NOAA Technical Memorandum ERL ARL-210

REAL-TIME ENVIRONMENTAL APPLICATIONS AND DISPLAY SYSTEM (READY): USER'S GUIDE

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[1]Note: Bold indicates a menu, submenu, or program option.

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REAL-TIME ENVIRONMENTAL APPLICATIONS AND DISPLAY SYSTEM (READY): USER'S GUIDE

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ABSTRACT. A user-friendly system of menus has been developed for accessing and displaying meteorological data and dispersion model products on the National Oceanic and Atmospheric Administration's Air Resources Laboratory (ARL) computer system. These menus bring together dispersion models, graphical display programs and textual forecast programs generated over many years at ARL into a form that is easy to use by atmospheric scientists. Access is made through an Internet connection, and X-windows software is needed to display the graphics. Descriptions of the menus and detailed instructions on the programs are given. A guest account for outside users has been established on ARL's computers for testing and evaluation. Further arrangements can be made for more permanent access to READY.

1. INTRODUCTION

One of the functions of the Air Resources Laboratory (ARL) of the National Oceanic and Atmospheric Administration (NOAA) is to provide meteorological services and related research to NOAA and to other Federal agencies, in order to predict the consequences of atmospheric releases of radioactivity and other potentially harmful materials. For example, ARL personnel involved with the Department of Energy's (DOE) Atmospheric Studies in Complex Terrain (ASCOT) program provide guidance for evaluation of terrain effects on dispersion; DOE's Hazardous Materials Release Facility, which is coupled with ARL's UF6 modeling program, provides dense gas dispersion data; ARL's volcanic ash program provides critical information on plume transport and dispersion to the aviation industry; ARL's involvement in the Kuwait oil fires provided real-time application of ARL's emergency response capabilities; and ARL Headquarters provides on-site support to the Operations Center of the Nuclear Regulatory Commission (NRC) during emergency exercises and events occurring at its regulated facilities. In addition, ARL is a Regional Specialized Meteorological Center (RSMC) for transport and dispersion products through the World Meteorological Organization (WMO). ARL, along with the Atmospheric Environment Service (AES) of Canada, the other RSMC for this region, will provide meteorological guidance and dispersion predictions in the event of an atmospheric release of radioactive or hazardous materials crossing international boundaries in North and Central America.

ARL Headquarters in Silver Spring, MD, has a unique working arrangement with its partner organization, the National Centers for Environmental Prediction (NCEP), formerly the National Meteorological Center (NMC), of the National Weather Service (NWS). This arrangement allows ARL to access meteorological observations and forecast model data normally too detailed for distribution to remote or non-NOAA users. This includes forecast model output with higher spatial and temporal resolution as well as boundary layer fields such as the surface fluxes of heat, momentum, and moisture. With this working arrangement, ARL is able to access the data as soon as the meteorological forecast model completes its execution at NMC.

The ARL transport and dispersion products are all produced in our offices. The forecasts, analyses, and other data are transmitted automatically from the NMC mainframe computer, located in Suitland, MD, to a pair of IBM RS-6000 workstations at ARL via a high-speed T1 connection, and are immediately available as input to several display programs and transport and dispersion models. All NCEP model data are converted to our own 1 byte packed format, either before or after transmission from Suitland, to conserve storage space and provide consistency between datasets.

In addition, the Regional Atmospheric Modeling System (RAMS) mesoscale model is run operationally at ARL to produce a high-resolution meteorological dataset. This dataset is used as a tool for qualitative evaluation of more local meteorological conditions or as input into a more quantitative transport and dispersion model calculation. Currently RAMS is run daily over the Chesapeake Bay and Nevada using 20 and 40 km grid cell spacing.

ARL also has installed a direct communications line between a third IBM RS-6000 workstation in our office and the NWS Telecommunications Gateway (NWSTG) computers. This connection allows ARL to receive all regularly transmitted textual and gridded data from the Family of Services (FOS) offered by NWS. These data include observations and forecasts issued by NWS. This line also gives ARL the ability to transmit its own dispersion products over the NWSTG.

A software system has been developed to pull together the meteorological data and the modeling resources on our computer system in a format that can be readily accessed by anyone in our office in the event of an emergency. This system is known as the Real-time Environmental Applications and Display sYstem (READY). READY is a UNIX shell-scripted series of menus that point the user to a host of products available on the system, many of which were developed at ARL over the last several years.

ARL has set up a guest account for a limited number of outside users. These users can use the guide presented here to access all products within READY, except for ARL emergency-response programs.

The only other limitation on the use of READY by and outside user is the user's ability to display graphical output. If the user has connected to our computer via Telnet, or if the user does not have X-windows capability, then it will not be possible for the user to see graphical plots. However, all textual output programs can be run with any connection. READY has several conversion routines to convert X-windows graphics into other formats, such as PostScript, Graphic Interchange Format (GIF), Printer Control Language (PCL), Hewlett Packard Graphics Language (HPGL), which the user may download through READY and view with locally installed software.

Section 2 of this document describes how to access READY, and Sec. 3 presents all the menu and submenu options of READY. Appendix A defines acronyms used in the guide, and Appendix B lists meteorological fields definitions used in several READY programs.

Information presented in bold brackets (i.e., **[help]**) are commands to be entered by the user in READY.

2. ACCESSING READY

2.1 Internet Connection

The primary connection method to READY is through the Internet. Direct connection with a modem is possible. However because of limited phone jacks on the ARL RS-6000 computer, this connection is reserved for ARL computer administrators only. The READY guest account Internet address is arlrisc.ssmc.noaa.gov (dotted decimal address: 140.90.134.87).

To display graphics, assuming you have X-windows software running, type the following UNIX command on your computer before trying to log on to the guest account:

xhost +140.90.134.87

Next, you have the choice of using Telnet **[tn]** (text only) or remote login **[rlogin]** to connect to the guest account, depending on what is available locally to you. **[rlogin]** is the preferred method when combined with X-windows, because this method allows for graphics to be displayed. You can enter the following commands:

tn arlrisc.ssmc.noaa.gov -l guest

or

rlogin arlrisc.ssmc.noaa.gov -l guest

where **guest** is the username on the RS-6000. Assuming the RS-6000 is not undergoing maintenance, the computer will ask for a password. The guest password is changed every so often for security reasons; therefore you should call the READY system administrator at (301) 713-0295 ext. 134 for the current password.

2.2 After Connection is Established

Once you are connected READY will display the following message:

Your terminal type has been detected to be: XXXXXXX

where **XXXXXX** is your terminal type. If you are using a computer with X-windows capability and your terminal type is not one of the following, you should contact the READY system administrator to have it added to the list of known terminal types, otherwise you will not be able to see graphics.

aixterm
xterm
hpterm
iris-ansi-net
SUN-CMD

READY will then ask for the system hostname or number that you are presently connected with:

Enter your host name or number:

and for your display number. If you do not know the display number enter a 0.

Enter your display number (0-9, usually 0):

READY will display an introductory screen (Fig. 1) and ask you to enter your name, company, and voice phone number. You should enter this information so contact can be made if problems develop with the connection. You will then be asked if you would like to use the National Center for Atmospheric Research (NCAR) Graphic IDT viewer to display graphical plots within READY (Fig. 2). The IDT viewer allows you to loop and zoom NCAR Graphic images when they are displayed by READY, however is does require that another program is run each time you want to view an image and this can be cumbersome. If the you do not have X-windows capability or do not want to use IDT, reply with **[n]**. At this point the main READY menu

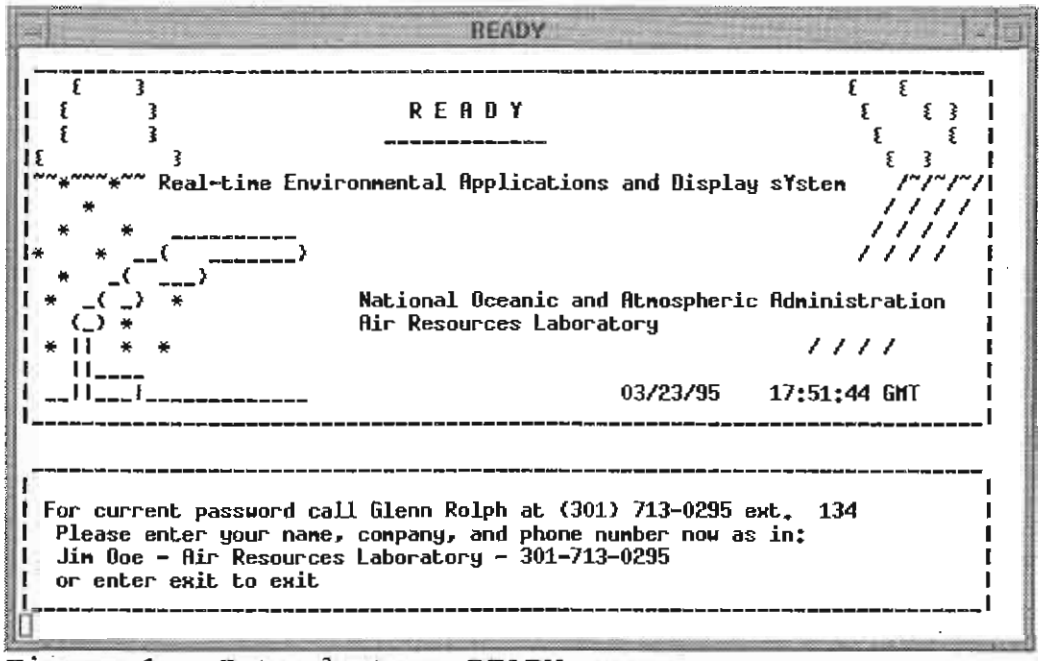

Figure 1. Introductory READY screen.

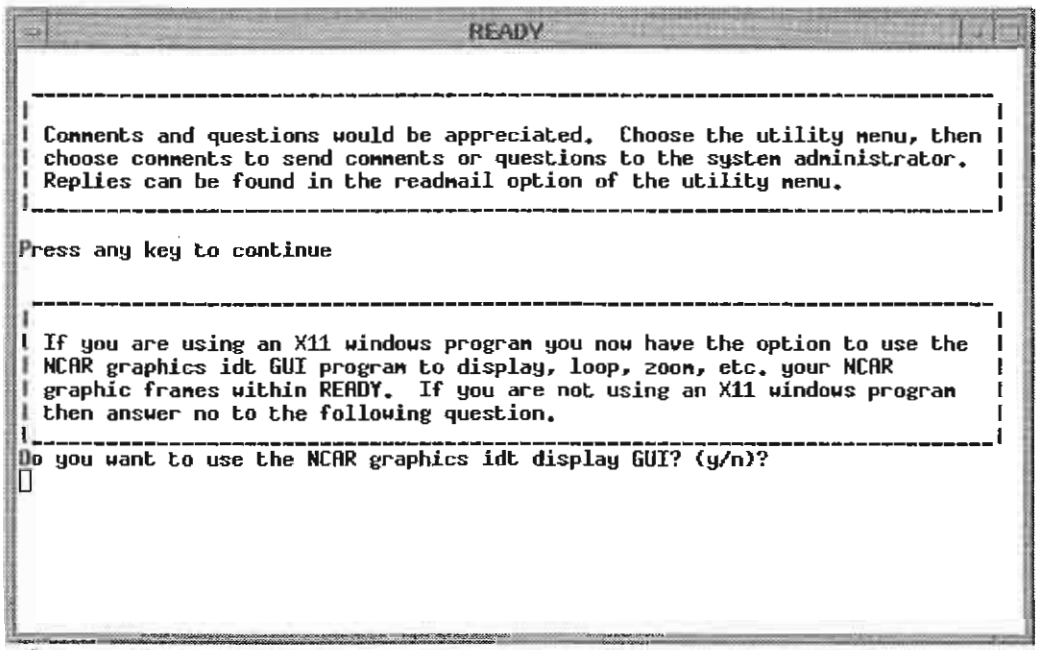

Figure 2. IDT request screen.

(Fig. 3) will be presented.

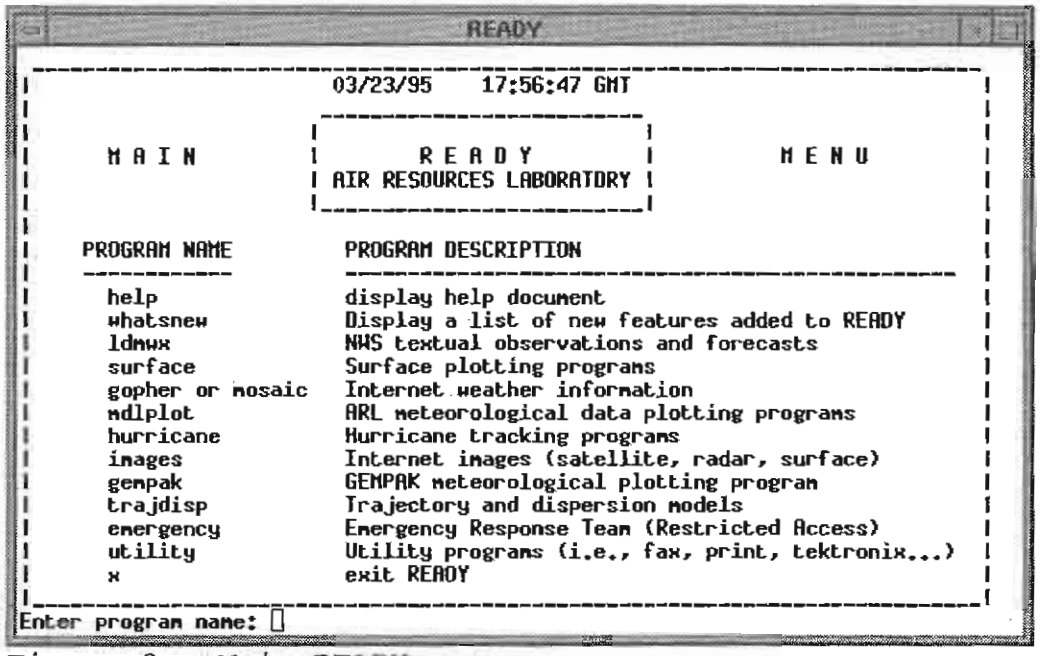

Figure 3. Main READY menu.

3. MAIN MENU

After the initial log-in screens, you will be presented with a main menu of 13 choices (Fig. 3).

1. **help** is for on-line help information about READY.

2. **whatsnew** is a listing of changes made to READY after this report was written.

3. **ldmwx** provides you with access to NWS forecasts, warnings, and observations received at ARL directly from NWS.

4. **surface** allows you to plot current (or past 24 hour) surface weather, mainly within the United States and Canada.

5. **gopher or mosaic** will connect you to several universities using special software to display weather images using X-windows.

6. **mdlplot** gives you a choice of programs to display NCEP meteorological products.

7. **hurricane** displays a map of the analysis and forecast positions and a map of the strike probabilities of a hurricane as issued by the National Hurricane Center (NHC).

8. **images** presents another menu of graphical GIF images,

including satellite, radar, and other map analyses.

9. **gempak** allows access to the GEneral Meteorology PAcKage (GEMPAK, desJardins et al., 1991). GEMPAK is a sophisticated meteorological display and data manipulation package developed at NASA and NOAA/NCEP.

10. **trajdisp** accesses transport and dispersion models developed at ARL for determining recent and future transport of atmospheric pollutants.

11. **emergency** allows ARL emergency response personnel quick access to special programs used during an emergency. Examples include initiation of the RAMS (RAMS, Pielke et al., 1992) mesoscale model over any location in the world, automatic data archiving routines, and emergency message transfer.

12. **utility** presents another menu of display, print, file conversion, and file transfer programs.

13. Finally, the **x** menu choice allows you to exit cleanly from READY. More detailed descriptions of each choice are presented next in the following sections.

3.1 help

The **help** menu accesses current on-line READY help. The **help** option on the main READY menu displays an overview of READY, whereas the **help** option on a submenu provides more detailed instructions on the use of products from that current submenu. After you enter the **[help]** command, the help document will be displayed as one page of text. You can press the space bar to continue to the next page, press **[q]** to quit the help, or press **[h]** for paging options. On the last page of **help**, press **[Enter]** to return to the previous menu.

3.2 whatsnew

The **whatsnew** option of the READY main menu displays information about changes made to READY since this document was written. After you enter the **[whatsnew]** command, READY will display one page of text. You can press the space bar to continue to the next page, press **[q]** to quit, or press **[h]** for paging options. On the last page of **whatsnew**, press **[Enter]** to return to the previous menu.

3.3 **ldmwx**

The **ldmwx** option on the READY main menu is a very powerful tool for accessing the NWS suite of analysis, forecast and general text information products. ldm (in **ldmwx**) stands for Local Data Manager, which is a program available from Unidata (LDM, 1994) that is used at ARL to process the NWS data. Figure 4 shows the **ldmwx** submenu.

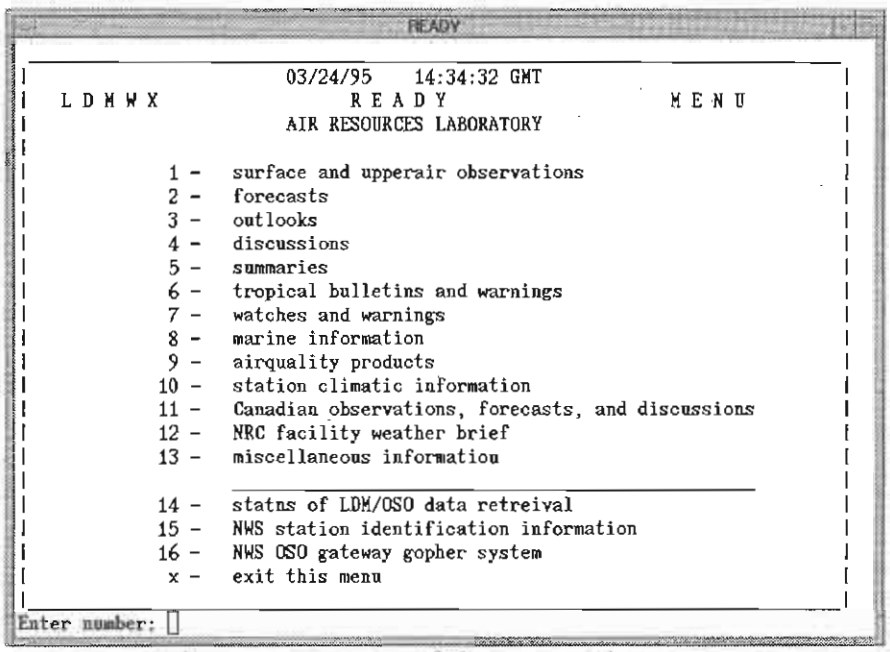

Figure 4. Submenu of the **ldmwx** option of the READY main menu.

3.3.1 **surface and upperair observations**

This submenu choice presents another submenu of 14 surface and upper-air options (Fig. 5). Option **[1]** (**surface airways & upper-air observations**) uses the GEMPAK software to list surface and upper-air data from around the world. After you enter a **[1]**, another submenu (not shown) is presented with three options (besides the **[x]** for exit): **[1] surface airways observations**, **[2] upper-air observations in text form**, and **[3] help**.

If you enter a **[1]** (**surface airways observations**), you will be asked to enter a location for the surface observations. A **[/]** will default to DCA (Washington, DC). You can enter instead a three-letter station ID; a two-letter state ID; a center latitude, longitude, and radius; or lower left and upper right latitude and longitude positions. Next READY will ask for the day of the data.

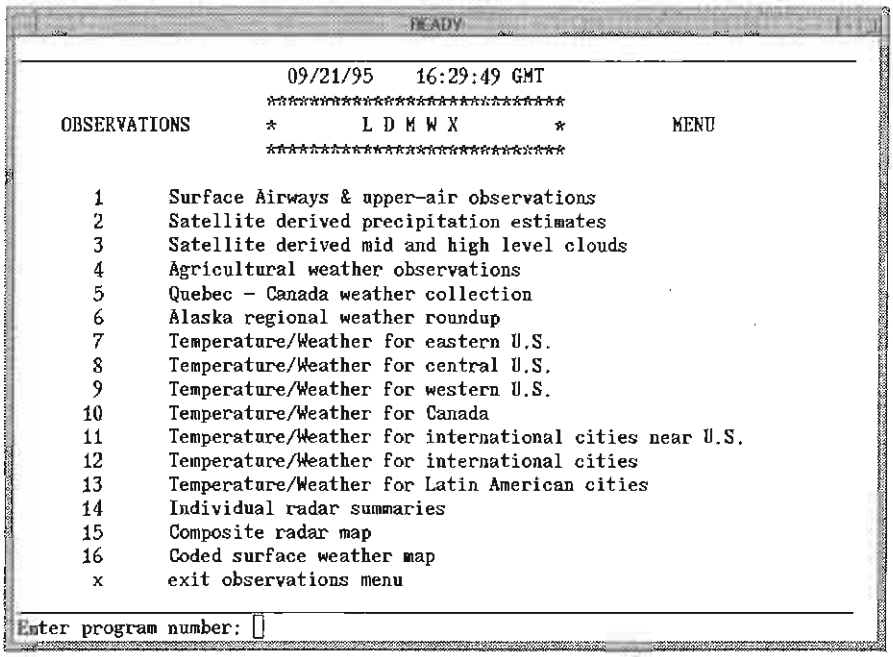

Figure 5. Submenu of the **surface and upperair observations** option of **ldmwx**.

At this time, only the current and previous day's data are saved. You can press **[/]** for today's data or enter yesterday's day of the month as a two-digit number. And finally, READY will ask for the hour(s) in UTC of the data. You can enter a single hour (e.g., 12), a range of hours (e.g., 12-18), or the word **[all]** for all of the chosen day's data. The computer will page the data requested, an example of which is given in Fig. 6.

If you enter a **[2]** (**upper-air observations in text form**) from the **surface airways & upper-air observations** submenu, you will be asked for the location of the upper-air sounding. This is entered in the same format as for surface observations: three-letter station ID; two-letter state ID; a center latitude, longitude, and radius; or a lower left and upper right latitude and longitude. If you enter a **[/]**, the program will default to IAD (Dulles, VA). As with surface data, only today's and yesterday's data are stored. If you enter a **[/]**, the program will default to today's data. Upper-air observations are normally taken twice a day, at 00 and 12 UTC, and the data are usually available within 1 to 2 hours after the observation time. You will be prompted to enter one of these two times (00 or 12). A **[/]** will default to the most recent time. An example of the upper-air data for IAD is presented in Fig. 7. The following abbreviations and units are applied: PRES - pressure (mb); TMPF - temperature (°F); DWPF - dewpoint temperature (°F); HGHT - height (m); DRCT - wind direction (deg); SPED - wind speed (m/s).

READY

Surface weather observations for dca on day:24 / hour(s):all UTC

NOTE: A * denotes an ASOS station (cloud info only to 12000 ft)

HOUR UTC	ID	VISB mi	WTHR	PRES mb	TEMP F	DEW PNT F	WIND DRCT deg.	WIND SPED kt	STAB CLAS PG	CLD CVR 10s	CLD HGT 100sFT	RELV HUMD %	6-HR RAIN in/6h	SNOW COVR in
0	DCA	12.0		1004	48	33	340	11	D	10	85	55		
1	DCA	12.0		1006	48	33	310	14	D	10	40	55		
2	DCA	12.0		1006	48	33	330	16	D	10	40	55		
3	DCA	12.0		1007	47	33	320	14	D	10	44	58		
4	DCA	12.0		1007	46	33	320	14	D	10	48	60		
5	DCA	12.0		1007	46	33	330	14	D	10	45	60		
6	DCA	12.0		1008	46	32	320	16	D	10	50	57		
7	DCA	12.0		1008	45	32	350	13	D	10	55	60		
8	DCA	12.0		1008	45	30	320	13	D	10	55	55		
9	DCA	15.0		1008	43	28	310	14	D	3	55	55		
10	DCA	15.0		1008	42	26	320	13	D	0	CLEAR	52		
11	DCA	15.0		1009	41	27	330	15	D	0	CLEAR	57		
12	DCA	15.0		1010	41	28	320	14	D	0	CLEAR	59		
13	DCA	20.0		1010	43	28	310	16	D	0	CLEAR	55		
14	DCA	20.0		1010	46	28	310	15	D	0	CLEAR	49		

(EOF):

Figure 6. Example of surface data listing for DCA (Washington, DC).

