NOAA Techniques Development Laboratory
Computer Program NWS TDL CP 84-2

AFOS SURFACE OBSERVATION DECODING

Silver Spring, Md.
September 1984

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

PREFACE

The Techniques Development Laboratory's (TDL's) computer program (CP) series is a subset of TDL's technical memorandum series. The CP series documents computer programs written at TDL primarily for the Automation of Field Operations and Services (AFOS) computers.

The format for the series follows that given in the AFOS Reference Handbook, Volume 6, Background Applications.

NOAA Technical Development Laboratory
Computer Program NWS TDL

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

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

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

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

CP 84-1 AFOS Display of MDR Data on Local Map Background. Newton, July 1984.

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1. INTRODUCTION

A significant amount of the communications traffic transmitted over the Automation of Field Operations and Service (AFOS) network is surface observations. These observations are used by forecasters for visual analysis and as input to locally run FORmula TRANslation (FORTRAN) computer programs. Before the data can be used by these programs for mathematical computations, they must be converted from American National Standard Code for Information Interchange (ASCII) to numerical form. Applications programs capable of running in the background partition of the AFOS hardware have been written to standardize the conversion of these data. These programs can be run locally as stand alone tasks or their subroutines can be incorporated into other computer programs.

One of the primary uses of surface observations at local AFOS sites is to display them on specified map backgrounds for synoptic analysis. Many sites create synoptic displays each hour during inclement weather. To create these displays, four programs are included in the standard package generally referred to as the "SAO Decoder" (Thomas, 1981).

2. METHODOLOGY AND SOFTWARE STRUCTURE

Data flow and program relationships from program initiation to graphics plot file output are illustrated in Fig. 1. Software structures and load lines are shown in Fig. 2. SAODEC is the first program activated. It reads optional switches from the command line entered on the Alphanumerics Display Module (ADM) and sets default values to be passed to the rest of the programs in the decoder system. SAODEC chains to (activates) SAOD1 which extracts the observations from the database and decodes them, converting them to numerical form. SAOD1 outputs the decoded data to disk and chains to PLTGEN (Spry and Anderson, 1981), which reads the data and creates a graphics plot file. The plot file can be used as input to one of the graphics generation programs to produce a displayable product. PLTSELECT is an alternate entry into the system to allow the user to create plot files of selected meteorological parameters using the existing decoded data. It is similar to SAODEC except it chains directly to PLTGEN.

A. PROGRAM SAODEC

The first program to be run, SAODEC, reads option switches from the command line. Switches not included on the command line are assigned default values. The program then creates SAOXXX, an output Real-time Disk Operating System (RDOS) file, and writes the user supplied and default values to it. The contents of a sample SAOXXX file are shown in Fig. 3. Table 1 shows the default values and definitions of the words in this file. The switches stored in SAOXXX can be used by any of the three other tasks.

Each site has the option of selecting the AFOS nodes, Weather Service Forecast Offices, and collectives for which it wishes to have observations decoded. A master list of AFOS nodes and collectives (MCPSDC) is provided with the standard software package as shown in Fig. 4. This list may be modified and stored as one or more separate RDOS files giving the user the capability of retaining customized files for different applications. Appendix I provides a step-by-step guide to editing, storing, and using this file.

B. PROGRAM SAOD1

The decoding program, SAOD1, reads the user specified list of nodes and collectives from CCCLIST.nn. The extension nn is supplied to SAOD1 through the "nn/C" switch, available from the SAOXXX file. SAOD1 retrieves the observations for designated CCC list from the AFOS database. The most current observations, for a time window of T+30 minutes and T-30 minutes, where T is either the current system time or the time specified by the "hhmm/T" option switch, are retrieved. Special observations are not included unless the "/S" switch is used. Buoy and ship observations will be included only if the North American map background is used (Unknown Author, 1983). Coast Guard observations are decoded when the character string CGR is included in the list of input nodes. Great Lakes ships are decoded when LAW is included in the list. Figs. 5 and 6 show the raw observation for land and ocean stations as they would appear when displayed on the ADM. Each observation is decoded in the format shown in Tables 2, 3, 4, 5, 6, and 7 and written to an RDOS file (SAODATA). Fig. 7 shows a partial listing of the data stored in the SAODATA file.

C. PROGRAM PLTGEN

The standard plot file generation program, PLTGEN, also reads and uses the values stored in the SAOXXX file. PLTGEN reads the SAODATA file and creates an RDOS file (NMCPLTSAO) in Universal Graphics Generator (UGG) format. Fig. 8 shows a partial listing of this file and explains some of the entries. This program also reads the RDOS file, STDIR.MS, to obtain latitude (in pixels), longitude, and zoom plot settings. The zoom plot settings determine graphics zoom thresholds at which stations are first plotted. The user regulates the plot density by assigning a zoom level setting for each station. Each AFOS site sets the zoom threshold values by editing the STDIR.MS file (Scott, 1983). Program ZOOMEDIT has been designed to do this. Your regular source for applications programs will supply you with this program if you don't have it. Appendix II contains a brief description of its use.

D. PROGRAM PLTSELECT

PLTSELECT reads the same switches and files as PLTGEN and creates a similar output file. It also provides the user with the option to choose the meteorological element to be displayed. PLTSELECT may be run several times on the same data to create different plot files. SAODEC has a global switch, described below, which will accomplish the same purpose. Current users of PLTSELECT may elect to use SAODEC in its place.

3. PROCEDURES

The decoder is initiated from the ADM by entering:

RUN:SAODEC/M/S/Z/W/I/J hhmm/T bb/B nn/C dd/D p/P mmMM/R

This entry will execute all programs from setting the optional switches thru creating the plot file. The optional global and local switches and their default settings are shown in Table 8.

Program PLTSELECT is designed to reuse the decoded observations in the SAODATA file to create different plots. PLTSELECT is initiated from the ADM by entering:

RUN:PLTSELECT bb/B p/P

where "bb" and "p" have the values shown in Table 8.

The complete set of programs runs in 20K words of memory. The execution time varies with the complexity of the observations being decoded, the number of observations, and the AFOS system workload. On the average, it takes about one second to decode an observation and another second to convert each observation to plot file format.

Upon completion of all the programs, the alarm light is activated alerting the user that a message was sent to the ADM. Contained in this message is the name of the file where the plot data is stored. The user may then run one of the graphics generation programs to create a product displayable on the Graphics Display Module (GDM).

The generation of graphic synoptic displays from plot files can be done by either program MODELUGF (Chia, 1984) or PMOD (Davis, 1983). The generation of weather depiction displays can be produced by the program WXPLOT (Sunkel, 1982). Appendix III has descriptions of the use of these programs as they pertain to plotting SAO data.

The subroutines which decode United States airways observations can be used by other FORTRAN programs. An explanation of their use is described in Appendix IV.

4. CAUTIONS

a. The maximum number of nodes and collectives allowed in CCCLIST.nn, the list of input nodes, is 70.

b. It can take as much as 20 minutes to execute the whole procedure through graphics display. This is mainly dependent on the number of observations; the fewer the observations, the faster the execution time.

c. At least 150 RDOS blocks should be available before execution of the SAO decoder series of programs.

d. When the PMOD graphics generation software package is used to generate regional maps, the map background switch set in SAODEC (bb/B) should be "02/B".

e. If buoys and ships are included over large water areas, a coastal node and a large radius must be specified to the graphics generation program.

f. The decoder is designed to recognize observations in World Meteorological Organization (WMO) formats (U.S. Dept. of Commerce, Defense, and Transportation, 1979). Observations deviating from these formats may cause misinterpretation of data.

5. REFERENCES

Chia, R. R., 1984: Displayable Graphics from Plot Files. NOAA Integrated Systems Laboratory Computer Program No. 1, National Weather Service, NOAA, U.S. Department of Commerce, 13 pp.

Davis, R. A., 1983: PMOD plotting system for AFOS. NOAA AFOS Operations Division Computer Programs NWS AOD CP 83-1, National Weather Service, NOAA, U. S. Department of Commerce, 50 pp.

Scott, C. M., 1983: Controlling station spacing on regional SAO plots. Unpublished manuscript, Eastern Region Headquarters, National Weather Service, NOAA, U. S. Department of Commerce, 4 pp.

Spry, A. J. and Anderson, J. L., 1981: An enhanced plotter for surface observations. NOAA Technical Memorandum NWS WR-170, National Weather Service, NOAA, U.S. Department of Commerce, 25 pp.

Sunkel, W. E., 1982: A regional weather depiction plot. Central Region Computer Programs and Problems, NWS CRCP No. 6, National Weather Service, NOAA, U. S. Department of Commerce, 33 pp.

Thomas, R. D., 1981: Surface airways observations decoder. Unpublished manuscript, National Meteorological Center, National Weather Service, NOAA, U. S. Department of Commerce, 22 pp.

Unknown Author, 1983: Enhancement of the SAO decoder and plotter to include ships and buoys. Western Region Headquarters, National Weather Service, NOAA, U. S. Department of Commerce, 9 pp.

U. S. Department of Commerce, Defense, and Transportation, 1979: Surface observations. Federal Meteorological Handbook No. 1, 600 pp.

SURFACE AIRWAYS OBSERVATION DECODER

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: SAODEC

AAL ID: DBC007
Revision No.: 04.00

FUNCTION: Extracts specific airways, buoys, and ship observations from the AFOS database, reformats them into combination integer and ASCII records, stores these records in RDOS disk files, and optionally generates a plot file (NMCPLTSAO), a data file (SAODATA), or both.

