NOAA Western Region Computer Programs and Problems NWS WRCP - NO. 53

DATACOL - AFOSPLOT PROGRAM

Salt Lake City, Utah
February 1986

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

PREFACE

This Western Region publication series is considered as a subset of our Technical Memorandum series. This series will be devoted exclusively to the exchange of information on and documentation of computer programs and related subjects. This series was initiated because it did not seem appropriate to publish computer program papers as Technical Memoranda; yet, we wanted to share this type of information with all Western Region forecasters in a systematic way. Another reason was our concern that in the developing AFOS-era there will be unnecessary and wasteful duplication of effort in writing computer programs in National Weather Service (NWS). Documentation and exchange of ideas and programs envisioned in this series hopefully will reduce such duplication. We also believe that by publishing the programming work of our forecasters, we will stimulate others to use these programs or develop their own programs to take advantage of the computing capabilities AFOS makes available.

We solicit computer-oriented papers and computer programs from forecasters for us to publish in this series. Simple and short programs should not be prejudged as unsuitable.

The great potential of the AFOS-era is strongly related to local computer facilities permitting meteorologists to practice in a more scientific environment. It is our hope that this new series will help in developing this potential into reality.

NOAA WESTERN REGION COMPUTER PROGRAMS AND PROBLEMS NWS WRCP

1 Standardized Format for Computer Series. REVISED January 1984. (PB85 109668)
2 AFOS Crop and Soil Information Report Programs. Ken Mielke, July 1979. (PB85 110419)
3 Decoder for Significant Level Transmissions of Raobs. John A. Jannuzzi, August 1979. (PB85 109676)
4 Precipitable Water Estimate. Elizabeth Morse, October 1979.
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7 Plotting of Ocean Wave Energy Spectral Data. John R. Zimmerman, December 1979. (PB85 112860)
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28 AFOS Interactive Graphics. Jim Fors, Don Laurine, and Sandy MacDonald, April 1981(PB85 110401)
29 Computer Programs for Aviation Forecast Transmission. Kenneth B. Mielke and Matthew R. Peroutka, May 1981.(PB85 110518)
30 AFOS Product Collective Program. Morris S. Webb, Jr., September 1981. (PB85 109841)
31 Graphic Display of FOUS Output. Stephen D. Steenrod, September 1981. (PB85 109817)
32 Automation of Hourly Aviation Observation Calculations. W. Paul Duval, October 1981. (PB85 109650
33 Mesoscale Objective Analysis. Andrew J. Spry and Jeffrey L. Anderson, December 1981. (PB85 109825)
34 Orographic Snowfall Rate Model for Alta, Utah. Steven K. Todd and Glenn E. Rasch, December 1981. (PB85 109874)
35 F-6 Monthly Climatic Summary Program for AFOS. Peter G. Mueller, May 1982. (PB85 109858)

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DATACOL - AFOSPLOT PROGRAM

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This technical publication has been reviewed and is approved for publication by Scientific Services Division, Western Region.

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I. INTRODUCTION

A. Purpose

AFOSPLOT uses station time series data stored in the RFC DATACOL data base to construct a clear, understandable AFOS graphic plot covering 3, 10 or 31 day periods (See Figures 1, 2 and 3). A typical use of this program is to generate hydrograph plots but any type of data stored in DATACOL can be plotted.

B. Motivation

DATACOL was designed primarily to be a data storage and retrieval system, and has no graphics display capability. Viewing data in graphical form can be a valuable aid to a river forecaster in many situations. This program takes advantage of the AFOS graphics display capability and the ability of DATACOL to communicate with AFOS.

C. Benefits to the User

After the product has been successfully generated and sent to AFOS, the user displays the plot on an AFOS graphics console by entering the appropriate product name. A rectangular background grid with horizontal spacing corresponding to the period of time covered by the plot is simultaneously displayed. The program plots the following information:

1. Along the base of the background grid, a label for the horizontal axis, which consists of the date for each day covered by the plot.

2. Along the left side of the grid, the vertical axis label, the units of which are listed at the top of the grid.

3. Above the top of the grid, descriptive information for the station being plotted, consisting of the station name, data units, elevation (msl) of the location where the data is collected, and if the plot is a hydrograph, peak discharge along with the date and time of occurrence.

4. Plotted on the grid, the graph line showing variation of data values with time. If desired by the user, up to 3 plots covering the same time period can be generated successively to be viewed together on an AFOS graphics console

along with their common background grid. The first plot generated will be the base and the next one or two generated will be overlays. If this overlay option is chosen, the vertical axis label and the station description label on each plot will be written in offset locations such that they are spaced evenly apart when the plots are viewed together (Figure 4). However, if the user knows that the data plotted on the base and overlay(s) will be of the same type and will share a similar range of values, the user can choose to have a single vertical axis label positioned in the same place on each plot which covers the range of values needed for all plots (Figure 5).