READY

```
SNPARM = PRES;TMPF;DWPF;HGHT;DRCT;SPED
STNPRM = LIFT

STID = IAD          STNM =    72403   TIME = 950324/1200
SLAT =  38.97     SLON =   -77.45   SELV =    85.0
STIM =  1200

LIFT =    12.74
```

PRES	TMPF	DWPF	HGHT	DRCT	SPED
1000.00	37.76	23.36	85.00	310.00	4.00
992.00	38.48	24.08	149.78	312.93	7.52
972.96	36.44	23.53	305.00	320.00	16.00
936.62	32.42	22.45	610.00	325.00	16.00
925.00	31.10	22.10	710.00	325.00	15.00
901.61	29.82	16.54	914.00	340.00	15.00
886.00	28.94	12.74	1053.19	344.54	14.55
867.60	26.21	10.92	1219.00	350.00	14.00
850.00	23.54	9.14	1381.00	355.00	13.00
834.63	21.06	7.55	1524.00	355.00	14.00
819.00	18.50	5.90	1672.18	355.00	14.49
815.00	19.22	-5.98	1710.37	355.00	14.61
803.00	22.82	-5.98	1826.58	355.00	14.99

:

Figure 7. Example of upper-air data listing for IAD (Dulles, VA).

Finally, if you enter a **[3]** (**help**) from the submenu help information from GEMPAK will be displayed. This help includes more information about abbreviations and units.

The other submenu options listed in fig. 5 display surface and radar information in text form for specific regions of the United States and for other areas of the world.

3.3.2 **forecasts**

The submenu of the **forecasts** option of **ldmwx** (Fig. 8) presents local and specialized forecasts, most of which are self explanatory. In most menu options, the user is requested to enter a three-letter forecast office ID, or two-letter state ID, for the particular area of interest. The user can type **[list]** at the prompt for a station ID to view IDs of offices with current forecasts. The only menu option with a submenu is **[12]** (**Forecast model output**). This submenu (not shown) includes five submenu options for accessing NCEP Model Output Statistics (MOS) for selected cities. Submenu **[1]** (**NCEP forecast model production discussion**) gives a summary of current model run progress at NCEP, numbers **[2]** - **[4]** give MOS products for selected cities from the Nested Grid Model (NGM), Aviation run of the Medium Range Forecast (MRF) model (AVN), and MRF models, respectively, and number **[5]** gives extratropical storm surge forecasts for selected U.S. East Coast locations.

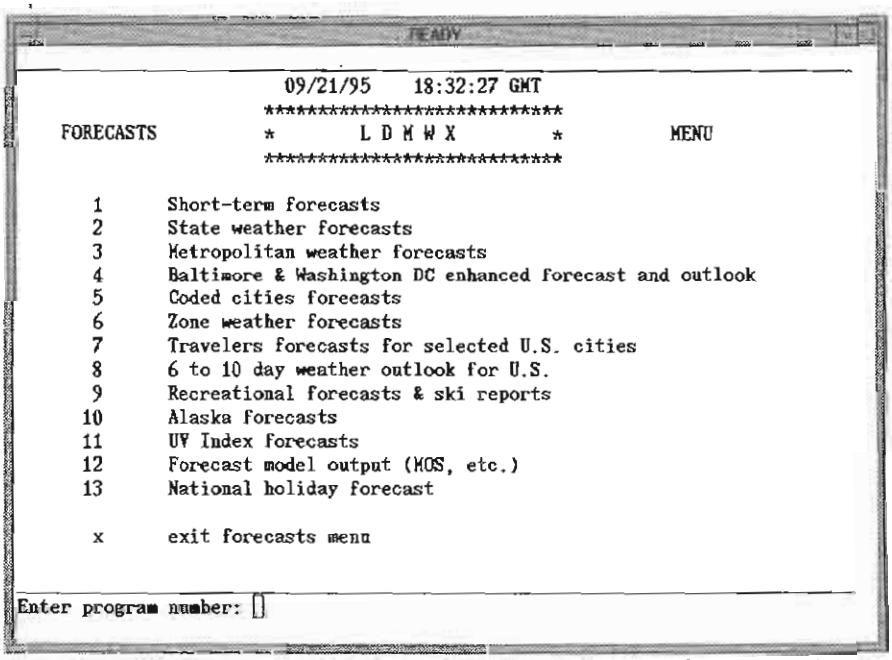

Figure 8. Submenu of the **forecasts** option of **ldmwx**.

3.3.3 **outlooks**

The **outlooks** submenu (Fig. 9) of **ldmwx** provides convective outlooks for the next 2 days, areas of excessive rainfall and flooding potential, water supply, and, when available, severe-weather public information statements. You can type **[list]** for a list of three-letter forecast IDs.

3.3.4 **discussions**

The **discussions** submenu (Fig. 10) of **ldmwx** provides regional, state, and local discussions, and hemispheric long-range NWS forecast discussions. Alaskan forecast discussions are also available.

3.3.5 **summaries**

The **summaries** submenu (Fig. 11) of **ldmwx** provides NWS state, national, and worldwide weather summaries, and river and flood summaries. Menu option number **[3]** will bring up another submenu (not shown) of areas of the world where temperature and precipitation summaries are available.

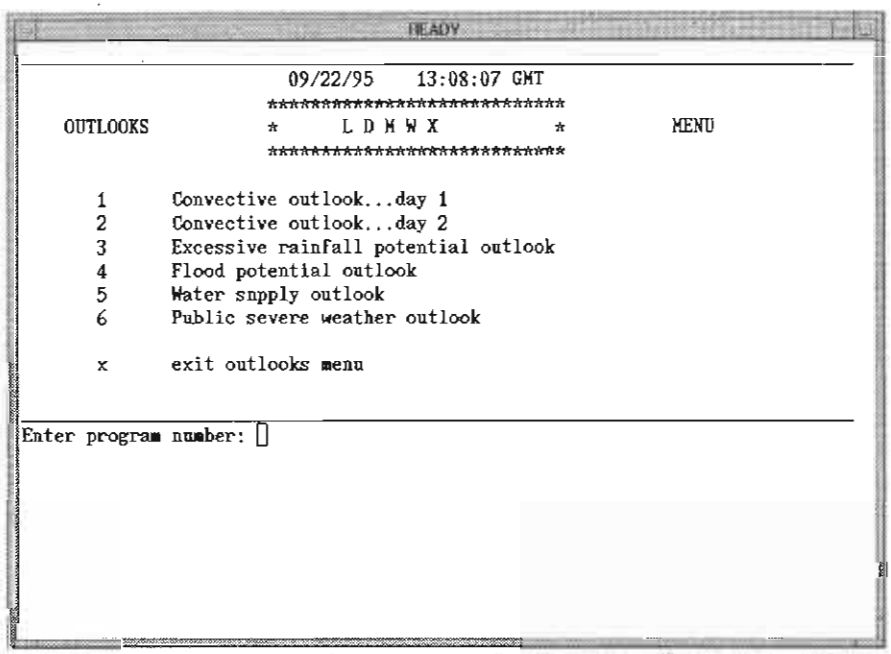

Figure 9. Submenu of the **outlooks** option of **ldmwx**.

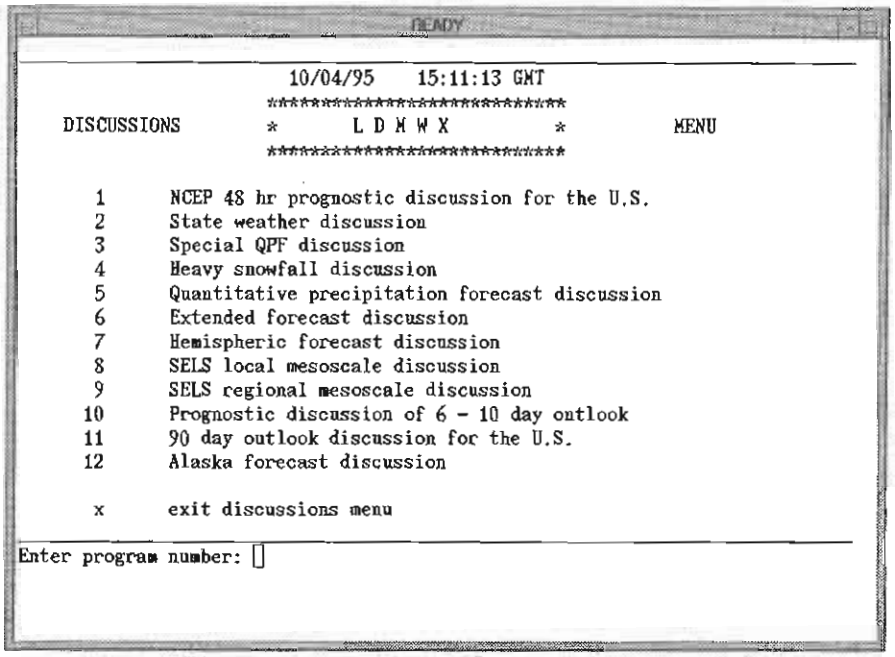

Figure 10. Submenu of the **discussions** option of **ldmwx**.

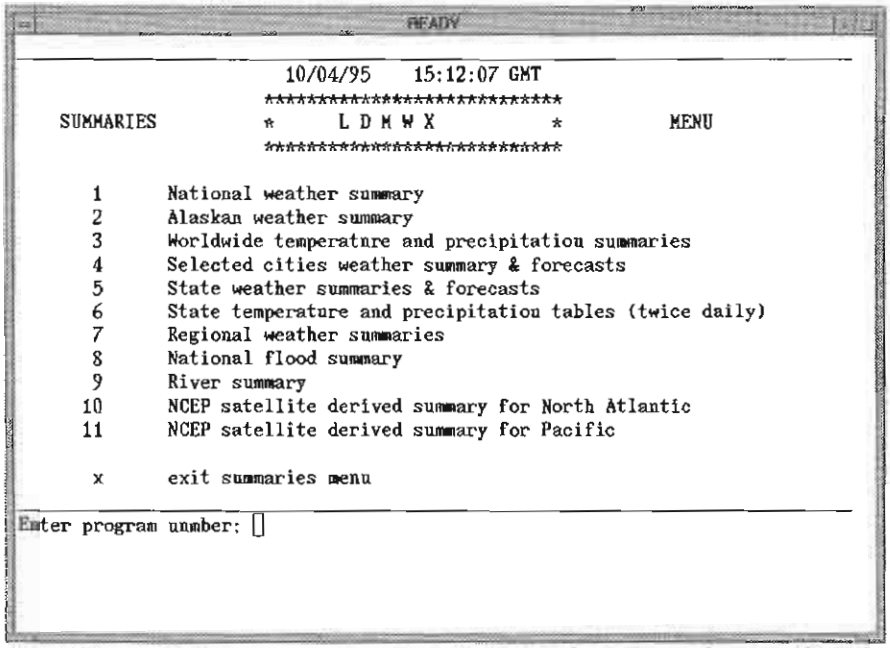

Figure 11. Submenu of the **summaries** option of **ldmwx**.

3.3.6 **tropical bulletins and warnings**

The **tropical bulletins and warnings** submenu (Fig. 12) of **ldmwx** accesses National Hurricane Center (NHC) products, including outlooks, discussions, watches, and warnings of tropical activity primarily within the Atlantic Ocean and Gulf of Mexico. Information on a particular storm may be contained in several bulletins, and therefore you should check all pertinent menu options. **Tropical storm and local hurricane statements [8]** and **post storm hurricane reports [9]** options require the three-letter ID of the issuing NWS office as discussed for other products in Sec. 3.3.

3.3.7 **watches and warnings**

The **watches and warnings** submenu (Fig. 13) of **ldmwx** accesses severe weather products issued by local NWS offices and the National Severe Storms Forecast Center (NSSFC), which include severe thunderstorms, floods, tornadoes, winter storms, wind, and fog. Some menu options require the three-letter ID of the issuing NWS office as discussed for other products in Sec. 3.3. Menu option **[1]** will ask for a three-letter forecast office ID and then search for the last issued (since 00 UTC) watch and warning for that office.

3.3.8 **marine information**

The **marine information** submenu (not shown) of **ldmwx** provides information on **[1]** Coast Guard weather reports, **[2]** coastal flood statements, **[3]** special marine warnings for coastal waters, **[4]** AVN-based extratropical storm surge forecasts for selected U.S. East Coast locations, **[5]** river, stream, and precipitation information, **[6]** offshore waters forecasts, **[7]** nearshore waters forecasts, **[8]** bay/coastal marine forecasts, and **[9]** marine weather statements.

3.3.9 **air quality products**

The **air quality products** submenu (not shown) of **ldmwx** presents a list of NWS air quality bulletins, such as **[1]** air stagnation numerical data and **[2]** narratives, **[3]** daily dispersion outlooks, **[4]** air stagnation advisories, **[5]** special dispersion statements, **[6]** smoke management weather information near forest fires, and **[7]** air quality index statements from selected cities.

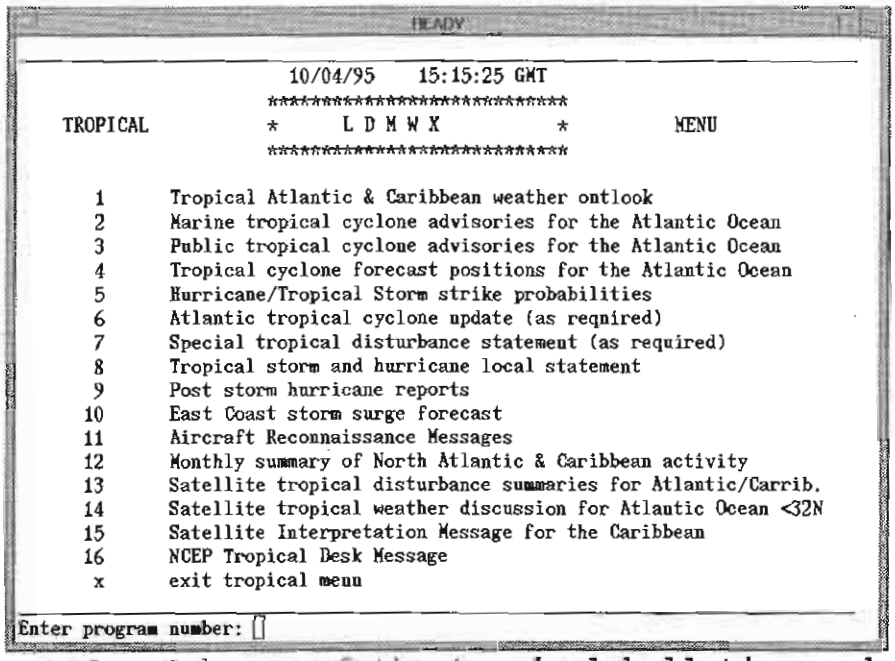

Figure 12. Submenu of the **tropical bulletins and warnings** option of **ldmwx**.

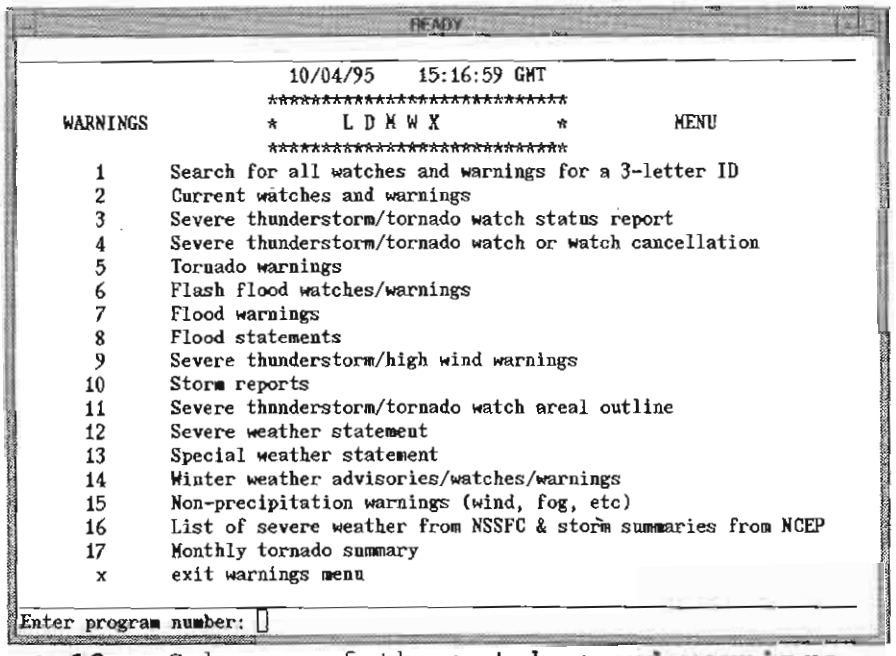

Figure 13. Submenu of the **watches and warnings** option of **ldmwx**.

3.3.10 **station climatic information**

The **station climatic information** submenu (not shown) of **ldmwx** lists climatic information available from the NWS, including **[1]** monthly and **[2]** daily climatic reports, **[3]** monthly mean climatic data, **[4]** weekly weather and climate reports, **[5]** weekly climate summaries, **[6]** miscellaneous climatic data and **[7]** record reports. Some menu options require the three-letter ID of the issuing NWS office as discussed for other products in Sec 3.3.

3.3.11 **Canadian observations, forecasts, and discussions**

The **Canadian observations, forecasts, and discussions** submenu (Fig. 14) of **ldmwx** accesses several informative discussions and forecasts on current weather forecasts issued by the (AES).

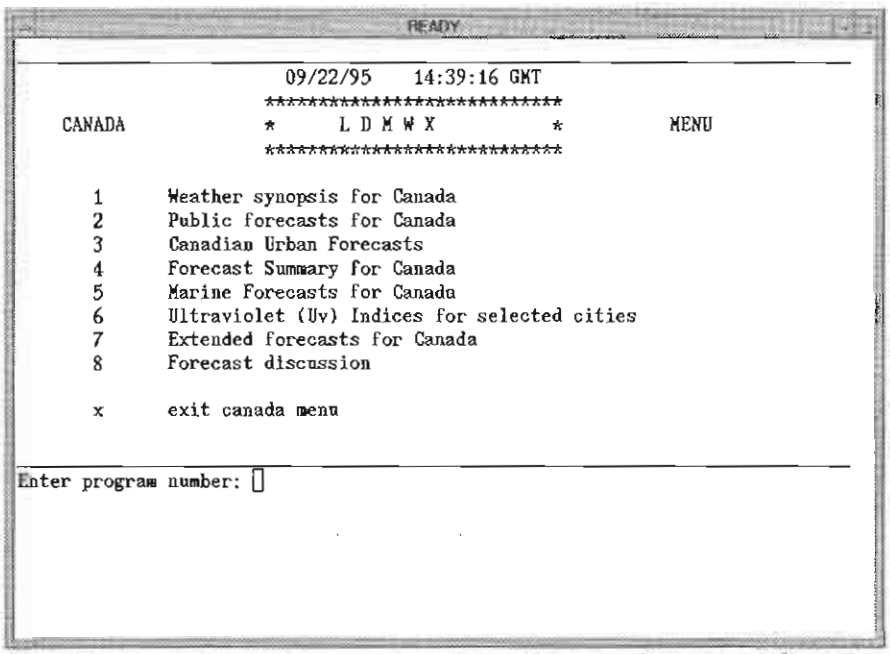

Figure 14. Submenu of the **Canadian observations, forecasts, and discussions** option of **ldmwx**.

3.3.12 **NRC facility weather brief**

The **NRC facility weather brief** option of **ldmwx** is unique in that it automatically provides surface data, forecasts, watches and warnings, and MOS for the immediate area surrounding an NRC licensed facility, or other ARL emergency operations location, by typing only a four-letter abbreviation. You can type **[list]** to list plant abbreviations.

3.3.13 **miscellaneous information**

This **miscellaneous information** submenu (not shown) of **ldmwx** lists miscellaneous notices, messages, and bulletins. The submenu may change often as new products are added to or deleted from READY.

3.3.14 **status of LDM/OSO data retrieval**

This **status of LDM/OSO data retrieval** option of **ldmwx** will display the date and time of the last processed FOS message as it was received via the NWS Office of Systems Operations (OSO) Global Telecommunications Gateway (GTS) and processed at ARL using the LDM. At times the data stream can be interrupted for various reasons, causing a loss of data. If you do not find the product you are searching for, or if you find only old data, you can use this option to see if data collection has been interrupted.

3.3.15 **NWS station identification information**

This **NWS station identification information** submenu (Fig. 15) of **ldmwx** allows you to search for station IDs. Many combinations are given to help find the information needed.

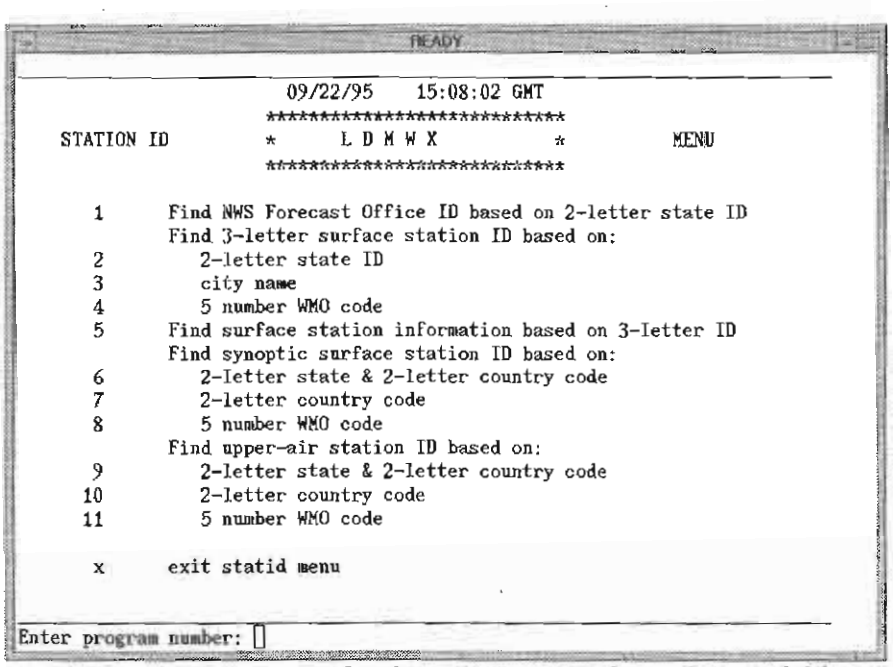

Figure 15. Submenu of the **NWS station identification information** option of **ldmwx**.

3.3.16 **NWS OSO gateway gopher system**

This option of **ldmwx** connects you to the NWS OSO gopher server, which contains information related to meteorological data and its communication. It does not contain current meteorological observations or forecasts. It is maintained by NWSTG at the Systems Operations Center in Silver Spring, MD.

This server accesses information not yet published in standard source documents such as NWS manuals, WMO manuals, or announcements. It is not a replacement for these documents, and the material provided will be removed after updates to standard reference documents have been issued.

3.4 **surface**

The submenu (Fig. 16) of the **surface** option of the READY main menu lists programs primarily to plot surface observations, mostly in the United States and Canada, using standard station model plots. You can also print a text list of surface observations to the screen or to a file. You have the choice of location and parameter(s) to display.

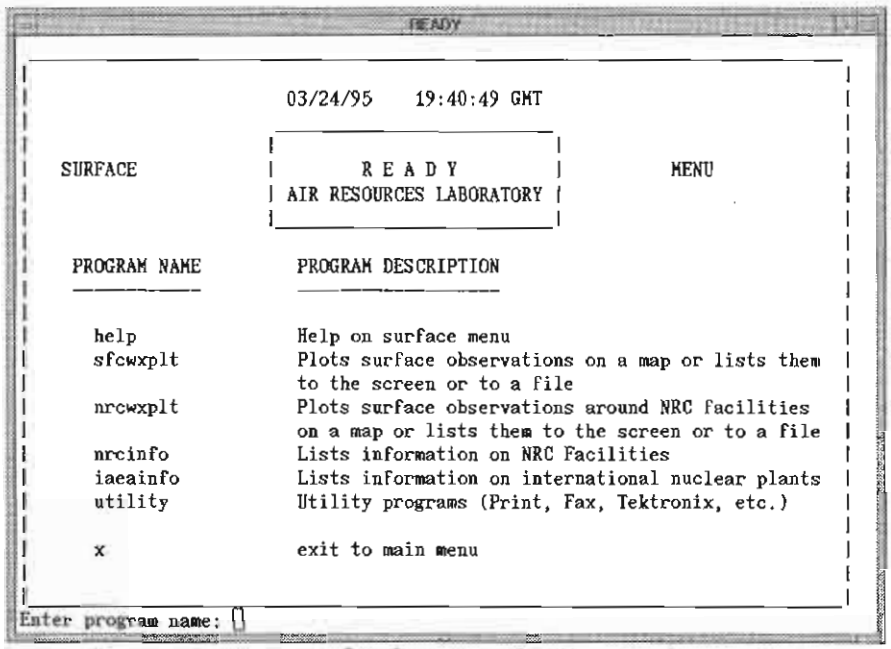

Figure 16. Submenu of the **surface** option of the READY main menu.

