. To end the current session, press <PF4/PF16> to return to the *UAMPES Main Menu* and press <PF3/PF15> to exit the system.

This message will appear if the ending time occurs earlier than the starting time. Change either the starting or ending time so that the analysis starts before it ends. The program will not run if you start the analysis at 12 and end it at 10.

You, the user, are responsible for determining that both of the data sets consider the same species of pollutant. Obviously, it makes no sense to compare predicted levels of ozone with observed levels of carbon monoxide. Check the data sets you intend to analyze before you start the system to be sure that they contain values for the same species of pollutant. This is one instance in which you can ask for nonsense and the system will let you have it.

5.5.2 Print File Selection Window

For each graph produced by the UAMPES, there will be a corresponding text file produced that records the exact values or data points plotted in each graph and contains the summary statistics table (Figure 2-1, Section 2.2). The summary statistics table is generated every time the user selects a graph for which an aggregation method is specified. The text file will duplicate the titles and label of the graph it accompanies. The Print File Selection window, shown in Figure 5-7, allows you to tell the system what to name this text file. Choose any file name that is a valid name for your computer system. If your system requires file allocation, UAMPES will allocate the file if it has not been previously allocated. The Print File Selection window will appear on top of the *Data File Selection Menu.* After each graph or group of graphs you generate, various options allow you to return to the *Data File Selection Menu* or to an earlier menu to generate multiple graphs or groups of graphs within the same session. Thus, it is possible to be presented with the *Data File Selection Menu* several times in a single session. The Print File Selection window will only appear the first time through the *Data File Selection Menu.* Text files will be appended to each other until you end the session by exiting the system.

After you run the UAMPES the first time, the **Report File Name** field will be saved and recalled just like most of the other fields in the UAMPES. If you use the same file name in a subsequent session, the file from the previous session will be over written. This is intended as a convenience to the user as a method of conserving computer resources. If you do not want the previous file to be over written, either rename the existing file before starting the UAMPES, or specify a new name in the Print File Selection window.

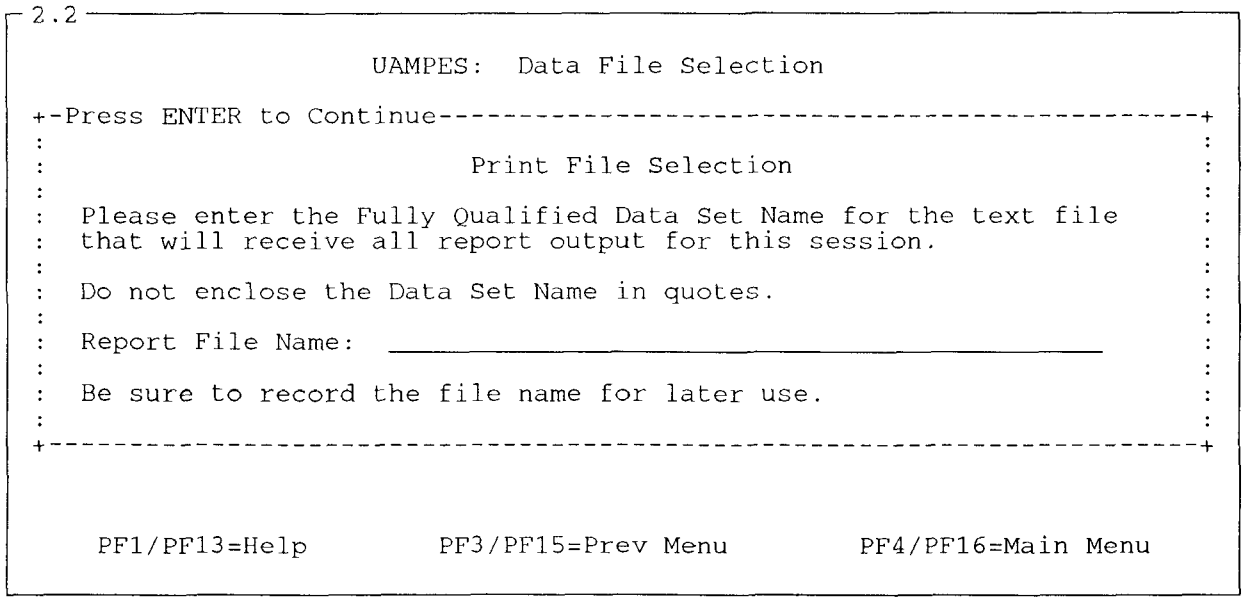


Figure 5-7. *Data File Selection Menu* with Print File Selection window.

5.6 MONITOR SELECTION MENU

The *Monitors Located Within Domain Menu* (2.3), shown in Figure 5-8, will be presented only if you select the second Monitor Selection option (subset monitors) in the *Method/Type Selection Menu* (Section 5.4).

2.3

Monitors Located Within Domain

Place an S in the selection column for all monitors desired in this run.
Press PF20 to scroll down the list, PF19 to scroll up.
After all selections have been made, press PF15 to save selections.

Select	Bar Label	Monitor ID	State/County/Site Address
_	13007	090013007	CT/FAIRFIELD/USCG LIGHTHOUSE, PROSPECT
_	31003	090031003	CT/HARTFORD/30 REMINGTON ROAD
_	70007	090070007	CT/MIDDLESEX/CONN. VALLEY HOSP., SHEW
_	91123	090091123	CT/NEW HAVEN/715 STATE STREET
_	31001	090131001	CT/TOLLAND/ROUTE 190, SHENIPSIT STATE
_	70006	340170006	NJ/HUDSON/VETERANS PARK ON NEWARK BAY
_	10005	340210005	NJ/MERCER/RIDER COLLEGE;LAWRENCE TOWNS
_	30006	340230006	NJ/MIDDLESEX/RYDERS LANE & LOG CABIN R
_	10004	360810004	NY/QUEENS/QUEENS COLLEGE, 65-20 KISSEN
_	30002	361030002	NY/SUFFOLK/EAST FARMINGDALE WATER DIST
_	92004	361192004	NY/WESTCHESTER/WHITE PLAINS PUMP STATI

Figure 5-8. *Monitors Located Within Domain Menu.*

Before presenting the list that appears in this menu, the UAMPES compares the two data sets entered in the *Data File Selection Menu*, and matches the monitors and their locations in the AIRS AMP350 workfile with the geographical area described by the domain in the extracted data set. Only the monitors that are located within the domain of the extracted data set are included in the UAMPES analysis. The monitors that do fit this criteria are then listed in the *Monitors Located Within Domain Menu.*

The *Monitors Located Within Domain Menu* lets you preview the group of monitors that will be used in the model performance analysis. You may then select all of the monitors, a single monitor, or any subset of monitors you wish. The monitor list consists of four columns of information. The first column is the **Select** field. The second column, the **Bar Label** field, is an abbreviated identification. By default, the **Bar Label** is composed of the last five characters of the monitor ID. The third column is the **Monitor ID** field. The fourth column describes the location of the monitor in terms of **State**, **County**, and **Site Address**. The State

is listed in the standard two-letter abbreviation followed by the county and then as many characters of the site address (as listed in the AMP350 workfile) as will fit on the screen.

Instructions

Only 11 monitors can be listed on the screen at one time. If there are more than 11 monitors to choose from, you will need to use the <PF7/PF19> and <PF8/PF20> keys to scroll the list. Use <Tab> to move the cursor to the **Select** field of each monitor that you wish to include in this graph. Type an "S" to indicate that this monitor is to be included. If you type an "S" and then decide you don't want this monitor included in this graph, return the cursor to the **Select** field using the <Tab> key and press the <Space bar> to erase the "S". Selections remain while you scroll through the list.

The **Bar Label** column is used only in composing bar charts. Refer to Section 4.4.5 for a discussion of how to use this column if you are generating a bar chart. After you have selected all the monitors that you want for the current analysis (and you are satisfied with the **Bar Label** column if generating a bar chart), press the <PF3/PF15> key to save the selections you have made and move on to the next menu. The <PF3/PF15> key takes the place of <Enter> in this menu because the selections to be saved may include selections that have been scrolled off of the screen.

Error Messages

There are no error messages associated with this menu. The system will read any character that appears in the **Select** field as though it were an "S".

5.7 ATTRIBUTE SELECTION MENUS

Each of the six graphics groups has a corresponding *Attribute Selection Menu* (UAMPES menus 2.4.1, through 2.4.6) that determines certain appearance attributes for that particular graphic. These graphic-specific *Attribute Selection Menus* are discussed separately, in the following subsections.

You will notice that these menus present selection fields without presenting selection lists to accompany them. You may view the list that is available for a particular selection field by typing a question mark (?) in the field of interest and then pressing <Enter>. A window with a list of possible choices will appear (e.g., see Figure 4-10 in Section 4.4.5).

When the window appears, the cursor will be on the first item in the list. To make a selection from the list, use the <Tab> or cursor movement keys to move the cursor to the item of your choice and press <Enter>. The window will disappear and the item that you have chosen will appear in the selection field. Any field may be changed at any time as long as the menu is displayed on your screen. You may also return to any selection list as many times as you wish using the <?> <Enter> sequence.

The selection list window only displays the most popular options. For a complete list of options for each selection field, you will want to refer to the following figures and tables in the SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990).

- Fonts, see Table 6.3
- Symbols, see Figure 6.3
- Colors, see Table 7.2.
- Patterns, see Figure 15.4
- Line types, see Table 16.5

5.7.1 Spatial Graphics Pattern Selection and Statistical Composition of Data

The *Spatial Graphics Pattern Selection Menu* (2.4.1) shown in Figure 5-9 lets you select cutoff values for the class breaks and a corresponding color or monochrome fill pattern to be displayed on the graphic. The *Statistical Composition of Data Menu* shown in Figure 5-10 is the second page of the *Spatial Graphics Pattern Selection Menu*, and is invoked by pressing <PF8/PF20> after the *Spatial Graphics Pattern Selection Menu* is displayed. The purpose of the *Statistical Composition of Data Menu* is to provide you with the information necessary to enter the cutoff values on the *Spatial Graphics Pattern Selection Menu*. Based on the graphic chosen on the *Graphic Selection Menu* (Figure 5-3), you will be presented with the values of the data to be plotted, broken down into several percentiles. Thus, you can determine the approximate percent of the data that will be contained in the cutoff ranges you select.

2.4.1A

Spatial Graphics Pattern Selection

Press PF20 to see the Statistical Composition of the Data.

Select the appropriate class breaks and corresponding colors or patterns.
The available colors and patterns for your device are specified below.

Class	Default Cutoff Value		Assigned Cutoff Value		Assigned Color/Pattern
1	<	82	<	80	BLUE
2	<	96	<	95	CYAN
3	<	110	<	110	GREEN
4	<	124	<	125	YELLOW
5	<	138	<	140	PINK
6	>,=	138	>,=	140	RED

Available Colors (for Color graphics)

BLUE	CYAN	GREEN	YELLOW	PINK	RED	WHITE

Available Patterns (for Monochrome graphics)

E	M1N45	M3N45	M4N45	M5N45	S

PF1/PF13=Help PF3/PF15=Prev Menu PF4/PF16=Main Menu

Figure 5-9. *Spatial Graphics Pattern Selection Menu.*

2.4.1B

Statistical Composition of Data

Press PF19 to return to the Pattern Selection Menu.

Percentile	Value	Percentile	Value
5	81.4	55	126.3
10	89.9	60	129.6
15	94.1	65	132.3
20	97.1	70	134.8
25	99.1	75	138.4
30	105.1	80	140.7
35	110.6	85	143.5
40	115.5	90	145.5
45	119.4	95	148.8
50	122.2		

Minimum Value: 68.4 Maximum Value: 154.5

Number of Records: 667

PF1/PF13=Help PF3/PF15=Prev Menu PF4/PF16=Main Menu

Figure 5-10. *Statistical Composition of Data Menu.*

Instructions

The **Default Cutoff Value** column offers a suggestion of six cutoff values derived from the data range detailed on the *Statistical Composition of Data Menu*. You may enter these values in the **Assigned Cutoff Value** field of the *Spatial Graphics Selection Menu* (Figure 5-9), or enter your own values. All six fields must have a value, and the values must be in ascending magnitude from top to bottom. Note that the logical operator preceding the **Assigned Cutoff Value** field will be used to subset the data for this class. For example, as shown in Figure 5-9, the following class breaks are defined:

- Class 1 -- Data values less than 80 will be colored blue.
- Class 2 -- Data values greater than or equal to 80 but less than 95 will be colored cyan.
- Class 3 -- Data values greater than or equal to 95 but less than 110 will be colored green.
- Class 4 -- Data values greater than or equal to 110 but less than 125 will be colored yellow.
- Class 5 -- Data values greater than or equal to 125 but less than 140 will be colored pink.
- Class 6 -- Data values greater than or equal to 140 will be colored red.

You must also enter a color or monochrome fill pattern in the corresponding **Assigned Color/ Pattern** field. We recommend that you choose from the colors/patterns listed at the bottom of this screen, because these colors are supported by the device you specified on the *Graphic Selection Menu*. Also, the available monochrome patterns (listed) have yielded good results, therefore they should be used if pattern fills are needed.

Note that the values for **Assigned Cutoff Value** and **Assigned Color/Pattern** fields are retained from the previous run. If you change species, levels, or analysis types, the **Assigned Cutoff Value** may not adequately represent the range of values present. Always refer to the **Default Cutoff Value** column or the *Statistical Composition of Data Menu* before selecting cutoff values.

Error Messages

```
Value required at cursor location.
```

If the Class 1 **Cutoff Value** field or any **Color/Pattern** field is left blank, then the above message will appear. Enter a value at the appropriate location.

```
Cutoff value <3> must be greater than cutoff value <2>.
```

Each succeeding **Cutoff Value** field must be greater than the preceding one. If this message appears, change the appropriate fields to meet this condition.

5.7.2 Cities Within Domain

If **City Annotation** field selection 3 is chosen on the *Spatial Graphics Annotation Selection Menu* (Figure 5-4), then the *Cities Located Within Domain Menu* (2.4.1.1) shown in Figure 5-11 will be displayed. It allows you to subset the cities within the domain covered by the extracted data set.