PROGRAM INFORMATION:

Development Programmer(s):

Rich Thomas
Herman Perrotti

Location: AFOS Operations Division
Phone: FTS 427-7436

Maintenance Programmer(s):

Herman Perrotti

Location: Techniques Development Laboratory
Phone: FTS 427-7639

Language: FORTRAN IV/REV 5.20

Type: Chain

Save file creation dates: SAODEC

Original release/Revision 01.00	-	January 1981
TDL release/Revision 02.00	-	September 1983
TDL release/Revision 02.10	-	December 1983
TDL release/Revision 03.02	-	April 1984
TDL release/Revision 04.00	-	September 1984

Save file creation dates: SAOD1

Original release/Revision 01.00	-	January 1981
TDL release/Revision 02.00	-	September 1983
TDL release/Revision 02.10	-	December 1983
TDL release/Revision 03.02	-	April 1984
TDL release/Revision 04.00	-	September 1984

Save file creation dates: PLTGEN

Original release/Revision 01.00	-	December 1980
TDL release/Revision 02.00	-	September 1983
TDL release/Revision 02.10	-	December 1983
TDL release/Revision 03.02	-	April 1984
TDL release/Revision 04.00	-	September 1984

Save file creation dates: PLTSELECT

Original release/Revision 01.00	-	June 1981
TDL release/Revision 02.00	-	September 1983

Running time: one second per observation

Disk space:	Program files	-	200 RDOS blocks
	Data files	-	3 RDOS blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
SAODEC.SV	SAODEC chains to SAOD1.
SAOD1.SV	SAOD1 chains to PLTGEN.
PLTGEN.SV	
PLTSELECT.SV	

Data files:

NAME	DP location	READ/WRITE	COMMENTS
CCCLIST.nn	DP0	R	Created by message comp.
SAOXXX	DP0	R/W	Created by SAODEC.
SAODATA	DP0	W	Created by SAOD1.
WXDATA.XX	DP0	W	Created by PLTGEN.
STDIR.MS	DP0	R	Station Directory (DBC035)

AFOS Products:

ID	ACTION	COMMENTS
NMCPLTSAO	Stored	Output from PLTGEN program, if specified.

LOAD LINE

```
SAODEC:     RLDR SAODEC INTGR BG.LB UTIL.LB FORT.LB
SAOD1:      RLDR SAOD1 SAO AIRDX INTGR CLOUD PRECIP SKY
                 VSBYWX BLKCHK STRING WIND GROSS TEMPDP
                 DRSP REMARK DECVIS SHIP BUOY MARDEC
                 ONEOB INTALL HEADER DTCHK FRAC IFAH MB INCHES
                 ICEL CG CGOBS MEX MEXOBS BFILL FILTER
                 WX SYNWX SYNVV THERMO.LB BG.LB
                 UTIL.LB SETFLSZ FORT.LB
PLTGEN:     RLDR PLTGEN VV WW CT MASC BNSCH OUTPUT CART
                 MERC UTIL.LB BG.LB FORT.LB
PLTSELECT:  RLDR PLTSELECT UTIL.LB FORT.LB
```

PROGRAM INSTALLATION

1. Move the executable modules, SAODEC.SV, SAOD1.SV and PLTGEN.SV, to DP0 or link them to DP0 from another directory.

2. All existing CCCLIST.nn files are compatible with this version of the program. To add buoys and ships, new CCCLIST.nn files will have to be created or existing CCCLIST.nn files will have to be modified.

SURFACE AIRWAYS OBSERVATION DECODER

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: SAOD1 AAL ID: DBC007
Revision No.: 04.00

PROGRAM EXECUTION:

1. Just as in previous versions, CCCs are added or deleted from the CCCLIST.nn file using the established preformats at your site. The CCC for Pacific ships is SHP and for Atlantic, Gulf of Mexico, and Great Lakes, it is SHA. The CCC for Pacific buoys is BYP and for Atlantic, Gulf of Mexico, and Great Lakes, it is BYA. Buoys and ships may be plotted alone or in combination with land stations. PLTGEN (Revision 02.10) has been modified to handle buoys and ships.

2. Run SAODEC which passes the appropriate parameters to SAOD1. SAODEC chains to SAOD1, which chains to PLTGEN.

   At an ADM enter:

   RUN:SAODEC/S/Z/W/I/J/X hhmm/T bb/B nn/C dd/D p/P ttMM/R

   Definition of switches:

   GLOBAL

   /S The most recent observation received will be plotted (include specials).

   /Z Plot all observations at a 1:1 zoom setting.

   /W Create a plot file compatible with WXPLOT (create weather depiction chart).

   /I Plot station ID's below the station circle.

   /J Rerun the program using the existing decoded data (works the same as PLTSELECT).

   /M Calculate the mixing ratio and include the result in the decoded observation.

   /X Prints program diagnostic information to the PPM and the Dasher.

   LOCAL

   hhmm/T = Observations will be decoded for the time range hhmm+15 through hhmm-30.
   dd/D = Day
   bb/B = Map background number for which a plot file is to be generated.
   nn/C = Extension (.nn) of CCCLIST file.
   p/P = Element display plot parameter

ttMM/R = Decode observations in the range hhmm-tt through hhmm+MM

Defaults (Switch not used):

/T = Current system time
/D = Current system day
/S = No specials
/B = No plotfile
/C = CCCLIST.00
/P = All parameters with sea level pressure
/Z = Zoom level will be read from STDIR.MS file
/M = No mixing ratio calculation
/X = No diagnostic print

Options:

bb/B = 02 - North American map background (must be used if plotting ships and buoys).
03 - United States map background (will not accommodate ships and buoys).

p/P = Q - All parameters with sea level pressure (millibars).
B - All parameters with altimeter setting (inches of Hg).
A - Altimeter setting only.
P - Pressure only.
T - Temperature only.
D - Dewpoint only.
C - Pressure tendency only.
W - Wind barbs only.

Note: All single parameter plots include wind barbs and sky cover.

3. PLTSELECT is used to create a new plot from the SAODATA file without having to rerun SAODEC.

At an ADM enter:

RUN:PLTSELECT bb/B p/P

Definition of switches:

The bb/B and the p/P switches have the same options and defaults as SAODEC.

4. To create a synoptic graphics display from the plot file (NMCPLTSAO) generated by either SAODEC or PLTSELECT, run one of the graphics generation programs such as MODELUGF from a macro.

Example:

MODELUGF NMCPLTSAO NMCGPHxxx CCC/c nnnn/R

Where:

xxx = An appropriate graphics product bin.
CCC = A WSFO which will be used as the center of a circle with the plot radius nnnn/R.

5. To create a weather depiction graphics display from the data file (WXDATA.XX) generated by either SAODEC or PLTSELECT, run the program WXPLOT.

Example:

WXPLOT

ERROR CONDITIONS

DASHER MESSAGES	MEANING
1- "1"	Couldn't get I/O channel for SAOXXX. Probable system or disk problem.
2- "2"	Couldn't open SKEL file. Program not linked to or located on same directory as SKEL file. Establish appropriate links to SKEL file.
3- "3"	Couldn't read SKEL file. Probable system or disk problem.
4- "4"	Couldn't get I/O channel for SKEL file. Probable system or disk problems.
5- "5"	Couldn't open SAODATA. Program not linked to or located on same directory as SAODATA file. Establish appropriate links to SAODATA file.
6- "6"	Couldn't read SAODATA file. Probable system or disk problems.
7- "7"	Couldn't locate next key. Entry in CCCLIST.nn file is not in database. Verify CCCLIST.nn entries, make corrections, and rerun program.
8- "8"	Couldn't write header to SAODATA file. Probable system or disk problem.
9- "9"	Couldn't write ETX to SAODATA file. Probable system or disk problem.
10- "10"	Couldn't write time to SAODATA file. Probable system or disk problem.

11- "11"	Couldn't chain to PLTGEN. Program not in the same directory. Establish appropriate links or move programs to same directory.
12- "12"	Couldn't write decoded observation to SAODATA file. Probable system or disk problem.
13- "13"	Couldn't close SAOXXX file. Probable system or disk problem.
14- "GCHN"	Couldn't get I/O channel for SAOXXX. Probable system or disk problem.
15- "OPEN"	Couldn't open SAOXXX file. Probable system or disk problem.
16- "WRS ERROR"	Couldn't write to SAOXXX file. Probable system or disk problem.
17- "KLOSE"	Couldn't close SAOXXX file. Probable system or disk problem.

Table 1. The contents, default settings, and definitions of the data stored in the SAOXXX File.

Word Number	Default	Definition
1	mm	Current month of the year
2	dd	Current day of the month
3	yyyy	Current calendar year
4	tttt	Current time of the day (GMT)
5	0	0 = Include most recent specials 1 = Don't include specials
6	0	Map background
7-8	00	CCCLIST file extension
9	1	1 = Pressure/ 0 = None
10	1	1 = Temperature/ 0 = None
11	1	1 = Dew point/ 0 = None
12	1	1 = Wind/ 0 = None
13	1	1 = Pressure tendency/ 0 = None
14	0	1 = Weather depiction chart/ 0 = None
15	0	1 = All zoom settings set to 0 0 = Zoom settings read from STDIR.MS file
16	30	Maximum value for time window
17	15	Minimum value for time window
18	0	1 = Plot station ID's/ 0 = None
19	0	1 = Mixing ratio calculation/ 0 = None

Table 2. Format of the SAODATA File.

