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NOAA Techniques Development Laboratory
Computer Program NWS TDL CP 84-1

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

Silver Spring, Md.
July 1984

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

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NOAA Techniques Development Laboratory
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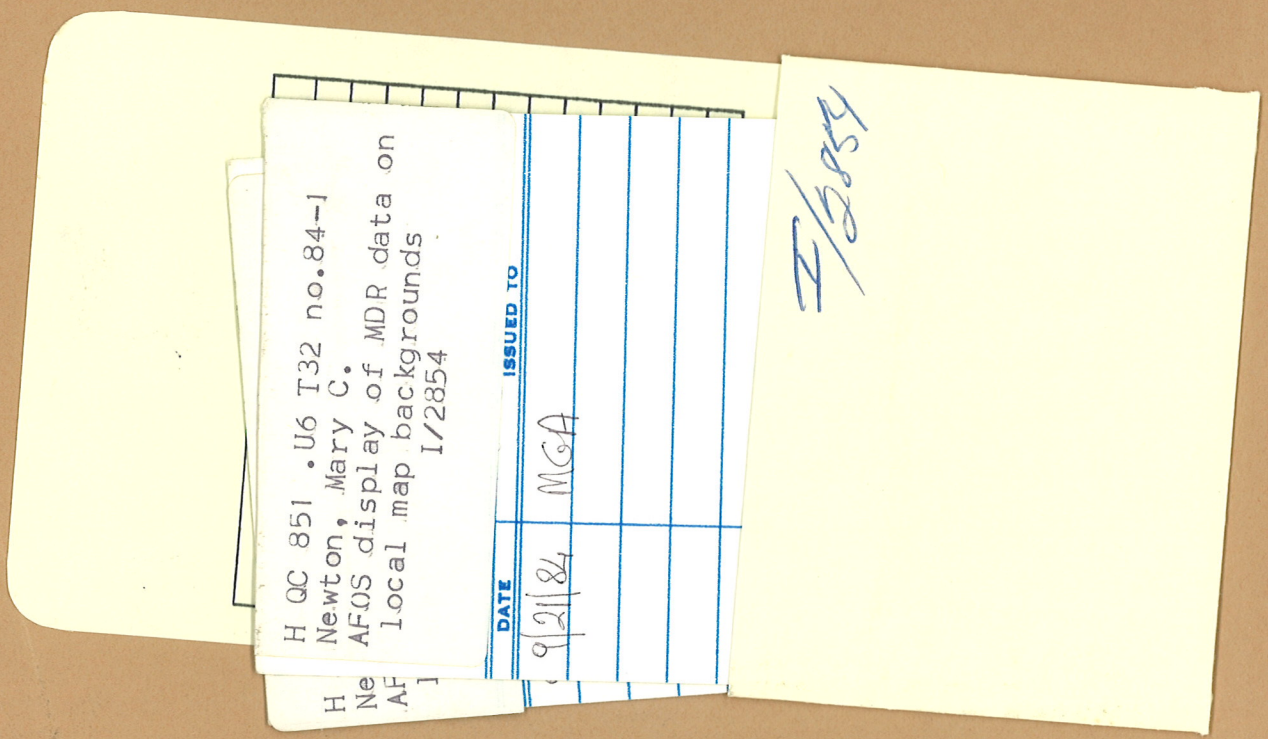
CP 83-1 Cross Sectional Analysis of Wind Speed and Richardson Number. Gilhousen, Kemper, and Vercelli, May 1983. (PB83 205062)

CP 83-2 Simulation of Spilled Oil Behavior in Bays and Coastal Waters. Hess, October 1983. (PB84 122597)

CP 83-3 AFOS-ERA Forecast Verification. Heffernan, Newton, and Miller, October 1983. (PB84 129303)

CP 83-4 AFOS Monitoring of Terminal Forecasts. Vercelli, December 1983.

CP 83-5 Generalized Exponential MARKOV (GEM) Updating Procedure for AFOS. Herrmann, December 1983.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Newton, Mary C.
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TDL CP 84-1
May 1984

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

Mary C. Newton

1. INTRODUCTION

A powerful tool available to meteorologists in Weather Service Forecast Offices (WSFO's) and Weather Service Offices (WSO's) for issuing flash flood warnings is Manually Digitized Radar (MDR) data. MDR data give a detailed picture of the intensity pattern of the area of precipitation. MDR data are available to WSO's and WSFO's via the Automation of Field Operations and Services (AFOS) system in the last section of the reported hourly radar observation.

Unfortunately, MDR data are not used at a number of field sites since manual summing and plotting of MDR digits is quite cumbersome and tedious. The potential value of MDR data in heavy rainfall events is lost unless a systematic procedure exists to ensure that the data are routinely examined. An AFOS applications computer program described by this document will, upon forecaster initiation, produce an AFOS display of MDR data on detailed local area map backgrounds.

The program will create two graphics each time it is run. One of the graphics consists of an array of MDR digits with each digit representing a single hour's MDR value for the grid square where it appears. The number of hours that will be plotted is determined by the user when the program is initiated. A maximum of 6 hours is allowed. A second graphic will depict the summed MDR values for each grid square for the selected number of hours. A 1-h selection will only produce one graphic.

Either of the two graphics may then be overlayed on a local map background. Local map backgrounds, developed in the Office of Hydrology (OH), are state maps that give such features as county boundaries, rivers and lakes, watershed boundaries, and major highways and roadways. When the Office of Meteorology (OM) completes the database for the zone forecast areas, a local map background consisting of zones will be available for plotting MDR data. To date, local map backgrounds have been created by OH for all states in the Southern Region and for most states in the Eastern, Central, and Western Regions. OH can create any local map background, provided they are given "window" coordinates. The term "window" refers to coordinates of the top and bottom latitudes and left and right longitudes of the map area.

2. METHODOLOGY AND SOFTWARE STRUCTURE

The software that produces the two graphics is composed of two main programs: MDRCREAT and MDRPLT. Fig. 1 gives an overview of the data flow and program relationships for the plotting of MDR data on local map backgrounds.

A. MDRCREAT

The first program, MDRCREAT, is an interactive program that is run only once, at program installation time. It defines for MDRPLT which radar station observations are to be plotted, the coordinates of the radar sites, the

coordinates of the upper left and lower right corners of the rectangular area on which data are to be plotted, and the "window" size of the map background. This information is written to a random RDOS disk file named MDRFIL that is one block in length. MDRFIL is the only permanent file that MDRPLT requires. Table 1 describes the format of MDRFIL.

The rectangular area to be plotted should be determined from the overlay map used with the teletype plots of MDR data (the "paper doll" map). Fig. 2 gives an example of this map, taken from the Radar Code User's Guide (NWS, 1980). The program limits this area to a grid size of 30 x 30. Execution time for the primary program, MDRPLT, depends on the size of this area and on the number of radar reports that are decoded. The coordinates of the radar sites are also taken from the "paper doll" overlay map. These coordinates have been extracted from this map and are contained in Tables 2 and 3.