II. METHODOLOGY AND SOFTWARE STRUCTURE

A. Description

AFOSPLOT is a multitask program consisting of a single executable save file. It was written in FORTRAN 5 and was designed to run in the background of a River Forecast Center's Data General S-140 computer. AFOSPLOT begins by calling subroutine LOGRUN, which writes the program name along with date and time of execution on the user's screen and the master console. File CONFIG is read to obtain the highest station number established in DATACOL, and files DATABANK and RATAB are opened for subsequent use by the program. The background timer task BGTIMR is then started, which terminates program execution if the user fails to respond to a program request for input within a period of time specified in the program source code.

The user is then asked successively to enter the AFOS destination for the plot, plot duration (3, 10 or 31 days) and plot starting date. The question, "want to generate overlays?" is asked next, and if the user responds with a "yes" then the following two questions are asked: "How many overlays on top of 1st plot (1 or 2)?" and "Want same label for vertical axis on all (2 or 3) graphs?".

The program then proceeds to a large DO-LOOP which is repeated up to 3 times if the user intends to generate overlays. First, the question, "Do you want plot of routed flow?" is asked. If the response is affirmative, the locations for which routed flows can be computed are read from file RECARDS and written to the user's terminal. After the routing location is selected, the program re-reads file RECARDS to store routing parameters and the DATACOL station numbers for locations needed to compute routed flows. If the response to the question "Do you want plot of routed flow?" is negative, the program assumes that data from a single station is to be plotted. In this case the user is asked to enter a station number or name, which is read by subroutine READSTN. If the user enters a station name or a

portion of a station name, subroutine FINDSTN is called to seek out all possible DATACOL stations that match the input string. If only one match can be found in the DATACOL sensor list, the station number is immediately passed back to the main program and control proceeds to the next step. If more than one match is found, all possible matches are listed to the user's terminal and either a station number for one of the stations listed or another station name (or portion of a name, which will cause the search process to repeat) must be entered. If at any time a station number is entered, the search process is skipped and control proceeds to the next step. File SENSORLIST is then read to obtain the DATACOL station name, elevation and data type code. For both routed flow and single station plots, a data type description string is then read from a location in file DTCODE calculated using the data type code.

Control then proceeds to the next DO-LOOP, which is the graph computation portion of the program. The title for the location being plotted is written to the user's terminal. The newest block of time-value data available for the station in the data base is read from file DATABANK. If stage data is being used, AFOSPLOT assumes that the plot is to be a hydrograph, and subroutine GETRAT is called to obtain a copy of the station rating table from file RATAB. If a rating table shift is stored in the second location of the table header, the user must decide whether or not to use the shift in calculating flows to be plotted. When routed flows are to be plotted, this question is repeated for each of the flow stations used in the routing. The program then loops through progressively older blocks of data until all data needed for the plot period is obtained. Subroutine DECODE is called to decode each data value, and if the plot is to be a hydrograph, subroutine STG2QUE is called to calculate the discharge corresponding to each stage value. The version of STG2QUE used by AFOSPLOT includes modifications allowing rating table shifts and correct calculation of discharge for stages between and including the last two stages in the rating table. When the first piece of data is read which is older than the starting time for the plot, the program proceeds to the next step. If routed flow is being plotted, flows from all required upstream locations are "routed" downstream and added together to construct the simulated hydrograph. For all types of plots, the program then calculates the maximum and minimum values occurring during the plot period. If 2 or 3 plots are being generated to be viewed as base and overlay(s) with a common vertical axis label, the user must choose maximum and minimum values that encompass the range of values needed for each individual plot. In all other cases, the user must choose between maximum and minimum values for the vertical axis computed by the program or his/her own selection of maximum and minimum values for each individual plot.

After selection of maximum and minimum values for the vertical axis label, the horizontal axis label is written in a position below the background grid using subroutine LABEL. The vertical axis label and graph description title are written to the appropriate locations on the plot using subroutine TEXT. Each data item to be plotted is then converted to graphical coordinates in pixels, taking into account the maximum and minimum values selected for the vertical axis. The graph line is then plotted using subroutine LINES. Creation of the graphic product is complete after subroutine UTF is called (which in turn calls subroutine OUT) which puts out the communication header and graphic product definition. All of the AFOS graphic generation routines used by AFOSPLOT (TEXT, LINES, LABEL, UTF and OUT) are compatible with the new DATACOL-TRADE load.

The last question asked to the user is: "Want another plot?". An affirmative response causes the program procedure to repeat beginning with "Enter destination for plot" while a negative response leads to termination of the program.

B. Equations and Algorithms

The background grid is 3720 pixels wide and 2500 pixels high. Therefore the distance x (pixels) spanned on the plot by a one hour period is:

$$x = 3720 / n$$

where n = plot duration in hours. Given that V_y, V_{min} and V_{max} all have the same units, the plotting position y (pixels) for a data value is

$$y = 2500 (V_y - V_{min})/(V_{max} - V_{min}) + 200$$

where: V_y = decoded data value

V_{min} = minimum value for vertical axis label

V_{max} = maximum value for vertical axis label

200 = adjustment for location of background grid, which is 200 pixels above the base of plot.

