NOAA Technical Memorandum ERL ARL-169

METEOROLOGICAL SUPPORT: DESCRIPTIONS OF APPLICATION PROGRAMS FOR ACCESSING AND DISPLAYING DATA

Glenn D. Rolph
Barbara J. B. Stunder

Air Resources Laboratory
Silver Spring, Maryland
March 1989

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NOAA Tech Memo ERL ARL-169

CORRECTIONS

Overall

1. Plots can no longer be displayed on NMC's Versatec printer.

2. HYTEK tektronix emulator now replaces TEKDMK

Specific Programs

2.1.4 NGM field plotting routine II
- this program is out of date and no longer is supported. The information gained from this program can be obtained from section 2.1.3

2.2 Medium Range Forecast (MRF) Model Plotting Program
- To obtain a map of Europe, the user must turn Fig. 2.14 upside-down to define the map region.

- Do not chose a longitude range that crosses zero longitude

- A new program has been added that gives these fields and more in polar stereographic coordinates. Their names are:

  EX 'ERL.R32.GR.CLIST(MRFPSG05)' (for 0 to 5 day forecasts)

  EX 'ERL.R32.GR.CLIST(MRFSPG10)' (for 6 to 10 day forecasts)

2.3.1 AVN plotting routine
- The option to change the year, month, day and cycle has been removed

3.1 Surface Weather Map (WXMAP) for the pc
- The user no longer has to enter the min and max latitudes and longitudes. He can enter a number corresponding to the area of interest, or enter latitude and longitude coordinates.

- Much work has been done here on the PC, including a color version called SFCMAP.

3.2 Upper-Air Observations and Skew-T, Log P Diagrams
- This program can now be run in color on the pc using SKEWT after downloading the Wind-Temp data to the pc.

4.3 **Program for Operational Trajectories (POT)**

- On page 56, step 4, the program names should read:

```
RGL.TRAJ (forecast)
AVN.TRAJ (forecast, N. Hemisphere)
MRFS     (forecast, S. Hemisphere)
RAA.TRAJ (analysis)
FAA.TRAJ (analysis, N. Hemisphere)
MRFAS    (analysis, S. Hemisphere)
```

CONTENTS

METEOROLOGICAL SUPPORT: DESCRIPTIONS OF APPLICATION PROGRAMS FOR ACCESSING AND DISPLAYING DATA

Glenn D. Rolph
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ABSTRACT. Programs for accessing and displaying meteorological data are described. Surface and upper-air observations and model-generated forecast data may be accessed. Step-by-step procedures and examples are provided for each application program. Brief descriptions of air-parcel trajectory models are also included. Most of the programs require access to the NAS 9000 computer in Suitland, MD. Meteorological data for these programs are provided by NOAA's National Meteorological Center in Camp Springs, MD.

1. INTRODUCTION

This manuscript is intended to be used as an operational tool for accessing and displaying meteorological data using various application programs. Detailed information about each program is given. The programs are described as they exist at the time of this writing and may be updated to respond to changing needs and new technology.

Each section or subsection describing a program is divided into five parts:

PROGRAM NAME

DESCRIPTION: A brief description of the program.

NOTES: Limitations, problems, and additional features about the program.

PROCEDURE: A detailed listing of how to run the program: ==> means the computer is expecting the user to enter an option or command; ** means the computer will print this message on the screen. In some cases, the user will be referred to other programs that must be accessed in order to complete the required product.

EXAMPLES: In most cases examples will be given that can be followed when accessing the data bases. The examples of how to run specific programs are also annotated with arrows indicating user responses.

Most of the programs require access to the NAS 9000 computer in Suitland, MD. Some of the application programs will produce FR80 graphical plots that can be output to the screen, a dot matrix printer, and/or a Versatec printer. Information on FR80 plot file names and instructions for sending these plots to output devices will be provided when needed.

2. FORECAST PRODUCTS

2.1 Nested Grid Model (NGM) Programs

2.1.1 NGM cross section

DESCRIPTION: This program will print a vertical cross section, in tabular form, of data from the five lowest sigma levels in the National Meteorological Center (NMC) regional Nested Grid Model (NGM). The user enters the date and time of the most recent operational cycle (00 GMT or 12 GMT) and the end points (latitude and longitude) of the cross section. The program will print cross sections of wind direction (deg), wind speed (m/s), height of the sigma level where the data are valid (m/10), temperature (deg C), specific humidity (g/kg), vertical velocity (cm/s), vertical mixing (m^2/s), stability in terms of the Monin-Obukhov length (m/10), mixing depth (m/10), precipitation (in x 100), and the latitude and longitude of the grid point.

NOTES: There are no values of specific humidity, wind, or temperature at the surface. This program was written by Roland Draxler, National Oceanic and Atmospheric Administration/Air Resources Laboratory (NOAA/ARL), Silver Spring, MD.

PROCEDURE:

```
      ==>     Logon to the NAS 9000.
      ==>     EX 'ERL.R32.GR.NGM.NGMCROSS.CLIST'
      **      **** PULLING NGM DATA ****
      **      ENTER THE DESIRED CYCLE TIME OF THE NGM
      **      (00 OR 12)
      **      ZZ
      ==>     Enter the cycle hour 00 or 12 GMT.
      **      ENTER THE LENGTH OF FORECAST DESIRED (00,06,...48)
      ==>     Enter the forecast length

      **      NGM ARCHIVING ROUTINE -- TESTING VERSION
      **      ENTER THE DESIRED FORECAST DURATION AS BEFORE
      **      00,06,...48
      ==>     Enter the forecast length again
      **      9 47  7 45
      **      **** NGMCROSS SECTION PROGRAM ****
      **      ENTER: YEAR, MONTH, DAY, FORECAST HOUR AS ABOVE
      **      YY MM DD HH
      **      ?
      ==>     Enter year month day and forecast hour, e.g., 88
              04 07 00 (forecast hour is 00, 06, 12, or 18 and
              date must be current day).
```

```
**      ENTER: LEFT EDGE LAT AND LON
==>     Enter one point's latitude and longitude, e.g.,
        40 90.

**      ENTER: RIGHT EDGE LAT AND LON
==>     Enter other point's latitude and longitude,
        e.g., 40 70.

        Turn printer on for output.  The program will
        repeat until a BREAK is received.

EXAMPLE:    See Fig. 2.1.
```

```
EX 'ERL.R32.GR.NGM.NGMCROSS.CLIST'
     **** PULLING NGM DATA ****
 ***********************************************
 *                                             *
 *           NGM RETRIEVAL PROGRAM             *
 *                                             *
 *         (NON-OPERATIONAL VERSION)           *
 *                                             *
 ***********************************************

 ENTER THE DESIRED CYCLE TIME OF THE NGM
 (00 OR 12)
 22
 12

 ENTER THE LENGTH OF FORECAST DESIRED (00,06,12,18,24,...48)
 06
             PLEASE  WAIT ......

  ** NGM ARCHIVING ROUTINE -- TESTING VERSION **
 ENTER THE DESIRED FORECAST DURATION AS BEFORE
 00,06,12,18,24,...48
 06
  9 47  7 45
 00
 06

 *****  NGM DATA RETRIEVAL NOW COMPLETE  ******


 THE FOLLOWING TEMPORARY DATA SETS HAVE BEEN CREATED....

 NGMARC.HEADER  --  CONTAINS RECORD HEADERS
 FP00  --  CONTAINS 0 HOUR NMC UNPACKED DATA.
 FP06  --  CONTAINS 6 HOUR NMC UNPACKED DATA.

 CHECK DATES AND ERROR NUMBERS IN DATA SET NGMARC.HEADER
 TO BE SURE RETRIEVAL WAS SUCCESSFUL.

 **** NGMCROSS SECTION PROGRAM ****
  ENTER: YEAR, MONTH, DAY, FORECAST HOUR AS ABOVE
  YY MM DD HH
 ?
 89 02 27 06
  ENTER: LEFT EDGE LAT AND LON
 ?
 35 100
  ENTER: RIGHT EDGE LAT AND LON
 ?
 35 70

 89  2 27  6   35.0  100.0   35.0   70.0

VARIABLE: WIND (DEG)
 293 291 269 248 234 238 248 253 259 260 253 249 246 245 243 248 247
 299 304 274 245 221 228 237 245 250 249 248 250 246 248 245 247 251
 314 346 305 236 190 207 220 240 241 239 236 237 240 247 248 244 252
 339   4 342 239 120 192 212 243 236 231 227 228 233 245 248 238 247
 344   4 343 243  81 178 206 248 234 227 221 221 228 243 247 235 248

VARIABLE: SPEED  M/S
  16  13  13  16  15  17  18  19  20  20  20  18  18  17  16  16  14
  14   8   7  12  10  13  16  16  20  20  19  17  16  15  14  12  11
  11   6   4   8   5   8  12  11  16  17  15  14  13  13  11   9   9
   8   7   4   5   2   4   8   6  12  14  11  11  10  11  10   5   7
   5   5   3   3   1   2   5   3   7   8   7   8   8   9   8   3   6

VARIABLE: HGHT  M/10
 220 208 206 205 203 203 203 202 204 204 203 200 199 199 199 199 199
 155 146 145 144 143 143 144 143 145 144 144 142 141 141 141 141 141
  99  94  93  93  92  92  93  92  93  93  93  92  91  91  91  91  91
  53  50  50  50  50  50  50  50  50  50  50  49  49  49  49  49  49
  16  15  15  15  15  15  15  15  15  15  15  15  15  15  15  15  15

VARIABLE: TEMP DEG C
   8   8   8   8   5   5   5   3   3   3   2   3   2   3   3   3   3
  11   8   9  10   7   7   8   5   6   6   6   6   6   7   7   7   8
  12   6   7  10   8  10  10   8   9  10   9  10  10  10  11  11  12
  12   7  10  13  11  13  14  11  13  14  13  14  13  14  15  14  14
  16  10  13  17  14  16  18  14  17  18  16  17  15  16  17  16  18

VARIABLE: HUMID G/KG
   3   3   3   4   6   5   5   6   6   6   6   6   5   5   4   4   4
   3   4   5   7   7   7   7   6   7   7   7   7   6   5   5   5   6
   4   6   7   8   8   8   9   8   8   8   7   8   7   7   7   7   8
   5   6   8   9   8   9   9   8   9   8   8   8   7   8   9   8   9
   5   6   8   9   9   9   9   8   8   8   7   8   8   9  10   8   9

VARIABLE: U-VEL CM/S
   2   1   3   4   4   2   1   0   0   1   2   1   1   1   2   1   0
   1   1   2   4   3   3   1   1   1   1   2   1   0   1   1   1   0
   1   0   1   3   3   2   2   1   1   1   1   0   1   1   1   1   0
   0   0   1   1   1   1   1   1   1   1   1   0   0   0   1   0   0
   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0

VARIABLE: V-MIX M2/S
   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
   0   0   0   0   0 401 309   0 231 221 202 205   0   0   0   0   0
 431 425 447 406 511 684 528 329 395 380 345 351   0   0   0   0   0
 266 263 277 252 316 260 202 204 153 148 134 137  51  72  76  78  63

VARIABLE: STAB  L/10
  -5  -4  -2  -2   0  -1  -7  -4 -21 -29 -25 -25 -47  -9  -7   0  -5

VARIABLE: MIXD  M/10
  99  94  93  93  92 143 144  92 145 144 144 142  49  49  49  49  49

VARIABLE: PPT IN*100
   0   0   1   3   4   3   2   5   5   5   6   3   1   3   3   2   4

VARIABLE: DEGREE LAT
  34  35  35  35  36  36  35  36  36  35  36  35  36  35  35  35  34

VARIABLE: DEGREE LON
 100  98  96  94  92  91  89  87  85  83  81  79  77  75  74  71  70


 ENTER: YEAR, MONTH, DAY, FORECAST HOUR AS ABOVE
 YY MM DD HH
?
:I
READY
```

Figure 2.1. An example of how to print cross sections of NGM fields.

2.1.2 NGM 48-hour station forecast

DESCRIPTION: This program will list the hourly amount of precipitation, temperatures of the first three sigma levels, and the wind speed, wind direction, dewpoint, and relative humidity of the first sigma level of a user-specified station as forecast by the Nested Grid Model (NGM).

NOTES: This program will list the NGM forecast for a particular station hour by hour out to 48 hours on the NAS 9000. The program was written by the Development Division of the National Meteorological Center (NMC), Camp Springs, MD.

PROCEDURE:

```
      ==>     Logon to the NAS 9000.

      **      EX 'ERL.R32.GR.CLIST(NGM48HRV)'
      **      ENTER YEAR, MONTH, DAY, HOUR (00 OR 12), AND
              STATION NUMBER
      **      ENTER WITH COMMAS SEPARATING NUMBERS: YR, MN, DY,
              HR, IDIDI
      **      ?
      ==>     Enter parameters
```

EXAMPLE: See Fig. 2.2.

```
→ EX 'ERL.R32.GR.CLIST(NGM48HRV)'
  ENTER THE YEAR, MONTH, DAY, HOUR (00 OR 12), AND STATION NUMBER
  ENTER WITH COMMAS SEPARATING NUMBERS: YR,MN,DY,HR,IOIDI
  ?
→ 89,03,01,12,72405

  INITIAL TIME: 89  3  1 12   STATION: 72405
```

FHR	GMT	PRCP IN	T1 F	TD1 F	RH1 %	DIR1 DEG	SPD1 M/S	T2 F	T3 F
0	12	0.000	29.9	17.0	58.8	283.1	9.4	26.8	24.3
1	13	0.000	28.5	15.1	57.4	290.6	11.2	26.3	23.7
2	14	0.000	27.7	13.9	56.3	296.6	10.0	25.0	22.9
3	15	0.000	30.2	12.4	47.5	299.0	8.0	25.2	20.7
4	16	0.000	31.7	10.4	41.1	297.1	7.4	26.3	20.2
5	17	0.000	33.1	9.6	37.5	293.1	6.7	27.7	21.0
6	18	0.000	34.2	8.5	34.2	288.5	6.2	28.7	21.9
7	19	0.000	35.2	7.0	30.9	284.1	5.9	29.7	22.8
8	20	0.000	35.9	6.6	29.5	281.8	6.0	30.3	23.4
9	21	0.000	36.2	6.3	28.8	281.0	6.4	30.6	23.6
10	22	0.000	35.9	6.0	28.7	281.9	7.7	30.4	23.4
11	23	0.000	35.5	5.8	28.9	282.6	8.6	30.2	23.2
12	0	0.000	34.8	5.3	29.1	285.3	9.6	29.9	22.9
13	1	0.000	33.7	4.7	29.5	293.4	10.1	29.5	22.5
14	2	0.000	32.3	3.9	30.2	304.0	10.7	28.9	22.0
15	3	0.000	30.2	3.1	31.6	312.1	11.4	28.0	21.3
16	4	0.000	27.8	2.3	33.6	319.3	11.0	27.0	20.8
17	5	0.000	25.9	1.9	35.6	324.0	9.7	26.2	20.7
18	6	0.000	24.4	1.6	37.4	324.4	8.6	25.5	20.6
19	7	0.000	23.3	1.4	38.8	322.5	7.5	25.1	20.7
20	8	0.000	22.6	1.4	39.8	321.9	6.4	25.0	21.0
21	9	0.000	22.1	1.3	40.6	322.4	6.1	24.9	21.5
22	10	0.000	21.5	1.3	41.5	323.7	6.4	24.8	21.7
23	11	0.000	20.9	1.2	42.5	326.2	7.0	24.5	21.7
24	12	0.000	20.3	1.2	43.7	329.1	7.1	24.2	21.6
25	13	0.000	19.8	1.3	44.6	329.6	6.2	24.0	21.5
26	14	0.000	20.4	2.4	45.8	327.7	3.5	23.7	21.6
27	15	0.000	24.6	6.7	46.6	297.4	1.1	23.5	21.7
28	16	0.000	28.2	8.6	43.7	255.4	1.1	24.1	21.9
29	17	0.000	30.4	9.2	41.1	236.6	1.2	25.5	22.1
30	18	0.000	31.9	9.8	39.8	215.4	1.4	26.8	22.7
31	19	0.000	33.2	10.4	38.7	188.6	1.7	27.9	23.6
32	20	0.000	34.0	10.8	38.1	163.7	2.2	28.7	24.7
33	21	0.000	34.2	11.4	38.9	153.3	3.2	28.8	25.4
34	22	0.000	33.9	12.1	40.6	151.0	4.9	28.7	26.0
35	23	0.000	33.6	12.3	41.6	152.3	6.7	28.9	26.6
36	0	0.000	33.3	12.6	42.5	155.5	8.4	29.2	27.1
37	1	0.000	33.2	12.9	43.3	158.9	9.7	29.9	27.1
38	2	0.000	33.3	13.0	43.2	161.0	10.4	30.6	26.9
39	3	0.000	33.7	13.5	43.5	162.1	10.6	30.9	26.9
40	4	0.000	33.7	16.3	49.0	162.7	10.8	30.9	27.2
41	5	0.000	33.7	20.5	58.6	163.0	10.7	30.5	27.8
42	6	0.001	32.8	26.0	75.9	163.6	10.5	30.2	28.6
43	7	0.007	32.2	30.2	92.5	163.7	10.0	30.3	30.0
44	8	0.017	32.4	32.0	98.6	162.7	9.3	31.6	31.2
45	9	0.019	33.0	32.8	99.2	162.2	8.7	33.2	32.4
46	10	0.017	33.6	33.2	98.3	161.9	7.9	34.9	33.3
47	11	0.015	34.1	33.5	97.5	160.4	6.8	36.5	34.2
48	12	0.011	34.7	34.0	97.5	156.4	5.7	37.9	35.0

```
  TOTAL PRECIPITATION (IN) FOR  FORECAST=       0.089

  ANOTHER ( Y/N)
→ N
  READY
```

Figure 2.2. An example of an NGM 48-hour forecast for Washington, DC, where FHR is the forecast hour, GMT is Greenwich Mean Time, PRCP is the amount of precipitation (in), T1 through T3 are the temperatures (°F) of the first three sigma layers, SPD1 and DIR1 are the wind speed (m/s) and direction (°) of the first sigma layer, TD1 is the dew point (°F) of the first sigma layer, and RH1 is the relative humidity (%) of the first sigma layer.

2.1.3 NGM field plotting routine I

DESCRIPTION: This program will plot and contour fields from the Nested Grid Model (NGM) on the NAS 9000. Users can choose either a set of default operational maps or maps of fields and levels (pressure and sigma) from a 14-item menu. Plots can be output to a PC screen using a Tektronics emulator (see section 5) or to a Versatec printer.

NOTES: The fields are from the twice-daily production suite of the NGM. The following are default operational maps:

Mean sea level pressure (mb) at 0 hours
500 mb heights (m) at 0 hours
Mean sea level pressure (mb) at 24 hours
Accumulated precipitation (m) at 24 hours
Mean sea level pressure (mb) at 48 hours
Accumulated precipitation (m) at 48 hours

For a list of possible selections, see the menu in Figure 2.3.

This program was written by G.D. Rolph, NOAA/ARL, Silver Spring, MD

PROCEDURE:

==> Using a Tektronics emulator or another communications package, dial the NAS 9000 and logon as explained in the Tektronics section (see section 5).

==> EX 'ERL.R32.GR.CLIST(WXMAPS)'

** ***** NGM PLOTTING ROUTINE *****

** SPECIFY EITHER 00 OR 12 AS THE CYCLE OF TODAY'S OPERATIONAL RUN

** ZZ

==> Enter 00 or 12 GMT.

** ENTER A RETURN FOR ARL DAILY WEATHER MAPS OR THE NUMBER 1 FOR A MENU OF MAPS.

==> Enter a return for default maps or 1 for a menu.

See the examples in Figs. 2.3 and 2.5 for the remaining input, and Figs. 2.4 and 2.6 for output.