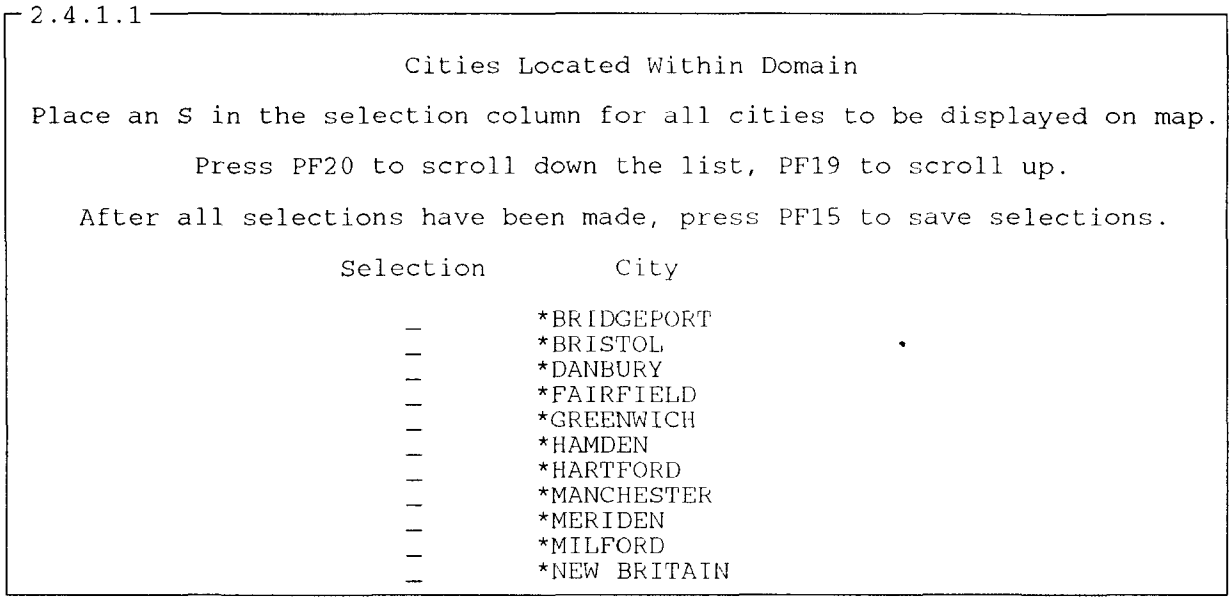


Figure 5-11. *Cities Located Within Domain Menu.*

Instructions

All cities included in the SAS cities data set that fall within the current domain will be present in the list of cities. The list may be several screens long. To scroll down the list, press the <PF8/PF20> key; to scroll up, press the <PF7/PF19> key. Type an "S" in the **Selection** column next to each city that you want in the **City** subset. After you have completed the selection process, press <PF3/PF15> to save the subset and move on to the next menu.

Error Messages

There are no error messages for this menu.

5.7.3 Time-Series Attribute Selection

The time-series graph displays symbols that represent the data points being plotted. Each group of symbols is connected by a line that helps show relationships between the two data sets. The *Time-Series Attribute Selection Menu* (2.4.2) shown in Figure 5-12 allows you to specify line type, line color, symbol type, and symbol size. The most common line types are solid, dashed, and dotted. Line color also determines symbol color and may be any color supported by the device you are using. The most common symbol types are squares, triangles, and stars.

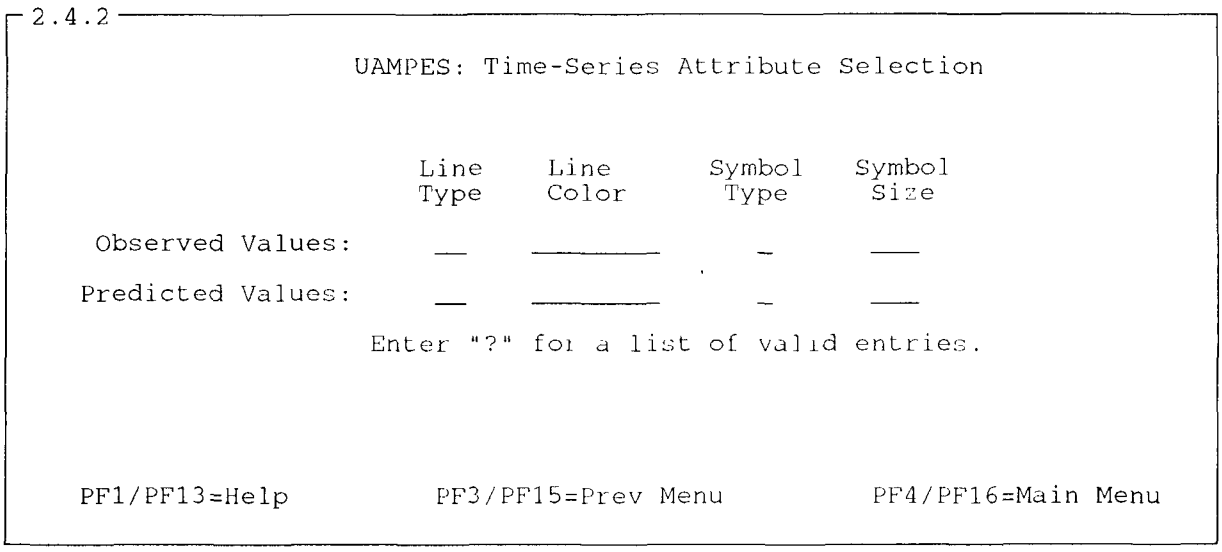


Figure 5-12. *Time-Series Attribute Selection Menu.*

Instructions

Enter a "?" in the **Line Type**, **Line Color**, and **Symbol Type** fields to see a list of valid entries for each field. Within a selection list, <Tab> to the entry you wish to select and press <Enter>. Your selection will appear in the selection field. The size of the symbol may be adjusted to improve clarity or detail. Enter a number between 0 and 10 in the **Symbol Size** field. **Symbol Size** is a three-character field, because you may want to enter decimal values (e.g., ".75", "2.2").

Error Messages

Please enter a size between <valid range>.

The error message will be displayed if any value other than 0 through 10 is entered in the **Symbol Size** field. The cursor will be placed on the **Symbol Size** field to allow you to enter a number within the range of 0 through 10.

There are no error messages for the **Line Type**, **Line Color**, or **Symbol Type** fields. If the entry is not valid, the system will select a default entry and plot the graph accordingly. Note that system defaults may give unexpected results.

5.7.4 Bar Chart Attribute Selection

The *Bar Chart Attribute Selection Menu* (2.4.3) shown in Figure 5-13 lets you select the pattern and color of the bars in the bar chart.

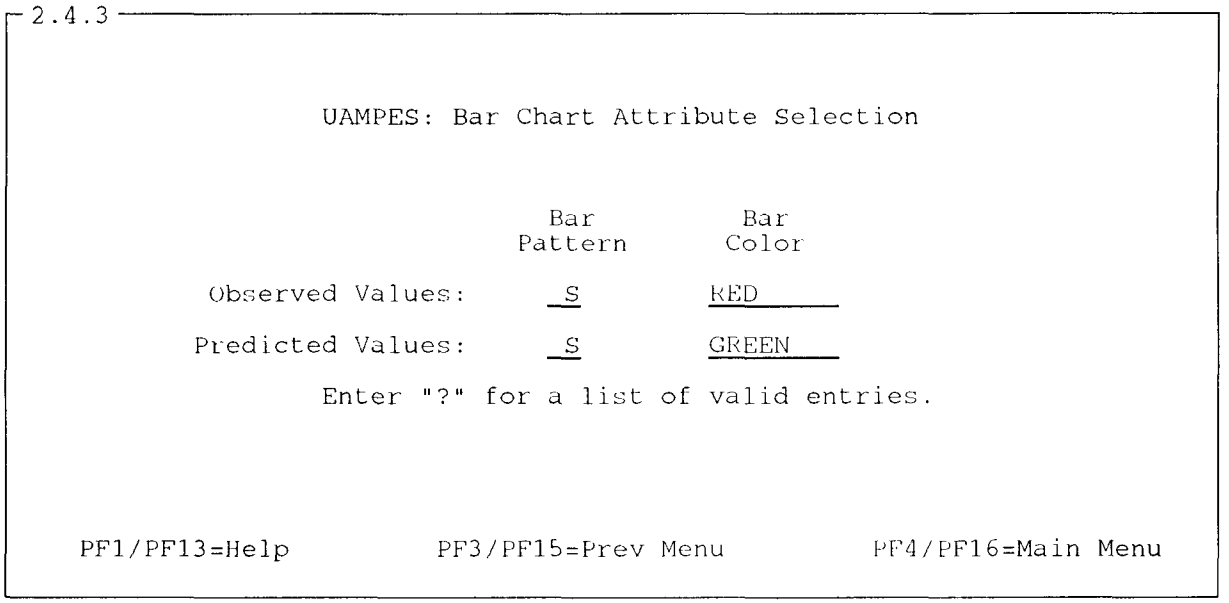


Figure 5-13. *Bar Chart Attribute Selection Menu.*

Instructions

You should enter a "?" in the **Bar Pattern** and **Bar Color** fields to see a list of valid entries for each field. As shown in the example in Figure 5-13, the values "S", "RED" and "S", "GREEN" will result in a solid red bar for the observed concentrations and a solid green bar for the predicted concentrations. Thus, by changing colors from one bar to the next, you may want to specify the same pattern for both bars. On the other hand, you may on occasion wish to change the pattern from one bar to the next, but specify the same color for both bars. You may also change both the pattern and the color for both bars.

Error Messages

There are no error messages for this menu. If the entry is not valid, the system will select a default entry and plot the graph accordingly. Note that system defaults may give unexpected results.

5.7.5 Scatter Plot Attribute Selection

The *Scatter Plot Attribute Selection Menu* (2.4.4), shown in Figure 5-14, lets you select appearance attributes for the symbol that is plotted and adjust the location of the reference lines in the scatter plot.

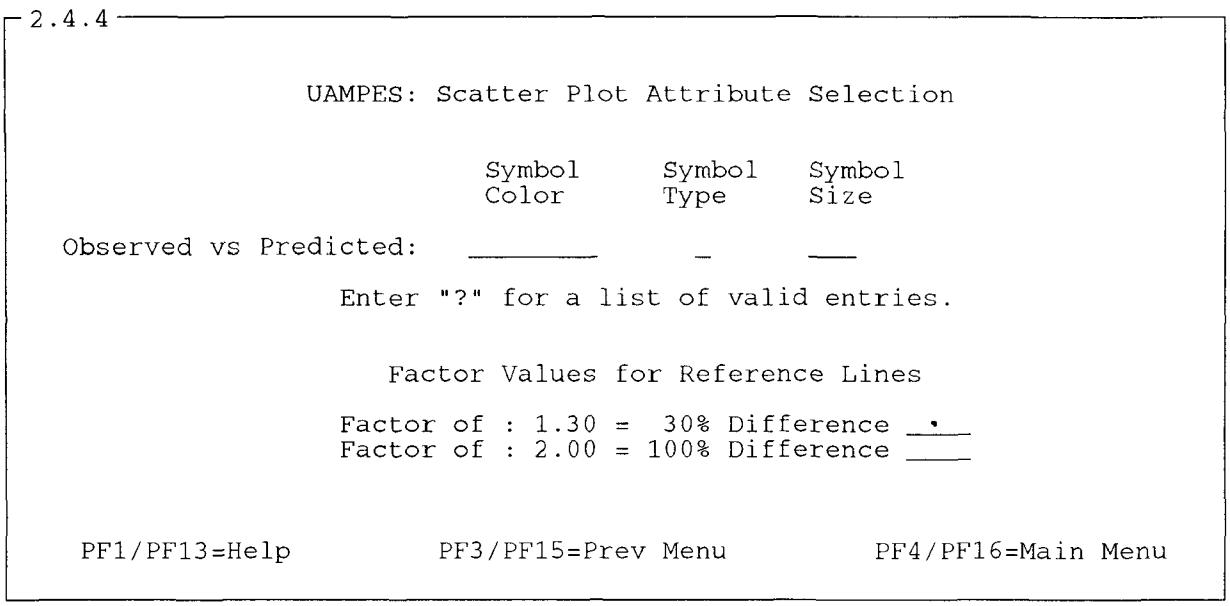


Figure 5-14. *Scatter Plot Attribute Selection Menu.*

Instructions

Select the desired color, type, and size of the symbol. Enter a "?" in the **Symbol Color**, **Symbol Type**, and **Symbol Size** fields to see a list of valid entries for each field. Within a selection list, <Tab> to the entry that you wish to select and press <Enter>. Your selection will appear in the selection field. Enter a number between 0 and 10 in the **Symbol Size** field. **Symbol Size** is a three-character field, because you may want to enter decimal values (e.g., ".75", "2.2").

Reference lines are located by default at 0%, indicating no difference between observed and predicted values; plus or minus 30%, indicating that observed values are 30% larger or smaller than predicted values; and plus or minus 100%, indicating that observed values are 100% larger or smaller than predicted values. You may change the two plus or minus reference lines to any factor value >1 and ≤51. The 0% reference line is always plotted. Be sure to enter factor values rather than percentages. The text in the menu reminds you that a 30% difference is the same as 1.3 times larger, or a factor of 1.3 larger; and a 100% difference is twice as large, or a factor of 2.0 larger. Use these examples to guide you and

remember that entering the digits "30" in the selection field will show the location of values that are 30 times larger rather than 30 percent larger.

Error Messages

```
Please enter a size between <valid range>.
```

The above message will be displayed if any value other than 0 through 10 is entered in the **Symbol Size** field. The cursor will be placed on the **Symbol Size** field to allow you to enter a number within the range of 0 through 10.

```
Invalid Factor Value.  Please reenter.
```

The above message will be displayed if you enter a **Factor Value** less than or equal to 1 or greater than 51.

There are no error messages for the **Symbol Color** or **Symbol Type** fields. If the entry is not valid, the system will select a default entry and plot the graph accordingly. Note that system defaults may give unexpected results.

5.7.6 Quantile Plot Attribute Selection

The *Quantile Plot Attribute Selection Menu* (2.4.5), shown in Figure 5-15, lets you select a color for the symbols and change the location of the reference lines in the quantile plot. This plot uses empty circles for data points and filled circles for annotated percentiles. Because the design of this plot is built around empty and filled circles, you are not given an option to change the **Symbol Type**.

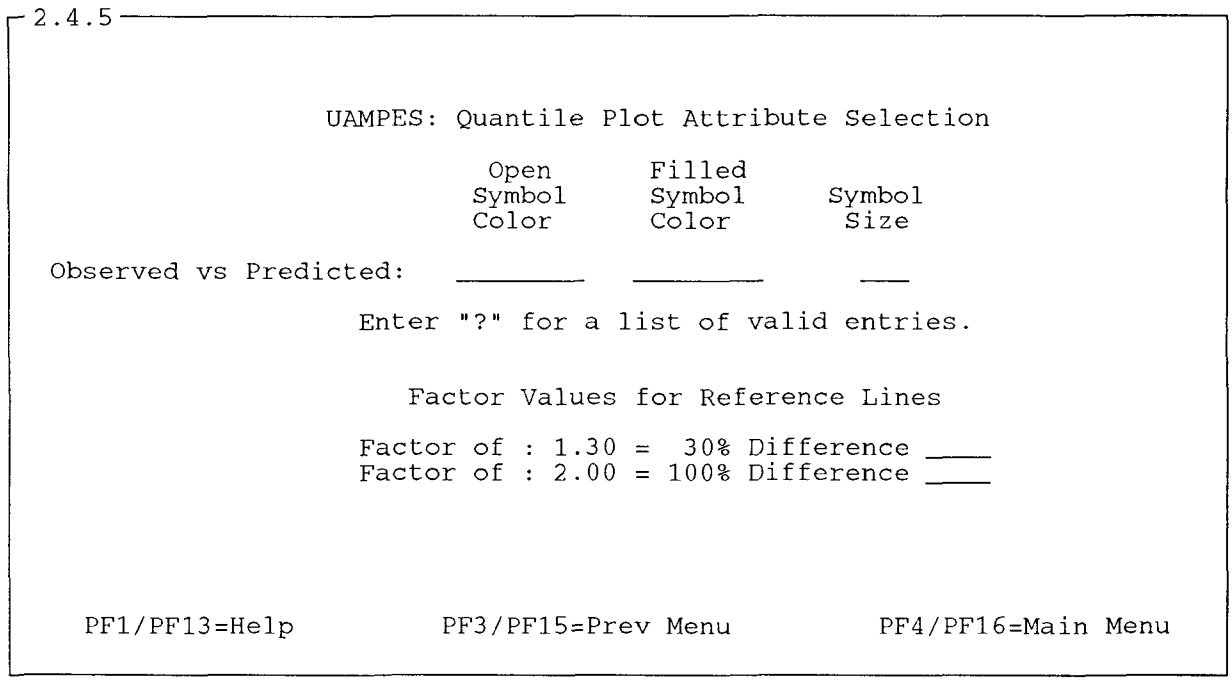


Figure 5-15. *Quantile Plot Attribute Selection Menu.*

Instructions

Select the desired color and size of the symbol. Enter a "?" in the **Open Symbol Color** and **Filled Symbol Color** fields to see a list of valid entries for each field. Enter a number between 0 and 10 in the **Symbol Size** field. These fields operate the same as the fields in the *Scatter Plot Attribute Selection Menu.* Please refer to the instructions for *Scatter Plot Attribute Selection Menu* (in Section 5.7.5) for details on adjusting reference lines.