From this equation it can be seen that the user's choice for maximum and minimum values of the vertical axis label controls the vertical extent of the graph line.

C. INPUT and OUTPUT Files

Files CONFIG, DATABANK, RATAB, DTCODE, SENSORLIST, and RECARDS are used as input to the program. The first five of these are standard DATACOL files. File RECARDS was set up at CBRFC as a

control file for a program (RECPGM) that lists flows at river recreational points. RECARDS can contain information on points where a data collection platform (DCP) is located at a stream gaging station or points where simulated flow is computed from flows routed from one or more upstream stations. Only information on the latter type of point is needed by AFOSPLOT. The format of file RECARDS is as follows:

Column	FORMAT	Type of Input
1-40	20A2	Name of observation point.
41-42	I2	Basin number (at CBRFC:) 1 = Colorado River 2 = Green River 3 = San Juan 4 = Great
43-46	I4	Station Number (-1 indicates routing point)
47-50	I4	First station to route downstream (DATACOL Number)
51-53	I3	Lag time for first station (hours) (Neg. time means flow is subtracted)
54-57	I4	Second station to route downstream (DATACOL Number)
58-60	I3	Lag time for second station (hours) (Neg. time means flow is subtracted)
61-64	I4	Third station to route downstream (DATACOL Number)
65-67	I3	Lag time for third station (hours) (Neg. time means flow is subtracted)
68-74		Unused

75-80	F5.0	Weight which is applied to calculated flow. This produces a weighted flow based on current flows at upstream points. If this value is left blank it is assumed to be 1.0.

At CBRFC, output from AFOSPLOT is stored in AFOS graphic products NMCGPHW03 for 3 day plot, NMCGPHW10 for a 10 day plot, and NMCGPHW31 for a 31 day plot. For RFC's outside the Western Region, the program will need to be modified so that products will be generated with authorized regional product ID's.

III. CAUTIONS AND RESTRICTIONS

If the user strikes only a "return" in response to the AFOS destination of plot question, the AFOS destination defaults to local.

If file RECARDS does not exist, none of the questions regarding routing will be asked to the user, and all routing computations in the program will be bypassed.

A station number listed in file RECARDS that is outside the range of established DATACOL station numbers will trigger an error message and cause the program to skip to the point where the user is asked if another run is wanted.

Any decoded data that is less than -90 is assumed to be bad data. If bad or missing data occur continuously for 36 hours or more, no graph line will be plotted for that period. If bad or missing data occurs continuously for less than 36 hours, a graph line will be interpolated between the points immediately before and after the period. If the day of the month assigned to a piece of data is greater than 31, an error message is written and that data is not plotted.

In cases where the user is manually entering the low and high values for the vertical axis label, the low value must be less than the minimum data value occurring during the plot period, and the high value must be greater than the maximum data value occurring during the plot period. If either criteria is violated, the user is asked to re-enter both values. There is no limit to the number of runs that can be made in succession but the user should be aware of the number of versions of the product that are stored in the RFC AFOS system. The user should also be aware of how files are transferred from DATACOL to AFOS, as there are times that a generated plot must wait in a queue until DATACOL executes the transferring of products to AFOS. Some DATACOL functions may cause the plot to wait in queue several minutes until they are complete.

DATACOL - AFOSPLOT PROGRAM

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: AFOSPLOT

AAL ID:
REVISION NO.: 1.00

PURPOSE: Uses 3, 10 or 31 days of data stored in DATACOL to generate an AFOS graphic product.

PROGRAM INFORMATION:

Development Programmers:
Donald P. Laurine
Timothy K. Helble
Location: RFC SLR
Phone: FTS 588-5130

Maintenance Programmer:
Timothy K. Helble

Language: Data General FORTRAN V Rev. 6.16

Running Time: For 10 day plots, about 60 seconds for a single plot; 80 seconds for a base and 1 overlay; and 100 seconds for a base and two overlays. May be much longer if foreground is under heavy demand.

At CBRFC, the source code file AFOSPLOT, load line AFOSPLOTL, relocatable binary file AFOSPLOT.RB and save file AFOSPLOT.SV are all stored on the applications directory APL. To run AFOSPLOT from a DATACOL CRT, the save file or a link must reside in the system master directory.

The grid backgrounds used for 3, 10 and 31 day plots are generated by 3 FORTRAN IV programs on the DG S230 computer. The 3 day grid is generated by program 3BACK.SV, and consists of 10 horizontal divisions and 6 vertical divisions. Small ticks plotted at the top and bottom represent one hour periods. The 10 day grid is generated by program 10BACK.SV, and consists of 10 horizontal divisions and 20 vertical divisions. Small ticks represent two hour periods. The 31 day grid is generated by program 31BACK.SV, and consists of 10 horizontal divisions and 62 vertical divisions. The first, third, fifth, etc. vertical lines represent the beginning of each day on each type of background grid.