Note: Plots will be output to the FR80 TSO temporary file called ARLMAPS and on the second frame.

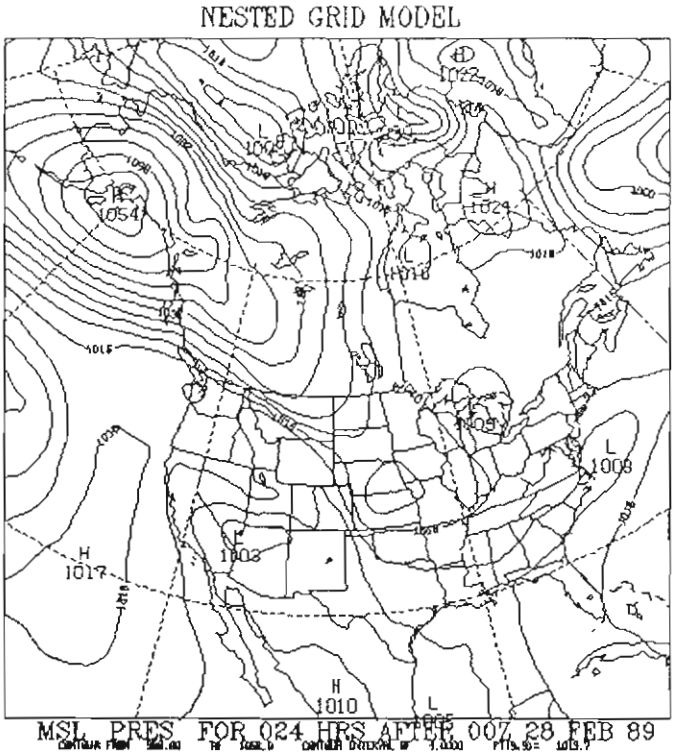
EXAMPLE: See Figs. 2.3 - 2.6.

```
→ EX 'ERL.R32.GR.CLIST(WXMAPS)'


          *****  NGM PLOTTING ROUTINE *****

                    G.D. ROLPH
                      NOAA
                AIR RESOURCES LAB


    SPECIFY EITHER 00 OR 12 AS THE CYCLE OF TODAY'S OPERATIONAL RUN
    ZZ
→   00


    SCREEN OUTPUT IS SAVED IN FILE WXMAPS.JSINK

    TEMPNAME ASSUMED AS MEMBERNAME

      ENTER A RETURN FOR ARL DAILY WEATHER MAPS OR
            THE NUMBER 1 FOR A MENU OF MAPS
→   1


       SELECT A GRID TYPE FOR PLOTTING DATA ONTO
       1 - LFM GRID
       2 - NGM GRID C     (VERY FEW FIELDS ABOVE SURFACE)
→   2

    2

     ENTER THE FIELD (I2) TO BE PLOTTED FROM THE FOLLOWING
    ------------------------------------------------------------
          SIGMA SURFACES                  PRESSURE SURFACES
          --------------                  -----------------
    01 - TEMPERATURE                   04 - TEMPERATURE
    02 - SPECIFIC HUMIDITY             05 - SPECIFIC HUMIDITY
    03 - HORIZONTAL WIND               06 - HORIZONTAL WIND
                                       07 - VERTICAL VELOCITY
                                       08 - RELATIVE HUMIDITY
                                       09 - HEIGHTS
    ------------------------------------------------------------
    10 - 12-HOUR ACCUM. TOTAL PRECIP.  13 - SNOW COVER
    11 - MEAN SEA-LEVEL PRESSURE       14 - QUIT
    12 - SURFACE PRESSURE
    ------------------------------------------------------------
→   11

    11
     -->   SELECT A FORECAST HOUR IN FORMAT I2    <--
     -->   ENTER ONLY  00, 12, 24, 36, OR 48  <--
→   24

    24

     DEFAULT CONTOUR INTERVAL IS :  4.000  MB
     ENTER NEW VALUE OR RETURN FOR DEFAULT
    CC.CCC
→


     4.000

     KTL=          MSL  PRES  FOR 024 HRS AFTER 00Z 28 FEB 89
          FINISHED PLOT NUMBER  1

     ENTER THE FIELD (I2) TO BE PLOTTED FROM THE FOLLOWING
    ------------------------------------------------------------
          SIGMA SURFACES                  PRESSURE SURFACES
          --------------                  -----------------
    01 - TEMPERATURE                   04 - TEMPERATURE
    02 - SPECIFIC HUMIDITY             05 - SPECIFIC HUMIDITY
    03 - HORIZONTAL WIND               06 - HORIZONTAL WIND
                                       07 - VERTICAL VELOCITY
                                       08 - RELATIVE HUMIDITY
                                       09 - HEIGHTS
    ------------------------------------------------------------
    10 - 12-HOUR ACCUM. TOTAL PRECIP.  13 - SNOW COVER
    11 - MEAN SEA-LEVEL PRESSURE       14 - QUIT
    12 - SURFACE PRESSURE
    ------------------------------------------------------------
→   10
```

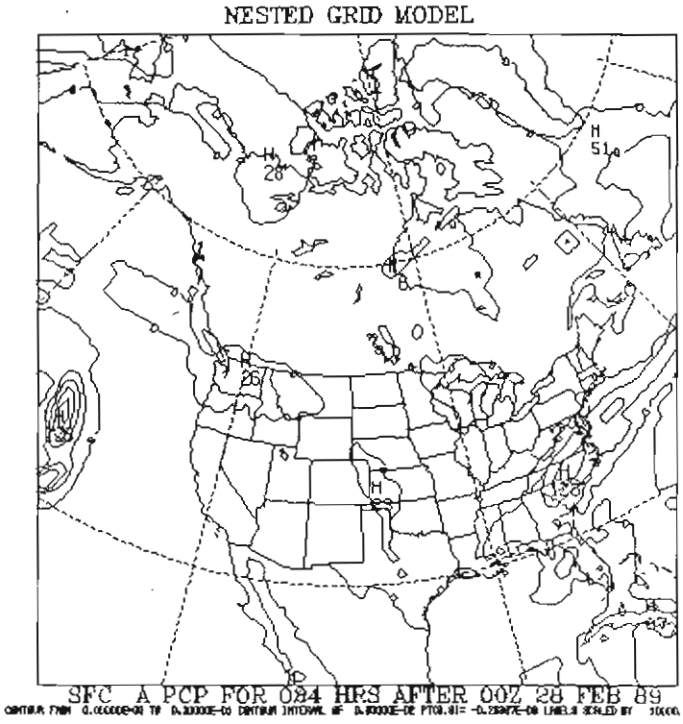
Figure 2.3. A sample run to plot NGM mean sea level pressure and 12-hour accumulated precipitation as shown in Figure 2.4.

```
10
 -->   SELECT A FORECAST HOUR IN FORMAT I2     <--
 -->   ENTER ONLY  00, 12, 24, 36, OR 48  <--
→ 24

24

 DEFAULT CONTOUR INTERVAL IS :  0.005  M
 ENTER NEW VALUE OR RETURN FOR DEFAULT
CC.CCC
→
 0.005

 KTL=          SFC  A PCP FOR 024 HRS AFTER 00Z 28 FEB 89
      FINISHED PLOT NUMBER  2

 ENTER THE FIELD (I2) TO BE PLOTTED FROM THE FOLLOWING
-------------------------------------------------------------
      SIGMA SURFACES                    PRESSURE SURFACES
      --------------                    -----------------
01 - TEMPERATURE                   04 - TEMPERATURE
02 - SPECIFIC HUMIDITY             05 - SPECIFIC HUMIDITY
03 - HORIZONTAL WIND               06 - HORIZONTAL WIND
                                   07 - VERTICAL VELOCITY
                                   08 - RELATIVE HUMIDITY
                                   09 - HEIGHTS
-------------------------------------------------------------
10 - 12-HOUR ACCUM. TOTAL PRECIP.  13 - SNOW COVER
11 - MEAN SEA-LEVEL PRESSURE       14 - QUIT
12 - SURFACE PRESSURE
-------------------------------------------------------------
→ 14

14
   ***** RAN TO PLANNED COMPLETION *****
 TOTAL NUMBER OF PLOTS =    2

*********************************************************
PLOTS HAVE BEEN PUT INTO $MGCOGR.ARLMAPS AND MAY NOW
BE DISPLAYED ON PC WITH A TEKTRONIX EMULATOR OR ON
THE VERSATEC WITH FR2VTC COMMAND.
*********************************************************


DO YOU WANT TO DISPLAY THE PLOTS WITH A TEKTRONICS EMULATOR (T)
  OR WITH NMC'S VERSATEC PRINTER (V)
→ T

T

NOTE:  THIS CHOICE REQUIRES YOU TO BE LOGGED ON WITH
       A TEKTRONICS EMULATOR.  IF YOU ARE NOT LOGGED
       ON WITH AN EMULATOR ANSWER NO TO THE NEXT QUESTION
       AND LOGOFF/LOGON WITH AN EMULATOR. THEN EXECUTE
       THE FOLLOWING:
       EX 'ERL.R32.GR.CLIST($PLOT)' 'ARLMAPS'

 ARE YOU LOGGED ON WITH AN EMULATOR (Y/N)?
→ Y

   $PLOT $MGCOGR.ARLMAPS
   HELP/.  DEFAULT PARAMETER VALUES AND DESCRIPTION LISTING
   GO/-1.  COMMAND FOR THE FIRST FRAME OF PLOT
    COMMUNICATIONS:  MUST DIAL IN ON 736-5800 AND TYPE   GRF
PLEASE ENTER COMMAND
→ SK/1.

OK
→ GO/.
```

Figure 2.3. Continued.



a)

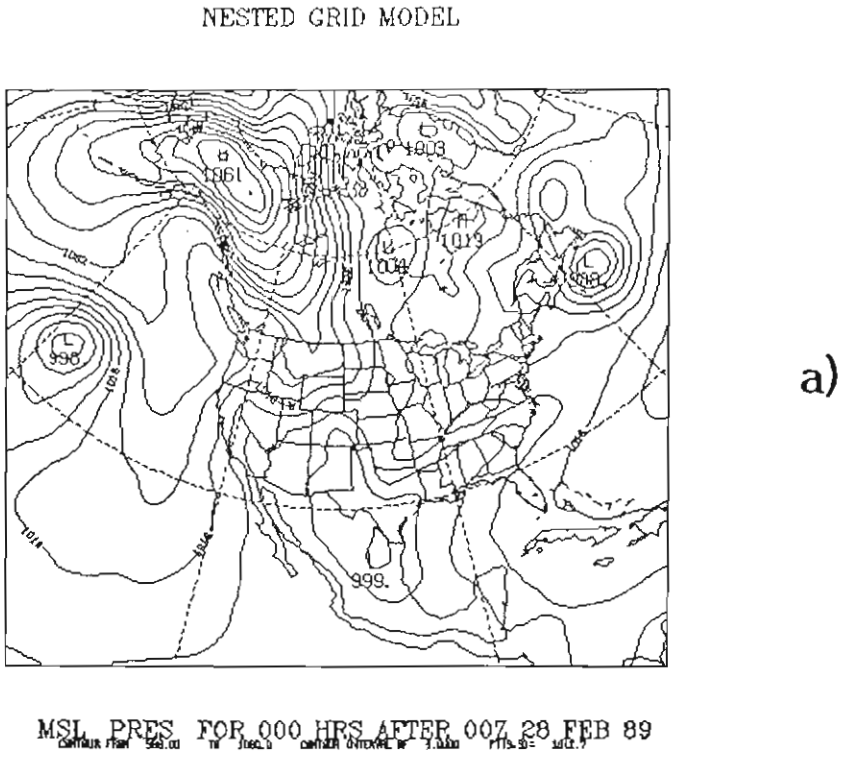


b)

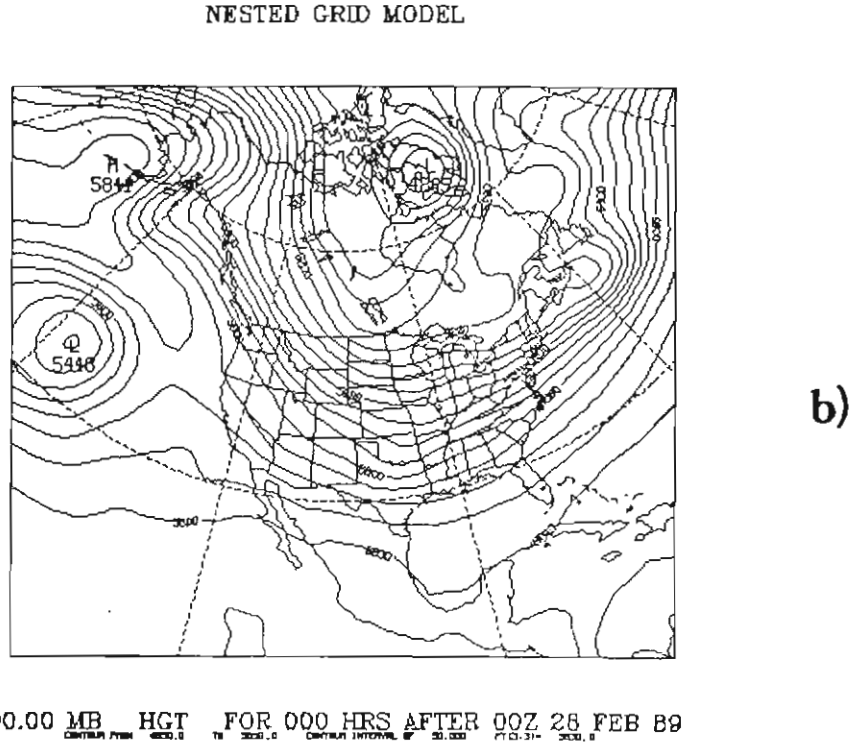
Figure 2.4. 24-hour forecasts of (a) mean sea level pressure (mb) and (b) 12-hour accumulated precipitation (cm x 100) as forecast by the NGM at 00 GMT on February 28, 1989.

```
→ EX 'ERL.R32.GR.CLIST(WXMAPS)'

            *****  NGM PLOTTING ROUTINE *****

                       G.D. ROLPH
                         NOAA
                  AIR RESOURCES LAB


     SPECIFY EITHER 00 OR 12 AS THE CYCLE OF TODAY'S OPERATIONAL RUN
     ZZ
→    00

     SCREEN OUTPUT IS SAVED IN FILE WXMAPS.JSINK

     TEMPNAME ASSUMED AS MEMBERNAME

       ENTER A RETURN FOR ARL DAILY WEATHER MAPS OR
             THE NUMBER 1 FOR A MENU OF MAPS
→

      KTL=          MSL  PRES  FOR 000 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  1


      KTL=   500.00 MB   HGT   FOR 000 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  2


      KTL=          MSL  PRES  FOR 024 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  3


      KTL=          SFC  A PCP FOR 024 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  4


      KTL=          MSL  PRES  FOR 048 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  5


      KTL=          SFC  A PCP FOR 048 HRS AFTER 00Z 28 FEB 89
           FINISHED PLOT NUMBER  6

        ***** RAN TO PLANNED COMPLETION *****
      TOTAL NUMBER OF PLOTS =    6

     ********************************************************
     PLOTS HAVE BEEN PUT INTO $MGCOGR.ARLMAPS AND MAY NOW
     BE DISPLAYED ON PC WITH A TEKTRONIX EMULATOR OR ON
     THE VERSATEC WITH FR2VTC COMMAND.
     ********************************************************


     DO YOU WANT TO DISPLAY THE PLOTS WITH A TEKTRONICS EMULATOR (T)
       OR WITH NMC'S VERSATEC PRINTER (V)
→    T
     T

     NOTE:  THIS CHOICE REQUIRES YOU TO BE LOGGED ON WITH
            A TEKTRONICS EMULATOR.  IF YOU ARE NOT LOGGED
            ON WITH AN EMULATOR ANSWER NO TO THE NEXT QUESTION
            AND LOGOFF/LOGON WITH AN EMULATOR. THEN EXECUTE
            THE FOLLOWING:
            EX 'ERL.R32.GR.CLIST($PLOT)' 'ARLMAPS'

      ARE YOU LOGGED ON WITH AN EMULATOR (Y/N)?
→    Y
        $PLOT $MGCOGR.ARLMAPS
        HELP/.  DEFAULT PARAMETER VALUES AND DESCRIPTION LISTING
        GO/-1.  COMMAND FOR THE FIRST FRAME OF PLOT
         COMMUNICATIONS:  MUST DIAL IN ON 736-5800 AND TYPE   GRF
     PLEASE ENTER COMMAND
→    SK/1.
     OK
→    GO/.
```

Figure 2.5. A sample run to plot default maps of NGM fields for 00 GMT on February 28, 1989.



a)



b)

Figure 2.6. NGM maps of (a) mean sea level pressure (mb) and (b) 500 mb heights (m), for 00 GMT on February 28, 1989.

2.1.4 NGM field plotting routine II

DESCRIPTION: This program is similar to, but not as general as, NGM I (see section 2.1.3). Only three maps are available, but two fields are plotted on each map. Other differences from NGM I are that the 1000-500 mb thickness is available and the horizontal wind field is displayed using vectors. The map background and data field plots are generated separately.

NOTES: Fields are from the twice-daily production suite of the NGM. The user first runs a clist to compile the program and then has a choice of two subprograms. The following fields may be plotted:

- MSL pressure (mb) and 1000-500 mb thickness (m)
- 12-hour accumulated precipitation (in/100) and 700 mb relative humidity (RH) (%)
- Heights (m) and wind vectors on pressure surfaces or wind vectors on sigma surfaces.

Precipitation at forecast hour 00 is not available. Wind vector lengths are proportional to the wind speed up to 28 m/s.

This program was developed by J.L. Heffter, NOAA/ARL, Silver Spring, MD.

PROCEDURE:

==> Using a Tektronics emulator or another communications package, dial the NAS 9000 and logon as explained in the Tektronics section (see section 5).

==> EX 'ERL.R32.JH.NGM.WXWH.SETUP.CLIST'

** OUTPUT TYPE: GRAPHICS(GRFX) OR PRINTED(PRINT)
** [DEFAULT IS GRFX]

==> Enter only GRFX. PRINT is a diagnostic program.

==> When the clist is finished the user has a choice of executing two subprograms (WX or WH):

==> (1) EX WX for MSL pressure and 1000-500 mb thickness or precipitation and 700 mb RH, or

(2) EX WH for wind vectors and heights at a level.

The following prompts are common to both sub-programs:

```
**      OBSERVATION HOUR (00 or 12)

==>     Enter observation hour 00 or 12 GMT.

**      MAP RUN (1)
**      DATA RUN (2)

==>     Either a map background (1) or data plot (2) is
        generated.

**      SUB-DATA ARRAY BOUNDARIES
**      (I = 01 to 53, J = 01 to 53)
**      I1 J1 I2 J2
**      27 12 45 30 DEFAULT

==>     Enter a return for default values or enter array
        boundaries.

        Refer to Fig. 2.7 for coordinates.

**      SCALE FACTOR
**      (0.1 to 1.0)
**      0.8 DEFAULT

==>     Enter a return for default or enter a scale
        factor.  Smaller scale factors give smaller plots.

**      FORECAST HOUR (00 06 ... 48)

==>     Enter forecast hour.
```

Note: Plots are output to the FR80 TSO file FR80 and begin on the first frame. The following apply to the Tektronics emulator TEKDMK (see section 5):

Viewport coordinates 40-740 (abscissa) and 160-865 (ordinate) work well with the program defaults. For both WX and WH programs, entering a CNTL-C when prompted clears the screen and memory. For the MAP run (of either WX or WH) enter a CNTL-S after the map is displayed to save the map background to the file BKGD.BIN on the PC. Then

on the DATA run (of either WX of WH), enter CNTL-L when prompted to load in the background map. After the data are displayed, a CNTL-P prints memory, which contains both the map and data.

