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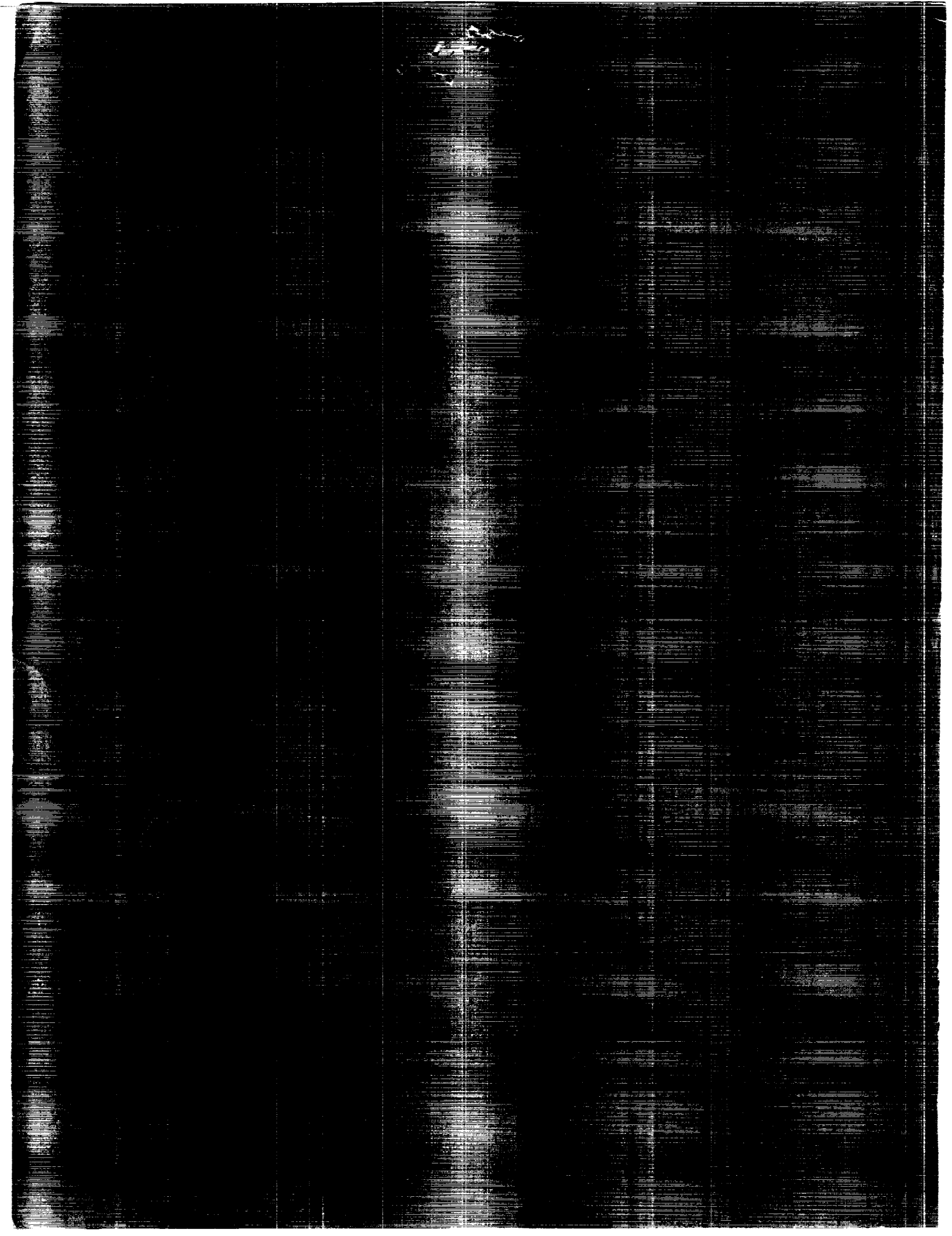

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GEMPAK5 User's Guide

Version 5.0

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CHAPTER 1

GEMPAK OVERVIEW

This document is the user manual for GEMPAK. It is intended to help users running GEMPAK programs and to serve as a reference guide.

Information on how to run GEMPAK is contained in Chapter 2. Chapter 3 contains descriptions of the variables used by the GEMPAK programs. Chapter 4 contains descriptions of the GEMPAK programs.

CHAPTER 2

USER INTERFACE

The Transportable Applications Executive, TAE, is the user interface for the GEMPAK programs. A simple, optional interface, called the no-TAE, is also available. This chapter gives a brief description of these interfaces.

2.1 TAE INTERFACE

The TAE provides menus and tutors which are helpful in running the GEMPAK programs. The logical names GEMUSR, GPUSR, and TAE must be assigned to point to the GEMPAK, GEMPLT, and TAE software. These names may be system logical names or may be assigned in your LOGIN.COM file, which resides in your home directory.

In order to run GEMPAK programs you must enter the TAE. This is done by executing the command:

```
@GEMUSR:GEMSTRT
```

Define the following symbol as a system symbol in your LOGIN.COM :

```
GEMPAK :== @GEMUSR:GEMSTRT
```

This will allow you to get to the main menu by simply typing:

```
GEMPAK
```

Once you have logged into the TAE, you will be presented with the GEMPAK root menu displaying several options. Select the option that you want by entering the appropriate number. When you have selected a program you will enter tutor mode. After selecting parameters in the tutor, enter RUN to execute the program. To exit the program, type EXIT. If you need help at any time, type HELP.

Most of the GEMPAK programs will enter an interactive tutor mode after executing the program or encountering an error. This dynamic tutor simply provides a way to execute the program again with new values for the variables. The dynamic tutor is a NOSCREEN tutor. It is functionally the same as the usual SCREEN tutor. It is used in GEMPAK so that the terminal screen will not be cleared within a program. Instead, the user will be prompted with

GEMPAK-PROGRAM>

Any of the input parameters may be changed. The following commands can be entered:

parm = value	change the value of an input parameter
RUN	run the program
LIST	list the parameters with their current values
LIST parm	list the value of the parameter
DISPLAY	list parameters, level 1 helps, and values
DISPLAY parm	list parameter, level 1 help, and value
SCREEN	enter the SCREEN tutor mode
NOSCREEN	enter the NOSCREEN tutor mode
EXIT	exit and return to the TAE
SAVE name	save the program variables in a file, name
RESTORE name	restore the program variables from name
HELP	list help for the program
HELP parm	list help for the parameter

This interactive mode will not be entered if the value of the global parameter, $RESPOND, is NO.

2.2 NO-TAE INTERFACE

The no-TAE mode is also available to run programs on systems where the TAE is not installed. It can also be used to run programs directly, without entering the TAE. Any program can be executed by typing:

RUN GEMEXE:PROGRAM

The program will display a tutor similar to the NOSCREEN dynamic tutor in the TAE. All the options mentioned above are available, except the SCREEN mode. Parameter values will be retained between programs. In the no-TAE, $RESPOND and $MAPFIL can be set in the tutor for any program. This allows a map file to be changed for later runs of the program.

CHAPTER 3

GEMPAK VARIABLES

This chapter describes variables used in the GEMPAK5 programs. The values of these variables are retained between programs.

3.1 ADDSTN

ADDSTN is a logical variable which indicates whether stations which are in STNFIL, but not already in the station file, should be added to the file.

Enter YES to add stations. Enter NO to update current stations but not add new ones.

3.2 ANLYSS

ANLYSS is the information to be stored in the analysis block of a grid file. This information is used in the objective analysis programs.

The average station spacing and the grid extend region are separated by a slash. The station spacing is in degrees of latitude and is used to compute the weighting functions in the Barnes analysis programs. The grid extend area is specified by four integers, separated by semicolons, which are the numbers of grid points to extend the grid left, down, right, and up. Only data within the extended grid area can be used after the first Barnes pass.

The default for the average station spacing is twice the grid spacing. The default for the grid extend region is 2;2;2;2.

3.3 AREA

AREA is the data area. Only data within the area specified will be processed.

Areas may be defined containing subareas. Subareas must be separated by slashes. Each subarea is additive, +, or subtractive, -, depending on the first character following the slash, with + being the default. Additive subareas add stations to the list of valid stations; subtractive subareas eliminate stations which were previously valid.

Subareas may be specified in the following ways:

1. lat1;lon1;lat2;lon2
   This defines a latitude/longitude range where (lat1, lon1) is the lower left corner and (lat2, lon2) is the upper right corner. West longitude is negative.

   #clat;clon;dlat;dlon
   This defines a latitude/longitude range by the center latitude and longitude. The lower left corner is (clat-dlat; clon-dlon); the upper right corner is (clat+dlat; clon+dlon). No corrections are made for the poles or the International Date Line.

2. GEOG
   This is an abbreviation for a geographic area defined in the GEMPAK geographic table which includes abbreviations for states, provinces and countries as well as other names. If #GEOG is entered, the user's geographic table, GEOG.TBL, will be searched. * or - after the name may be used to reduce/expand the area.

3. STN
   This defines an area centered on a station found in the GEMPAK station table, which currently contains US, Canadian and Mexican surface stations. * or - after the name may be used to reduce/expand the area.

4. DSET
   This includes all the stations in the current data set.

5. @ST
   This area includes those stations located in the state, province or country defined by ST. Only some countries are recognized (US,CN,MX,CI,BW,AU); other countries may be specified using method 6.

6. @CN:C
   This area includes those stations located in the country defined by CN.

7. @STN1;STN2;...;STNn
   This area includes the stations listed, where STNi may be a station identifier or a station number.

8. SHDR:iloval:ihival
   This area defines a range of integer values for the station header, SHDR. Valid keywords for SHDR are:

   COUN -- country
   SELV -- elevation (in meters)
   SLAT -- latitude (in degrees x 100)
   SLON -- longitude (in degrees x 100, West is negative)
   STAT -- state
   STID -- character identifier
   STNM -- station number (WMO 5-digit number for upper air, 6 digits for surface--usually the WMO 5-digit number followed by a 0)

   where COUN, STAT and STID are not very useful, since the integer representation of characters is system dependent.

   For example, SELV:0:2000 specifies stations whose elevations are less than 2000 meters.

3.4 BORDER

BORDER is the color, line type and line width of the plot background. The three numbers must be separated with slashes.

If the color is 0, no background will be drawn. The defaults for color, line type and line width are each 1.

3.5 CCOMP

CCOMP specifies the color components.

When CTYPE = NAME, CCOMP should contain a color name such as red, blue, maroon, etc. Only the first three letters are used to search for the name.

When CTYPE = RGB or CTYPE = HLS, three real-number values between 0 and 1. should be entered, separated by slashes.