The background grid program load lines are:

For 3BACK: 3BACK VEC2 SLR.LB FORT.LB

For 10BACK: 10BACK VEC2 SLR.LB FORT.LB

For 31BACK: 31BACK VEC2 SLR.LB FORT.LB

The AFOSPLOT program load line is:

```
2/K AFOSPLOT ANSWER GETRAT LABEL
FINDSTN READSTN RWLINE IDCOD STRCMP IHALF STRSET STRLOC
BGTIMR Q64WR GBTERM IRANG JULIA JULHC AILUJ NUUTF NUTEXT OUT
RANGE FILMA DECODE LINES STG2QUE AOPEN ARWBK ACLOSE LOGRUN 12/C
@TFLIB@
```

PROGRAM INSTALLATION

1. Move AFOSPLOT.SV to the directory where application programs are stored on the S140 disk system, and link the program from that directory to the master directory where DATACOL operates.

2. Run each of the three background grid generation programs on the S230, which generate an RDOS file containing the grid. Instruct AFOS to store the grid so that it will be included when calling out the product. For example, if while running program 3BACK the user decided to call the output RDOS file 3BACK.BG, the command would be:

   ```
   STORE:DPIF:3BACK.BG NMCGPHB63
   ```

   Similarly, after running 10BACK and storing the output in 10BACK.BG, the command would be:

   ```
   STORE:DPIF:10BACK.BG NMCGPHB62
   ```

   and after running 31BACK and storing the output in 31BACK.BG, the command would be:

   ```
   STORE:DPIF:31BACK.BG NMCGPHB61
   ```

3. Establish products NMCGPHW03, NMCGPHW10 and NMCGPHW31 in AFOS. Link the appropriate background to each of these products using the KEY commands.

4. Ensure that there is a data path between DATACOL and AFOS.

PART B: EXECUTION PROCEDURES AND ERROR CONDITIONS

PROGRAM EXECUTION

1. Before a plot is generated, the user should make certain that data exists in the data base for the period of time to be plotted. AFOSPLOT has no way of determining whether data to be plotted is good or bad, so it is up to user to check the data before it is plotted.

2. To run the program, the user simply grabs background control at a DATACOL ALM terminal and enters the program name AFOSPLOT, or uses a freeground terminal and enters AFOSPLOT/C. A series of questions as discussed in the program description section are asked to the user. All questions requiring a negative or positive response can be answered with a "Y", an "N", or simply a carriage return, which is interpreted by the program as an "N".

ERROR CONDITIONS

Four error conditions will cause an error message and no plot will be generated.

1. If the user enters a station number that is higher than the maximum number of stations allowed in DATACOL (MAXS), the message "Invalid Station" is written and the question "Enter Station DATACOL Number or Name" is asked again. If the same error is repeated two more times, no plot can be generated and control skips to the statement "Want Another Plot?"

2. If a station number that is greater than MAXS is read from file RECARDS, the message "Invalid Station listed in file RECARDS" is written and control skips to "Want Another Plot?"

3. If no data can be found for the period specified by the user, no plot will be generated and control skips to "Want Another Plot?"

4. An automatic timeout task runs simultaniously with AFOSPLOT. If the user waits too long (usually 30 seconds) to respond to a question, AFOSPLOT is terminated.