EXAMPLE: See Figs. 2.8 - 2.10.

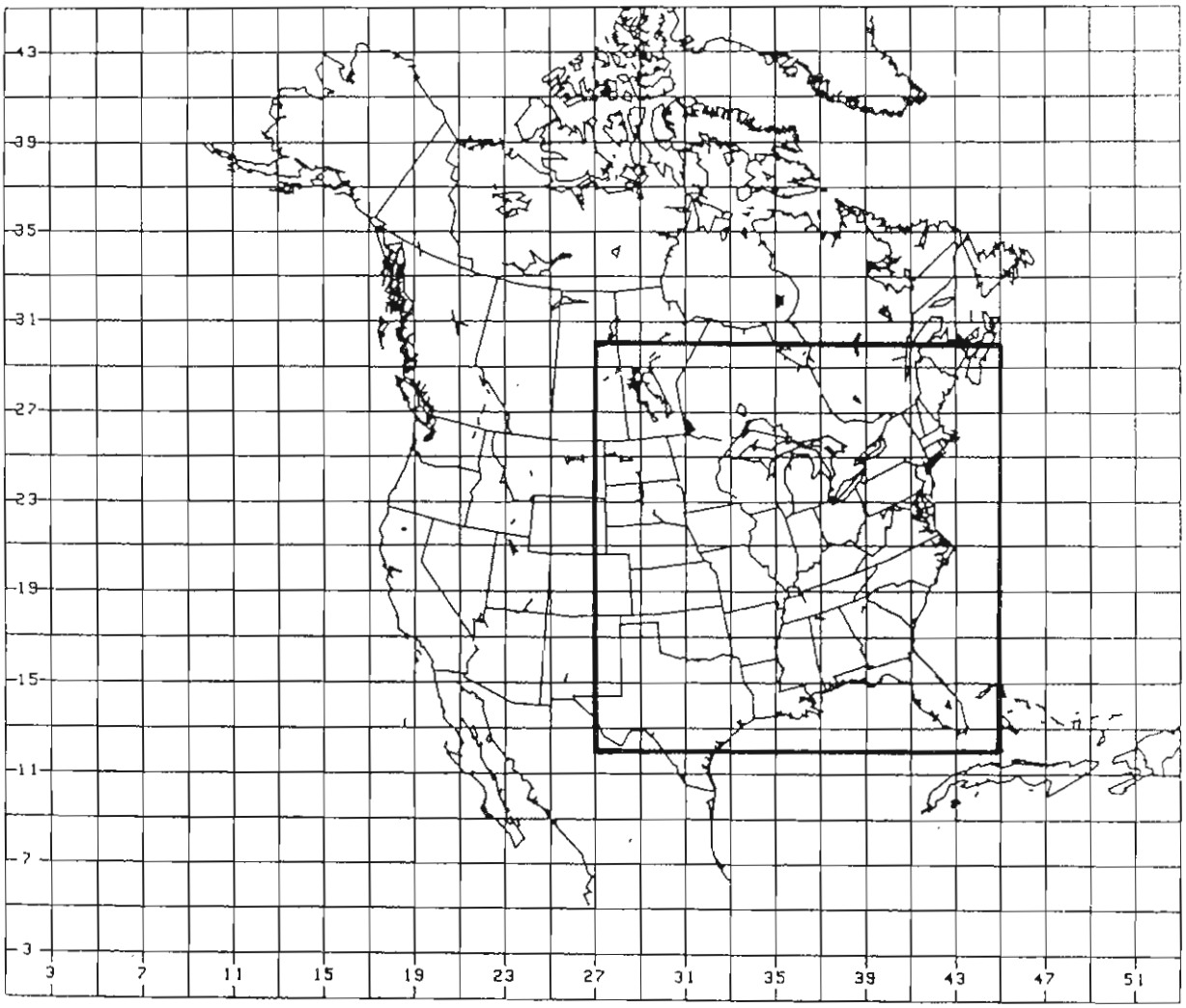


Fig. 2.7. Grid domain for NGM plotting Routine II. Area inside the heavy box is the default region.

Figure 2.8. Examples of how to (a) run the clist to compile the program and (b) run the subprogram WX to plot MSL pressure and 1000-500 mb thickness or 12-hour accumulated precipitation and 700 mb relative humidity, as shown in Fig. 2.9.

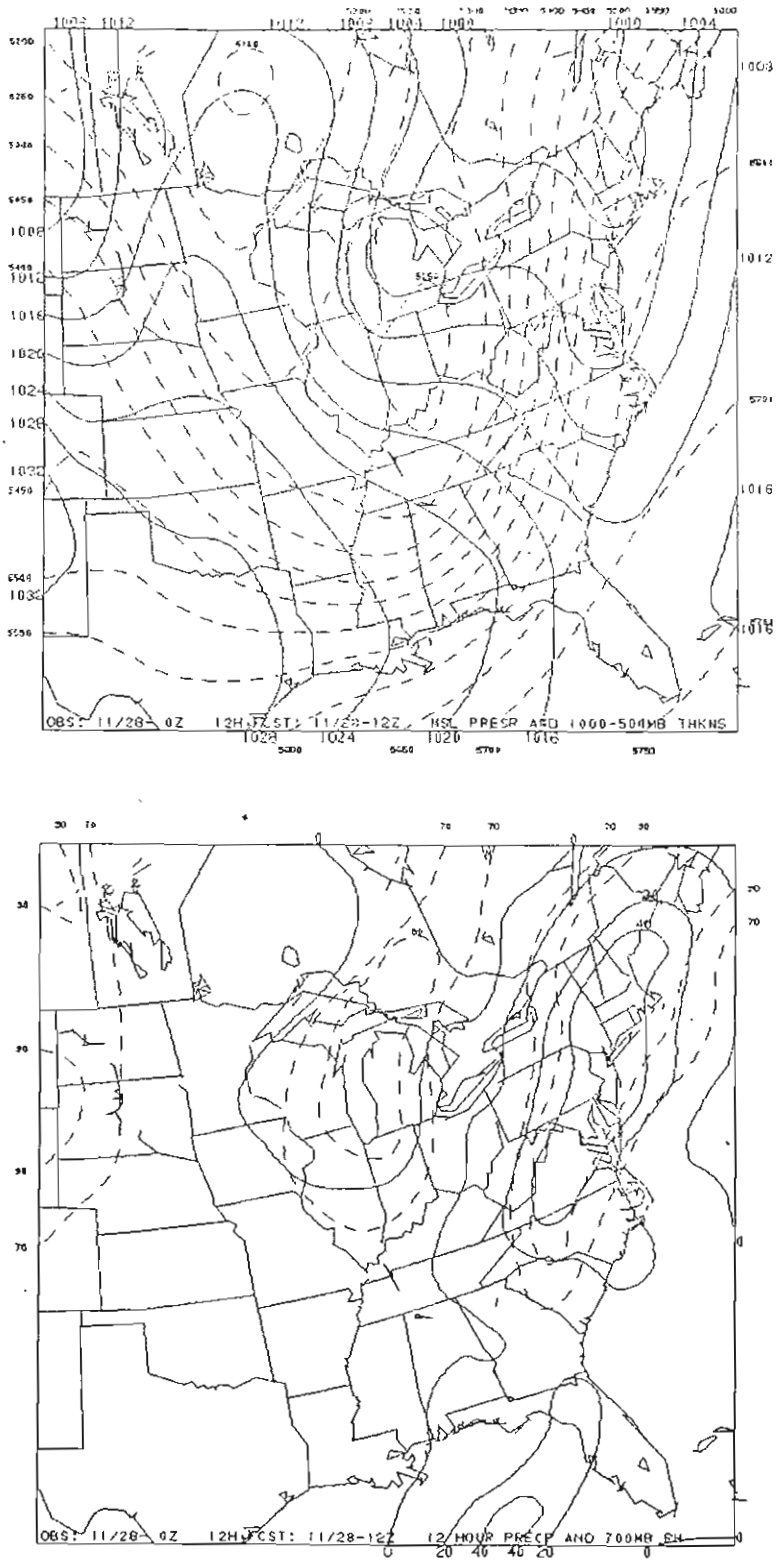
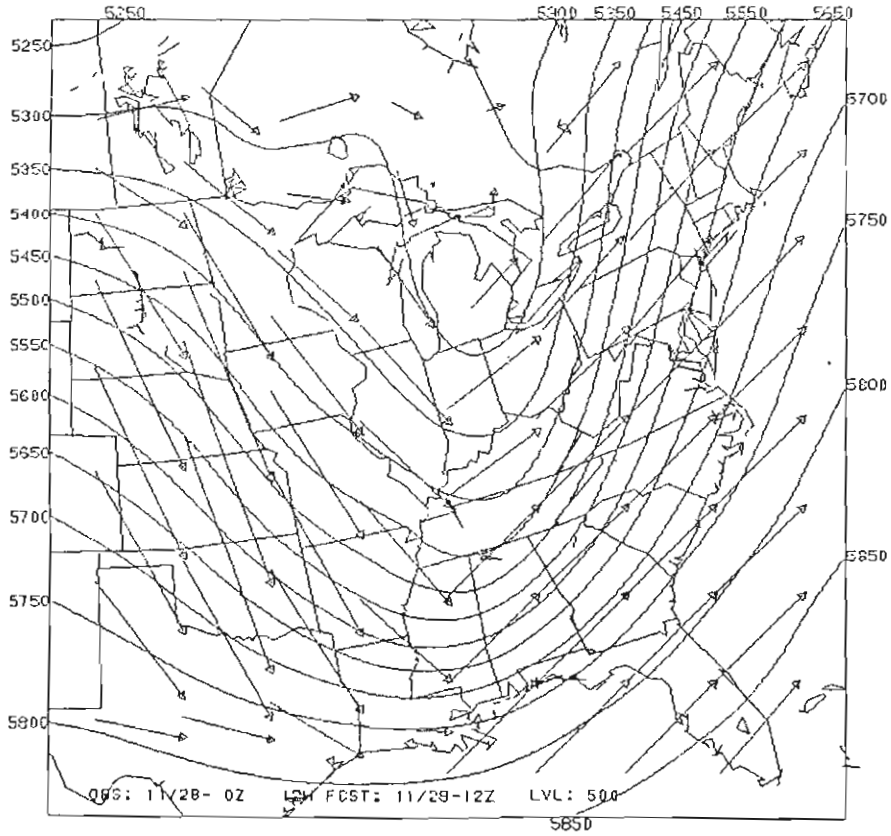


Figure 2.9. NGM forecast maps from subprogram WX: (a) MSL pressure (mb) and 1000-500 mb thickness (m) and (b) 12-hour accumulated precipitation (in/100) and 700 mb relative humidity (%) for 12 hours after 00 GMT on November 28, 1988.

```
→ EX WH
  OBSERVATION HOUR (00 OR 12)
→ 00
  MAP RUN  (1)
  DATA RUN (2)
→ 1
  SUB-DATA ARRAY BOUNDARIES
  (I=01 TO 53,  J=01 TO 33)
  I1 J1 I2 J2
  27 12 45 30 DEFAULT
→
  SCALE FACTOR
  (0.1 TO 1.0)

  0.8 DEFAULT
→
  FORECAST HOUR (00 06 ... 48)
→ 12
  LEVEL:
  850 700 500 300 MB
  098 094 090 084 078 SIGMA
→ 500
                    ----------------------------------------
                    * OBS=11/28- 0Z   12H FCST=11/28-12Z *
                    ----------------------------------------

          CONTOUR MAP  1 FINISHED.
            MOST LINE INCREMENTS   756 ON CONTOUR    5650.00
            MOST SQUARES  37 ON CONTOUR    5600.00

  IT HAS BEEN A PLEASURE SERVING YOU.  I HOPE YOU ENJOY YOUR    1. FRAMES OF FR 80 OUTPUT.


        0. ERRORS DETECTED.
  PLEASE ENTER COMMAND
→ GO/.
```

a)



b)

Figure 2.10. (a) An example of how to run the subprogram WH to plot heights and wind vectors. (b) NGM forecast map of 500 mb heights (m) and 500 mb wind vectors, for 12 hours after 00 GMT on November 28, 1988.

2.2 Medium Range Forecast (MRF) Model Plotting Program

DESCRIPTION: This program will plot and contour fields from the global Medium Range Forecast (MRF) model on the NAS 9000. The purpose of this once-daily run of the MRF is to provide forecasts in the medium range time scale of five to ten days. However, forecast maps can be produced every twelve hours out to ten days. Plots are on a cylindrical projection and can be plotted on a PC screen using a Tektronics emulator (see section 5) or output to a Versatec printer.

NOTES: The following fields are plotted:

Height (m) of chosen level
Temperature (K) of chosen level
Relative humidity (%) of chosen level

Map boundaries can be changed from the default values (North America) by entering the lower left longitude and latitude and the upper right longitude and latitude, with reference to Figure 2.11. Longitudes greater than 180° must be entered as numbers from 180 to 360 going counterclockwise in the Northern Hemisphere.

This program was developed by G.D. Rolph, NOAA/ARL, Silver Spring, MD, and J. Alpert, National Meteorological Center, Camp Springs, MD.

PROCEDURE:

==> Using Smartcom or another communications package, dial the NAS 9000 and logon.

==> EX 'ERL.R32.GR.CLIST(MRFPLTRT)'

==> See the example in Fig. 2.12 for the remaining input.

Note: Plots are output to the FR80 TSO plot file called MRFFR80 and begin on the second frame.

EXAMPLE: See Figs. 2.12 - 2.13.

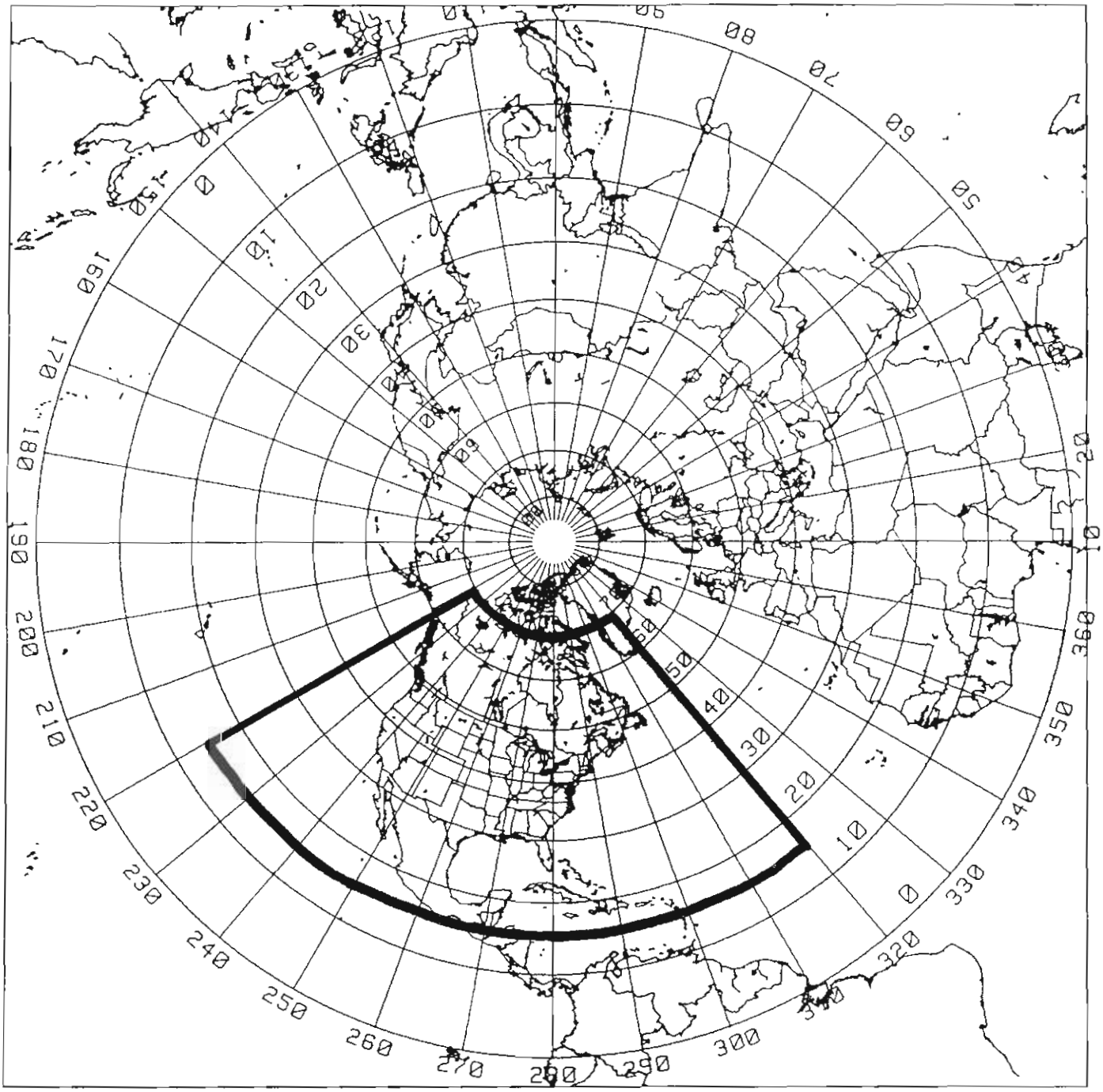
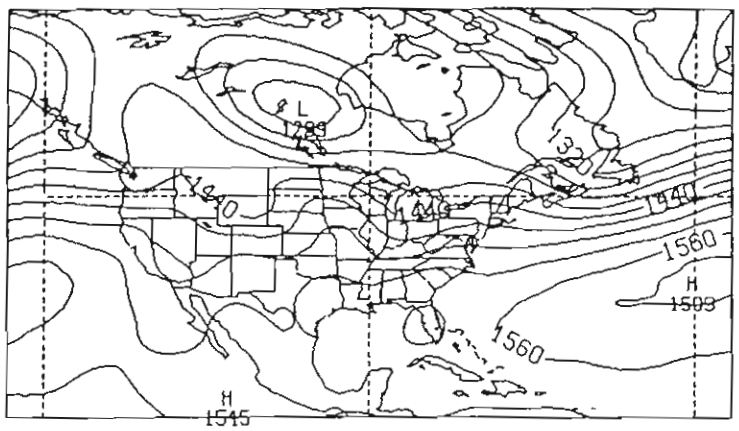


Figure 2.11. MRF grid domain for the Northern Hemisphere. Area inside the heavy box is the default region of the MRF plotting routine.

```
EX 'ERL.R32.GR.CLIST(MRFPLTRT)'
C:)=:  :O~::  ::

          *****  MRF PLOTTING ROUTINE *****

                    G.D. ROLPH
                      NOAA
                AIR RESOURCES LAB


SCREEN OUTPUT IS SAVED IN FILE MRFPLTRT.JSINK

TEMPNAME ASSUMED AS MEMBERNAME
 ******    88   313    11     8     3  1392******
 YR, MTH, DAY, FHR, LEVEL:
 88   11    8    48  1000.
 ENTER CHANGES OR <RETURN> FOR DEFAULT
 YR MO DY ZZZ LLLL
            12  850
 88   11    8    12   850.
  850.00 MB   HGT   FOR 12.0 HRS AFTER 88-11-08 00Z

 DEFAULT COORDINATES COVER MOST OF NORTH AMERICA

 DEFAULT: MINLON, MAXLON, MINLAT, MAXLAT
          220.   320.    15.    70.
 ENTER NEW COORDINATES OR RETURN FOR DEFAULT
 MUST BE DIVISABLE BY 2.5
 LLL. LLL. LL. LL.

 220. 320. 15. 70.

 CONTOUR INTERVAL FOR     HGT  IS :30.
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

30.
 TITLE: 850.00 MB   HGT   FOR 12.0 HRS AFTER 88-11-08 00Z
     FINISHED PLOT NUMBER 1

  850.00 MB   TMP   FOR 12.0 HRS AFTER 88-11-08 00Z

 CONTOUR INTERVAL FOR     TMP  IS : 5.
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

 5.
 TITLE: 850.00 MB   TMP   FOR 12.0 HRS AFTER 88-11-08 00Z
     FINISHED PLOT NUMBER 2

  850.00 MB   R H   FOR 12.0 HRS AFTER 88-11-08 00Z

 CONTOUR INTERVAL FOR      RH  IS :25.
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

25.
 TITLE: 850.00 MB   R H   FOR 12.0 HRS AFTER 88-11-08 00Z
     FINISHED PLOT NUMBER 3

      FINISHED MRF PLOTS
FILE DUMMY NOT FREED, IS NOT ALLOCATED

*****************************************************
PLOTS HAVE BEEN PUT INTO $MGCOGR.MRFFR80 AND MAY NOW
BE DISPLAYED ON PC WITH A TEKTRONICS EMULATOR OR ON
A VERSATEC PRINTER.
*****************************************************

READY
```

Figure 2.12. An example of how to plot MRF fields with changes made to the forecast hour (12 hours) and level (850 mb).