When CTYPE = INIT, all the device colors are initialized to a standard set of colors.

Color table

NAME	RED	GREEN	BLUE	HUE	LIGHT	SATUR
RED	1.000	.000	.000	.000	.333	1.000
GREen	.000	1.000	.000	.333	.333	1.000
BLUe	.000	.000	1.000	.667	.333	1.000
YELlow	1.000	1.000	.000	.167	.667	1.000
CYAn	.000	1.000	1.000	.500	.667	1.000
MAGenta	1.000	.000	1.000	.833	.667	1.000
WHIte	1.000	1.000	1.000	.000	1.000	.000
BLAck	.000	.000	.000	.000	.000	.000
GRAy	.500	.500	.500	.000	.500	.000
VANilla	1.000	.900	.750	.102	.883	.320
ORAnge	1.000	.500	.000	.083	.500	.816
DKOrange	.863	.471	.000	.092	.445	.710
GBRown	.500	.281	.281	.000	.354	.216
BROwn	.500	.294	.196	.051	.330	.269
BEIge	1.000	.672	.500	.055	.724	.464
SANd	.851	.600	.298	.092	.583	.456
MUD	.395	.100	.160	.970	.218	.308
AQUa	.000	.718	.718	.500	.479	.678
SKY	.000	.640	1.000	.558	.547	.831
LTBlue	.000	.500	1.000	.583	.500	.816
NAVy	.000	.000	.500	.667	.167	.632
DKBlue	.000	.000	.750	.667	.250	.816
INDigo	.578	.000	1.000	.764	.526	.821
LTGreen	.600	1.000	.000	.232	.533	.824
AVOcado	.250	.500	.125	.280	.292	.343
DKGreen	.000	.562	.000	.333	.187	.679
TAN	.750	.500	.000	.113	.416	.632
GOLd	1.000	.750	.000	.129	.583	.862
BLOnd	.900	.820	.390	.143	.703	.490
LEMon	.900	1.000	.250	.186	.717	.738

PINk	1.000	.600	.600	.000	.733	.426
DKPink	1.000	.500	.500	.000	.667	.500
MARoon	.578	.000	.000	.000	.193	.691
APRicot	1.000	.700	.375	.000	.692	.553
VIOlet	.625	.250	.625	.833	.500	.354
PURple	.500	.000	.500	.833	.333	.500

3.6 CINT

CINT is the contour interval, minimum and maximum values separated by slashes. The scale factor is now entered in the variable SCALE.

The contour interval may be any real number. If it is not specified or if the value is 0, the program will select a contour interval which will generate 5 to 10 levels.

The minimum and maximum values specify the range of data to use in selecting contour levels. If either value is not specified, the value will be obtained from the range of values in the dataset. If the minimum and maximum are equal, that value will be used and only one contour level will be drawn.

A list of two or more contour levels may be entered using semicolons to separate the individual values. In this case, the minimum and maximum are ignored.

3.7 CLEAR

CLEAR determines if the screen is to be cleared before plotting.

Enter YES to clear screen or NO to leave current graphics.

3.8 COLORS

COLORS specifies a list of color numbers which must be separated using semicolons.

The color list will be repeated, if necessary, to determine colors for all the parameters or contours to be drawn. The colors corresponding to the color numbers used in each entry are device dependent.

If no color is input, the default is color 1. If a color number of 0 is given, no plotting will be done.

A specific color may be assigned to a color number by entering =NAME after the color number. The first three letters in NAME will be used to identify the color in the GEMPAK color table. For example, COLORS=1=red;2=blue, will set color number 1 to red and color number 2 to blue. If the last character in COLORS is a ?, then the current color names will be listed.

3.9 CPYFIL

CPYFIL identifies the location of the grid navigation and analysis information to be stored in a grid file. Three options are available:

1. If CPYFIL is blank, the information is taken from the inputs for PROJ, GRDAREA, KXKY, and ANLYSS.

2. If CPYFIL begins with a #, the information is read from the line in the grid navigation table which has the grid name or number corresponding to the rest of CPYFIL.

3. If CPYFIL is the name of a current grid file, the grid and navigation information will be copied from that file.

Note that if CPYFIL is not blank, the values of PROJ, GRDAREA, and KXKY will be ignored.

3.10 CTLFLG

CTLFLG is a logical flag which indicates whether control characters are included in a raw surface data set to be decoded.

The raw surface data set must contain either bulletins from the Domestic Data Service or single station reports. If the data set contains bulletins, the records in the file must be 80 bytes each, and each bulletin must begin with a <CNTL>A in column 1. If the input contains reports, each report must be written on a single line. CTLFLG is a logical variable indicating whether control characters are present. If CTLFLG = YES, the input file must contain bulletins. If CTLFLG = NO, the file must have reports.

3.11 CTYPE

CTYPE specifies the manner in which the colors are to be changed:

INIT -- colors are initialized to their default values.
NAME -- color name is given in CCOMP.
RGB -- RGB components are given in CCOMP.
HLS -- HLS components are given in CCOMP.

3.12 CURVE

CURVE is a number corresponding to the method to be used to fit the curve. Generally, CURVE should be set to 2.

The curve types currently available are:

1 - piecewise straight line
2 - cubic spline
21 - cubic spline with linear ends
22 - cubic spline with parabolic ends
23 - cubic spline with extrapolated ends

Note that types 2 and 21 are the same. Types 22 and 23 produce slightly different results at the ends of the splines.

3.13 CXSTNS

In SNCROSS, CXSTNS is the list of stations, separated with semicolons, to be used for the cross section. Stations may be entered using either character or numeric identifiers.

In GDCROSS, CXSTNS contains the endpoints of the cross-section line separated using a >. Each endpoint may be defined as follows:

1. a station character or numeric identifier;

2. a latitude and longitude pair separated by a semicolon;

3. an @ followed by a grid x and y coordinate pair separated using a semicolon, e.g., @1.5;2.3>@25.9;30.

3.14 DATTIM

DATTIM is the date and time to be used by GEMPAK programs.

The standard format for DATTIM is an 11-character string YYMMDD/HHMM, where:

```
YY is the last two digits of the year    (ex: 84 for 1984)
MM is the month                          (ex: 03 for March)
DD is the day of the month
/  is the date and time separator
HH is the hour                           (ex: 14 for 2:00 pm)
MM is the minutes past the hour
```

The part before the / is the DATE; the part after the / is the TIME.

DATTIM may be abbreviated. If the input has no / , it is assumed to be the TIME part. An abbreviated version of either TIME or DATE is assumed to be the part closest to the /. The rest of the standard time is obtained from the last time in the file. For example, if the last time in the file is 840515/1200 the following translations will be done:

```
13/11        ---->   840513/1100
13           ---->   840515/1300
13/          ---->   840513/1200
0412/1300    ---->   840412/1300
```

A list of times may be entered for DATTIM. Times in the list must be separated with semicolons. For example:

```
13/11;0412/13;0515/6
```

In the above example, the times are:

```
840513/1100
840412/1300 and
840515/0600.
```

DATTIM may also be entered as a range. The first and last times must be separated by a minus sign, for example:

```
13/11-15/14
```

A range with an increment may also be entered using minus signs as separators. The format of the increment is hhhmm. If the increment is one or two digits, it is assumed to be in hours.

The following options are also valid for DATTIM:

```
LAST -- the last time in the file
LIST -- lists all times and waits for input
ALL  -- all the times in the file
/ALL -- all the times for a single DATE.
```

If /ALL is entered, all the times for the most recent date are processed. If /ALL is appended to a specific date, then all the times for that date will be processed.

3.15 DELTAN

DELTAN is the average station spacing in degrees of latitude. The Barnes objective analysis programs use this number to compute weights for data interpolation.

3.16 DELTAX

DELTAX is the spacing between grid points in the x direction on CED grids. This value is in degrees longitude.

3.17 DELTAY

DELTAY is the spacing between grid points in the y direction on CED grids. This value is in degrees latitude.

3.18 DEVICE

DEVICE is the graphics device.

The following valid graphics devices may be available:

VT	: VT100 Retrographics terminal
DI	: Ditto graphics terminal
QM	: QMS laser printer
CT	: Tektronix 4107 color terminal
II	: IIS Image Terminal
RE	: VT240 REGIS graphics device
LA	: LA100 printer plotter
LN	: LN03 laser printer
HP	: Hewlett Packard Pen Plotter
MC	: Macintosh with Versaterm
SG	: Silicon Graphics Personal Iris
AP	: Apollo
GKS	: GKS standard
BGL	: BGL printer

3.19 DTAAREA

DTAAREA defines the area over which station data will be input to the Barnes objective analysis. Since data must be interpolated from the first pass grid back to stations, only data within the EXTEND area will be used after the first pass. If the DTAAREA is not specified by the user, it will default to the EXTEND area in OAGRID or to the data area stored in the grid file analysis block in OABSFC and OABSND.

DTAAREA can be specified in three ways:

1. lat1;lon1;lat2;lon2
   This defines a latitude/longitude range where

(lat1, lon1) is the lower left corner and (lat2, lon2) is the upper right corner. West longitude is negative.

#clat;clon;dlat;dlon
This defines a latitude/longitude range by the center latitude and longitude. The lower left corner is (clat-dlat; clon-dlon); the upper right corner is (clat+dlat; clon+dlon). No corrections are made for the poles or the International Date Line.

2. GEOG
This is an abbreviation for a geographic area defined in the GEMPAK geographic table which includes abbreviations for states, provinces and countries, as well as other names. If #GEOG is entered, the user's geographic table, GEOG.TBL, will be searched. *, - after the name may be used to reduce/expand the area.

3. STN
This defines an area centered on a station found in the GEMPAK station table, which currently contains US and Canadian stations. *, - after the name may be used to reduce/expand the area.

Note that the other ways of specifying AREA are not valid for DTAAREA in OAGRID but are valid in both OABSFC and OABSND.

For all projections, the lat/lon corners defined will be used exactly. For projections which include the pole, if lat1 = lat2 and lon1 = lon2, then lat1 will specify the range of data from the pole and lon1 will specify the central longitude. West longitude is negative.

Note that the stations actually used for the data area may be changed in the objective analysis programs using DTAAREA.

3.20 EXTEND

EXTEND specifies the numbers of grid points beyond the GRDAREA which define the grid extend area in the Barnes objective analysis. The first pass is computed on the extend area to reduce edge effects on the GRDAREA.

EXTEND is specified as four integers, which are the number of grid points to extend the grid left, down, right, and up. The values are separated by semicolons. The default for EXTEND is 2;2;2;2.

3.21 FILTER

FILTER is a logical flag used to filter data to eliminate plotting of overlapping stations.