3.4.1 **sfcwxplt**

The **sfcwxplt** program of **surface** will plot surface weather maps of the past 24 hours, primarily in the United States and Canada

A. The first prompt in **sfcwxplt** is for what dataset to use. Enter **[1]** to choose an hour from the last 24 hours of on-line data, then enter an hour (UTC) or a **[/]** for the most recent hour. If the data chosen are unavailable, or older than 24 hours, you can choose number **[2]** (HDS backup surface data) as an alternative. ARL sometimes has research surface datasets available. These are viewed by choosing **[3]** or **[4]**.

B. The next prompt is for your choice of map area. You can choose a state **[1]**-**[48]**, region or country **[49]**-**[60]**, or a central latitude and longitude and radius of the area desired **[61]**. If you have run **config** previously from any of the **utility** submenus (see Sec. 3.12.10) and have set up a default configuration, you will be given those defaults, and the program will not ask for the location.

C. Next is your choice of plotting the data on a graphical map **[0]** or as text **[1]**.

D. If you choose text, **[1]** in step C, READY will ask for your choice of writing to the screen **[0]** or to a file **[1]** called **SFCOB.DAT** for file transfer. If you choose maps, **[0]** in Step C, READY will ask you to choose between displaying the full station model plot or individual elements.

E. If you choose individual elements in step D, the next prompt will ask if you want to plot three-letter station IDs on the map.

F. When finished plotting maps, choose **[0]** from the menu to display the maps and exit the program.

An example **sfcwxplt** for Maryland is shown in Fig. 17.

3.4.2 **nrcwxplt**

The **nrcwxplt** program of surface will plot surface weather maps of the past 24 hours around NRC licensed nuclear power plants and fuel facilities. If you have already specified a plant location using the **config** from any of the **utility** submenus (see Sec. 3.12.10), the program will use it; however, the latitude and longitude have to be exactly the same as the ARL defined latitude and longitude found in **nrcinfo** (see Sec. 3.4.3).

A. The first prompt in **nrcwxplt** is for your choice of nuclear

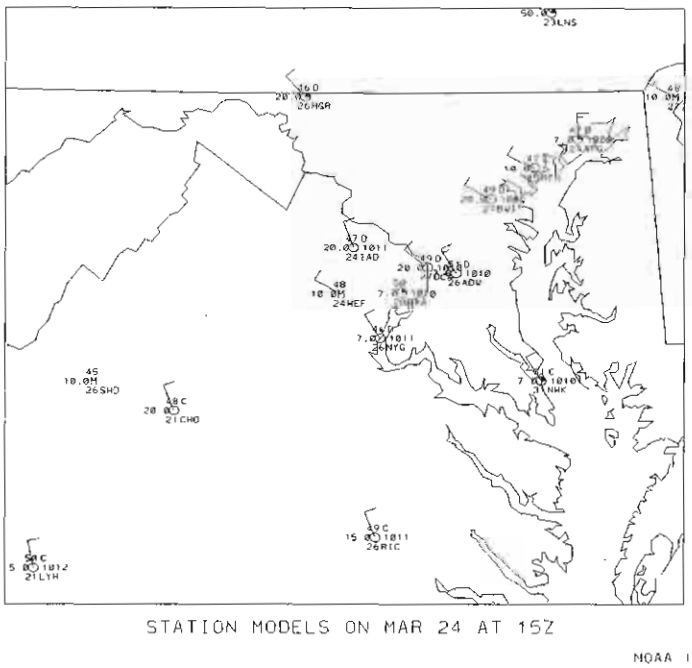

Figure 17. Surface plot for Maryland using the **sfcwxplt** program.

power plant. You can choose from a list of four-letter site IDs by typing **[list]**.

B. The next prompt is to choose the meteorological dataset to use. Enter **[1]** to choose an hour from the last 24 hours of on-line data, then enter an hour or a **[/]** for the most recent hour. If these data are unavailable, or older than 24 hours, you can choose number **[2]** (HDS backup surface data) as an alternative. ARL sometimes has research surface datasets available. You can view these by choosing **[3]** or **[4]**.

C. Next is your choice of plotting the data on a graphical map **[0]** or as text **[1]**.

D. If you choose text **[1]** in step C, READY will ask for the your choice of writing to the screen **[0]** or to a file **[1]** called **SFCOB.DAT** for file transfer. If you choose maps **[0]** in step C, READY will ask you to choose between displaying the full station model plot or individual elements.

E. If you choose individual elements in step D, the next prompt will ask if you want to plot three-letter station IDs on the map as well.

F. READY will ask if you want another plot to be generated. If not, type **[n]**, and the plot you requested will be displayed

An example **nrcwxplt** for Calvert Cliffs nuclear facility in Calvert, MD, is shown in Fig.18.

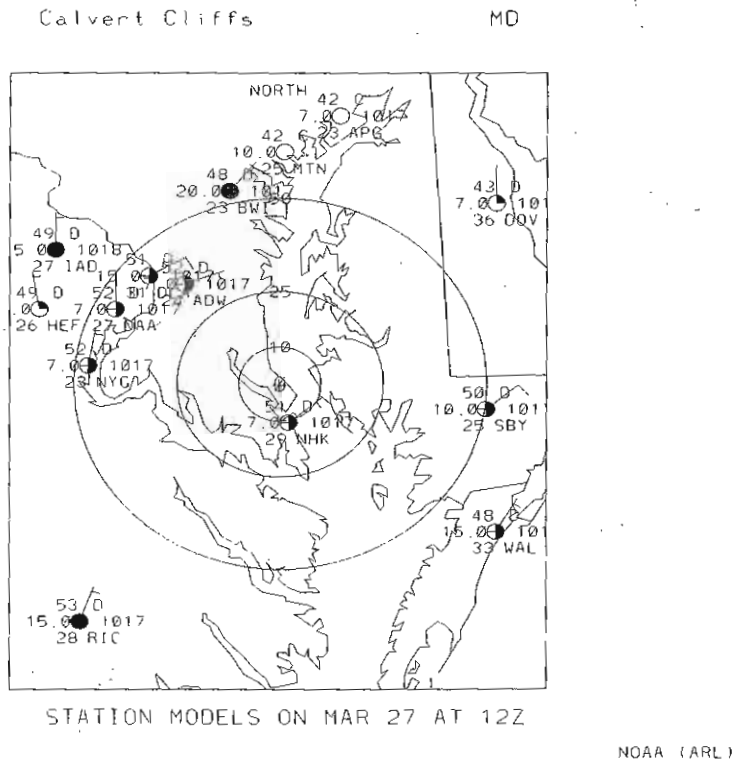

Figure 18. Surface weather plot for Calvert Cliffs nuclear plant using **nrcwxplt**. Mileage rings are from the center: 10, 25, and 50 miles.

3.4.3 **nrcinfo**

The **nrcinfo** program of **surface** will list information for each NRC licensed facility. Information includes the site ID, state, latitude and longitude, time zone, elevation, and nearest NWS office. After you enter **[nrcinfo]**, the document will display one page at a time. You can press the space bar to continue to the next page, press **[q]** to quit, or press **[h]** for further paging options.

3.4.4 **iaeainfo**

The **iaeainfo** program of **surface** will list information on worldwide nuclear power stations, as listed by the International Atomic Energy Agency (IAEA). Information includes country ID, latitude and longitude, and name. After entering **[iaeainfo]**, the document will display one page at a time. You can press the space bar to continue to the next page, press **[q]** to quit, or press **[h]** for further paging options.

3.5 **gopher or mosaic**

Gopher and **mosaic** are public domain programs that, in the case of READY, allow the user to connect to Internet computer systems, such as universities and government agencies, to retrieve radar maps, weather maps, and satellite and other images. You must have X-windows available to use this **gopher or mosaic** option from the READY main menu.

3.5.1 **gopher**

The **gopher** submenu (Fig. 19) of **gopher or mosaic** lists universities and government agencies that supply weather-related images, such as surface and upper-air maps, model output forecasts, and satellite images. X11 windows software is required to view the images. However, the images can be transferred using File Transfer Protocols (FTP) (see any of the **utility** submenus) and viewed with locally available software.

3.5.2 **mosaic**

The **mosaic** submenu (Fig. 20) of **gopher or mosaic** lists universities and government agencies with weather-related images. **Mosaic** allows access to many graphical weather images including surface and upper-air maps, model output forecasts, and satellite images. X11 windows software is required to view the images.

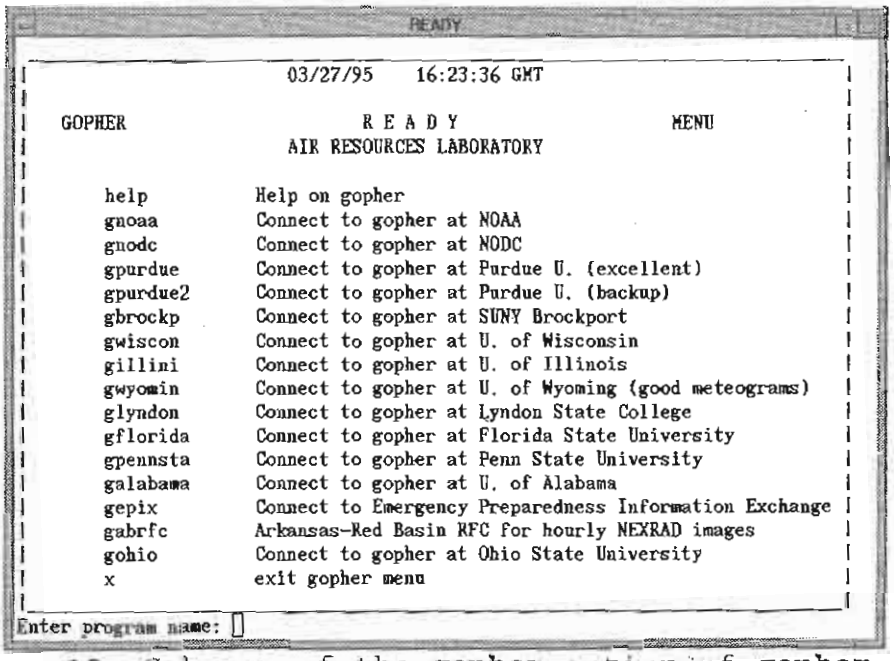

Figure 19. Submenu of the **gopher** option of **gopher or mosaic**.

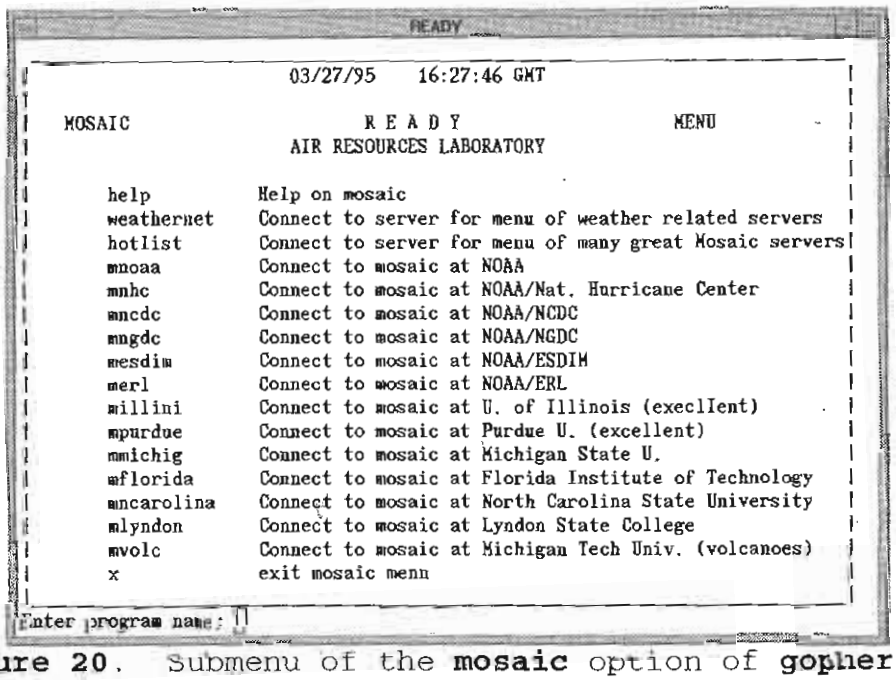

Figure 20. Submenu of the **mosaic** option of **gopher or mosaic**.

3.6 **mdlplot**

The submenu (Fig. 21) of the **mdlplot** option of the READY main menu lists programs available to display maps, time-series, and vertical profiles of gridded analysis and forecast data.

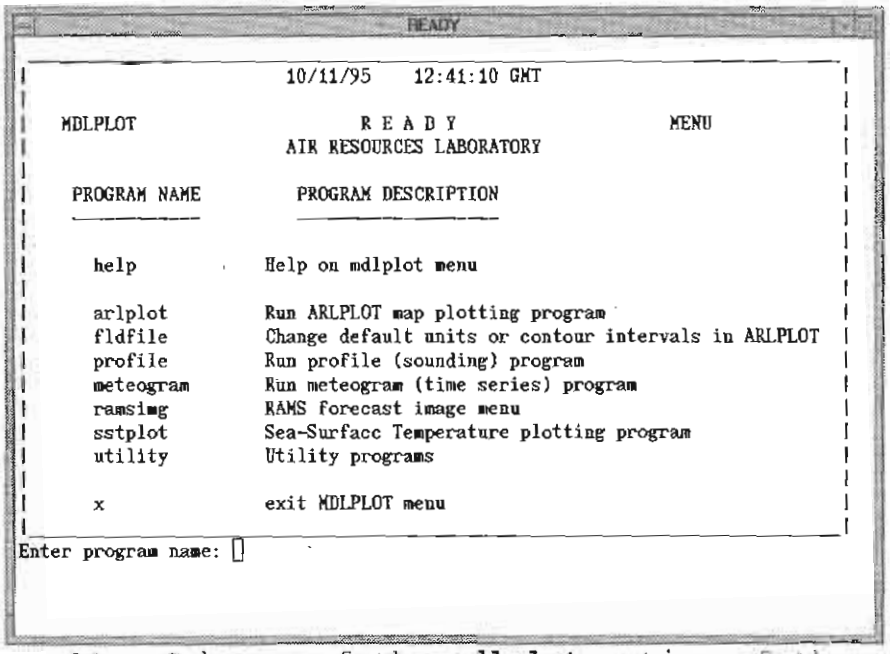

Figure 21. Submenu of the **mdlplot** option of the READY main menu.

3.6.1 **arlplot**

arlplot is a mapping program from **mdlplot**, written at ARL using NCAR Graphics, to plot gridded meteorological fields from NCEP on a map chosen by the user. To run the program, type **[arlplot]** at the **mdlplot** submenu prompt. Note: any defaults in **arlplot** can be chosen by typing a **[/]** at the prompt.

A. The first prompt in **arlplot** is for your choice of which meteorological database (or HY-SPLIT concentration file **[14]** if it is available) to query. You can enter **[18]** for information on any of the databases. The default is **[1]**, the ETA048, which is the Eta model 48 hour forecast dataset.

B. The next prompt is for the title to be plotted at the top of each plot. The title can be up to 50 characters. Above the input line is a marker showing the 50 character positions. This is helpful for centering the title between the two arrow heads.

C. The next prompt is for your choice of one of the following display areas (note that certain display areas may not be applicable for a particular database):

1. Plot entire grid area.

2. Enter central X,Y position and radius: Allows you to specify a central location (latitude/longitude **[LAT/LON]** or X,Y grid location) and radius (degrees latitude or grid units).

3. Define lower left and upper right positions: Allows you to enter the lower left corner and upper right corner (LAT,LON) positions of a box, defining the area and the grid orientation desired (LON). This option can be tricky as you must take into account the curvature of the polar-stereographic projection defined by the data.

4.~ United States.

5.~ Eastern United States.

6.~ Western United States.

7. Default HY-SPLIT area: This option is shown only if HY-SPLIT is run (although any of the other options can be chosen for displaying a HY-SPLIT map). It will take the origin of the HY-SPLIT source and a variable number of degrees of latitude radius, depending on the distance covered by the plume.

D. The next prompt, which may or may not appear, is the x/y scale of the output map. Choosing **[0]** (default) will cause the x axis to be longer by one-third than the y axis. Choosing **[1]** will force a square box (x=y).

E. The next prompt is for your choice of latitude/longitude line intervals to be plotted on the map. Note that latitude/longitude numbers are not plotted on the map because NCAR Graphics does not support them.

F. The next prompt is for your choice of meteorological field. This menu will vary for each database, because different fields are available for each database. Four-letter notation is used to define the available fields (see Appendix B for additional information).

G. For surface fields, the next prompt is for your choice of time (MM DD HH). For upper-level fields, the prompt is for the height of the level to plot (LL). For meteorological data, the prompt is for the valid time (either analysis or

forecast), whereas for HY-SPLIT concentration the time is the beginning of the averaging period. The forecast hour (HH) can be typed with month (MM) and day (DD) set to zero, if this is more convenient.

H. The next prompt is for your choice of the display type:

1. line contours: Plots simple color line contours, where the contour interval has been set in the **FLDFILE.CFG** file (see Sec. 3.6.2). For HY-SPLIT concentration files, contours are on a log scale and concentration numbers are plotted as follows: 213 = 2.0E-13.

2. color fill: Plots color-filled line contours, where the contour interval has been set in the **FLDFILE.CFG** file (see Sec. 3.6.2). For HY-SPLIT concentration files, contours are on a log scale. (Note: these plots can be displayed only with X11 windows software.)

3. gray shading: Plots gray-shaded line contours, where the contour interval has been set in the **FLDFILE.CFG** file (see Sec. 3.6.2). For HY-SPLIT concentration files, contours are on a log scale.

4. grid point values of meteorological data: Plots numerical values of meteorological data at each grid point. The user will be asked for a multiplier to scale the data to two digits (i.e., a multiplier of 100 for precipitation in inches will plot 0.25 inches as 25).

5. concentration grid box plot: Plots shaded boxes representing concentration on a log scale over each grid box.

6. concentration grid point values: Plots three-digit concentration numbers as 412 = 4.0E-12.

I. The next prompt is to create or add to a four-panel chart. If you reply with a **[y]**, then the plot will be added to the four-panel chart; otherwise, the plot will be on one frame.

J. The final prompt is to overlay another field. If the reply is **[y]**, then the next field plotted will be overlaid on the last field plotted. Enter a **[0]** to exit the program and view the plots or enter another field from the menu.

Figure 22 shows a map of mean sea-level pressure overlaid with wind flags at 10 m above model terrain produced with **arlplot**. This map uses data from the 24 hour Eta model forecast.

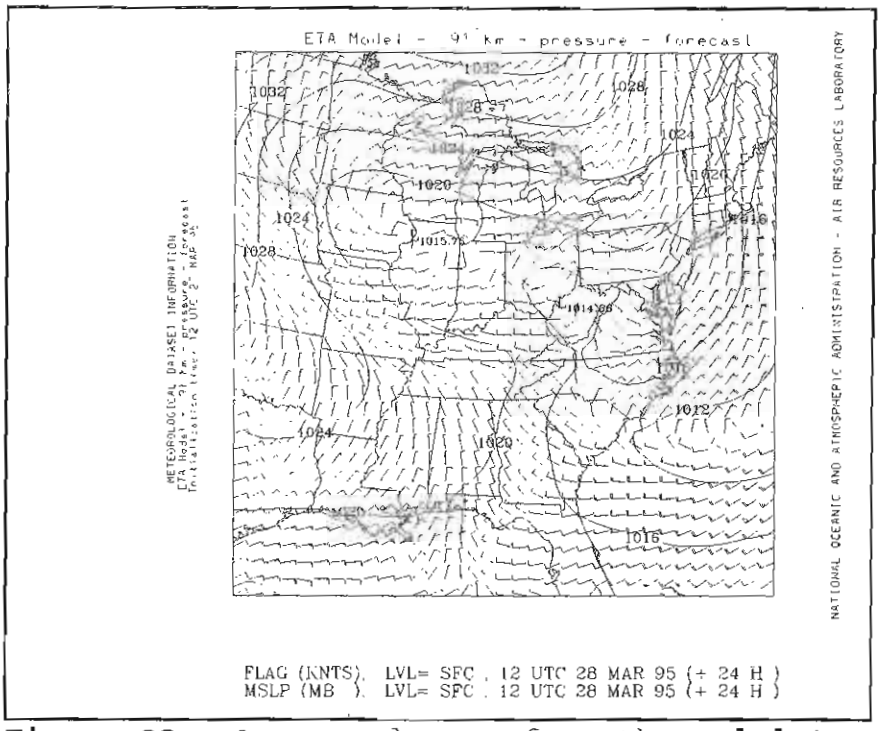

Figure 22. An example map from the **arlplot** program of **mdlplot**, showing mean sea-level pressure (MSLP) and wind flags (FLAG) at 10 m above model terrain over the eastern United States from a 24 hour forecast of the Eta model.

3.6.2 **fldfile**

The **fldfile** submenu option of **mdlplot** allows you to edit, using the unix vi editor, the default units, and contour interval information in your local **FLDFILE.CFG** file for use with **arlplot**. Use the following keys when editing the file:

r or **shift-r**	replace character or characters
i or **shift-i**	insert a character or characters
:q!	exit vi without saving
:w	save changes and keep editing
:wq	save changes and exit

The first column indicates whether the field is (1) a surface level field, (2) an upper-level field, or (3) a special field. The second column is the four-letter ID of the field. The third column is the multiplier to use on the data. The fourth column is the units (valid unit types are DEGF, DEGC, KNTS, MI/H, INMG, IN , MM , CM . Note that the spaces in IN, MM, and CM are important). Finally, the fifth column is the contour interval to be used.

3.6.3 **profile**

The **profile** program of **mdlplot** will plot thermodynamic diagrams of model forecast data at any available forecast hour and at any location within the model domain chosen by the user.

A. The first prompt in **profile** is for your choice of the meteorological database to query. You can enter **[15]** for help on any of the databases. The default is **[1]**, the ETATO48.

B. The second prompt is for your choice of latitude and longitude of the sounding to plot. The default is Washington, DC. To quit the program and display the plots, enter **[0]** for the latitude and longitude.

C. The third prompt is for the title to be plotted at the top of each plot. The title can be up to 50 characters. Just above the input line is a marker showing the 50 character positions. This is helpful for centering the title between the two arrow heads.

D. The fourth prompt is for the time (MM DD HH) of the sounding to plot. You can type the forecast hour with month (MM) and day (DD) set to zero, if this is more convenient.

E. At the fifth prompt, the program will print a text listing of the vertical sounding (Fig. 23). It will ask you to select a full plot or a plot up to 400 mb. The program then plots a skew-T log-P diagram and a potential temperature versus height

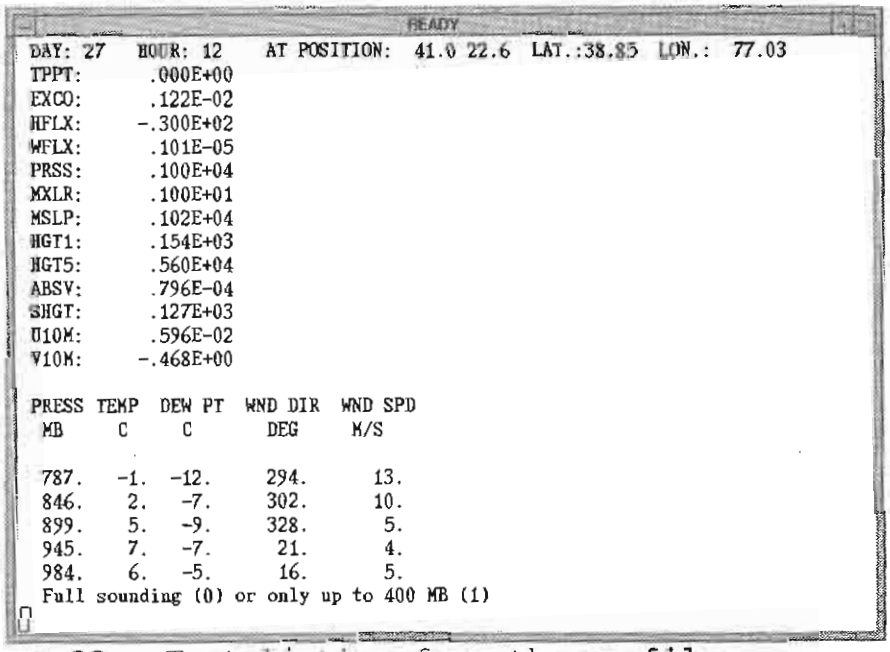

Figure 23. Text listing from the **profile** program of **mdlplot**, using the NGM model.

diagram.