MDRCREAT consists of three primary subroutines--MDRG1, MDRG2 (Peroutka, 1983a), and MDRG3. MDRG1 loads the call letters and the radar coordinates for all network and local warning radar stations in the rectangular regional area of concern into MDRFIL. A network radar maintains continuous radar surveillance and reports observations each hour. A local warning radar normally reports radar observations each hour only when severe weather or flash flooding is suspected to exist. A distinction is made between local warning and network radars in MDRFIL. If the call letters described in MDRFIL (Table 1) in words 0 to 4 describe a network radar, then word 5 is 1. Otherwise word 5 is 0. A maximum of 20 radar stations can be defined in MDRFIL.

MDRG2 accepts the coordinates of the upper left and lower right corners of the region. The height of the region is computed by subtracting the x-coordinate of the upper left corner from the x-coordinate of the lower right corner. The width of the region is computed similarly with the y-coordinates. Both height and width of the desired area are written into MDRFIL. Then the station coordinates are converted into offsets to get to the regional grid. MDRCREAT generates the offsets by subtracting the region's upper left (I,J) coordinates from the radar station's (I,J) coordinates, respectively. The offsets are then loaded into MDRFIL. Finally, MDRG3 accepts the "window" coordinates of the local map background and the station's call letters and writes them into MDRFIL.

B. Program MDRPLT

MDRPLT is the primary program for plotting MDR data on local map backgrounds. It is initiated each time a plot of MDR totals or array of MDR values is desired. The program reads the command line to decide what date (month and day), ending time, and number of hours should be plotted and summed. These data are entered into the program by the user via local switches. If no switches are used, the program defaults to the following:

Date: Month - Current
Day - Current

Time: Hour - Current if minute is after 35; otherwise, previous hour is used

Totals: Total - 1 hour

The following is the format of the command line and some examples of its use.

Command Line:

MDRPLT NN/M NN/D NN/E N/T

NN/M MONTH (One or two digits)

NN/D DAY (One or two digits)

NN/E ENDING TIME HOUR (One or two digits)

N/T TOTALS (One digit)

EXAMPLES:

(1) MDRPLT 12/E 3/T
- Array and summed MDR digits, 10Z to 12Z today.

(2) MDRPLT 10/M 8/D 00/E 6/T
- Array and summed MDR digits, 19Z to 00Z, October 8.

(3) MDRPLT
- Gives 1-h display of MDR values.
Single map for today at current hour if current minute is after 35; otherwise, previous hour is used.

After MDRPLT reads the command line to get the date, ending time, and number of hours to sum, the MDRFIL file is read. The program then enters a loop that is executed the same number of times as totals requested for each radar station. In this loop, the first station's key record, cccROBxxx, is extracted in order to get the number of versions stored. Then all versions stored are checked to find the one that matches the requested date and time. When the correct version is found, the report is searched through for any contractions, i.e., ROBEPS, ARNO, RHINO, or PPIOM, that qualify the radar's operational performance. A number is stored for each type found. These contractions have the following meaning:

ROBEPS - Radar operating below performance standards,

ARNO - A-scope of radar which measures the amplitude and range of the radar's signal is inoperative,

RHINO - Range height indicator of radar which measures the height of the cell is inoperative, and

PPIOM - Radar is out for maintenance.

When these occur, they will be displayed in abbreviated form along with the corresponding radar station's call letter in the upper right hand corner on the MDR maps. They will appear only at zoom levels of 4:1 and above.

MDRPLT decodes the MDR section of the radar report using ROBDEC (Peroutka, 1983b), and transfers the data into the MDR array using the MDRGRID subroutine. MDRGRID decides which Video Integrator and Processor (VIP) level code to accept when two observations disagree at a common grid square. VIP level codes represent echo or precipitation intensity. There will be times when there are two codes for the same MDR square since two or more radars' area of coverage may overlap. If so, the priority used is as follows: 6, 5, 4, 3, 2, 1, 8, 9, and 0 VIP levels. VIP level codes and associated echo and precipitation intensity is found in Table 4 (NWS, 1980).

After the above loop is completed for the first station, the second and subsequent stations enter the loop. Once the loop is complete for all stations, the MDR array is filled with the requested number of hours of MDR data. The program then calls in another subroutine, MDRADD, to sum the MDR values for the requested number of hours. The sums are then transferred into array ISUM.

The final task of the program is to convert the MDR array into a graphical display. The subroutines MDRGPH and SUMGPH produce the charts. They use AFOS Graphic Library routines (MacDonald, 1981; Van Blargan and Olsen, 1983).

In subroutines MDRGPH and SUMGPH, a subroutine POLAR is called to determine the conversion factors necessary for converting latitude and longitude values to coordinate values on the AFOS Graphics Display Module (GDM). Equations for a polar stereographic projection are used. Next, the program enters a loop that converts the coordinates of MDR values in the MDR and ISUM array to latitude and longitude and then to AFOS screen values, x and y. The AFOS display space is a cartesian grid with x representing distance in the horizontal and y representing distance in the vertical. The AFOS screen values are checked against the limits of the AFOS display space, $0 < x \leq 4095$ and $0 \leq y \leq 3071$. The MDR values and sums are converted from integer to ASCII format. The subroutines MDRLB and SUMLB are called to generate the labels to be placed on the map showing ending time and number of hours displayed.

Finally, the subroutines TEXT and UTF are called to create and store the graphic(s) in the AFOS database. The graphic(s) are originally created in temporary buffer files, DR# and SR# which are deleted by MDRPLT after they have been successfully stored in the database. The "#" represents the number of hours that will be plotted in the array display of MDR digits (DR#) and number of hours used in the sum display of MDR digits (SR#), respectively.

The software structure and load line for both MDRCREAT and MDRPLT are shown in Fig. 3.

3. DESCRIPTION OF OUTPUT

An example of the output graphic that depicts the hourly array of MDR digits for each grid square is shown in Fig. 4. The following station model is used:

1 3 4 2 M 3

The first digit to the left is centered over the MDR grid square and represents the oldest hour's VIP level. Each subsequent digit represents the

the next hour's VIP level for that same grid square. A 0 indicates a VIP level of no echo intensity. An "M" appears if an MDR digit is missing for a particular hour. An "M" indicates the radar report is missing from the AFOS database or the station's radar is PPIOM, or the radar report is not available (PPINA). An "M" may also indicate that the grid square is located outside of any radar's area of coverage. A label at the bottom of the graphic shows the ending date and time and how many hours are displayed.

Fig. 5 is an example of the second graphic that depicts the summed MDR values for each square over a certain time period.

For the summed MDR values, a similar station model is used:

12
M+

The tens digit of the MDR sum is centered over the grid square. A plus sign appears only if a level 5 or 6 was encountered during the summing computation. An "M" for missing appears only if at least one hour's digit was missing from the summing computation. Levels 8 and 9, unknown intensity echoes, are not summed. A label at the bottom of the graphic shows the ending date and time and total number of hours contained in the sum.