Error Messages

The error messages for this menu are the same as those for the *Scatter Plot Attribute Selection Menu* (see Section 5.7.5).

5.7.7 Bias Plot Attribute Selection

The *Bias Plot Attribute Selection Menu* (2.4.6), shown in Figure 5-16, lets you select the appearance attributes for the symbol that is plotted and adjust the location of the reference lines in the bias plot.

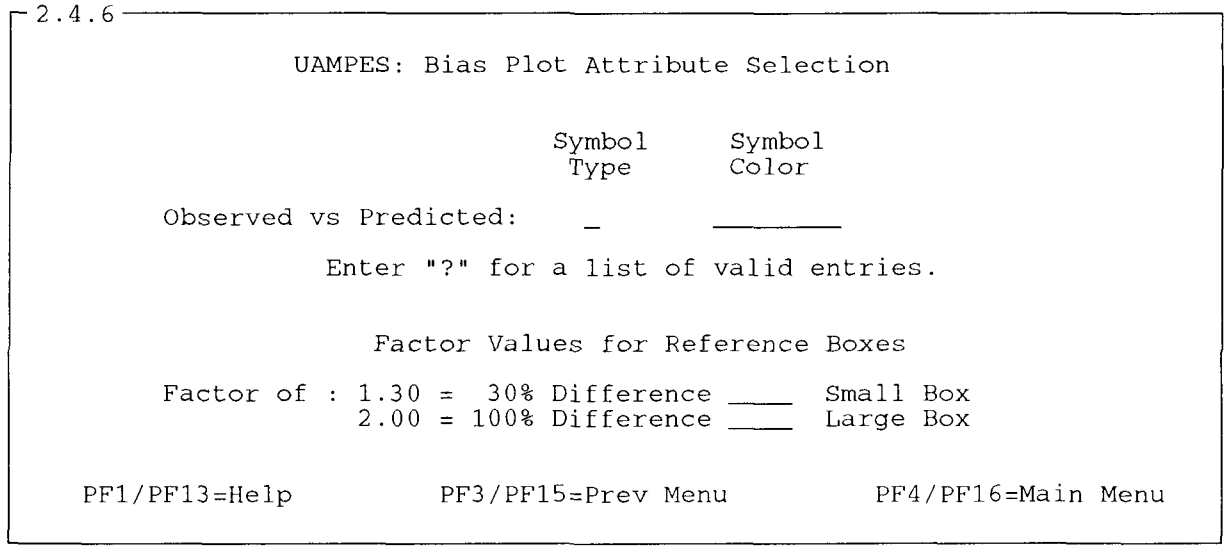


Figure 5-16. *Bias Plot Attribute Selection Menu.*

Instructions

You should enter a "?" in the **Symbol Type** and **Symbol Color** fields to see a list of valid entries for each field. Select the desired type and color of the symbol.

Factor Values are similar to those in the scatter plot and quantile plot except that the values are applied to reference boxes rather than reference lines. Please refer to the discussion for the *Scatter Plot Attribute Selection Menu* (see Section 5.7.5) for details on adjusting reference lines.

Error Messages

Invalid Factor Value. Please reenter.

The above message will be displayed if you enter a **Factor Value** less than or equal to 1 or greater than 51.

There are no error messages for the **Symbol Type** or **Symbol Color** fields. If the entry is not valid, the system will select a default entry and plot the graph accordingly. Note that system defaults may give unexpected results.

5.8 GRAPHIC TITLE/DESCRIPTION SPECIFICATION MENU

The *Graphic Title/Description Specification Menu* (2.5), shown in Figure 5-17, presents a table of the text information that will accompany the graphic. This menu will appear with default titles and axis labels that accurately describe the graph based on information in the data sets you specified earlier in the *Data File Selection Menu* and in previous menu entries.

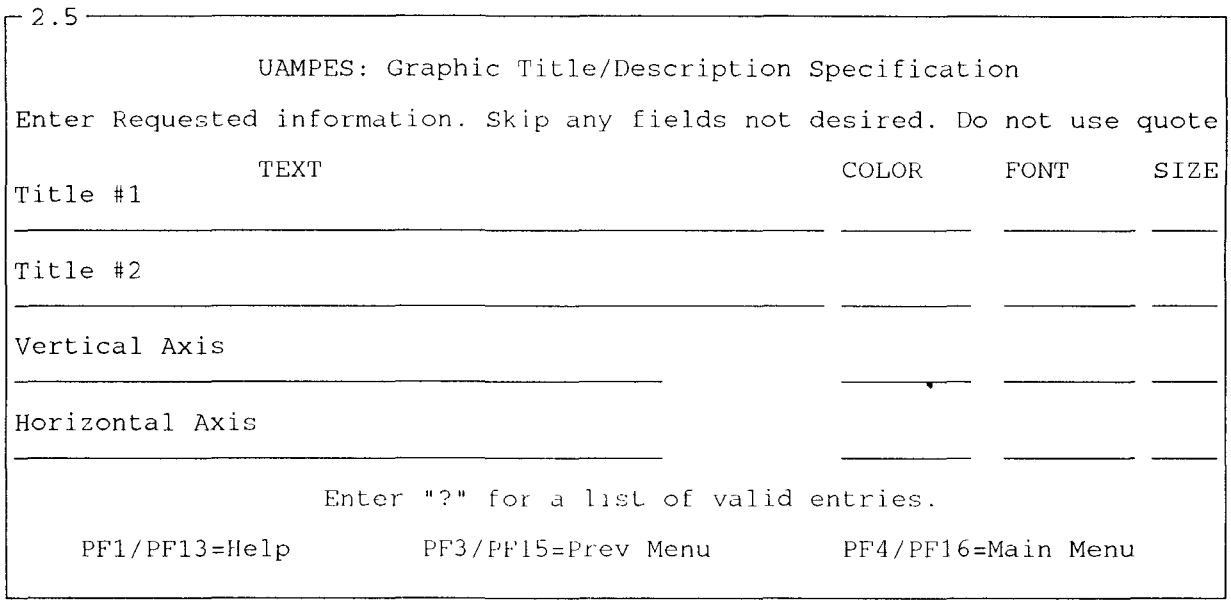


Figure 5-17. *Graphic Title/Description Specification Menu.*

Instructions

The UAMPES automatically searches the specified data sets and inserts the species, study (defined by the user when running the Extract module), date, and hours of the data being analyzed. You may change the wording of these descriptions, but the changes will not be saved. Each time you run the system, default values for the **Text** fields will be derived from the data sets specified in the *Data File Selection Menu*. This feature allows you to verify the files specified in that menu.

The values that you enter in the **Color**, **Font**, and **Size** fields will be saved and recalled just like most other fields in the UAMPES. Colors may be any that are supported by the device you are using. Fonts may include any listed in Chapter 6 of SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990). Enter a "?" in the **Color** and **Font** fields to see a list of valid entries for each field. Within a selection list, <Tab> to the entry that you wish to select and press <Enter>. Your selection will appear in the selection field. Enter a number between 0 and 6 in the **Size** field. **Size** is a four-character field, because you may want to enter decimal values (e.g., "1.75", "2.25").

Be aware that as the size of text increases, the size of the graph decreases; and as the size of text decreases, the text becomes less legible. Until you have run the UAMPES once or twice, we recommend that you use a **Size** value of "3" for the **Title** fields and "2" for the **Axis** label fields. Note that the **Color**, **Font**, and **Size** specified for the **Horizontal Axis** label control the color, font, and size of the bar labels in the bar chart graphic. In addition, for all of the graphic categories except the spatial graphics category, the **Color** specified for **Title #1** will also be used to color the box that surrounds the graph and the box that surrounds the legend, as well as the reference lines and other annotations that appear in the graph. The **Color** specified for **Title #2** will be used to color the text that appears in the legend.

By allowing the user to completely control the color of the entire display, the user may eliminate the need for color mapping when sending graphs to a printer. Color mapping is a process for changing all occurrences of a color (in a single graph) to another color. This process is a standard feature of the GREPLAY procedure in SAS and is fully described in Chapter 36 of SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990). The use of color mapping is frequently necessary in a graph that displays the color "white" on the monitor screen. White shows up quite clearly on the black background of the monitor screen, but white is invisible on the white background of hard-copy printouts. Color mapping allows the user to issue an instruction (e.g., to map white to black) when sending a graph to a printer to make graphic elements visible that would otherwise be invisible. Note that the color mapping process is usually not necessary if none of the graphic elements are white, and the user can simplify the printing process by specifying colors other than white.

The graphics category, spatial graphics, is a special case. This category requires a minimum of eight colors (including the background color) to generate a color graph. However, some color terminals can only display a maximum of eight colors. Thus, the use of the color white may be unavoidable. For this reason, certain elements in the spatial graphics (e.g., grid lines, map lines, and monitor location outlines) are specified as white by the system, and the color mapping process is unavoidable.

Error Messages

```
Please enter a size between <valid range>.
```

The above message will be displayed if any value other than 0 through 6 is entered in the **Size** field. The cursor will be placed on the **Size** field to allow you to enter a number within the range of 0 through 6.

There are no error messages for the **Text**, **Color**, or **Font** fields. If an entry in the **Color** or **Font** fields is not valid, the system will select a default entry and plot the graph accordingly. Note that system defaults may give unexpected results.

5.9 AXIS SCALING MENU

The Axis Scaling Menu (2.6) allows users to select the maximum and minimum scale values for the scaled axes. For example, if all the graphed values are in the range of 500 to 600, the user may want to specify a minimum scale value of 400 in order to take a closer look at the details of the graph. Also, if users are creating several graphs to be compared to each other, this menu allows them to ensure the use of the same scale.

The *Axis Scaling Menu* is appropriate for only four graphics types: time series, bar chart (illustrated in Figure 5-18), scatter plot, and quantile plot. (For spatial graphics and bias plot graphics, the system will proceed directly from the *Title/Description Menu* to the graphics display.) For time series and bar chart graphics, only the vertical axis is scaled. Therefore, for these two graphics, the values chosen in the *Axis Scaling Menu* will only apply to the vertical axis. Both the vertical and horizontal axes are scaled in the scatter plots and quantile plots. By design, both scales are identical; i.e., the maximum, minimum, and interval values chosen in the *Axis Scaling Menu* will apply to both axes in the scatter plots and quantile plots.

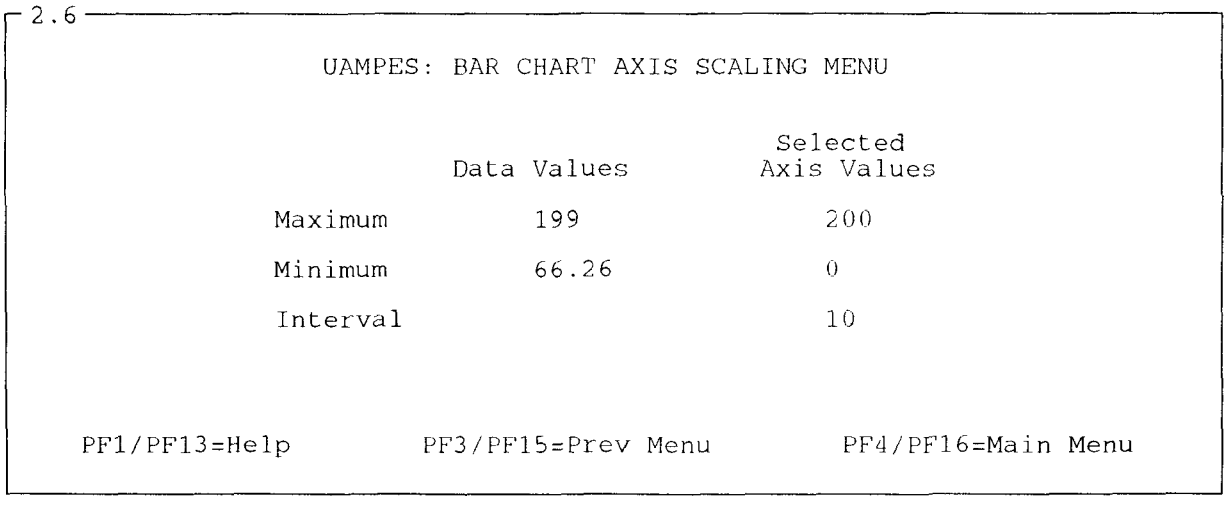


Figure 5-18. *Bar Chart Axis Scaling Menu.*

Instructions

The system checks the data about to be plotted and reports the maximum and minimum values in the **Data Values** column of the *Axis Scaling Menu.* The **Selected Axis Values** column provides selection fields for the user to specify maximum and minimum axis values (which should always encompass the full range of the data values) and the interval to be indicated along the length of the scale line.

In Figure 5-18, a **Maximum Selected Axis Value** of "200", a **Minimum Selected Axis Value** of "0", and an **Interval** value of "10" have been entered. These values will result in about 20 labeled tic marks along the scale line.

The fields in the **Selected Axis Values** column will be blank for the first run of the system. In subsequent runs, these fields will contain the values from the previous run. Users should always check the new **Data Values** against the previous **Selected Axis Values** to be sure that the **Selected Axis Values** encompass the full range of data values. If the **Data Values** fall above or below the range of **Selected Axis Values**, an error message will be displayed (see discussion below) and no graph will be produced.

At this point, you have given the UAMPES all the information necessary to produce a graph. After you press <Enter>, there will be a pause of one or two minutes while the UAMPES generates the graph you have requested. The graph will be generated and displayed on your screen. After the graph has been displayed, you may press <Enter> to continue to the next menu.

Error Messages

```
Data Values greater than Maximum Axis Value. . .Reenter.
```

The above message will be displayed if the **Maximum Data Value** is larger than the **Maximum Selected Axis Value**. The cursor will be placed at the **Maximum Selected Axis Value** field to allow you to enter a number that is larger than the **Maximum Data Value.**

```
Data Values less than Minimum Axis Value. . .Reenter.
```

The above message will be displayed if the **Minimum Data Value** is smaller than the **Minimum Selected Axis Value.** The cursor will be placed at the **Minimum Selected Axis Value** field to allow you to enter a number that is smaller than the **Minimum Data Value.**

```
Range not evenly divisible by step value. . .Reenter.
```

The above message will be displayed if the difference between the **Maximum** and **Minimum Selected Axis Values** is not evenly divisible by the value entered for the **Interval.** The cursor will be placed at the **Interval** field to allow you to enter a number that will evenly divide the difference between the **Maximum** and **Minimum Selected Axis Values.**

5.10 TERMINATION SELECTION MENU

The *Termination Selection Menu* (2.7), shown in Figure 5-19, presents five possible options for a variety of actions you may want to take after generating a graphic. The first three options allow you to restart the system at various points to make changes and/or display the graphic again. The fourth option allows you to save the graphic in a graphics catalog and brings up a menu for specifying the options associated with catalog entries. The last option allows you to exit the system.