Figures 24 and 25 show examples of profiles for Washington, DC, using the Eta model. Figure 24 is a potential temperature profile showing the temperature and dewpoint after conversion to potential temperature, and Fig. 25 shows the standard skew-T log-P diagram.

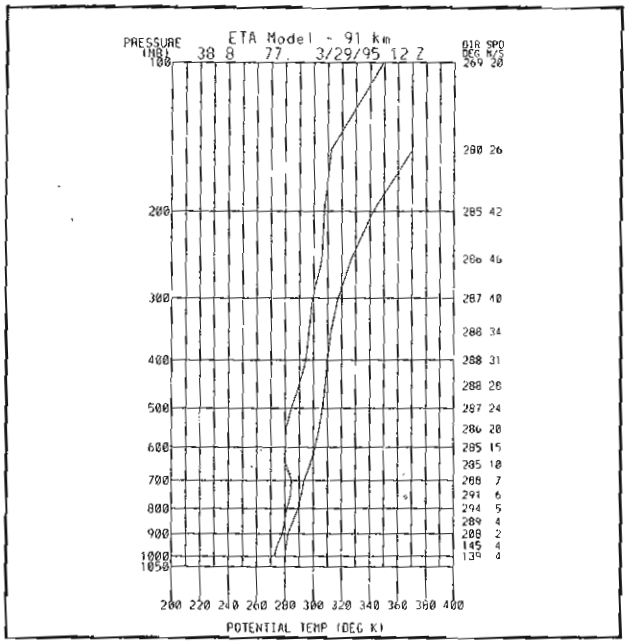

Figure 24. Potential temperature diagram from the **profile** program of **mdlplot**.

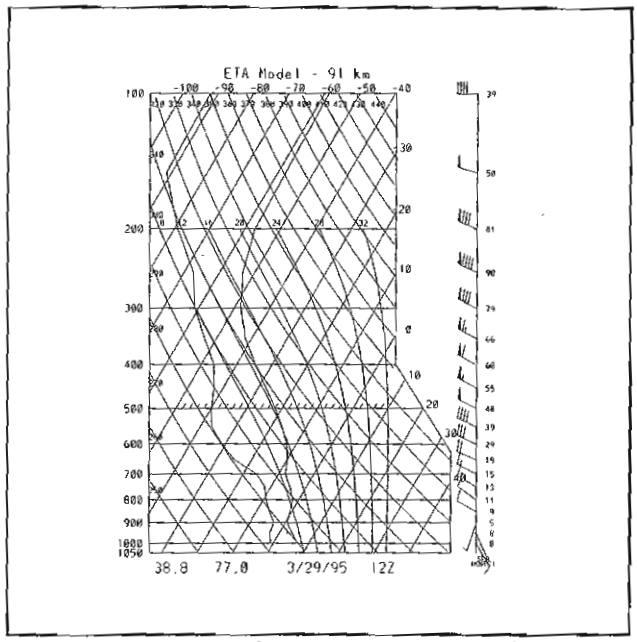

Figure 25. Skew-T log-P diagram from the **profile** program of **mdlplot**.

3.6.4 **meteogram**

The **meteogram** program of **mdlplot** plots a time series of NCEP gridded model forecasts at a user-selected location on the model domain. Fields can be plotted separately, or a "canned" meteogram can be plotted to include precipitation, 1000-500 mb thickness, surface (or lowest level) temperature, mean sea-level pressure, and wind flags at several levels.

A. The first prompt in **meteogram** is for your choice of meteorological dataset or a user-defined dataset. You can enter **[15]** for help on any dataset. The default is **[1]**, the ETATO48.

B. The second prompt is for the location of the meteogram using latitude and longitude. The default is Washington, DC.

C. The third prompt is for the optional title to display above the meteogram. You must enter the title within single quotes, unless you choose the default of no title.

D. The fourth prompt is the field to display. These are self-explanatory, except for the canned meteogram, which plots precipitation, 1000-500 mb thickness, lowest level temperature, mean sea-level pressure, and wind flags.

Figure 26 shows an example "canned" meteogram using the Eta model data for the Prairie Island nuclear plant in Minnesota.

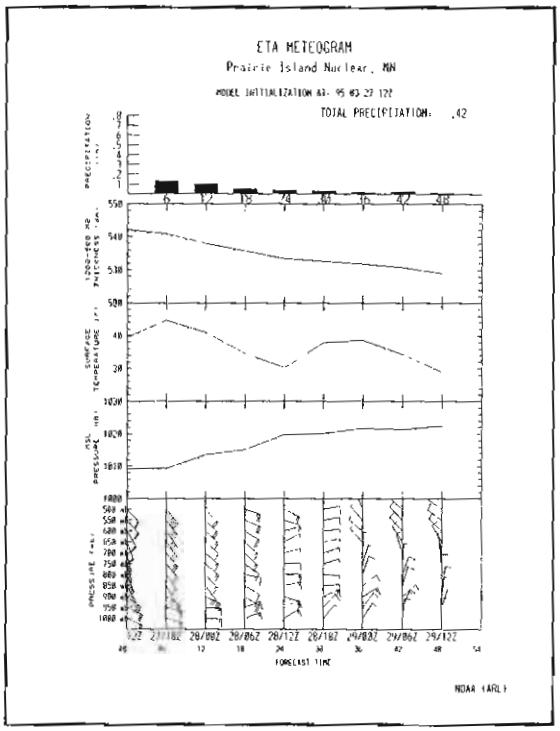

Figure 26. Canned meteogram for the Prairie Island nuclear plant in Minnesota.

3.6.5 **ramsimg**

The submenu of the **ramsimg** option of **mdlplot** allows you to display the current operational RAMS (Pielke et al., 1992) model grid domains and forecast maps from the ARL RAMS dataset. The following two options are available under **ramsimg**:

showrams: Displays on an X11 window the current RAMS operational coarse (Fig. 27) and fine (Fig. 28) grid domains. Press **[q]** to quit the image.

ramfcst: Displays on an X11 window RAMS forecast fields as a series of maps. Press **[Enter]** to move to the next map.

Figure 29 shows an example of the output on the fine-grid domain of the RAMS model over Nevada at 2891 m above model terrain. Plotted are wind vectors at every 10 km grid position, and contours of temperature.

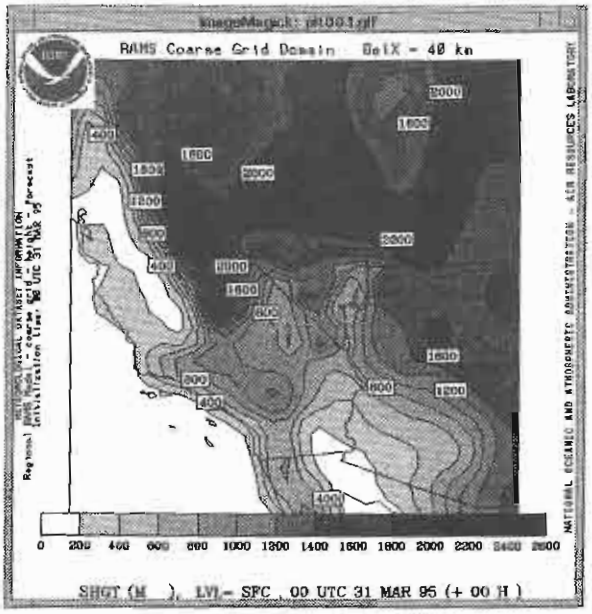

Figure 27. RAMS model coarse-grid domain. Contours of surface height are in meters.

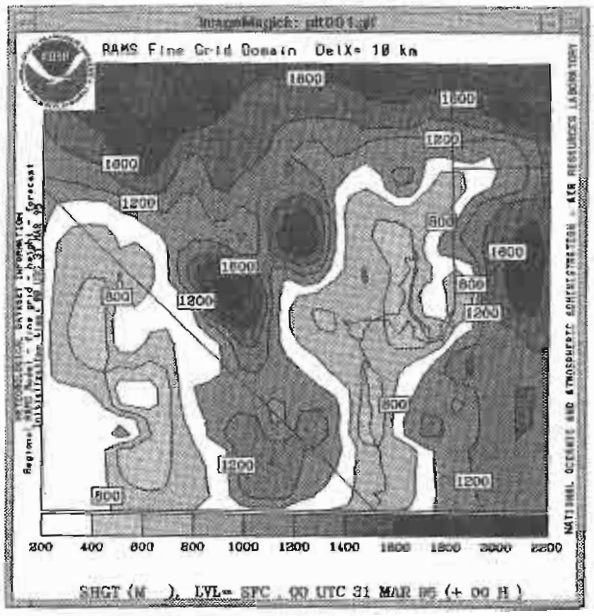

Figure 28. RAMS model fine-grid domain. Contours of surface height are in meters.

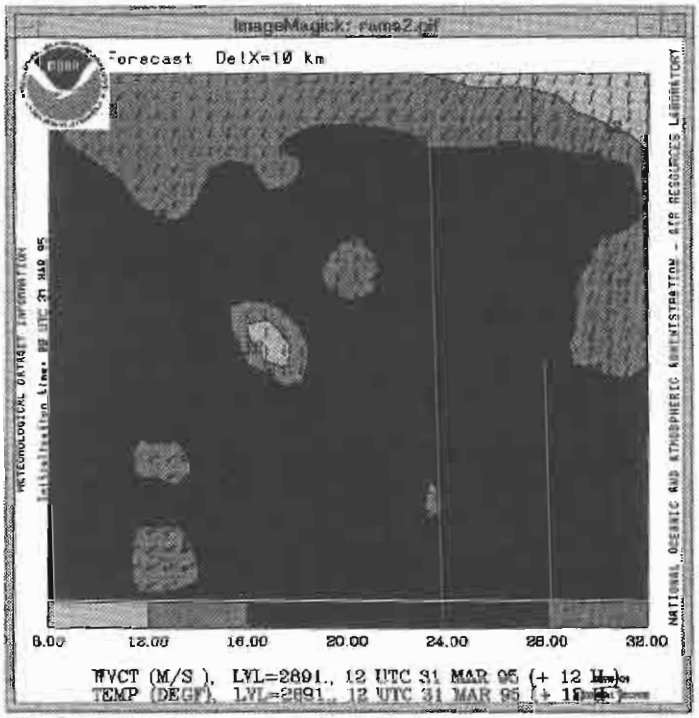

Figure 29. RAMS 12 hour forecast of wind at 10 km intervals and contours of temperature, both at 2891 m, on the fine-grid domain.

3.6.6 **sstplot**

The **sstplot** program of **mdlplot** will plot global NCEP sea-surface temperature (SST) analyzed fields on a fixed map or will allow you to define the map. The data for this program are also read in RAMS during its initialization. The optimum interpolation (OI) SST analysis is produced weekly on a 1° grid. The analysis uses insitu and satellite SST plus SST simulated by sea-ice cover.

Insitu data are obtained from radio messages carried on the GTS. Satellite observations are obtained from the National Environmental Satellite, Data and Information Service (NESDIS). Weeks are centered on Wednesday. This agrees with the ocean modeling definition.

A. The first option asks for the location of the SST map (**[1]** East Coast of the United States, **[2]** West Coast of the United States, or **[3]** user-defined location).

B. If the user-defined location was selected, the program asks for the lower left and upper right latitudes and longitudes.

Figure 30 shows an example of the SST plot for the U.S. East Coast.

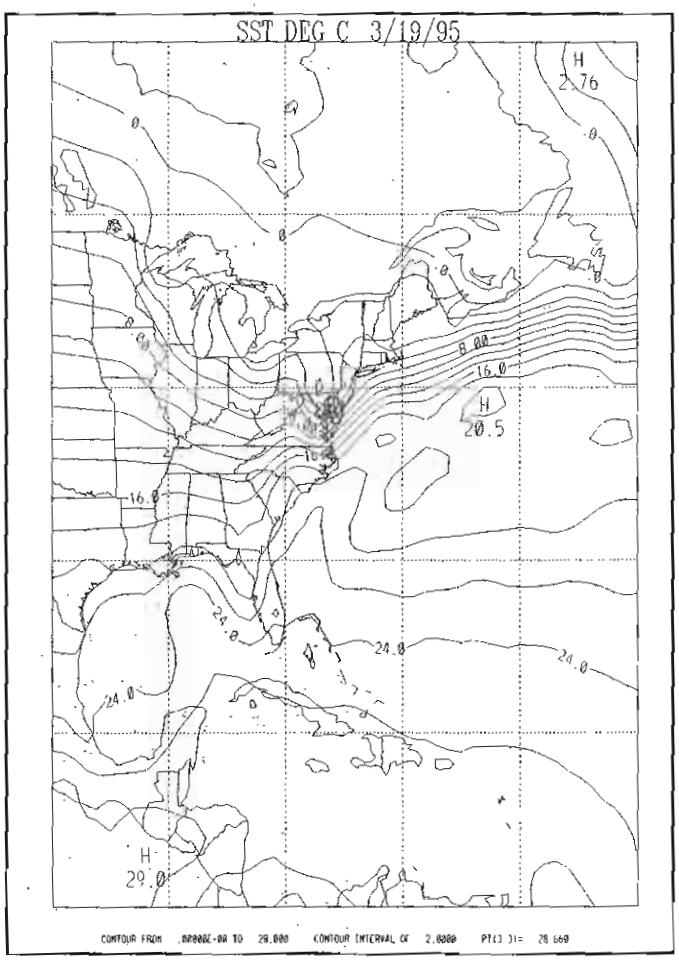

Figure 30. SST plot off the U.S. East Coast. Contours are plotted every 2°F.

3.7 **hurricane**

The submenu of the **hurricane** option of the READY main menu allows you to access the latest tropical outlook and NHC forecast of tropical storm activity. The data come over the GTS from the NWS, and are plotted using NCAR Graphics. The **hurricane** submenu contains the following options:

3.7.1 **plotpos**

The **plotpos** program of **hurricane** will plot on a map the previous and/or forecast tropical depression, tropical storm, or hurricane positions as reported by NHC. The program will ask you to enter the number of the storm you want to plot (1-5), if any are available. After entering the storm number, a text listing of the current forecast track message will be displayed to the screen. The next question will ask you if you want to plot the previous analysis positions of the storm. After entering a **[y]** or **[n]**, the plot will be displayed. Figure 31 shows an example forecast of tropical storm XXXXXX along the U.S. East Coast. Text information is plotted along the right-hand side.

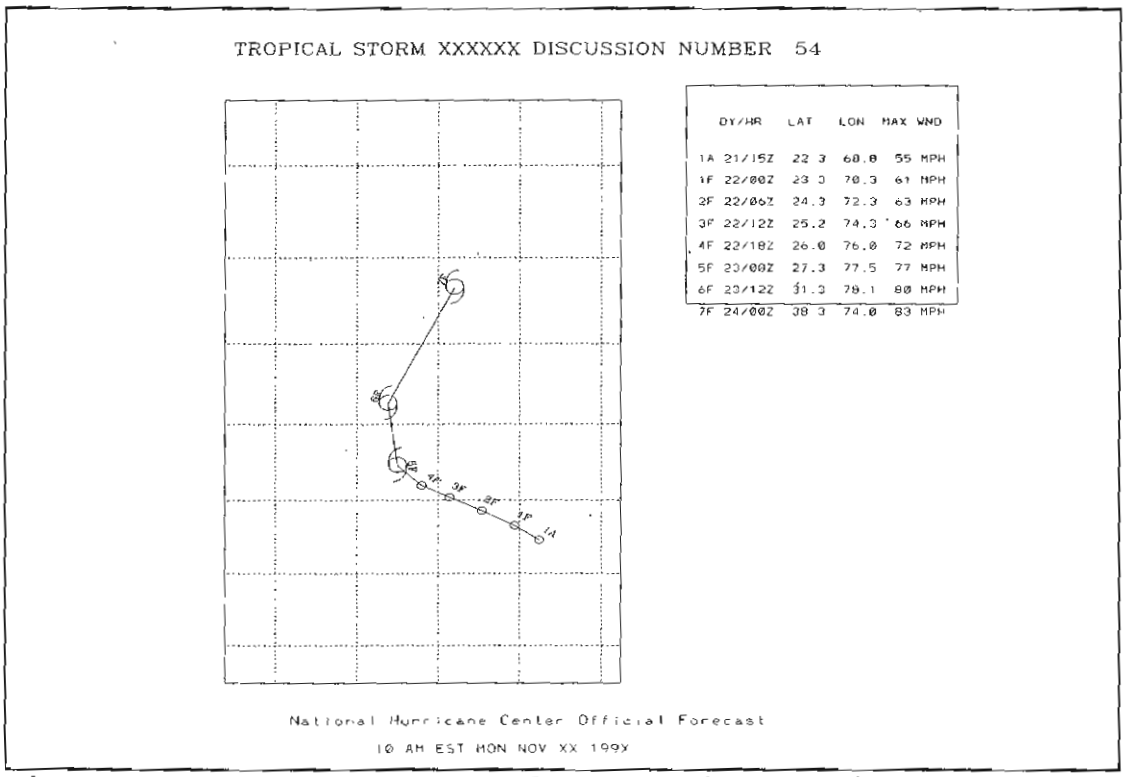

Figure 31. An example NHC forecast for tropical storm XXXXXX along the U.S. East Coast.

3.7.2 **plotprob**

The **plotprob** program of **hurricane** will plot strike probabilities issued by the NHC for tropical depressions, tropical storms, and hurricanes. Information may not be up-to-date, so you should check the day and time on the plots.

3.7.3 **outlook**

The **outlook** program of **hurricane** displays the textual tropical outlook issued by the NHC. This same bulletin is available in **ldmwx** (See Sec. 3.3.6).

3.7.4 **tropical**

The submenu of the **tropical** option of **hurricane** is the same as was discussed in Sec. 3.3.6. It is repeated in this submenu as a short-cut for accessing the tropical text information.

3.8 **images**

ARL automatically transfers images from several universities and other government agencies to its pair of RS6000 computers. The images are in GIF (Compuserve) format and are displayed using X11 windows display software. X11 windows is required to use this feature; however the images may be downloaded and displayed locally with your own software. Figure 32 shows the submenu of the **images** option of the READY main menu, which includes further submenus for displaying meteorological GIF images.

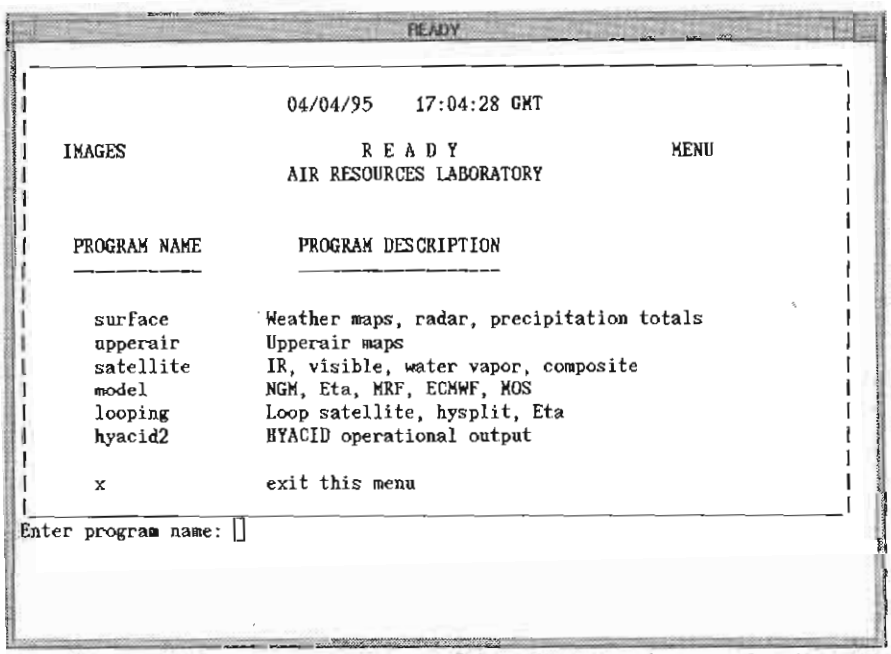

Figure 32. Submenu of the **images** option of the READY main menu.

After viewing an image, press the left mouse button to display a menu of image options, such as enlargement and rotation. The middle mouse button zooms. If no mouse is available, press **[q]** to return to the menu window.

3.8.1 **surface**

The submenu (Fig. 33) of the **surface** option of **images** lists the types GIF images available containing depictions of surface weather. This includes a composite surface map, weather depiction for aviation, radar maps, and precipitation maps for the United States over the last 24 hours and month, as well as severe weather forecast charts for days 1 and 2. These images are updated hourly at about 30 minutes past the hour. A (P) after the description in the menu means that the image was transferred from Purdue University, and an (I) means transferred from the University of Illinois. Following are descriptions of the images available from the **surface** submenu; some of the descriptions were obtained from Purdue University:

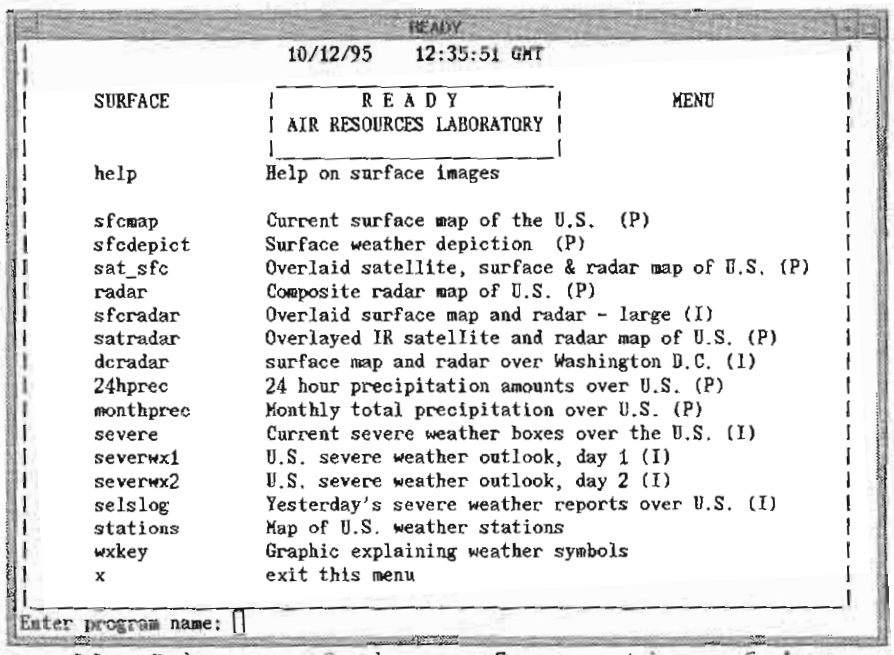

Figure 33. Submenu of the **surface** option of **images**.

3.8.1.1 **sfcmap**

This composite map contains the following analyses: radar summary (color-filled areas), surface data plot (composite station model), frontal locations (in various bold lines), and pressure

contours (in thin blue lines).

The surface map depicts as much surface weather information as possible. The radar summary displays areas where precipitation is indicated. Intensity is color coded as follows:

Color	Intensity	Description
blue	light	light rain or snow
cyan	moderate	
green	heavy	light thunderstorms/moderate rain showers
yellow	very heavy	moderate thunderstorms
magenta	intense	potential flooding rains/severe thunderstorms
red	extreme	flooding rains

The surface data plot gives the following information (see **wxkey**: Sec. 3.8.1.15):

temperature (°F)	upper left
present weather	symbol center left
dewpoint (°F)	lower left
pressure (mb-coded)	upper right
cloud cover	center circle (white fill indicates % cloud coverage)
winds	wind barb

Frontal locations are denoted by bold lines in the following colors:

cold front	blue
warm front	red
occluded	magenta
stationary	alternating red/blue
trough	dashed yellow

High- and low-pressure areas are plotted with **H** and **L** and the associated pressure in millibars is displayed below the letter. Pressure contours (or isobars) are plotted every 4 mb.

NOTE: Frontal data are available only every 3 hours, so fronts may not exactly match the weather conditions. A label at the bottom left denotes the time the front analysis is valid.

3.8.1.2 **sfcdepict**

The surface weather depiction chart is a composite chart aimed at aviation users. These data are plotted:

cloud cover	center circle (white fill indicates % cloud coverage)
present weather	symbol left center
cloud height	below (in 100s feet)

A frontal analysis is added (see **wxkey**: Sec. 3.8.1.15), as well as contours of flight conditions. Any region shaded in gray is experiencing Instrument Flight Rule (IFR) conditions. Any area enclosed by a white line is experiencing Marginal Visual Flight Rule (MVFR) conditions.

3.8.1.3 **sat_sfc**

This is a surface weather map (see **wxkey**: Sec. 3.8.1.15) overlaid on either the visible or infrared (IR) image, depending on the time of day. Figure 34 shows an example of **sat_sfc**.