4. MACHINE REQUIREMENTS

The program MDRCREAT.SV and MDRPLT.SV use less than 9 K and 30 K words of core, respectively. MDRCREAT.SV requires about 25 blocks of disk space but is only needed once when the program is installed. MDRPLT.SV requires about 65 RDOS blocks of disk space.

Execution time depends on the size of the area of interest and the number of hours requested. A fair estimate for MDRPLT.SV is from 1.5 to 2.5 minutes. An MDRFIL may be produced from MDRCREAT.SV in about 5 seconds after all information has been entered.

MDRPLT accesses one permanent and two temporary files. The permanent file, MDRFIL, one RDOS block in length, is described in Table 1. The two temporary graphics files, DR# and SR#, are random RDOS files that are created by the graphic subroutine TEXT. Each file is about 2 blocks each. The format of these files is described in MacDonald (1981). No other files are created or accessed in the program.

5. AFOS DATABASE REQUIREMENTS

The desired radar observations should be stored in the local PIL. Although the program will plot up to 6 hours, more versions should be stored to account for special and corrected observations. The observations should be version purged, not time purged.

There are 11 graphical product keys that must be in the database. They are:

NMCGPHDR1	
NMCGPHDR2	NMCGPHSR2
NMCGPHDR3	NMCGPHSR3
NMCGPHDR4	NMCGPHSR4
NMCGPHDR5	NMCGPHSR5
NMCGPHDR6	NMCGPHSR6

The DR1-DR6 keys will contain the graphics consisting of the array of MDR digits from 1 to 6 hours. The SR2-SR6 keys hold the graphics of accumulated sums of MDR digits from 2 to 6 hours.

Another key, CCCMSGMDR, used for storing error messages generated from the program must also be in the database. The "CCC" refers to your station's call letters.

Also, the appropriate local map background should be stored in the database.

6. PROCEDURES

A. MDRCREAT

The first step prior to running MDRCREAT is to decide on a rectangular area of interest. Use Fig. 2, the overlay map for the teletype paper doll plot to determine this area. The size of the rectangle has a great effect on program run time, and is limited to a 30x30 grid. The coordinates of the upper left and lower right corners must be found. Decide which radar sites are to be used and take note of whether they are network radars. Tables 2 and 3 will determine which radars are network or local warning and give their coordinates. Don't select a radar site unless it lies within seven grid squares of the area of interest.

Decide which local map background you will use. Determine top and bottom latitudes and left and right longitudes of the local map. Make sure all of the ROB's, graphic keys, and error message key are stored in the database. Using the key management alarm/alert commands, an alert should be set for this product so that accumulated error messages will automatically display when the alarm/alert key is depressed. Run the program MDRCREAT to generate the data file MDRFIL. The program proceeds with a rather simple dialog. If, at some time in the future, you wish to change the parameters in MDRFIL, you can rerun MDRCREAT; it will delete the old MDRFIL file.

B. MDRPLT

The program MDRPLT can be run once the database is ready and MDRPLT.SV and MDRFIL exist on DP0 (or as links). The command "RUN:MDRPLT" at an ADM will produce a current hour display of MDR digits over the specified area. No other manual intervention is required. An alert light showing program completion will be activated. The graphic may then be displayed on a GDM.

7. CAUTIONS

The MDR decoder, ROBDEC, checks the date-time polynomial, the date in the WOUSOO line, and the time in the body of the observation. If an observation is miscoded or missing, it is impossible to bogus it into the database without adjusting the date-time on the AFOS console's system clock.

The MDR decoder will process "corrected" observations. However, since ROB nonrecord "specials" do not contain updated MDR data, they will not be processed by the MDR decoder.

8. REFERENCES

MacDonald, A. E., 1981: AFOS graphics creation from FORTRAN. NOAA Western Region Computer Programs and Problems NWS WRCP No. 18, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 21 pp.

National Weather Service, 1980: Radar code user's guide. National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 179 pp.

Peroutka, M. R., 1983a: (unpublished documentation).

_____, 1983b: A decoder for manually digitized radar observations. NOAA Eastern Region Computer Programs and Problems NWS ERCP No. 13, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 8 pp.

Van Blargan, E. J., and B. G. Olsen, 1983: Creation of AFOS graphics using the IBM 360/195. NOAA Office of Hydrology Technical Note No. 2, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 37 pp.

9. PROGRAM INFORMATION and PROCEDURES for INSTALLATION and EXECUTION

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURES

PROGRAM NAME: MDRCREAT

AAL ID: GPH013
Revision No.: 01.00

FUNCTION: Creates an MDR information file (MDRFIL) that contains the local station's call letters, the call letters of the radar observations that must be decoded, the coordinates of the relevant radar sites, the coordinates and size of the region to be monitored, and the "window" coordinates of the local map background. Accepts the above information from the background terminal.

PROGRAM INFORMATION:

Development Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Language: FORTRAN IV/ Rev 5.20

Maintenance Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Type: Standard program

Save file creation dates: MDRCREAT.SV
Original release/Rev 01.00 - April 18, 1984

Running time: about 5 seconds - user interactive program

Disk space: Program - 25 RDOS blocks
Data files - 1 RDOS block

PROGRAM REQUIREMENTS

Program Files:

NAME	COMMENTS
MDRCREAT.SV	

Data Files:

NAME	DP	READ/WRITE	COMMENTS
MDRFIL	DP0	W	Created by program

AFOS Products: None

LOAD LINE

RLDR MDRCREAT MDRG1 MDRG2 MDRG3 UTIL.LB FORT.LB

PROGRAM INSTALLATION

1. Move MDRCREAT.SV to an available directory.

2. Be prepared to give the following information:
   (1) Upper left and lower right coordinates of desired rectangular regional area selected from Fig. 2,
   (2) Call letters (cccnnnxxx) of all radar stations that are within the desired regional area,
   (3) Radar station's coordinates, (I,J), and whether it is a network or local warning radar found in Tables 2 and 3, and
   (4) Top and bottom latitudes and left and right longitudes of the local map background that will be used.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MDRCREAT

AAL ID: GPH013
Revision No.: 01.00

PROGRAM EXECUTION

1. Make sure the current directory contains MDRCREAT.SV. From the dasher enter:

   MDRCREAT

2. Enter answers to questions asked.

   A message signifying that the MDRFIL has been built denotes successful execution of the program.

ERROR CONDITIONS

	MESSAGE	MEANING
	"CAN'T DELETE MDRFIL"	This message will be displayed when a previously created MDRFIL can't be deleted. Probable cause is that MDRFIL has been made permanent on disk. CHATR the file to remove the permanency attribute and rerun MDRCREAT.
2.	"REGION IS TOO LARGE-- 30x30 IS MAXIMUM"	Error occurred because the size of the desired rectangular region to be monitored is larger than the program allows (30x30 grid size). Decrease the size of the desired area and re-enter the upper left and lower right coordinates.