COLORADO BASIN RFC

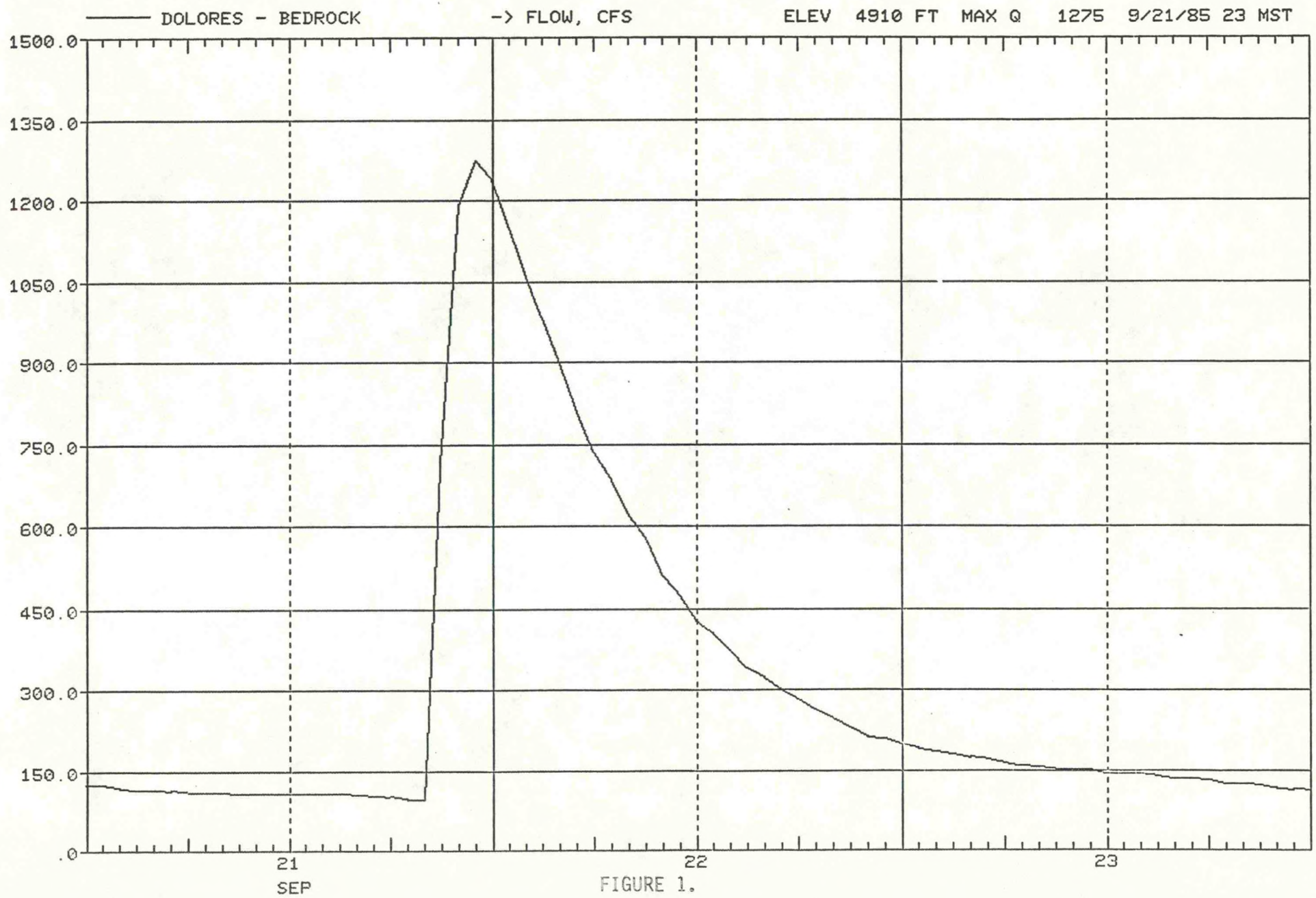

FIGURE 1.