Figure 34. An example of the **sat_sfc** satellite, surface, and radar overlaid map GIF image from Purdue University.

3.8.1.4 **radar**

This image displays Manually Digitized Radar (MDR) summaries of precipitation echoes. These data are recorded once an hour at

about 30 minutes past the hour, and are visualized as a contour plot of the digitized precipitation grid for six intensity scales: 1 (light) to 6 (extremely heavy). This information is recorded on a 40 km grid, which is coarse compared with the 1 km resolution of the NEXt generation RADar (NEXRAD) now being deployed across the country. The observer also reports maximum precipitation tops, and cell and line movement, and estimates precipitation type with overlays of the additional text data. Individual cell movement is plotted as a wind barb (see **wxkey**: Sec. 3.8.1.15), area movement is plotted as a vector and precipitation tops are plotted over the top as a number in hundreds of feet. This is the maximum altitude of precipitation as seen by the radar. It can range from 10,000 feet in snow showers to 20,000 feet with rain showers to 40,000 feet or more with thunderstorms. Severe thunderstorm tops can reach 50,000 to 70,000 feet.

Finally, severe weather watch boxes, if any, are shown. The area covered by the watch is enclosed by a white box. The watch number and type, as well as the expiration time, are also listed. Following are two examples of watch information:

T335 to 5Z Specifies a tornado watch #335 that expires at 5Z

S336 to 8Z Specifies a severe thunderstorm watch #336 that expires at 8Z

The radar summary displays areas where precipitation is indicated. The intensity is based on six colors where:

Color	Intensity		Description
blue	-	light	light rain or snow
cyan		moderate	
green	+	heavy	light thunderstorms/moderate rain showers
yellow	++	very heavy	moderate thunderstorms
magenta	x	intense	potential flooding rains/severe thunderstorms
red	xx	extreme	flooding rains

Radar sites can also report:

NE no echoes/precipitation within the radar range
NA radar data not available
OM radar out for maintenance

Precipitation type and intensity are plotted as follows:

R	rain
RW	rain showers
TRW	thundershowers
S	snow
SW	snow showers
IP	ice pellets/sleet

3.8.1.5 **sfcradar**

This image displays an hourly color U.S. surface map with computer-generated frontal positions overlaid with radar echoes. Radar intensity is depicted by varying color (green being light precipitation). Severe weather boxes are displayed in red.

3.8.1.6 **satradar**

This is the standard IR image overlaid with the associated radar summary. The IR image highlights the deeper/higher clouds, and the radar summary associates precipitation with those clouds.

3.8.1.7 **dcradar**

This image is the **sfcradar** image (Sec. 3.8.1.5) zoomed in on the Washington, DC, area.

3.8.1.8 **24hprec**

This image displays the previous day's precipitation in inches from 1200 UTC to 1200 UTC, and is available at about 1500 or 1600 UTC.

3.8.1.9 **monthprec**

This image displays total precipitation in inches for the current month ending at 1200 UTC today and is available at about 1500 or 1600 UTC.

3.8.1.10 **severe**

This is the current radar image with watch and warning boxes, which is available hourly from the University of Illinois.

3.8.1.11 **severwx1**

This is a U.S. map with areas of possible severe weather for today. It is available once per day from the University of Illinois.

3.8.1.12 **severwx2**

This is a U.S. map with areas of possible severe weather tomorrow. It is available once per day from the University of Illinois.

3.8.1.13 **selslog**

This is a U.S. map with reported severe weather from the previous day. This map is available once per day from the University of Illinois.

3.8.1.14 **stations**

This is a U.S. map with weather station identifications plotted at their locations. This map may not be up-to-date.

3.8.1.15 **wxkey**

This is a key to weather symbols plotted on surface maps.

3.8.2 **upperair**

This submenu (Fig. 35) option of **images** lists GIF images of data taken from rawinsondes, which measure upper-air conditions over a particular location. Currently, only two levels are available and are retrieved from the University of Illinois: 850 and 500 mb. These data are updated once every 12 hours at about 1545 UTC.

3.8.2.1 **850mb**

This is a composite upper-air map for the 850 mb level. The plot contains individual rawinsonde-reported conditions for that level, along with contours of height (solid lines) every 30 m and temperature (dashed lines) every 5°C.

The upper-air data plot displays the following information:

temperature (°C)	upper left
dewpoint (°C)	lower left
height (m)	upper right
winds	wind barb

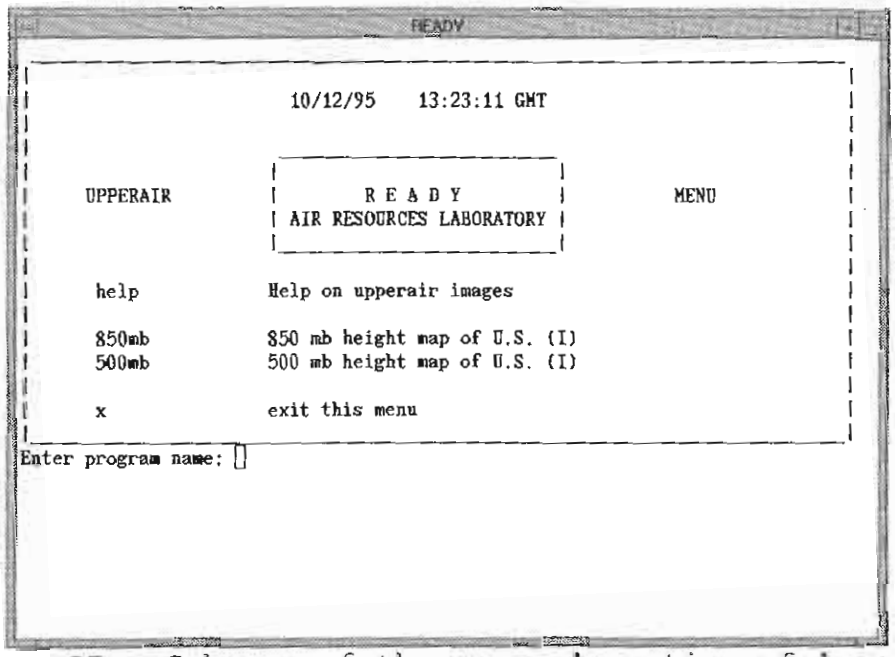

Figure 35. Submenu of the **upperair** option of **images**.

3.8.2.2 **500mb**

This is a composite upper-air map for the 500 mb level, with overlaid, computer-drawn surface fronts. The plot contains station data with contours of height (solid lines) every 60 m and temperature (dashed lines) every 5°C.

3.8.3 **satellite**

The submenu (Fig. 36) of the **satellite** option of **images** lists the currently available satellite images retrieved from the University of Wisconsin (W), the University of Illinois (I), Purdue University (P), and the University of Edinburgh (E).

The **usir**, **usir1** and **usir2** images show heat-based IR radiation. The warmer the surface, the more IR radiation it emits. For a satellite image, cooler surfaces are bright, whereas warmer surfaces are dark. As a result, tall thunderstorm clouds will show

up as bright white, and fog will be hard to discern from land areas. The advantage of IR is that you can view it 24 hours a day.

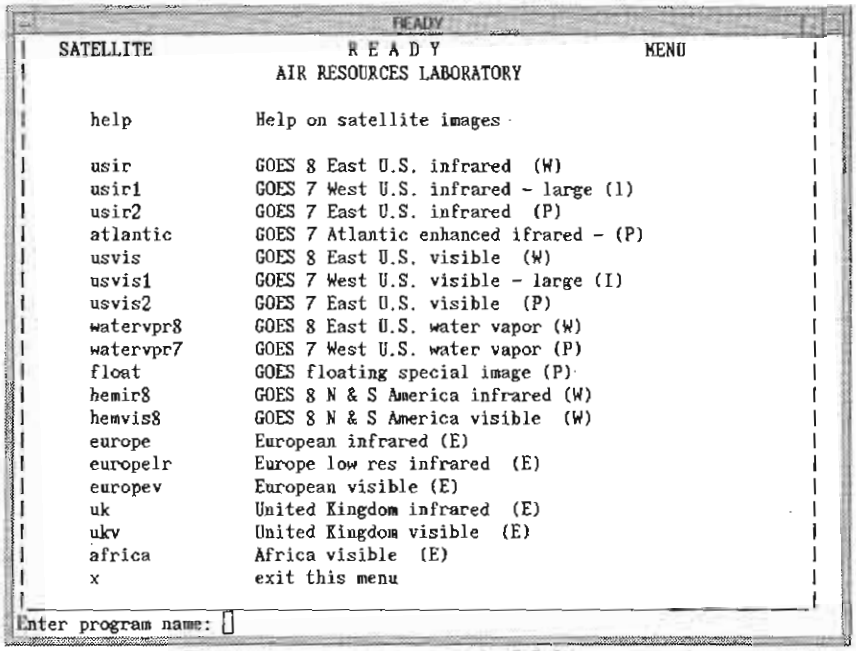

Figure 36. Submenu of the **satellite** option of **images**.

3.8.3.1 **usir**

This is a Geostationary Operational Environmental Satellite number 8 (GOES 8) IR satellite image (Fig. 37) over eastern North America, which is available hourly from the University of Wisconsin.

3.8.3.2 **usir1**

This is a large GOES 7 IR satellite image over western North America, which is available hourly from the University of Illinois.

3.8.3.3 **usir2**

This is a GOES IR satellite image over western North America, which is available hourly from Purdue University. This is a slightly smaller version of the Illinois image (**usir1**).

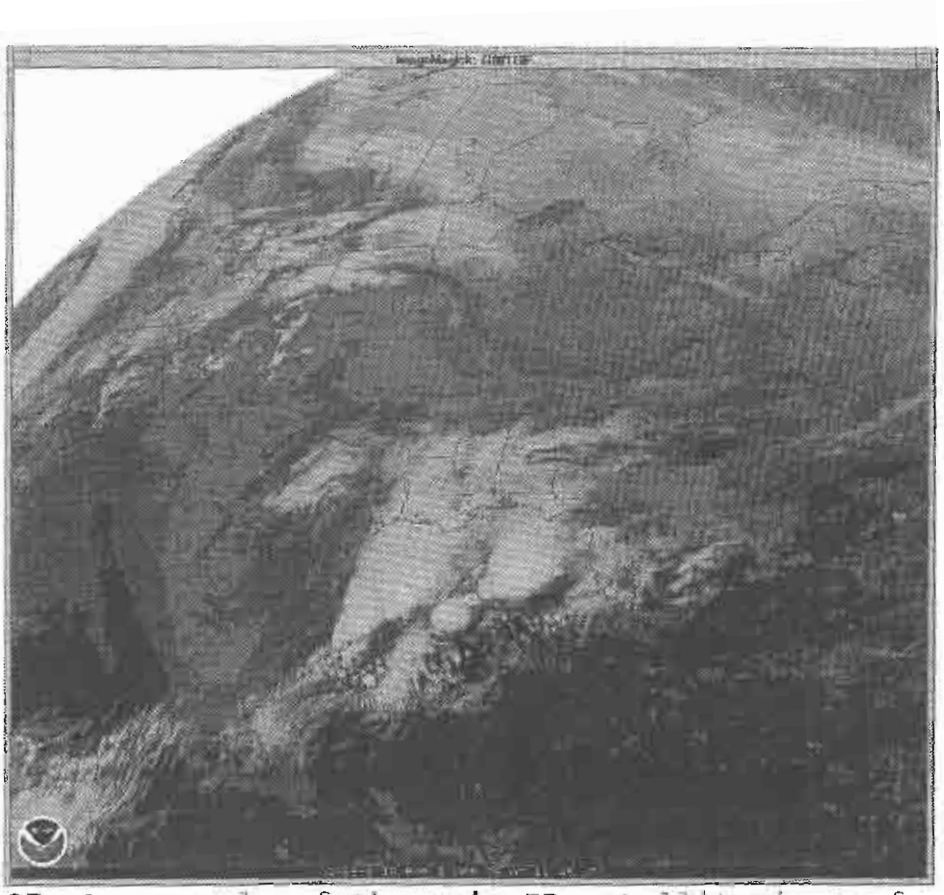

Figure 37. An example of the **usir** IR satellite image from the GOES 8 satellite. Retrieved from the University of Wisconsin.

3.8.3.4 **atlantic**

This image shows a color-enhanced IR image over the western Atlantic Ocean, which is available hourly from Purdue University.

3.8.3.5 **usvis**

This **usvis**, **usvis1** and **usvis2** images, are visible satellite images taken from the GOES 7 and 8 satellites. There is a major limitation to visible imagery in that it is only relevant during daylight. The **usvis** image is a GOES 8 visible image over eastern North America, which is available hourly from the University of Wisconsin.

3.8.3.6 **usvis1**

This is a GOES 7 visible satellite image over western North America, which is available hourly from 1000 to 0300 UTC from the

University of Illinois. This image is a slightly larger version of the Purdue (**usvis2**) image.

3.8.3.7 **usvis2**

This is a GOES 7 visible satellite image over western North America, which is available hourly from 1000 to 0300 UTC from Purdue University.

3.8.3.8 **watervpr8**

The **watervpr8** and **watervpr7** images, which are slight modifications of IR images, indicate integrated water vapor, especially weighted toward the upper atmosphere. Moist areas show up as white, and dry areas as black. **Watervpr8** is a GOES 8 water vapor image over eastern North America, which is available hourly from the University of Wisconsin.

3.8.3.9 **watervpr7**

This is a GOES 7 water vapor image over western North America, which is available hourly from Purdue University.

3.8.3.10 **float**

This is a variable-area image used to highlight or zoom in on a particularly interesting weather event or phenomena. This can either be visible or IR and is available hourly from Purdue University.

3.8.3.11 **hemir8**

This is a GOES 8 full-disk IR satellite image over North and South America, which is available once a day (1800 UTC) from the University of Wisconsin.

3.8.3.12 **hemvis8**

This is a GOES 8 full-disk visible satellite image over North and South America (Fig. 38), which is available once a day (1800 UTC) from the University of Wisconsin.

Figure 38. An example of the **hemvis8** GOES 8 North and South America visible satellite image.

3.8.3.13 **europe**

This is a Meteosat high resolution IR satellite image over western Europe, which is available twice a day (0000 and 1200 UTC) from the University of Edinburgh.

3.8.3.14 **europelr**

This is a Meteosat IR satellite image over western Europe, which is available once a day (1500 UTC) from the University of Edinburgh.

3.8.3.15 **europev**

This is a Meteosat visible satellite image over western Europe, which available once a day (1500 UTC) from the University of Edinburgh.

3.8.3.16 **uk**

This is a Meteosat IR satellite image over the United Kingdom, which is available once a day (1500 UTC) from the University of Edinburgh.

3.8.3.17 **ukv**

This is a Meteosat visible satellite image over the United Kingdom, which is available once a day (1500 UTC) from the University of Edinburgh.

3.8.3.18 **africa**

This is a Meteosat visible satellite image over Africa, which is available once a day (1500 UTC) from the University of Edinburgh.

3.8.4 **model**

The sub-menu (Fig. 39) of the model option of images lists available NCEP model products retrieved from Purdue University.

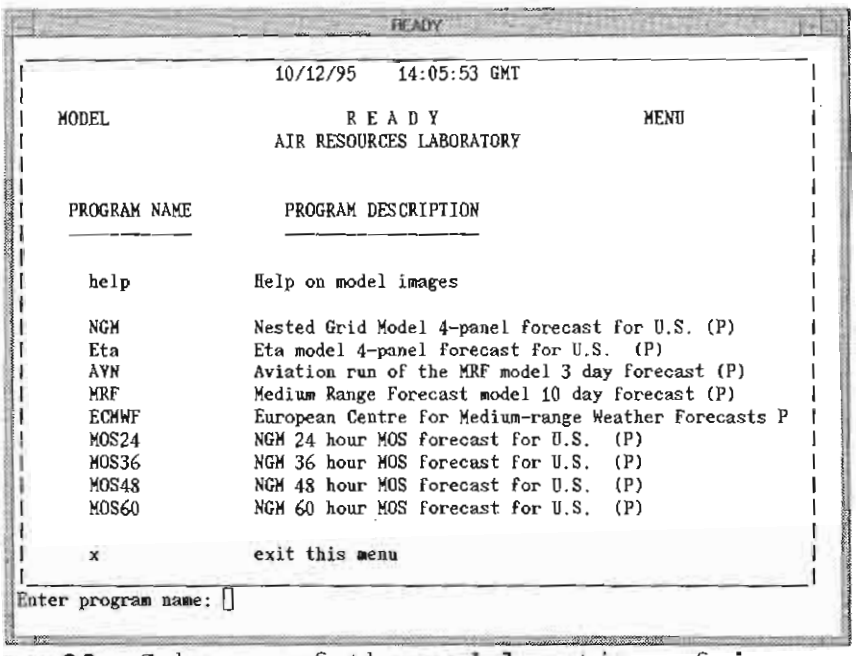

Figure 39. Submenu of the **model** option of **images**.

3.8.4.1 **NGM**

This option displays contours of data from the NGM. The NGM forecasts are shown out to 48 hours and are updated once every 12 hours at roughly 0430 and 1630 UTC.

The NGM surface forecast chart (Fig. 40) includes three parameters: sea level pressure (cyan lines), 1000-500 mb thickness (brown dotted lines), and quantitative precipitation (colored contours). The quantitative precipitation field shows estimated 12 hour precipitation (liquid equivalent) for the 12 hour period prior to the valid time. The contours follow the following scale:

black	no measurable precipitation.
dark magenta	0.01 to 0.05 inches
medium magenta	0.05 to 0.10 inches
light magenta	0.10 to 0.25 inches
blue-magenta	0.25 to 0.50 inches
blue	0.50 to 1.0 inches
green	1.0 to 2.0 inches
yellow	2.0 to 4.0 inches
orange	greater than 4.0 inches

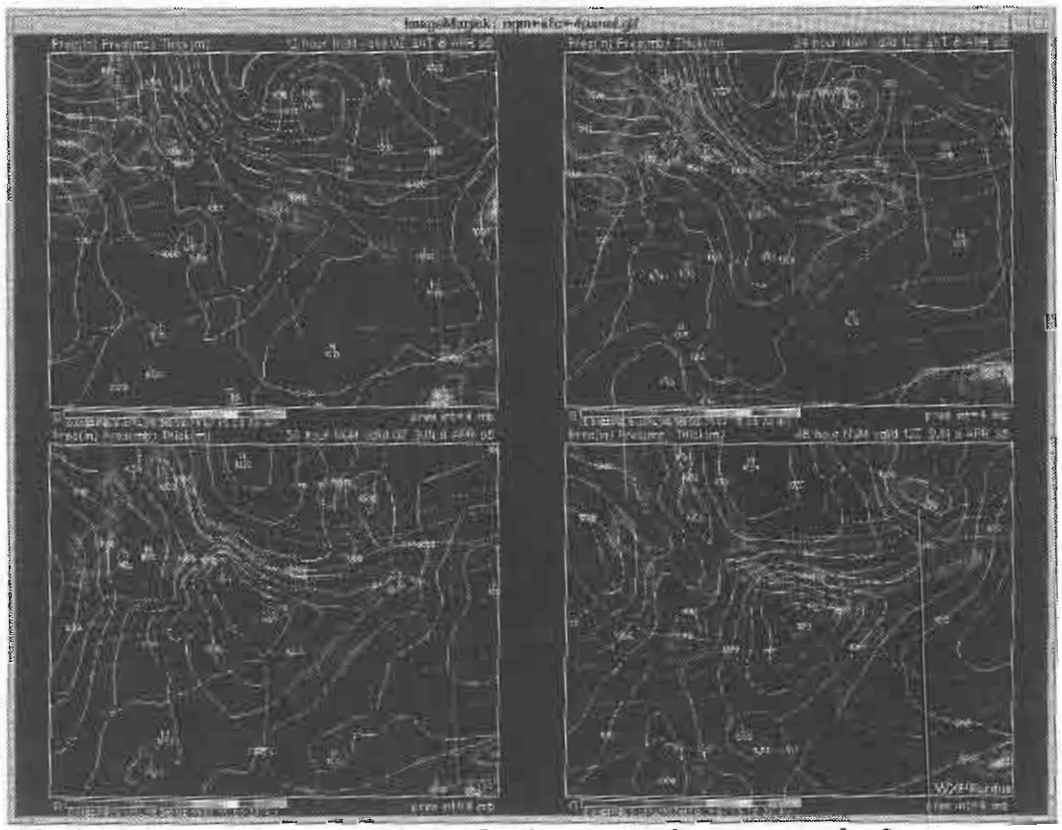

Figure 40. An example of the NGM four-panel forecast product from Purdue University.

3.8.4.2 **Eta**

This is a four-panel plot of data from the Eta forecast model. Output fields are the same as the **NGM** (Sec. 3.8.4.1). The Eta model forecasts out to 48 hours, and the plots are updated once every 12 hours at roughly 0400 and 1600 UTC.

3.8.4.3 **AVN**

This is a 6-panel plot of data from the Aviation (AVN) run of the **MRF** (Sec. 3.8.4.4) forecast model. Output fields are the same as the **NGM** (Sec. 3.8.4.1). The AVN model forecasts out to 72 hours with plots available at 12 hour intervals. These plots are updated once every 12 hours at roughly 0700 and 1900 UTC.

3.8.4.4 **MRF**

This is a nine-panel contour plot from the MRF model. The plots show data from the initialized time and every 12 hours out to 10 days. These plots are updated once a day at about 1200 UTC, based on the 0000 UTC model run. The MRF plots show two parameters: 500 mb heights (in color contours) and sea-level pressure (in black line contours).

3.8.4.5 **ECMWF**

This is a six-panel contour plot from the European Centre for Medium-range Weather Forecasts (ECMWF) forecast model. This model runs to 7 days and provides plots at 24 hour intervals for 500 mb heights (in color contours) and sea-level pressure (in black line-contours). These plots are generated once a day at 0145 UTC.

3.8.4.6 **MOS24**

These are plots of MOS from the NGM model. NGM gridpoint data are used to derive conditions specific to a particular city. These are compiled through statistical techniques to best describe the weather conditions at a particular location over the forecast period. The data derived include temperature, dewpoint, pressure, precipitation, weather, etc., running out to the 60 hour forecast.

This NGM MOS plot, and the next three (Secs. 3.8.4.7-3.8.4.9), are updated twice a day at about 0500 and 1700 UTC, and show forecasted surface conditions for several major cities. The plots contain a contour analysis of 12 hour quantitative precipitation. The colored contours represent the following precipitation amounts:

black	no measurable precipitation.
dark magenta	0.01 to 0.05 inches
medium magenta	0.05 to 0.10 inches
light magenta	0.10 to 0.25 inches
blue-magenta	0.25 to 0.50 inches
blue	0.50 to 1.0 inches
green	1.0 to 2.0 inches
yellow	2.0 to 4.0 inches
orange	greater than 4.0 inches

The surface conditions are plotted as a station model for the valid time. The MOS station model contains the following information (see **wxkey**: Sec. 3.8.1.15):

temperature (˚F)	upper left
forecasted weather	symbol center left
dewpoint (˚F)	lower left
probability of precipitation	upper right
cloud cover	center circle (white fill indicates % cloud coverage)
winds	wind barb

3.8.4.7 **MOS36**

Same as Sec. 3.8.4.6, but for 36 hours.

3.8.4.8 **MOS48**

Same as Sec. 3.8.4.6, but for 48 hours.

3.8.4.9 **MOS60**

Same as Sec. 3.8.4.6, but for 60 hours.