If FILTER is set to YES, the data will be filtered. Otherwise, all data will be plotted.

3.22 GAMMA

GAMMA, the convergence parameter, is a multiplier for the weight and search radius for passes after the first pass of the Barnes analysis programs. GAMMA must be within the range 0 - 1. Any value outside this range will default to a value of .3. If GAMMA is 0, the number of passes will be set to 1. The recommended value for GAMMA is .3.

3.23 GAREA

GAREA is the graphics area. This is the area which will be displayed on a graphics device.

GAREA can be specified in three ways:

1. lat1;lon1;lat2;lon2
   This defines a latitude/longitude range where (lat1, lon1) is the lower left corner and (lat2, lon2) is the upper right corner. West longitude is negative.

   #clat;clon;dlat;dlon
   This defines a latitude/longitude range by the center latitude and longitude. The lower left corner is (clat-dlat; clon-dlon); the upper right corner is (clat+dlat; clon+dlon). No corrections are made for the poles or the International Date Line.

2. GEOG
   This is an abbreviation for a geographic area defined in the GEMPAK geographic table which includes abbreviations for states, provinces and countries, as well as other names. If #GEOG is entered, the user's

geographic table, GEOG.TBL, will be searched. *, - after the name may be used to reduce/expand the area.

3. STN
This defines an area centered on a station found in the GEMPAK station table, which currently contains US and Canadian stations. *, - after the name may be used to reduce/expand the area.

Note that the other ways of specifying AREA are not valid for GAREA.

For all projections, the lat/lon corners defined will be used exactly. For projections which include the pole, if lat1 = lat2 and lon1 = lon2, then lat1 will specify the range of data from the pole and lon1 will specify the central longitude. West longitude is negative.

If satellite projections are used, PROJ must be set to AOI for AOIPS/2 navigation or to NPG for Naval Postgraduate School navigation and GAREA must be the file name of an AOIPS image for AOI or the navigation base file name for NPG.

3.24 GDATTIM

GDATTIM is the date/time for the grid.

Grids may contain two date/time fields, in which case the fields must be separated using a colon. If the grid to be selected contains only one time, the colon and second time may be omitted.

The standard format for grid times is a character string

YYMMDD/HHMMthhhmm

where:

YYMMDD	is	the year, month, day
HHMM	is	the hour, minute
/	is	the date and time separator
t	is	the type (F=forecast A=analysis G=guess)
hhhmm	is	the forecast hour, minute

This format allows the two time fields to be used, for example, for the difference of two times. If only a single time is needed, TIME (2) is blank. If t is blank, an analysis grid is assumed. If hhhmm is blank, 00000 is assumed. If hhhmm has one or two digits, they represent hours. With

three or more digits, zeros will be added at the beginning of the field.

The field YYMMDD is called the date; HHMM is the time; t is the type; hhhmm is the forecast time. The fields may be abbreviated. If the input has no /, it is assumed to be the time part. Any abbreviated version of either date or time is assumed to be the part closest to the /. The rest of the date and time is obtained from the last time in the file. If the type is missing, then A is assumed, and a missing forecast time is replaced by 00000.

The type and forecast time fields are used with forecast model data. If GDATTIM is 880831/0000F24, the grid to be found is the 24-hour forecast from the model run at 00Z on Aug 31.

Examples (with the last time = 851205/1600):

GDATTIM	TIME1	TIME2
851205/1200	851205/1200	
12:15	851205/1200	851205/1500
LAST	851205/1600	
/00F24	851205/0000F24	

The value in GDATTIM may be overridden by specifying ^GDATTIM with the grids to be found. For example, GFUNC = SUB (TMPF^28/12,TMPF^27/12) will compute the same layer difference as GFUNC = LDF (TMPF) with GDATTIM=28/12:27/12.

Note that a grid from an objective analysis will have forecast type and time A00000, which is the default for a blank forecast type and time.

3.25 GDEFIL

GDEFIL is the name of the grid edit file which will be used to update a grid file. The edit file must contain only complete grids.

GDEFIL is a text file which may be created using the program GDLIST with F as an output device. A text editor may be used to create or change the grid edit file.

GDEFIL must contain the following information before the complete grid data.

The time, level, vertical coordinate and parameter name MUST appear on the same line in the order given. The time must be a fully qualified GEMPAK time. The parameter name is the name of the grid.

The first and last row and column information must appear on one line. Column information must be preceded by the word COLUMNS:. Row information must be preceded by the word ROW:. The first row and column must be 1. The last row and column must be the same as the grid size in the file. For example:

```
COLUMNS:  1  8        ROWS:  1  6
```

If the string FACTOR:, appears and is followed by an integer, the data will be divided by 10**SCALE before being stored in the grid file. In the following example, the data will be divided by 10**5.

```
SCALE FACTOR:  10**5
```

The string COLUMN: signals the beginning of the grid data. If the required grid information has not already been found, an error will result.

The data for the grid follows the grid keywords. The data for a grid is listed from the top (last) row to the bottom row in the grid. The beginning of each row of data must be preceded by the string ROW. Data consists of numeric values for each data point; missing data should be entered as -9999.0.

3.26 GDFILE

GDFILE is the name of the file which contains gridded data.

3.27 GDNUM

GDNUM allows the user to select grids by number.

GDNUM may be specified in the following ways:

GDNUM = range
The first and last grid numbers in the range are separated by a -. If an increment is included, it will be ignored.

GDNUM = list
The grids numbers in the list are be separated using semicolons.

GDNUM = ALL
All the grids in the file will be included.

GDNUM = LIST
All the grids in the file will be listed. The user will be prompted to select the grids to be included.

3.28 GDOUTF

GDOUTF is the output grid data file name.

GDOUTF is used in programs which create a new grid data file. It is also used in programs that move data from an input file to an output file. In that case, GDFILE is the original file.

3.29 GFUNC

See the GPARM documentation.

3.30 GLEVEL

GLEVEL is the vertical level for the grid.

Grids may contain two levels separated by a colon. If the grid to be selected contains only one level, the colon and second level may be omitted. In this case, the second level is stored in the grid file as -1.

Note that the vertical coordinate system for GLEVEL is specified by GVCORD.

The value in GLEVEL may be overridden by specifying @GLEVEL with the grids to be found. For example, the following two computations are identical:

GFUNC = SUB (TMPF@850,TMPF@500)

GFUNC = LDF (TMPF) and GLEVEL = 850:500.

3.31 GNAME

GNAME is the geographic name abbreviation and full name to be saved in the geographic table. These names must be separated with a slash.

The abbreviation may later be input as an area name in AREA or GAREA. The full name will be saved in the table but will not be used.

3.32 GPACK

GPACK is the number of bits and packing type to be used to pack the grid data in the output file. The two values must be separated using a slash.

The valid packing types are:

NONE	No packing
GRIB	Data is packed in GEMPAK GRIB format
DIF	Data is packed in GEMPAK DIF format
DEC	Data is packed in GEMPAK GRIB format.

If the number of bits is 32, the data will be stored as real numbers, using packing type NONE.

If the number of bits is less than 32, the packing type specified will be used. If no packing type is given, the data will be packed using the GEMPAK GRIB scheme.

If the packing type is DEC, the first value is the precision used to pack the data instead of the number of bits.

In general, data should be stored using packing type NONE or in GRIB format using 16 bits. Care should be taken using the other packing schemes.

3.33 GPARM (GFUNC, GVECT)

GFUNC and GVECT are the scalar and vector grid functions. They are input as nested strings of operators and operands. The operand list for an operator is enclosed in parentheses or square brackets, with operands separated by semicolons or commas.

The following grids will be computed automatically from grids in the grid file:

TEMP	DWPC	MIXR*	THTA*	DRCT
TMPC	DWPF	SMXR	STHA	SPED
TMPF	DWPT	RELH*	THTE*	STHE

where * indicates names which may be used as operators also. Other special scalar parameter names denote constant value grids:

DTR	Conversion factor for degrees to radians = PI / 180
E	Base of natural logarithms = 2.71828182
GRAVTY	Gravitational constant = 9.80616 (note spelling)
KAPPA	Gas constant/specific heat = 2/7
PI	3.14159265
RTD	Conversion factor for radians to degrees = 180 / PI
nnn	Any number (e.g., 2, -10.2)

Another class of special parameter names depends on the grid navigation:

CORL	Coriolis force = 2. * OMEGA * SIN (LATR)
LATR	Latitude in radians
LONR	Longitude in radians
XVAL	Value of the x coordinate in graph coordinates
YVAL	Value of the y coordinate in graph coordinates

A grid may be identified by its number in the grid file by prefixing the number with the symbol #, e.g., #5.

Standard vector grids are:

OBS	Observed wind (with conversion, if needed)
GEO*	Geostrophic wind
AGE*	Ageostrophic wind
ISAL*	Isallobaric wind
THRM*	Thermal wind

where * indicates names that also may be used as operators.

Time, level, and vertical coordinate as specified through the user interface may be overridden by in-line parameters:

^time @level %ivcord

appended to an operand in any combination.

Grid operators may be nested. Note that layer and time range operators expect operands read directly from the grid file.

In the following list of diagnostic operators, scalar operands are named Si and vector operands are Vi. Vector components are denoted by u and v. All meteorological grids are in MKS units, except as noted. POL following the description indicates that the computation currently can only be performed on polar (R, THETA) grids. In the trigonometric functions, the angles are expressed in radians.