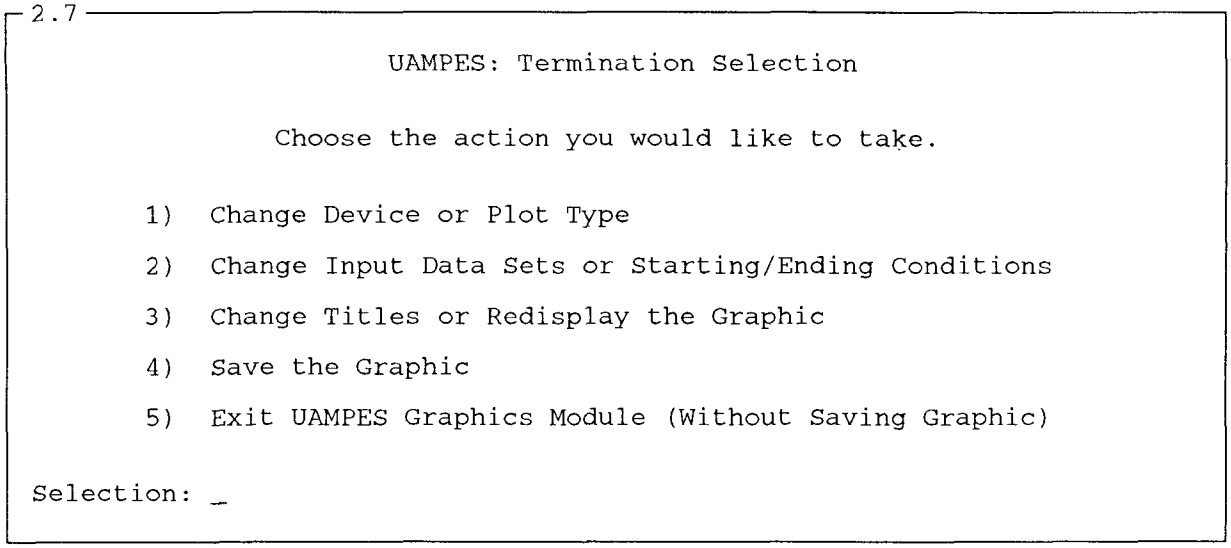
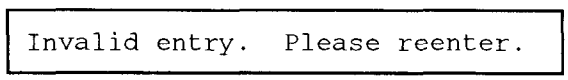


Figure 5-19. *Termination Selection Menu.*

Instructions

Type the number of the option you want in the **Selection** field and press <Enter>. Enter "1" to return to the *Graphic Selection Menu,* where you may change any of the options and generate a completely different graph. Enter "2" to return to the *Data File Selection Menu* and generate a similar graph using different data. Enter "3" to return to the *Graphic Title/Description Selection Menu,* where you may change the titles and axis labels or make no changes to simply re-display the graphic. Enter "4" to bring up the *Graphics Catalog Generation Menu,* which will allow you to save the graphic that you just generated in a graphics catalog. Enter "5" to end your current session with the Graphics module and return to the *UAMPES Main Menu.*

Error Messages



The above message will be displayed if any value other than "1" through "5" is entered in the **Selection** field. The cursor will be placed on the **Selection** field to allow you to enter a number within the range of 1 through 5.

5.11 GRAPHICS CATALOG GENERATION MENU

The *Graphics Catalog Generation Menu* (2.7.1), shown in Figure 5-20, allows you to permanently save any or all graphics that you generate in a device-independent SAS Graphics Catalog.

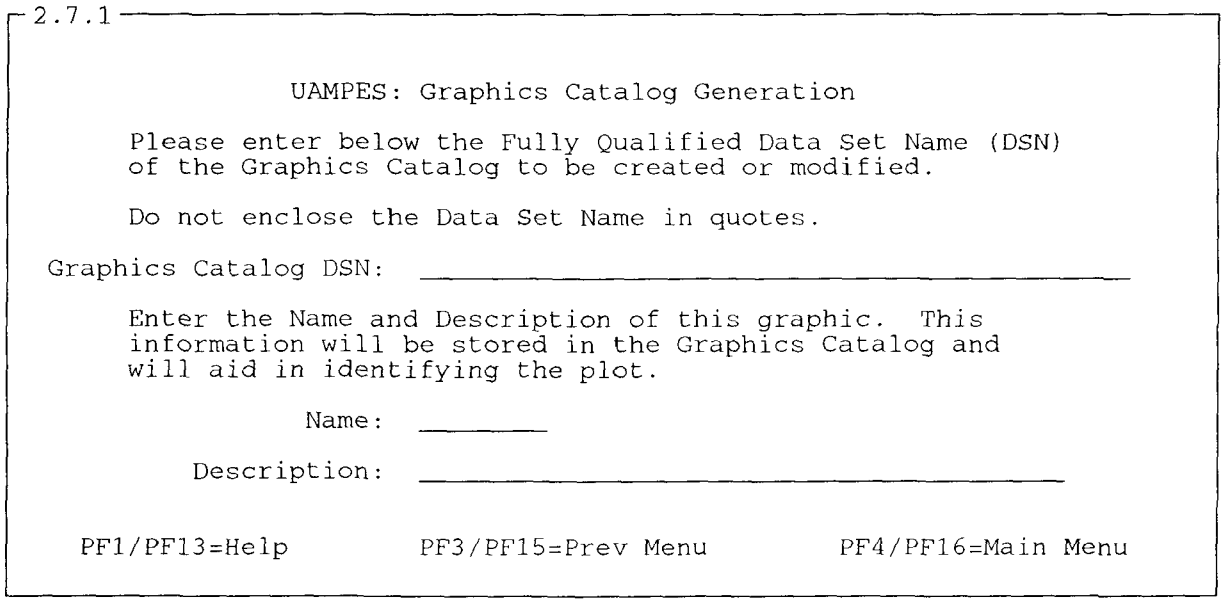


Figure 5-20. *Graphics Catalog Generation Menu.*

Instructions

You will need to provide a data set name (DSN) for the graphics catalog, as well as a name and brief description of the graph that you have just produced. A single catalog may contain any number of graphics so you may only need to have a single catalog for all the graphics you produce. On the other hand, you may wish to have more than one catalog for organizational purposes.

The **Graphics Catalog DSN** may be any name that is acceptable to the computer system you are using. If you are using the EPA's IBM computer system at the NCC, refer to Section 4.5 of this manual for an example and refer to the NCC user's guide (EPA, 1990b) for further naming conventions.

The UAMPES will display a default **Name** and **Description** based on the graphic category and the first title line of the graph. If the default entries are not satisfactory, you may type over them with any **Name** and **Description** that you prefer. The graphic **Name** should be no

more than 8 alphanumeric characters containing no blanks, and the graphic **Description** may be up to 40 characters long and may contain blanks. Refer to Section 4.5 of this manual for examples.

After you have provided names and a description in the appropriate selection fields, press <Enter> to save the graphic to the graphics catalog.

The screen will then display the PROC GREPLAY window; an example is shown in Section 4.5 (Figure 4-16). PROC GREPLAY will allow you to verify that the graphic has been placed in the graphics catalog. For complete information on using PROC GREPLAY, see Chapter 36 of the SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990).

Press <PF3> or <PF15> to return to the *Termination Selection Menu.* You may choose to produce a different graphic by selecting options 1 or 2; take another look at the current graphic by selecting option 3; save another copy of the current graph (possibly to a second catalog) by selecting option 4 again; or end the session by selecting option 5.

Error Messages

There are no error messages for the *Graphics Catalog Generation Menu.* The **Graphics Catalog DSN** field is checked by the computer system that you are using. If this data set name is not valid for the computer system, you will probably see a blank PROC GREPLAY window without any entry corresponding to the **Name** and **Description** fields that you entered. (The exact response to an invalid data set name is dependent on the computer system that you are using.) The **Name** field will be checked by the SAS system. If the **Name** that you have entered is not a valid SAS name, the system will enter the default name (i.e., the graphic name in the **Name** field before you typed over it).

6. FILES

This section describes the formats and contents of files created by the UAMPES.

6.1 FORMAT

Two types of output files are created by the UAMPES: graphics and tables. The graphics are generated and stored in a binary file using SAS/Graph software and may be replayed or reproduced on a wide variety of terminals and hard-copy devices using the SAS/Graph software. If you have access to the UAMPES, you have access to this software.

Tables produced by the UAMPES are saved in TSO data sets as text files. These files are sequential data sets with a record length of 133 and record format of fixed-block-A. Because the file is 133 columns wide, you will need to use the <PF11> and <PF10> keys to scroll right and left to see the whole file on your terminal in Interactive System Productivity Facility (ISPF). If you print these files, be sure that the printer device is formatted to print 132 columns by 60 lines per page. If you need help with viewing or printing, consult the user support department for the computer system that you are using.

6.2 SAS GRAPHICS CATALOG

The graphics images that you generate with the UAMPES can be saved to a SAS Graphics Catalog for later use. The topics of generating and saving graphics are discussed in Sections 4.4, 4.5, and 5.11 of this manual.

Once a graphic is saved in the catalog, it can be replayed by invoking the SAS system at the TSO READY prompt and using the GREPLAY procedure, or by selecting the **Graphics Catalog** option from the *UAMPES Main Menu*. This option provides a shortcut to the GREPLAY procedure and substantially reduces the need for knowledge of SAS programming. The **Graphics Catalog** option is common to both the UAMPES and the UAMPPS, and is described in detail in Section 4.3 of the UAMPPS user's guide (EPA, 1990a); see Appendix D of this manual. The GREPLAY procedure is described in Chapter 36 of SAS/GRAPH Software, Version 6 (SAS Institute, Inc., 1990). The image can be displayed or printed on any SAS-supported device, regardless of the device on which it was generated. For example, if you created a graphic using an IBM 3179G terminal and saved it to a graphics catalog, you can use the SAS command, PROC GREPLAY, or the **Graphics**

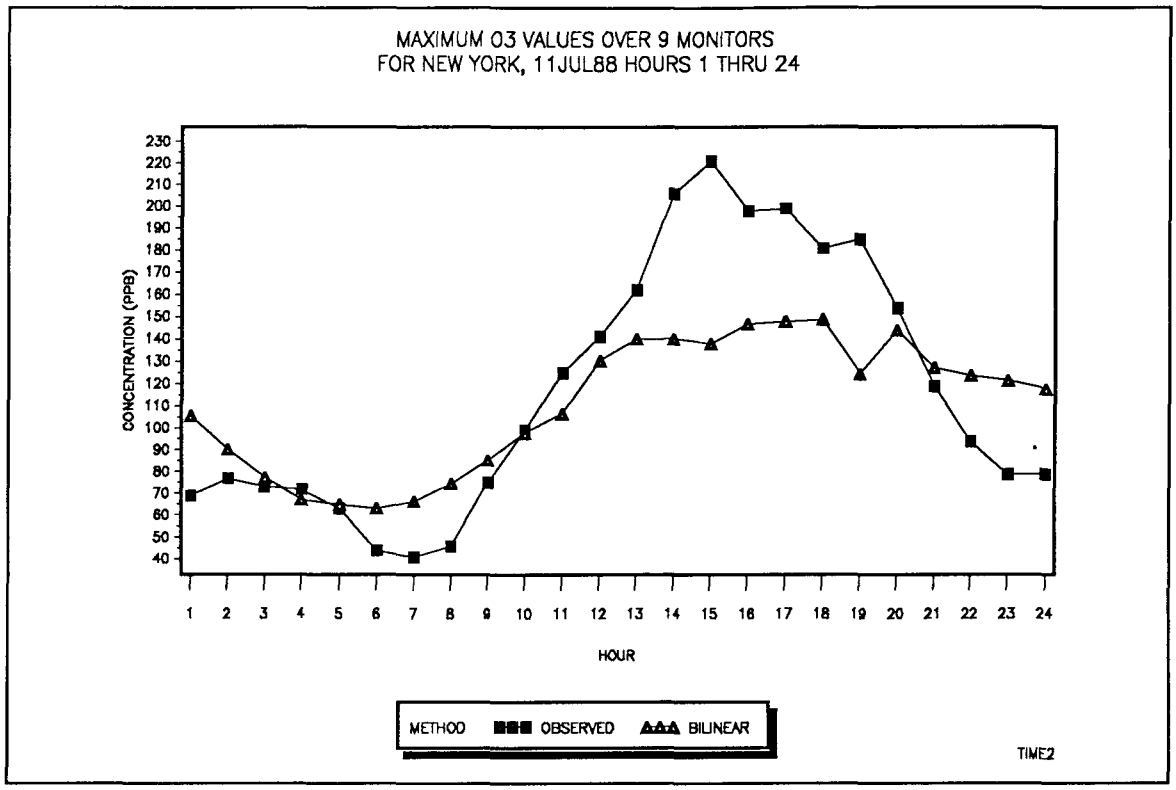
Catalog option to display this graphic on a Tektronix 4211 terminal or any other device supported by SAS.

For a list of SAS-supported devices, invoke SAS from the TSO READY prompt and submit the program statement "PROC GDEVICE; RUN;" in the Program Editor window of the SAS Display Manager. The SAS system will then display a scrollable list of close to 700 devices that are currently supported on the EPA's IBM system at the NCC.

This list has also been output to a JUSD data set which you may browse and/or print. The fully qualified data set name is: JUSD.SASGRAPH.V6.DATA(DEVICES). Note that the parentheses in the data set name indicate that DEVICES is a member in a partitioned data set. You may find that other members in this data set are very helpful; in particular, members CAL5845, CGM, DEVNOTES, and EXPORT. For assistance, contact the EPA's NCC User Support Department (see Section 1.4).

6.3 TABLES

For each graph generated by the UAMPES, an accompanying table lists the values that have been plotted on the graph. For each point plotted on the graph, there is a corresponding value or pair of values. The titles used in each graph are repeated in the table. In addition, each table of plotted data values has a footnote at the bottom of each page corresponding to the label that appears in the lower right hand corner of each graph. Figure 6-1 shows a time--series plot of maximum concentrations and its accompanying table. By referring to the titles and footnotes, there should be no problem determining which table goes with which graph.



MAXIMUM 03 VALUES OVER 9 MONITORS 1
FOR NEW YORK, 11JUL88 HOURS 1 THRU 24

---------- METHOD=BILINEAR ----------

HOUR	MAXIMUM OBSERVED VALUE	MAXIMUM PREDICTED VALUE	PERCENT DIFFERENCE
1	69	105	-53
2	77	90	-17
3	73	77	-6
4	72	67	7
5	63	65	-3
6	44	63	-44
7	41	66	-62
8	46	75	-62
9	75	85	-14
10	99	98	1
11	125	107	15
12	141	130	7
13	162	140	14
14	206	140	32
15	221	138	38
16	198	147	26
17	199	148	26
18	181	149	18
19	185	124	33
20	154	144	6
21	119	127	-7
22	94	124	-32
23	79	122	-54
24	79	118	-49

TIME2 DATA

Figure 6-1. TIME2 graph and table.

In addition to the table of plotted data values, there is a table of summary statistics. This table provides all seven of the statistical measures for model performance evaluation recommended in Section 5.1.2 of the *Guideline for Regulatory Application of the Urban Airshed Model* (EPA, 1991a). The table of summary statistics is automatically appended to the table of plotted data values in the print file specified by the user in the Print File Selection window.

