Western Region Computer Programs and
Problems NWS WRCP - NO. 48

HURRICANE PLOTTING PROGRAM

Salt Lake City, Utah
October 1984

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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9 The SWAB Program. Morris S. Webb, Jr., April 1980. (PB80-196041)
10 Flash-Flood Procedure. Donald P. Laurine and Ralph C. Hatch, April 1980. (PB80-298658)
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16 AFOS System Local Data Base Save and Rebuild Procedures or A Master Doomsday Program. Brian W. Finke, July 1980. (PB81-108342)
17 AFOS/RDOS Translator Subroutine. Morris S. Webb, Jr., August 1980. (PB81-108334)
18 AFOS Graphics Creation from Fortran. Alexander E. MacDonald, August 1980. (PB81-205304)
19 DATAKEYØ Repair Program. Paul D. Tolleson, August 1980. (PB81-102543)
20 Contiguous File Transfer from the DPCM to the DCM. Paul D. Tolleson, September 1980. (PB81-128035)
21 Freezing Level Program. Kenneth B. Mielke, September 1980. (PB81-128043)
22 Radar Boresighting Verification Program. Thomas E. Adler, November 1980. (PPB81-182677)
23 Accessing the AFOS Data Base. Matthew Peroutka, January 1981.(PB81-190266)
24 AFOS Work Processor. Morris S. Webb, Jr., February 1981. (PB81-210007)
25 Automated Weather Log for Terminal Forecasting. John A. Jannuzzi, February 1981. (PB81-210999)
26 Program to Computer Downwind Concentrations from a Toxic Spill. John R. Zimmerman, February 1981. (PB81-205296)
27 Animation of AFOS Graphics. Joe Wakefield and Jim Fors, April 1981. (PB85 109833)
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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HURRICANE PLOTTING PROGRAM

Paul D. Tolleson
Weather Service Forecast Office
Los Angeles, California

October 1984

UNITED STATES
DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and
Atmospheric Administration
John V. Byrne, Administrator

National Weather
Service
Richard E. Hallgren, Director

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

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Western Region Headquarters
Salt Lake City, Utah

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HURRICANE PLOTTING PROGRAM

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I. INTRODUCTION

A. Purpose

The completely automated hurricane plotting program (HURCN.SV) provides a detailed description of the progression and prognosis of a tropical system using a single AFOS graphic by decoding marine/aviation advisories issued by the Eastern Pacific Hurricane Center in San Francisco.

B. Motivation

This program was written to assist the Public Service Unit at WSFO Los Angeles in answering the myriad of public telephone calls each summer and fall for tropical storm information. Concerns range from proper clothing for a vacation to Mexico, to the protection of boats in the waters near Cabo San Lucas. The program also assists the forecaster in monitoring any particular system in the eastern Pacific Ocean.

C. Benefits to the User

On 1:1 zoom the program plots the following information:

1. in the upper left hand corner the storm name, month and year of genesis, sustained winds, and gusts from the most recent advisory;

2. in the lower left hand corner the distance and direction of the most recent position of the center of the system from six major locations along the West Coast of the United States and Mexico;

3. the six hourly positions since inception and the 12-hour and 24-hour forecast positions, using an asterisk for depressions, the "clear sky" symbol for forecasts, and standard symbols for tropical storms and hurricanes (as found in WRCP NO. 18[3]).

On 4:1 zoom and higher, the following additional information is displayed:

1. the storm name just above the storm track;

2. index numbers next to the plotted symbols, with more appearing at higher zooms;

3. a storm data table to the left of the storm track, with index numbers, dates, times, sustained winds, and gusts corresponding to the numbered symbols;

4. 12-hour and 24-hour forecast data labeled "1F" and "2F", respectively.

Examples of a plotted storm on 1:1 zoom and on 9:1 zoom are shown in Figures 1 and 2, respectively.

II. METHODOLOGY AND SOFTWARE STRUCTURE

A. Description

The hurricane plotting program consists of a single executable save file that uses marine/aviation advisories CCCTCMEP1 through CCCTCMEP5 as input from the AFOS data base and disk files EP1 through EP5 to produce output graphics NMCGPHT21 through NMCGPHT25.

The program begins by determining the station's CCC from the SKEL file[1]. It then searches the AFOS data base[2] for CCCTCMEP1. If no product is found, or the product is at least 6 hours old, the program searches for CCCTCMEP2. This process continues until a current CCCTCMEPx (x = 1-5) is found.

Once a current CCCTCMEPx is found, the program attempts to decode the storm name, the date, the time, the latitude, the longitude, the sustained winds, and the gusts for the storm. If the program fails at any juncture to decode these times properly, it produces an error message at the ADM and proceeds to the next CCCTCMEPx. If the program succeeds, it tries to decode the 12-hour and 24-hour forecasts. If it is not successful in doing so, the program simply continues the plotting process and does not abort.

Once the advisory is decoded, the program accesses the disk storage file EPx and reads the month and year of genesis, date and time of the last bulletin, and the storm history. Combining this data with the decoded data, the program uses AFOS graphics routines[3] (including a version of UTF.RB with SDC addressing) to create the NMCGPHT2x (x = 1-5).

If the EPx file has not been accessed within the past 5 days, the program re-initializes the file, treating the current decoded data as the first advisory for the storm. The program processes the first 60 advisories for the storm, or 15 days worth of data. For the structure of files EP1 through EP5, see Figure 3.

After reading the data from EPx, the program reconfigures the data into a format suitable for the AFOS graphics routines. It then creates the output graphic NMCGPHT2x.

When completed with CCCTCMEPx, the program proceeds sequentially to the next CCCTCMEPx, in the same manner as described above, until CCCTCMEP5 is reached. AFOS graphics NMCGPHT21 - T25 are produced, if appropriate.

Disk files NMCGPHT21 through NMCGPHT25 (created by UTF.RB) are deleted upon completion of the program

B. Equations and Algorithms

The program plots the storm data on a window extracted from the western hemispheric mercator projection using the PMOD software package[4]. The equation for the map distance between 2 lines of north latitude[5] is:

$$R \cdot \ln \left| \sec x + \tan x \right| \qquad R = \text{radius of earth}$$

Since the radius of the globe used in the AFOS projection was not known (in pixels), the equation was solved for R given 2 latitudes and measurements from a graphic (which is 4096 x 3072 pixels). In addition, 202 pixels were added to the result to account for the 3 degrees of south latitude on the chart. These results were used in subroutine PIXEL.

The procedure used to develop the map background can be found in the Appendix.

The program computes distances and directions of the center of the storm from six major locations along the west coast of the United States and Mexico by using spherical trigonometry[6]. Refer to Figure 4 for the relationships of the various angles to each other.

The half angle formula used in subroutine ANGLE to determine an angle on the surface of a sphere is

$$\tan \frac{\alpha}{2} = \left(\frac{\sin(s-b) \cdot \sin(s-c)}{\sin s \cdot \sin(s-a)} \right)^{1/2}$$

where 2s = a + b + c. To use this formula given 3 points on a sphere, angles, a, b, and c must be calculated. This was done, together with calculating distances on the surface of the sphere, between these points using the following procedure (Figure 5).