3.8.5 **looping**

The submenu (Fig. 41) of the **looping** option of **images** uses X-windows to loop some images in READY, such as satellite and HY-SPLIT concentration. **looping** uses the program **xanim**. **looping** may not work on low-memory computers, and may take several minutes to generate, depending on the number and complexity of the plots. **looping** will start immediately after loading the images. A tool box will also appear that can be used with a mouse to stop, start, slow-down, speed-up, reverse, and exit the loop. You can also exit by clicking on the loop window and typing a **[q]**. The mouse buttons

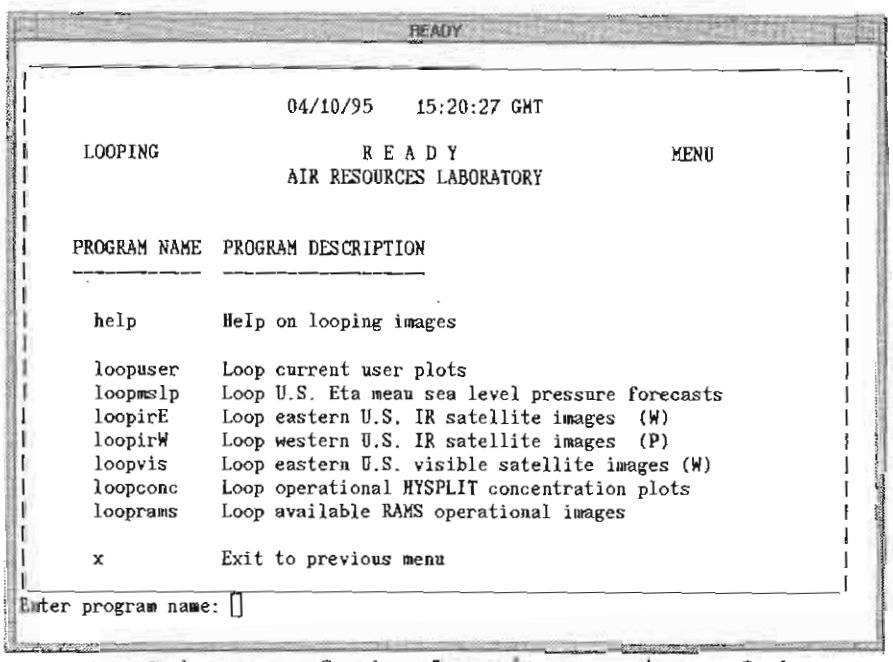

Figure 41. Submenu of the **looping** option of **images**.

also have the following capability:

left button	single step back one frame
middle button	toggle; starts/stops animation
right button	single step forward one frame

Press **[=]** to slow down the speed of the loop, press **[-]** to speed up the loop, or press **[0]** to restore the speed to the original value.

3.8.5.1 **loopuser**

loopuser will loop the last user plots created in all programs, except **gempak** (Sec. 3.9) and **images** (Sec. 3.8).

3.8.5.2 **loopmslp**

loopmslp will loop the latest Eta four-panel forecasts of 500 mb heights, mslp/1000-500 mb thickness, 700 mb relative humidity, and precipitation. The frames show the forecast every 6 hours out to 48 hours.

3.8.5.3 **loopirE**

loopirE will loop the last several hours of GOES 8 IR

satellite images over eastern North America. These are the same images as in **usir** (Sec. 3.8.3.1), and are from the University of Wisconsin.

3.8.5.4 **loopirW**

loopirW will loop the last several hours of GOES 7 IR satellite images over western North America. These are the same images as in **usir1** (Sec. 3.8.3.2), and from Purdue University. These images take up less memory than those in **loopirE** (Sec. 3.8.5.3).

3.8.5.5 **loopvis**

loopvis will loop the last several hours of GOES 8 visible satellite images over eastern North America. These are the same images as in **usvis** (Sec. 3.8.3.4), and are from the University of Wisconsin.

3.8.5.6 **loopconc**

loopconc will normally loop eight 6-hour average concentration maps produced from the HY-SPLIT model using the latest Eta forecast. The content will be dependent on the needs of the ARL staff and the specific emergency.

3.8.5.7 **looprams**

looprams will loop the current RAMS operational output. The fields and output interval displayed will vary with the interest of the RAMS users.

3.8.6 **hyacid2**

The six GIF images displayed when you select the hyacid2 option of images are operational outputs from the HYSPLIT Atmospheric Chemistry Including Deposition (HYACID) precipitation chemistry model, which is run operationally, once each day, at ARL. The HYACID model, under development over the last few years, now includes sulfur and nitrogen liquid- and gas-phase chemistry. The nitrate output results are still experimental, and the content of these images may change from time to time. The meteorological data used by HYACID comes from the NGM. Emissions of SO_2 and NO_x come from the National Acid Precipitation Assessment Program (NAPAP) 1985 emissions inventory. Additional information on the sulfur aspects of the model can be found in Rolph et al. (1993).

The six images will be displayed successively. Press **[q]** after viewing each image to advance to the next. Details of the images follow:

1. Shows four contoured plots of air concentration ($\mu g/m^3$) of (A) SO_2, (B) SO_4, (C) NO_2, and (D) NO_3 (Fig. 42). Contour intervals are 2.0, 1.0, 2.0, and 0.5 $\mu g/m^3$, respectively.

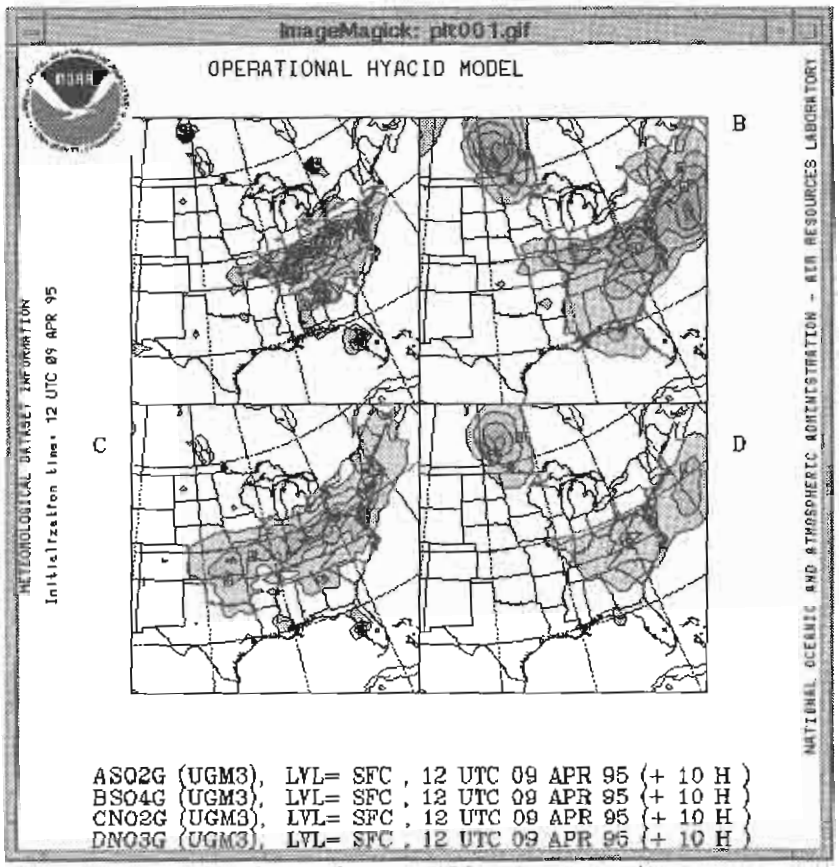

Figure 42. An example of the first GIF image from the **hyacid2** option of **images**. See text (Sec. 3.8.6) for an explanation.

2. Shows four contoured plots of air concentration ($\mu g/m^3$) of (A) HNO_3, (B) PAN, (C) SO_4, and (D) NO_3. Contour interval is 1.0 $\mu g/m^3$.

3. Shows three contoured plots of deposition (mg/m^2) of (A) SO_4, (B) NO_3, and (C) NH_4. Plot D also shows the pH of the precipitation. Contour intervals are 5.0 mg/m^2, 2.0 mg/m^2, 0.5 mg/m^2, and 0.5 pH, respectively.

4. Shows the NGM forecast accumulated precipitation (cm) from 1200 UTC to 1200 UTC. This predicted precipitation is used by

the HYACID chemistry model and is based on the first 12 hours of predicted precipitation from each of the two NGM runs at 1200 and 0000 UTC.

5. Shows the NGM-predicted wind flags and mean sea-level pressure (MSLP) at 0200 UTC. Each full barb on the wind flag equals 10 knots, and each half barb equals 5 knots. MSLP is contoured at 3 mb intervals.

6. Shows the HYACID predicted pHs valid at 1200 UTC at every model grid point. The two-digit number represents the pH multiplied by 10 (i.e., 35 means a pH of 3.5). Locations represented with a dot had no precipitation forecasted.

3.9 **gempak**

The GEneral Meteorology PAcKage (GEMPAK; desJardins et al., 1991) is a meteorological display and data analysis package originally developed jointly by the National Aeronautics and Space Administration (NASA), NSSL, and the NCEP Central Operations (formerly the Automation division of the National Meteorological Center), and most recently at the NCEP Automated Weather Information Processing System (AWIPS) Transition division (now termed NAWIPS). GEMPAK "LDM bridges" are also running on the NOAA/ARL RS6000 computers to process surface and upper air data from the NWS GTS. To run a GEMPAK program, select **gempak** from the READY main menu, then select a program from the **gempak** submenu (Fig. 43) and answer the questions that follow. For most of the programs, these are the questions that will be asked:

Do you want to view the help listing for the program chosen (y/n)?

This listing will provide information on the program and its options.

An area has been defined previously with config...use it (y/n)?

This question assumes that the user has run **config** (Sec. 3.12.10) from any of the **utility** submenus and set up a default source. GEMPAK will use this area as the default area if you reply **[y]**; otherwise you can enter a new area.

Enter location : / for default = iad
or enter list to view all GEMPAK pre-defined areas

The default area is for iad. You can change this default.

Use (1) Surface Airways data or (2) Synoptic data?

For surface analysis programs this question will define the

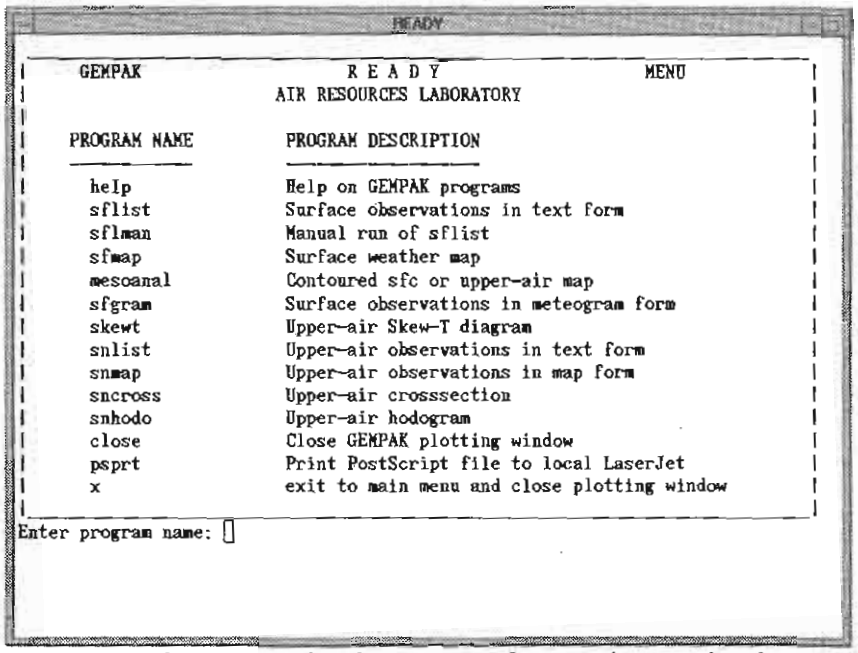

Figure 43. Submenu of the **gempak** option of the READY main menu.

area of interest. Choose **[1]** for U.S. and Canada or **[2]** for all other areas.

Enter month day in UTC (9 or 10 only)
/ for default = 10

To specify today's data just press **[/]** and **[Enter]**, otherwise enter yesterday's date exactly as specified above (9 or 10). Less than two full day's worth of data are saved.

Enter hour in UTC
/ for default = 17

Enter the UTC hour (one or two digits) of the data to plot.

Enter vertical pressure level : Default = 925

For upper-level plots enter the pressure level.

Output devices:

---

xw : X-windows plot
ps1 : B/W postscript file (ps1.plt)
psc : Color postscript file (psc.plt)

Enter output device : / for default = xw

Output device can be the X11 screen **[xw]**, a black/white Postscript file **[ps1]**, or a color Postscript file **[psc]**.

A plot will then be generated. If you choose **[xw]** it will be displayed to a window on the screen. Click on the original submenu window to answer the final question:

Do you want to print image ? (y/n)

This action will print the image only to the ARL laser printer. There is currently no way for others to directly print to a local printer.

3.9.1 **sflist**

The **sflist** program is similar to the **ldmwx** (Sec. 3.3.1). It displays a list of current surface observations in text form.

3.9.2 **sflman**

The **sflman** program is the same as **sflist** (Sec. 3.9.1), except that the user has complete control of the GEMPAK parameters. Only persons knowledgeable with GEMPAK should attempt to use this option. Type **[exit]** at the prompt to exit the program if you mistakenly enter it.

3.9.3 **sfmap**

sfmap plots a surface map (Fig. 44) in standard weather station format (see **wxkey**: Sec. 3.8.1.15)

3.9.4 **mesoanal**

mesoanal plots a pressure-contoured surface (Fig. 45) or upper-air map over a user-selected area.

3.9.5 **sfgram**

sfgram plots a timeseries or meteogram of temperature (°F), dewpoint temperature (°F), mean sea-level pressure (mb), wind flags (kts), and current weather symbols at a user-chosen surface station. Data can be plotted for today or yesterday, and begins at 0000 UTC.

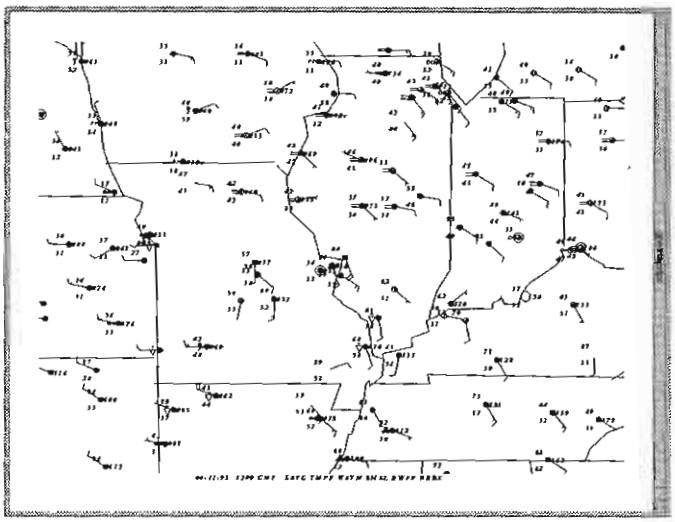

Figure 44. An example of the GEMPAK **sfmap** surface weather map.

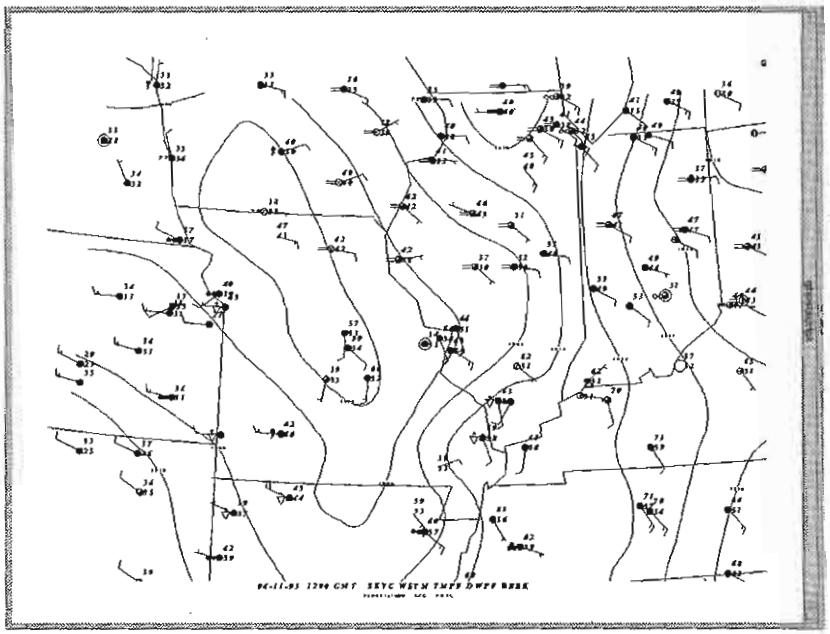

Figure 45. An example of the GEMPAK **mesoanal** pressure contoured surface weather map over St. Louis, MO.

3.9.6 **skewt**

skewt draws an upper-air sounding of temperature, dewpoint temperature, and wind flags on a skew-T log-P diagram (Fig. 46).

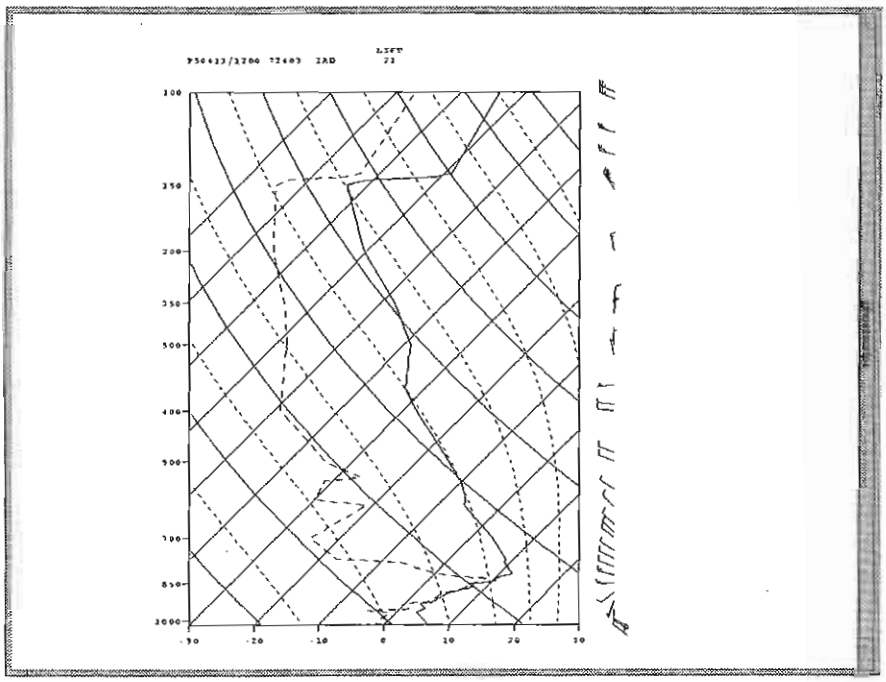

Figure 46. An example of the GEMPAK **skewt** plot for Dulles, VA (IAD).

3.9.7 **snlist**

snlist lists pressure (PRES: mb), temperature (TMPC: ˚C), dewpoint temperature (DWPF: ˚C), height (HGHT: m), wind direction (DRCT: deg from N), and wind speed (SPED: m/s) at mandatory and significant levels for a user-chosen rawindsonde station.

3.9.8 **snmap**

snmap plots an upper-air map in standard upper-air weather station format. Data can be plotted on pressure or height surfaces.

3.9.9 **sncross**

sncross plots an X-P (pressure) crosssection (Fig. 47) of potential temperature through a series of upper-air soundings. The default is set for an east-west crosssection, from Scotts Bluff, NE

(LBF), to Wallops Island, VA (WAL). Contours of potential temperature (temperature the air would be if brought down to 1000 mb adiabatically) and wind flags are plotted on the crosssection. The user can plot the crosssection between two, or more, upper-air stations.

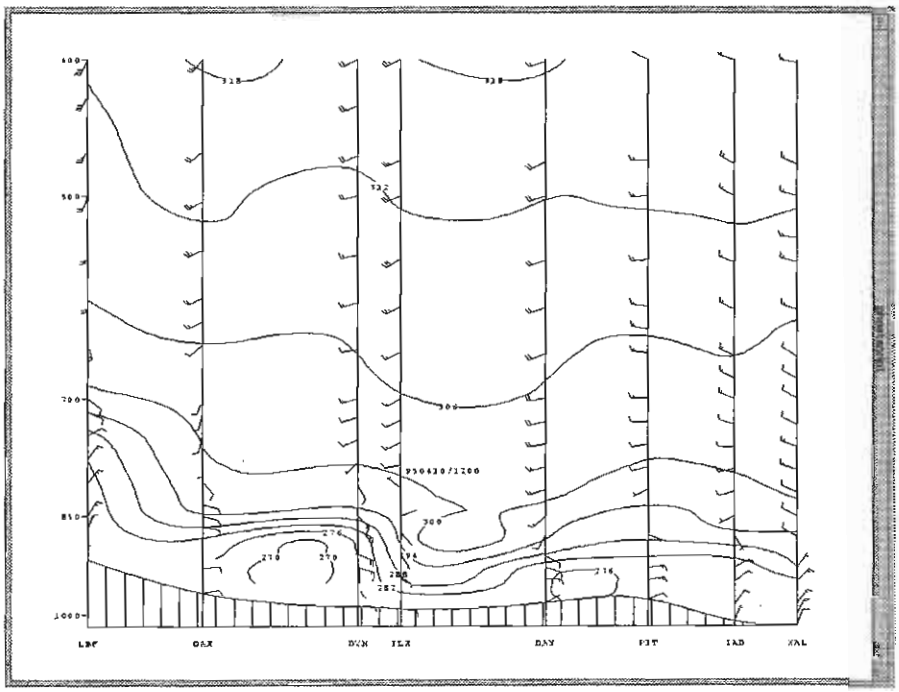

Figure 47. An example of a GEMPAK potential temperature crosssection (**sncross**) between Scotts Bluff, NE (LBF), and Wallops Island, VA (WAL).

3.9.10 **snhodo**

snhodo plots a wind hodogram (vertical distribution of the horizontal wind), from upper-air sounding data at a user-specified station. Winds are plotted in meters/second.

3.9.11 **close**

close will close an X11 window previously opened by GEMPAK. Users should close the GEMPAK window frequently to speed up the display of subsequent plots.

3.9.12 **psprt**

Psprt will send the last created black and white PostScript picture to the local ARL LaserJet printer.

3.10 **trajdisp**

The submenu (Fig. 48) of the **trajdisp** option of the READY main menu allows the user to run the HYbrid Single-Particle Lagrangian Integrated Trajectories (HY-SPLIT) model developed at NOAA/ARL by Roland Draxler (Draxler, 1992). The HY-SPLIT model's calculational method is a hybrid between the Eularian and Lagrangian approaches. Initially, a single pollutant particle represents the source, and advection and diffusion calculations are made in the Lagrangian framework. However, as the dispersion about the initial particle spreads it into regions of different wind direction or speed, the single particle is divided into multiple particles to provide a more accurate representation of the complex flow field. Air concentrations are calculated on a fixed three-dimensional grid by integrating all particle masses over the sampling time. Refer to the NOAA Technical Memorandum ERL ARL-195 (Draxler, 1992) for more detailed explanations of the model inputs and calculational methods. In READY, HY-SPLIT can be run using any of the NMC operational gridded meteorological databases saved on the NOAA/ARL RS/6000 computers. The inputs to HY-SPLIT, within READY, have been simplified to give unfamiliar users the ability to run the model.

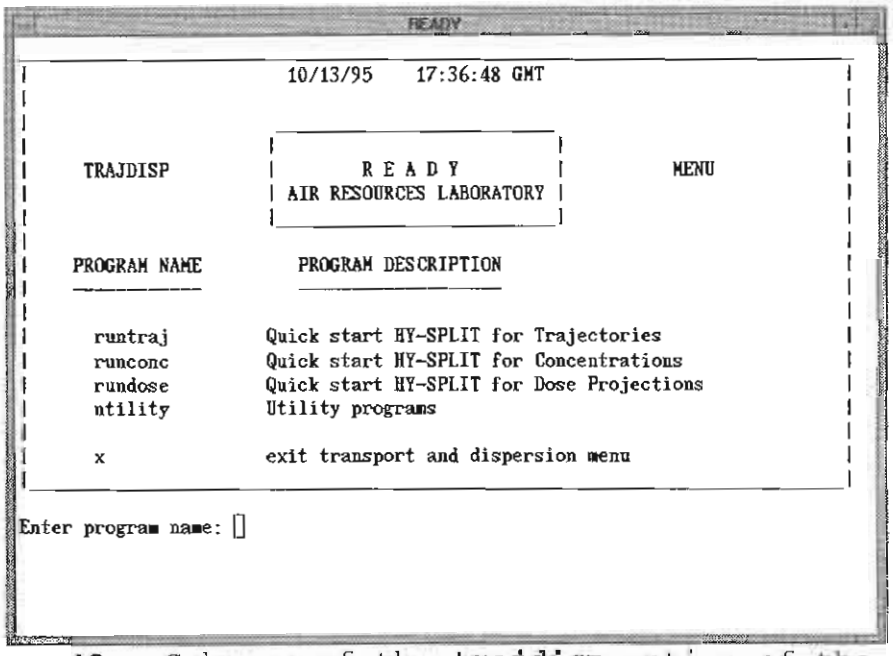

Figure 48. Submenu of the **trajdisp** option of the READY main menu.

3.10.1 **runtraj**

The **runtraj** program will display single- or multiple-level, forward or backward trajectories computed by HY-SPLIT using NCEP

gridded meteorological data.