Word Number	Contents	Variable Type	Default
1-2	Station call letters	Packed ASCII	blank
3	Return code (see Table 3.)	Integer	-99
4	Time (hhmm GMT)	Integer	-99
5	Observation type (see Table 4.)	Integer	-99
6	Latitude	Integer	-99
7	Longitude	Integer	-99
8	Elevation	Integer	-99
9	Amount of highest cloud layer (Table 5.)	Unpacked ASCII	blank
10	Thin/variable flag (see Table 6.)	Integer	0
11	Height in 100's of feet	Integer	0
12	Ceiling indicator (see Table 7.)	Unpacked ASCII	blank
13	Amount of next lower cloud layer	Unpacked ASCII	blank
14	Thin/variable flag	Integer	0
15	Height in 100's of feet	Integer	0
16	Ceiling indicator	Unpacked ASCII	blank
17	Amount of next lower cloud layer	Unpacked ASCII	blank
18	Thin/variable flag	Integer	0
19	Height in 100's of feet	Integer	0
20	Ceiling indicator	Unpacked ASCII	blank
21	Visibility Positive = miles Negative = thousands of miles	Integer	-99
22	Variable visibility indicator ("V")	Unpacked ASCII	blank
23-27	Obstruction to vision (right justified)	Packed ASCII	blank
28	Sea level pressure (tenths of millibars)	Integer	-99
29	Temperature degrees Fahrenheit	Integer	-99
30	Dew point degrees Fahrenheit	Integer	-99
31	Mixing ratio in tenths g/kg	Integer	-99
32	Wind direction tenths of whole degrees	Integer	-99
33	Wind speed in knots	Integer	-99
34	Wind gusts or squalls in knots	Integer	-99
35	Altimeter setting in hundredths of inches	Integer	-99
36	Temperature degrees Celsius	Integer	-99
37	Dew point degrees Celsius	Integer	-99
38-40	Visibility (left justified)	Packed ASCII	blank
41	Pressure tendency characteristic	Integer	-99
42	Pressure tendency in hundredths of mb	Integer	-99
43	12 hour precipitation amount in hundredths of inches to 999	Integer	-99
44	Low cloud type	Unpacked ASCII	blank
45	Middle cloud type	Unpacked ASCII	blank
46	High cloud type	Unpacked ASCII	blank
47	Maximum or minimum temperature	Integer	-99
48	Zoom level	Integer	-99
49	Not used		

Table 3. Return codes and their definition reported in word three of the decoded observation.

Return Code	Definition
-2	Fatal error in WMO header
-3	Fatal decoding error - obscure end of observation
-4	Fatal decoding error - no call sign
0	Fatal error - too many missing values
1	Observation successfully decoded
2	File read error for ccc
3	No appropriate time version
4	Observation type could not be identified
5	Observation time could not be identified
71	Coast Guard observation successfully decoded
86	Buoy or CMAN observation successfully decoded
91	Ship observation includes present weather
96	Ship observation successfully decoded

Table 4. Observation types

Value	Definition
1	Record observation (SA)
2	Record special (RS)
3	Special observation (SP)
4	Automated unmanned observing stations (AMOS/RAMOS/AUTO)
5	Automated manned observing stations (AMOS/RAMOS)
6	(SW)
7	Local observation (L)
8	Corrected (SA)
9	Corrected (RS)
10	Corrected (SP)
11	Corrected unmanned AMOS/RAMOS/AUTO
12	Corrected manned AMOS/RAMOS
13	Corrected (SW)

Table 5. Cloud amount indicator.

Value	Definition
C	Clear (CLR)
S	Scattered (SCT)
B	Broken (BKN)
O	Overcast (OVC)
X	Obscured (X)

Table 6. Thin or variable cloud layer indicator

Value	Definition
0	Default
1	Thin or partial
50	Variable ceiling height
51	Thin variable

Table 7. Ceiling indicator

Value	Definition
M	Measured
E	Estimated
W	Obscured

Table 8. Optional switches used to run the SAO decoder.

Global Switches	Default	Definition
/S	Specials	Only plot most recent record observations
/Z	From STDIR	Plot all observations at 1:1 zoom setting
/W	No weather depiction	Create a plot file compatible with WXPLOT (weather depiction plot program)
/I	No station ID	Plot station ID's below station circle
/J	Decode obs	Rerun programs using existing data to create different plots
/M	No mixing ratio	Include the mixing ratio in the decoded observation

Local Switches	Default	Definition
hhmm/T	Current time	Observations will be decoded for the time range hhmm-15 through hhmm+30.
dd/D	Current day	Day of the month.
bb/B	No plotfile	Map background number for which a plot file will be generated.
nn/C	CCCLIST.00	Extension (.nn) of CCCLIST.nn file.
mmMM/R	T+30/T-30	Observations will be decoded for the time range hhmm-mm through hhmm+MM.
p/P	Q	Element display plot parameter where p may equal: Q = All parameters with sea level pressure B = All parameters with altimeter settings A = Altimeter settings only P = Sea level pressure only T = Temperature only D = Dew point only C = Pressure tendency only W = Wind barbs only

Note: All single parameter plots include wind barbs and sky cover.

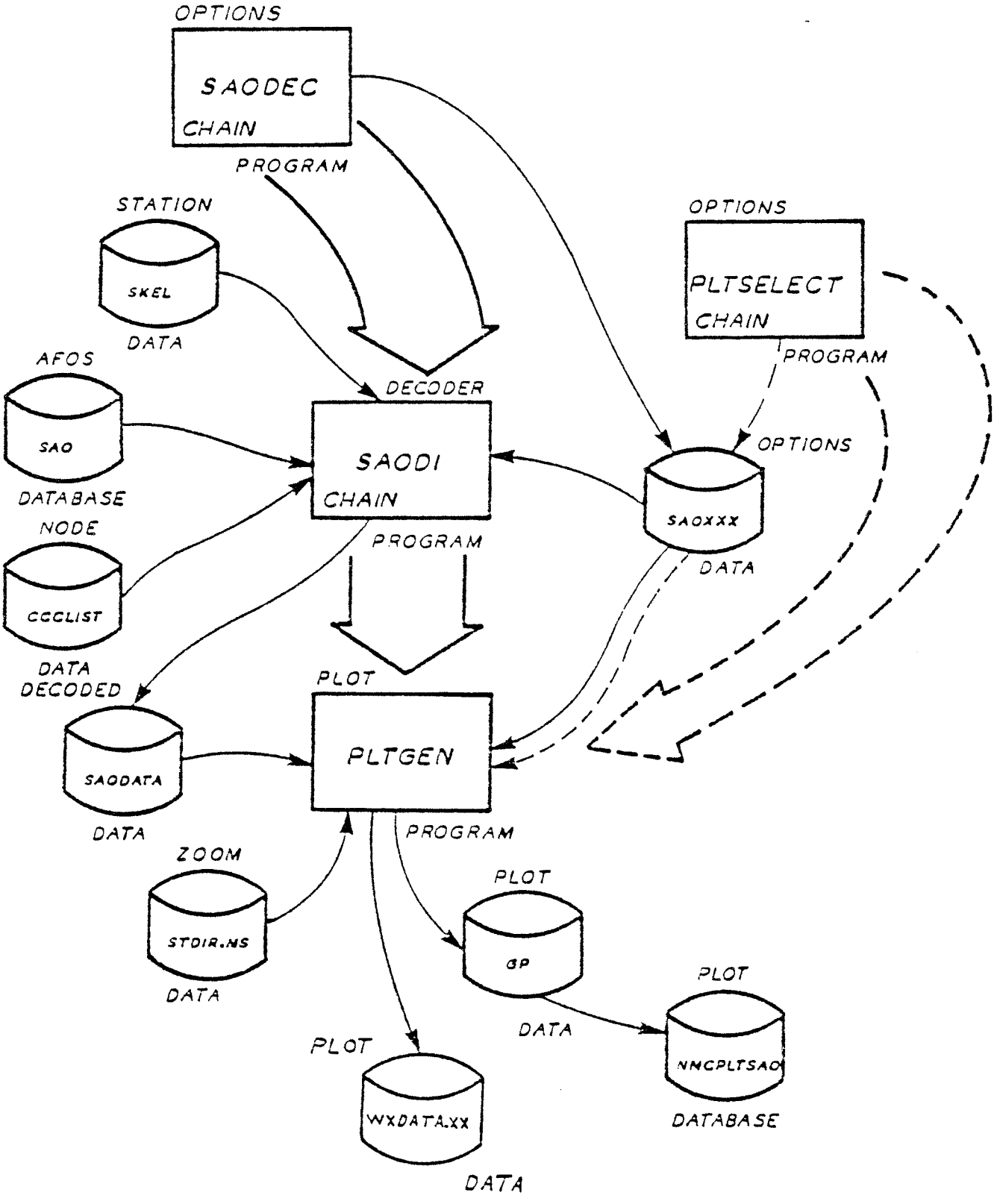


Figure 1. Data flow and program relationships for the SAO decoder system. Program tasks are designated by boxes and AFOS and RDOS disk files by cylinders. The dashed lines represent alternate links. Large arrows represent program module logical flow.