First, the latitudes and longitudes of any two points are converted to (x,y,z) space for each point. Using the distance formula

$$d = \left(x^2 + y^2 + z^2 \right)^{1/2}$$

the distance of the chord D is determined. In Figure 5, D2 is then half of D. The length of SIDE may be determined from the right triangle formed by R (radius of the earth) D2, and SIDE.

The angle ARG is

$$ARG = \arctan(D2/SIDE).$$

The angle subtended by the arc between the initial points is 2•ARG. The distance between the points is

$$DIST = 2(R)(ARG).$$

C. Input and Output Files

Products CCCTCMEP1 through CCCTCMEP5 and disk files EP1 through EP5 are files used as input to the program. Output files include both EP1 through EP5, as well as graphics NMCGPHT21 through NMCGPHT25. The relationships of these files are illustrated in Figure 6.

D. Software Structure

AFOS graphics routines are contained in the AFOS grpahics library AG.LB. For the version of the hurricane plotting program used at WSFO Los Angeles, however, revised versions of UTF and OUT were used which contained coding for SDC addressing. The software structure and loadline for this version is in Figure 7. The software structure and load line for versions without SDC addressing are illustrated in Figure 8.

III. CAUTIONS AND RESTRICTIONS

If no advisory exists in the AFOS data base or if the advisory is at least 6 hours old, no messages are generated. Otherwise, five messages may be generated by the program at the ADM.

If a graphic was successfully stored, a messge will be generated indicating which graphic was stored.

If the program failed to decode an advisory, one of four reasons will be given at the ADM. "Name unknown" indicates a failure to decode the storm name. "No wind" indicates that the current sustained winds or gusts were not decoded. "No lat/long" indicates the latitude or longitude could not be decoded. "Data base" indicates the advisory is garbled or is somehow different from its normal format. All four messages may be due to missing spaces or linefeeds.

Other restrictions or features of the program include the following:

1. The program re-initializes any disk file after 5 days of inactivity.

2. The program will not process advisories more than 6 hours old.

3. Disk file structure must be maintained.

4. Only the first sixty advisories per storm can be processed.

5. The program may be run more than once between advisory issuances without duplicating the latest data.

IV. REFERENCES

1. Mielke, Ken, 1984: "Reading the CCC and XXX from the SKEL File", AFOS Applications Group Quarterly Report, May.

2. Peroutka, Matthew, 1981: "Accessing the AFOS Data Base", WRCP-23, January.

3. MacDonald, Alexander E., 1981: "AFOS Graphics Creation from Fortran", WRCP-18, March.

4. AFOS Operations Division, 1983, "MOD Plotting System for AFOS" AD CP83-1, May.

5. Thomas, Jr., George B., and Finney, Ross L., 1979: Calculus and Analytic Geometry; 5th Ed., Addision-Wesley May.

6. Gellert, W. Kustner, H., Hellwich, M., and Kastner, H., 1985: The VNR concise Encyclopedia of Mathematics, Van Nostrant Reinhold, pp. 262-269.

APPENDIX

Map Background Creation

The map background used for graphics produced by the hurricane plotting program was especially created using PMOD[4] and the AFOS graphics library routines[3]. The following is a brief description of how the map background came into existence.

It was first decided to extract a window from the western hemisphere Mercator projection (Figure 9). Using instructions from the PMOD User's Guide[4], HCEP.CF was created (Figure 10). The following commands, executed at the dasher, extracted the window (Figure 11):

```
HCOPY B9Ø HCEP.CF

GENUTF XPLOT B95
```

Further examination of the extracted map backgorun (B95) revealed that the longitude labels appeared only at 4:1 zoom or higher and at 15°N latitude, a prime area for tropical storm activity. Using information from Appendix D of WRCP-18[3] on the structure of offset alphanumeric characters in UTF format, the labels were moved and made to appear at 1:1 zoom.

First, the graphic was saved to disk. Two FPRINTs were made of the disk file, one in byte format and one in word format (Figure 12). The byte having 31Ø (octal) denotes the beginning of the alphanumeric character string. The second byte contains 2 bits determining the zoom threshold. The fifth and sixth bytes determine the vertical positioning. These three bytes were changed to make the longitude labels appear at 30°N and at 1:1 zoom. The changes, made using the octal editor, are listed in Figure 12.

A program was then written using AG.LB routines to create a graphic with a border around the edge, with the title "TRACKING CHART", and with eight different cities labeled. This graphic was NMCGPHB96 (Figure 13). A copy of that program with its load line appear in Figure 14.

Finally, the two graphics thus far created were combined into a single map background by using the PMOD software. The following commands were entered at the dasher:

```
HCOPY B95 SPC.PF B96 SPC.CF

GENUTF XPLOT B97
```

Parameter files SPC.PF and SPC.CF are in Figure 15. Map background B97 is shown in Figure 16.

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: HURCN

AAL ID:
REVISION NO.: 1.ØØ

PURPOSE: Plots current conditions, past history, and 12-hour and 24-hour forecasts from marine/aviation tropical storm advisories issued by the Eastern Pacific Hurricane Center in San Francisco.

PROGRAM INFORMATION:

Development Programmer:
Paul D. Tolleson
Location: WSFO LAX
Phone: FTS 793-7215

Maintenance Programmer:
Paul D. Tolleson

Language: Data General FORTRAN IV Rev 5.57

Save File Creation Dates:
HURCN.SV 1Ø/Ø3/84

Running Time: About 25 seconds per graphic with a maximum of 5 graphics.

Disk Space:		
	Program Files	7Ø RDOS Blocks
	Disk Data Files	12 RDOS Blocks

PROGRAM REQUIREMENTS:

Program Files:

Name	Comments
HURCN.SV	None

Data Files	DP Location	Read/Write	Comments
EP1	DPØ	Both	Contains history on each tropical system found in the corresponding CCCTCMEP1-EP5 files. Must maintain appropriate file structure.
EP2	DPØ	Both	
EP3	DPØ	Both	
EP4	DPØ	Both	
EP5	DPØ	Both	

AFOS Products:

ID	Action	Comments
CCCTCMEP1	Input	
CCCTCMEP2	Input	
CCCTCMEP3	Input	
CCCTCMEP4	Input	
CCCTCMEP5	Input	
NMCGPHT21	Output	From CCCTCMEP1 and EP1
NMCGPHT22	Output	From CCCTCMEP2 and EP2
NMCGPHT23	Output	From CCCTCMEP3 and EP3
NMCGPHT24	Output	From CCCTCMEP4 and EP4
NMCGPHT25	Output	From CCCTCMEP5 and EP5
NMCGPHBXX	Map Background	Assigned to NMCGPHT21-T25

LOAD LINE

```
RLDR/P HURCN AFREAD INTCVT FLTCVT PROD
       WIND PIXEL LEGEND DIRECT SPHERE
       ANGLE AG.LB BG.LB UTIL.LB FORT.LB
       AFOSE.LB
```

PROGRAM INSTALLATION

1. Move HURCN.SV to DPØ, or to another directory, and link the program from DPØ to that directory.

2. Move EP1, EP2, EP3, EP4, and EP5 to DPØ or to another directory with a link to DPØ.

3. Assign the supplied map background to NMCGPHT21-T25 with the KEY: command.

4. Be sure to have the marine/aviation tropical advisories CCCTCMEP1-EP5 in your data base.

   The TCM category causes these products to be national products. However, using subroutine PROD, program HURCN accesses the SKEL file to determine your station's CCC. Therefore, the program is not site specific.