After you type **[runtraj]**, a menu of currently available NCEP gridded data types will appear (Fig. 49). Options **[1]** through **[6]** are for regional models that cover the United States, whereas options **[7]** through **[11]** are global models. The RAMS dataset location and horizontal resolution are variable, and depend on the needs of NOAA/ARL. After you enter a number for the dataset, or, as for most **trajdisp** questions, a **[/]** for the default (Eta model), you will be asked for the trajectory type (**FWRD**: forward; **BACK**: backward). The default is forward. If the chosen dataset is available, HY-SPLIT will then ask you to provide the following information:

Starting month [XX]

where **XX** is the current initialization month of the chosen dataset.

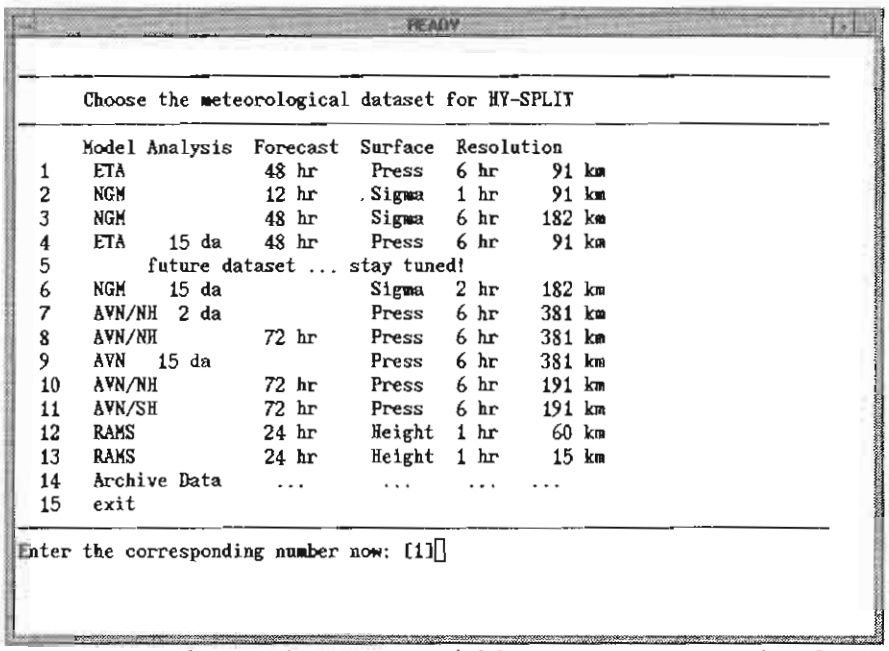

Figure 49. List of NCEP gridded meteorological data types.

The starting time is used to position the meteorological input file to the correct initial date. Enter a **[/]** for the default or type a two-digit integer for the month.

Starting day [XX]

where **XX** is the current initialization day of the chosen dataset. The starting day is the forward trajectory starting point or in

backward mode it is the termination time of the forward trajectory. Enter a **[/]** for the default or type a two-digit integer for the day to start the trajectory.

Starting hour (GMT) [XX]

where **XX** is the current initialization hour of the chosen dataset. Enter a **[/]** for the default or type a two-digit integer for the hour to start the trajectory.

Duration in days (always add a trailing .0, i.e. 4.0) [X.0]

where **X** is the number (real) of days to run the model. The model will run for the number of days beginning at 0000 UTC on the start day. If you start a trajectory in the middle of a day, it will terminate that day, unless more than one run-day is specified.

Origin latitude - use negative for SH (deg and frac) [41.97]

where the default is 41.97°N latitude. Use negative values for southern hemisphere starting locations.

Origin longitude - west is positive (deg and frac) [83.27]

where the default is 83.27°W longitude. Use negative values for eastern hemisphere starting locations.

Origin height meters AGL (MB use suffix P) [10.0]
Note: to do multiple trajectories separate levels with a comma

where the height of the starting location is specified in meters above terrain. Optionally, you may specify the starting height in absolute pressure units (mb). In that case, the pressure level is directly followed (no space) by the capital letter **P**. Also, you may run multiple-level trajectories simultaneously by entering the levels separated with commas (i.e., **1000.P,850.P,700.P)**.

The model will begin computing the trajectory(ies) and display some date positioning information to the screen so that you can make sure the model is running.

Enter/Return to continue...

After pressing **[Enter]**, you will be given a list of **runtraj** plotting options (Fig. 50). Running the **trajplot** option of **runtraj** will display the trajectory(ies) to an X-window. After typing **[trajplot]**, the following question will appear:

Optimize and rotate trajectory map: [y or n]

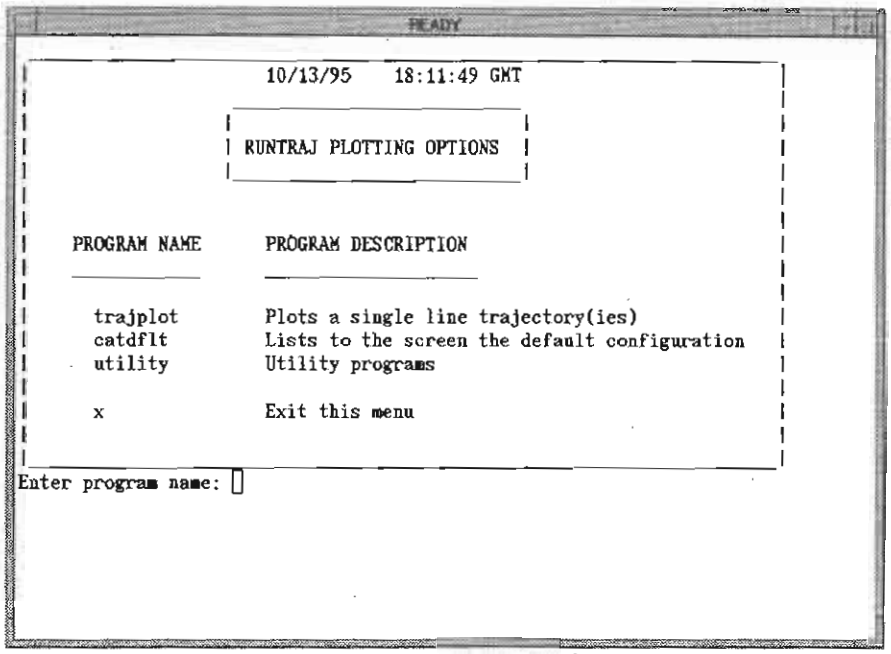

Figure 50. Submenu of the **runtraj** option of **trajdisp**.

If you choose **[y]**, the program will zoom in on the area of the trajectories, and rotate the map, if needed. Choose **[n]** only if the output is unsatisfactory when a **[y]** is chosen. The following will then be displayed:

> **When the window opens, press the left mouse button on the window, or press [Enter], to view image. Do the same to exit the image.**
>
> **Press any key to continue...**

Pressing any key will display the trajectory map. Figure 51 is an example of the **trajplot** program output, for three trajectories started at levels 500, 1000, and 2000 m, and originating at 32°N and 90°W. The box at the bottom of the trajectory map is a projection of the trajectory in the vertical plane for the corresponding horizontal positions. The ordinate for the vertical projection is millibars. Note the upward movement of all three trajectories ahead of a low-pressure system. The label at the top of the map is the trajectory starting time, the NCEP model name and initialization time for the chosen dataset. The two-digit numbers along the trajectories are the UTC hours valid at the plus signs on the trajectories, whereas the numbers over the Atlantic Ocean are the latitude and longitude reference markers. Finally, the starting level of each trajectory is labeled to the right of the last trajectory end-point.

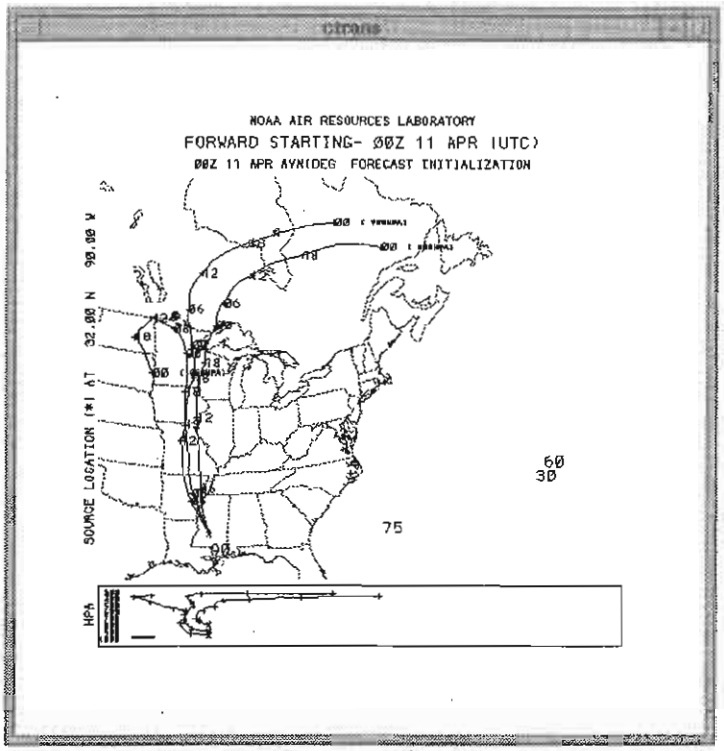

Figure 51. An example of the trajectory output from the **runtraj** program of **trajdisp**, for three levels (500, 1000, and 2000 m) originating at 32°N and 90°W.

The other option in the **runtraj** submenu (Fig. 50), besides **utility**, is **catdflt**. The **catdflt** program will print to the screen the current HY-SPLIT configuration files: **DEFAULT.DAT** and **DEFAULT.CFG**. These files may be helpful to the experienced HY-SPLIT user when problems are encountered with the model run.

3.10.2 **runconc**

The **runconc** program will display average pollutant concentration contours at 10 m from the HY-SPLIT model on a regional map background surrounding the pollutant emission (source) location. Wet and dry deposition is optional.

After you type **runconc**, a menu of currently available NCEP gridded data types will appear (Fig. 49). [This is the same menu that appears for **runtraj** and **rundose**.] Options **[1]** through **[6]** are for regional models that cover the U.S., while options **[7]** through **[11]** are global models. The RAMS dataset location and horizontal resolution are variable and depend on the needs of NOAA/ARL. After you enter a number for the dataset, or, as for most **trajdisp** questions, a **[/]** for the default (Eta model), and if the chosen dataset is available, HY-SPLIT will then ask you to provide the

following information:

Starting month [XX]

where **XX** is the current initialization month of the chosen dataset. The starting time is used to position the meteorological input file to the correct initial date. Enter a **[/]** for the default or type a two-digit integer for the month.

Starting day [XX]

where **XX** is the current initialization day of the chosen dataset. Enter a **[/]** for the default or type a two-digit integer for the day to start the pollutant emission.

Starting hour (GMT) [XX]

where **XX** is the current initialization hour of the chosen dataset. Enter a **[/]** for the default or type a two-digit integer for the hour to start the pollutant emission.

Duration in days (always add a trailing .0, i.e. 4.0) [X.0]

where **X** is the number (real) of days to run the model. The model will run for the number of days, beginning at 0000 UTC on the start day. If you start emissions in the middle of a day, they will terminate that day, unless more than one run-day is specified.

Origin latitude - use negative for SH (deg and frac) [41.97]

where the default is 41.97°N latitude. Use negative values for southern hemisphere starting locations.

Origin longitude - west is positive (deg and frac) [83.27]

where the default is 83.27°W longitude. Use negative values for eastern hemisphere starting locations.

Origin height meters AGL (MB use suffix P) [10.0]
(Note layer average can be entered with a comma, i.e. 0,500)

where the height of the source is specified in meters above terrain. Optionally, you may specify the starting height in absolute pressure units (mb). In that case, the pressure level is directly followed (no space) by the capital letter **P**. Also, instead of a point source, you may enter a layer-average source with the lower and upper heights separated by commas; i.e., **[0,500]** would represent a source with a layer average from 0 to 500 m above terrain.

Next the model will ask for the source value.

Source value (arbitrary units per hour) [1.0]

where the source value is always specified in mass units per hour, regardless of the hours of emission. The units of the mass are not relevant because output concentration values are in mass units per cubic meter. The default is 1 unit of mass per hour, which will allow the user to scale the resulting concentrations by a known emission rate at a later time. The model will then ask for the number of hours of emissions

Number of hours of emissions [1]

in which case the model will release particles continuously for the number of hours you specify. The default is 1 hour.

Next the model will ask for the averaging period.

Note: Concentration averaging will start with start of release
Averaging period in hours [12]

where all output maps will occur at this interval in hours, and will be averaged over this same period of hours. Note also that the first averaging period will begin with the start of the release, and, therefore, may not be averaged over the full averaging period specified here.

The model will next ask the following question:

Run with default Cs-137 wet and dry deposition? [y]

The model has been configured to run with cesium-137 (a particle) dry and wet deposition defaults. The default dry deposition velocity is 1 cm/s, the in-cloud wet scavenging ratio is 2.4×10^5, the below-cloud scavenging coefficient is 5.0×10^{-5} s^{-1}, and the radioactive half-life is 9,855 days. If you choose **[n]**, then no wet or dry deposition and no radioactive decay will occur.

In either case, the model will begin computing the concentrations and display some date positioning information to the screen so that you can make sure the model is running. When the run is finished, the following will be displayed:

Enter/Return to continue...

After you press **[Enter]**, you will be given a list of **runconc** plotting options (Fig. 52). Run the **arlautocon** option of **runconc** to automatically create contoured pollutant concentration plots. This should be the first display program you run after you finish the model run. You can choose other options if the plots are not exactly what you want. In **arlautocon** the only information you are asked to provide is for the type of contours to plot: color fill,

black and white fill, or color lines. After the plots are prepared, the following will be displayed:

When the window opens, press the left mouse button on the window or press [Enter] to view image. Do the same to exit the image.

Press any key to continue...

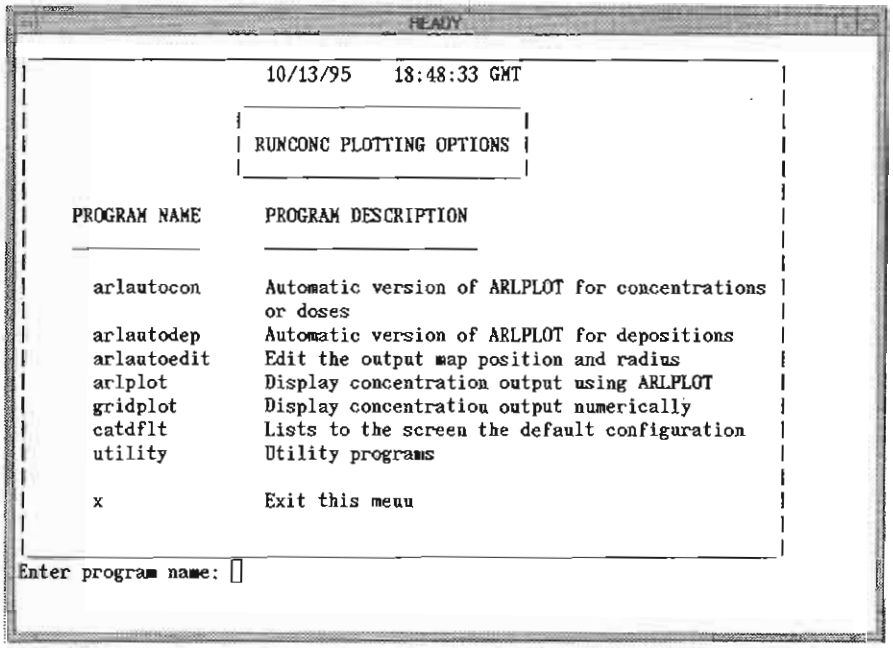

Figure 52. Submenu of the **runconc** option of **trajdisp**.

Press any key to display the concentration map(s). Figure 53 shows an example of the concentration output at 10 m using the **arlautocon** or **arlplot** plotting programs with the black and white fill option. The example was run with a 48 hour averaging period and a 6 hour release of 1 unit per hour, using the Eta model meteorological forecast.

If the plot obtained with **arlautocon** is not exactly what you want, that is, if the map is not centered on the plume or if the map area is too large or too small, you can run **arlautoedit** to modify the plotting parameters. In the example in Fig. 53, the following parameter file was defined:

```
37.00  80.00            (Source lat/lon)
37.00   80.00 11.09     (map center lat/lon and radius)
48                      (concentration averaging period [hr])
```

You should adjust only the second line, map center latitude/longitude and radius. If you change the other information, erroneous information will be displayed on the plot. The radius is defined in degrees of latitude. **Arlautoedit** will invoke the vi editor. To replace a number, press **[r]**, then enter the replacement number. Repeat this for each number to be changed. When finished editing, press **[Esc]** twice and type **[:wq]** to save and exit or **[:q!]** to exit without saving the changes.

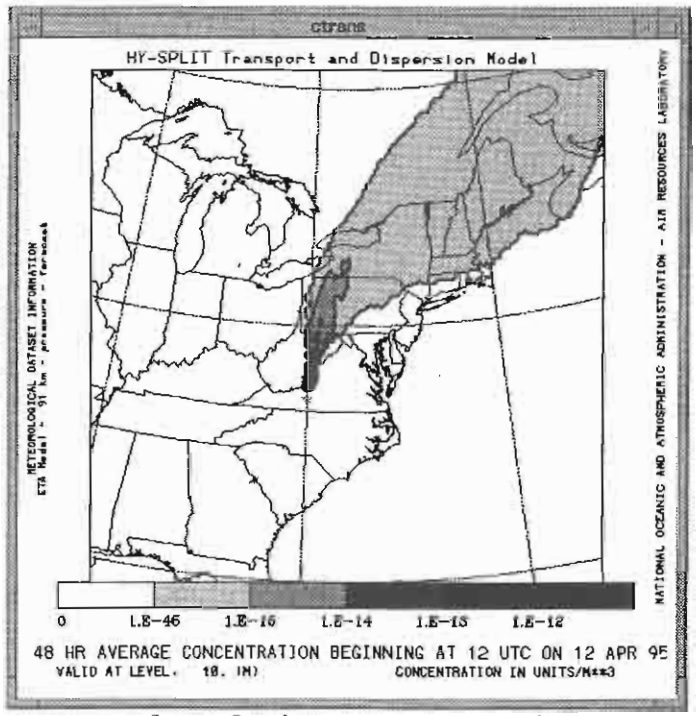

Figure 53. An example of the concentration output from the **runconc** program of **trajdisp**, using the **arlautocon** or **arlplot** plotting programs.

If you choose to run **runconc** with dry and wet deposition, you will use an additional plotting program, called **arlautodep**, shown in the **runconc** submenu (Fig. 52) of **trajdisp**. This program works the same as the **arlautocon** plotting program, except that total deposition at the ground is contoured instead of average concentration. Total deposition is defined as the sum of the deposition to the ground for the duration of the model run. The units are mass per meter squared. Figure 54 shows an example of the deposition corresponding to the concentrations shown in Fig. 53.

The program **arlplot** (Fig. 52) is the same program used for **arlautocon** and discussed in section 3.6.1 with the following additional questions asked of the user:

The current contour interval exponents range from: X to X
Override the contour intervals? (y/n)

This question gives you the ability to respecify the contour intervals for more detailed analysis.

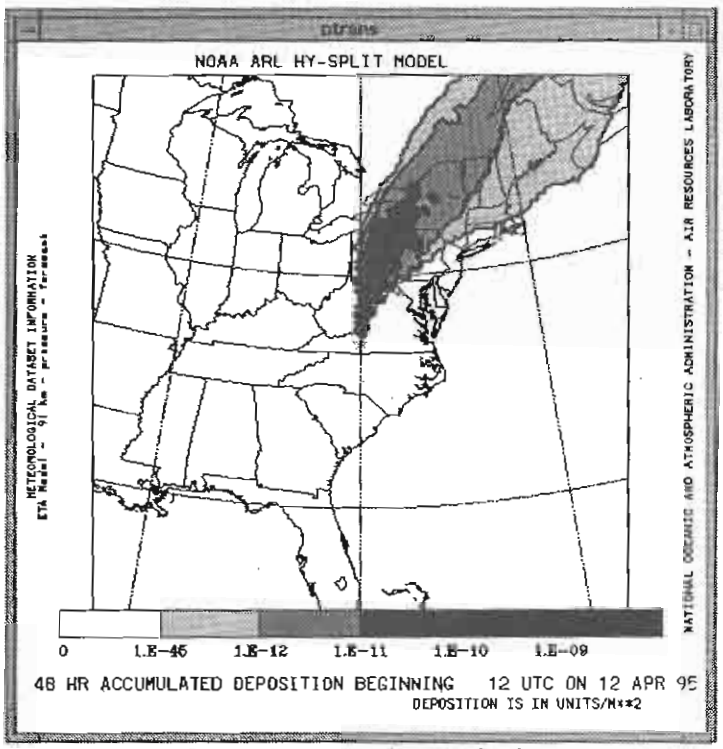

Figure 54. An example of the deposition output from the **runconc** program of **trajdisp**, corresponding to the concentrations shown in Fig. 53, using the **arlautodep** plotting program.

The **gridplot** program (Fig. 52) of **runconc** will display the concentration and deposition maps using symbols instead of contour lines. Figures 55 and 56 show the same concentration and deposition maps, respectively, as shown in Figs. 53 and 54. In **gridplot** you will not be asked to provide further input.

The only other option in the **runconc** program menu (Fig. 52), besides **utility**, is **catdflt**. The **catdflt** program will print to the screen the current HY-SPLIT configuration files: **DEFAULT.DAT** and **DEFAULT.CFG**. These files may be helpful to the experienced HY-SPLIT user when problems are encountered with the model run.

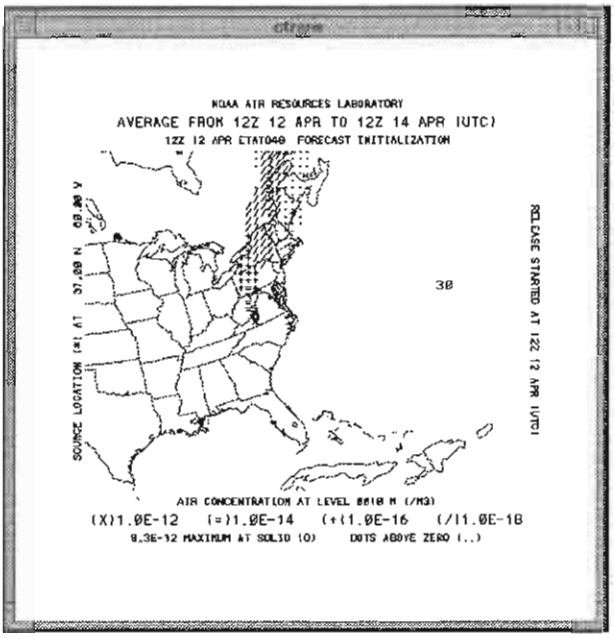

Figure 55. An example of the same concentrations as shown in Fig. 53, but produced using **gridplot** and displayed using symbols.

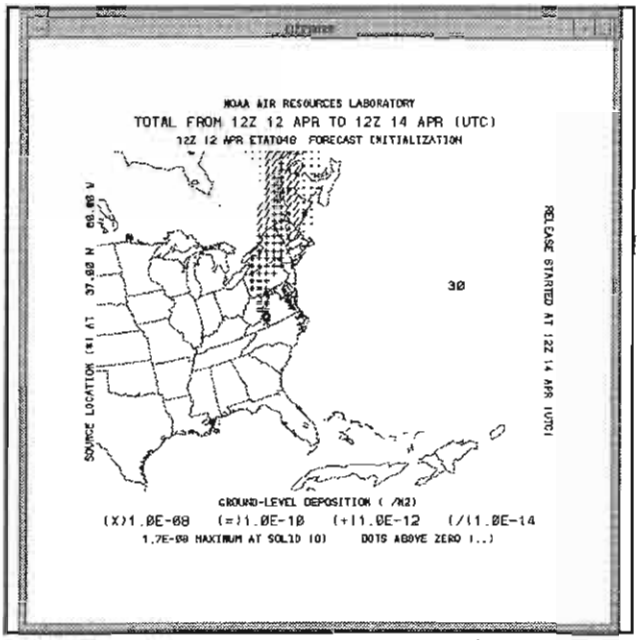

Figure 56. An example of the same depositions as shown in Fig. 54, but produced using **gridplot** and displayed using symbols.