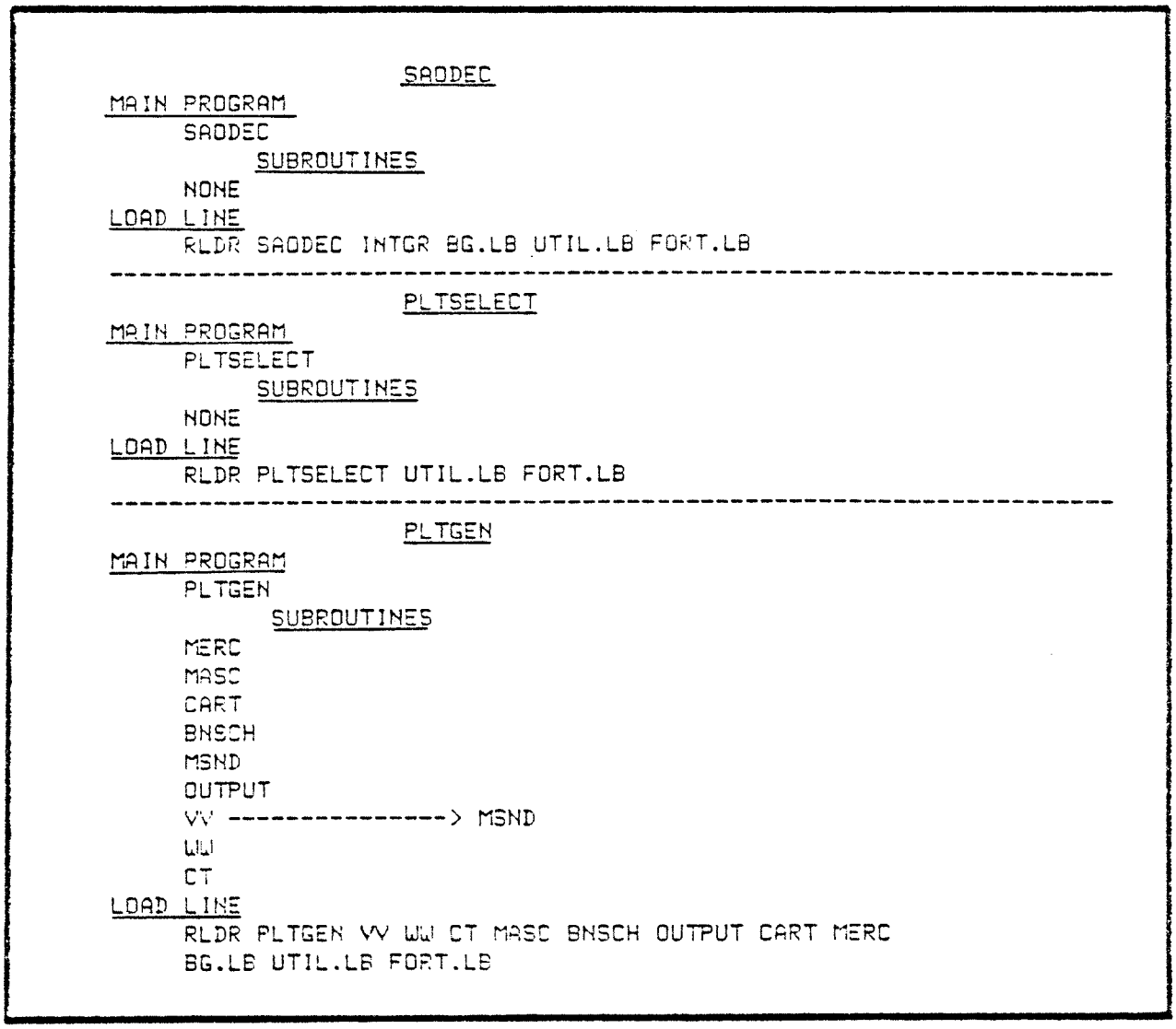


Figure 2. Software structures and load lines for programs SAODEC, PLTSELECT, PLTGEN, and SAOD1 (continued on next page).

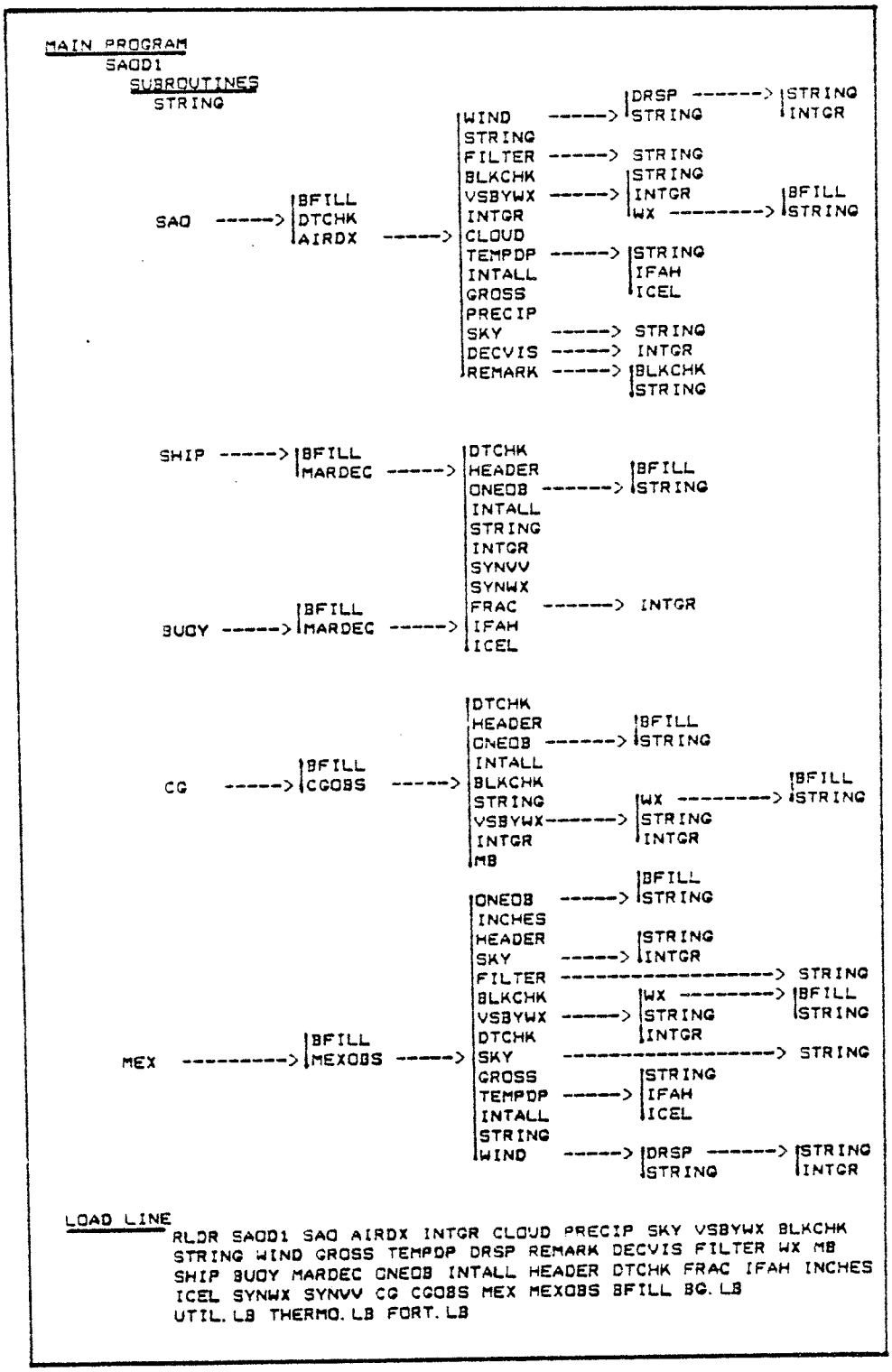


Figure 2. (continued).

```
 0 000012 000033 003677 003410 000001 000002 000060 000060 .............0.0
10 000001 000001 000001 000000 000001 000000 000000 000000 ................
20 000000 000000  ----   ----   ----   ----   ----   ----  ................
```

Figure 3. An octal dump of the SAOXXX file as it would be displayed by the RDOS utility program, FPRINT.

```
                SURFACE AIRWAYS OBSERVATION DECODER (SAO)

          ENTER CCC'S OF OBS TO BE DECODED

              **ANY OF THE CCC'S BELOW MAY BE ELIMINATED**
            **BLANK SPACES ARE SKIPPED - KEEP PROPER FORMAT**

             [ABQ,ALB,ANC,ARB,ATL,BHM,BIS,BOI,BOS,BUF,CAE,CHI,CLE,CRW]
             [CYS,DEN,DSM,FAI,FSD,FTW,GTF,HNL,IND,JAN,JNU,LAX,LBB,LIT]
             [MEM,MIA,MKC,MKE,MSP,NEW,NYC,OKC,OMA,PDX,PHL,PHX,PIT,PWM]
             [RDU,SAT,SDF,SEA,SFO,SJU,SLC,STL,TOP,WBC,WHX,WUL,YFB,YQX]
             [YYZ,BYA,BYP,SHA,SHP,IMX,   ,   ,   ,   ,   ,   ,   ,   ]
           [PLACE CURSOR ON THIS LINE AND ENTER                        ]
```