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME; HURCN AAL ID:

PROGRAM EXECUTION:

1. Wait for the marine/aviation tropical advisory, CCCTCMEP(1-5), to arrive. Then simply type...RUN:HURCN...at an ADM, and depress the enter button.

2. An alert light will be received indicating which graphics have been stored.

3. The program will process an advisory from the data base only if it is less than six hours old. This facilitates disk bookkeeping since advisories are issued every six hours.

4. The program re-initializes the disk files (EP1-EP5) after 5 days of inactivity for that file allowing a new storm to be plotted separately from the previous one.

ERROR CONDITIONS

Four error messages are generated by the program as an alert at the ADM.

1. NAME UNKNOWN. The program could not decode the storm name.

2. NO WIND. The program could not decode the winds or gusts.

3. DATA BASE. The advisory was somehow garbled or did not exist.

4. NO LAT/LONG. The program could not decode the latitude or longitude.

All four error conditions occur when the product is jumbled from its usual format. Many times this is due to missing spaces.

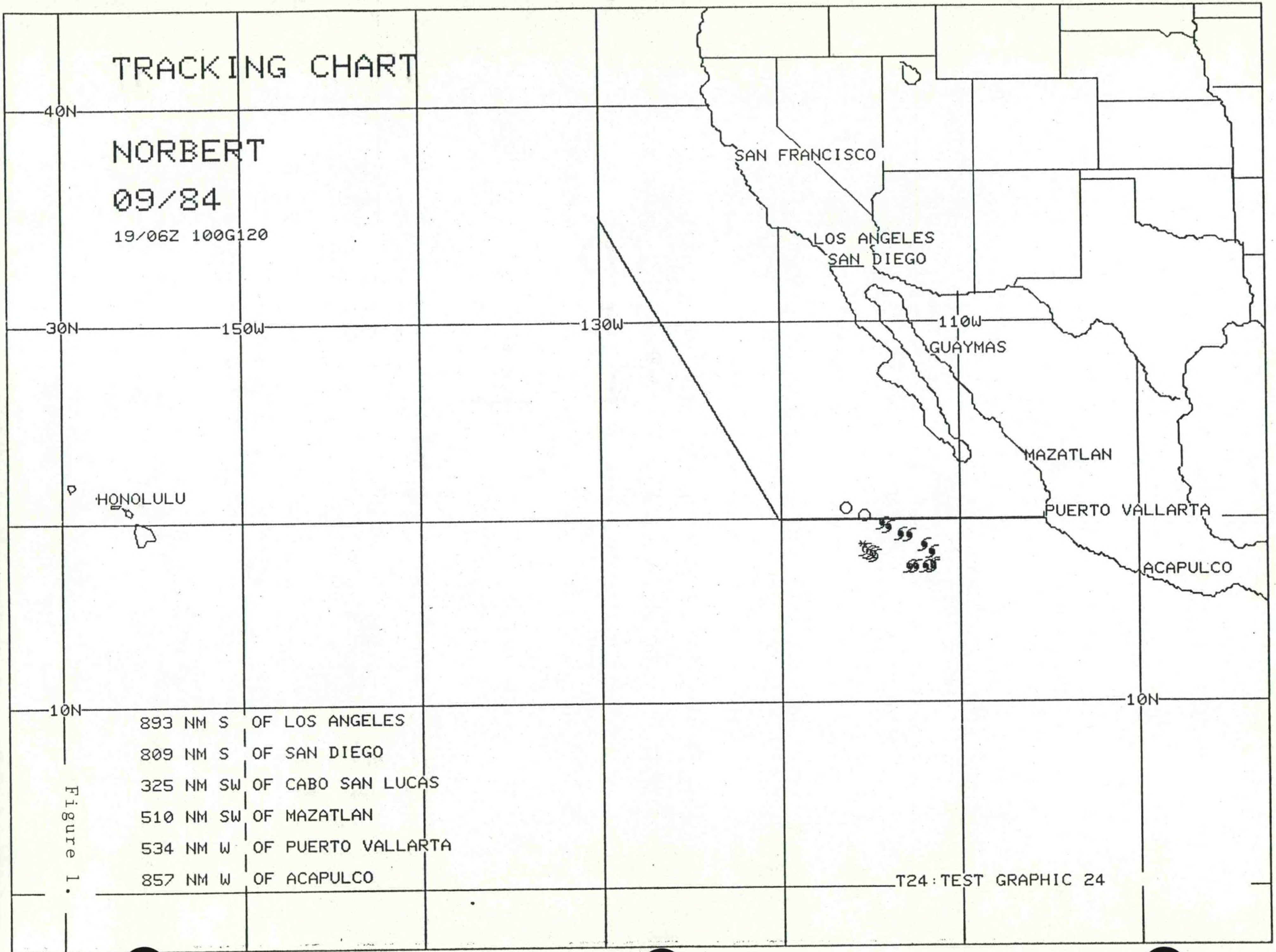
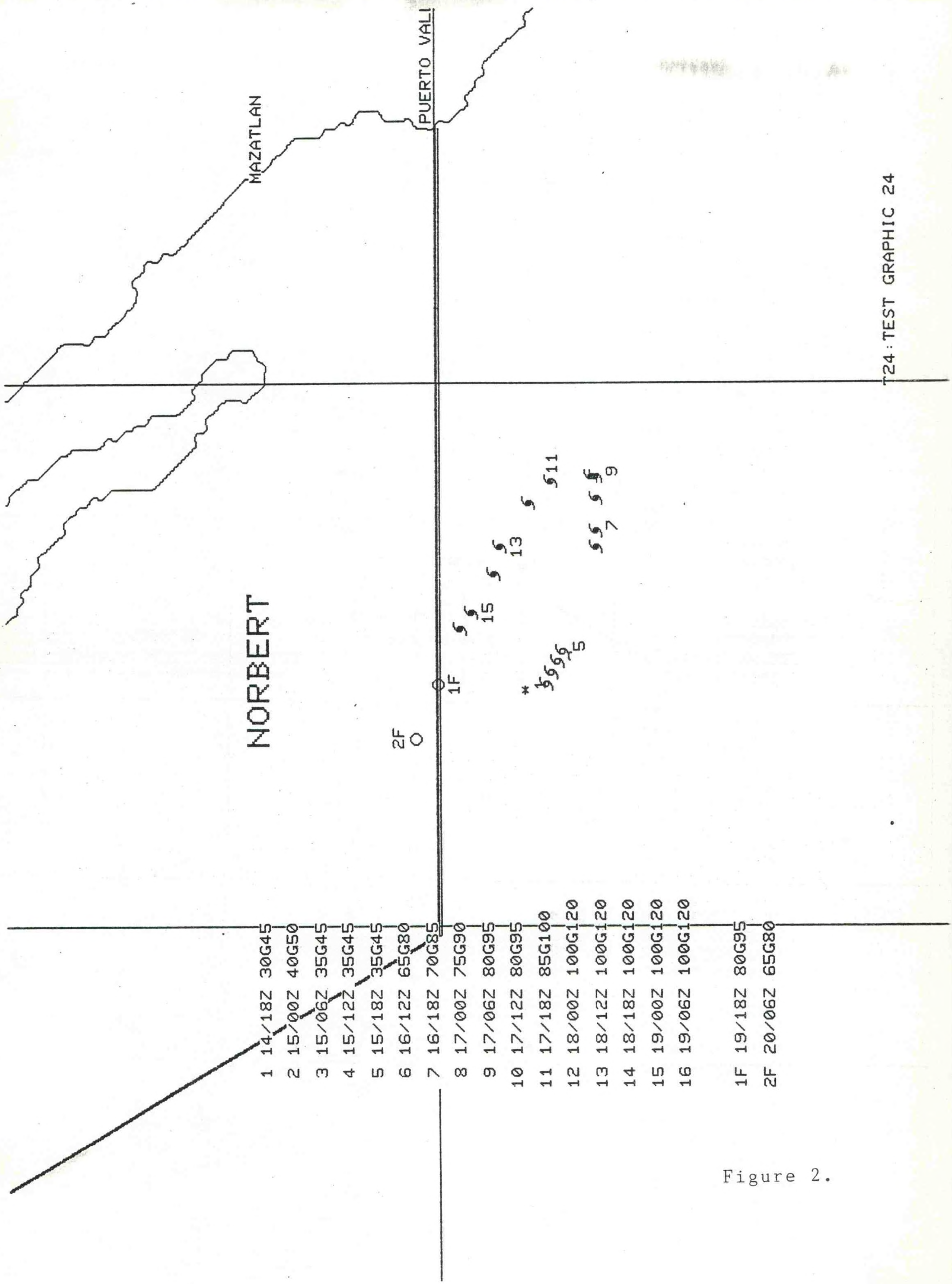