3.10.3 **rundose**

Specification of a radionuclide in the HY-SPLIT deposition module results in the computation of accumulation of total deposition as well as average air concentrations during the calculations. The dose model used in the **rundose** program of **trajdisp** is a post-processing model and is similar to that of the NRC's Radiological Assessment System for Consequences AnaLysis (RASCAL; Sjoreen et al., 1994) FM-DOSE model. Both plume-phase (acute) and intermediate-phase (chronic) doses are computed by multiplying the exposure in Curie-hours (average air concentration at the surface multiplied by exposure time) by the appropriate dose factor. Breathing rates and dose factors are for an adult man and were taken directly from Environmental Protection Agency (EPA, 1992) guidelines. Decay and decay product ingrowth are included in the intermediate-phase doses. Some radionuclides have short-lived decay products that can contribute significantly to external dose during the initial plume phase. For these particular radionuclides, the decay product dose factors were added to the parent dose factors.

At this time, only one radionuclide may be considered per model run. Calculated plume-phase doses are the ground shine, cloud submersion (semi-infinite cloud), and inhalation doses, and

are for a 30-day commitment. Although cloud shine is not currently calculated because of its complexity (caution should be exercised when interpreting the doses), the larger computational grid sizes usually result in complete plume submersion for ground-level receptors. Computed intermediate-phase dose is the dose from ground shine, and is for a 50-year commitment.

Doses are displayed on maps of the region surrounding the source, and include ground shine, acute bone marrow inhalation, acute lung inhalation, thyroid, effective-dose equivalent, cumulative effective-dose equivalent, total effective-dose equivalent, and total bone dose.

After you choose **[rundose]** from the **trajdisp** submenu, a menu of currently available NCEP gridded data types will appear (Fig. 49). [This is the same menu that appears for **runtraj** and **runconc**.] Options **[1]** through **[6]** are for regional models that cover the United States, whereas options **[7]** through **[11]** are global models. The RAMS dataset location and horizontal resolution are variable, and depend on the needs of NOAA/ARL. After you enter a number for the dataset, or, as for most **trajdisp** questions, a **[/]** for the default (Eta model), and if the chosen dataset is available, HY-SPLIT will then ask you to provide the following information:

Starting month [XX]

where **XX** is the current initialization month of the chosen dataset. The starting time is used to position the meteorological input file to the correct initial date. Enter a **[/]** for the default or type a two-digit integer for the month.

Starting day [XX]

where **XX** is the current initialization day of the chosen dataset. Enter a **[/]** for the default or type a two-digit integer for the day to start the radioactive pollutant emission.

Starting hour (GMT) [XX]

where **XX** is the current initialization hour of the chosen dataset. Enter a **[/]** for the default or type an integer for the hour to start the radioactive pollutant emission.

Duration in days (always add a trailing .0, i.e. 4.0) [X.0]

where **X** is the number (real) of days to run the model. The model will run for the number of days beginning at 0000 UTC on the start day. If you start emissions in the middle of a day, they will terminate that day, unless more than one run-day is specified.

Origin latitude - use negative for SH (deg and frac) [41.97]

where the default is 41.97°N latitude. Use negative values for southern hemisphere starting locations.

Origin longitude - west is positive (deg and frac) [83.27]

where the default is 83.27°W longitude. Use negative values for eastern hemisphere starting locations.

Origin height meters AGL (MB use suffix P) [10.0]

where the height of the source is specified in meters above terrain. Optionally, you may specify the starting height in absolute pressure units (mb). In that case, the pressure level is directly followed (no space) by the capital letter **P**. Also, instead of a point source, you may enter a layer average source with the lower and upper heights separated by commas; i.e., **[0,500]** would represent a source with a layer average from 0 to 500 m above terrain.

Next the model will ask for the radioactive source value.

Source value (Ci/hour only) [1000.0]

where the source value is always specified in Curries per hour, regardless of the hours of emission. The model will then ask for the number of hours of emissions.

Number of hours of emissions [1]

in which case the model will release particles continuously for the number of hours you specify. The default is 1 hour.

Next the model will ask for the cumulative dose period in hours.

Cumulative dose period in hours [6]

where all output maps will show doses over this period in hours. The model will next give you the opportunity to change the default nuclide and deposition defaults.

The default radionuclide is Cs-137
Edit the nuclide and deposition defaults: [y or n]

The model has been configured to run with cesium-137 (a particle) dry and wet deposition defaults. If you choose **[n]**, the default dry deposition velocity is set to 1 cm/s, the in-cloud wet scavenging ratio is set to 2.4×10^5, the below-cloud scavenging coefficient is set to 5.0×10^{-5} s^{-1}, and the radioactive half-life is set to 9,855 days. If you choose **[y]**, you will be first shown a list of available radionuclides, and then the program will put

you in the vi editor so that you can edit the deposition default values. To replace a number, press **[r]**, then enter the replacement number. Repeat this for each number to be changed. When finished editing, press **[Esc]** twice, and type **[:wq]** to save and exit, or **[:q!]** to exit without saving the changes.

In either case, the model will begin computing the concentrations and display some date positioning information to the screen so that you can make sure the model is running. When the run is finished the following will be displayed

Enter/Return to continue...

After you press **[Enter]**, you will be given a list of plotting options (Fig. 52). Running the **arlautocon** option of **rundose** will automatically create the eight dose maps mentioned earlier. This should be the first display program you run after you finish the model run. You can choose other options if the plots are not exactly what you want. After the plots are prepared, the following will be displayed:

When the window opens, press the left mouse button on the window or press {Enter] to view image. Do the same to exit the image.

Press any key to continue...

Press any key to display the dose maps. Figure 57 shows an example of the cumulative effective-dose equivalent output map using the **arlautocon** program. The example was run with a 12 hour cumulative dose period and a 6 hour release of 100,000 Ci Cs-137 per hour using the Eta model meteorological forecast.

If the plot obtained with **arlautocon** is not exactly what you want, that is, if the map is not centered on the plume, or if the map area is too large or too small, you can run **arlautoedit** to modify the plotting parameters. An example parameter file looks like the following:

```
37.00   80.00              (Source lat/lon)
37.00    80.00 11.09       (map center lat/lon and radius)
48                         (concentration averaging period [hr])
```

You should adjust only the second line, map center latitude/longitude and radius. If you change the other information, erroneous information will be displayed on the plot. The radius is defined in degrees of latitude. **Arlautoedit** will invoke the vi editor. To replace a number, press **[r]**, then enter the replacement number. Repeat this for each number to be changed. When finished editing, press **[Esc]** twice and type **[:wq]** to save and exit, or **[:q!]** to exit without saving the changes.

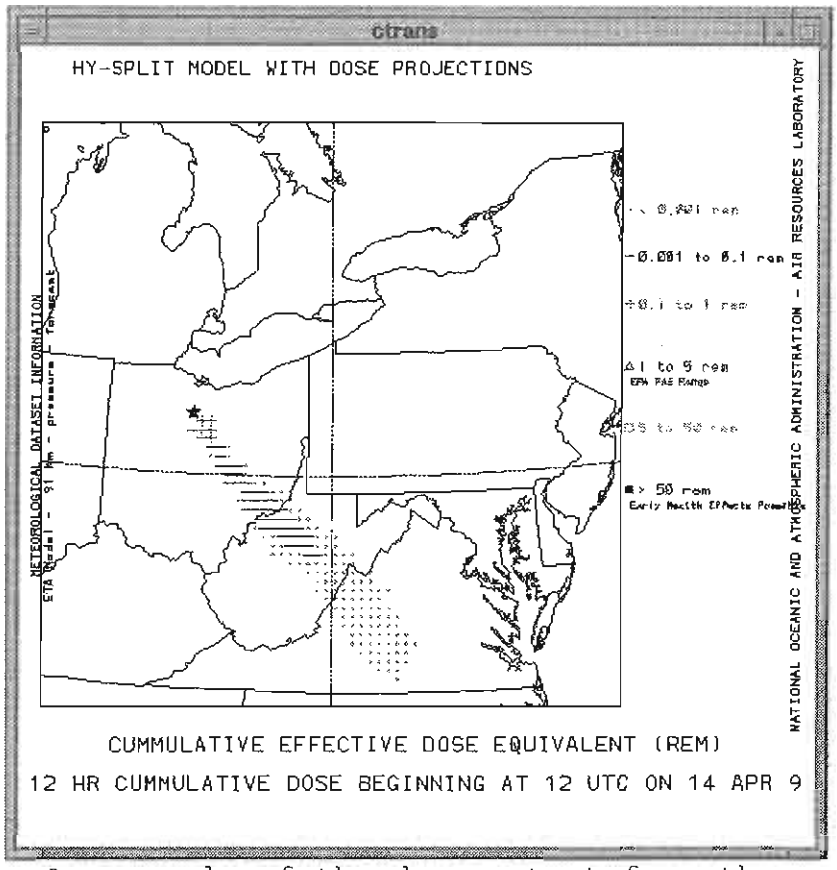

Figure 57. An example of the dose output from the **rundose** program of **trajdisp**, using the **arlautocon** plotting program. Shown is the 12-hour cumulative effective-dose equivalent (CEDE) in units of rem.

The **arlautodep** program (Fig. 52) of **rundose** will contour the deposition associated with the doses over the user-specified area. Total deposition is defined as the sum of the deposition to the ground for the duration of the model run. The units are mass per meter squared. An example of a deposition map is shown in Sec. 3.10.2 (Fig. 54).

The **arlplot** program (Fig. 52) of **rundose** is the same program as used for **arlautocon**; it is discussed in Sec. 3.6.1. It gives the user the ability to look at individual dose maps.

The **gridplot** program (Fig. 52) of **rundose** will display the concentration and deposition maps that were used to compute the doses, but using symbols instead of contour lines. Figures 55 and 56, in Sec. 3.10.2, show examples of **gridplot** concentration and deposition maps, respectively.

The only other option in the **rundose** program menu (Fig. 52), besides **utility**, is **catdflt**. The **catdflt** program will print to the

screen the current HY-SPLIT configuration files: **DEFAULT.DAT** and **DEFAULT.CFG**. These files may be helpful to the experienced HY-SPLIT user when problems are encountered with the model run.

3.11 **emergency**

The **emergency** option of the READY main menu is for ARL emergency-response personnel only, and is password restricted. This menu contains programs specific to ARL Headquarters emergency-response operations, such as moving the operational RAMS model, archiving meteorological data, and running special versions of the HY-SPLIT model for international nuclear accidents.

3.12 **utility**

The submenu (Fig. 58) of the **utility** option of the READY main menu (as well as in any other submenus) gives you choice of display, print, file conversion, and file transfer programs. It also allows you to set up a default configuration for use in several READY programs, and check on the current status of the operational NCEP meteorological datasets.

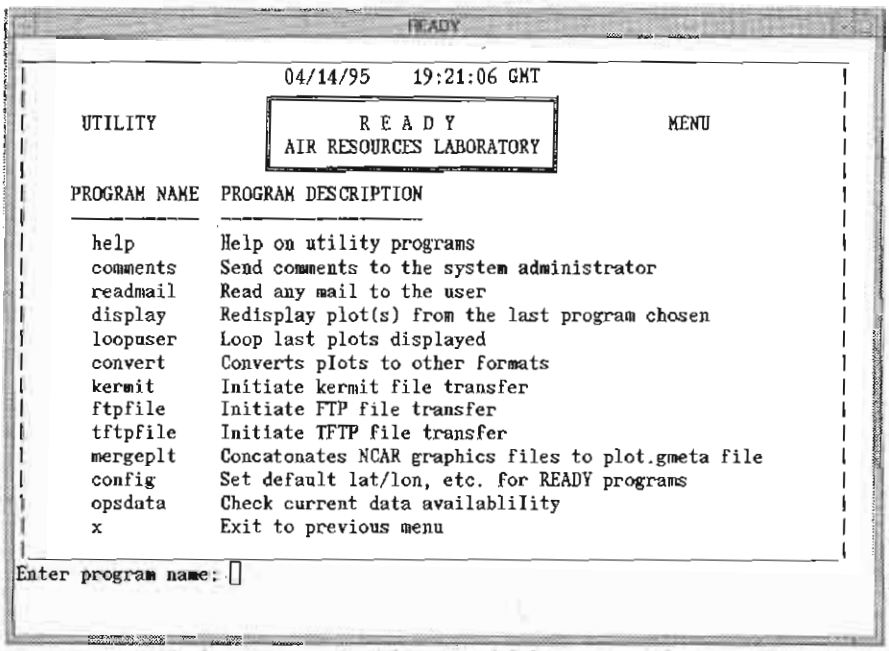

Figure 58. Submenu of the **Utility** option of the READY main menu.

3.12.1 **comments**

The **comments** menu option of **utility** will allow you to send questions and comments to the READY system administrator. The system administrator will either reply directly to you if the pertinent information is given, or send a mail message to your READY account. Note that if you are using the **guest** account, the mail can be read by other guest users. To send mail, you must first choose **comments** from the **utility** submenu. After you view an introductory screen, and type a **[C]** to continue, you will be asked for a subject for the mail. You should enter your name for the subject and press **[Enter]**. You will then be put into the mail editor and can start typing a message. When finished, type **[CTRL-d]** and press **[Enter]** at the **Cc:** prompt, and then any other key to exit the **comments** program. You can check for mail by choosing **readmail** (Sec. 3.12.2) from the **utility** submenu.

3.12.2 **readmail**

The **readmail** menu option of **utility** will allow you to read any mail sent to your account. After you type **[readmail]** and a **[C]** to continue, you should look for your name, and type the number of that message. The message will then be displayed to the screen. You can also type the word **[page]**, and the number of the message (i.e., **[page 1]**), at the **&** prompt, and the mail will be displayed page by page, with a press of the **[Enter]** key between each page.

3.12.3 **display**

The **display** option of **utility** will redisplay the last user-generated graphical plot(s) created in any READY program, except **gempak** and **images** in X11 windows. When a blank screen appears, press **[Enter]**, or the left mouse button, to display each plot, if any plots exist.

3.12.4 **loopuser**

The **loopuser** option of **utility** will loop the last user-generated graphical plots created in any READY program except **gempak** and **images**. This option works only with X11 windows, may not work on low-memory computers, and may take several minutes to generate, depending on the number and complexity of the plots. **loopuser** uses a program called **xanim**. The looping will start immediately after the program loads the images. A tool box will appear on the screen so that you can use a mouse to stop, start, slow-down, speed-up, reverse, and exit the loop. You can also exit by clicking on the loop window and typing a **[q]**. The mouse buttons also have the following capability:

Left button	single step back one frame
Middle button	toggle; start/stop animation
Right button	single step forward one frame

Press **[=]** to slow the loop speed, press **[-]** to speed up the loop, or press **[0]** to restore the speed to the original value.

3.12.5 **convert**

The **convert** program of **utility** will convert the last user-generated graphical plot(s) created in any READY program, except **gempak** and **images**, into several more popular graphical formats: GIF, PCL, PostScript, Tektronix, and HPGL. The conversion utilities **ncar2gif** and **ncar2ps**, are the only ones that ask any questions: **ncar2gif** will give you the option to start **kermit** file transfer (Sec. 3.12.6) after the plot is converted; **ncar2ps** asks if the plot is to be converted to color or black and white PostScript. The following file names will be used for each program:

program	**file name**
ncar2gif	**plot###.gif, where ### is 001, 002,...**
ncar2pcl	**plot.pcl**
ncar2ps	**plot.ps**
ncar2tek	**plot.tek**
ncar2hpgl	**plot.hp**

3.12.6 **kermit**

The **kermit** program of **utility** will initiate the kermit file transfer program. You must have kermit available locally on your computer system to run **kermit**. You will be given four choices of available files for downloading: user-generated graphical files, user-generated text files, university GIF images, and archived gridded meteorological data. A listing of current files will be displayed, if any, and kermit will be initiated. For information on how to use kermit, type **[?]** at the **C-kermit>** prompt. Type **[q]** to quit **kermit**.

3.12.7 **ftpfile**

The **ftpfile** program of **utility** will initiate the FTP file transfer program. You must have FTP software available locally on your computer system to transfer files with FTP. The user will be given four choices of available files for transfer: user-generated graphical files, user-generated text files, university GIF images, and archived gridded meteorological data. A listing of current

files will be displayed, if any, and FTP will be initiated. For information on how to use FTP, type a **[?]** at the **ftp>** prompt. Type **[quit]** to quit **ftpfile**.

3.12.8 **tftpfile**

The **tftpfile** program of **utility** will initiate the TFTP file transfer program. You must have TFTP software available locally on your computer system to transfer files with TFTP. The user will be given four choices of available files for transfer: user-generated graphical files, user-generated text files, university GIF images, and archived gridded meteorological data. A listing of current files will be displayed, if any, and TFTP will be initiated. For information on how to use tftp, type a **[?]** at the **tftp>** prompt. Type **[quit]** to quit **tftpfile**.

3.12.9 **mergeplt**

The **mergeplt** program of **utility** will concatenate the last user-generated NCAR Graphics frame to previously concatenated frames. NCAR Graphics plot(s) are plots created in any READY program, except **gempak** and **images**. The first frame requires no user input. Subsequent NCAR Graphics frames will ask you if you want to delete the current merged file (**plot.gmeta**). If not, the current frame will be concatenated to the file **plot.gmeta**. The concatenated file (**plot.gmeta**) will be deleted when you exit READY. Note that whenever a concatenated file (**plot.gmeta**) exists, and the **display** command is called, READY will remind you that the file exists, and ask if you wish to view it.

3.12.10 **config**

The **config** program of **utility** will allow you to set up default READY parameters. **config** will ask for the default gridded meteorological data file, the default start time of the pollutant release, the default full grid or subgrid, the default latitude and longitude of the source and the radius in degrees of latitude for creating a map around the source, and the default title for the maps. An example of the default map will then be displayed, and you will be given a chance to modify the defaults again. These defaults will be used in many programs within READY and will save you from having to constantly type in the information. The defaults can be re-specified at any time, and as many times as needed.

3.12.11 **opsdata**

The **opsdata** program of **utility** will give you a listing of the initialization date and times of several NCEP meteorological datasets available within READY. This can be useful if you are awaiting a new run of a particular NCEP model for input into HYSPLIT.

4. REFERENCES

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Appendix A: Acronyms

AES	Atmospheric Environment Service
ARL	NOAA Air Resources Laboratory
ASCOT	Atmospheric Studies in COmplex Terrain
AVN	Aviation [run of the Medium Range Forecast model]
DOE	U.S. Department of Energy
ECMWF	European Centre for Medium-range Weather Forecasts
EPA	U.S. Environmental Protection Agency
Eta	Eta [meteorological forecast model]
FOS	Family of Services
FTP	File Transfer Protocol
GEMPAK	GEneral Meteorology PAcKage
GIF	Graphics Interchange Format
GOES	Geostationary Operational Environmental Satellite
GTS	Global Telecommunications Gateway
HPGL	Hewlett Packard Graphics Language
HYACID	HYSPLIT Atmospheric Chemistry Including Deposition [model]
HY SPLIT	HYbrid Single Particle Lagrangian Integrated Trajectories model
IAEA	International Atomic Energy Agency
IFR	Instrument Flight Rule
IR	Infrared
LAT	latitude
LDM	Local Data Manager
LON	longitude
MDR	Manually Digitized Radar
MOS	Model Output Statistics
MRF	Medium Range Forecast model
MSLP	Mean Sea-level Pressure
MVFR	Marginal Visible Flight Rule
NAPAP	National Acid Precipitation Assessment Program
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NESDIS	National Environmental Satellite, Data and Information Service
NEXRAD	NEXt generation RADar system
NGM	Nested Grid Model
NHC	National Hurricane Center
NCEP	National Center for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NSSFC	National Severe Storms Forecast Center
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
NWSTG	National Weather Service Telecommunications Gateway
OI	optimum interpolation
OSO	Office of Systems Operations (NWS)
PCL	Printer Control Language
RAMS	Regional Atmospheric Modeling System

RASCAL	Radiological Assessment System for Consequences AnaLysis
READY	Real time Environmental Applications and Display sYstem
RSMC	Regional Specialized Meteorological Center (RSMC)
SST	sea surface temperature
UTC	Universal Time Coordinates
WMO	World Meteorological Organization

Appendix B: Meteorological Fields

The following is the contents of a typical **FLDFILE.CFG** file, located in the user's local directory, showing: the type of field (1:surface, 2:upper level, 3:special), the four letter field ID, the multiplication factor, the units, the contour interval, and the title used in READY plots.

```
3 INDX       1.00             0.00 INDEX RECORD
3 NULL       1.00             0.00 MISSING DATA
1 TMPS       1.00  DEGF       5.00 SURFACE TEMPERATURE
1 MSLP       1.00  MB         4.00 MEAN SEA-LEVEL PRESSURE
1 PRSS       1.00  MB         0.00 SURFACE PRESSURE
1 ICWT       1.00  0--1       1.00 ICE-COVERED WATER
1 SNOW       1.00  0--1       1.00 SNOW COVERAGE
1 SHGT       1.00  M          0.00 SURFACE HEIGHT
1 TOPO       1.00  M          0.00 TOPOGRAPHY
1 CPPT       1.00  IN         0.25 CONVECTIVE PRECIPITATION
1 TPP6       1.00  IN         0.25 6-HOUR ACCUMULATED PRECIPITATION
1 TPPT       1.00  IN         0.25 TOTAL ACCUMULATED PRECIPITATION
1 HFLX       1.00  W/M2      25.00 LATENT HEAT FLUX
1 SHTF       1.00  W/M2       0.00 SENSIBLE HEAT NET FLUX
1 LHTF       1.00  W/M2       0.00 LATENT HEAT NET FLUX
1 ULWF       1.00  W/M2       0.00 UPWARD LONG WAVE RADIATION FLUX
1 DSWF       1.00  W/M2       0.00 DOWNWARD SHORT WAVE RADIATION
                                   FLUX
1 QSTR    1000.00  G/KG       1.00 FLUX MIXING RATIO
1 WFLX    1000.00  GM2S       1.00 WATER VAPOR FLUX
1 EXCO    1000.00  GM2S       0.00 EXCHANGE COEFFICIENT
3 MXLR       1.00  0--N       1.00 NUMBER OF MIXED SIGMA LAYERS
1 THTS       1.00  DEGF       5.00 SURFACE POTENTIAL TEMPERATURE
1 U10M       1.00  M/S         .00 10 M U-WIND COMPONENT
1 V10M       1.00  M/S         .00 10 M V-WIND COMPONENT
1 UMOF       1.00  N/M2       0.00 MOMENTUM FLUX, U-WIND COMPONENT
1 VMOF       1.00  N/M2       0.00 MOMENTUM FLUX, V-WIND COMPONENT
1 USTR     100.00  M/S       10.00 FRICTION VELOCITY
1 TSTR       1.00  DEGF       0.00 FLUX TEMPERATURE
1 T02M       1.00  DEGF       5.00 2 M TEMPERATURE
2 TEMP       1.00  DEGF       5.00 TEMPERATURE
2 UWND       1.00  M/S        5.00 U-WIND COMPONENT
2 VWND       1.00  M/S        5.00 V-WIND COMPONENT
2 FLAG       1.00  KNTS       0.00 WIND FLAGS
2 WVCT       1.00  KNTS       0.00 WIND VECTORS
2 WSPD       1.00  KNTS       5.00 WIND SPEED
2 WWND    3600.00  MB/H       5.00 W-WIND COMPONENT
2 SPHU    1000.00  G/KG       1.00 SPECIFIC HUMIDITY
2 RELH       1.00  PCT       20.00 RELATIVE HUMIDITY
2 HGTS       0.10   DM        6.00 HEIGHT
2 TKEN       1.00  JOUL       0.00 TOTAL KINETIC ENERGY
2 PRES       1.00  MB         4.00 PRESSURE
1 THKN       0.10   DM        6.00 THICKNESS
```

```
3 HGT1        1.00   M          60.00 1000 MB HEIGHT
3 HGT5        1.00   M          60.00 500 MB HEIGHT
3 ABSV   100000.00   /S          2.00 ABSOLUTE VORTICITY
3 CONC        1.00    /M3         .00 CONCENTRATION
1 SFCC        1.00    /M3         .00 SURFACE CONCENTRATION
1 DEPS        1.00    /M2         .00 SURFACE DEPOSITION
1 OPPT        1.00   IN           .25 OBSERVED PRECIPITATION
1 LUNG        1.00   REM         1.00 ACUTE LUNG DOSE
1 BONE        1.00   REM         1.00 ACUTE BONE DOSE
1 CEDE        1.00   REM         1.00 CUMULATIVE EFFECTIVE DOSE EQUIV.
1 THYR        1.00   REM         5.00 THYROID DOSE
1  EDE        1.00   REM         1.00 EFFECTIVE DOSE EQUIV.
1 GSHN        1.00   REM          .50 GROUND SHINE
1 TBNE        1.00   REM         1.00 TOTAL BONE DOSE
1 TEDE        1.00   REM         1.00 TOTAL EFFECTIVE DOSE EQUIV.
```


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