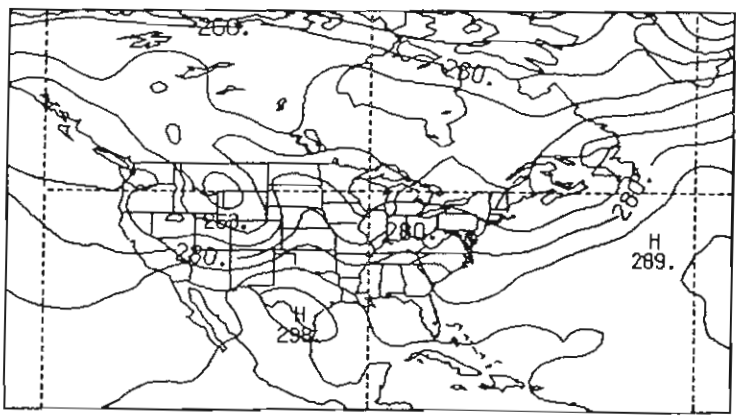
MRF MODEL



a)

850.00 MB HGT FOR 12.0 HRS AFTER 88-11-08 00Z

MRF MODEL



b)

850.00 MB TMP FOR 12.0 HRS AFTER 88-11-08 00Z

Figure 2.13. 12-hour MRF forecasts of (a) 850 mb heights (m) and (b) temperatures (K), from 00 GMT on November 8, 1988.

2.3 Programs for the Aviation (AVN) Run of the MRF Model

2.3.1 AVN plotting routine

DESCRIPTION: This program will plot and contour fields from the Aviation (AVN) run of the global Medium Range Forcast (MRF) model on the NAS 9000. The primary purpose of the AVN is to provide a global forecast for aviation interests as soon as possible after the observations are reported (00 and 12 GMT). Forecast maps may be plotted every six hours out to 72 hours. Plots are on a polar stereographic projection and can be plotted on a PC screen using a Tektronics emulator (see section 5) or output to a Versatec printer.

NOTES: Maps are produced for the following:

Mean sea level pressure (mb)
Height (m) of chosen level
Temperature (K) of chosen level
Relative humidity (%) of chosen level
Vertical velocity (mb/s) of chosen level

Map boundaries can be changed from th default values (North America) by entering the lower left longitude and latitude and the upper right longitude and latitude, with reference to Fig. 2.14. Longitudes greater than 180° must be entered as numbers from 180 to 360 going counterclockwise in the Northern Hemisphere.

This program was developed by G.D. Rolph, NOAA/ARL, Silver Spring, MD

PROCEDURE:

==> Using Smartcom or another communications package, dial the NAS 9000 and logon.

==> EX 'ERL.R32.GR.CLIST(MRFAVN)'

==> See the example in Fig. 2.15 for the remaining input.

Note: Plots are output to the FR80 TSO plot file called AVNFR80 and begin on the second frame.

EXAMPLE: See Figs. 2.15 - 2.17.

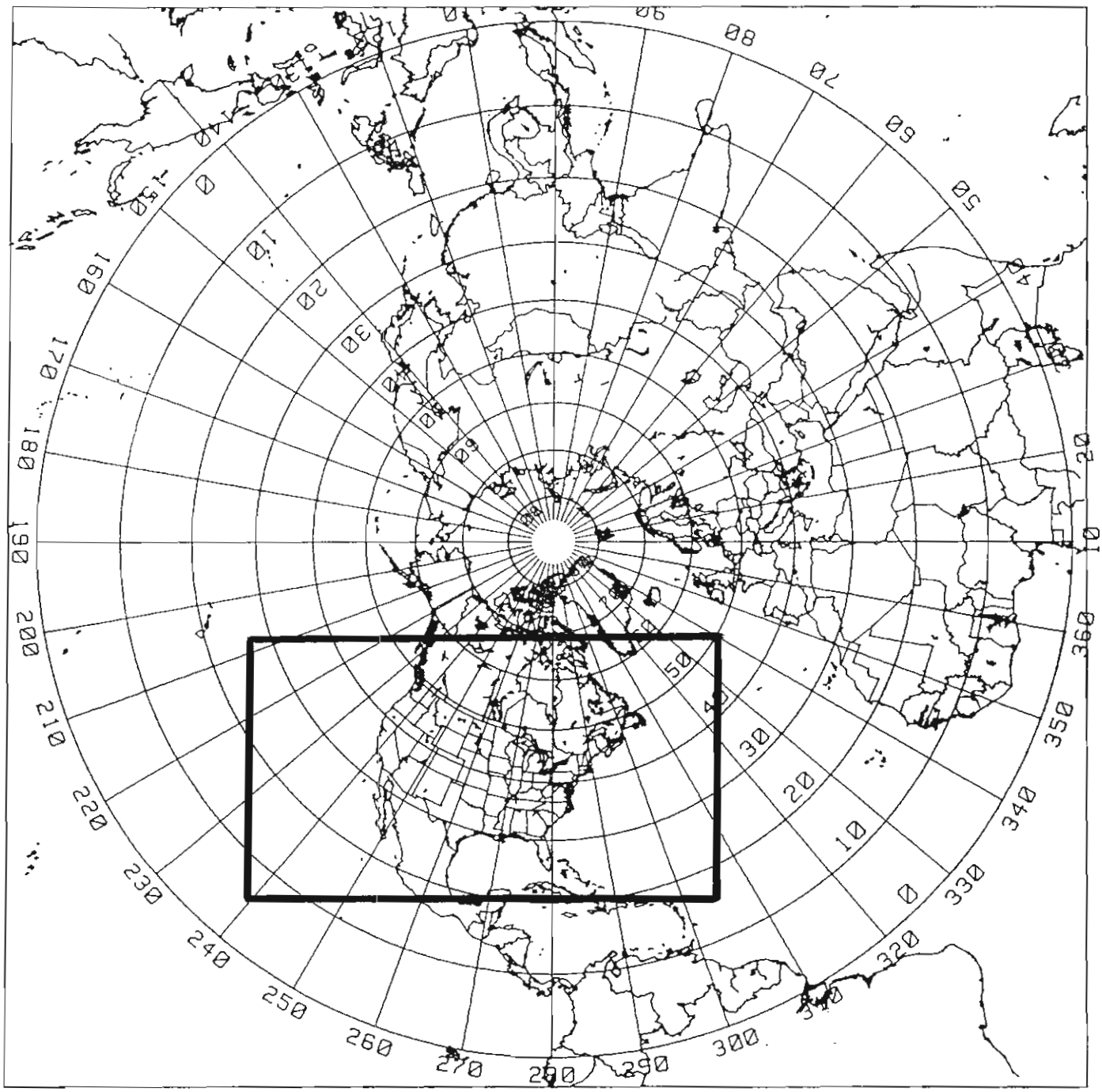
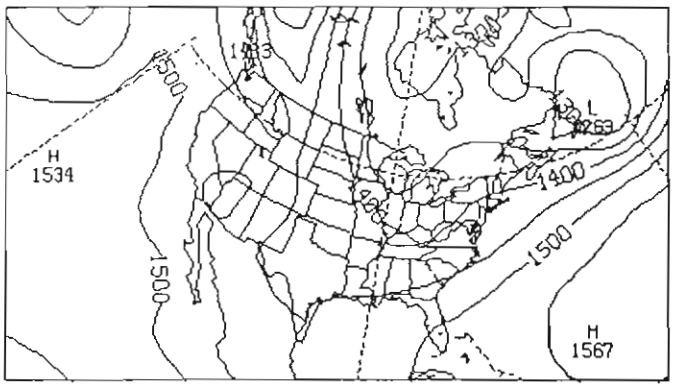


Figure 2.14. AVN grid domain for the Northern Hemisphere. Area inside the heavy box is the default region of the AVN plotting routine.

```
EX 'ERL.R32.GR.CLIST(MRFAVN)'

C:)=:  :O-::  ::

        *****  MRF AVN PLOTTING ROUTINE *****

                    G.D. ROLPH
                      NOAA
                AIR RESOURCES LAB



ENTER MRF AVN CYCLE HOUR TO ALLOCATE FILES
 (00 OR 12)
ZZ
00



SCREEN OUTPUT IS SAVED IN FILE MRFAVN.JSINK

TEMPNAME ASSUMED AS MEMBERNAME
 ******    89    59     2    28     3  1170******

 ********************** CHOICES *************************
  LEVEL -- 1000 850 700 500 400 300 250 200 150 100
 ********************************************************
  FORECAST HOUR -- 00,06,12,18,24,...,72
 ********************************************************

 YR, MTH, DAY, CTC, FHR, LEVEL:
 89    2   28    0    0   1000
 ENTER CHANGES OR <RETURN> FOR DEFAULT
 TR MO DT ZZ ZZ LLLL
             12  850

 89    2   28    0   12    850

      DEFAULT COORDINATES COVER MOST OF NORTH AMERICA
 ------------------------------------------------------------
 LOWER LEFTLON & LEFTLAT - UPPER RGHTLON & RGHTLAT
         240.        5.          340.      50.

 ENTER NEW COORDINATES OR RETURN FOR DEFAULT
 (0 TO 360 LONGITUDE GOING COUNTERCLOCKWISE)
 SLLL. SLL. SLLL. SLL.

  240.   5.  340.  50.

 CONTOUR INTERVAL FOR     HGT  IS :50.  M
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

50.
 TITLE: 850.00 MB   HGT   FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 1

 CONTOUR INTERVAL FOR     TMP  IS : 5.  DEG C
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

 5.
 TITLE: 850.00 MB   TMP   FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 2

 CONTOUR INTERVAL FOR      RH  IS :25.  %
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

25.
 TITLE: 850.00 MB   R H   FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 3

 CONTOUR INTERVAL FOR    V VEL IS :0.001  MB/S
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 C.CCC

0.001
 TITLE: 850.00 MB   V VEL FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 4

 CONTOUR INTERVAL FOR  MSL PRS IS : 4.  MB
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

 4.
 TITLE:        MSL  PRES  FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 5

---> SELECT A WIND PLOTTING ROUTINE <---
        1.   WIND VECTORS          (SLOW ON P.C.)
        2.   STREAMLINES           (MORE CPU TIME)
        3.   CONTOURS OF U AND V   (BEST FOR P.C.)
1

1
 TITLE: 850.00 MB   U GRD FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 6

 TITLE: 850.00 MB   V GRD FOR 12.0 HRS AFTER 89-02-28 00Z
     FINISHED PLOT NUMBER 7

      FINISHED MRF PLOTS
FILE DUMMY NOT FREED, IS NOT ALLOCATED

*****************************************************
PLOTS HAVE BEEN PUT INTO $MGCOGR.AVNFR80 AND MAY NOW
BE DISPLAYED ON PC WITH A TEKTRONICS EMULATOR OR ON
A VERSATEC PRINTER.
*****************************************************

READY
```

Figure 2.15. An example of how to plot AVN fields with changes made to the forecast hour (12 hours) and level (850 mb).

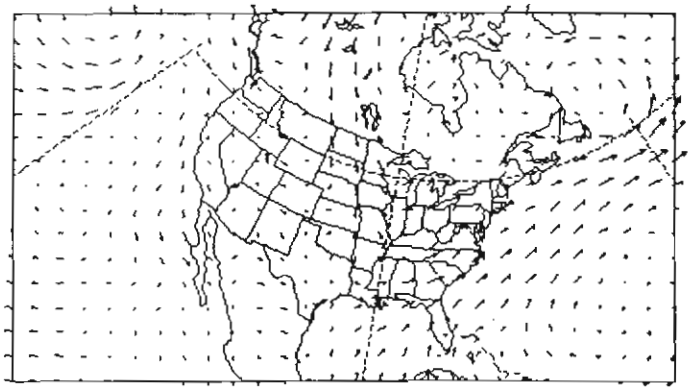
MRF(AVN) MODEL



a)

850.00 MB HGT FOR 12.0 HRS AFTER 89-02-28 00Z

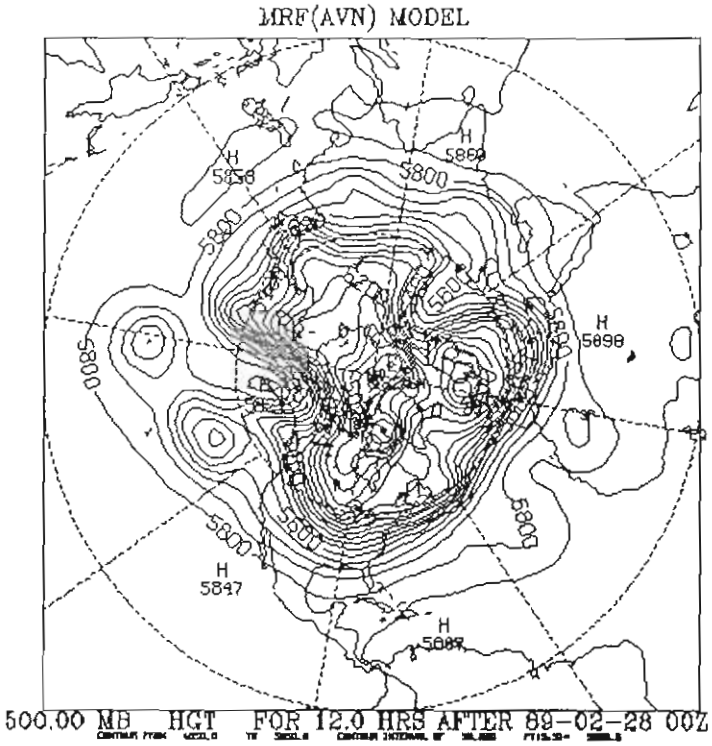
MRF(AVN) MODEL



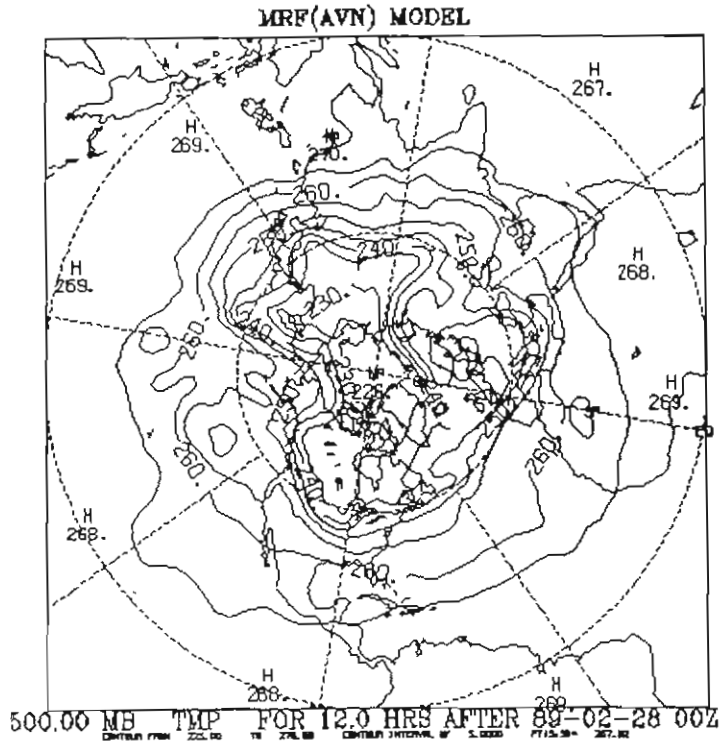
b)

850.00 MB V GRD FOR 12.0 HRS AFTER 89-02-28 00Z

Figure 2.16. 12-hour AVN forecasts of 850 mb (a) heights (m) and (b) wind vectors, from 00 GMT on February 28, 1989.



a)



b)

Figure 2.17. 12-hour AVN Northern Hemispheric forecasts of 500 mb (a) heights (m) and (b) temperatures (K), from 00 GMT on February 28, 1989. Map boundaries chosen were LLON=235., LLAT=-20., RLON=55., and RLAT=-20.

2.3.2 WATOX AVN plotting routine

DESCRIPTION: This program will plot and contour fields from the Aviation (AVN) run of the Medium Range Forecast (MRF) model on the NAS 9000. This version of the AVN plotting routine is similar to the original version in section 2.3.1, except the fields and default map boundaries were originally designed for use during the Western Atlantic Ocean Experiment (WATOX) (Galloway and Whelpdale, 1987). Plots can be output to a PC screen using a Tektronics emulator (see section 5) or output to a Versatec printer.

NOTES: The program is set up for six plots:

(1) 850 mb heights (m)
(2) 850 mb relative humidity (%)
(3) 700 mb heights (m)
(4) 700 mb relative humidity (%)
(5) 500 mb heights (m)
(6) MSL pressure (mb)

It covers the western Atlantic Ocean region by default. The fields can be changed for other applications; however, the program will need to be recompiled.

This program was developed by G.D. Rolph, NOAA/ARL, Silver Spring, MD.

PROCEDURE:

==> Using Smartcom or another communications package, dial the NAS 9000 and logon.

==> EX 'ERL.R32.GR.CLIST(AVNWTX)'

==> See the example in Fig. 2.18 for the remaining input.

Note: Plots are output to the FR80 TSO plot file called AVNFR80 and begin on the second frame.

EXAMPLE: See Figs. 2.18 - 2.19.