An example table of summary statistics is illustrated in Figure 6-2. Note the three title lines. The UAMPES automatically prints the name of the urban airshed region (New York), the date of the study (11JUL88), the range of hours (1 through 24), the aggregation method (BILINEAR), and the number of monitors (9). The range of hours, aggregation method, and number of monitors have a direct bearing on the calculation of the statistical measures provided in the summary statistics table. Because the range of hours, aggregation method, and/or monitors may change each time a graph is generated, the UAMPES will generate a summary statistics table for each graph for which an aggregation method is specified (i.e., all graphics categories except the spatial graphics category). As noted earlier, a summary statistics table follows each table of plotted data values.

Summary Statistics of UAM Recommended Performance Measures
for NEW YORK, 11JUL88, hours 1 through 24
using BILINEAR method and 9 monitors

Perf. Measure Description	Notation	Units	Value
Unpaired highest prediction accuracy (1)	Au	%	32.65
Normalized bias test (1)	D*	none	-0.95
Gross error for all pairs > 60 ppb	Ed*	none	0.23
Average station peak prediction accuracy	$\bar{A}$	%	25.94
Bias of all pairs > 60 ppb (1)	D60	ppb	10.84
Bias of all station peaks (1)	Dpeak	ppb	21.44
Fractional Bias for Peak Concentration			
Peak Monitor/Station Values			
Fractional bias of means (1)	Fm	none	0.32
Fractional bias of standard deviation (1)	Fs	none	0.26
Peak Hourly Values			
Fractional bias of means (1)	Fm	none	0.06
Fractional bias of standard deviation (1)	Fs	none	0.63

(1) Note: For these measures, a positive value indicates UNDERprediction and a negative value indicates OVERprediction.

Figure 6-2. Summary statistics table.

The spatial graphic will produce two different tables of plotted values. The first table lists cell values used in plotting the map; the second table lists monitor values. These two tables are illustrated in Figure 6-3. Note that the first two title lines are identical in both tables. These title lines duplicate the title that will appear on the graph. The third line distinguishes between the two tables. Note that the table of "Predicted Concentration Levels" lists rows in descending order. This order holds the rows in the same relative relationship as that seen in the spatial graphic. That is, the value that is listed in the upper right hand corner of the table is the same value that is plotted in the upper right hand corner of the spatial graphic. The table of "Observed Concentration Levels" simply lists the row and column location of each monitor along with the concentration level.

MAXIMUM O3 VALUES FOR LEVEL 1 FOR NEW YORK
11JUL88 FOR HOURS 1 THRU 24
PREDICTED CONCENTRATION LEVELS

ROW NUMBER (Y)	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30
24	52	52	52	52	54	55	57	57	57	58	59	60	62	64	65	68	70	71	71	70	70	70	71	74	76	77	78	78	79
23	53	52	52	53	55	57	59	59	59	60	62	63	66	68	70	72	74	75	75	75	76	75	77	80	82	84	85	85	85
22	53	53	53	55	57	59	61	61	61	62	64	65	68	70	72	75	76	77	79	79	80	80	81	84	86	87	88	89	89
21	54	53	54	56	59	61	63	63	63	64	66	68	70	72	74	77	79	81	82	83	84	85	86	89	90	91	92	91	91
20	55	55	56	59	61	64	66	65	65	66	67	69	71	73	75	78	81	83	86	87	89	89	90	92	93	95	96	96	96
19	57	57	59	61	64	67	69	67	67	67	69	70	72	75	77	80	83	86	89	90	91	91	92	94	95	97	98	99	98
18	59	59	61	64	66	69	70	68	69	70	71	73	75	77	79	83	86	88	90	91	92	93	95	97	98	99	99	100	99
17	61	62	64	66	69	71	72	71	70	71	72	73	76	78	80	84	87	89	92	94	96	98	100	101	101	100	100	101	100
16	64	64	66	69	71	73	73	71	71	73	74	76	78	80	83	86	89	92	95	97	100	102	103	103	102	101	100	100	99
15	66	66	68	71	73	73	72	71	72	74	77	78	81	84	86	90	93	96	98	101	103	103	103	101	100	98	97	96	95
14	68	68	70	72	74	73	72	70	73	77	79	81	84	87	90	93	96	98	100	102	103	103	102	101	99	98	97	96	95
13	69	69	71	73	74	73	71	72	75	78	80	83	86	90	92	95	98	99	100	101	101	101	101	101	101	100	100	98	97	96
12	70	70	72	74	74	72	71	74	76	79	82	85	88	92	95	98	100	99	99	99	99	99	99	100	100	99	98	97	96
11	70	71	72	74	74	72	72	75	77	80	83	86	89	93	97	99	99	99	99	99	100	100	100	101	101	101	100	99	98
10	70	72	73	75	74	71	71	75	78	81	85	87	91	95	98	99	99	99	100	102	104	105	106	106	106	105	104	103	102
9	70	72	73	75	74	72	72	76	78	80	83	86	90	94	94	95	96	98	100	103	104	106	107	107	107	107	106	105	103
8	71	73	73	74	73	71	71	75	77	78	81	84	86	90	91	93	95	98	101	104	106	107	108	108	108	107	106	104	102
7	72	73	73	74	73	72	72	74	74	76	79	81	83	86	87	91	94	98	101	103	105	106	107	107	106	105	102	101	98
6	72	73	72	74	73	73	78	80	81	81	83	84	85	88	89	92	96	99	101	103	105	105	105	104	102	100	98	96	92
5	73	73	73	75	72	78	82	84	85	85	85	85	86	89	91	94	97	100	101	102	102	102	101	99	97	95	92	91	87
4	74	75	75	77	80	83	85	86	86	86	87	86	87	89	92	95	97	99	100	100	99	98	97	94	92	90	87	85	81
3	76	78	80	82	85	88	89	89	89	89	89	88	89	91	94	96	97	98	98	97	96	94	92	89	86	84	81	79	76
2	80	83	86	88	89	91	91	92	92	91	91	91	92	93	95	95	96	96	95	94	92	89	87	84	82	79	77	76	73

MAP1 DATA

MAXIMUM O3 VALUES FOR LEVEL 1 FOR NEW YORK
11JUL88 FOR HOURS 1 THRU 24
OBSERVED CONCENTRATION LEVELS

MONITOR I. D.	DESCRIPTION	ROW NUMBER	COLUMN NUMBER	OBSERVED CONCENTRATION
340230006	0006	3	4	195
340170006	0006	6	7	199
360810004	0004	7	10	161
361030002	0002	7	15	172
361192004	2004	11	11	166
090013007	3007	13	18	221
090091123	1123	15	20	153
090070007	0007	18	23	181
090031003	1003	22	23	185

MAP1 DATA

Figure 6-3. Spatial graphic tables.

The table that accompanies the quantile plot includes a column of deciles in addition to columns for observed and predicted concentration values. The decile column indicates the values that were annotated in the quantile plot. In some instances, one or more deciles will fall between two of the ranked concentrations. If this happens, the system will calculate the midpoint between the two ranked values. These midpoints will be listed along with the decile in question, but the rank order of these midpoint values will be indicated by a period "." (see the 50th percentile shown in Figure 6-4). This figure shows ranked maximum values over 24 hours. The midpoint (i.e., 50th percentile) of 24 hours occurs halfway between the 12th and 13th ranks. The midpoint values may not appear to be properly calculated due to rounding. In Figure 6-4, values of 96.5 and 116.5 are rounded up to 97 and 117, respectively. Also, keep in mind that the ranked values listed in the table have also been rounded and the midpoint is calculated using the ranked values before any rounding has taken place.

MAXIMUM O3 VALUES OVER 9 MONITORS FOR NEW YORK, 11JUL88
(HOURS 1 THROUGH 24)

RANK ORDER NUMBER	RANKED MAXIMUM OBSERVED VALUES	RANKED MAXIMUM PREDICTED VALUES	DECILE
1	221	151	MAX
2	206	150	
3	199	146	90%
4	198	146	
5	185	141	80%
6	181	138	
7	162	135	
8	154	130	70%
9	141	126	
10	125	121	60%
11	119	119	
12	99	118	
.	97	117	50%
13	94	115	
14	79	106	
15	79	105	40%
16	77	98	
17	75	93	30%
18	73	86	
19	72	79	
20	69	75	20%
21	63	69	
22	46	67	10%
23	44	67	
24	41	64	MIN

QQ2 DATA

Figure 6-4. Quantile plot table.

There are two tables that accompany the bias plot (see Figure 6-5).

The first table lists the values from which means and standard deviations are calculated. In the case of monitor maximums across hours (BIAS1, illustrated in Figure 6-5), this table will be a list of monitors. The monitors may include all the monitors in the domain or the subset of monitors selected from the *Monitor Selection List Menu.* In the case of hourly maximums across monitors (BIAS2, not illustrated), this table will be a list of all the hours in the range specified in the *Data File Selection Menu.* Both BIAS1 and BIAS2 are sensitive to and will be affected by both the range of hours specified and the monitors selected.

The second table lists (1) the mean and standard deviation of the observed values listed in the first table, (2) the mean and standard deviation of the predicted values listed in the first table, and (3) the fractional bias of the two means and the fractional bias of the two standard deviations.

MAXIMUM O3 VALUES OVER 24 HOURS FOR NEW YORK, 11JUL88
(N = 9 MONITORS - HOURS 1 THROUGH 24)

Source data for calculating means and standard deviations
used in calculating fractional biases.

---------- METHOD=BILINEAR ----------

MONITOR I.D.	MAXIMUM OBSERVED VALUE	MAXIMUM PREDICTED VALUE
090013007	221.00	147.74
090031003	185.00	127.26
090070007	181.00	144.17
090091123	153.00	148.85
340170006	199.00	111.12
340230006	195.00	102.03
360810004	161.00	124.65
361030002	172.00	140.08
361192004	166.00	132.79

BIAS1 DATA

MAXIMUM O3 VALUES OVER 24 HOURS FOR NEW YORK, 11JUL88
(N = 9 MONITORS - HOURS 1 THROUGH 24)

---------- METHOD=BILINEAR ----------

MEAN OF OBSERVED VALUE	STD. DEV. OF OBSERVED VALUE	MEAN OF PREDICTED VALUE	STD. DEV. OF PREDICTED VALUE	FB OF MEAN	FB OF STD. DEV.
181	21.28	131	16.38	0.32	0.26

BIAS1 DATA

Figure 6-5. Bias plot tables.

In certain instances, the tables that accompany two different graphs may be virtually identical except for the footnote indicating the source of the table. This is the case with the TIME1 and SCAT1 tables illustrated in Figure 6-6. This duplication of data occurs because both graphs are plotting the same data. The only difference is that the data are plotted in one graph as a time-series plot and in the other graph as a scatter plot.

A variation of duplicating data may be seen by comparing a TIME1 table with a BAR1 table. For a given data set, both graphs are based on the same information. The TIME1 graph compares observed versus predicted values across hours and produces a separate graph for each monitor. The BAR1 graph compares observed versus predicted values across monitors and produces a separate graph for each hour. Consequently, the TIME1 table allows a subheading for each monitor with a group of hours under each monitor. The BAR1 table allows a subheading for each hour with a group of monitors under each hour. In Figure 6-7, the values for hour = 16 and monitor = 09003 have been highlighted to illustrate how the same data may simply be tabulated differently.

(a)

O3 VALUES FOR NEW YORK, 11JUL88
HOURS 10 THROUGH 18
METHOD = BILINEAR

---------- MONITOR I.D.=090013007442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	18	13	71	92	29
11	18	13	106	98	-7
12	18	13	162	107	-34
13	18	13	206	134	-35
14	18	13	221	140	-37
15	18	13	198	138	-30
16	18	13	148	147	-1
17	18	13	128	148	15
18	18	13	115	130	13

---------- MONITOR I.D.=090031003442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	23	22	95	77	-19
11	23	22	112	79	-30
12	23	22	101	71	-29
13	23	22	96	60	-38
14	23	22	93	57	-39
15	23	22	109	60	-45
16	23	22	118	66	-44
17	23	22	172	71	-59
18	23	22	185	75	-59

TIME1 DATA

(b)

O3 VALUES FOR NEW YORK, 11JUL88
(ALL MONITORS, HOURS 10 THROUGH 18)
METHOD = BILINEAR

---------- MONITOR I.D.=090013007442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	18	13	71	92	29
11	18	13	106	98	-7
12	18	13	162	107	-34
13	18	13	206	134	-35
14	18	13	221	140	-37
15	18	13	198	138	-30
16	18	13	148	147	-1
17	18	13	128	148	15
18	18	13	115	130	13

---------- MONITOR I.D.=090031003442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	23	22	95	77	-19
11	23	22	112	79	-30
12	23	22	101	71	-29
13	23	22	96	60	-38
14	23	22	93	57	-39
15	23	22	109	60	-45
16	23	22	118	66	-44
17	23	22	172	71	-59
18	23	22	185	75	-59

SCAT1 DATA

Figure 6-6. Comparison of (a) TIME1 and (b) SCAT1 tables.

(a)

O3 VALUES FOR NEW YORK, 11JUL88
HOURS 10 THROUGH 18
METHOD = BILINEAR

---------- MONITOR I.D.=090013007442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	18	13	71	92	29
11	18	13	106	98	-7
12	18	13	162	107	-34
13	18	13	206	134	-35
14	18	13	221	140	-37
15	18	13	198	138	-30
16	18	13	148	147	-1
17	18	13	128	148	15
18	18	13	115	130	13

---------- MONITOR I.D.=090031003442011 ----------

HOUR	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
10	23	22	95	77	-19
11	23	22	112	79	-30
12	23	22	101	71	-29
13	23	22	96	60	-38
14	23	22	93	57	-39
15	23	22	109	60	-45
16	23	22	118	66	-44
17	23	22	172	71	-59
18	23	22	185	75	-59

TIME1 DATA

(b)

O3 VALUES FOR NEW YORK, 11JUL88
(WITH PERCENT DIFFERENCE ANNOTATED)

---------- METHOD=BILINEAR HOUR=16 ----------

MONITOR I.D.	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
09001	18	13	148	147	-1
09003	23	22	118	66	-44
09007	23	18	168	96	-43
09009	20	15	136	133	-2
34017	7	6	199	110	-45
34023	4	3	174	102	-41
36081	10	7	112	111	-1
36103	15	7	121	104	-14
36119	11	11	166	133	-20

---------- METHOD=BILINEAR HOUR=17 ----------

MONITOR I.D.	COLUMN	ROW	OBSERVED VALUE	PREDICTED VALUE	PERCENT DIFFERENCE
09001	18	13	128	148	15
09003	23	22	172	71	-59
09007	23	18	181	96	-47
09009	20	15	104	148	42
34017	7	6	140	111	-21
34023	4	3	138	98	-29
36081	10	7	106	120	13
36103	15	7	109	104	-4
36119	11	11	135	132	-2

BAR1 DATA

Figure 6-7. Comparison of (a) TIME1 and (b) BAR1 tables.

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APPENDIX A

DATA EXTRACTION

This appendix provides information on the extracted data set, as discussed in Section 1 and Section 2.2 of this manual. This appendix is identical to Section 4.1 of the user's manual for the UAM postprocessing system (EPA, 1990a).