TRACKING CHART
NORBERT
09/84
19/06Z 100G120
40N
30N
10N
150W
130W
110W
10N
HONOLULU
SAN FRANCISCO
LOS ANGELES
SAN DIEGO
GUAYMAS
MAZATLAN
PUERTO VALLARTA
ACAPULCO
893 NM S OF LOS ANGELES
809 NM S OF SAN DIEGO
325 NM SW OF CABO SAN LUCAS
510 NM SW OF MAZATLAN
534 NM W OF PUERTO VALLARTA
857 NM W OF ACAPULCO
T24:TEST GRAPHIC 24

Figure 1.



MAZATLAN
PUERTO VAL
NORBERT
T24:TEST GRAPHIC 24
1 14/18Z 30G45
2 15/00Z 40G50
3 15/06Z 35G45
4 15/12Z 35G45
5 15/18Z 35G45
6 16/12Z 65G80
7 16/18Z 70G85
8 17/00Z 75G90
9 17/06Z 80G95
10 17/12Z 80G95
11 17/18Z 85G100
12 18/00Z 100G120
13 18/12Z 100G120
14 18/18Z 100G120
15 19/00Z 100G120
16 19/06Z 100G120
1F 19/18Z 80G95
2F 20/06Z 65G80

Figure 2.

```
 91719 9 984
1418 30 45276212841
15 0 40 50276812602
15 6 35 45279212482
1512 35 45278012542
1518 35 45280312422
1612 65 80291512063
1618 70 85293212063
17 0 75 90296712063
17 6 80 95299112063
1712 80 95299112123
1718 85100298512543
18 0100120296112783
1812100120291513093
1818100120288513153
19 0100120284413393
19 6100120282713513
1918 80 95276813763
20 6 65 80271014003
0000000000000000000
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```