SCALAR OUTPUT GRID

ABS (S)	Absolute value
ACOS (S)	Arc cosine function
ASIN (S)	Arc sine function
ATAN (S)	Arc tangent function
ATN2 (S1,S2)	Arc tangent function
COS (S)	Cosine function
EXP (S1,S2)	Exponential to real
EXPI (S1,S2)	Exponential to integer [uses NINT(S2)]
LN (S)	Natural logarithm
LOG (S)	Base 10 logarithm
SIN (S1,S2)	Sine function
SQRT (S)	Square root
TAN (S)	Tangent function
ADD (S1,S2)	Addition
MUL (S1,S2)	Multiplication
QUO (S1,S2)	Division
SUB (S1,S2)	Subtraction
ADV (S,V)	Advection
AVG (S1,S2)	Average
AVOR (V)	Absolute vorticity
DDEN (PRES,TMPC)	Density of dry air

DDR (S)	Partial derivative with respect to R (POL)
DDT (S)	Time derivative
DDX (S)	Partial derivative with respect to X
DDY (S)	Partial derivative with respect to Y
DEF (V)	Total deformation
DIRN (V)	Direction relative to north
DIRR (V)	Direction relative to grid
DIV (V)	Divergence
DOT (V1,V2)	Vector dot product
DTH (S)	Partial deriv. with respect to THETA (POL)
FCNT (S)	Coriolis force at grid center (POL)
FRNT (THTA,V)	Frontogenesis
JCBN (S1,S2)	Jacobian determinant
KNTS (S)	Convert meters / second to knots
LAP (S)	Laplacian operator
LAV (S)	Layer average (2 levels)
LDF (S)	Layer difference (2 levels)
MAG (V)	Magnitude of a vector
MASS	Mass per unit volume in a layer from PRES
MDIV (V)	Layer-average mass divergence
MIXR (DWPC,PRES)	Mixing ratio g/g internally, g/kg on output
MSDV (S,V)	Layer-avg. mass-scalar flux divergence
NORM (V)	Normal component (for cross sections)
PLAT (S)	Latitude at each point (POL)
PLON (S)	Longitude at each point (POL)
POLF (S)	Coriolis force at each point (POL)
PVOR (V)	Potential vorticity in a layer
RELH (TEMP,DWPT)	Relative humidity
RICH (V)	Richardson stability number in a layer
ROSS (V1,V2)	Rossby number
SAVG (S)	Average over whole grid
SAVS (S)	Average over subset grid
SDIV (S,V)	Flux divergence of a scalar
SHR (V)	Shearing deformation
SM5S (S)	5-point smoother
STAB (TMPC)	Lapse rate over a layer in K/km
STR (V)	Stretching deformation
TANG (V)	Tangential component (for cross sections)
TAV (S)	Time average
TDF (S)	Time difference
THTA (TMPC,PRES)	Potential temperature
THTE (PRES,TMPC,DWPC)	Equivalent potential temperature
UN (V)	North relative u component
UR (V)	Grid relative u component
VN (V)	North relative v component
VOR (V)	Vorticity
VR (V)	Grid relative v component
XAV (S)	Average along a grid row
XSUM (S)	Sum along a grid row
YAV (S)	Average along a grid column
YSUM (S)	Sum along a grid column

VECTOR OUTPUT GRID

AGE (S)	Ageostrophic wind
CIRC (V,S)	Circulation (for cross section)
GEO (S)	Geostrophic wind
GRAD (S)	Gradient of a scalar
INAD (V1,V2)	Inertial advective wind
ISAL (S)	Isallobaric wind
KNTV (V)	Convert meters/second to knots
LTRN (S,V)	Layer-averaged transport of a scalar
OBS	Observed wind
NRMV (V)	Vector normal wind (for cross sections)
ROT (angle,V)	Coordinate rotation
SMUL (S,V)	Multiply a vector's components by a scalar
SM5V (V)	5-point smoother
TNGV (V)	Vector tangential wind (for cross sections)
THRM (S)	Thermal wind over a layer
VADD (V1,V2)	Add the components of two vectors
VAVE (V)	Average vector over whole grid
VAVS (V)	Average vector over subset grid
VECN (S1,S2)	Create vector from north relative components
VECR (S1,S2)	Create vector from grid relative components
VLAV (V)	Layer average for a vector
VLDF (V)	Layer difference for a vector
VMUL (V1,V2)	Multiply the components of two vectors
VQUO (V1,V2)	Divide the components of two vectors
VSUB (V1,V2)	Subtract the components of two vectors

3.34 GPOINT

GPOINT is the grid location to be used for the plot.

GPOINT can be entered in the following ways:

1. station numeric of character identifier

2. a latitude and longitude pair separated with a semicolon

3. @ followed by a grid x and y coordinate pair separated with a semicolon.

If necessary, the grid data will be interpolated using a bilinear interpolation to the point specified.

Examples:

GPOINT = @1;1.5 Grid point (1,1.5)

GPOINT =	30;-120	Grid point at 30 latitude and -120 longitude
GPOINT =	5;5	Grid point at 5 latitude and 5 longitude. Note that this is probably an error and the input should have been @5;5
GPOINT =	BWI	Point located at Baltimore-Washington International Airport.

3.35 GRDAREA

GRDAREA specifies the area to be covered by the grid. This area is combined with PROJ to define the region over which the grid is evenly spaced.

GRDAREA can be specified in three ways:

1. lat1;lon1;lat2;lon2
   This defines a latitude/longitude range where (lat1, lon1) is the lower left corner and (lat2, lon2) is the upper right corner. West longitude is negative.

   #clat;clon;dlat;dlon
   This defines a latitude/longitude range by the center latitude and longitude. The lower left corner is (clat-dlat; clon-dlon); the upper right corner is (clat+dlat; clon+dlon). No corrections are made for the poles or the International Date Line.

2. GEOG
   This is an abbreviation for a geographic area defined in the GEMPAK geographic table which includes abbreviations for states, provinces and countries, as well as other names. If #GEOG is entered, the user's geographic table, GEOG.TBL, will be searched. *, - after the name may be used to reduce/expand the area.

3. STN
   This defines an area centered on a station found in the GEMPAK station table, which currently contains US and Canadian stations. *, - after the name may be used to reduce/expand the area.

Note that the other ways of specifying AREA are not valid for GRDAREA.

For all projections, the lat/lon corners defined will be used exactly. For projections which include the pole, if lat1 = lat2 and lon1 = lon2, then lat1 will specify the range of data from the pole and lon1 will specify the central longitude. West longitude is negative.

3.36 GRDNAM

GRDNAM is the parameter name for the output grid. If this name is blank, the default name generated by the grid diagnostics package will be used.

3.37 GUESS

GUESS contains the information to use as a first guess for objective analysis programs. The name of the grid file containing the guess field and the time to be used to extract the field must be entered using * as a separator.

3.38 GVCORD

GVCORD is the vertical coordinate of the grid to be selected.

The valid values are:

NONE	for surface data
PRES	data in pressure coordinates (millibars)
THTA	data in isentropic coordinates (Kelvin)
HGHT	data in height coordinates (meters)

The value in GVCORD may be overridden by specifying %GVCORD with the grids to be found. For example,

```
GFUNC = SUB (TMPC@850%PRES,TMPC@1500%HGHT)
```

will compute the difference between temperatures on the 850-mb level and the 1500- meter level.

3.39 GVECT

See the GPARM documentation.

3.40 IDNTYP

IDNTYP is the type of station identifier to use for input or output. The valid values are STID and STNM. STID is used to specify station character identifiers; STNM specifies station numbers.

If the value in IDNTYP is not STNM, the default of STID will be used.

3.41 KXKY

KXKY specifies the size of a grid. Two numbers separated by a semicolon must be input. These numbers are KX, the number of grid points in the x direction, and KY, the number of grid points in the y direction.

If the projection is CED, these numbers may be DELTAX and DELTAY, the grid spacing in degrees in the x and y directions. If the spacing is input, the first character in KXKY must be #.

3.42 LATLON

LATLON specifies the latitude and longitude grid lines to be drawn. The line color, line type, line width, label frequency and increment are separated by slashes. The increment specification contains the latitude and longitude increments in degrees separated by a semicolon.

If the color is 0 or LATLON is blank, grid lines are not drawn. The latitude and longitude increments will default to 10 degrees. The label frequency defaults to 1.

Examples:

LATLON = 1

Lat/lon grid lines are drawn every 10 degrees in color 1 using line type 1 and line width 1.

LATLON = 4/8/3/2/5;5

Lat/lon grid lines are drawn every 5 degrees in color 4 using line type 8 and line width 3. Every other line is labelled.

3.43 LEVELS

LEVELS is the variable specifying vertical levels to be extracted from the data set. The coordinate system for the levels is specified in the variable VCOORD as PRES, HGHT or THTA.

LEVELS may be a list separated by semicolons. The following items may be included in the list:

a single level;
MAN for the mandatory levels below 100 mb;
VAS for the standard VAS levels;
a range of levels with an increment separated by - .

The following items are also valid, provided they are not part of a list:

ALL for all levels;
a range of levels without an increment.

SFC or 0 may be entered for surface data. TOP or -1 is the top level at the station. These values may not be entered for a range with an increment.

3.44 LINE

LINE is the color, line type, line width, and line label freqency separated by slashes. The individual values in each group are separated by semicolons. For example,

```
LINE = 1;2/7;8/4;5/2
```

assigns colors 1 and 2 to alternate lines, dashing patterns 7 and 8 to alternate lines, line widths 4 and 5 to alternate lines, and labels every other line.

If no color is input, the default is color 1. If a color number of 0 is given, no plotting will be done.

A specific color may be assigned to a color number by entering =NAME after the color number. The first three letters in NAME will be used to identify the color in the GEMPAK color table. For example, COLORS=1=red;2=blue, will set color number 1 to red and color number 2 to blue. If the last character in COLORS is a ?, then the current color names will be listed.

If line type or width is zero, the current default will be used. There are ten distinct line types:

```
 1 - solid
 2 - short dashed
 3 - medium dashed
 4 - long dash short dash
 5 - long dash
 6 - long dash three short dashes
 7 - long dash dot
 8 - long dash three dots
 9 - medium dash dot
10 - dotted
```

These patterns can be expanded or compressed by prefixing the single digit with a number from 1 to 9. A prefix of 1 compresses the pattern, 2 is the default and prefixes 3 -- 9 expand the basic pattern. For example, 32 expands line type 2 while 12 compresses the same pattern.

If the line type and line width are entered as more than one number separated by semicolons, then successive lines will have different characteristics corresponding to the different numbers. The pattern established will be repeated to accommodate all lines.

If the label information is a single number, n, then every nth line will be labeled. If a label is a sequence of numbers separated by semicolons, lines corresponding to positive integers will be labeled. The pattern established will be repeated to accommodate all lines.

3.45 LSTALL

LSTALL is a flag indicating whether a full listing of the contents of a file is to be given. For example, in GDINFO, if LSTALL=YES, the grid identifiers will be listed if LSTALL=NO, grid identifiers will not be listed.

3.46 MAP

MAP is the map color, line type and line width separated by slashes.

If the color is 0, the map is not drawn. If the map color, line type, or line width is blank, a default of 1 is used.

3.47 MAPFIL

$MAPFIL is the name of the map file to be used for maps drawn by GEMPAK programs. If no directory is specified, the GEMPLT map files in GEMMAPS will be used.

The map files in GEMMAPS are named by concatenating the resolution, map boundaries, and area with the three-letter source file type. For example, the medium-resolution political world map from GSFC is called MEPOWO.GSF.

RESOLUTION	BOUNDARIES	AREA	SOURCE
HIgh	POlitical	WOrld	GSFc
MEdium	COastline	NW quadrant	WISconsin
LOw	REgional	NE quadrant	
	CouNty	SE quadrant	
		SW quadrant	
		WEst hemisphere	
		North Hemisphere	
		South Hemisphere	
		US	
		MarylanD	

The default map is GEMMAPS:MEPOWO.GSF.