Error conditions other than those listed above occur during file manipulation. This includes creating, opening a channel to, writing, and closing the MDRFIL. These errors occur most likely because of system/disk problems rather than program failure. Check the RDOS error code and rerun MDRCREAT, if necessary.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURES

PROGRAM NAME: MDRPLT

AAL ID: GPH013
Revision No.: 01.00

FUNCTION: Reads and decodes the MDR section of radar observations from the database. Generates two graphical displays of MDR VIP level codes on local area map backgrounds. One graphic contains an hourly array of MDR digits; the other graphic contains the sum of the MDR digits per grid square over a certain number of hours. A maximum of 6 hours of MDR data may be plotted.

PROGRAM INFORMATION:

Development Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Maintenance Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Language: FORTRAN IV/ Rev 5.20

Type: Standard program

Save file creation dates: MDRPLT.SV
Original release/Rev 01.00 - April 18, 1984

Running time: 1.5 to 2.5 minutes

Disk space: Program files - 65 RDOS blocks
Data files - 1 RDOS block

PROGRAM REQUIREMENTS

Program Files:

NAME	COMMENTS
MDRPLT.SV	

Data Files:

NAME	DP	READ/WRITE	COMMENTS
MDRFIL	DP0	R	Created by MDRCREAT
DR#	DP0	W	Created by MDRPLT and deleted after being stored in the AFOS database.
SR#	DP0	W	

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHDR#	Stored	"#" refers to the number of hours displayed at each grid square.
NMCGPHSR#	Stored	"#" refers to the number of hours over which a sum was taken.

LOAD LINE

```
RLDR MDRPLT MDR<CMD SU> CKEY MADM ROBDEC GROB ROBOP MASK
   IASC<R L> MDRGRID MDRGPH POLAR MDRCOORD ASIN PIXEL LIMITS MDRSTAT
   MDRLB JDATE J2MDA MDRADD SUMGPH
   SUMLB <AG AG TOP BG UTIL FORT >.LB
```

PROGRAM INSTALLATION

1. Move MDRPLT.SV and MDRFIL to an available directory. If the directory is not DP0, create links to MDRPLT.SV and MDRFIL on DP0.

2. Verify that the required 11 graphic product keys for the output products are stored in the database.

3. Verify that the required radar observations are stored in the database and that they are version rather than time purged.

4. Verify that the appropriate local map backgrounds are stored in the database. Use the "key:" command to set the output graphics with the appropriate map background.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MDRPLT

AAL ID: GPH013
Revision No.: 01.00

PROGRAM EXECUTION

1. From an ADM console, enter:

   RUN: MDRPLT MM/M DD/D HH/E N/T

   The local switches that follow the program name allow default data to be replaced by the information given in the command line. MM and DD refer to the desired month and day, respectively. HH and N refer to the ending hour and the hourly total for a computed MDR sum, respectively. If the local switches are omitted, the programs default to a 1-hour MDR display for the current date (month and day). The latest hour is used if the current minute is after 35; otherwise, the previous hour is used.

2. The ADM alarm light will be activated once for each graphic product stored and when the program has completed.

ERROR CONDITIONS

	ADM MESSAGE	MEANING
1.	!!ROB DECODER ERROR MESSAGES "CCC MODA HHMM"	Problem occurred because an observation was not found or could not be decoded properly. Station name, month, day, hour and minute of the observation is printed at console. Error message is displayed by depressing blinking light at program completion.

	DASHER MESSAGES	COMMENTS
1.	"CAN'T READ MDRFIL"	Probable cause is that the MDRFIL has been deleted or its contents have been destroyed. Restore from backup or rerun MDRCREAT.
2.	"CAN'T DELETE 'FILENAME'"	Error occurred because the specified RDOS file could not be deleted. A manual deletion should be applied.

Table 1. Format of the MDRFIL file. Data type "A" indicates packed ASCII data; data type "B" indicates binary data.

Word	Description	Data Type
0-4	cccnnnxxx for station 1	A
5	Network radar	A
6	Offset to convert station I-coordinate to regional I-coordinate	B
7	Offset to convert station J-coordinate to regional J-coordinate	B
8-15	Same as 0-7 for station 2	
16-23	Same as 0-7 for station 3	
.		
.		
.		
152-159	Same as 0-7 for station 20	
160	I-coordinate of upper left corner of regional grid	B
161	J-coordinate of upper left corner of regional grid	B
162	Height of regional area in grid squares	B
163	Width of regional area in grid squares	B
164	Top latitude of area map	B
165	Bottom latitude of area map	B
166	Left longitude of area map	B
167	Right longitude of area map	B
168	Local station's call letters	A
169-255	Future expansion	

Table 2. Network warning radars and their coordinates.

Radar Site	I Coordinate	J Coordinate	Radar Site	I Coordinate	J Coordinate
Alliance, Nebr.	40	46	Lake Charles, La.	70	71
Amarillo, Tex.	59	49	Limon, Colo.	48	44
Apalachicola, Fla.	66	91	Little Rock, Ark.	57	70
Athens, Ga.	53	91	Longview, Tex.	65	66
Atlantic City, N.J.	31	101	Marseilles, Ill.	38	73
Binghamton, N.Y.	26	95	Medford, Ore.	35	8
Bristol, Tenn.	46	91	Memphis, Tenn.	54	75
Brownsville, Tex.	84	62	Miami, Fla.	72	107
Brunswick, Maine	16	103	Midland, Tex.	68	48
Buffalo, N.Y.	27	90	Minneapolis, Minn.	31	63
Cape Hatteras, N.C.	42	105	Missoula, Mont.	27	26
Centreville, Ala.	59	83	Monett, Mo.	52	66
Charleston, S.C.	53	99	Nashville, Tenn.	50	82
Chatham, Maine	21	106	Neenah, Wis.	31	71
Cincinnati, Ohio	41	83	New York, N.Y.	28	100
Daytona Beach, Fla.	63	101	Oklahoma City, Okla.	57	58
Des Moines, Iowa	40	64	Patuxent River, Md.	36	99
Detroit, Mich.	32	82	Pensacola, Fla.	66	85
Evansville, Ind.	46	78	Pittsburgh, Pa.	34	90
Fargo, N. Dak.	27	56	Sacramento, Cal.	45	7
Galveston, Tex.	73	67	Slidell, La.	68	79
Garden City, Kans.	51	51	Stephenville, Tex.	66	58
Grand Island, Nebr.	43	55	Saint Louis, Mo.	45	71
Hondo, Tex.	75	56	Tampa, Fla.	69	99
Huron, S. Dak.	34	54	Volens, Va.	41	96
Jackson, Miss.	62	77	Waycross, Ga.	59	96
Kansas City, Mo.	46	63	Wichita, Kans.	51	58
Key West, Fla.	77	105	Wilmington, N.C.	47	102

Table 3. Local warning radars and their coordinates.