```
 9 17 19 9 984
 1 2  3  4 5 6

 14 18 30 45 2762 1284 1
 7  8  9  10 11   12   13
```

EP1

1. TIME OF MOST RECENT ADVISORY
2. NUMBER OF LINES IN EP1 EXCLUDING FORECAST DATA
3. DAY OF LATEST ADVISORY
4. MONTH OF LATEST ADVISORY
5. MONTH OF STORM GENESIS
6. YEAR OF STORM GENESIS

STORM DATA

7. DAY
8. TIME
9. SUSTAINED WINDS
10. GUSTS
11. X-COORDINATE (PIXELS)
12. Y-COORDINATE (PIXELS)
13. STORM TYPE — 1=DEPRESSION, 2=TROPICAL STORM, 3=HURRICANE

Figure 3.

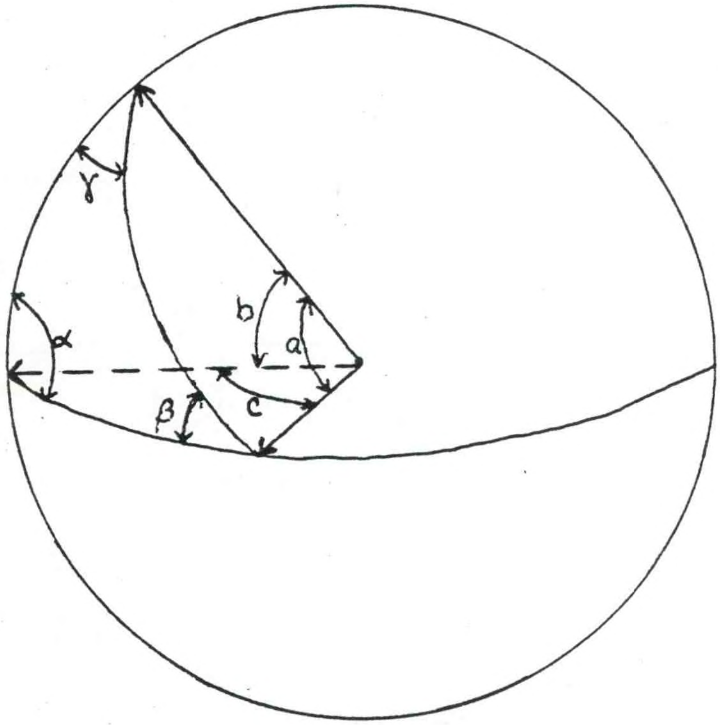

Figure 4. Spherical angles.

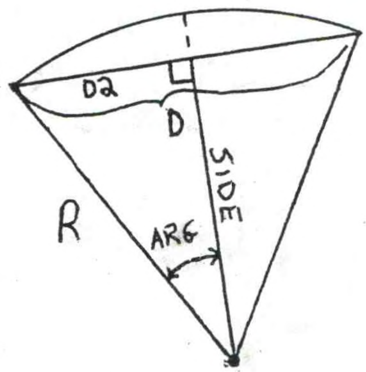

Figure 5. Distance on a sphere.

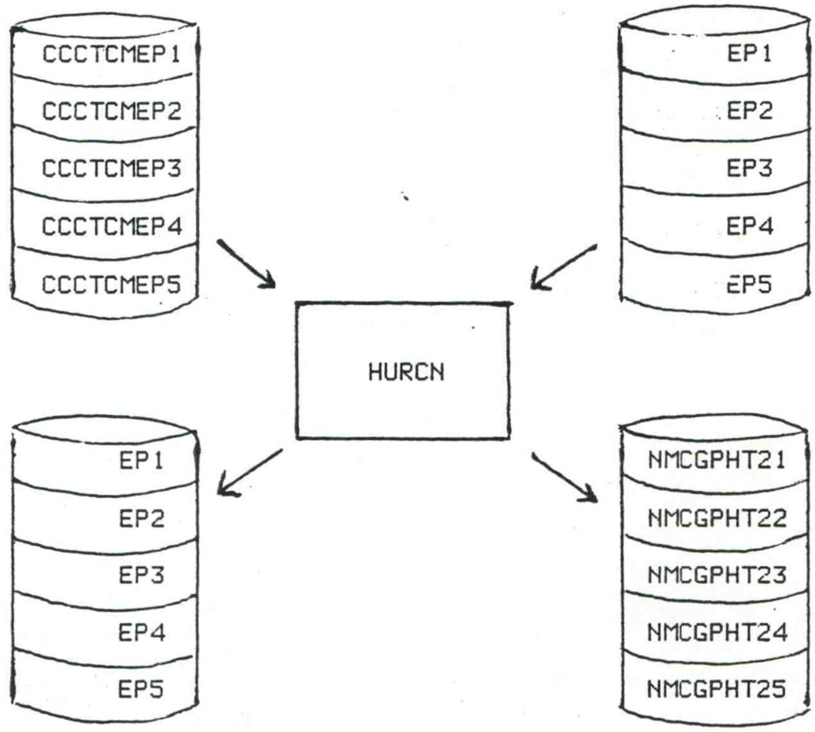

Figure 6. Data flow and program interaction

```
MAIN PROGRAM

       HURCN


          SUBROUTINES

          AFREAD
          INTCVT
          FLTCVT
          PROD
          WIND
          PIXEL
          LEGEND ----> [DIRECT ----> [SPHERE
          UTF          [SPHERE       [ANGLE
          OUT
```

LOAD LINE

```
RLDR/P HURCN AFREAD INTCVT FLTCVT PROD WIND PIXEL LEGEND DIRECT
   SPHERE ANGLE UTF OUT AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB
```

Figure 7. Program structure and load line with SDC addressing.

```
MAIN PROGRAM

       HURCN


          SUBROUTINES

          AFREAD
          INTCVT
          FLTCVT
          PROD
          WIND
          PIXEL
          LEGEND ----> [DIRECT ----> [SPHERE
                       [SPHERE       [ANGLE
```

LOAD LINE

```
RLDR/P HURCN AFREAD INTCVT FLTCVT PROD WIND PIXEL LEGEND DIRECT
   SPHERE ANGLE AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB
```

Figure 8. Program structure and load line without SDC addressing.

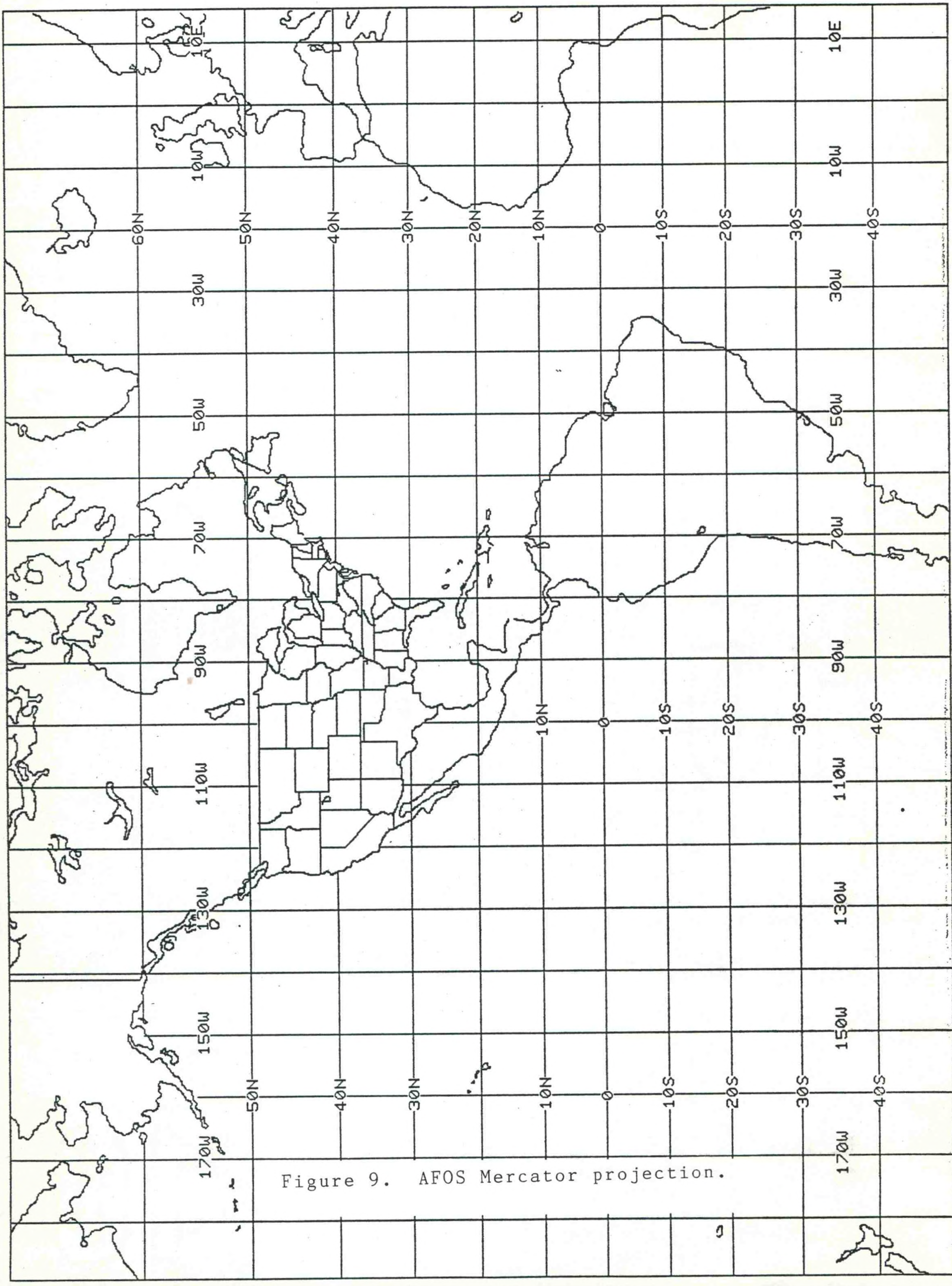

Figure 9. AFOS Mercator projection.