The following map files are currently available:

HICNMD.GSF	MECOWO.WIS	LOCONH.GSF
HICNUS.GSF	MEPOWE.WIS	LOCOSH.GSF
HIPONE.GSF	MEPOWO.GSF	LOCONW.WIS
HIPONW.GSF		LOREWE.WIS
HIPOSE.GSF		
HIPOSW.GSF		
HIPOWO.GSF		

3.48 MARKER

MARKER is the marker color, type, size, line width, and hardware/software flag separated by slashes.

If the marker color is 0, no markers will be drawn. If the marker color is not specified, a default of 1 will be used.

The marker type specifies the shape of the marker to be drawn. If the type is unspecified or zero, the current marker type will be used. The software marker types are:

1	plus sign	9	Z with bar
2	hexagon	10	Y
3	triangle	11	box with diagonals
4	box	12	asterisk
5	small X	13	X with top, bottom bars
6	diamond	14	star
7	up arrow	15	dot
8	X with top bar	16	large X

Hardware marker types may differ.

The marker size is a real number multiplier for the default marker size. If the size is zero or unspecified, the current size will be used.

The hardware/software marker flag must be HW or SW. Otherwise, the current value is assumed.

3.49 MAXGRD

MAXGRD is the maximum number of grids that can be stored in the grid file being created.

3.50 MIXRLN

MIXRLN specifies the color, line type, line width, minimum, maximum, and increment for the background water vapor mixing ratio lines. The values should be separated by slashes. If the color is 0, or MIXRLN is blank, no lines will be drawn.

3.51 MRGDAT

MRGDAT contains a flag indicating whether data is to be merged or unmerged. The type of merged data follows a slash with the default being 3. The valid types are:

1 = mandatory data below 100 mb (TTAA)
2 = mandatory and significant level data below 100 mb (TTAA, TTBB, PPBB)
3 = mandatory and significant level data below and above 100 mb (TTAA, TTBB, PPBB, TTCC, TTDD, PPDD)

If MRGDAT is used to create a sounding file, it indicates whether the file is to contain merged or unmerged data. Unmerged data sets will store the data as separate parts. Merged data sets contain values for each parameter at each level.

If MRGDAT is used in a program to list data, the data will be merged if MRGDAT = YES. If MRGDAT = NO, the separate parts requested by the type will be listed.

3.52 NPASS

NPASS controls the number of passes. Valid values are in the range 1 - 5. Note that two passes are STRONGLY RECOMMENDED.

3.53 NTRACE

NTRACE is the number of traces to be drawn in the meteogram.

If NTRACE is less than 5, the user input in the traces after ntrace will be ignored.

3.54 OLDGRD

OLDGRD is the name of a GEMPAK3 grid file.

3.55 OLDSFC

OLDSFC is the name of a GEMPAK3 surface file.

3.56 OLDSND

OLDSND is the name of a GEMPAK3 sounding file.

3.57 OUTPUT

OUTPUT determines the output devices. The valid devices are the terminal, T, the default printer, P, a file, F, or none, N.

Specify the output devices desired by entering the appropriate letters with no separators.

If output is sent to a file, the file name may be specified after a slash. If no file name is entered, the output will be written to PROGRAM.FIL, where PROGRAM is the name of the program being executed.

If N appears anywhere in the output string other than in the file name, no output will be generated.

3.58 PANEL

PANEL specifies the panel location, panel outline color, line type and width separated with slashes.

The panel location determines the location of the view region on the graphics device. It may be specified using a number or abbreviation as follows:

NUMBER	ABBREVIATION	DESCRIPTION
0	ALL	Entire device
1	UL	Upper left quadrant
2	UR	Upper right quadrant
3	LL	Lower left quadrant
4	LR	Lower right quadrant
5	L	Left half
6	R	Right half
7	T	Top half
8	B	Bottom half

The view region may also be specified as four numbers separated with semicolons, giving the lower left and upper right corners in fractions of the graphics display area. The origin is in the lower left of the display. For example, the lower left quadrant can be given as:

```
0;0;.5;.5
```

If the panel location is unspecified, the current location is unchanged.

The panel outline color, line type and line width specify the values used to draw a box around the view region. If the color is 0 or unspecified, no box is drawn.

3.59 POINTS

POINTS determines the grid points at which the data values will be plotted. The four numbers, start x, start y, increment x and increment y, should be separated with semicolons. If any number is not included, the value 1 will be used. Note that grid point (1,1) is in the lower left hand corner of the grid.

Examples:

POINTS=1 -- A data value will be plotted at every grid point.

POINTS=2;2;2;2 -- The data value will be plotted at grid point (2,2) and at every second grid point in each direction.

3.60 POSN

POSN is the position number to be used to plot the data.

If the position number is 0, the data will be plotted centered at the station.

The other position numbers are:

```
      7
1           3
2     0     4
5           6
      8
```

3.61 PROJ

PROJ is the map projection, projection angles, and margins separated by slashes.

The following simple map projections may be specified:

MER Mercator

NPS	North Polar Stereographic
SPS	South Polar Stereographic
LCC	Northern Hemisphere Lambert Conic Conformal
SCC	Southern Hemisphere Lambert Conic Conformal
CED	Cylindrical Equidistant
MCD	Modified Cylindrical Equidistant
UTM	Universal Transverse Mercator
NOR	North Orthographic
SOR	South Orthographic

For simple map projections, the lower left and upper right corners of the graphics area should be specified in GAREA.

The following full map projections may also be specified:

MER	(CYL)	Mercator
CED	(CYL)	Cylindrical Equidistant
MCD	(CYL)	Modified Cylindrical Equidistant
STR	(AZM)	Polar Stereographic
AED	(AZM)	Azimuthal Equidistant
ORT	(AZM)	Orthographic
LEA	(AZM)	Lambert equal area
GNO	(AZM)	Gnomonic
LCC	(CON)	Northern Hemisphere Lambert Conic Conformal
SCC	(CON)	Southern Hemisphere Lambert Conic Conformal
UTM	(OBM)	Universal Transverse Mercator
TVM	(OBM)	Transverse Mercator

For these projections, GAREA specifies the lower left and upper right corners.

In addition, three angles MUST be specified in PROJ. The angles have the following meanings for the different projection classes:

CYL The angles are not used. A default value for angle2, polon is used.

AZM
```
angle1 -- polat must be +90. or -90.
angle2 -- polon is the central longitude
angle3 -- not used
```

CON
```
angle1 -- standard latitude 1
angle2 -- polon is the central longitude
angle3 -- standard latitude 2
```

OBM
```
angle1 -- tangential longitude
angle2 -- not used
angle3 -- not used
```

The angles for the full map projection types are given as

three numbers separated with semicolons. Note that THREE angles must be entered even if some angles are not used.

There are two satellite projections available:

AOI specifies AOIPS/2 navigation where GAREA is an AOIPS image name

NPG specifies Naval Postgraduate School navigation where GAREA is the base name of NPGS navigation lat/lon files.

If the projection is DEF, the current map projection will be used.

In the grid programs the following graph projections are also available:

LIN	linear x, linear y
LOG	linear x, logarithmic y
KAP	linear x, y ** KAPPA
POL	polar coordinates (R, THETA)

Margins may be input as four numbers separated with semicolons. NM will specify that no margins are to be set.

3.62 PTYPE

PTYPE is the type of y axis plot to be used, the height-to-width ratio of the plot, and the margins, separated by slashes.

The valid inputs for plot type for the y axis are:

LIN	linear
LOG	logarithmic
STUVE	scaled by raising to KAPPA, 2/7, power
KAP	same as STUVE
SKEWT	logarithmic y-axis; skewed x-axis
SKEW	same as SKEWT

If the height-to-width ratio is 0, the entire screen will be used. This is also the default when ratio is not specified.

The margins are specified as: left;bottom;right;top. The values are multiples of the current character size. If the

margin specification is missing or incomplete, a default appropriate to the program will be used. The default in the profile programs is: 10;5;(6 times wind barb);5. The right margin allows room for plotting winds and typically has a value around 20.

3.63 RAOBFL

RAOBFL is the name of the raob data file created by the TRAFIC real-time ingest program. Data from this file will be extracted and written to a GEMPAK sounding file.

3.64 REGION

In GPBOX, REGION may be VIEW, PLOT or DEVICE where:

VIEW corresponds to the view region (includes margins);

PLOT corresponds to the plot region (excludes margins);

DEVICE corresponds to the entire device space.

In OABOX, the region must be GRID, DATA, or EXTEND where:

GRID corresponds to the area over which the objective analysis is performed;

DATA corresponds to the area from which data will be extracted for the objective analysis;

EXTEND corresponds to the extended grid area over which the first pass of the objective analysis is performed.

3.65 RESPOND

$RESPOND is a logical variable indicating whether the user will respond interactively to GEMPAK programs. If set to NO, programs will not wait for input from the user.

RESPND does not appear as a parameter in any program. In order to change RESPND within the TAE, the global variable, $RESPOND must be modified. This can be done either in the GEMGLB tutor or with the TAE command LET in command mode.

In no-TAE mode, simply set $RESPOND to YES or NO in any program.

3.66 SAVFIL

SAVFIL is the name of a file in which graphics from a graphics device can be saved. The graphics can only be saved on a device with readback capability. This file does not save graphics commands as they are executed. Rather, it saves a bitmap of the current graphics screen. GPSAVE can be used to create the file. GPREST will display a file stored using GPSAVE. The only device which currently has this capability is the IIS.

3.67 SCALE

SCALE is the scaling factor for the data. All data will be multiplied by 10 ** SCALE.

If SCALE is not specified, an appropriate scaling will be selected in the grid programs. In the surface and sounding programs, a default of 0 will be used.

If the absolute value of SCALE is greater than 5 in a surface or sounding program, a value of 0 will be used. If the absolute value in a grid program is greater than 20, a default will be computed.

Note that scaling data may create integer overflow problems in programs, such as SFMAP, which round data to the nearest integer. Valid integers must be in the range -2*10**9 to 2*10**9, approximately.

3.68 SEARCH

SEARCH is used to control the search radius in an objective analysis program. The radius is the maximum distance that a station may be from a grid point to be used in the analysis for that point. The search radius will be set so that stations whose weighting factor would be less than EXP(-SEARCH) will not be used. SEARCH must have a value in the range 1 - 50. If the value is outside this range, a default value of 20 will be used. If SEARCH is given a very small value, many grid points will not have three stations within the search area, and consequently will be set to the missing data value.