Radar Site	I Coordinate	J Coordinate	Radar Site	I Coordinate	J Coordinate
Abilene, Tex.	66	54	Los Angeles, Calif.	58	11
Akron, Ohio	34	87	Louisville, Ky.	44	81
Albany, N.Y.	23	98	Lubbock, Tex.	63	49
Alpena, Mich.	26	79	Macon, Ga.	57	91
Atlanta, Ga.	55	88	Madison, Wis.	34	71
Augusta, Ga.	53	94	Marquette, Mich.	24	71
Austin, Tex.	72	60	Meridian, Miss.	61	80
Baton Rouge, La.	68	76	Mobile, Ala.	66	82
Beckley, W. Va.	41	91	Moline, Ill.	38	70
Billings, Mont.	31	35	Montgomery, Ala.	60	85
Bismarck, N. Dak.	28	49	Muskegon, Mich.	32	76
Burlington, Vt.	18	97	Norfolk, Nebr.	40	56
Charleston, W. Va.	40	89	North Platte, Nebr.	43	50
Charlotte, N.C.	48	94	Omaha, Nebr.	41	59
Cheyenne, Wyo.	43	42	Phoenix, Ariz.	63	25
Cleveland, Ohio	33	86	Portland, Oreg.	27	11
Columbia, Mo.	46	68	Raleigh, N.C.	44	98
Columbia, S.C.	51	95	Rapid City, S. Dak.	35	45
Columbus, Ga.	58	88	Rochester, Minn.	33	64
Columbus, Ohio	37	85	San Angelo, Tex.	69	53
Concordia, Kans.	46	57	San Juan, Puerto Rico	69	155
Corpus Christi, Tex.	79	61	Shreveport, La.	64	68
Duluth, Minn.	26	63	Sioux Falls, S. Dak.	35	57
Erie, Pa.	30	88	Springfield, Ill.	42	72
Fort Smith, Ark.	56	65	Topeka, Kans.	47	61
Fort Wayne, Ind.	37	80	Tulsa, Okla.	55	62
Goodland, Kans.	47	48	Victoria, Tex.	76	62
Harrisburg, Pa.	32	96	Waco, Tex.	68	60
Hartford, Conn.	23	101	Waterloo, La.	37	65
Houghton Lake, Mich.	28	78	West Palm Beach, Fla.	69	106
Huntsville, Ala.	54	82	Wichita Falls, Tex.	61	57
Indianapolis, Ind.	40	79	Williston, N. Dak.	25	44
Jackson, Ky.	44	87	Worcester, Mass.	22	102
Las Vegas, Nev.	54	19			

Table 4. VIP level codes and associated echo and precipitation intensity and rainfall rate.

Code Number	Echo Intensity	Precipitation Intensity	Rainfall Rate (in/hr) Stratiform	Convective
0	None	None	0.0	0.0
1	Weak	Light	0.0-0.1	0.0-0.2
2	Moderate	Moderate	0.1-0.5	0.2-1.1
3	Strong	Heavy	0.5-1.0	1.1-2.2
4	Very Strong	Very Heavy	*	2.2-4.5
5	Intense	Intense	*	4.5-7.1
6	Extreme	Extreme	*	More than 7.1
8**	Unknown	Unknown	Unknown	Unknown
9**	Unknown	Unknown	Unknown	Unknown

*Stratiform rain with an intensity of very heavy, intense, or extreme does not occur. Rainfall rates for these intensities are, therefore, omitted here.

**The code number 8 is used if an unknown intensity echo is known or believed associated with severe weather. The number 9 is used with all other unknown intensity echoes.

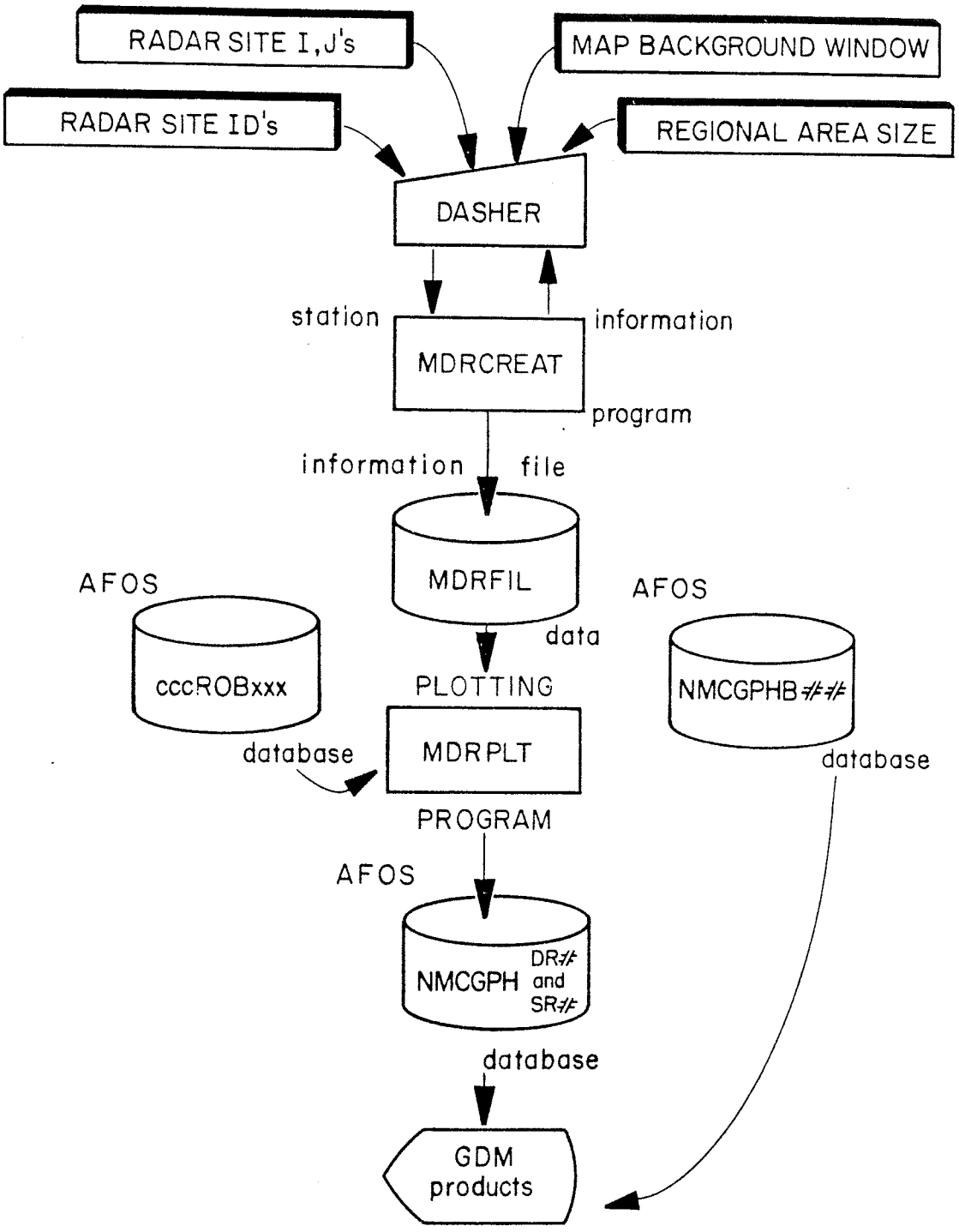


Figure 1. Data flow and program relationships for the plotting of MDR data on local map backgrounds. Program names, disk, and AFOS data set names appear within the data flow symbol.