```
526
1050
2048
1536
146
600
1050
0
0
-1
226
1800
```

Figure 10. HCEP.CF

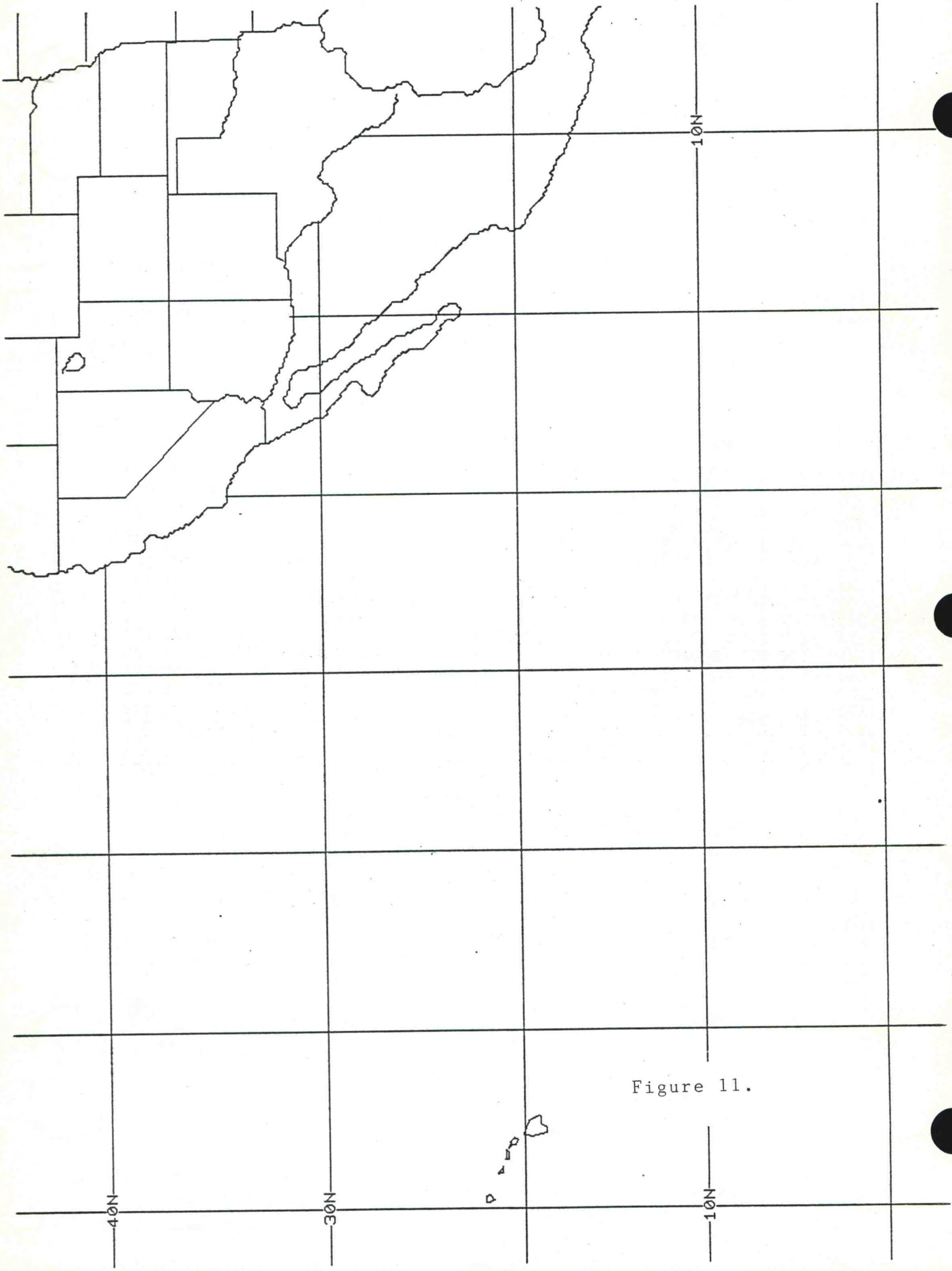

Figure 11.

ZOOM THRESHOLDS:

WORD 1203 FROM 044201 TO 040201

WORD 1211 FROM 044020 TO 040020

WORD 1217 FROM 144110 TO 144100

VERTICAL POSITIONING:

WORD 1204 FROM 076402 TO 076403

WORD 1205 FROM 016361 TO 174361

WORD 1213 FROM 001034 TO 001770

WORD 1221 FROM 001034 TO 001770

Figure 12.

1160	004 006	250 000	000 001	127 040	000 303	000 007	377 004	264 000
1170	002 030	001 040	172 303	000 000	000 005	134 000	004 004	172 000
1200	000 003	205 040	000 310	110 201	175 002	034 361	372 061	065 060
1210	127 310	110 020	014 305	002 034	361 372	061 063	060 127	310 110
1220	206 015	002 034	361 372	061 061	060 127	310 100	200 131	001 207
1230	365 374	061 060	116 000	310 100	200 131	003 370	365 374	063 060
1240	116 000	310 100	200 131	005 136	365 374	064 060	116 000	310 100
1250	207 061	001 207	365 374	061 060	116 000	203 203	005 222	002 275
1260	363 373	053 061	066 310	100 005	222 002	355 363	373 053	061 062
1270	310 100	005 222	003 026	363 373	053 060	070 310	100 005	222 003
1300	136 363	373 053	060 064	310 100	005 222	004 003	363 373	053 060
1310	064 310	100 005	222 004	160 363	373 053	060 070	310 100	005 222
1320	004 242	363 373	053 061	062 310	100 005	222 005	022 363	373 053
1330	061 062	310 100	005 222	005 127	363 373	053 060	070 310	100 002
1340	244 000	225 363	373 053	060 060	310 100	003 024	000 247	363 373
1350	053 060	060 310	100 004	374 000	213 363	373 053	060 064	310 100