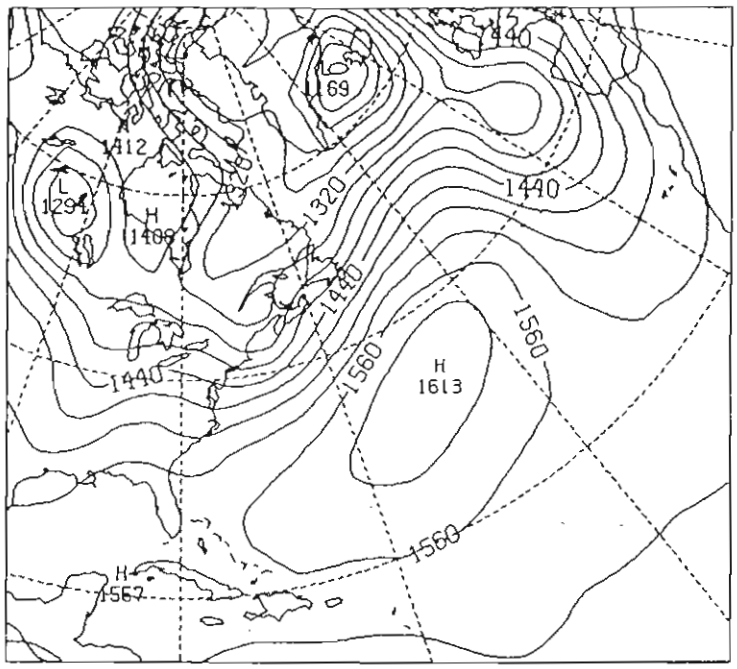
```
EX 'ERL.R32.GR.CLIST(AVNWTX)'
C:)=:  :O-::  ::

        *****  AVN WATOX PLOTTING ROUTINE *****

                    G.D. RALPH
                      NOAA
                AIR RESOURCES LAB


ENTER MRF AVN CYCLE HOUR TO ALLOCATE FILES
 (00 OR 12)
ZZ
00



SCREEN OUTPUT IS SAVED IN FILE AVNWTX.JSINK

TEMPNAME ASSUMED AS MEMBERNAME
 ******    88   313    11     8     3  1488******

 ********************* CHOICES *************************
  FORECAST HOUR -- 00 12 24 36 48 60 72
 ***********************************************************

 YR, MTH, DAY, CYC, FHR:
 88   11    8    0    0
 ENTER CHANGES OR <RETURN> FOR DEFAULT
 YR MO DY ZZ ZZ

 88   11    8    0    0

      DEFAULT COORDINATES COVER WATOX 88 REGION
 ---------------------------------------------------------------
 LOWER LEFTLON & LEFTLAT - UPPER RGHTLON & RGHTLAT
         265.        11.              5.       26.

 ENTER NEW COORDINATES OR RETURN FOR DEFAULT
 (0 TO 360 LONGITUDE GOING COUNTERCLOCKWISE)
 SLLL. SLL. SLLL. SLL.

  265.  11.    5.  26.
 DEFAULT LAT/LON SPACING IS 10
 ENTER SPACING OR RETURN FOR DEFAULT.
GG
20
20

 CONTOUR INTERVAL FOR     HGT  IS :30.  M
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

30.
 TITLE: 850.00 MB   HGT   ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 1


 CONTOUR INTERVAL FOR      RH  IS :25.  %
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

25.
 TITLE: 850.00 MB   R H   ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 2


 CONTOUR INTERVAL FOR     HGT  IS :30.  M
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

30.
 TITLE: 700.00 MB   HGT   ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 3


 CONTOUR INTERVAL FOR      RH  IS :25.  %
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

25.
 TITLE: 700.00 MB   R H   ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 4


 CONTOUR INTERVAL FOR     HGT  IS :30.  M
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.
```

Figure 2.18. An example of how to plot AVN fields over the WATOX 1988 region using default values.

```
30.
 TITLE: 500.00 MB   HGT   ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 5

 CONTOUR INTERVAL FOR MSL PRS  IS : 4.  MB
 ENTER NEW VALUE OR RETURN FOR DEFAULT
 CC.

 4.
 TITLE:         MSL  PRES  ANALYSIS  VALID AT 88-11-08 00Z
     FINISHED PLOT NUMBER 6

      FINISHED MRF PLOTS

**************************************************
PLOTS HAVE BEEN PUT INTO $MGCOGR.AVNEXP AND MAY NOW
BE DISPLAYED ON PC WITH A TEKTRONICS EMULATOR OR ON
A VERSATEC PRINTER.
**************************************************

READY
```

Figure 2.18. Continued.

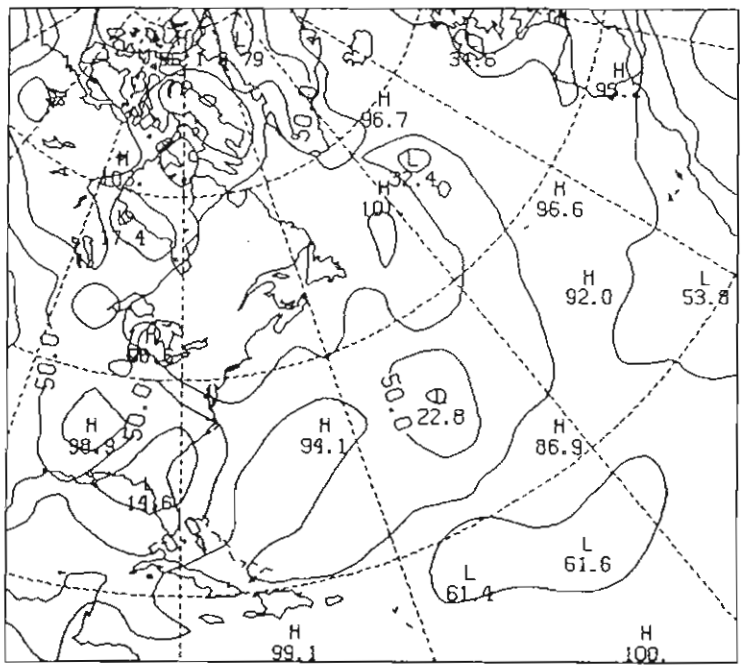
MRF(AVN) MODEL



a)

850.00 MB HGT ANALYSIS VALID AT 88-11-08 00Z

MRF(AVN) MODEL



b)

850.00 MB R H ANALYSIS VALID AT 88-11-08 00Z

Figure 2.19. Analyses of 850 mb (a) heights (m), and (b) relative humidity (%), at 00 GMT on November 8, 1988 over the WATOX 1988 region.

2.4 Model Output Statistics (MOS) Program

DESCRIPTION: This program will print the twice-daily Model Output Statistics (MOS), which are available on the NAS 9000. The user selects the time (00 GMT or 12 GMT) of the output and a three-letter ID for the station desired.

NOTES: This program was developed by the NOAA National Weather Service Techniques Development Laboratory, Silver Spring, MD (see Carter and Dallavalle, 1985, for a complete bibliography on MOS).

PROCEDURE:

==> Using Smartcom or another comunications package, logon to the NAS 9000.

==> EX 'ERL.R32.GR.CLIST(MOSXX)'
(where XX = 00 or 12)

** ENTER STATION XXX ; ENTER STOP OR XXX TO END PROGRAM.

==> Enter three-letter ID of station desired. The data will be listed.

EXAMPLE: See Fig. 2.20.

```
→ EX 'ERL.R32.GR.CLIST(MOS12)'
  ENTER STATION XXX   ENTER STOP OR XXX TO END PROGRAM

→ DCA


  DATE OF FORECAST IS  TUE FEB 28 1989          EARLY GUIDANCE

  WASHINGTON, DC
                                                    VALID TIME
   ELEMENT     UNITS        00Z   06Z   12Z   18Z   00Z   06Z    12Z   18Z   00Z
                          (--TONIGHT--)(-TOMORROW-)(-TMRW NGHT-)(--NEXT DAY--)
   TEMP M/M    DEG F              30           47           29           45
   TEMP        DEG F     44 40 37 36 34 31 38 44 46 39 36 34 32 31 38
   DEW PT      DEG F     28 28 27 26 24 22 22 20 19 18 19 21 21 21 23
   POP(12)     PERCENT                0            3            8           28
   POP(6)      PERCENT              1    0    1    1    0   10    17    27
   POF(P)      PERCENT        80    81   96   95   96   89   64    56    20
   POZR(P)     PERCENT         1    1    1    0    0    1    7     6     9
   PREC TYP    CATEGORY        2    2    2    2    2    2    2     2     3
   R SHR(L)    PERCENT              22        46        27        18
   DRZL(L)     PERCENT              72        10         0         8
   RAIN(L)     PERCENT               6        44        87        74
   TSTM        PERCENT               4         0         0         0
   SVR T(T)    PERCENT               1         0         0
   QPF         CATEGORY                  1         1         1
   CLOUDS      CATEGORY        4    2    2    1    2    2    2     4     4
   08 VIS      CATEGORY        1    1    1    1    1    1    1
   WIND D/S    DEG MPH    3412  3111 3112 3014 3407 0306 0805  1406  1207
   CIG         CATEGORY        5    6    6    6    6    6    6
   VIS         CATEGORY        6    6    6    6    6    6    6
   SNOW AMT    CATEGORY                  0


  DATE OF FORECAST IS  TUE FEB 28 1989          EARLY GUIDANCE

  WASHINGTON, DC
   .TONIGHT...CLOUDY THIS EVENING, BECOMING MOSTLY CLEAR AFTER MIDNIGHT.
   LOW NEAR 30.  LIGHT NORTHWEST WINDS.
   .WEDNESDAY AND WEDNESDAY NIGHT...PARTLY CLOUDY, HIGH IN THE UPPER
   40S, LOW IN THE UPPER 20S.  WINDS 5 TO 15 MPH.
   .THURSDAY...BECOMING CLOUDY WITH A CHANCE OF RAIN OR RAIN AND SNOW
   MIXED.  HIGH IN THE MID 40S.  CHANCE OF PRECIPITATION 30 PERCENT.

→ XXX

  READY
```

Figure 2.20. An example showing how to list the MOS forecast for Washington, DC.

3. METEOROLOGICAL OBSERVATION PROGRAMS

3.1 Surface Weather Map (WXMAP) for the PC

DESCRIPTION: This program will enable the user to download surface weather data from the NAS 9000 to the PC and plot it on one of five available base maps. The user can choose one or all of the following weather elements to plot:

Temperature	Dew point
Visibility	Wind direction
Wind speed	Pressure
Weather	Cloud coverage

NOTES: This program requires downloading the current surface data from the NAS 9000. The following procedure assumes the user is using the Smartcom communications package (other communications packages should work with only minor modifications). Because of the 1200 baud transmission rate on the NAS 9000, be conservative when choosing a region; however, choosing a large region allows plotting of smaller regional maps. For example, downloading data for the entire United States allows plotting of regional maps.

It is assumed that the user has the following programs available to produce the maps on the PC. These files are available upon request (see Appendix):

WXMAP.EXE	EASTRNUS.BIN
WXMAPS.BAT	SEASTUS.BIN
DATACONV.BAS	MIDATLAN.BIN
ALLUS.BIN	MDVAWV.BIN

PROCEDURE:

==> Logon to the NAS 9000 using Smartcom.

==> TERM LINESIZE(132)

==> EX 'ERL.R32.GR.CLIST(SORTOBS)'

** ENTER POSITIONAL PARAMETER HOUR

==> Enter the hour in GMT time of observations desired.

	AREA	ULAT	LLAT	LLON	RLON
1.	Eastern U.S.	45.00	30.00	095.00	070.00
2.	Mid-Atlantic States	43.00	36.00	081.00	070.00
3.	Southeastern U.S.	40.00	33.00	085.00	070.00
4.	United States	55.00	23.00	120.00	070.00
5.	MD, VA and WVA	41.00	36.00	083.00	070.00

```
**      ENTER UPPER LATITUDE
==>     Choose upper latitude (ULAT) from chart above.

**      ENTER LOWER LATITUDE
==>     Choose lower latitude (LLAT) from chart above.

**      ENTER LEFT LONGITUDE
==>     Choose left longitude (LLON) from chart above.

**      ENTER RIGHT LONGITUDE
==>     Choose right longitude (RLON) from chart above.

**      WMO STATIONS ONLY (Y/N)
==>     Enter Y for WMO stations or N for all stations.
**      READY

        The program will create TSO data sets OBS.DATA and
        HRLY.OBS.

==>     LIST OBS.DATA NONUM     (Do NOT hit return!!!)

==>     Press Smartcom F4 key to download data.
        Data will scroll across screen until finished.
**      READY

==>     Press Smartcom F1 key to end data transmission.

**      RENAME FILE RECEIVED: C:----------
==>     OBS   (if file already exists enter E to erase old
        copy).
**      READY

==>     LOGOFF
        Get out of Smartcom and into DOS.
        The batch file WXMAPS.BAT may have to be modified
        for the specific PC directory structure.

==>     WXMAPS  <RETURN>
        Data will scroll.

**      ENTER THE MONTH, DAY, TIME .. XX,XX,XX?
```

==> Enter the month, day, and time.

** ENTER MAP TYPE?
==> Choose map background from the list displayed.

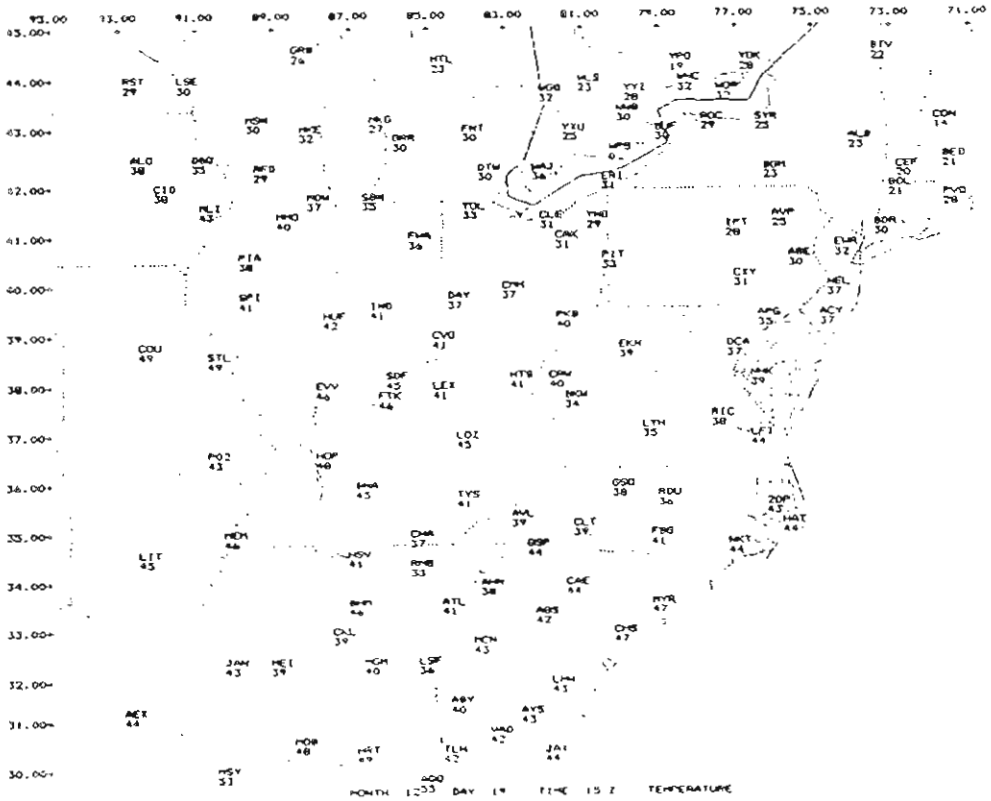
** DO YOU WANT ONLY WMO STATIONS?
==> Enter Y for WMO stations only; otherwise enter N.

** ENTER WEATHER TYPE
==> Enter weather element from the list displayed.
Map will print out and program may be repeated.

EXAMPLE: See Fig. 3.1 for an example of input on the NAS 9000 and a plot on a PC printer.

```
→ TERM LINESIZE(132)
  READY
→ EX 'ERL.R32.GR.CLIST(SORTOBS)'
  ENTER POSITIONAL PARAMETER HOUR -
→ 15

  ...  CURRENT TIME IS 11:46:16 ON 12/19/88 ...

  HOURLY COPIED
                MAP BOUNDARIES
       AREA                ULAT  LLAT  LLON   RLON
  1. EASTERN U.S           45.00 30.00 095.00 070.00
  2. MID-ATLANTIC STATES   43.00 36.00 081.00 070.00
  3. SOUTHEASTERN U.S.     40.00 33.00 085.00 070.00
  4. UNITED STATES         55.00 23.00 120.00 070.00
  5. MD. VA AND WVA        41.00 36.00 083.00 070.00

  ENTER UPPER LATITUDE (XX.XX)
→ 55.00
  ENTER LOWER LATITUDE (XX.XX)
→ 23.00
  ENTER LEFT LONGITUDE (XXX.XX)
→ 120.00
  ENTER RIGHT LONGITUDE (XXX.XX)
→ 070.00
  WMO STATIONS ONLY (Y/N)
→ Y

  SORT COMPLETE.....SFC DATA SAVED IN OBS.DATA

  READY
  LIST OBS.DATA NONUM
   OBS.DATA
  ABE  ALLENTOWN-BETHLEHEM      PA 72517  0118  N40.39 W075.26 1453   30   18 15.0
         230      15//        018
```

a)



b)

Figure 3.1. (a) An example showing how to access surface meteorological data on the NAS 9000 for downloading to the PC for plotting. (b) A surface weather map plotted on the PC for 15 GMT on December 19, 1988.

3.2 Upper-Air Observations and Skew-T, Log P Diagrams

DESCRIPTION: This program will access upper-air observations and produce skew-T, log P (skew-T) plots if desired. Data for current diagnostic skew-T plots are obtained from an NMC disk file, converted to "NAMER-WINDTEMP" format (Fig. 3.2), and then may be plotted or used for other purposes. The skew-Ts are plotted using the FR80 plotting package on the NAS 9000 and can be output to the PC screen using a Tektronics emulator (see section 5) or to a Versatec printer.

NOTES: Skew-T plotting requires several submits to the NAS 9000, which can be time consuming. First, diagnostic upper-air data are extracted from an NMC disk file, converted to "NAMER-WINDTEMP" format, and stored on a TSO data set. Second, data for chosen stations and times are extracted from the TSO data set and stored in another TSO data set, SNDING.DATA, for use by the plotting program or for providing the user with a tabular listing of the data. Finally, skew-Ts may be plotted. Note that the data extend only to 500 mb because of NAMER-WINDTEMP restrictions; however, the user has a choice of two skew-T background charts (up to 100 mb or 400 mb). The plotting program code was provided by J. Harris, NOAA/ERL/ARL/GMCC, Boulder, CO.

PROCEDURE:

```
      ==>     Logon to the NAS 9000.
      ==>     EX 'ERL.R32.GR.ADP2WT.CRE8.CLIST'

      **      TODAY (SUN=1...SAT=7)
      ==>     Enter the day number.

      **      NUMBER OF DAYS BACK TO START (YESTERDAY=1...)
      ==>     If getting most recent sounding data type a 1.

      **      NUMBER OF DAYS
      ==>     If getting most recent sounding data type a 2.

              The program will submit job EGRADP.  Please wait
              until the job has successfully ended.

              The TSO temporary data set STADAT will be created.

      ==>     EX 'ERL.R32.GR.ADP2WT.G.CLIST'
```

The program will put upper-air data from the TSO temporary data set STADAT into NAMER-WINDTEMP format.

The TSO temporary data set STADAT is deleted and SKEWT.WT is created.

==> EX 'ERL.R32.GR.SKEWT.CLIST'

** ENTER THE NUMBER OF STATIONS FOR SKEWTS (##)
==> Enter the two-digit number of stations.

** ENTER THE STATION ID, DAY, AND HOUR (IDIDI DDHH)
==> Enter this data for each station wanted.

The program submits job EGRWTDMP. Wait until the job finishes before continuing.

The program creates TSO temporary data set SKEWT.STATID, which contains information on the stations desired. The program also puts NAMER-WINDTEMP data for the stations specified into the TSO temporary data set SNDING.DATA (Fig. 3.3).

If no skew-T plot is desired, the data may be read from SNDING.DATA. Otherwise choose one of the following programs for plotting skew-Ts:

(1) For a skew-T extending from 100 to 1050 mb type:

==> EX 'ERL.R32.GR.SKEWT.G.CLIST'

(2) For a skew-T extending from 400 to 1050 mb type:

==> EX 'ERL.R32.GR.SKEWT4.G.CLIST'

The program submits a job to plot skew-Ts.

1. submits job EGRSKEWT
2. submits job EGRSKWT4

The TSO temporary plot file called FR80 is created. The plots will start on the first frame. Go to the Tektronics emulator section (section 5) to plot the skew-T on the PC screen.