Figure 4. The master list of nodes distributed with the complete SAO decoder software package in message composition format.

```
 992 AMOS 34/24/3202/033 106
ALB SA 1350 M50 BKN 90 OVC 30 270/40/32/3611/032/SML BINOVC
BGM SA 1350 -X 1/4F 255/33/31/3507/024/F9
BTV SA 1350 200-BKN 20 294/31/27/3108/038
 GFL SA 1253 E45 BKN 100 OVC 40 270/37/27/1304/031/BINOVC
 MPV SA 1355 E80 BKN 25 286/34/28/3006/033
 MSS SA 1256 100 SCT 250 -SCT 10 300/33/31/0609/041
 MSV SA 1349 E15 OVC 15 42/37/0306/016/BINOVC-N
 P8G SA 1255 100 SCT 200 -OVC 35 292/32/24/3610/037=
 POU SA 1350 E13 BKN 22 OVC 10 244/39/37/0111/024
 RME SA 1255 W1 X 0F 258/30/26/0000/027/R33VR10-=
 RUT SP 1157 -X E10 OVC 5F /33/33/0000/027/F8
 SLK SA 0350 E60 OVC 7 33/26/0603/023/ LAST
 SWF SA 1350 -X E12 OVC 5F 39/36/0213G20/028/F2 VSBY LWR-SW/ RW-
 UCA SA 1356 W0X0F 267/33/33/2304/029
```

Figure 5. Example SAO's in a database for the node Albany, New York (ALB).

```
NMCBOYOC5
SNVD15 KWBC 161300
BBXX
44008 16131 99405 70694 46/// /0000 10086 40168
22200 00068 11108 333 921//=
42002 16131 99260 70935 46/// /1404 10212 40182
22200 00208 10602 333 92104=
44007 16131 99435 70701 46/// /0208 10041 40242
22200 00036 11104 333 92112=
41002 16131 99323 70753 46/// /0000 10198 40209
22200 00207 10905 333 921//=
41001 16131 99349 70729 46/// /2705 10178 40199
22200 00182 10905 333 92106=
44005 16131 99427 70683 46/// /0306 10062 40199
22200 00057 11105 333 92108=
42001 16131 99259 70997 46/// /1606 10229 40174
22200 00226 10501 333 92107=
41006 16131 99293 70773 46/// /0504 10205 40195
22200 00231 11107 333 92105=
44003 16131 99408 70685 46/// /1602 10082 40171
22200 00052 11107 333 92102=
44004 16131 99385 70707 46/// /3102 10126 40167
22200 00148 11006 333 92104=
42011 16131 99296 70935 46/// /3103
22200 1//// 333 92103=
42008 16131 99287 70953 46/// /0204 10154 40182
22200 1//// 333 92104=
42007 16131 99301 70809 46/// /3505 10159 40166
22200 00131 10401 333 92108=
```

Figure 6. Buoy reports from the collective titled, NMCBOYOC5.

```
 MONTH  DAY   YR TIME
   2    16   84 1200

-1-2-3----4---5---6---7--8910-11--14-15--18-19----21-23----26-----28-29-30-31-32-33-34---35--36---3738--40-41-42-43------46-47-49
ALB  1 1158   1 -99 -99-990 0 98 0 0 45M  0  0    25          10253 36 31 37340 12-99 3027   3    025      1  7 -255     47 36  0
BGM  1 1151   2 -99 -99-99X 0  1U  0  0   0  0  -187         F10251 33 31 37  0  8-99 3022   1    0 3/16   1  7  0       32 33  0
BTV  1 1158   1 -99 -99-990 0208E  0  0   0  0    15          10266 31 28 35330  7-99 3036   0   -115      2 14  608     55 31  0
GFL  1 1155   1 -99 -99-990 0280 0 0 50E  0  0    25          10263 37 25 30330  4-99 3029   3   -325      2 15  0       32 37  0
MPV  1 1158   1 -99 -99-990 0250 0 0 60E  0  0    25          10278 33 28 35320  4-99 3031   1   -125      1  3  0       32 33  0
MSV  1 1158   1 -99 -99-990 0 25ES 0 15   0  0    12            -99 48 37-99350 10-99 3018   4    312    -99-99-99       32-99  0
PBG  1 1155   1 -99 -99-990 0208ES 0100   0  0    15          10269 33 25 30360 12 18 3036   1   -315      1  6  007     55-99  0
POU  1 1158   1 -99 -99-990 0 15E  0  0   0  0     0          10230 38 38 46340 10-99 3020   3    30       2 20  0       32 38  0


LAL  1 1147   1 -99 -99-990 0  6M  0  0   0  0     3         F10282 40 43 57320  0-99 3012   9    63     -99-99-99       32-99  0
YHU  1 1200   1 -99 -99-995 1230   0  0   0  0    15         *10362 31 20 22 40  6-99 3041  -1   -715    -99-99-9902     51-99  0
YKL  1 1200   1 -99 -99-995 1220 S 0 25   0  0    15          10303 -2 -7  6310 12-99 3026 -19  -2215    -99-99-99       32-99  0
YQB  1 1200   1 -99 -99-998 1220   0  0   0  0    20          10320 31 20 22 60  4-99 3046  -1   -720    -99-99-9902     49-99  0
YUL  1 1200   1 -99 -99-995 1220   0  0   0  0    45          10304 34 28 22 60 10-99 3042   1   -745    -99-99-9902     49-99  0
YHM  1 1200   7 -99 -99-995 0250   0  0   0  0     4         F10266 29 29 32 60  9-99 3029  -2   -24     -99-99-99       32-99  0
YOW  1 1200   1 -99 -99-995 0240   0  0   0  0    25          10301 32 25 20 30  7-99 3040   0   -425     -99-99-99       32-99  0
YQT  1 1200   1 -99 -99-998 1250 S 0120   0  0     0          10219 32 31 35 40  8-99 3014   0   -10      -99-99-99       32-99  0
YYZ  1 1200   1 -99 -99-995 0250   0  0   0  0    15         *10279 29 25 26350  5-99 3033  -2   -415     -99-99-99       32-99  0


KHAG96 1200 -99 360 376 645 0  0   0  0   0  0   -99          -99  2 31-99 50 17-99  -99 -17   -10402  -99-99-9945 12343-99 16
VCTG96 1200 -99 379 699 438 0  0   0  0   0  0   -99        10160 66 52-99240 16-99  -99  15   110202    7  6-9904 12340-99 10
HBAD96 1200 -99-366 516 325 0  0   0  0   0  0   -99        10157 73 63-99100 12-99  -99  23   170702    2 17-9977 12340-99 24
GX2N96 1200 -99 355 458 635 0  0   0  0   0  0   -99        10197 60 48-99 30 22-99  -99  16    90506    2 12-9930 12344-99 17
SIGR96 1200 -99 336 537 238 0  0   0  0   0  0   -99        10260 60 55-99 50 10-99  -99  16   130404    4  0-9950 12342-99 18
GUX296 1200 -99 171 611 535 0  0   0  0   0  0   -99        10156 77 66-99 70 15-99  -99  25   190403    3 20-9994 12336-99 26
UNFN91 1200 -99 455 558 120 0  0   0  0   0  0  -9950       10225 41 39-99220 13-99  -99   5    40503    3  9-99       32-99-99
007 86 1200 -99 301 889  0  0  0   0  0   0  0   -99        10154 62-99-99170 12 14  -99  17  -990401    2  1-99       32-99 13
007 86 1200 -99 301 889  0  0  0   0  0   0  0   -99        10154 62-99-99170 12 14  -99  17  -990401    2  1-99       32-99 13

NUMBER OF STATIONS PROCESSED =      299
```

Figure 7. An example of the structure of the SAODATA file. Shown are American, Canadian, and ship observations. The numbers across the top designate the word number in the file, where two ASCII characters equal one word and integer numbers may have as many as five digits.