4. SCREEN

4.1 DATA EXTRACTION

The results of a UAM execution contain a large volume of information. All 24 species (see Table 4-2), a variable number of levels, hourly concentration, and descriptive information about the model run are contained in one file. The Extract module of the UAMPPS provides the data extraction capability for subsetting the model results based on species and level. In addition, the extraction process transforms the data from a gridded binary format to either a SAS-formatted data file used in the UAMPPS or a generic text file that can be imported into other graphics packages. The resulting files are named according to species, level, control strategy, and date, and thus provide a default method of organizing commonly used data.

TABLE 4-2. DEFINITION OF THE UAM (CB-IV) STATE SPECIES

UAM species	Species name
NO	Nitric oxide
NO2	Nitrogen dioxide
O3	Ozone
OLE	Olefinic carbon bond (C=C)
PAR	Paraffinic carbon bond (C-C)
TOL	Toluene (C_6H_5-CH_3)
XYL	Xylene (C_6H_6-$(CH_3)_2$)
FORM	Formaldehyde (CH_2=O)
ALD2	High molecular weight aldehydes (RCHO, R > H)
ETH	Ethane (CH_2=CH_2)
CRES	Cresol and higher molecular weight phenols
MGLY	Methyl glyoxal ($CH_3C(O)C(O)H$)
OPEN	Aromatic ring fragment acid
PNA	Peroxynitric acid (HO_2NO_2)
NXOY	Total of nitrogen compounds ($NO + NO_2 + N_2O_5 + NO_3$)
PAN	Peroxyacyl nitrate ($CH_3C(O)O_2NO_2$)
CO	Carbon monoxide
HONO	Nitrous acid
H2O2	Hydrogen peroxide
HNO3	Nitric acid
MEOH	Methanol (optional)
ETOH	Ethanol (optional)
ISOP	Isoprene (optional)
CLBR	Calibration

```
1.0

            URBAN AIRSHED MODEL POSTPROCESSING SYSTEM (UAMPPS)
                              Extract Module

NOTE:

 THE EXTRACT MODULE IS CAPABLE OF OUTPUTTING EITHER A SAS FORMAT DATA
 FILE FOR PROCESSING BY THE UAMPPS/UAMPES GRAPHICS SYSTEMS OR A GENERIC
 TEXT FILE FOR USE WITH OTHER SOFTWARE PROGRAMS.

 IF YOU WANT TO PRODUCE THE GENERIC TEXT FILE, YOU MUST ENTER A 'Y'
 IN THE FIELD BELOW.  NOTE THAT SUCH A FILE MAY BE DOWNLOADED AND
 MANIPULATED AS WOULD ANY TEXT FILE FOR INPUT INTO OTHER SYSTEMS.
 IT MAY NOT, HOWEVER, BE USED AS INPUT FOR UAMPPS OR UAMPES GRAPHICS.

 IF YOU DO NOT ENTER A 'Y' THE SYSTEM WILL DEFAULT TO THE SAS FORMAT.

 DO YOU WANT TO OUTPUT A GENERIC TEXT FILE (Y/N)? N

   PF1/PF13=HELP        PF3/PF15=PREV MENU        PF4/PF16=MAIN MENU
```

The Extract Module Startup Screen gives you an opportunity to specify what type of output file will be produced by the extract. The default output file is an extracted SAS-formatted data set, which is used as input for the UAMPPS and UAMPES graphics modules. You may choose to output a generic text file by entering a Ⓨ at the prompt. If you enter anything other than the Ⓨ or nothing at all, the SAS-formatted data set will be produced.

The naming convention for the extracted output file is as follows:

uidacct.UAM.ftyp.EXT.spec.Xddmmmyy.Lnss

where:	uid	=	your User ID supplied by the NCC
	acct	=	your account number supplied by the NCC
	ftyp	=	SASD for SAS-formatted data sets; or TEXT for generic text files
	spec	=	the species you are extracting in this run
	dd	=	the starting day of the UAM run
	mmm	=	the starting month of the UAM run (JAN, FEB, MAR, etc.)
	yy	=	the starting year of the UAM run
	n	=	the number of the level you are extracting in this run
	ss	=	the scenario corresponding to this run. Possibilities are: 1) B (for base case) and the corresponding year, or 2) C (for control) and the corresponding control strategy, i.e., 1, 2, 3, etc.

4. SCREEN

Extract: Extract Module Startup Screen (concluded)

Note that, if you are attempting to perform an extraction for a given species, level, start date combination, and base/control strategy that has previously been performed, the existing file will be deleted and the results of the present run will be contained in a data set with the same name.

Instructions:

Press [Enter] to continue. Press [PF4] or [PF16] to abort the extract and return to the main menu.

Error Messages:

None.

```
1.1
                    UAMPPS:  Extract File Selection

    Please enter the Fully Qualified Data Set Name for the UAM file from
    which you wish to extract a Species and Level subset of information.
    Also, supply the name of the Boundary File.

    Do not enclose the Data Set Name in quotes.

       UAM Output Data Set:  uidacct.UAM.MODEL.GR8X8.BS88.JUL1188.AVGCNC

    Boundary File Data Set:  uidacct.AIRSHED.GR8X8.BS88.JUL1188.BCBIN

    Please supply Study Description and Scenario Information

    Study: New York   Base or Control (B or C): B  Year or Control #: 88

    Please enter the User Id and the Account that will be used to create
    the data set name containing the extracted UAM data.

            User Id:  uid        Account Number:  acct

      PF1/PF13=Help          PF3/PF15=Prev Menu          PF4/PF16=Main Menu
```

The information requested on this panel is used to determine the name of the extracted data set and to provide some information on its name and location.

Instructions:

You must supply fully qualified names of both the UAM output file from which you wish to extract data and the UAM boundary file. Do **NOT** enclose the data set name in quotes. Please note that the input file should be binary and not ASCII or EBCDIC and must be a cataloged disk file residing on the NCC IBM mainframe.

Generally, the name of the domain is placed in the "Study" field, although you may choose any type of identifier. You must also indicate the Base/Control and the Year/Control indicators in the appropriate fields.

For example, if the file you are performing the extraction on is a base file for the year 1988, then enter "B" in the "Base or Control" field and "88" in the "Year or Control" field. Otherwise, enter "C" and the control strategy number in the corresponding fields. Both fields are required. The information you supply is stored as descriptive information and is used to generate the name of the output data set.

4. SCREEN

Extract: File Selection Screen
(concluded)

Finally, you must supply User ID and account information in order to determine the prefix of the output data set being created. These two pieces of information were supplied to you by the NCC when you received your IBM account authorization.

When you are finished specifying all of the necessary information, press (Enter) to process your selections.

Error Messages:

Entering an invalid file name on either the "UAM Input Data Set" field or the "Boundary File Data Set" field will result in the following message displayed in the center of the screen:

```
Press PF15 to continue
   DATA SET DOES NOT EXIST.  PLEASE REENTER DATA SET NAME.
```

If the geographical boundaries in the boundary file do not fall within the geographical domain of the data file, the following message will appear:

```
Press PF15 to continue
    FILE DOMAINS ARE INCOMPATIBLE... REENTER ONE OR BOTH.
```

Press (PF15) to continue and reenter file names.

All other fields are required. If you leave any of the these fields blank, the following message will result:

```
Press PF15 to continue
              VALUE REQUIRED AT CURSOR LOCATION.
```

For the "Base or Control" field, any value other than B or C will result in:

```
Press PF15 to continue
               PLEASE ENTER B OR C TO CONTINUE.
```

For the "Year or Control" field, the response must be a numeric value between 0 and 99. Any other response will result in:

```
Press PF15 to continue
              VALID RANGE 0-99...PLEASE REENTER.
```

When you press (PF15) to continue, the cursor will be placed on the appropriate field for data entry.

```
1.2
                    UAMPPS:  Extract Species/Level Data

    Model Run
      Start Day: 11JUL88    Hour:  1        End Day: 11JUL88    Hour: 24
      Number of Species: 24                 Number of Segments: _1

    Domain
      Columns(x):  31            Rows(y):  25
      Vertical Levels(z):  5     ( Upper  3 , Lower  2 )

    Enter a ? and Press Enter to Select from a List of Available Species

    Select Species:  03                     Select Level:  1

           Press PF20 for a Spatial Description of the Domain.

      PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

```
1.2
              UAMPPS:  Extract Spatial Description of the Domain

      UTM Zone:  18
      Reference Origin(x):      0       Reference Origin(y):        0
      Origin of Grid(x):   520000       Origin of Grid(y):    4460000

      Columns(x):  31                   Rows(y):  25
      Grid Interval(x):  8000           Grid Interval(y):  8000

      Vertical Levels(z):   5           ( Upper  3 , Lower  2 )
      Height to Base of Surface Level:    0
      Minimum Height to Lower Level:     50
      Minimum Height to Upper Level:    150

      Press PF19 to return to the Species/Level Data Extraction Menu.

      PF1/PF13=Help        PF3/PF15=Prev Menu        PF4/PF16=Main Menu
```

4. SCREEN

Extract: Species/Level Data Screen
(concluded)

This screen is a 2-page screen. Page 1 of this screen lists the starting and ending periods of the UAM run and the species present, along with some spatial information. Page 2 is purely informational, showing the spatial description of the domain. The number of columns, rows, and vertical levels are repeated from page 1 so that you will not have to page back and forth to see a complete spatial description of the domain.

Instructions:

On Page 1 of this screen, you are asked to supply the name of the species and the number of the level from which you would like data extracted. The name of the species must match one of the names supplied in the list of available species. If you enter a "?" in the "Select Species" field and press Enter, a list of available species will be displayed. You may select a species by placing the cursor on a member of the list and pressing Enter. The level you select must be less than or equal to the total number of vertical levels.

When you are finished specifying all the necessary information, press Enter to process your selections.

Error Messages:

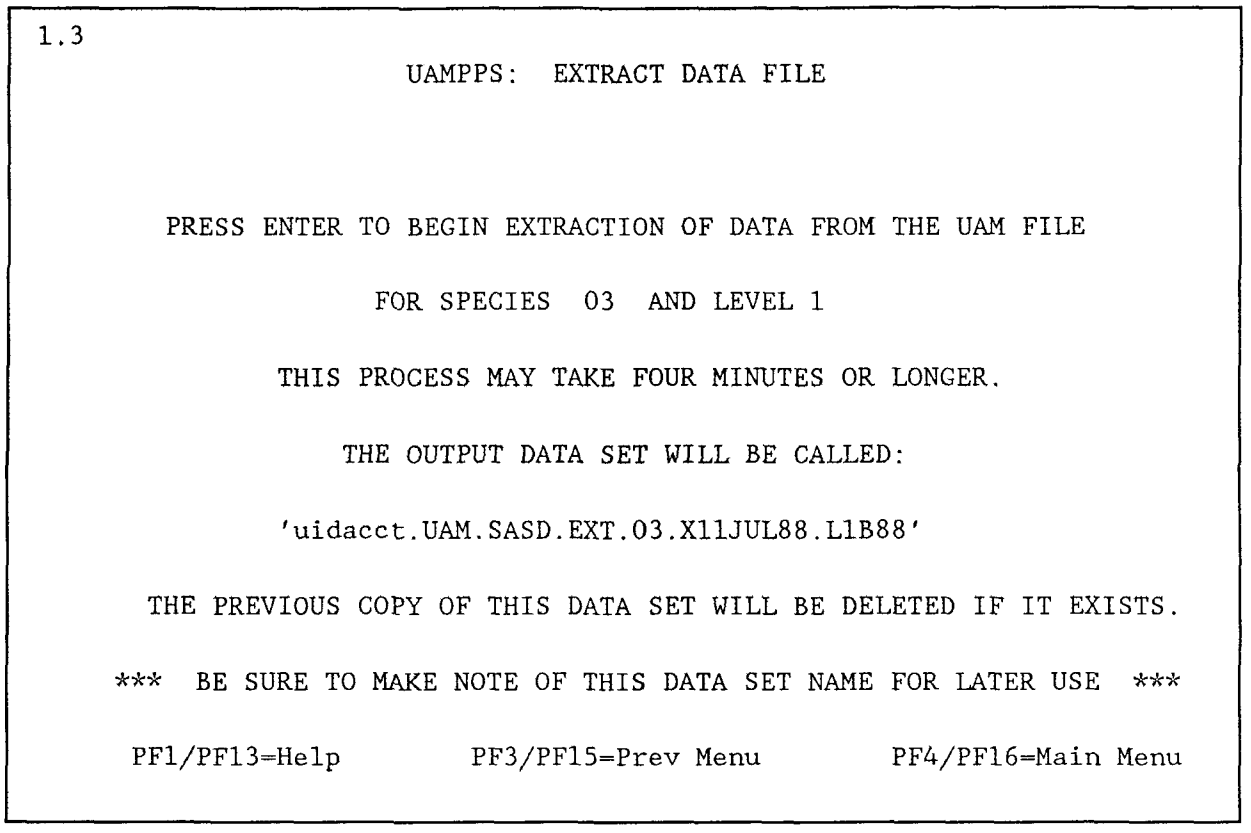
If the "Select Species" field is left blank or the species entered is not a valid species, the following message is displayed:

```
Press PF15 to continue
                INVALID SPECIES...PLEASE REENTER.
```

The "Select Level" field must be less than or equal to the number of vertical levels in the domain. If this is not the case, the following message will be displayed:

```
Press PF15 to continue
          SELECT LEVEL FIELD OUTSIDE VALID RANGE...REENTER.
```

When you press PF15 to continue, the cursor will be placed on the appropriate field for data entry.



After the Species/Level Data Selection Screen is completed, the extraction process begins. The message screen is displayed indicating the species and level being extracted along with the name of the extracted data set. At this time, you should make note of the name of the data set that is being created. When you enter the Graphics module, you will need to supply this or another extracted data set name. Therefore, it is recommended that you keep a list containing the names of all data sets you extract along with a brief description of their contents. After the extraction is complete, you are, of course, free to rename any or all files, if you so desire.

Instructions:

Make note of the name of the extracted data set and be sure to write it down for later use. This data set name is required by the UAMPPS Graphics module.

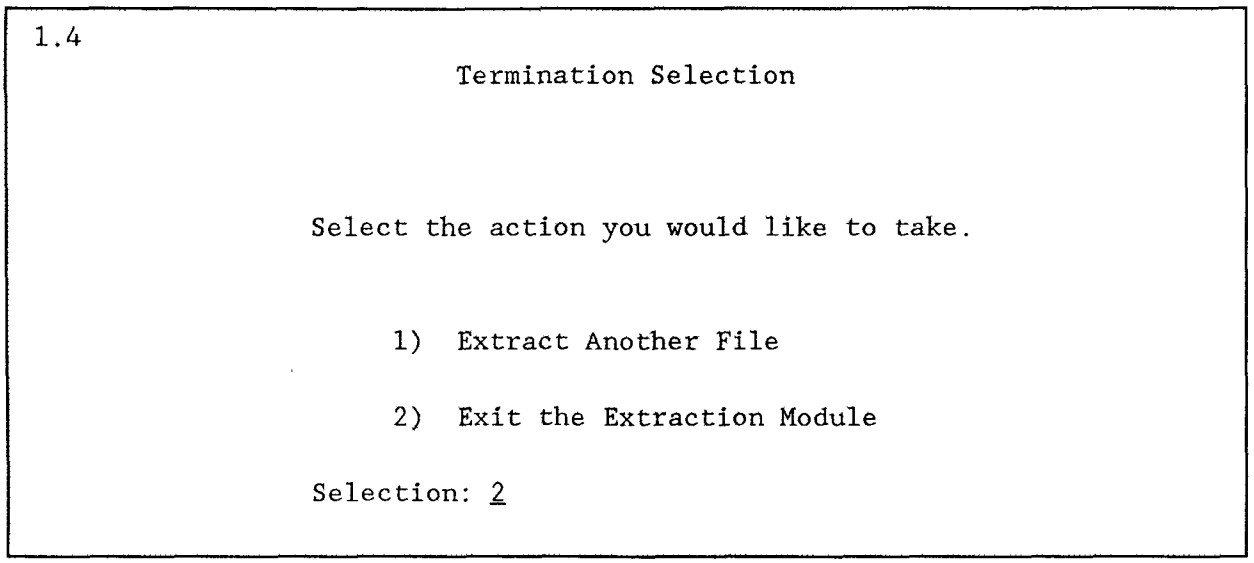
Because large data files are involved, the extraction process may take 4 minutes or longer.

Error Messages:

None.

4. SCREEN

Extract: Termination Selection Screen



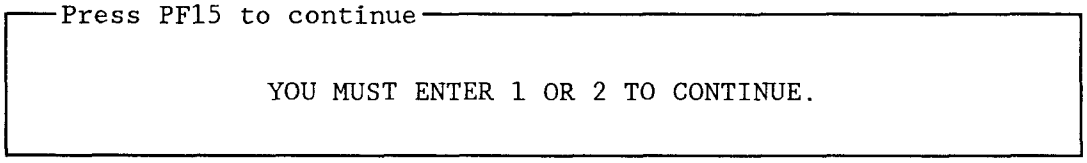
The Termination Selection Screen allows you to perform another extraction or to exit the Extract module. If another extraction is chosen, control is returned to the Extract Module Startup Screen described earlier.

Instructions:

To perform another extraction, enter "1" in the "Selection" field, otherwise, enter "2" to exit the Extract module. If you choose to exit the Extract module, you will be returned to the UAMPPS main menu.

Error Messages:

The values "1" or "2" are the only valid values for the "Selection" field. Any other entry will result in the following error message:



Press PF15 to remove the message from the screen. Then, enter a "1" or "2" and press Enter.

APPENDIX B

PERFORMANCE MEASURE FORMULATIONS

This appendix provides information on the notation, formulas, and statistical terminology, as discussed in Section 2.2 of this manual. This appendix is identical in content to Appendix C of the Guideline Document (EPA, 1991a).

PERFORMANCE MEASURE FORMULATIONS

RECOMMENDED PERFORMANCE MEASURES[1]

1. Unpaired Highest-Prediction Accuracy (A_u)

$$A_u = \frac{c_o(.,.) - c_p(.,.)}{c_o(.,.)} \times 100\%$$

where

A_u = unpaired highest-prediction accuracy (quantifies the difference between the magnitude of the highest[2] 1-hour observed value and the highest 1-hour predicted value

$c_o(.,.)$ = maximum 1-hour observed concentration over all hours and monitoring stations

$c_p(.,.)$ = maximum 1-hour predicted concentration over all hours and surface grid squares

---

[1]Based on Reference 17.

[2]"Highest" refers to the maximum 1-hour concentration across all hours and monitoring stations.

2. Normalized Bias Test (D^*)

$$D^* = \frac{1}{N_T} \sum_{i=1}^{N} \sum_{j=1}^{H_i} \frac{c_o(i,j) - c_p(i,j)}{c_o(i,j)}$$

where

D^* = normalized bias obtained from all hourly prediction-observation pairs

N = number of monitoring stations

H_i = number of hourly prediction-observation pairs for monitoring station i

N_T = total number of station-hours

$$= \sum_{i=1}^{N} H_i$$

$c_o(i,j)$ = observed value at monitoring station i for hour j

$c_p(i,j)$[3] = predicted value at monitoring station i for hour j

[3]Predicted value derived from bilinear interpolation of the predicted values at the four grid cells nearest to station station *i* for the given hour.

3. Gross Error of All Pairs >60 ppb (E_d^*)

$$E_d^* = \frac{1}{N_T} \sum_{i=1}^{N} \sum_{j=1}^{H_i} \frac{|c_o(i,j) - c_p(i,j)|}{c_o(i,j)}$$

where

E_d^* = normalized gross error for all hourly prediction-observation pairs for hourly observed values >60 ppb

N_T = total number of station hours (defined previously)

N = number of monitoring stations

H_i = number of hourly prediction-observation pairs for monitoring station i

$c_o(i,j)$ = observed value >60 ppb at monitoring station i for hour j

$c_p(i,j)$[4] = predicted value at monitoring station i for hour j

[4]Predicted value derived from bilinear interpolation of the predicted values at the four grid cells nearest to station *i* for the given hour.

OTHER SUGGESTED PERFORMANCE MEASURES

1. Average Station Peak Prediction Accuracy $\bar{A}$

$$\bar{A} = \frac{1}{N} \sum_{i=1}^{N} \left| \frac{c_o(i,t_i) - c_p(i,t_i)}{c_o(i,t_i)} \right| \times 100\%$$

where

$\bar{A}$ = mean paired peak[5] prediction accuracies averaged over all monitoring stations

N = number of monitoring stations

$C_o(i,t_i)$ = peak observed value at monitoring station i for hour t_i

$C_p(i,t_i)$[6] = predicted value at monitoring station i for hour t_i

---

[5] "Peak" refers to the daily maximum 1-hour concentration at a particular monitoring station.

[6] For these "Other Suggested Performance Measures, "predicted" can be interpreted in one of several ways: (1) as the result of bilinear interpolation described in footnote 4; (2) using the procedures described for paired predictions of daily maxima (described on page 52 of the text); (3) using the prediction for the grid square containing the monitor site only. The Modeling Protocol should document the procedure used to determine "predicted" values in these tests.

t_i = hour of peak observed value at monitoring station i

2. Bias of All Pairs >60 ppb(D_{60})

$$D_{60} = \frac{1}{N_T} \sum_{i=1}^{N} \sum_{j=1}^{H_i} [c_o(i,j) - c_p(i,j)]$$

where

D_{60} = non-normalized bias from all hourly prediction-observation pairs for observed values >60 ppb

N_T = total number of station-hours (defined previously)

N = number of monitoring stations

H_i = number of hourly prediction-observation pairs for monitoring station i

$c_o(i,j)$ = observed value >60 ppb at monitoring station i for hour j

$c_p(i,j)$[7] = predicted value at monitoring station i for hour j

3. Bias of All Station Peaks (D_{peak})

$$D_{peak} = \frac{1}{N} \sum_{i=1}^{N} [c_o(i,t_i) - c_p(i,t_i)]$$

where

D_{peak} = non-normalized bias from all prediction-observation pairs for peak[8] observed values at all monitoring stations

N = number of monitoring stations

$c_o(i,t_i)$ = peak observed value at monitoring station i for hour t_i

---

[7]For these "Other Suggested Performance Measures, "predicted" can be interpreted in one of several ways: (1) as the result of bilinear interpolation described in footnote 4; (2) using the procedures described for paired predictions of daily maxima (described on page 52 of the text); (3) using the prediction for the grid square containing the monitor site only. The Modeling Protocol should document the procedure used to determine "predicted" values in these tests.

[8] "Peak" refers to the daily maximum 1-hour concentration at a particular monitoring station.

$cp(i,t_i)$[9] = predicted value at monitoring station i for hour t_i

t_i = hour of peak observed value at monitoring station i

4. Fractional Bias for Peak Concentration

The fractional bias is calculated for both the mean and standard deviation of peak ozone values, as follows:

$$F_m = 2 \times \frac{(m_o - m_p)}{(m_o + m_p)}$$

$$F_s = 2 \times \frac{(s_o - s_p)}{(s_o + s_p)}$$

where

F_m = fractional bias of means

F_s = fractional bias of standard deviation

[9]For these "Other Suggested Performance Measures, "predicted" can be interpreted in one of several ways: (1) as the result of bilinear interpolation described in footnote 4; (2) using the procedures described for paired predictions of daily maxima (described on page 52 of the text); (3) using the prediction for the grid square containing the monitor site only. The Modeling Protocol should document the procedure used to determine "predicted" values in these tests.

m_o = mean maximum observed concentration

m_p = mean peak predicted concentration

s_o = standard deviation of peak observed concentrations

s_p = standard deviation of peak predicted concentrations

The means and standard deviations of predicted and observed concentrations are determined by each of two methods:

Peak station values:

$c_o(i,.)$ = maximum observed concentration at monitoring station i across all hours

$c_p(i,.)$[10] = maximum predicted concentration at monitoring station i across all hours

where i = 1,...,N monitoring stations

Peak hourly values:

---

[10]For these "Other Suggested Performance Measures, "predicted" can be interpreted in one of several ways: (1) as the result of bilinear interpolation described in footnote 4; (2) using the procedures described for paired predictions of daily maxima (described on page 52 of the text); (3) using the prediction for the grid square containing the monitor site only. The Modeling Protocol should document the procedure used to determine "predicted" values in these tests.

$c_o(.,j)$ = maximum observed concentration at hour j across all monitoring stations

$c_p(.,j)$[11] = maximum predicted concentration at hour j across all monitoring stations

where j = 1,...,H hours

The fractional bias of the mean and standard deviation varies from -2 to +2. Negative values indicate overprediction and positive values indicate underprediction.

[11]For these "Other Suggested Performance Measures, "predicted" can be interpreted in one of several ways: (1) as the result of bilinear interpolation described in footnote 4; (2) using the procedures described for paired predictions of daily maxima (described on page 52 of the text); (3) using the prediction for the grid square containing the monitor site only. The Modeling Protocol should document the procedure used to determine "predicted" values in these tests.

APPENDIX C

ALGORITHMS FOR CELL-AGGREGATION AND FRACTIONAL BIAS

C.1 DISTANCE-WEIGHTED ALGORITHM

Both the distance-weighted, nine-cell and the distance-weighted, four-cell aggregation method use the same algorithm. The algorithm calculates an average concentration that is weighted according to the squared inverse of the distance from the monitor to the center of each cell. Therefore, the predicted concentrations of the cell centers that are closer to the monitor are given greater weight than the values of the cell centers that are farther from the monitor. The formula for this algorithm is:

$$AV = \sum \frac{PR}{D^2} \div \sum \frac{1}{D^2}$$

where PR is the predicted concentration for each cell and D is the distance from cell center to monitor.

C.2 FOUR-CELL ALGORITHM

The three aggregation methods that are derived from a square of four cells are: four-cell closest value, distance-weighted four cell, and bilinear interpolation. These methods use a common algorithm to select a square of four cells, and then apply individual algorithms to arrive at a unique aggregation method.

The four-cell algorithm first determines which quadrant of cell 5 the monitor occupies. Next, it selects the three cells adjacent to that quadrant to complete a square of four cells. This process is illustrated in Figure C-1.

If the monitor is in the northwest quadrant of cell 5, then cells 5, 4, 7, and 8 are selected. If the monitor is in the northeast quadrant of cell 5, then cells 5, 6, 8, and 9 are selected. If the monitor is in the southwest quadrant of cell 5, then cells 5, 1, 2, and 4 are selected. If the monitor is in the southeast quadrant of cell 5, then cells 5, 2, 3, and 6 are selected.

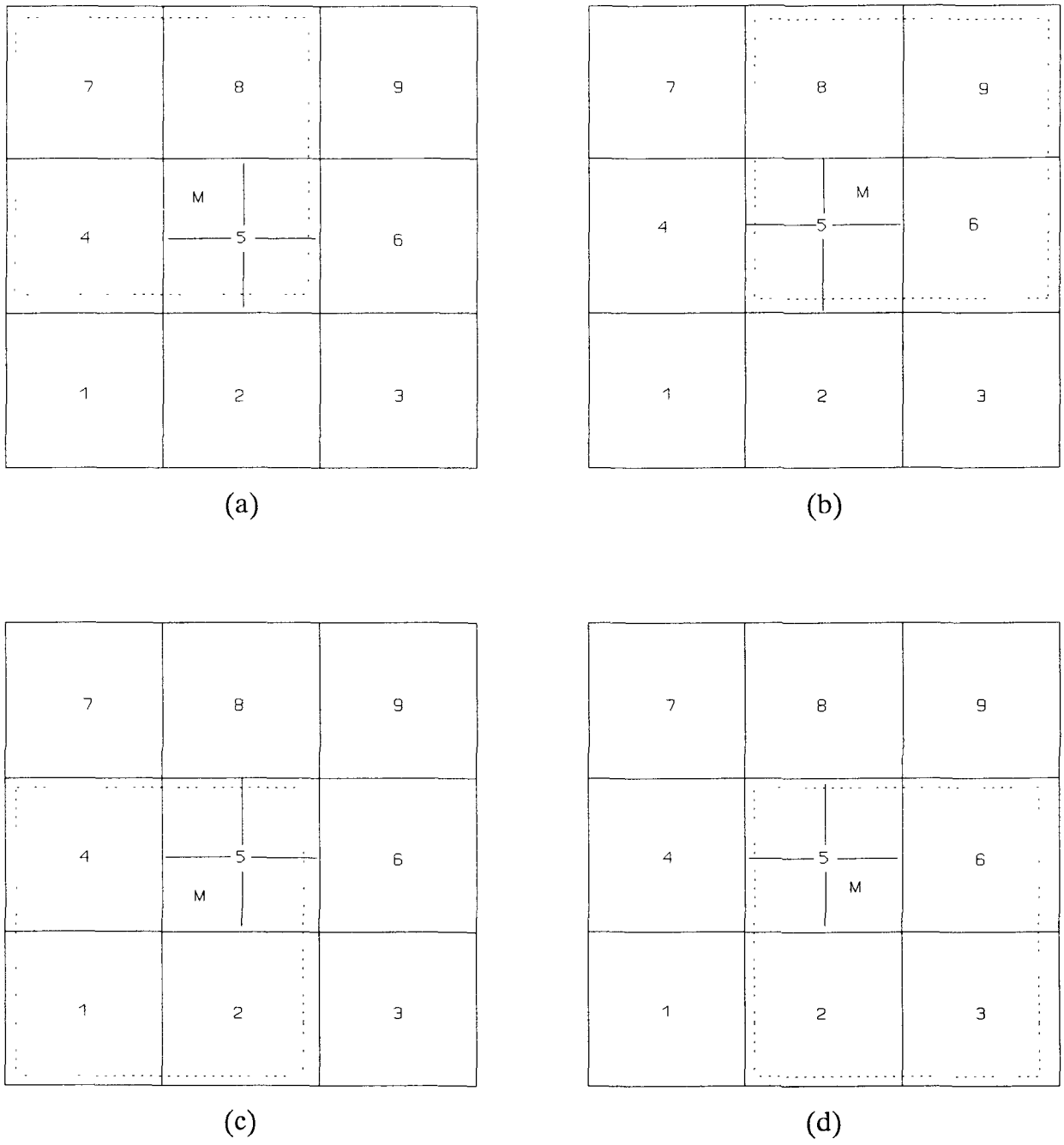


Figure C-1. The square of four cells.
(a) Monitor in northwest quadrant of cell 5.
(b) Monitor in northeast quadrant of cell 5.
(c) Monitor in southwest quadrant of cell 5.
(d) Monitor in southeast quadrant of cell 5.

C.3 BILINEAR INTERPOLATION ALGORITHM

The bilinear interpolation algorithm calculates a weighted average of the four predicted concentrations based on the following formulas and illustrated in Figure C-2. Linear interpolations are calculated along both the *x* and *y* axes, hence the term bilinear.

$$W(X1,Ym) = W(X1,Y1) + ((Ym - Y1) \div (Y2 - Y1)) \times (W(X1,Y2) - W(X1,Y1))$$
$$W(X2,Ym) = W(X2,Y1) + ((Ym - Y1) \div (Y2 - Y1)) \times (W(X2,Y2) - W(X2,Y1))$$
$$W(Xm,Ym) = W(X1,Ym) + ((Xm - X1) \div (X2 - X1)) \times (W(X2,Ym) - W(X1,Ym))$$

where *W* represents the concentration level at a given point and *m* represents the monitor location.

Concentration levels in the formulas correspond to concentration levels in Figure C-2 as follows:

W(X1,Y1) = Cell 1 concentration level
W(X1,Y2) = Cell 4 concentration level
W(X2,Y1) = Cell 2 concentration level
W(X2,Y2) = Cell 5 concentration level

A linear interpolation is calculated based on the monitor location along the *y* axis (Ym) between cells 1 and 4, and between cells 2 and 5. These calculations yield the formula values of W(X1,Ym) and W(X2,Ym). A linear interpolation is then calculated between these two values based on the monitor location along the *x* axis (Xm). The resulting value (W(Xm,Ym)) represents the bilinear interpolation.

Note that the cell numbers used in this discussion are specific to the example shown in Figure C-2, where the monitor is located in the southwest quadrant of cell 5. As the quadrant location of the monitor changes, the specific cells involved in the interpolation will also change according to the procedure discussed in Section C.2 of this manual. For a more thorough discussion of bilinear interpolation, see Chapter 3 in Press, et al. (1986).

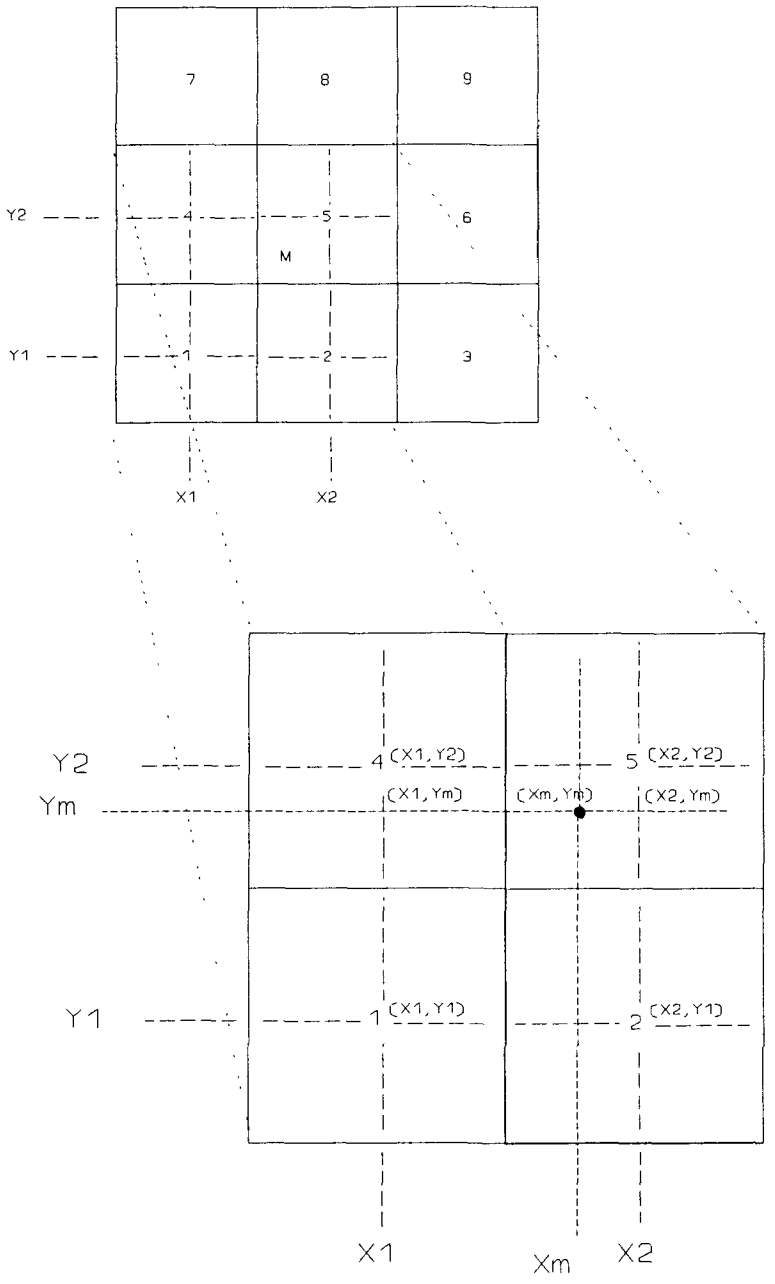


Figure C-2. Bilinear interpolation.

[Note: The upper diagram shows a square of four cells; monitor (M) is located in the southwest quadrant of cell 5; centerlines of selected cells are indicated as X1, X2, Y1, and Y2.
The lower diagram adds reference lines for the *x*-axis location (Xm) and the *y*-axis location (Ym) of the monitor. The *x*,*y* coordinates of each point used in the bilinear calculation are given in *parentheses.*]

C.4 FRACTIONAL BIAS ALGORITHM

Bias plots in the UAMPES are specifically designed to plot fractional biases. Fractional biases generally provide a way of comparing two values and indicating how closely one matches the other. In the context of the UAMPES, positive values of the fractional bias indicate that the observed concentration statistic (i.e., mean or standard deviation) is larger than the predicted concentration statistic. Negative values indicate that the observed concentration statistic is smaller than the predicted statistic. The formula for the fractional bias is given by:

$$FB = \frac{2(OB-PR)}{OB+PR}$$

where OB = statistic calculated using the observed data and PR = statistic calculated using the predicted data. For a discussion of the fractional bias and its use as a measure of discrepancy, refer to Cox and Tikvart (1990).

The fractional bias is computed for both the mean and standard deviation of peak ozone values. The mean and standard deviation of predicted and observed concentrations are determined by two methods.

(a) The data set corresponding to the peak station values (BIAS1) is determined from the highest 1-hour average concentrations at each monitoring station as indicated in Figure C-3(a). For each monitor, both the maximum observed and the maximum predicted 1-hour average concentrations (from among the hours) are determined. From these peak station concentration pairs, the fractional bias of the mean and standard deviation are computed using the fractional bias expression from above. This fractional bias measures the ability of the model to predict the mean and standard deviation of observed 1-hour average concentrations from data paired in space but not time.

(b) The data set corresponding to the peak hourly values (BIAS2) is determined from the highest concentration for each hour as indicated in Figure C-3(b). For each hour, both the maximum observed and the maximum predicted 1-hour average concentrations (from among the monitoring stations) are determined. From these peak hourly concentration pairs, the fractional bias of the mean and standard deviation are computed. This fractional bias measures the ability of the model to predict the mean and standard deviation of observed 1-hour average concentrations from data paired in time but not space.

(a) Maximum over all hours (BIAS1).

MONITOR	HOUR 1	2	3	4	5	6	7	8	Peak Station Values
A	28	31	12	59	**72**	46	63	56	**72**
B	32	24	**81**	60	65	56	19	45	**81**
C	56	48	**61**	49	33	36	52	40	**61**
D	65	27	42	34	53	70	**79**	38	**79**
E	41	39	43	66	47	**68**	26	49	**68**
F	50	**77**	29	53	41	39	72	52	**77**
									Sum(x)=438

Mean = Sum(x)/N = 438/6 = 73.0

(b) Maximum over all monitors (BIAS2).

MONITOR	HOUR 1	2	3	4	5	6	7	8	
A	28	31	12	59	**72**	46	63	**56**	
B	32	24	**81**	60	65	56	19	45	
C	56	48	61	49	33	36	52	40	
D	**65**	27	42	34	53	70	**79**	38	
E	41	39	43	**66**	47	**68**	26	49	
F	50	**77**	29	53	41	39	72	52	
Peak Hourly Values	**65**	**77**	**81**	**66**	**72**	**68**	**79**	**56**	**Sum(x) = 564**

Mean = Sum(x)/N = 564/8 = 70.5

Figure C-3. Source of statistics for fractional biases (applies to observed and predicted concentrations).

APPENDIX D

GRAPHICS CATALOG

This appendix provides information on the graphics catalog, as discussed in Section 4.5 (Saving the Graphic in a Graphics Catalog) of this manual. This appendix is identical to Section 4.3 of the user's manual for the UAM postprocessing system (EPA, 1990a).

4. SCREEN

4.3 GRAPHICS CATALOG

Within the SAS data management system, the Graphics Catalog is the storage area for the graphics command string that produces graphic output from the processed data. The resulting graphic data can be "replayed" to redisplay the graphic much more rapidly than repeating the graphic generation process. A temporary graphics catalog is always produced when SAS graphics procedures are run, but this temporary catalog and its contents are lost when the SAS session is concluded.

To save graphics output between SAS sessions, you must specify a permanent graphics catalog. The "Save the Graphic" option on the Termination Selection Screen of the graphics creation module allows you to create a permanent SAS graphics catalog and to store graphics output in it. To redisplay, merge graphics, remap colors, or otherwise manipulate the stored graphics, you must run the SAS GREPLAY procedure. GREPLAY may be run from the TSO Ready prompt by executing the SAS CLIST and subsequently submitting PROC GREPLAY to the system with the proper parameters. The Graphics Catalog management section of the UAMPPS allows you a "shortcut" to access PROC GREPLAY from the UAMPPS menu system.

Graphics Catalog: Catalog Management Menu Screen