1360	004 374	000 263	363 373	053 000	----	----	----	----

1160	002006	124000	000001	053440	000303	000007	177404	132000	..(...W .C....4.
1170	001030	000440	075303	000000	000005	056000	002004	075000	... .C....\.....
1200	000003	102440	000310	044201	076402	016361	175061	032460	... .HH.......150
1210	053710	044020	006305	001034	170772	030463	030127	144110	WHH..E....130WHH
1220	103015	001034	170772	030461	030127	144100	100131	000607	......110WH@.Y..
1230	172774	030460	047000	144100	100131	001770	172774	031460	..10N.H@.Y....30
1240	047000	144100	100131	002536	172774	032060	047000	144100	N.H@.Y.↑..40N.H@
1250	103461	000607	172774	030460	047000	101603	002622	001275	.1....10N......=
1260	171773	025461	033310	040005	111002	166763	175453	030462	..+16H@......+12
1270	144100	002622	001426	171773	025460	034310	040005	111003	H@......+08H@...
1300	057363	175453	030064	144100	002622	002003	171773	025460	↑..+04H@......+0
1310	032310	040005	111004	070363	175453	030070	144100	002622	4H@......+08H@..
1320	002242	171773	025461	031310	040005	111005	011363	175453	."..+12H@......+
1330	030462	144100	002622	002527	171773	025460	034310	040002	12H@...W..+08H@.
1340	122000	112763	175453	030060	144100	001424	000247	171773	$....+00H@...'..
1350	025460	030310	040004	176000	105763	175453	030064	144100	+00H@......+04H@
1360	002374	000263	171773	025400	----	----	----	----	...3..+.........

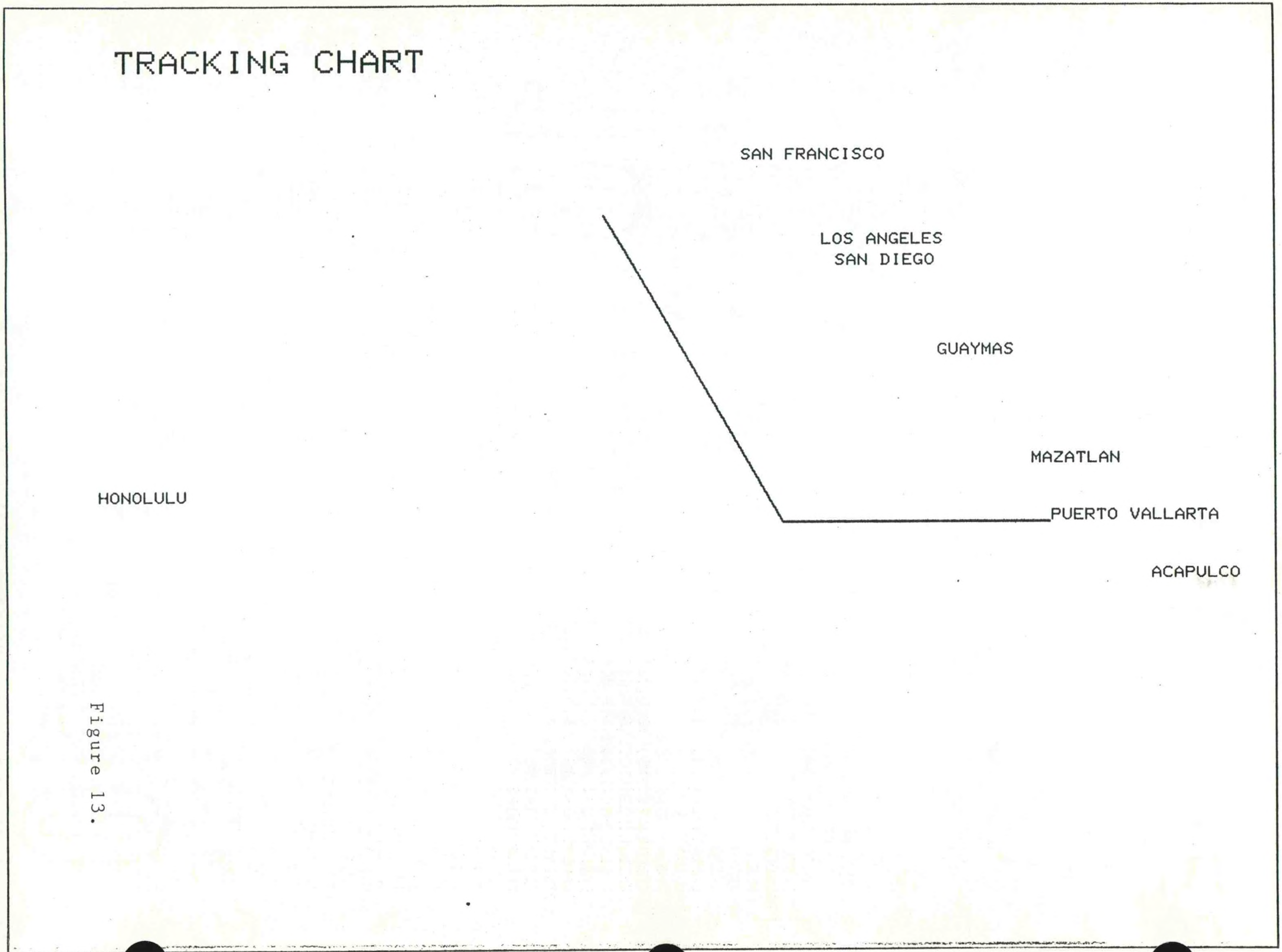
TRACKING CHART
SAN FRANCISCO
LOS ANGELES
SAN DIEGO
GUAYMAS
MAZATLAN
HONOLULU
PUERTO VALLARTA
ACAPULCO

Figure 13.