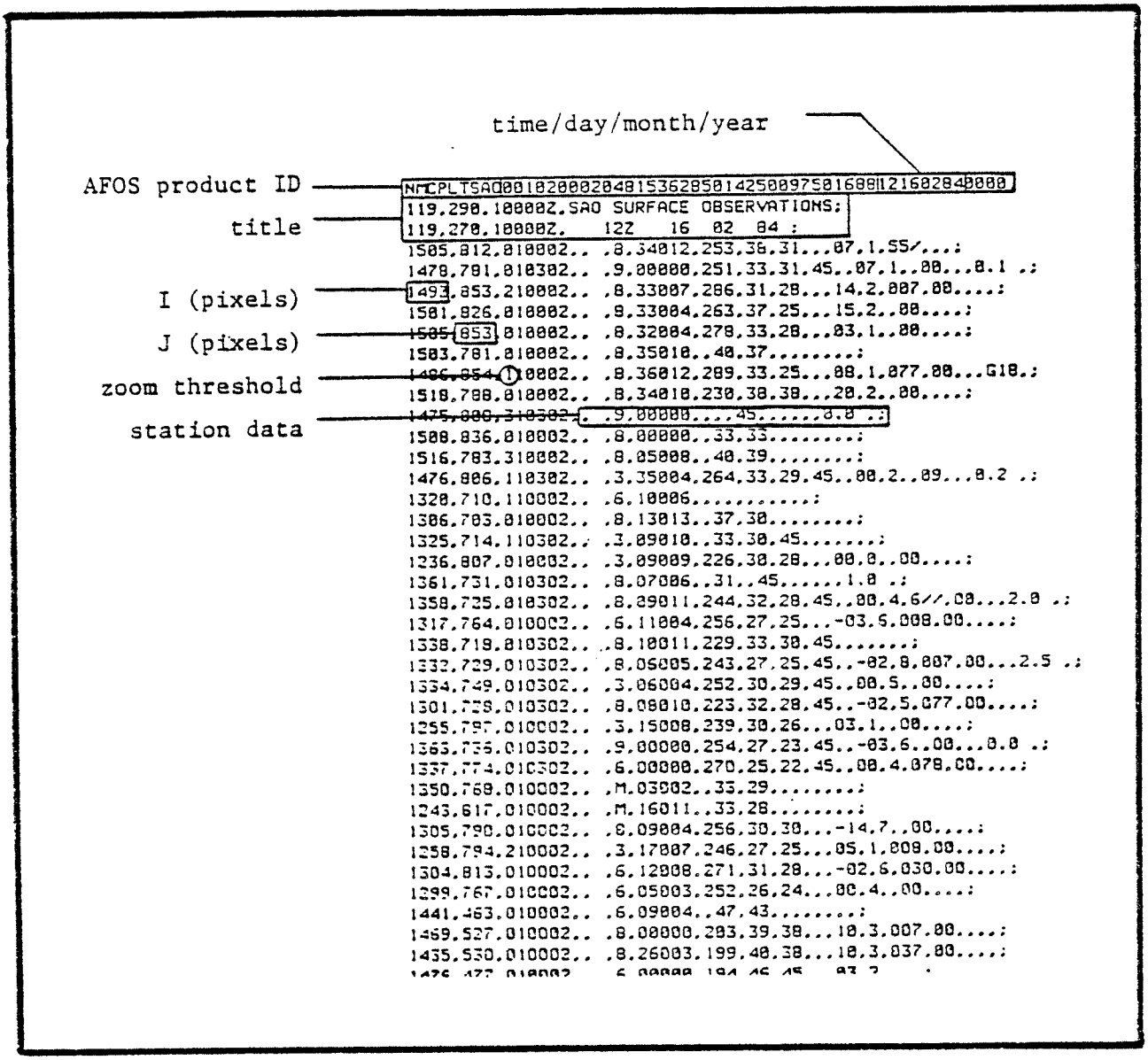


Figure 8. A partial listing of a plot file as it would appear on the ADM. Prominent features are identified. Note the zoom threshold settings read from the STDIR.MS file.

APPENDIX I

Creating Custom CCCLIST.nn Files

The program, SAOD1, determines which observations to decode by the list of ccc's in the CCCLIST.nn file. A master list of ccc's is provided with the standard software package. This list should be custom edited for each site.

1. Use an available preformat or piledit cccMCPSDC into your database to store the master list of ccc's.

   STORE:DP#:MCPSDC cccMCPSDC

2. Designate this file "fields only" so that only the data stored between the brackets are stored in the designated CCCLIST.nn file. This is done by using the AFOS KEY command.

   KEY:cccMCPSDC 0=1

3. Add to the database or wish list a product identified cccSDCSAO to store the custom edited master list of ccc's.

4. Edit the master list file by displaying the preformat with the AFOS command, M:SDC, deleting or changing the entries, and storing the result into the cccSDCSAO file you have established.

5. Transfer the edited information from the AFOS database to an RDOS file (CCCLIST.nn) of your choosing.

   SAVE:cccSDCSAO CCCLIST.nn

6. This CCCLIST.nn file is now ready for use.

7. To change an existing CCCLIST.nn file you must first store it back into the AFOS database.

   STORE:CCCLIST.nn cccSDCSAO

8. Edit this file using the AFOS editor.

   E:cccSDCSAO

9. Store the edited information back to the original RDOS file.

   SAVE:cccSDCSAO DP#:CCCLIST.nn

10. To display an existing RDOS file (CCCLIST.nn) you can use the AFOS display command.

    DSP:DP#:CCCLIST.nn

11. To print the contents of an RDOS file (CCCLIST.nn) on a AFOS printer plotter module you can use the RDOS utility program, FPRINT.

    RUN:FPRINT/Z/L CCCLIST.nn

If the ccc or collective you want is not in the master list, space has been provided at the end for additions. To include Coast Guard observations for one or more nodes, insert the characters CGR before the first of these nodes as they appear in the list. The node descriptors BYA and SHA are used to include Great Lakes buoys, Atlantic, and Gulf of Mexico ships and buoys. The descriptors BYP and SHP will include Pacific buoys and ships. LAW inserted before the first appropriate node will include Great Lake ships. IMX is the designator for Mexican observations. By inserting an XXX after the last node desired, the program will interpret this as a halt command and terminate any further node searches.

Since the standard SAO decoder package tends to run a long time, we advise that you limit your CCCLIST.nn file entries to the minimum required for your particular application.

APPENDIX II

Changing the Station Directory File

The station directory file (STDIR.MS) contains a listing of more than 2200 domestic surface, upper air, and radar observation stations. The information stored in this file for each station is the station ID, synoptic number, elevation, latitude, longitude, X and Y map background coordinates, and the zoom threshold. Program PLTGEN reads the STDIR.MS file to extract the X and Y map background coordinates and the zoom threshold value. This information, along with the data to be plotted, is written to a plot file on disk which is converted by one of the graphics generations programs into a displayable product.

Several utility programs are available to display or modify the STDIR.MS file. In this paper we are only concerned with two of them, WRDIR and ZOOMEDIT.

Program WRDIR will display the contents of the file on either the printer plotter module (PPM) or the background console (Dasher). To run this program, at the ADM, enter:

```
RUN:WRDIR
```

Program ZOOMEDIT can be used to change the zoom threshold levels for selected stations. ZOOMEDIT is an interactive background program which must be run at the Dasher.

1. At the Dasher enter:

   ```
   ZOOMEDIT
   ```

2. Respond to ENTER ID: with the call sign of the station you wish to change the zoom level for, 6 characters or less.

2. Respond to ZOOM (1, 2, 3) with one of the valid zoom threshold values, which are:

   0 = Data appears at all zoom levels
   1 = Data first appears at 4:1 zoom
   2 = Data first appears at 9:1 zoom
   3 = Data first appears at 16:1 zoom
   4 = Data not plotted.

4. The program will continue to re-cycle through the prompts until a space is entered for the ID to terminate it.

APPENDIX III

Creating SAO Synoptic Graphics Displays

There are two standard software packages used by the field to generate graphics in an AFOS environment, MODELUGF and PMOD. Shown below are examples of creating graphics displays from plot files generated by PLTGEN and PLTSELECT.

To create a displayable graphic with MODELUGF the following entry can be made at the ADM:

```
RUN:MODELUGF NMCPLTSAO NMCGPHxxx ccc/C nnnn/R
```

where:

xxx = An appropriate graphic product bin.
ccc = A WSFO which will be the center of a circle with radius nnnn within which the data will be plotted.
nnnn = The radius of a circle centered on ccc. All stations within the circle are plotted. Only stations with zoom level 0 are plotted outside the circle.

To create a displayable graphic with PMOD the following entries are made at the ADM:

```
RUN:PMOD/B/R 26/R ppp SFC.PM/O NA.PF/T
RUN:GENUTF XPLOT xxx
```

where:

ppp = The seventh, eighth, and ninth characters of an RDOS file, NMCPLTxxx, generated by either of the programs, PLTGEN or PLTSELECT.
xxx = The xxx of an RDOS file, NMCGPHxxx, where the final graphics product will be stored.

For further information on the use of MODELUGF or PMOD, see the appropriate National Weather Service publications.

At most stations RDOS indirect macro files have been established so the graphics programs don't have to be run directly. These files usually contain the appropriate RDOS commands to execute the programs for the station's area of interest. An example of the contents of one of these files is:

```
MODELUGF NMCPLTSAO NMCGHPT14 PDX/C 2500/R
```

In the example plotting will be centered on Portland, Oregon, with a plot radius of 2500 km and the final graphic product will be stored in NMCGPHT14. To initiate this indirect the entry:

```
RUN:@SHIPPLOT@
```

is typed on the ADM. SHIPPLOT is the name of the indirect RDOS file where the executable commands are stored.

Figs. 9 and 10 are examples of graphics displays created from decoded data by the PMOD graphics generation package. The data is distributed around the station circle in the standard plot format. Fig. 11 is an illustration of this.

Creating Weather Depiction Graphics Displays

To create a weather depiction graphic display you must first run the program SAODEC with the /W global switch option activated:

```
RUN:SAODEC/W bb/B nn/C
```

You may then run program WXPLOT to generate the weather depiction chart. WXPLOT requires an AFOS graphics storage product with the name NMCGPHP (bb+50), where bb is the map background indicator number. As an example, if the United States background (03) was used, the graphic product name would be NMCGPHP53. To create a weather depiction chart the following entry can be made at the ADM:

```
RUN:WXPLOT
```

See Fig. 12 for an example of a weather depiction graphics display created in this manner. Fig. 13 shows the data as it is distributed around the station circle on the weather depiction chart.

Creating a Full Set of Graphics Displays

It is often desirable to create synoptic and weather depiction charts from the same decoded data. The following example illustrates a procedure that may be installed on your system to decode observations, plot them on a North American map background, and then rerun the program SAODEC/J to reuse the same decoded data to create a weather depiction chart on a United States map background.

```
RUN:SAODEC/I 02/B 03/C
RUN:MODELUGF NMCPLTSAO NMCGPHT61 WBC/C 1000/R
RUN:SAODEC/J/W 03/B 03/C
RUN:WXPLOT
```

The "I" global switch on the first call to SAODEC instructs the program to include station call signs on the synoptic plot. The synoptic plot will be stored in the AFOS graphic product NMCGPHT61 and the weather depiction graphic in NMCGPHP53.