EXAMPLE: See Figs. 3.2 - 3.5.

```
DATA ORGANIZATION FOR EACH OBSERVATION TIME
TIME REC (FOR WINDS)
     STA REC (STATION 1)
            WIND REC (HEIGHT 1)
            WIND REC (HEIGHT 2)
            ETC.
     STA REC (STATION 2)
            WIND REC (HEIGHT 1)
            WIND REC (HEIGHT 2)
            ETC.
     ETC.
TIME REC (FOR TEMPERATURES)
     STA REC (STATION 1)
            TEMP REC (HEIGHT 1)
            TEMP REC (HEIGHT 2)
            ETC.
     STA REC (STATION 2)
            TEMP REC (HEIGHT 1)
            TEMP REC (HEIGHT 2)
            ETC.
     ETC.
```

DATA FORMAT

TIME REC:	YEAR	MONTH	DAY	HOUR	NUMBER OF REPORTS	NUMBER OF RECORDS	MET FIELDS
	I2	I2	I2	I2	I4	I5	I2 { 1 = WINDS; 2 = TEMPS

STA REC:	BLOCK STATION	LATITUDE (DEG*100)	LONGITUDE (DEG*100)	STATION HGT (M,MSL)	NUMBER OF LEVELS
	I5	I5	I6	I4	I3

WIND REC:	WIND HGT (M, MSL)	WIND DIRECTION (DEG)	WIND SPEED (M/S*10)
	I4	I4	I5

TEMP REC:	TEMPERATURE HGT (M, MSL)	PRESSURE (MB)	TEMPERATURE (DEG K*10)	DEWPOINT (DEG K*10)
	I4	I4	I5	I5

Figure 3.2. NAMER-WINDTEMP data organization and format of the sounding listed in Fig. 3.3.

```
1 ->  EX 'ERL.R32.GR.ADP2WT.CREB.CLIST'
      TODAY (SUN=1 ... SAT=7)
  ->  4
      NUMBER OF DAYS BACK TO START (YESTERDAY=1 ...)
  ->  1
      NUMBER OF DAYS (1 TO 9)
  ->  2
      00150 ADPUPA00,0BDY,0FDY,00,06,12,18,10,   ,        ,04,ADPUPA06
      00150 ADPUPA00,02,0FDY,00,06,12,18,10,   ,       ,04,ADPUPA06
      00150 ADPUPA00,02,02,00,06,12,18,10,   ,       ,04,ADPUPA06
      SAVED
      JOB EGRADP(JOB01344) SUBMITTED
      ENTRY (A) $MGC0GR.CREB.JCL DELETED
      CREB.JCL SUBMITTED
      WAIT FOR NOTIFY BEFORE EXECUTING ADP2WT.G.CLIST
      READY
      IAT6108 JOB EGRADP   ,1344 ENDED, COMP CODE = ZERO       CN(00)
2 ->  EX 'ERL.R32.GR.ADP2WT.G.CLIST'
      88 517 0
      88 517 0  96 1486 1
      88 517 0  94 1175 2
      88 517 6
      88 517 6   0    0 1
      88 517 6   0    0 2
      88 51712
      88 51712 110 1721 1
      88 51712 106 1367 2
      88 51718
      88 51718   9  115 1
      88 51718   3   49 2
      88 518 0
      88 518 0  96 1538 1
      88 518 0  96 1224 2
      88 518 6
      88 518 6   0    0 1
      88 518 6   0    0 2
      ENTRY (A) $MGC0GR.TEMP.TEMPS DELETED
      ENTRY (A) $MGC0GR.TEMP.WINDS DELETED
      ENTRY (A) $MGC0GR.STADAT DELETED
      READY
3 ->  EX 'ERL.R32.GR.SKEWT.CLIST'
      ENTER THE NUMBER OF STATIONS FOR SKEWTS (##)
  ->  01
      ENTER THE STATION ID, DAY, AND HOUR (IDIDI DDHH)
  ->  72403 1800
      JOB EGRWTDMP(JOB01414) SUBMITTED
      READY

  ->  LIST SNDING.DATA NONUM
       SNDING.DATA
      88 518 0  96 1538 1
      72403 3897  7746  85 19
        85   50    51
        85   50    51
       304   25   108
       609    5   154
       914  355   123
      1219  340    77
      1459  305    46
      1828  260    41
      2133  220    41
      2438  195    46
      2743  205    46
      3048  220    56
      3052  220    56
      3657  225    82
      4267  230    77
      4572  235    82
      4876  220    87
      5181  200   128
      5670  200   185
      88 518 0  96 1224 2
      72403 3897  7746  85 14
        85 1000  2892  2872
        85 1000  2892  2872
       411  962  2870  2853
       535  948  2886  2836
      1449  850  2848  2778
      1459  850  2848  2778
      2168  779  2792  2781
      2402  757  2778  2740
      3052  700  2732  2724
      3055  698  2729  2721
      3645  648  2699  2691
      4016  618  2657  2597
      5637  500  2591  2580
      5670  500  2591  2580
      READY
4 ->  EX 'ERL.R32.GR.SKEWT4.G.CLIST'
      JOB EGRSKWT4(JOB01578) SUBMITTED
```

Figure 3.3 An example showing how to plot a skew-T, log P diagram and list the sounding data.

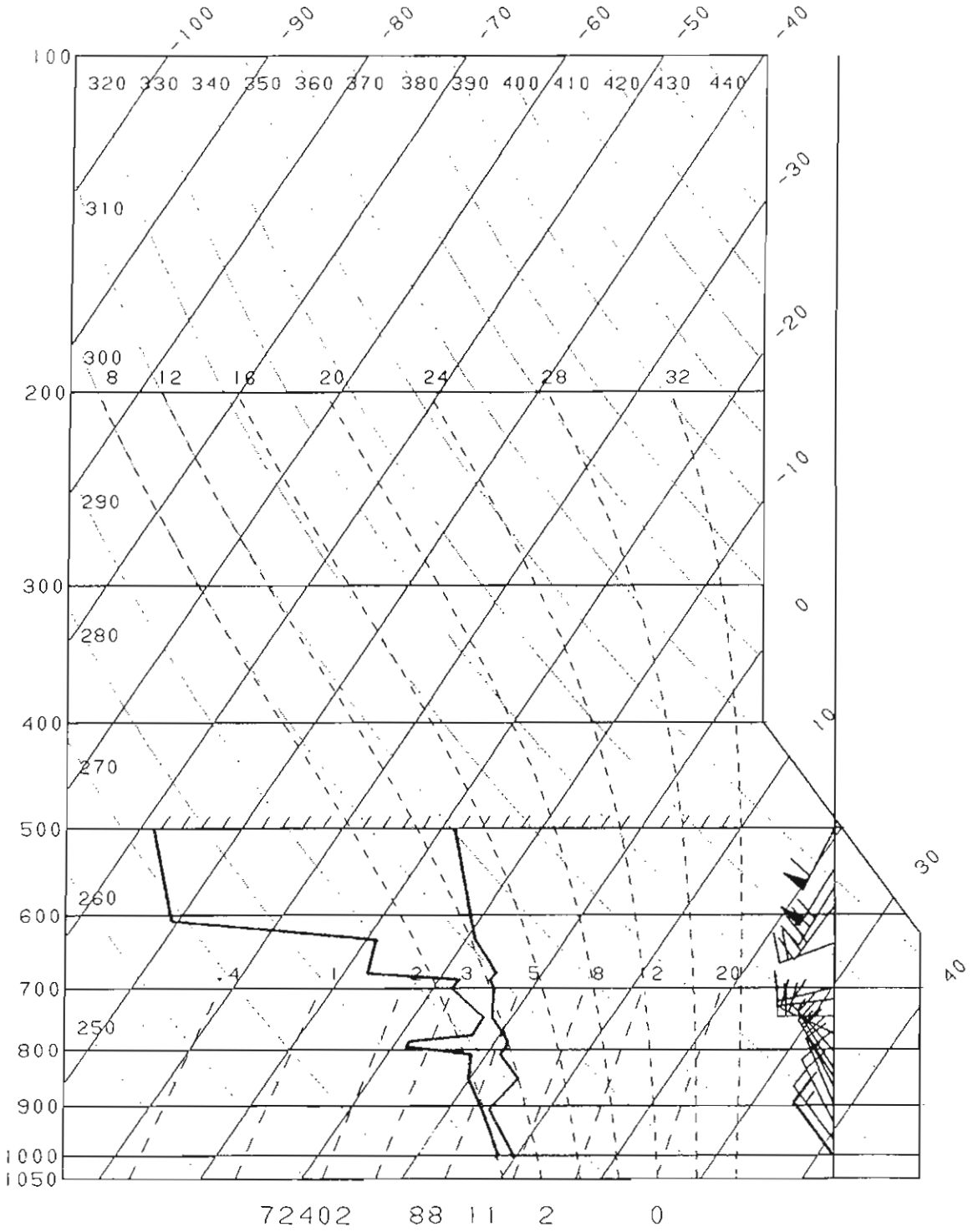


Figure 3.4. Skew-T, log P diagram extending from 1050 mb to 100 mb for Wallops Island, VA, at 00 GMT on November 2, 1988.

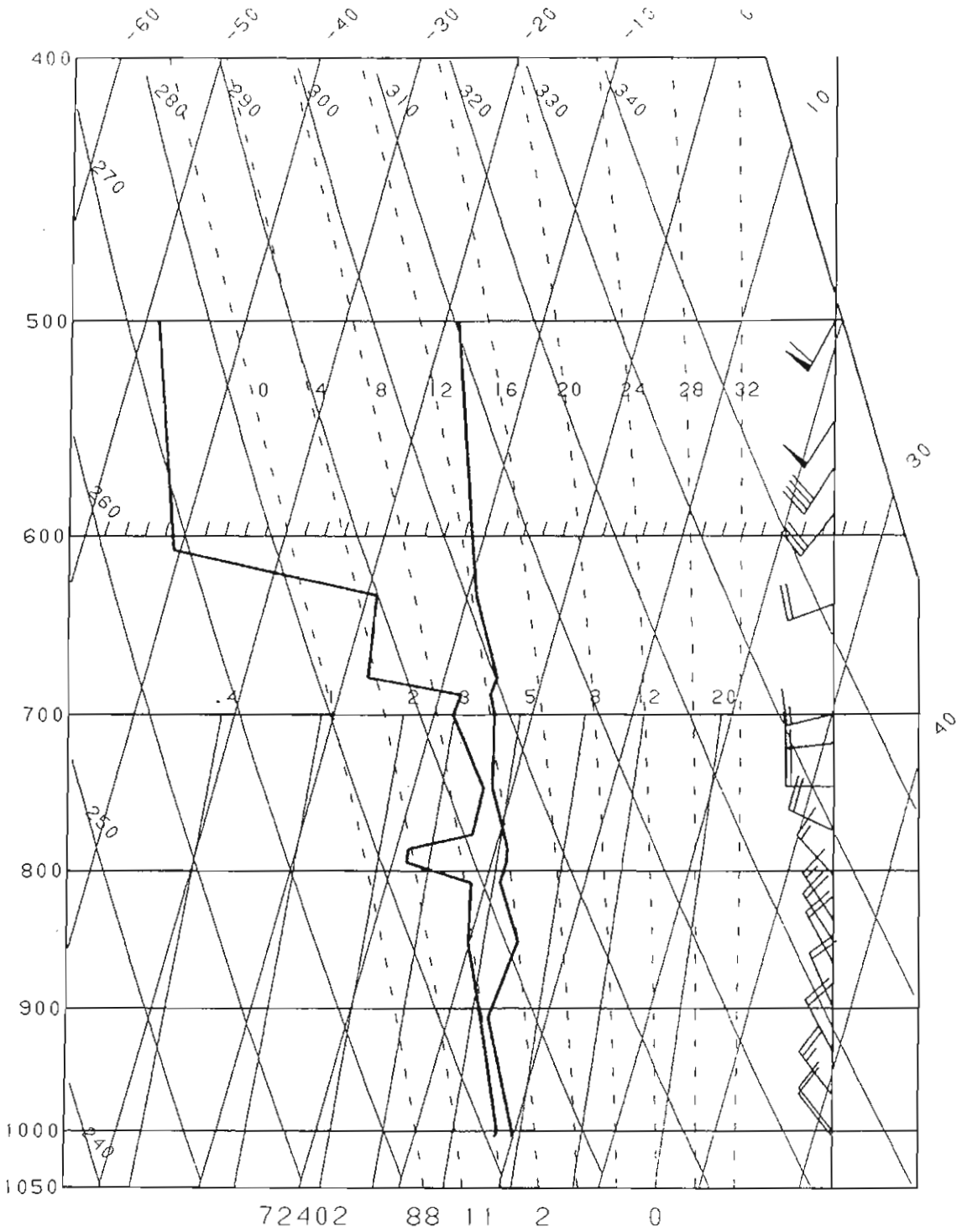


Figure 3.5. Skew-T, log P diagram extending from 1050 mb to 400 mb for Wallops Island, VA, at 00 GMT on November 2, 1988.

4. TRAJECTORY PROGRAMS

4.1 Branching Atmospheric Trajectory (BAT) Model

DESCRIPTION: The Branching Atmospheric Trajectory (BAT) model (Heffter, 1983) can be used to produce Lagrangian trajectories on the NAS 9000. The three-layer model produces forward or backward trajectories that branch due to vertical wind shear at day and night transition periods. The BAT model has been modified here in the following ways:

(1) BAT is run only in the backward mode.

(2) An option is provided to have trajectories start simultaneously in all model layers.

(3) An option is provided to constrain a trajectory to a layer (no branching).

These changes and options have been used successfully in the past for acid precipitation studies (Artz et al., 1988). For additional details on the BAT model in general, refer to Heffter (1983).

NOTES: The Job Control Language (JCL) must be modified to input the location of receptor, ending time, period of model run, tape number, date, map boundaries, etc. Forward and backward meteorological tapes from 1975 through 1987 are currently available from the National Climatic Data Center in Asheville, NC (Heffter, 1983).

PROCEDURE:

==> COPY 'ERL.R32.GR.BBAT.JCL' BBAT.JCL

==> QED BBAT.JCL

==> change...

line 90 - to BBAT.SRCOPS for standard backward BAT.

- to BBAT.SRCOPSM for multiple starting layers over the receptor.

line 120 - to BAT.MOD.NONE if standard backward BAT is wanted or if using SRCOPSM when no confining of the layers is wanted.

- to BAT.MOD.CLYR1 for constraining the trajectory to a layer or layers.

lines 230-266
and 300-315 - modify these DD statements depending on the data period of interest.

line 320 - backward-in-time meteorological tape number.

line 350 - latitude and longitude of receptor.

line 360 - ending day, month, year (i.e. start for back trajectory).

line 370 - number of days to run trajectories.

line 380 - toplat, bottmlat, leftlon, rightlon for the map boundary chosen by the user.

line 400 - ending GMT for trajectory on maps; must be a multiple of 3.

==> SAVE
==> END

==> QED 'ERL.R32.GR.BAT.MOD.CLYR1' if this was chosen as an option above; otherwise go to step A.

==> Change the following lines in reference to the constrained layer chosen:

ILT(1)=#### where #### is top of the layer

ILB(1)=#### where #### is bottom of the layer

ILT(2)=#### where #### is top of the layer

ILB(2)=### where #### is bottom of the layer,

step A==> SUB BBAT.JCL

EXAMPLE: See Figs. 4.1 - 4.2.

a)

```
 'ERL.R32.GR.BBAT.JCL'
00010 //EGRBBAT1 JOB (MGC0009WGN4032R,GRAMX9),ROLPH,REGION=1500K,TIME=3
00020 //*
00030 //*     ERL.R32.GR.BAT.JCL(BACKWARD)
00040 //*
00050 //*FORMAT PR,DDNAME=,DEST=LOCAL,CARRIAGE=8
00060 //*
00070 //          EXEC PGM=IEBUPDTE
00080 //SYSPRINT DD SYSOUT=A
00090 //SYSUT1   DD DSN=ERL.R32.GR.BBAT.SRCOPS,DISP=SHR
00100 //SYSUT2   DD DSN=&&SDS,UNIT=SYSDA,SPACE=(TRK,(20,10)),
00110 //          DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),DISP=(NEW,PASS)
00120 //SYSIN    DD DSN=ERL.R32.GR.BAT.MOD.NONE,DISP=SHR
00130 /*
00140 //COMPL    EXEC NFORVCL,
00150 //          PARM.FORT='NOSOURCE,NOSRCFLG',
00160 //          PARM.LKED='(LET,LIST,MAP)'
00165 //FORT.SYSPRINT DD DUMMY
00170 //FORT.SYSIN DD DSN=&&SDS,DISP=(OLD,PASS)
00180 /*
00190 //WTTAPE   PROC
00200 //GO       EXEC PGM=*.COMPL.LKED.SYSLMOD,COND=(8,LT)
00210 //FT05F001 DD DDNAME=SYSIN
00220 //FT06F001 DD SYSOUT=A
00230 //FT10F001 DD DSN=NAMER.WINDTEMP.&MOYR1,UNIT=T6250,VOL=SER=&S,
00240 //          LABEL=(&F1,SL,,IN),DISP=(OLD,PASS)
00250 //          DD DSN=NAMER.WINDTEMP.&MOYR2,UNIT=T6250,VOL=SER=&S,
00260 //          LABEL=(&F2,SL,,IN),DISP=(OLD,PASS)
00263 //          DD DSN=NAMER.WINDTEMP.&MOYR3,UNIT=T6250,VOL=SER=&S,
00266 //          LABEL=(&F3,SL,,IN),DISP=(OLD,PASS)
00270 //          PEND
00280 /*
00290 //          EXEC WTTAPE,
00300 //          MOYR1=DEC83,F1=1,
00310 //          MOYR2=NOV83,F2=2,
00315 //          MOYR3=OCT83,F3=3,
00320 //          S=E08039
00330 /*
00340 //GO.SYSIN DD *
00350 45.2 078.8
00360 31 12 83
00370 091
00380 55 40 090 065
00390 00
00400 21
00410 //
READY
```

b)

```
 'ERL.R32.GR.BAT.MOD.CLYR1'
./ CHANGE                                                    0000000
C**CONSTANT LAYER FOR ACID RAIN RUNS                         00000749
      ILT(1)=1800                                            00000750
      ILB(1)=1200                                            00000760
      ILT(2)=1800                                            00000810
      ILB(2)=1200                                            00000820
  200 IF(1.EQ.1) RETURN                                      00008445
READY
```

Figure 4.1. Listings of (a) the main BBAT JCL and (b) the FORTRAN that will constrain the trajectories to a layer.