COLORADO BASIN RFC

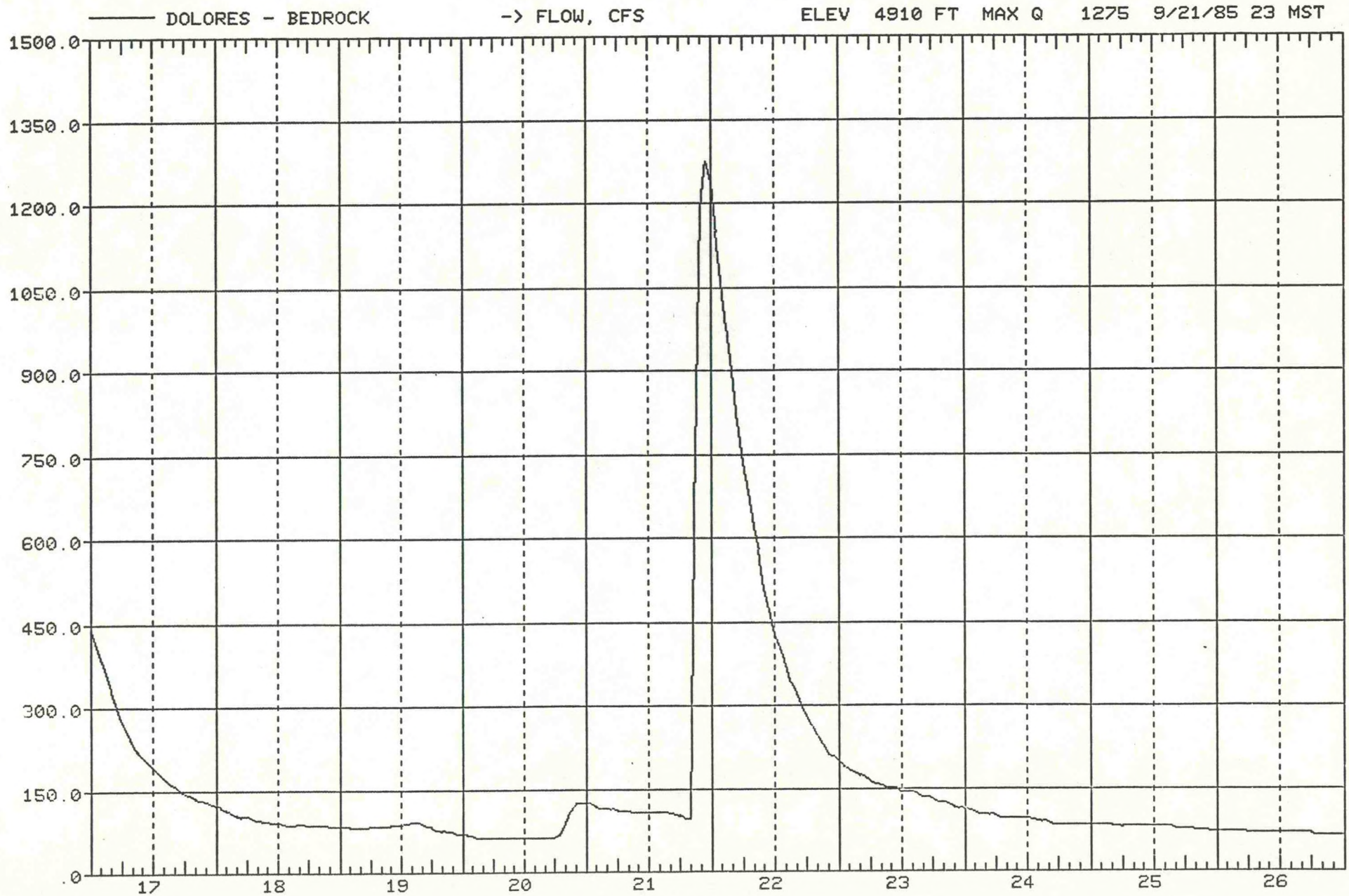

FIGURE 2.

COLORADO BASIN RFC

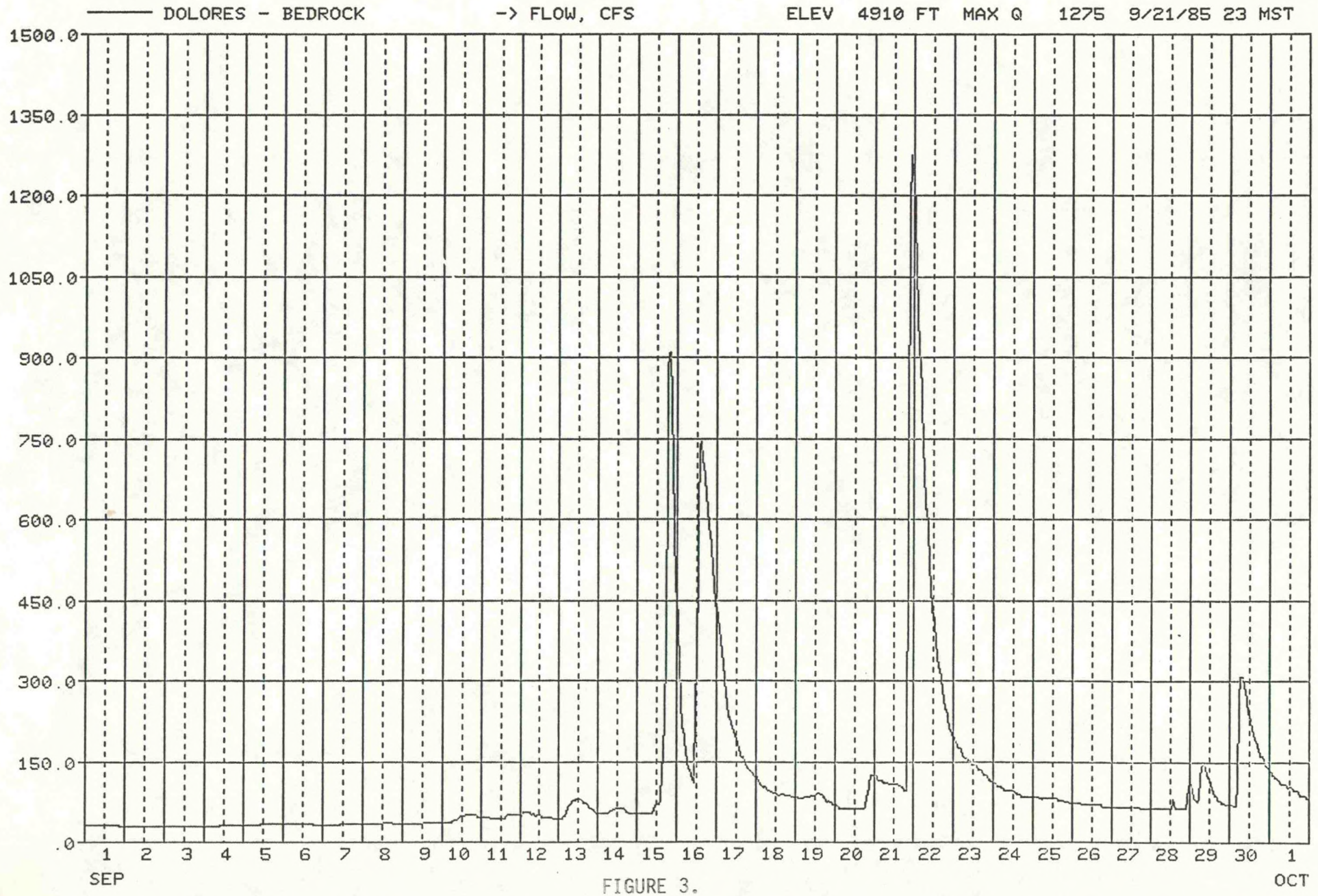

FIGURE 3.