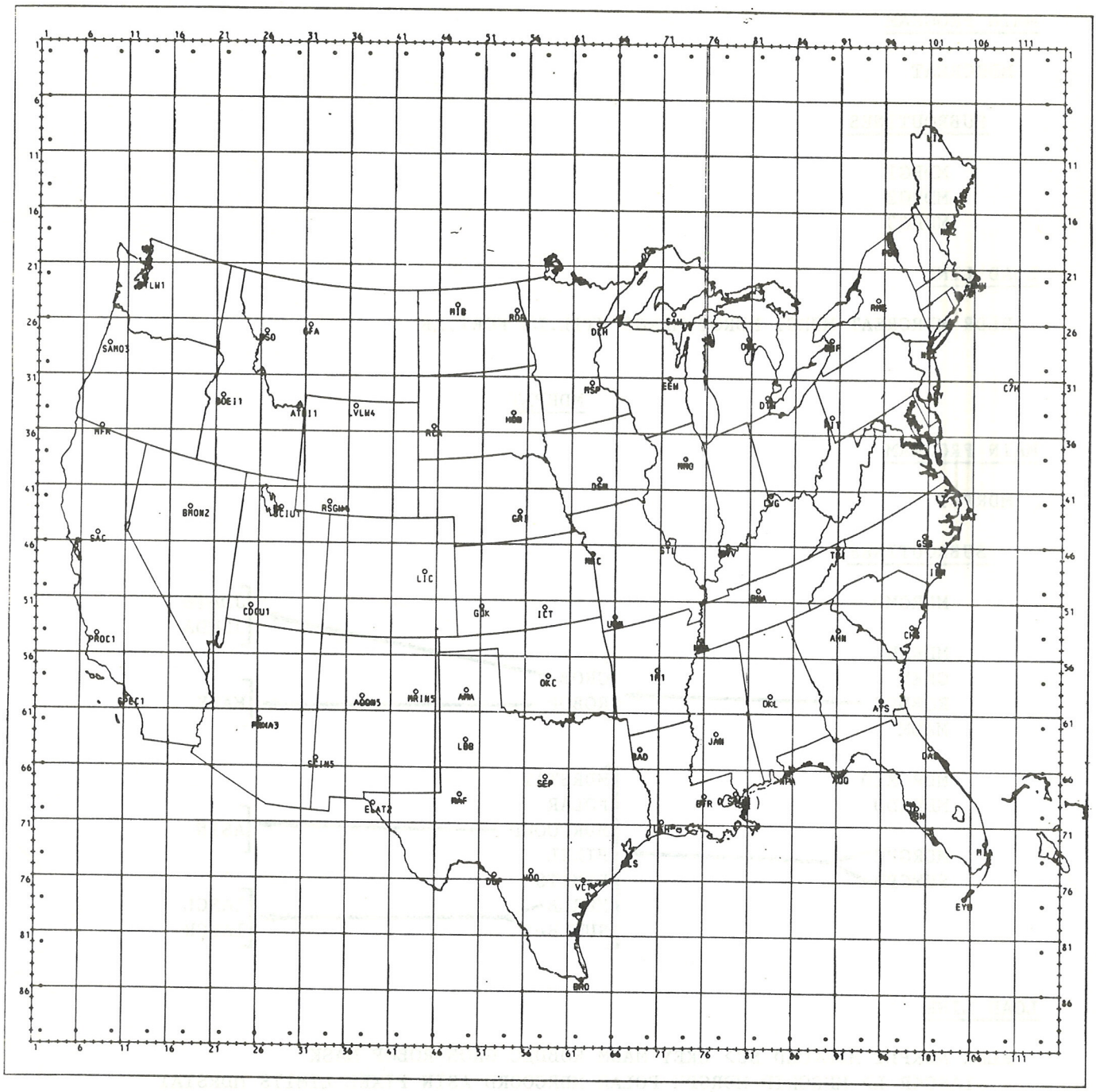


Figure 2. Overlay for use with the teletypewriter plot of the digital radar code. The rectangles on the overlay contain up to 25 intensity digits (i.e., five by five). I-coordinates are on the vertical and J-coordinates are on the horizontal.

MDRCREAT

MAIN PROGRAM

MDRCREAT

SUBROUTINES

MDRG1
MDRG2
MDRG3

LOAD LINE

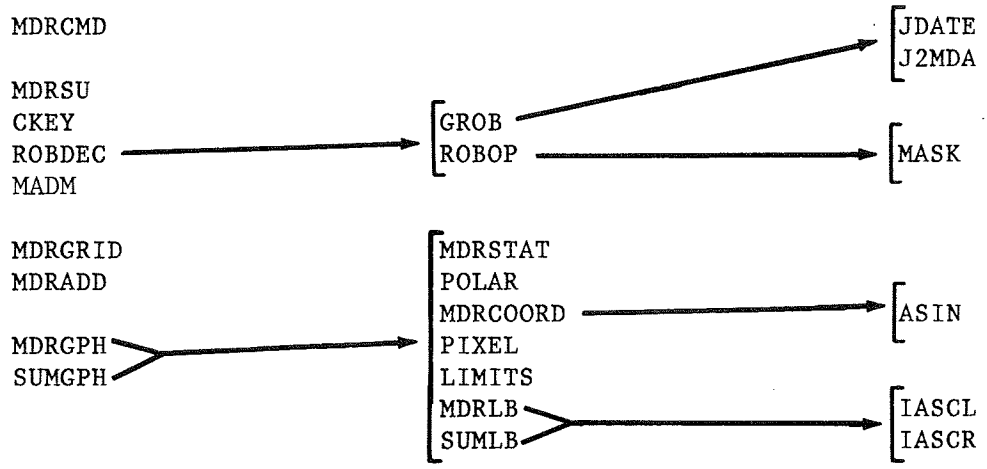
```
RLDR MDRCREAT MDRG1 MDRG2 MDRG3 UTIL.LB FORT.LB
```

MDRPLT

MAIN PROGRAM

MDRPLT

SUBROUTINES



LOAD LINE

```
RLDR MDRPLT MDR<CMD SU> CKEY MADM ROBDEC GROB ROBOP MASK
   IASC<R L> MDRGRID MDRGPH POLAR MDRCOORD ASIN PIXEL LIMITS MDRSTAT
   MDRLB JDATE J2MDA MDRADD SUMGPH
   SUMLB <AG AG TOP BG UTIL FORT >.LB
```

Figure 3. Software structure and load line for program MDRCREAT and program MDRPLT.