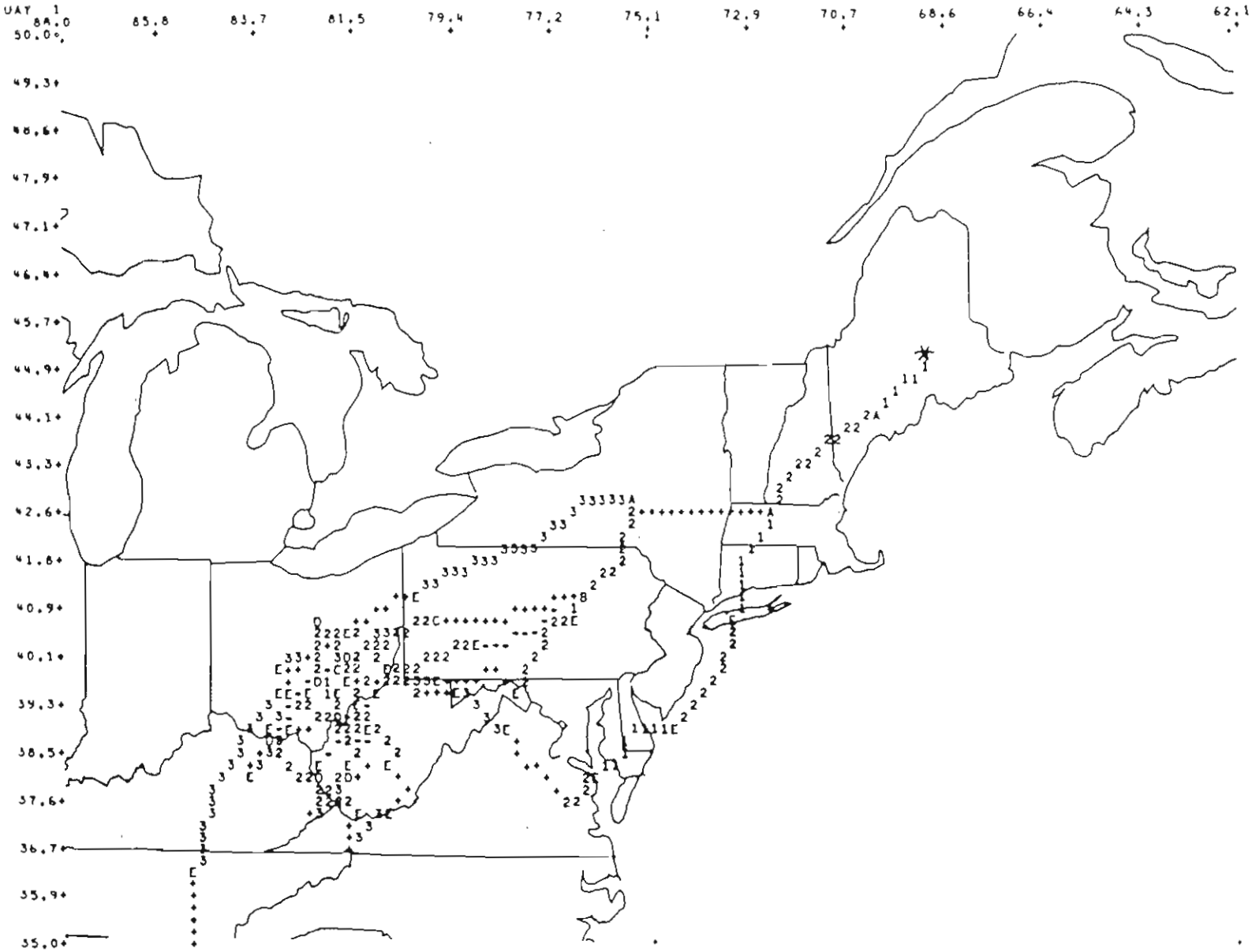


Figure 4.2. Branching backward trajectory originating in Maine (see Heffter, 1983 for details).

4.2 GAMBIT Models

DESCRIPTION: There are currently three versions of GAMBIT, NOAA's gridded atmospheric trajectory model (Harris and Bodhaine, 1983). The first version produces backward isobaric trajectories for the Northern Hemisphere using NMC's U and V wind components analyzed on a 65 x 65 Northern Hemispheric grid. Trajectories can be computed for up to four standard pressure levels at a time. Figure 4.3 shows a GAMBIT1 trajectory originating in Boston, MA. A complete description of this version of GAMBIT was presented by Harris (1982) and Bodhaine and Harris (1982).

The second version, which is similar to the first, produces forward or backward isobaric trajectories for the entire globe using analyzed U and V wind components from a 2.5° global grid. The program can be run in three modes: (1) Northern Hemisphere only, (2) Southern Hemisphere only, or (3) both hemispheres.

The third version, the most recent of the GAMBIT models, produces forward or backward isentropic trajectories using the wind fields on surfaces of constant potential temperature from either a 65 x 65 Northern Hemispheric grid or a 2.5° global grid. Because of the limitations of computer memory and costs, the model produces kinematic trajectories rather than dynamic isentropic trajectories. A complete description of this version can be found in Harris and Bodhaine (1983, pp. 70-75). An example of an isentropic trajectory originating in Bermuda is given in Fig. 4.4.

NOTES: For further information, contact

NOAA/ERL/ARL/GMCC
325 Broadway
Boulder, CO 80303
Attn: Joyce Harris, R/E/AR4

PROCEDURE: Contact Joyce Harris (see NOTES) for information on how to obtain these trajectories.

EXAMPLE: See Figs. 4.3 - 4.4.

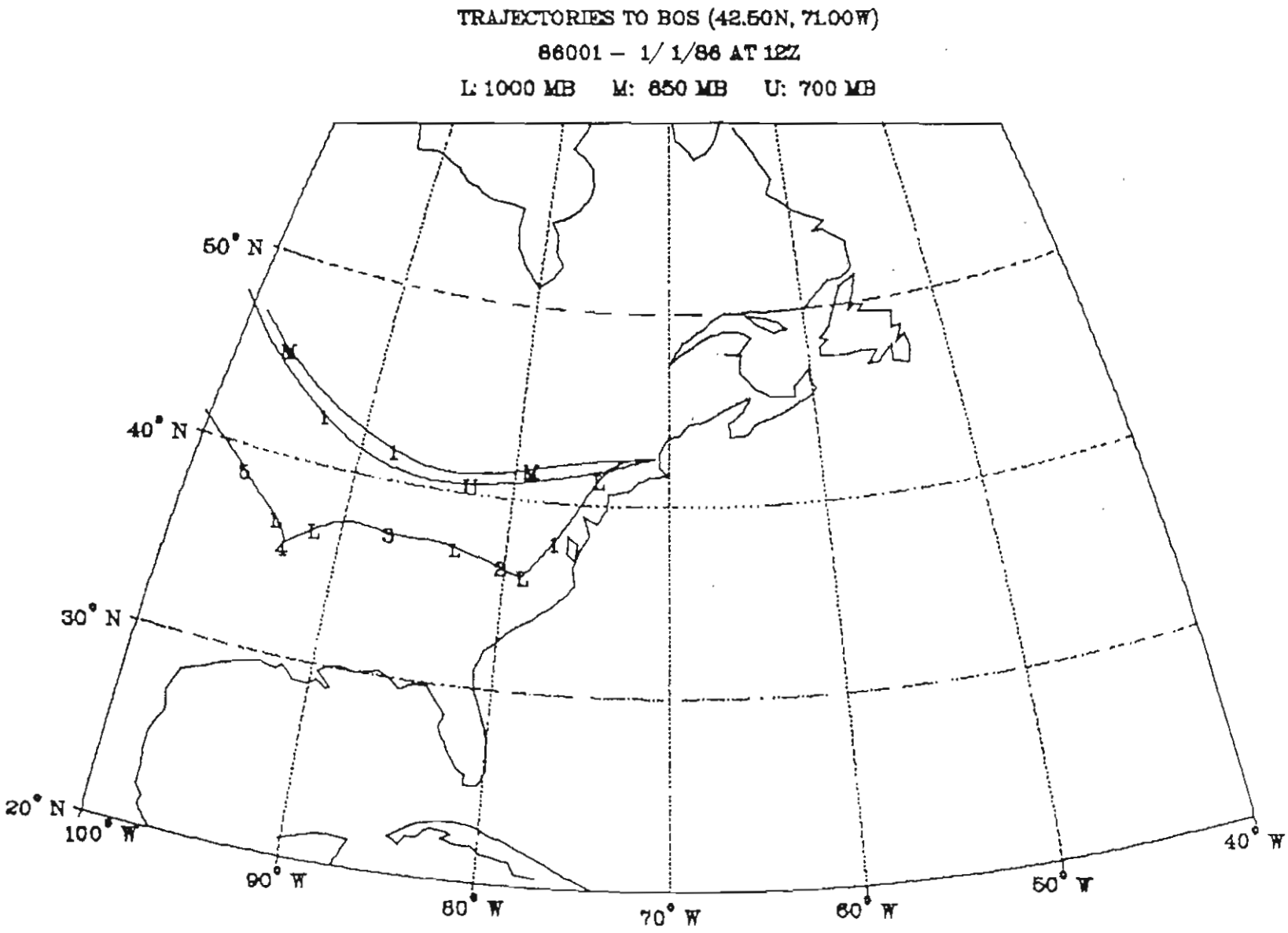


Figure 4.3. GAMBIT1 isobaric trajectory originating in Boston, MA, at 12 GMT on January 1, 1986.

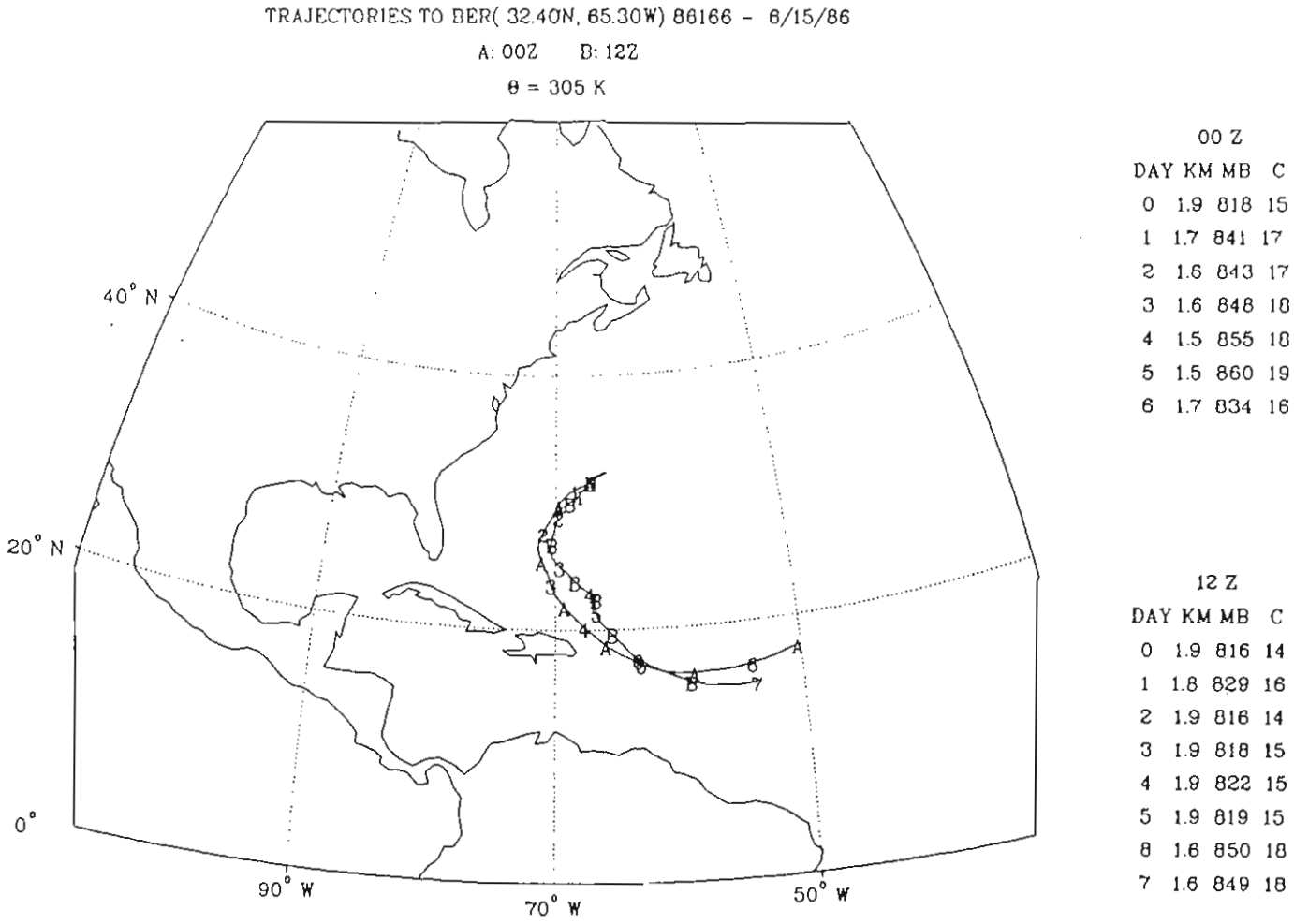


Figure 4.4. GAMBIT3 isentropic trajectories originating in Bermuda at (A) 00 GMT and (B) 12 GMT on June 15, 1986.

4.3 Program for Operational Trajectories (POT)

DESCRIPTION: POT is run on the NAS 9000 computer and produces forecast trajectories from either of the two latest runs of the Nested Grid Model (NGM) or the Medium Range Forecast (MRF) model (Aviation run), and analysis trajectories from either model during the past 36 days.

For more details see Heffter and Stunder (1987).

NOTES:

(1) MRF trajectories (Northern and Southern Hemisphere) use data on mandatory pressure levels only; however, trajectories may begin on any pressure level (1000-100 mb).

(2) NGM and Northern Hemisphere MRF forecast trajectories may be three-dimensional (3-D). (Must use SIZE(1500) at LOGON for MRF 3-D.)

(3) Analysis trajectories cannot be 3-D.

(4) NGM forecast trajectories use data on mandatory, sigma, and "significant" levels:

(a) Mandatory: 1000,950,850,700,500,400,300, 250,200,150,100 mb and .98 sigma.

(b) Sigma: .94, .90,. 84, .78

(c) Significant: 900,800,750,650,600,550 mb.

(5) NGM analysis trajectories are available on mandatory and sigma levels.

(6) The printer should be set to 8 lines/inch. Output is a mercator projection.

(7) If the output map is downloaded to the PC (say, using Smartcom F4 function key) a map background may be merged with the following two-step process (give downloaded POT file an .ASC extension):

(a) At the DOS prompt, to create a map background:

enter PGRAPH (for PGRAPH.EXE)
enter (subdirectory and) filename for map
enter desired geographic regions (use cursor control keys for editing)

```
                    enter rank (3 gives most detail)
                    enter desired map dot resolution
                    enter same lat/lon limits as in POT

               (b)  At the DOS prompt, to merge the trajectory
                    and map background:

                    enter MERGE (for MERGE.EXE)
                    enter .55
                    enter map background filename
                    enter POT filename
                    (both with subdirectory, if needed)
                    choose enhanced print if desired
                    1st line is line of longitudes

               The programs PGRAPH.EXE and MERGE.EXE are part of
               the Data Mapping Software developed by Roland
               Draxler, NOAA/ARL, Silver Spring, MD (see
               Appendix).
PROCEDURE:
 Step 1
      ==>      Using Smartcom or another communication package,
               dial the NAS 9000 and logon.

 Step 2
               For S. Hemisphere forecast trajectory only:
      ==>      SUB 'ERL.R32.JH.MRFS.CATVS.JCL'

               After job runs, continue with:
      ==>      EX 'ERL.R32.JH.MRFS.CRE8.CLIST'

      **       OBSERVATION TIME
      **       (00 OR 12)
      **       ZZ

      ==>      Enter time

      **       SAVED
      **       JOB ... SUBMITTED
      **       ENTRY ... DELETED
      **       WAIT FOR NOTIFY BEFORE EXECUTING
                  ERL.R32.JH.MRFS.CLIST

               After job runs, continue with Step 4.

 Step 3
               For MRF Northern and Southern Hemisphere
               analysis trajectories only:
      ==>      EX 'ERL.R32.JH.<MRFAN | MRFAS>.CRE8.CLIST'

      **       START DATE FOR FIRST DAY OF ANALYSIS FIELDS
      **       (YEAR MONTH DAY (WITH LEADING ZEROS))
```

```
**        YR MO DY

==>       Enter year, month, date

**        DATE FOR FOLLOWING DAY
**        (YEAR MONTH DAY (WITH LEADING ZEROS))
**        YR MO DY

==>       Enter year, month, date

**        SAVED
**        JOB ... SUBMITTED
**        ENTRY ... DELETED
**        WAIT FOR NOTIFY BEFORE EXECUTING ERL.R32.JH.<MRFAN|
          MRFAS>.CLIST

          After job runs, continue with Step 4.
```

Step 4

For all trajectories:

==> EX 'ERL.R32.JH.< progname >.CLIST'
where <progname> is one of the following:

NGM.TRAJ (forecast)
MRFN (forecast, N. Hemisphere)
MRFS (forecast, S. Hemisphere)
NGMA (analysis)
MRFAN (analysis, N. Hemisphere)
MRFAS (analysis, S. Hemisphere)

See the examples in Fig. 4.5 - 4.7 for the remaining input for NGMA, NGM.TRAJ and MRFN programs. Input for the other programs are similar.

NOTES:

(1) Observation time is 00 or 12 GMT.

(2) Delay from observation time is time between observation time and desired trajectory start time.

(3) West longitude is positive, East is negative.

(4) A "diagnostic" trajectory may be plotted with a forecast trajectory. The diagnostic trajectory was generated by the "Analysis" run (NGMA,MRFAN,MRFAS).

(5) Sigmas are entered as sigma*100 (98, 90, etc.).

(6) The following messages indicate why trajectories are not obtained:

(a) LEVEL _____ NEVER AVAILABLE
--- input level never available for given input; check mandatory/significant inputs

(b) SOME OR ALL FIELDS ARE NOT AVAILABLE
--- a requested field is missing from the 36-day archive, or a requested field is not, at the time of the request, available from the twice-daily Production Suite

(c) TRAJECTORY RAN OFF GRID
--- ran off the NGM/LFM grid (NGM, NGMA)

(d) TRAJECTORY RAN OFF TOP OR BOTTOM LEVEL
--- 3-D trajectory terminates at 100 and 1000 mb, or requested level is <100 mb (if >1000 mb, requested, 1000 mb is assumed)

EXAMPLES: See Figs. 4.5 - 4.8.

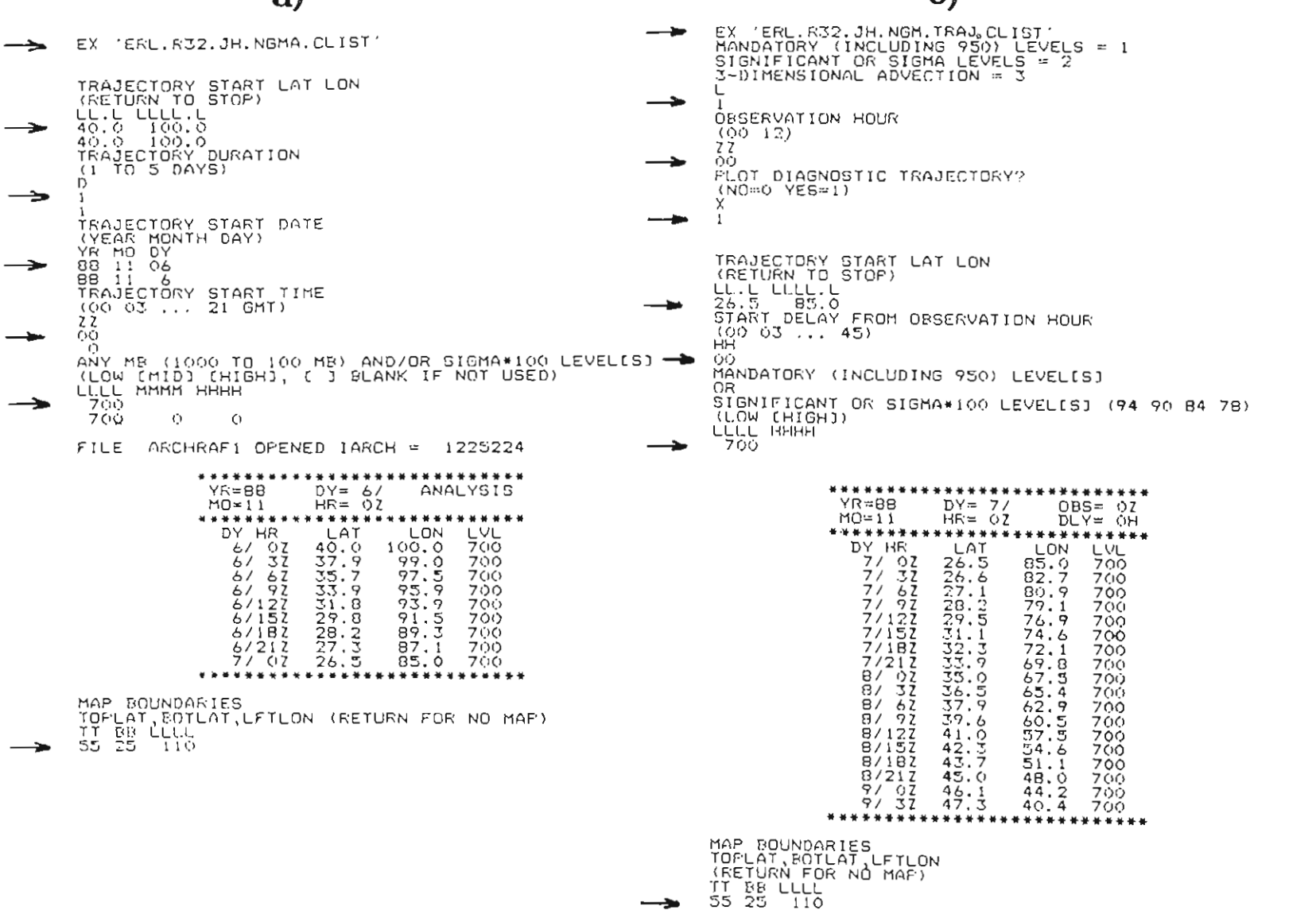


Figure 4.5. Input and tabular output for (a) NGMA (analyses) and (b) NGM.TRAJ (forecast).