COLORADO BASIN RFC

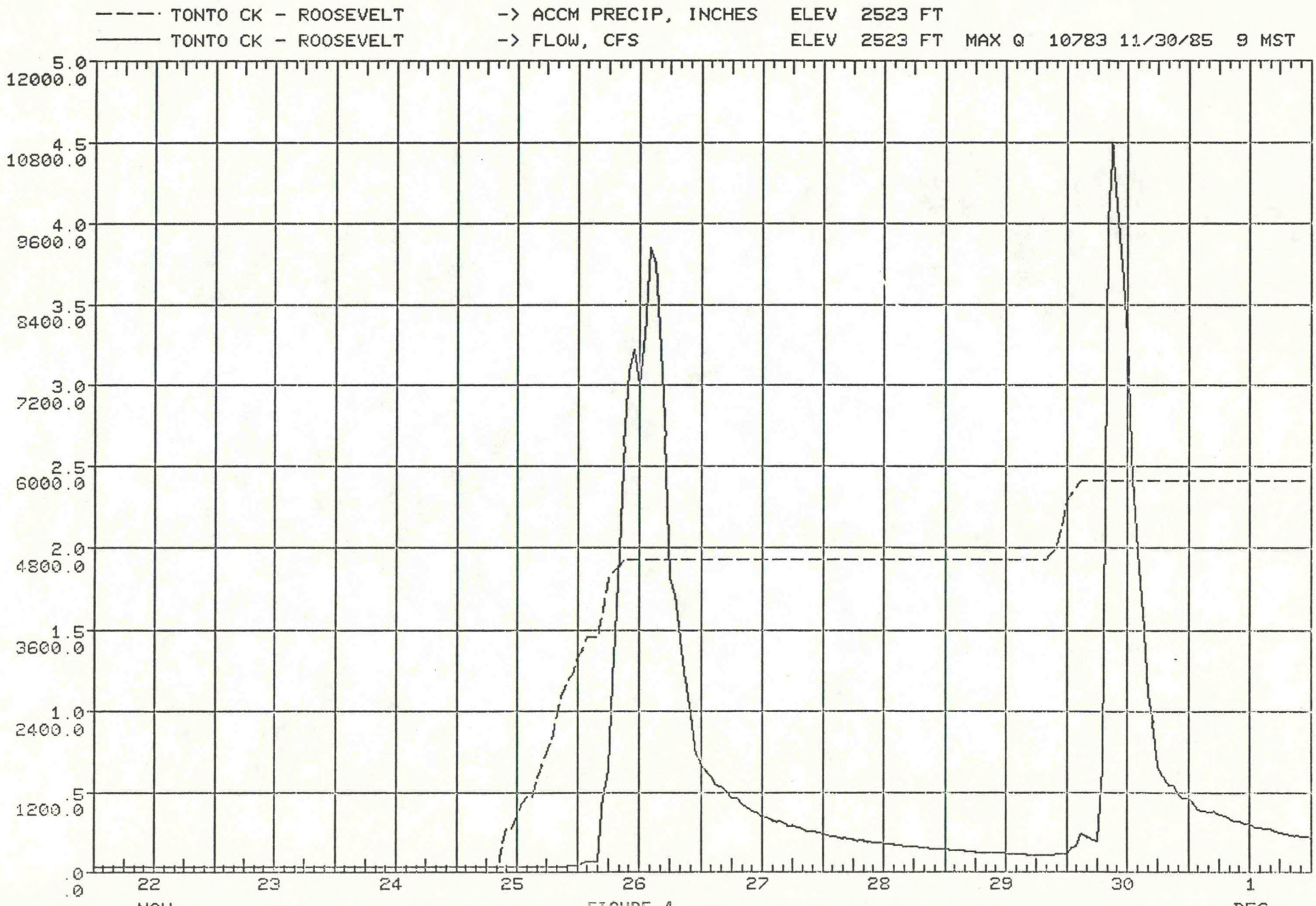

FIGURE 4.