3.69 SFEFIL

SFEFIL is the name of the surface edit file which will be used to update a surface file.

SFEFIL is a text file which may be created using the program SFLIST with F as an output device. A text editor may be used to create or change the surface edit file.

The parameters to be edited must be specified at the beginning of the surface edit file. For example:

```
PARM = TMPF;DWPF
```

Parameters that have character values, such as WTHR, cannot be edited. Instead, the numeric value must be used, e.g., W604 in the case of WTHR. All the parameters which are to be edited must already exist in the surface data file, since no parameter transformations will be done. Station information, such as latitude, longitude and elevation, cannot be changed with SFEFIL. Use GEMPAK program SFSTNS to update station information in a surface file.

The data follow the parameter list.

Stations and times which do not already exist in the surface data file will be added.

3.70 SFFILE

SFFILE is the name of the surface data file to be accessed.

3.71 SFOUTF

SFOUTF is the output surface data file.

SFOUTF is used in programs which create a new surface data file. It is also used in programs in which data is moved from an input file to an output file, in which case, SFFILE is the original file.

3.72 SFPARM

SFPARM is a list of surface parameters to be used in a surface program.

The four-character parameter names must be separated by semicolons. For example:

SFPARM = TMPF;DWPF;WTHR

If a parameter is not present in a data set, the program will attempt to derive it from those parameters which are present. For example, relative humidity can be computed from the temperature and dewpoint temperature. Note that STHA, STHE, and SMXR are computed from PALT.

Functions can be used to modify/qualify the output parameters. These functions must follow the parameter name and are applied in the order given. The function symbols must precede the qualifying value and are defined as follows:

*	multiply	=	equal to
/	divide	$	direction
+	add	%	vertical coordinate
-	subtract	!	depth
<	less than		
>	greater than		

GEMPAK VARIABLES

The GEMPAK surface parameters and the corresponding four-character abbrevations are:

TEMPERATURE

TMPC - temperature in Celsius
TEMP - temperature in Celsius (alternate name)
TMPF - temperature in Fahrenheit
TMPK - temperature in Kelvin
STHA - surface potential temperature in Kelvin
STHE - surface equivalent potential temperature in Kelvin
TVRK - virtual temperature in Kelvin
TVRC - virtual temperature in Celsius
TVRF - virtual temperature in Fahrenheit
THTV - virtual potential temperature in Kelvin
TMAX - maximum 24-hour temperature in Celsius
TMIN - minimum 24-hour temperature in Celsius
SSTC - sea surface temperature in Celsius
LTMP - surface lifted temperature

MOISTURE

DWPC - dewpoint in Celsius
DWPT - dewpoint in Celsius (alternate name)
DWPF - dewpoint in Fahrenheit
DWPK - dewpoint in Kelvin
DPDC - dewpoint depression Celsius
DPDF - dewpoint depression Farenheit
DPDK - dewpoint depression Kelvin
SMXR - surface mixing ratio in g/kg
SMXS - surface saturated mixing ratio in g/kg
RELH - relative humidity in percent
VAPR - vapor pressure in millibars
VAPS - saturation vapor pressure in millibars

PRESSURE AND ALTIMETER

PMSL - mean sea level pressure in millibars
PALT - pressure in millibars from altimeter
ALTI - altimeter setting in inches of mercury
ALTM - altimeter setting converted to millibars
SALT - abbreviated altimeter in millibars
SMSL - abbreviated mean sea level pressure
SALI - abbreviated ALTI
ZMSL - estimated height at PMSL
Z000 - estimated height at 1000 mbs
Z950 - estimated height at 950 mbs
Z900 - estimated height at 900 mbs
Z850 - estimated height at 850 mbs
Z800 - estimated height at 800 mbs

WIND

UWND - u component of the wind in meters/second
VWND - v component of the wind in meters/second
UKNT - u component of the wind in knots
VKNT - v component of the wind in knots
DRCT - wind direction in degrees
SPED - wind speed in meters/second
SKNT - wind speed in knots
PSPD - packed speed and direction (ddfff) in meters/second
PKNT - packed speed and direction (ddfff) in knots
GUST - wind gusts in knots
GUMS - wind gusts in meters/second

CLOUD

For the following parameters, the character x may be replaced by L, M, or H, indicating low, middle or high clouds. The character T indicates the value of the parameter at the level of maximum cloud coverage.

xCLD - character cloud coverage
TCLD - character maximum cloud coverage
xCLO - fractional cloud coverage
TCLO - fractional maximum cloud coverage
CLCx - numeric cloud coverage
CLCT - numeric maximum cloud cover
CLDS - combined cloud coverage from three levels
CMBC - numeric combined cloud coverage from three levels
CLHx - cloud height in hundreds of feet
CLDx - combined cloud height and coverage
CLDT - maximum value of CLDx
COMx - numeric combined cloud height and coverage
COMT - maximum value of COMx

For the next two cloud parameters the x can be replaced by 1, 2, or 3 and represents the cloud report number.

CHCx - numeric combined cloud height and coverage
CHDx - combined cloud height and short code

The following numeric cloud parameters are WMO standard codes.

CFRC - fraction of celestial dome covered by cloud from WMO Code 2700
CLFR - fraction of celestial dome covered by low or mid clouds from WMO Code 2700
CTYL - low-level cloud genera from WMO Code 0513
CTYM - mid-level cloud genera from WMO Code 0513
CTYH - high-level cloud genera from WMO Code 0513

CBAS - Cloud base height from WMO Code 1000

WEATHER

WTHR - character weather code from any numeric code
WCOD - character weather code
WNUM - numeric weather code
W604 - numeric weather code from the 604 file
WSYM - weather symbol number
WTMO - character weather code from WMO
WWMO - numeric WMO weather code
WASH - Asheville surface data weather code
RWSH - numeric Asheville surface data weather code
PWTH - character past weather in WMO code
PWWM - numeric past weather in WMO code

STATION VARIABLES

STID - character station identifier
STNM - 5-digit station identifier
SLAT - station latitude in degrees
SLON - station longitude in degrees, West is negative
SELV - station elevation in meters

MISCELLANEOUS

VSBY - visibility in statute miles
VSBK - visibility in kilometers
P06I - precipitation over last 6 hours in hundreths of inches
P06M - precipitation over last 6 hours in millimeters
P24I - precipitation over last 24 hours in hundreths of inches
P24M - precipitation over last 24 hours in millimeters
SNOW - snow depth in inches
HAIL - hail flag
HLSZ - hail size in centimeters
WHGT - wave height in meters
WPER - wave period in seconds

SPACING

SPAC - plot a space, accounted for in FILTER
BLNK - plot a blank, not accounted for in FILTER

3.73 SFPRMF

SFPRMF is the name of the surface parameter packing file or the information itself entered as follows:

SFPRMF=PRM1/MIN1-MAX1-RES1;PRM2/MIN2-MAX2-RES2; ...

where PRMn is the parameter name, MINn is the minimum for PRMn, MAXn is the maximum for PRMn, and RESn is the resolution. These entries are the same as those placed in a packing file as described below. If the data are not to be packed, the list of parameter names separated by semicolons can be entered: SFPRMF = PRM1;PRM2;...

IF SFPRMF specifies a file name, then each line of the file must contain the following information separated by blanks or tabs:

parameter name	CHAR*4
minimum data value	REAL
maximum data value	REAL
resolution	REAL

The resolution should be an integral power of 10; otherwise the next smaller resolution will be used. For example, res = .5 will become .1.

If the data are not to be packed, the minimum and maximum data values and the resolution should not be included. Note that either all of the parameters or none of them must have packing information.

GEMTABL:SFPACK.TBL is a typical table used to pack surface data. This file may be used as an example when creating a packing file.

3.74 SHIPFL

SHIPFL is a logical parameter which indicates that the surface file contains stations which are not at a fixed location, such as moving ships, aircraft, or floating buoys.

A ship file will store and write data differently from a standard GEMPAK surface file. However, these files can be read using the surface library and all programs which access data in surface files can be used unchanged.

Note that station information cannot be added to these files, since the station information must be stored with the data.

3.75 SKPMIS

SKPMIS is a logical flag which indicates whether non-reporting stations will be listed.

If SKPMIS is YES, nonreporting stations will not be listed. Otherwise, all stations will be listed.

In SFMAP, markers can be plotted at nonreporting stations when SKPMIS is NO.

3.76 SNEFIL

SNEFIL is the name of the sounding edit file which will be used to update a sounding file.

SNEFIL is a text file which may be created using the program SNLIST with F as an output device. A text editor may be used to create or change the edit file.

The parameters to be edited must be specified at the beginning of the edit file. For example:

```
SNPARM = PRES;TMPF;DWPF
```

If the output sounding file exists, the data set parameters must be the same as those listed in the edit file. Station information, such as latitude, longitude, and elevation, cannot be changed with SNEFIL. Use GEMPAK program SNSTNS to update station information in a sounding file.

If the file does not exist, a new, unpacked file with these parameters will be created.

The data follows the parameter list. Only level data will be added to the file. Stability indices from STNDEX will be ignored.

Stations and times which do not already exist in the surface data file will be added.

3.77 SNFILE

SNFILE is the filename for an upper air data set.

3.78 SNOUTF

SNOUTF is the output sounding data file.

SNOUTF is used in programs which create a new sounding data file. It is also used in programs in which data is moved from an input file to an output file, in which case SNFILE is the original file.

3.79 SNPARM

SNPARM is a list of upper air parameters to be used in an upper air program.

The four-character parameter names must be separated by semicolons. For example:

SNPARM = PRES;TMPC;DWPC;THTA

If a parameter is not present in a data set, the program will attempt to derive it from those parameters which are present. For example, if pressure, temperature and dewpoint are present in a data set, then relative humidity can be derived.

The layer parameters are computed over a default layer between the specified level and the next level upward in the sounding. The depth of the layer for layer averages may be specified preceded by ! in the user input. The shear and RICH calculations can be done relative to a direction by specifing the direction preceded by $ in the user input.

In-line functions can be use to modify/qualify the output parameters. These functions are applied in the order given. The function symbols must precede the qualifying value and are defined as follows:

*	multiply	=	equal to
/	divide	$	direction
+	add	%	vertical coordinate
-	subtract	!	depth
<	less than		
>	greater than		

The following page lists the GEMPAK sounding parameters and the corresponding four-character abbrevations.