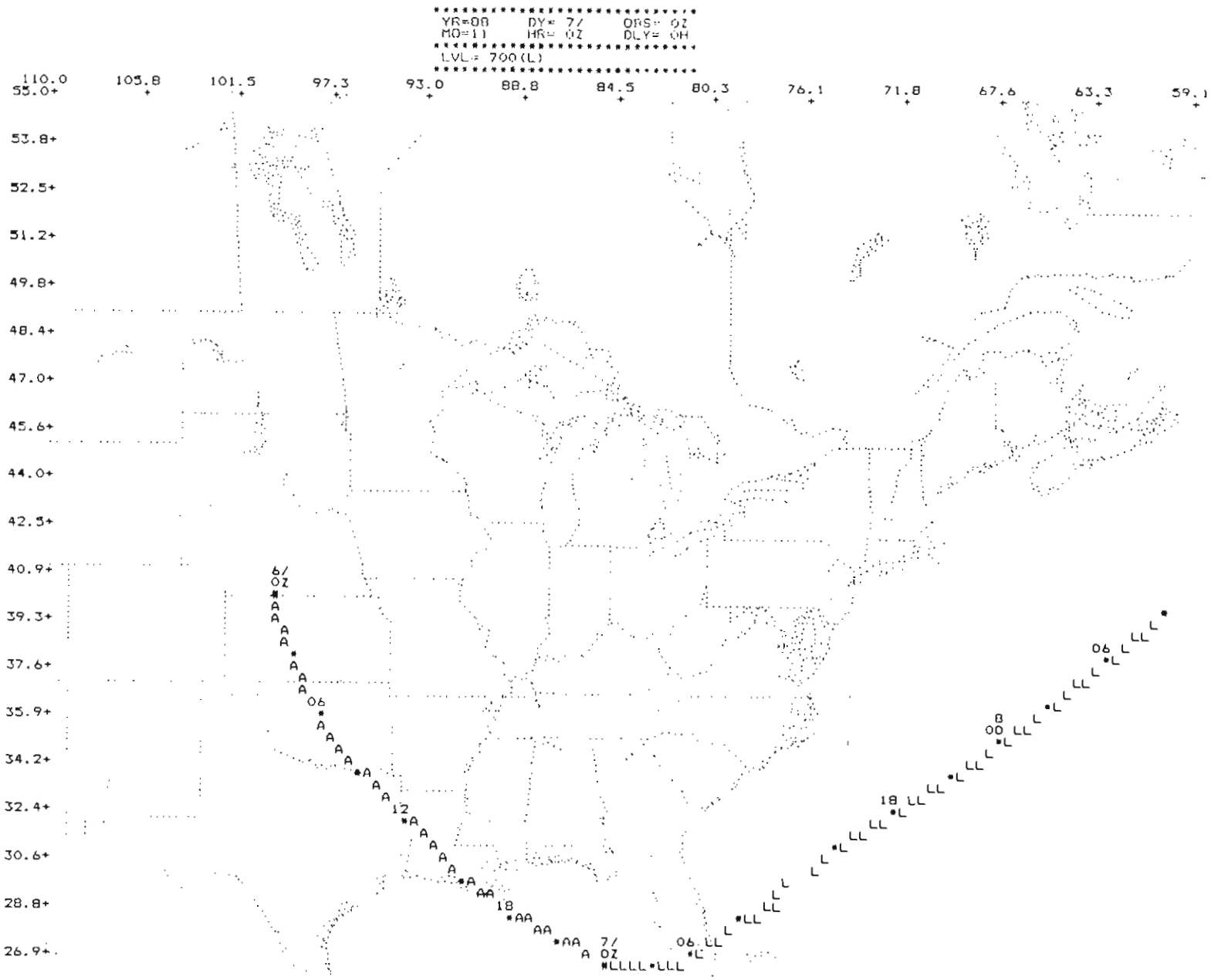


Figure 4.6. Graphical output for NGM.TRAJ linked with NGMA trajectory.

```
→  EX 'ERL.R32.JH.MRFN.CLIST'
   2-DIMENSIONAL ADVECTION = 2
   3-DIMENSIONAL ADVECTION = 3
   D
→  3
   OBSERVATION HOUR
   (00 12)
   ZZ
→  00
   PLOT DIAGNOSTIC TRAJECTORY?
   (NO=0 YES=1)
   X
→  0

   TRAJECTORY START LAT LON
   (RETURN TO STOP)
   LL.L LLLL.L
→  50.0     5.0
   50.0     5.0
   OBSERVATION DATE/TIME
   (YEAR MONTH DAY HOUR(SAME AS ABOVE))
   YR MO DY ZZ
→  88 11 07 00
   88 11  7  0
   TRAJECTORY START DELAY FROM OBSERVATION TIME
   (0 OR MULTIPLE OF 3)
   HH
→  00
    0
   ANY MB LEVEL(S) (1000 TO 100 MB)
   (LOW [MID] [HIGH], [ ] BLANK IF NOT USED)
   LLLL MMMM HHHH
→   700
    700     0     0

   ****************************
    YR=88     DY= 7/     OBS= 0Z
    MO=11     HR= 0Z     DLY= 0H
   ****************************
     DY HR     LAT      LON   LVL
      7/ 0Z   50.0      5.0   700
      7/ 3Z   50.3      4.3   700
      7/ 6Z   50.5      3.8   697
      7/ 9Z   50.7      3.3   697
      7/12Z   51.2      3.0   697
      7/15Z   51.5      2.6   697
      7/18Z   52.1      2.4   700
      7/21Z   52.5      2.2   703
      8/ 0Z   53.2      2.4   700
      8/ 3Z   53.8      2.7   697
      8/ 6Z   54.8      2.8   694
      8/ 9Z   55.7      2.9   691
      8/12Z   56.9      3.1   688
      8/15Z   58.3      3.2   680
      8/18Z   59.9      2.6   669
      8/21Z   61.7      1.5   654
      9/ 0Z   63.5     -0.3   641
      9/ 3Z   65.5     -3.2   625
      9/ 6Z   67.2     -7.3   610
      9/ 9Z   68.7    -12.9   599
      9/12Z   69.5    -19.6   593
      9/15Z   69.6    -26.4   589
      9/18Z   69.2    -32.1   581
      9/21Z   68.5    -37.4   576
     10/ 0Z   67.5    -41.5   567
     10/ 3Z   66.5    -44.1   562
   ****************************

   MAP BOUNDARIES
   TOPLAT,BOTLAT,LFTLON (RETURN FOR NO MAP)
   TT BB LLL
→  70 40   10
```

Figure 4.7. Input and tabular output for MRFN (forecast, 3-D), as shown in Fig. 4.8.

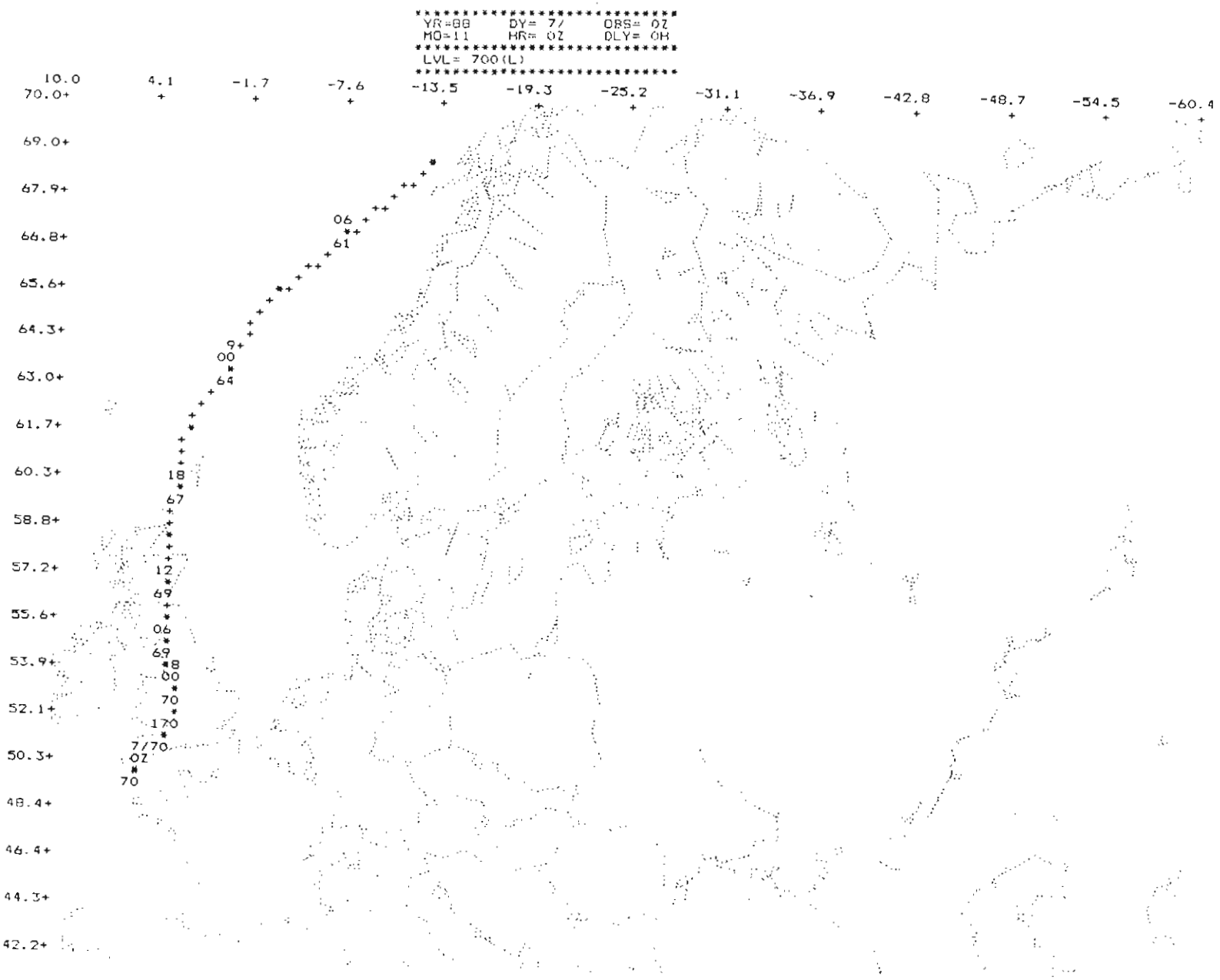


Figure 4.8. Graphical output for MRFN 3-D forecast trajetory as listed in Fig. 4.7.

5. TEKTRONICS EMULATOR PROGRAMS

DESCRIPTION: The following describes two Tektronics emulator programs to plot NAS 9000 FR80 files on the PC.

PROGRAM 1 TEKDMK

NOTES: The user must have the following PC programs which were developed by Roland Draxler, NOAA/ARL, Silver Spring, MD (see Appendix):

```
TEKDMK.EXE
TEKDMK.CFG
```

Special function keys:

```
CNTL-B = BREAK
CNTL-C = CLEAR MEMORY
CNTL-G = AUTOPRINT
CNTL-K = CHANGE COLOR (EGA and VGA
         monitors ONLY)
CNTL-L = LOAD INTO MEMORY
CNTL-P = ENHANCED PRINT SCREEN
CNTL-S = SAVE PLOT
CNTL-X = CHANGE VIEWPORT
```

PROCEDURE:

```
==>   Cut the line to the NAS or logoff after running a
      plotting program and creating a plot file.

==>   TEKDMK
**    TEKDMK - VERSION ......

**    SELECT EMULATION: CGA, EGA, or VGA
**    ....RETURN DEFAULTS TO CGA
**    ....SELECT?
==>   Choose monitor resolution (CGA, EGA, VGA)

**    SET TEKTRONICS VIEWPORT (RANGE: 1 - 1024)
**    ABCISSA MINIMUM?
**    75

      Note:  The viewport may need to be changed from
             default values for a particular plot.

==>   75

**    ABCISSA MAXIMUM?
**    800
==>   800
```

```
**        ORDINATE MINIMUM?
**        150
==>       150

**        ORDINATE MAXIMUM?
**        830
==>       830

**        SELECT SCREEN SCALING: (ABS)olute OR (REL)ative
**        ....RETURN DEFAULTS TO RELATIVE
**        ....SELECT?
==>       <Return>

**        MEMORY REDUCED: ..... TO .....
**        PLEASE WAIT.....

**        SELECT COM PORT?
**        1
==>       1

**        DIAL PHONE WHEN READY...
==>       ATDT 7365800  (area code 301 if needed)

**        CONNECT
==>       <Return>  Twice

**        ENTER SYSTEM ID
==>       GRFLOGON

**        ENTER USERID
==>       USER ID/PASSWORD RECONNECT (reconnect only if line
          was cut)

**        READY

          Note:  The next step will plot the plot file on
          the screen.

==>       EX 'ERL.R32.GR.CLIST($PLOT)'
**        ENTER POSITIONAL PARAMETER IN -
==>       Enter name of your FR80 plot file.

**        PLEASE ENTER COMMAND

OPTION==> SK/1.    (This skips the first frame, sometimes
          you may not need this step.)
**        OK

OPTION==> MODE/COMIC  or MODE/CINE  (these determine the
          orientation of the plot - experiment!!!)
**        OK
```

```
OPTION==>     RESCALE/N. (Changes the size of the plot.  N can
              be a number other than the default value of 16384.
              Smaller values make the plot smaller.)
      **      OK
      **      PLEASE ENTER COMMAND
      ==>     GO/N.  (Where N is the number of frames to plot.)

              When the first plot finishes, an arrow will appear
              in the lower left corner.  The plot can now be
              printed with:

              (1)  Control-G  for autoprint, which will print
                   all plots.

                   Note: also type Control-G to quit printing.

              (2)  Control-P for current picture only

      ==>     When finished hit <Return>.
      **      PLEASE ENTER COMMAND
      ==>     GO/.
      **      PLOTS DONE
      **      READY
      ==>     LOGOFF
      ==>     CONTROL-BREAK
      ==>     <Return>
              (You will now be back to the DOS prompt.)
```

PROGRAM 2 VTERM PLOTTING

NOTES: VTERM can be purchased from
Coefficient Systems Corp.
611 Broadway
New York, NY 10003

VTERM Feature:
Capture plot to PC file.

VTERM Function Keys:
CTRL-H to backspace
CTRL-PrintScrn to toggle printer on/off
ALT-Break to send a break
ALT-T for READY prompt
ALT-C to capture plot
ALT-A to abort capture
shift-shift (simultaneously) to toggle to DOS

For scrolling follow this procedure:
ALT-B to signal beginning of buffer
ALT-V and use arrow keys/PageUp, etc., to scroll
ESC
ALT-B to end buffer
ALT-E to erase buffer

FILES NEEDED TO RUN VTERM...

VTERM.EXE	VTERM.XF0
VTERM4.SET	VTERM.XFR
V4CONFIG.EXE	PLOT-HP.COM

PROCEDURE: Before logging on to the NAS 9000 do the following:

==> VTERM
==> <Return>
==> ATDT 7365800

When connected type:
==> GRFLOGON

The rest is the same as PROGRAM 1 except that a plot may be captured to a PC file according to the following instructions:

When ready to plot the picture and before typing the GO/. statement one can capture the picture to the PC by doing the following:

Step 1
==> GO/. (DO NOT press <Return>.)

```
==>     Press ALT-C
==>     Give the filename to be saved on PC and DO NOT
        Press <Return>!
==>     Press ALT-C

        When the plot is done press
==>     ALT-A
==>     <Return>
==>     Repeat starting at step 1 above until all plots
        are finished.

==>     SK/2.
==>     GO/.
==>     <Return>
**      PLOTS DONE.
==>     LOGOFF
==>     CNRL-Break

        (You will now be back to the DOS prompt.)

        After logging off the NAS and getting out of
        PROGRAM 2 (VTERM), one can plot the graphics on an
        HP plotter by doing the following:

        Type PLOT-HP filename.xxx
        Follow the prompts for the PC being used.

        The plot will then be sent to the plotter.
```

6. REFERENCES

Artz, R.S., G.D. Rolph, and J. Harris, 1988. Meteorological summary of four WATOX 1985 research intensives. Atmospheric Environment, Vol. 22, No. 11, 2361-2369.

Bodhaine, B.A., and J.M. Harris, 1982. Geophysical Monitoring for Climatic Change, No. 10: Summary Report 1981. NOAA Environmental Research Laboratories, Boulder, CO, 71-74.

Carter, G.M., and J.P. Dallavalle, 1985. Applications of the MOS technique: A Bibliography--No. 4. TDL Office Note 85-12, Techniques Development Laboratory, Silver Spring, MD.

Galloway, J.N., and D.M. Whelpdale, 1987. WATOX-86 overview and western North Atlantic Ocean S and N atmospheric budgets. Global Biogeochemical Cycles, Vol. 1, No. 4, 261-281.

Harris, J.M., 1982. The GMCC atmospheric trajectory program. NOAA Tech. Memo. ERL ARL-116, NOAA Air Resources Laboratory, Silver Spring, MD, 30 pp.

Harris, J.M., and B.A. Bodhaine, 1983. Geophysical Monitoring for Climatic Change, No. 11: Summary Report 1982. NOAA Environmental Research Laboratories, Boulder, CO, 67-75.

Heffter, J.L., 1983. Branching Atmospheric Trajectory (BAT) Model. NOAA Tech. Memo. ERL ARL-121, NOAA Air Resources Laboratory, Rockville, MD, 16 pp.

Heffter, J.L., and B.J.B. Stunder, 1987. Program for Operational Trajectories (POT). NOAA Tech. Memo. ERL ARL-157, NOAA Air Resources Laboratory, Silver Spring, MD, 12 pp.

APPENDIX

The following PC-based programs used in this report can be obtained by sending three diskettes to the authors at

NOAA Air Resources Laboratory
8060 13th Street, Rm. 927
Silver Spring, MD 20910

Section 3.1	Section 4.3	Section 5
WXMAP.EXE	PGRAPH.EXE	TEKDMK.EXE
WXMAPS.BAT	MERGE.EXE	TEKDMK.CFG
DATACONV.BAS	NAMCIL.DAT	
ALLUS.BIN	SAMCIL.DAT	
EASTRNUS.BIN	NAMBDY.DAT	
SEASTUS.BIN	SAMBDY.DAT	
MIDATLAN.BIN	NAMPBY.DAT	
MDVAWV.BIN	EURCIL.DAT	
	EURBDY.DAT	
	ASABDY.DAT	
	AFRCIL.DAT	
	AFRBDY.DAT	
	ASACIL.DAT	