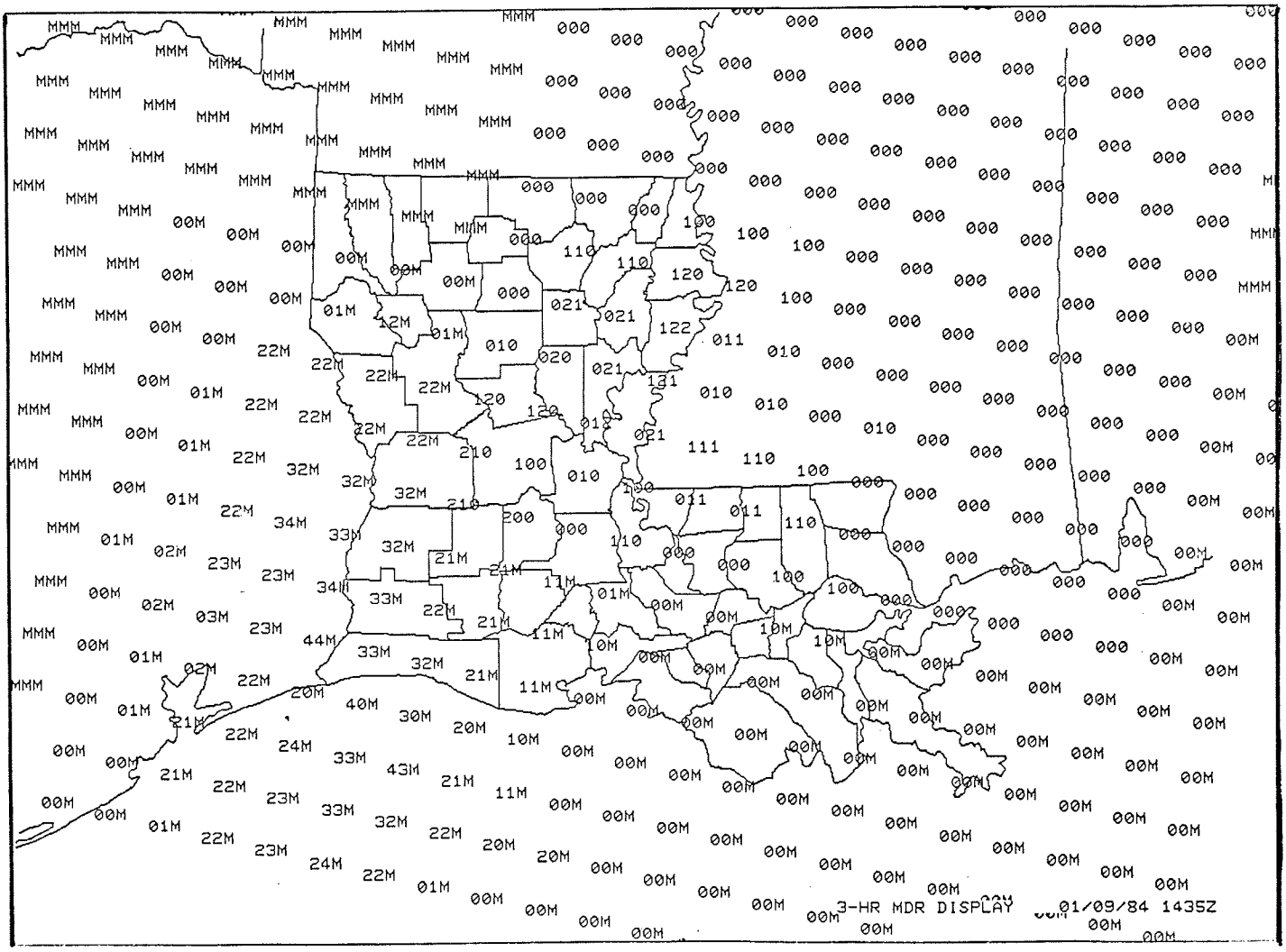


Figure 4. An example of an output graphic from MDRPLT that depicts a 3-h MDR display overlayed on a local area county map background.

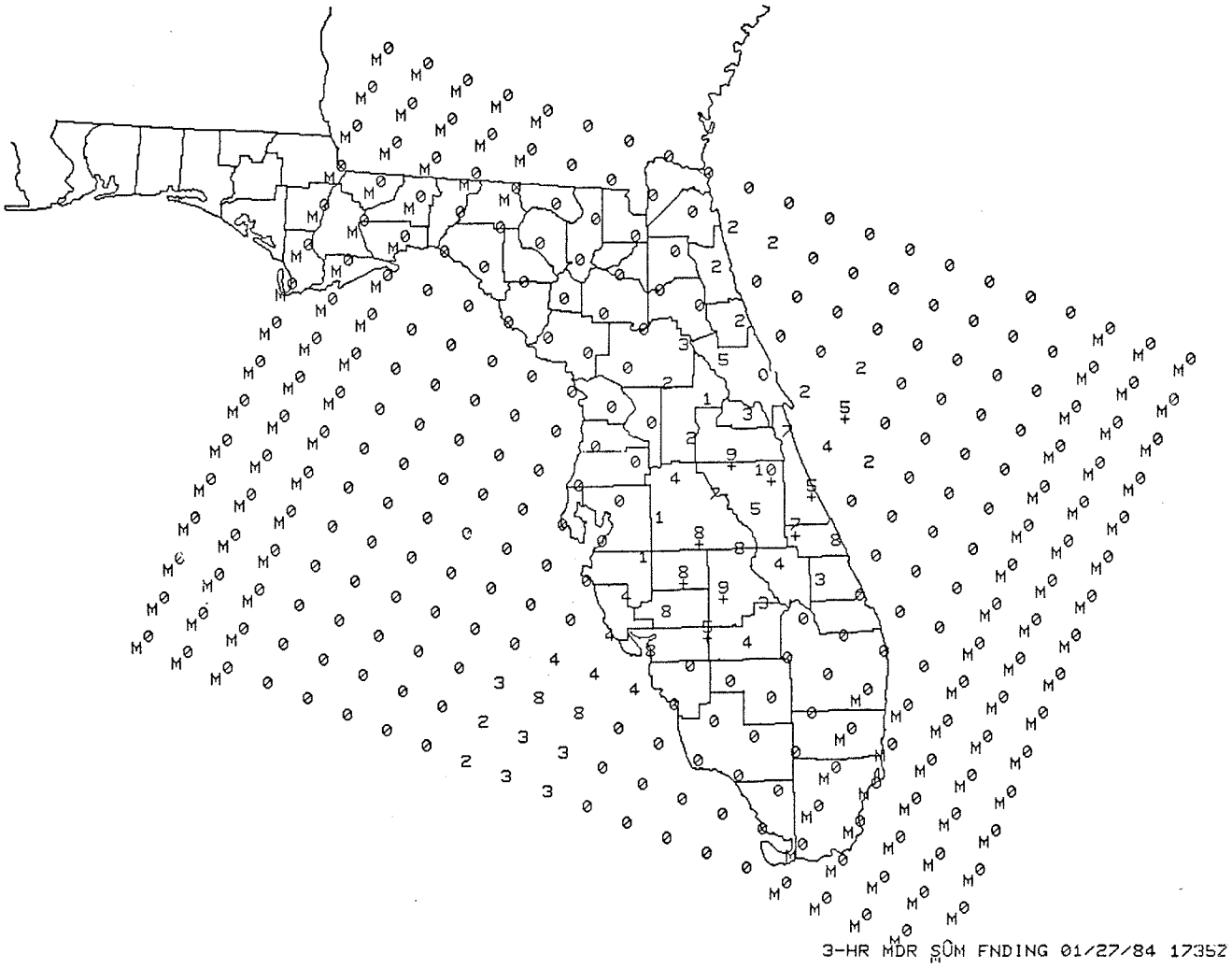


Figure 5. An example of an output graphic from MDRPLT that represents a 3-h MDR sum overlayed on a local area county map background.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURES

PROGRAM NAME: MDRCREAT

AAL ID: GPH013
Revision No.: 01.00

FUNCTION: Creates an MDR information file (MDRFIL) that contains the local station's call letters, the call letters of the radar observations that must be decoded, the coordinates of the relevant radar sites, the coordinates and size of the region to be monitored, and the "window" coordinates of the local map background. Accepts the above information from the background terminal.