COLORADO BASIN RFC

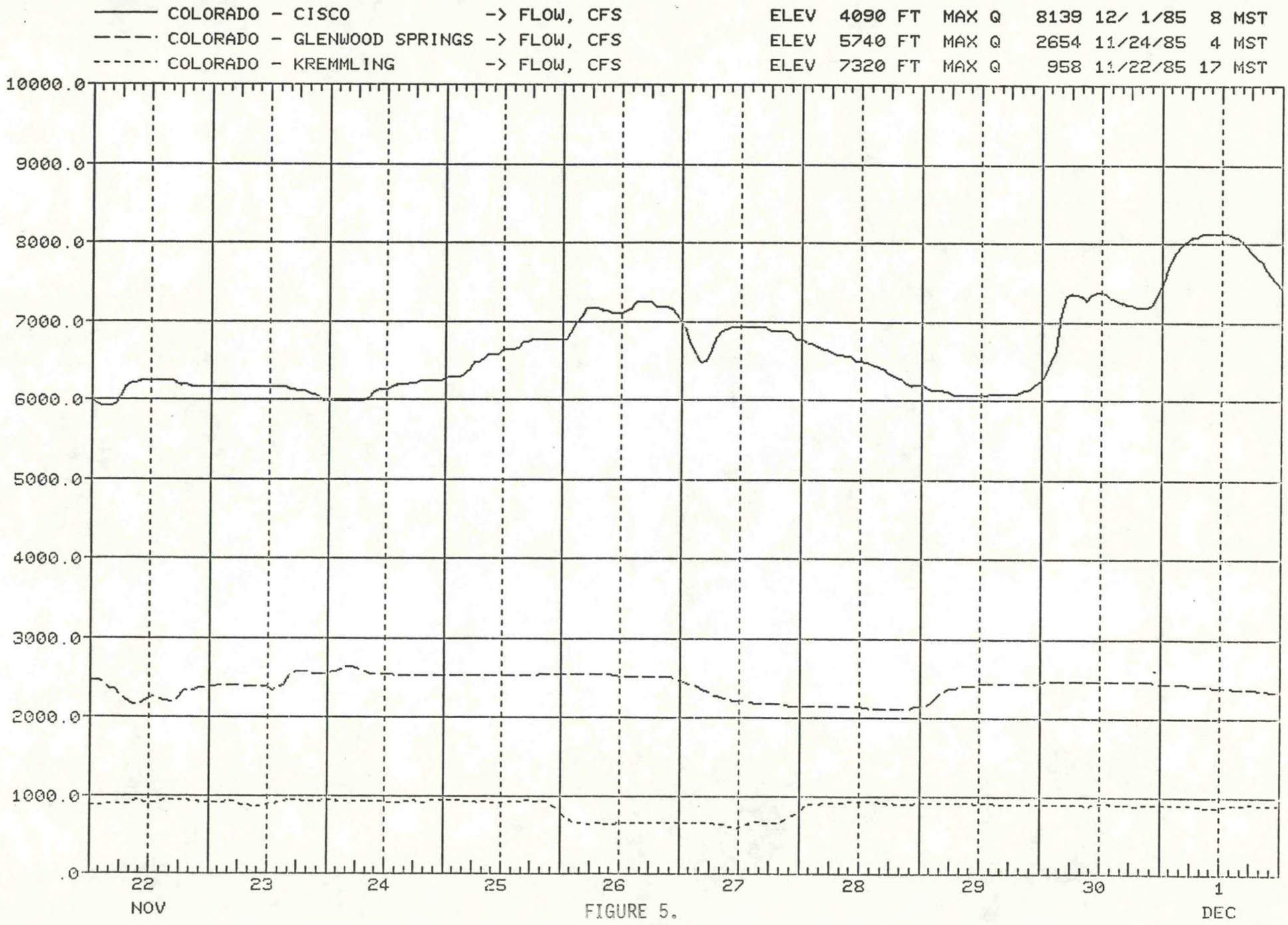

FIGURE 5.

NOAA Computer Programs and Problems NWS WR (continued)

36 Soaring Forecast Program. David S. Toronto, July 1982. (PB85 112274)
37 Program to Work Up Climatic Summary Weather Service Forms (F-6, F-52). Peter G. Mueller, August 1982. (PB85 109866)
38 The Hovmoller Diagram. Pamela A. Hudadoff, September 1982. (PB85 112159)
39 850-Millibar Charts Derived from Surface Data. Jeffrey L. Anderson, December 1982. (PB85 112175)
40 AFOS Vector Graphic to Grid Point Program. James R. Fors, December 1982. (PB85 109544)
41 A Pilot Briefing Program for the Background Partition. Kenneth B. Mielke and Joe L. Johnston, March 1983. (PB85 109551)
42 AEV Local Verification for Aviation, Precipitation, and Temperature Programs: AV, REl, TEM. Lawrence B. Dunn, Revised May 1985. (PB85 210342/AS)
43 OBLOG. Nancy Larsen, December 1983. (PB85 109528)
44 Communications Software for Olympics Micromation Computer System. Glen Sampson, June 1984. (PB85109510)
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49 Hemispheric Spectral Wave Analysis (Waves 0 to 7). Mary F. Milkovich, August 1985.
50 AOS Graphic to Grid Point Conversion and Departure from Normal Programs. Jeffrey L. Anderson and Mark A. Mathewson, August 1985.
51 Sunrise/Sunset and Moonrise/Moonset. Glenn R. Lussky, January 1986 (revised).
52 Objective Contour Analysis Using the Surface of Least Bending (Spline Analysis). Les Colin, November 1985.

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