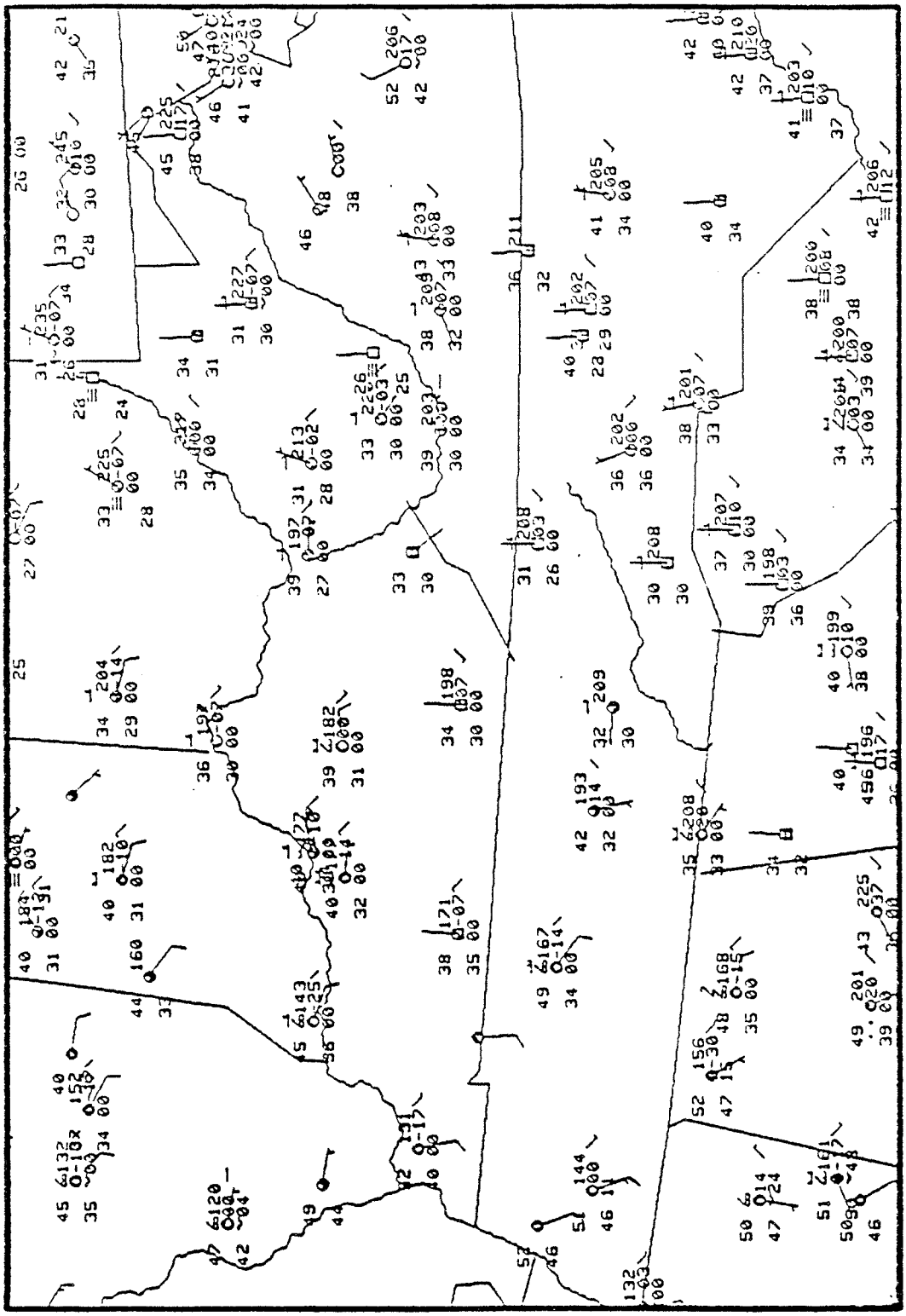


Figure 9. SAO data plotted on the PMOD Eastern Region map background and displayed at a 4:1 zoom ratio

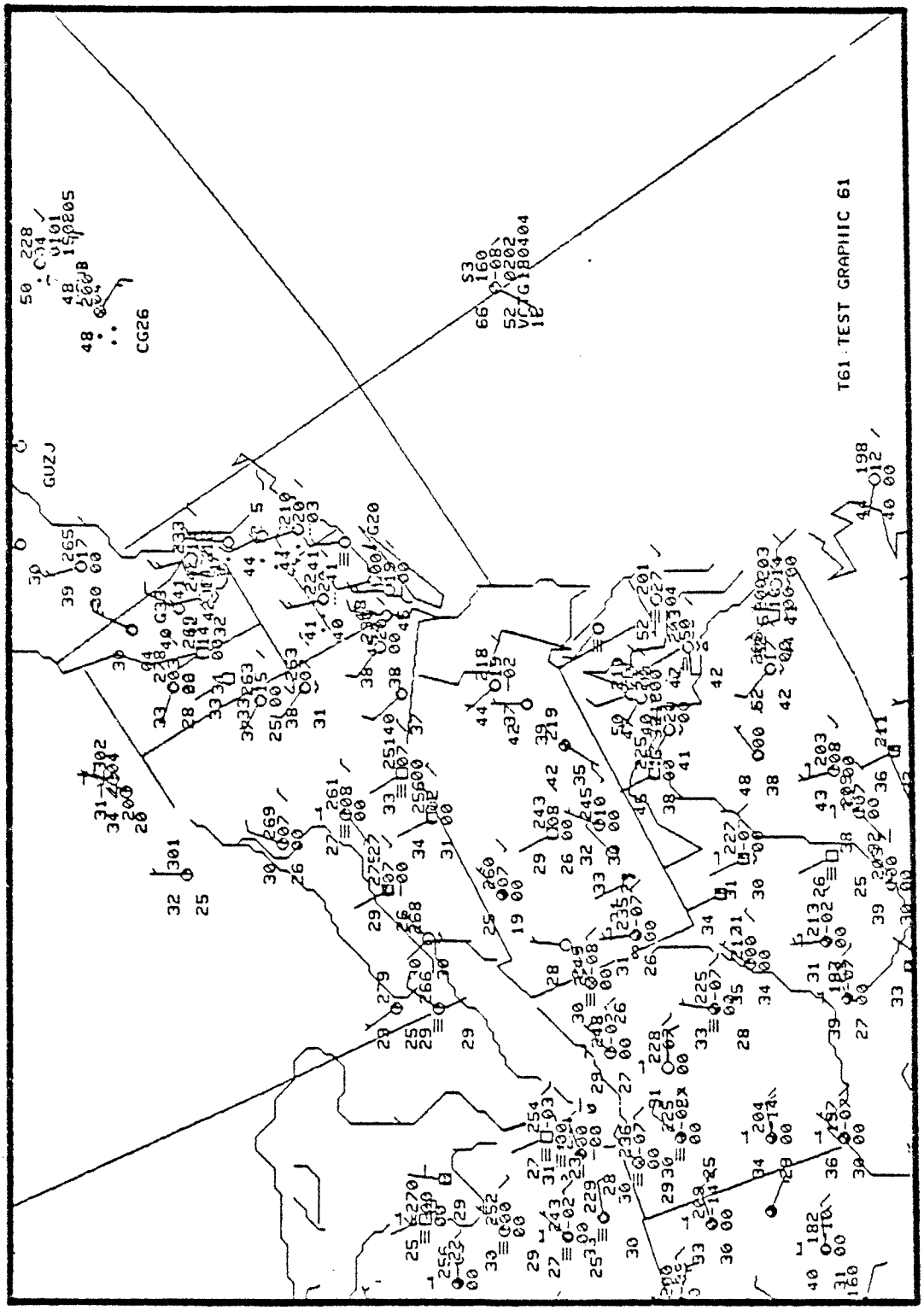
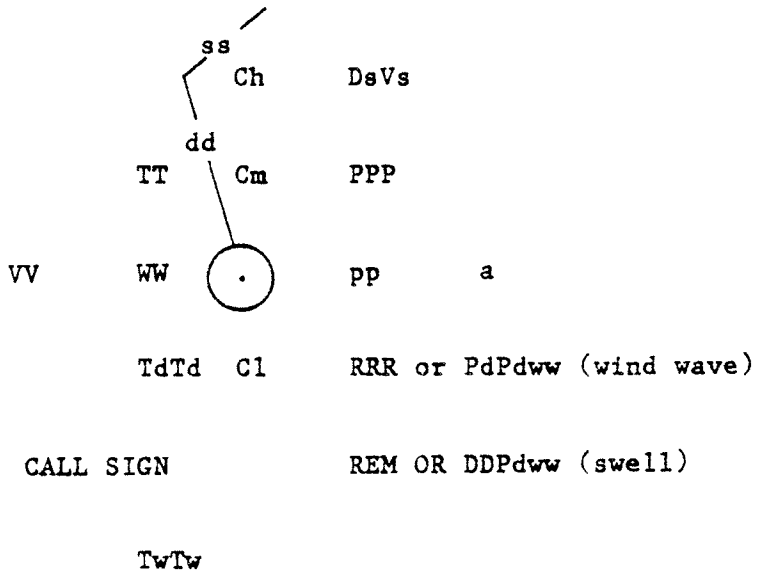


Figure 10. Data from land and ship stations plotted on a North American map background with the PMOD software at a 25:1 zoom ratio.



pp	-	3-hour pressure change
a	-	Pressure tendency
RRR	-	3-hour precipitation
PdPd	-	Wave period
ww	-	Wave height
REM	-	Remarks
DD	-	Wave direction
Cl	-	Low cloud type
TwTw	-	Water temperature
CALL SIGN	-	Station call sign
TdTd	-	Dew point
WW	-	Present weather
VV	-	Visibility
TT	-	Temperature
Cm	-	Middle cloud type
Ch	-	High cloud type
DsVs	-	Ship direction and speed of movement
PPP	-	Sea level pressure

Figure 11. The arrangement of data around the station circle as plotted by PMOD and MODELUGF. The data are designated by letter symbols also defined.