PROGRAM INFORMATION:

Development Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Language: FORTRAN IV/ Rev 5.20

Maintenance Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Type: Standard program

Save file creation dates: MDRCREAT.SV
Original release/Rev 01.00 - April 18, 1984

Running time: about 5 seconds - user interactive program

Disk space: Program - 25 RDOS blocks
Data files - 1 RDOS block

PROGRAM REQUIREMENTS

Program Files:

NAME	COMMENTS
MDRCREAT.SV	

Data Files:

NAME	DP	READ/WRITE	COMMENTS
MDRFIL	DP0	W	Created by program

AFOS Products: None

LOAD LINE

RLDR MDRCREAT MDRG1 MDRG2 MDRG3 UTIL.LB FORT.LB

PROGRAM INSTALLATION

1. Move MDRCREAT.SV to an available directory.

2. Be prepared to give the following information:
   (1) Upper left and lower right coordinates of desired rectangular regional area selected from Fig. 2,
   (2) Call letters (cccnnnxxx) of all radar stations that are within the desired regional area,
   (3) Radar station's coordinates, (I,J), and whether it is a network or local warning radar found in Tables 2 and 3, and
   (4) Top and bottom latitudes and left and right longitudes of the local map background that will be used.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MDRCREAT

AAL ID: GPH013
Revision No.: 01.00

PROGRAM EXECUTION

1. Make sure the current directory contains MDRCREAT.SV. From the dasher enter:

   MDRCREAT

2. Enter answers to questions asked.

   A message signifying that the MDRFIL has been built denotes successful execution of the program.

ERROR CONDITIONS

	MESSAGE	MEANING
1.	"CAN'T DELETE MDRFIL"	This message will be displayed when a previously created MDRFIL can't be deleted. Probable cause is that MDRFIL has been made permanent on disk. CHATR the file to remove the permanency attribute and rerun MDRCREAT.
2.	"REGION IS TOO LARGE-- 30x30 IS MAXIMUM"	Error occurred because the size of the desired rectangular region to be monitored is larger than the program allows (30x30 grid size). Decrease the size of the desired area and re-enter the upper left and lower right coordinates.

Error conditions other than those listed above occur during file manipulation. This includes creating, opening a channel to, writing, and closing the MDRFIL. These errors occur most likely because of system/disk problems rather than program failure. Check the RDOS error code and rerun MDRCREAT, if necessary.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURES

PROGRAM NAME: MDRPLT

AAL ID: GPH013
Revision No.: 01.00

FUNCTION: Reads and decodes the MDR section of radar observations from the database. Generates two graphical displays of MDR VIP level codes on local area map backgrounds. One graphic contains an hourly array of MDR digits; the other graphic contains the sum of the MDR digits per grid square over a certain number of hours. A maximum of 6 hours of MDR data may be plotted.

PROGRAM INFORMATION:

Development Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Maintenance Programmer:

Mary C. Newton

Location: Techniques Development Laboratory
Phone: FTS 427-7775

Language: FORTRAN IV/ Rev 5.20

Type: Standard program

Save file creation dates: MDRPLT.SV
Original release/Rev 01.00 - April 18, 1984

Running time: 1.5 to 2.5 minutes

Disk space: Program files - 65 RDOS blocks
Data files - 1 RDOS block

PROGRAM REQUIREMENTS

Program Files:

NAME	COMMENTS
MDRPLT.SV	

Data Files:

NAME	DP	READ/WRITE	COMMENTS
MDRFIL	DP0	R	Created by MDRCREAT
DR#	DP0	W	Created by MDRPLT and deleted after being stored in the AFOS database.
SR#	DP0	W	

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHDR#	Stored	"#" refers to the number of hours displayed at each grid square.
NMCGPHSR#	Stored	"#" refers to the number of hours over which a sum was taken.

LOAD LINE

```
RLDR MDRPLT MDR<CMD SU> CKEY MADM ROBDEC GROB ROBOP MASK
   IASC<R L> MDRGRID MDRGPH POLAR MDRCOORD ASIN PIXEL LIMITS MDRSTAT
   MDRLB JDATE J2MDA MDRADD SUMGPH
   SUMLB <AG AG TOP BG UTIL FORT >.LB
```

PROGRAM INSTALLATION

1. Move MDRPLT.SV and MDRFIL to an available directory. If the directory is not DP0, create links to MDRPLT.SV and MDRFIL on DP0.

2. Verify that the required 11 graphic product keys for the output products are stored in the database.

3. Verify that the required radar observations are stored in the database and that they are version rather than time purged.

4. Verify that the appropriate local map backgrounds are stored in the database. Use the "key:" command to set the output graphics with the appropriate map background.

AFOS DISPLAY OF MDR DATA ON LOCAL MAP BACKGROUNDS

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MDRPLT AAL ID: GPH013
Revision No.: 01.00

PROGRAM EXECUTION

1. From an ADM console, enter:

   RUN: MDRPLT MM/M DD/D HH/E N/T

   The local switches that follow the program name allow default data to be replaced by the information given in the command line. MM and DD refer to the desired month and day, respectively. HH and N refer to the ending hour and the hourly total for a computed MDR sum, respectively. If the local switches are omitted, the programs default to a 1-hour MDR display for the current date (month and day). The latest hour is used if the current minute is after 35; otherwise, the previous hour is used.

2. The ADM alarm light will be activated once for each graphic product stored and when the program has completed.

ERROR CONDITIONS

	ADM MESSAGE	MEANING
1.	!!ROB DECODER ERROR MESSAGES "CCC MODA HHMM"	Problem occurred because an observation was not found or could not be decoded properly. Station name, month, day, hour and minute of the observation is printed at console. Error message is displayed by depressing blinking light at program completion.

	DASHER MESSAGES	COMMENTS
1.	"CAN'T READ MDRFIL"	Probable cause is that the MDRFIL has been deleted or its contents have been destroyed. Restore from backup or rerun MDRCREAT.
2.	"CAN'T DELETE 'FILENAME'"	Error occurred because the specified RDOS file could not be deleted. A manual deletion should be applied.