TEMPERATURES

TMPC - temperature in Celsius
TEMP - temperature in Celsius (alternate name)
TMPF - temperature in Fahrenheit
TMPK - temperature in Kelvin
THTA - potential temperature in Kelvin
THTV - virtual potential temperature in Kelvin
TVRK - virtual temperature in Kelvin
TVRC - virtual temperature in Celsius
TVRF - virtual temperature in Fahrenheit

MOISTURE PARAMETERS

DWPC - dewpoint in Celsius
DWPT - dewpoint in Celsius (alternate name)
DWPF - dewpoint in Fahrenheit
DWPK - dewpoint in Kelvin
DPDC - dewpoint depression Celsius
DPDF - dewpoint depression Farenheit
DPDK - dewpoint depression Kelvin
MIXR - mixing ratio in g/kg
MIXS - saturation mixing ratio in g/kg
PWTR - precipitable water in mm
RELH - relative humidity in percent
THTE - equivalent potential temperature in Kelvin
VAPR - vapor pressure in millibars
VAPS - saturation vapor pressure in millibars
LHVP - latent heat of vaporization in J/kg

HEIGHT

HGHT - height in meters
HGTM - height in meters (alternate name)
HGTK - height in kilometers
HGTD - height in dekameters
HGFT - height in feet
HGFH - height in hundreds of feet
HGFK - height in thousands of feet

HGML - height in miles
STDZ - standard height convention used on upper air charts
DHGT - dry hydrostatic height in meters
MHGT - moist hydrostatic height in meters

PRESSURE AND ALTIMETER

PRES - station pressure in millibars
PMSL - mean sea level pressure in millibars
ALTI - altimeter setting in inches from PRES

WINDS

UWND - u component of the wind in meters/second
VWND - v component of the wind in meters/second
UKNT - u component of the wind in knots
VKNT - v component of the wind in knots
DRCT - wind direction in degrees
SPED - wind speed in meters/second
SKNT - wind speed in knots
PSPD - packed speed and direction (ddfff) in meters/second
PKNT - packed speed and direction (ddfff) in knots
WCMP - wind component toward a specific direction
WNML - wind component toward 90 deg from a specific direction

LIFTED CONDENSATION LEVEL

LCLT - temperature in Kelvin of parcel raised to LCL
LCLP - pressure in millibars of parcel raised to LCL

STABILITY INDICES

Note: Default depths are enclosed in parentheses.

SHOW - Showalter Index
LIFT - Lifted Index (100 mb)
SWET - Sweat Index
KINX - K Index
CTOT - Cross Totals Index
VTOT - Vertical Totals Index
TOTL - Total Totals Index
CAPE - Convective Available Potential Energy (500 m)
CINS - Convective Inhibition (500 m)
EQLV - Equilibrium Level
LFCV - Level of Free Convection
BRCH - Bulk Richardson Number (500 m, 6000 m)
MLTH - Mixed layer mean potential temperature (500 m)
MLMR - Mixed layer mean mixing ratio (500 m)

LAYER QUANTITIES

GEMPAK VARIABLES

Note: Default depths are the layer depths in the sounding except for SEPA for which the layer depth is 5 K.

RICH - Richardson number
BVFQ - Brunt-Vaisala frequency
BVSQ - Brunt-Vaisala frequency squared
BVPD - Brunt-Vaisala frequency
LAPS - Temperature lapse rate
STAB - Potential temperature lapse rate
STAP - Stability with respect to pressure in k/mb
SHRM - Wind shear magnitude
SHRD - Wind shear direction
SEPA - Vertical separation in mb between isentropes

STATION VARIABLES

STID - character station identifier
STNM - 5-digit station identifier
SLAT - station latitude in degrees
SLON - station longitude in degrees, West is negative
SELV - station elevation in meters
RANG - range (specialized data)
AZIM - azimuth (specialized data)
LATI - latitude in degrees
LONG - longitude in degrees, West is negative
DELT - delta time (specialized data)

MISCELLANEOUS

DDEN - density of dry air in kg/(m**3)
PSYM - Montgomery stream function

SPACING

SPAC - plot a space, accounted for in FILTER
BLNK - plot a blank, not accounted for in FILTER

3.80 SNPRMF

SNPRMF is the name of the sounding parameter packing file or the information itself entered as follows:

PRM1/MIN1-MAX1-RES1;PRM2/MIN2-MAX2-RES2; ...

where PRMn is the parameter name, MINn is the minimum for PRMn, MAXn is the maximum for PRMn, and RESn is the resolution. These entries are the same as those placed in a

packing file as described below. If the data are not to be packed, the list of parameter names separated by semicolons can be entered: SNPRMF = PRM1;PRM2;...

IF SNPRMF specifies a file name, then each line of the file must contain the following information separated by blanks or tabs:

parameter name	CHAR*4
minimum data value	REAL
maximum data value	REAL
resolution	REAL

The resolution should be an integral power of 10; otherwise the next smaller resolution will be used (e.g., res = .5 will become .1).

If the data are not to be packed, the minimum and maximum data values and the resolution should not be included. Note that either all of the parameters or none of them must have packing information.

GEMTABL:SNPACK.TBL is a typical table used to pack surface data. This file may be used as an example when creating a packing file.

Note that if MRGDAT is NO, the data will be packed using the standard packing for unmerged data, and the value of SNPRMF will be ignored.

3.81 SOURCE

SOURCE indicates whether the data used to compute the average station spacing are to be read from a surface or sounding file. Use SF to read from a surface file and SN to read from a sounding file.

3.82 STATION

STATION is the station to use in the meteogram program. Either a station identifier or station number may be entered.

If a single station is entered, all traces will use data from that station. If a list of stations is entered, trace 1 will be for station 1, trace 2 for station 2, ... Stations in the list must be separated using semicolons.

3.83 STNCOL

STNCOL specifies the color for the station identifier, time and the parameters specified in STNDEX. These parameters are written at the top of the plot.

3.84 STNDEX

STNDEX is the list of stability indices or station parameters for upper air data. The items in the list must be separated using semicolons. The depth for the layer averages may be specified preceded by a ! in the user input. For example, BRCH!1000!8000 instructs the program to average over a mixed layer 1000 meters deep and lower tropospheric layer 8000 meters deep. Similarly MLTH!750 results in an average potential temperature over a mixed layer 750 meters deep while the default is 500 meters.

The following is a list of valid names:

CTOT	Cross totals index
KINX	K index
LIFT	Lifted index
SHOW	Showalter index
SWET	SWEAT index
TOTL	Total totals index
VTOT	Vertical totals index
CAPE	Convective Available Potential Energy
CINS	Convective Inhibition
EQLV	Equilibrium Level
LFCV	Level of Free Convection
BRCH	Bulk Richardson Number
LCLT	Temperature in Kelvin of the LCL
LCLP	Pressure in millibars of the LCL
MLTH	Mean mixed layer potential temperature
MLMR	Mean mixed layer mixing ratio
STID	Station identifier
STNM	Station number

SLAT	Station latitude
SLON	Station longitude
SELV	Station elevation

3.85 STNFIL

STNFIL is the name of a station file which contains station information. This includes the character identifier, number, name, state, country, latitude, longitude and elevation for each station.

All this information, except the station name, is stored as station header information in surface and sounding data files.

The file GEMTABL:SFSTNS.TBL is a surface station table containing US and Canadian stations. GEMTABL:SNSTNS.TBL is an upper air table for the Northwest quadrant.

Information in the files must be stored using the exact format used in current tables, since they are read with a FORTRAN FORMAT statement. They may be changed using a text editor.

3.86 TAXIS

TAXIS contains the range, increment and location for labels on a time axis input as:

START-STOP-INC;LB;GL;TM

START and STOP are GEMPAK date/times which may be abbreviated. If the values are omitted, the data range will be used. The time axis will be reversed if the TAXIS specification begins with R or if the times are input with a later time first.

INC is the time increment in hours and minutes. The form for INC is HHHMM. If one or two digits are entered, hours will be assumed. If INC is omitted, a default appropriate for the range will be used. If the time range exceeds 720 days, the increment is ignored, and an appropriate

labeling interval is selected automatically.

LB, GL, and TM are the frequencies for labels, grid lines, and tick marks.

Examples:

5/12-6/18-6	Draw the axis from 5/12 to 6/18 with labels at 6-hour increments.

3.87 TEXT

TEXT is the size, font, text width and hardware/software flag for graphics text separated with slashes.

The size is a real number multiplier for the default text size. If the size is zero or unspecified, the current size will be used.

The text width is the integer line width to be used in generating software text. If the text size, font or width is not specified, the current value is used.

The hardware/software selector must be HW or SW to change to hardware- or software-generated text.

Examples:

TEXT = 1/2//HW -- text size = 1, hardware text font 2

TEXT = 2.5 -- text size = 2.5, current text font

3.88 THTALN

THTALN specifies the color, line type, line width, minimum, maximum, and increment for the background dry adiabats (potential temperature lines). The values should be separated by slashes. If THTALN is blank, no lines will be drawn.

3.89 THTELN

THTELN specifies the color, line type, line width, minimum, maximum, and increment for the background moist adiabats (equivalent potential temperature lines). The values must be separated by slashes. If THTELN is blank, no lines will be drawn.

3.90 TIMSTN

TIMSTN contains the maximum number of times to include in a file and the number of stations to be included in addition to the stations in STNFIL.

3.91 TITLE

TITLE is the title color, title line, and title string separated by slashes.

If the title color is 0, a title is not plotted.

The title line specifies the line on which the title will be written. If the line is not specified, a default of 0 will be used. The value of the title line has the following meanings:

0	bottom line
-n	n lines from bottom
+n	n lines from top

The title string is the title to be written. If no title string is specified, a default title will be determined by the program.

3.92 TRACE

The TRACE parameters contain specifications for each trace on the meteogram in the following format:

parameters/colors/range/witnes!parameters/colors/range/witnes

The parameters before the ! will be plotted on the left of the plot; those after the ! will be plotted on the right. The parameters may be any GEMPAK surface parameter. Real valued parameters will be drawn as a graph. Character valued parameters will be rotated 90 degrees and written on the plot. In addition to the standard surface parameters, the following are also valid:

BARB	--	wind barbs
ARRW	--	wind arrows
DARR	--	directional arrows
WSYM	--	weather symbols

For GUST and GUMS, the character G will be plotted. Up to four parameters may be plotted along each axis. The parameters must be separated using semicolons. Character and weather symbol data may only be plotted in positions 1, 2 or 3.

Each parameter name may be followed by an asterisk, the size or line type, a second asterisk and the width. For example, WSYM*.5*5 will draw weather symbols half the default size with a line width of 5. TMPF*3 will plot a temperature line using dash pattern 3.

The colors for the parameters must also be separated using semicolons. If a single number is entered, all parameters are drawn in that color. If a zero is entered, the current default color is used.