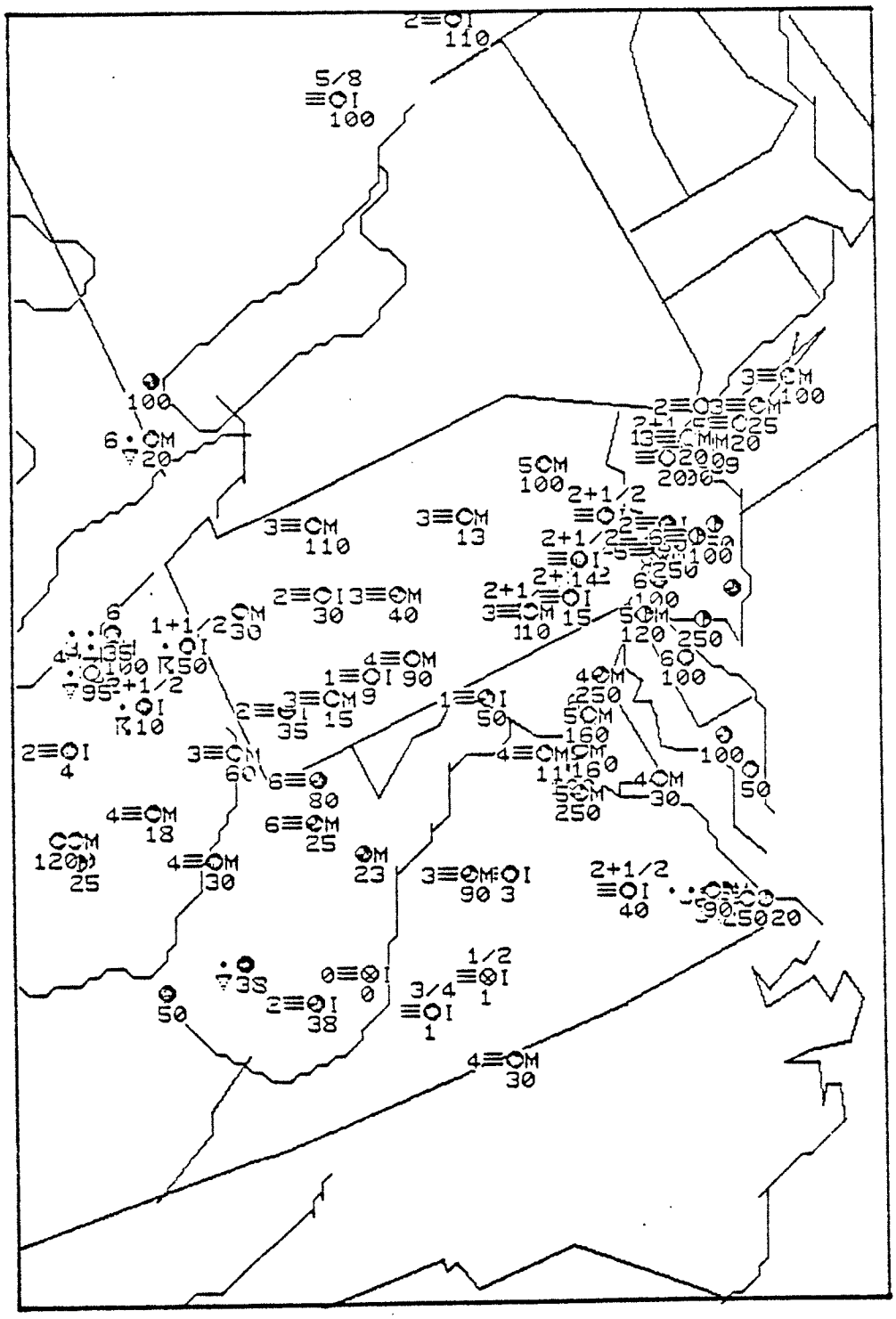
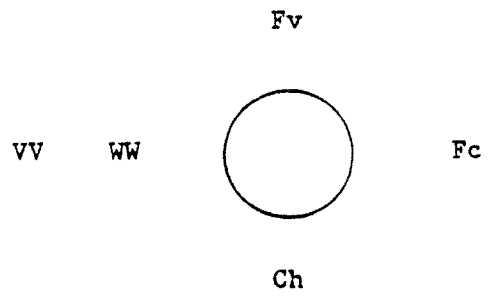


Figure 12. An example of the weather depiction chart produced by program WXPLOT. Each station plot contains the ceiling height below the station circle, the weather and visibility to the left, and cloud cover in the circle. To the right of the circle and "M" for marginal conditions, an "I" for IFR, or a blank for VFR conditions is plotted.



Fv	-	Fractional visibility below 3 miles
VV	-	Whole visibility in miles
WW	-	Present weather
Fc	-	Flying conditions
		I = IFR
		M = Marginal
Ch	-	Ceiling height

Figure 13. The arrangement of data around the station circle as plotted by WXPLOT. The data are designated by letter symbols defined in the table.

APPENDIX IV

Use of the Decoder Subroutines

The subroutines which do the actual decoding of the SAO data are FORTRAN callable and can be used by anyone. The main routine, AIRDX, accepts one unpacked SAO in array TDATA, decodes it, and returns the decoded observation in array IBUF in the format shown in Table 2. The call to AIRDX is:

```
PARAMETER ID1=256          ;DIMENSION OF TDATA( )
PARAMETER ID2=128          ;DIMENSION OF IBUF( )
          .
          .
CALL AIRDX(TDATA,ID1,IBUF,ID2,CAN,NOMIX,IER)
```

where:

TDATA( )	= An integer array of unpacked SAO data.
ID1	= Dimension of TDATA( )
IBUF( )	= An integer array of decoded unpacked data.
ID2	= Dimension of IBUF( )
NOMIX	= A logical variable indicating if the mixing ratio calculation is to be performed or not. .FALSE. = Do calculation/.TRUE. = Don't
CAN	= An integer variable indicating the observation is Canadian and reports its temperature in Celsius. 1 = Canadian/0 = Not Canadian
IER	= Error return codes indicating different states of the decoding process are shown in Table 3.

The following list contains all the subroutines necessary to use AIRDX.

CLOUD	PRECIP	BLKCHK	SKY
VSBYWX	TEMPDP	WIND	LOAD
REMARK	DRSP	INTGR	STRING
GROSS	DECVIS		

The new version of AIRDX, revision 4.0, returns the data in the SAODATA format shown in Table 2. This is a different format than that used in previous versions. Programmers currently using earlier versions who don't wish to change their existing programs can use subroutine REFORM which will reformat the data into the old format shown in Table 9.

```
CALL REFORM(IBUF,ID2)
```

where:

IBUF( )	= An integer array of unpacked decoded SAO data.
ID2	= Dimension of IBUF( )

An example load line to include both AIRDX and REFORM in your executable module would look like:

```
RLDR MYPROG LBS011.LB THERMO.LB UTIL.LB FORT.LB
```

where LBS011.LB is the AFOS Applications Program Library containing all the necessary decoder subroutines and THERMO.LB contains the mixing ratio calculation routine if it is desired.

Table 9. Format of the array, IBUF, returned from subroutine, AIRDX.

Word Number	Contents	Variable	Default
1-4	Station call letters	Unpacked ASCII	blank
5	Time (hhmm GMT)	Integer	-99
6	Observation type (see Table 4.)	Integer	-99
7-9	Not used		
10	Amount of highest cloud layer (Table 5.)	Unpacked ASCII	blank
11	Thin/variable flag (see Table 6.)	Integer	0
12	Height in 100's of feet	Integer	0
13	Ceiling indicator (see Table 7.)	Unpacked ASCII	blank
14	Amount of next lower cloud layer	Unpacked ASCII	blank
15	Thin/variable flag	Integer	0
16	Height in 100's of feet	Integer	0
17	Ceiling indicator	Unpacked ASCII	blank
18	Amount of next lower cloud layer	Unpacked ASCII	blank
19	Thin/variable flag	Integer	0
20	Height in 100's of feet	Integer	0
21	Ceiling indicator	Unpacked ASCII	blank
22	Visibility Positive = miles Negative = thousands of miles	Integer	-99
23	Variable visibility indicator ("V")	Unpacked ASCII	blank
24-33	Obstruction of vision (right justified)	Unpacked ASCII	blank
34	Sea level pressure (tenths of millibars)	Integer	-99
35	Temperature degrees Fahrenheit	Integer	-99
36	Dew point degrees Fahrenheit	Integer	-99
37	Mixing ratio in tenths g/kg	Integer	-99
38	Wind direction tenths of whole degrees	Integer	-99
39	Wind speed in knots	Integer	-99
40	Wind gusts or squalls in knots	Integer	-99
41	Altimeter setting in hundredths of inches	Integer	-99
42	Temperature degrees Celsius	Integer	-99
43	Dew point degrees Celsius	Integer	-99
44-49	Visibility (left justified)	Unpacked ASCII	blank
50	Pressure tendency characteristic	Integer	-99
51	Pressure tendency in hundredths of mb	Integer	-99
52	12 hour precipitation amount in hundredths of inches to 999	Integer	-99
53	Low cloud type	Unpacked ASCII	blank
54	Middle cloud type	Unpacked ASCII	blank
55	High cloud type	Unpacked ASCII	blank
56	Maximum or minimum temperature	Integer	-99
57-60	Not used		