```
RLDR/P PAULGPH AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

      INTEGER LX1(5),LY1(5),LX2(3),LY2(3),IP(8),JP(8),ISIZ,IZT,IZD,
     #N,SCRIPT(4),LAX(7),SAN(6),SFO(8),GYM(5),MZT(5),PVR(9),ACA(5),
     #HNL(5),LY3(3),LY4(3),LY5(3),LY6(3),TITLE(8)
      COMMON/D/LX1,LY1,LX2,LY2,IP,JP,LAX,SAN,SFO,GYM,MZT,PVR,ACA,HNL,
     #LY3,LY4,LY5,LY6,TITLE
      DATA LX1/0,0,4095,4095,0/
      DATA LY1/0,3071,3071,0,0/
      DATA LX2/3370,2505,1925/
      DATA LY2/1384,1384,2377/
      DATA LY3/1383,1383,2376/
      DATA LY4/1382,1382,2375/
      DATA LY5/1381,1381,2374/
      DATA LY6/1380,1380,2373/
      DATA IP/2636,2683,2379,3011,3315,3377,3697,296/
      DATA JP/2284,2218,2561,1925,1573,1389,1197,1456/
      DATA LAX/"LOS ANGELES "/
      DATA SAN/"SAN DIEGO "/
      DATA SFO/"SAN FRANCISCO "/
      DATA GYM/"GUAYMAS "/
      DATA MZT/"MAZATLAN"/
      DATA PVR/"PUERTO VALLARTA "/
      DATA ACA/"ACAPULCO"/
      DATA HNL/"HONOLULU"/
      DATA TITLE/"TRACKING CHART"/
C DRAW BORDER
      N=5
      IZT=1
      IZD=0
      CALL LINES(LX1,LY1,N,IZT,IZD)
C DRAW WINDOW
      N=3
      CALL LINES(LX2,LY2,N,IZT,IZD)
      CALL LINES(LX2,LY3,N,IZT,IZD)
      CALL LINES(LX2,LY4,N,IZT,IZD)
      CALL LINES(LX2,LY5,N,IZT,IZD)
      CALL LINES(LX2,LY6,N,IZT,IZD)
C PLOT SYMBOLS FOR CITIES
      SCRIPT(1)=22K
      SCRIPT(2)=3
      SCRIPT(3)=21K
      SCRIPT(4)=0
      ISIZ=0
      IZT=1
      IXOF=0
      IYOF=0
C     DO 10 I=1,8
C     CALL TEXT(SCRIPT,IP(I),JP(I),ISIZ,IZT,IXOF,IYOF)
C  10 CONTINUE
C WRITE CITY NAMES
      ISIZ=1
      IZT=1
      IXOF=0
      IYOF=0
      CALL TEXT(LAX,IP(1),JP(1),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(SAN,IP(2),JP(2),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(SFO,IP(3),JP(3),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(GYM,IP(4),JP(4),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(MZT,IP(5),JP(5),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(PVR,IP(6),JP(6),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(ACA,IP(7),JP(7),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(HNL,IP(8),JP(8),ISIZ,IZT,IXOF,IYOF)
      CALL TEXT(TITLE,359,2853,3,1,0,0)
      CALL UTF("NMCGPHB13","HURCNGPH")
      STOP
      END
```

Figure 14.

0
0
2048
1536
100
0
0
0
0
-1
60
60

SPC.PF

0
0
2048
1536
50
0
0
0
0
-1
60
60

SPC.CF

Figure 15.

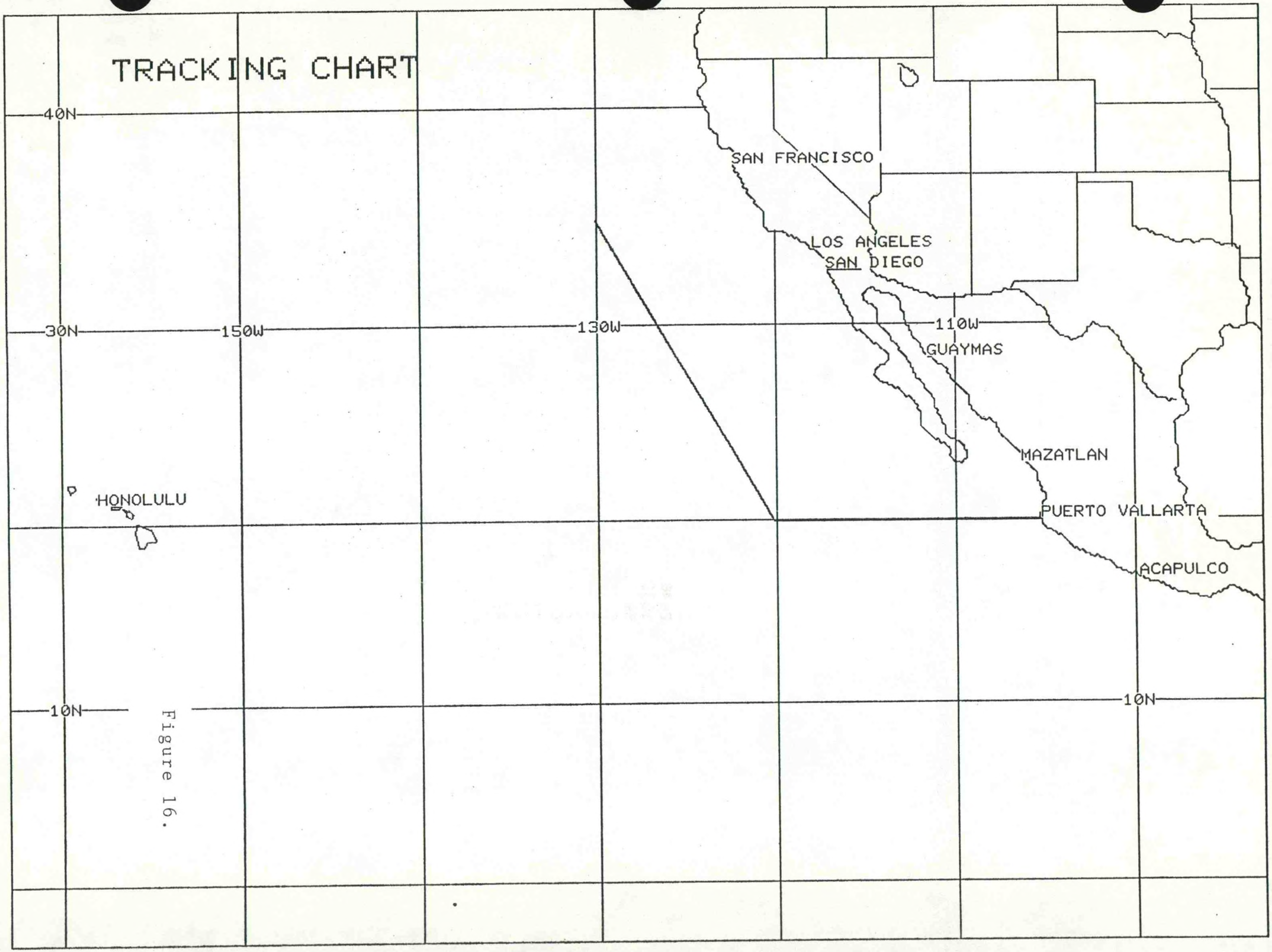
TRACKING CHART
40N
30N
10N
150W
130W
110W
10N
SAN FRANCISCO
LOS ANGELES
SAN DIEGO
GUAYMAS
MAZATLAN
PUERTO VALLARTA
ACAPULCO
HONOLULU

Figure 16.

36 Soaring Forecast Program. David S. Toronto, July 1982.
37 Program to Work Up Climatic Summary Weather Service Forms (F-6, F-52). Peter G. Mueller, August 1982. (PB85 109866)
38 The Hovmöller Diagram. Pamela A. Hudadoff, September 1982.
39 850-Millibar Charts Derived from Surface Data. Jeffrey L. Anderson, December 1982.
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 VERDAT and Four Local Verification Routines: TEM, BRI, REL, AV. Lawrence B. Dunn, September 1983. (PB85 109536)
43 OBLOG. Nancy Larsen, December 1983. (PB85 109528)
44 COMMUNICATIONS SOFTWARE FOR OLYMPICS MICROMATION COMPUTER SYSTEM. Glen Sampson, June 1984. (PB85109510)
45 PLOTFILE APPENDER. Wendy L. Wolf, July 1984. (PB85 109502)
46 SPECTRAL WAVE DATA ANALYSIS (NON-DIRECTIONAL). Lawrence Dunn, August 1984. (PB85 109577)

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