```
UAMPPS 3.0
                    Graphic Catalog Management Menu


        Please enter below the Fully Qualified Data Set Name
        of the Graphics Catalog to be created or modified.

        Do not enclose the Data Set Name in Quotes.

    Graphics Catalog DSN:  uidacct.UAM.OAQPS.GCATLG

    Graphics Device      :  IBM3179


      PF1/PF13=Help          PF3/PF15=Prev Menu          PF4/PF16=Main Menu
```

If you choose the "Graphics Catalog" block on the main menu, you will find yourself in the above screen. This screen is intended to be a quick way for you to access PROC GREPLAY from within the UAMPPS. You may create a graphics catalog from this screen or access any existing one.

Instructions:

Enter the fully qualified data set name for the Graphics Catalog. (Do not confuse this data set name with the extracted UAM data sets.)

Also, enter your graphics device.

When you press Enter, the screen will clear and the next screen displayed will be the PROC GREPLAY screen.

When you have finished using PROC GREPLAY, press PF15 to return to the main menu.

Error Messages:

None.

4. SCREEN


```
PROC GREPLAY
  Command ===>

  IGOUT:  GOUT.PLOTS          GOUT:  ____________________     Device:  IBM3179
  TC:     ____________________ Template: _________           Scroll:  PAGE
  CC:     ____________________ Cmap:  ___________

  Sel   Name          Type  Description                                  Updated
  ___   BAR           I     NEW YORK 11JUL88 03 L1 B88 GT THRESH         09/30/91
  ___   BOX           I     NEW YORK 11JUL88 03 L1 B88 HRLY CONC         09/30/91
  ___   SLINE         I     NEW YORK 11JUL88 03 L1 B88 HRLY MAXC         09/30/91
  ___   CVALUE        I     NEW YORK 11JUL88 03 L1 B88 HR OF MAX         09/30/91
  ___   CTILE         I     NEW YORK 11JUL88 03 L1 B88 PCT DIFF          09/30/91
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
  ___   ____________  _     ____________________________________________ ________
```

Field:	*Description:*
"IGOUT"	The name of the input catalog (the catalog currently displayed).
"GOUT"	The name of the output catalog (the catalog to which the graphic will be replayed or copied).
"Device"	The graphics device on which the graphic will be displayed (generally the current graphics device).
"TC"	The template catalog containing the template to be used when displaying the graphic (leave blank if no template is used).
"Template"	The name of the template to be used to display the graphic (leave blank if no template is used).
"Scroll"	The current scroll value for an entry list greater than one screen in length.
"CC"	The color map catalog from which the color map is drawn.
"Cmap"	The name of the color map used to display the graphic (leave blank if no color map is used).
"Sel"	The selection field; used to enter commands that apply to the corresponding catalog entry.

Graphics Catalog: GREPLAY Screen (concluded)

Field:	*Description:*
"Name"	The name that was assigned to the graphic by the "Name" field on the Graphics Catalog Generation screen.
"Type"	The type of graphics output. See Chapter 3 of SAS/GRAPH Reference for more information.
"Description"	The description that was assigned to the graphic by the "Description" field on the Graphics Catalog Generation screen.
"Updated"	The date that the catalog entry was generated.

Instructions:

Display a graphic:

Place an **S** in the "Sel" field and press Enter.

Delete a graphic:

Enter **DEL** in the "Sel" field and press Enter.

Copy a graphic:

Place a **C** in the "Sel" field and press Enter. The graphic entry will be copied to the catalog specified in the "GOUT" field.

Display a graphic (or graphics) in a template:

Enter a template catalog name in the "TC" field and the name of the template in the "Template" field. Next select the graphic (or graphics) from the catalog list by placing an **S** and a number (or numbers, i.e. **S1**, **S2**, etc.) in the "Sel" field(s) indicating the order in which to display the graphics in the template. Press Enter.

Change the colors in a graphic:

Enter a color map catalog name in the "CC" field and the name of the color map in the "Cmap" field. Next select the graphic from the catalog list by placing an **S** in the selection field. Press Enter.

Create or edit a template:

Enter a template catalog name in the "TC" field.

On the command line type: **edit templatename.TEMPLATE**, then press Enter. The TEMPLATE DESIGN window will be displayed for editing of the template. See SAS/GRAPH Reference (pages 1241-1244) for additional information on the TEMPLATE DESIGN window.

Create or edit a color map:

Enter a color map catalog name in the "CC" field.

On the command line type: **edit colormapname.CMAP**, then press Enter. The COLOR MAPPING window will be displayed for editing of the color map. See SAS/GRAPH Reference (pages 1244-1245) for additional information on the COLOR MAPPING window.

Change the current catalog:

Enter the new catalog name in the "IGOUT" field and press Enter. The new catalog list will be displayed.

TECHNICAL REPORT DATA *(Please read Instructions on the reverse before completing)*		
1 REPORT NO. EPA-450/4-90-007G	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE User's Guide for the Urban Airshed Model Volume VII: User's Manual for the Performance Evaluation System		5. REPORT DATE December 19, 1991 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Paul Jarrett (CSC) and Ellen Baldridge (EPA)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Computer Sciences Corporation (CSC) Applied Technology Division P.O. Box 12767 Research Triangle Park, NC 27709		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency (EPA) Technical Support Division (MD-14) Office of Air Quality Planning and Standards Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED 14. SPONSORING AGENCY CODE
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The UAM Performance Evaluation System (UAMPES) is a data display and analysis tool for evaluating UAM model performance. After executing the UAM system the results may be graphically compared to the air quality monitored data. The UAMPES creates time series plots, tile maps, bar charts, boxplots, scatter plots and quantile plots. Through a series of menus the user has a wide range of flexibility in scaling and labeling the graphs. This system calculates all of the performance measures cited in Appendix C of the **Guideline for Regulatory Application of the Urban Airshed Model**.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Urban Airshed Model (UAM) species, scenario, quantile, tiles, boxplots, SAS graphics catalog Aerometric Information Retrieval System (AIRS), air quality, fractional bias		

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