The range specifies the scaling of the y axis. The format is: start;stop;increment. Note that in this program, the parts of range must be separated using semicolons. If no range is given, it is selected using the data values.

Witness lines are specified in witnes. These are horizontal dotted lines. A list of y values may be entered separated by semicolons. If the value of witnes is YES, a witness line will be centered on the plot.

3.93 TRACE1

See the TRACE documentation.

3.94 TRACE2

See the TRACE documentation.

3.95 TRACE3

See the TRACE documentation.

3.96 TRACE4

See the TRACE documentation.

3.97 TRACE5

See the TRACE documentation.

3.98 VCOORD

VCOORD specifies the vertical coordinate system of the levels to process. There are four coordinates:

NONE - surface data only
PRES - pressure
THTA - theta (isentropic)
HGHT - height

A list or range of levels will be based on the vertical coordinate type, with the exception of MAN or VAS which always refer to a pressure coordinate system.

Note that data are ignored within superadiabatic layers found working upwards from the surface when interpolations are performed to isentropic coordinates.

3.99 WIND

WIND specifies the wind symbol, size, width, type, and head size separated by slashes.

The wind symbol contains a letter for symbol type, a letter for symbol units and a color number with no separators. The character meanings are:

TYPE	B = BARB	A = ARROW
UNITS	K = KNOTS	M = Meters/sec
COLOR	Color number	0 = no wind plotted

The default is BM1, i.e., barbs in meters/sec plotted in color number 1. If a partial specification is given, the remaining characteristics will be taken from the default.

The wind size is a real number which will be used as a multiplier for the default wind symbol size. If this number is negative, zero, or missing, the current size will be used. The sizes for barbs and arrows are independent.

The wind type defines the arrow or barb type to be used. If the wind type is equal to 1, calm winds are plotted. If the wind type is 2, calm winds will not be plotted.

The head size is a real valued multiplier used for the length of the arrow head. This variable is not used for wind barbs.

Note that the units will be ignored in GDWIND. In that program, the units are determined by the vector requested in GVECT.

3.100 WINPOS

WINPOS specifies the position for plotting winds. Up to three separate wind profiles may be plotted. The stability indices will also be positioned at the top of the plot according to WINPOS. Position 1 is the leftmost position. The value of WINPOS will be incremented modulo 3 until the screen is cleared or the program is run again.

3.101 XAXIS

XAXIS contains the left bound, right bound, label increment, and frequency information separated by slashes in the form:

```
left/right/increment/lbfq;gdfq;tkfq
```

The frequencies for labels, grid lines, and tick marks follow the last slash and are separated with semicolons. Appropriate defaults are provided if values are not specified. If the increment is positive, all the label values will be divisible by the increment. If it is negative, the label values will begin with the left value and be separated by the increment. The bounds and increment are for the scaled data.

3.102 YAXIS

YAXIS contains the lower bound, upper bound, label increment, and frequency information separated by slashes in the form:

```
lower/upper/increment/lbfq;gdfq;tkfq
```

The frequencies for labels, grid lines, and tick marks follow the last slash and are separated with semicolons. If the increment is positive, all the label values will be divisible by the increment. If it is negative, the label values will begin with the lower value and be separated by the increment. The bounds and increment are for the scaled data.

Defaults will be supplied if no specification is given.

The following defaults will be used when appropriate:

vcoord	lower	upper	defaults
PRES	1020	100	Mandatory levels
THTA	270	400	10
HGHT	0	20000	1000

CHAPTER 4

GEMPAK PROGRAMS

This chapter contains documentation on all the GEMPAK programs.

4.1 PROGRAM GDCFIL

GDCFIL creates a GEMPAK grid file.

INPUT PARAMETERS

GDOUTF	*Output grid file
PROJ	*Map projection/angles/margins
GRDAREA	*Area covered by grid
KXKY	*Number of grid points in x;y
MAXGRD	*Maximum number of grids
CPYFIL	*File to be copied
ANLYSS	*Grid analysis block

PROGRAM DESCRIPTION

This program creates a GEMPAK grid file. Information about the file to be created is received from the user, from the grid navigation table, or from another grid file.

Each grid file must contain navigation information. It must also contain analysis block information which is used when an objective analysis program writes to the grid file.

If the value in CPYFIL begins with a #, the rest of the string specifies a grid number or name to be found in the grid navigation table. This table currently contains the following grid names and numbers:

LFM	26
NGMC	101
SFUS	301
SFWV	302
SNUS	311
SNWV	312

Any other non-blank entry in CPYFIL is taken as the name of an existing grid file, whose navigation and analysis blocks will be copied to the new grid file.

If CPYFIL is blank, the navigation and analysis information will be obtained from PROJ, GRDAREA, KXKY, and ANLYSS. KXKY must contain the number of points in the x and y directions. The two integers must be separated with a semicolon. If the grid projection type specified in PROJ is CED, the grid spacing consisting of deltax and deltay may be entered in KXKY by prefixing the numbers with a #. Deltax and deltay

are in degrees longitude and degrees latitude, respectively. The analysis information must contain deltan, which is the station spacing, and the extend area separated by a slash. The extend area is four integers separated by semicolons. If ANLYSS is blank, default values will be assigned. If there is no analysis block in the file to be copied, ANLYSS is used to create one.

MAXGRD is the maximum number of grids which will be allowed in the grid file.

EXAMPLES:

1. Create a grid file called LFM.GRD from the information in the grid navigation table, allowing up to 100 grids in the file. PROJ, GRDAREA and KXKY are ignored since this information will be obtained from the grid navigation table.

```
GDOUTF  = lfm.grd
PROJ    =
GRDAREA =
KXKY    =
MAXGRD  = 100
CPYFIL  = #lfm
ANLYSS  =
```

2. Create a grid file called SOUND.GRD with a maximum of 15 grids. The grid dimensions are 20 by 30; the area is US with a Mercator projection. The station spacing is 5 degrees of latitude and the grid extension for objective analysis is 3 grid points.

```
GDOUTF  = sound.grd
PROJ    = mer
GRDAREA = us
KXKY    = 20;30
MAXGRD  = 15
CPYFIL  =
ANLYSS  = 5/3;3;3;3
```

3. Create a file for evenly spaced lat/lon grids over area IL- using a grid spacing of .75 degrees in each direction. Compute reasonable values for the analysis block.

```
GDOUTF  = il.grd
PROJ    = ced
GRDAREA = il-
KXKY    = #.75;.75
MAXGRD  = 100
```

```
CPYFIL  =
ANLYSS  =
```

4. Create a grid file called NEW.GRD from the information within grid file OLD.GRD .

```
GDOUTF  = new.grd
PROJ    =
GRDAREA =
KXKY    =
MAXGRD  = 100
CPYFIL  = old.grd
ANLYSS  =
```

ERROR MESSAGES

```
[GDCFIL  -1]    Fatal error initializing TAE.
[GDCFIL  -2]    Fatal error reading TAE parameters.
[GDCFIL  -3]    Fatal error initializing GEMPLT.
[GDCFIL  -4]    Invalid navigation.
[GDCFIL  -5]    Grid area ... is invalid.
[GDCFIL  -6]    Invalid grid size.
[GDCFIL  -7]    The grid file name may not be blank.
[GDCFIL  -8]    Error reading table.
[GDCFIL  -9]    Grid name ... cannot be found in grid table.
[GDCFIL -10]    Invalid extend region.  Try 0;0;0;0.
```

4.2 PROGRAM GDCNTR

GDCNTR draws contour lines through a gridded scalar field.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GDFILE	*Grid file
PROJ	*Map projection/angles/margins
GAREA	*Graphics area
LINE	*Line color/dash/width/label
CINT	*Contour interval/min/max
SCALE	*Scaling factor
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
TITLE	*Title color/line/title
DEVICE	*Graphics device
PANEL	*Panel location/color/dash/width
CLEAR	*Clear screen flag
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

GDCNTR draws contour lines through a scalar grid computed using the GEMPAK grid diagnostic functions.

The attributes of the contour lines, including the color, line type, line width, and label frequency are specified in LINE. The four attributes are separated with slashes; semicolons separate the values for each attribute. If the line type is set to a single negative number, negative contour values will have the absolute value of the line type and positive values will be solid. If the label type is set to a single number, n, then every nth value will be labeled.

Note that color components may be set by appending = NAME to a color number. For example, 1=PURPLE will set color number 1 to purple.

Using the variable, CINT, the contour interval, minimum value, and maximum value may be entered. A scaling factor may be entered in SCALE. The data in the grid file will be multiplied by 10 ** SCALE. If no contour interval is entered, a default value which will generate 5 to 10 contour lines will be

selected. The scaling will be done before the contour interval is computed.

A map, lat/lon grid, and title may also be included.

EXAMPLES

1. Draw contours every 4 degrees through the 850-mb temperature field for the 24-h forecast time. Negative values will be dashed using line type 3; every other contour line will be labeled; all the contour lines will be drawn in color number 1. The graphics area will be centered on Colorado. The contours are drawn on a clear screen with a dotted map, dotted lat/lon lines every 5 degrees and no title.

```
GDATTIM  =  f24
GLEVEL   =  850
GVCORD   =  pres
GFUNC    =  temp
GDFILE   =  ngm.grd
PROJ     =  mer
GAREA    =  co
LINE     =  1/-3/1/2
CINT     =  4
SCALE    =
MAP      =  1/10
LATLON   =  1/10/1/1/5;5
TITLE    =  0
DEVICE   =  vt
PANEL    =  0
CLEAR    =  yes
TEXT     =
```

2. Using the values of the variables supplied above, the dewpoint lines are to be drawn without erasing the temperature lines. The contour interval is set to 5. The lines should all be drawn in green using color number 2, with labeling and line types as above. Only parameters which must be changed from the above definitions are shown.

```
GFUNC    =  dwpt
LINE     =  2=green/-3/1/2
CINT     =  5
CLEAR    =  no
MAP      =  0
LATLON   =  0
```

3. Now clear the screen, scale the data by 10**5, draw contour lines of the divergence of the observed wind,

alternating between colors 3 and 7. Use a default contour interval. Use heavy solid lines, labeling every contour line.

```
GFUNC     =  div (obs)
CLEAR     =  yes
SCALE     =  5
CINT      =
LINE      =  3;7/1/7/1
MAP       =  1
```

ERROR MESSAGES

[GDCNTR +1]	WARNING. There are no contour levels.
[GDCNTR -1]	Fatal error initializing TAE.
[GDCNTR -2]	Fatal error reading TAE parameters.
[GDCNTR -3]	Fatal error initializing GEMPLT.
[GDCNTR -4]	Grid requested is not available.
[GDCNTR -5]	Error setting grid navigation for file ....
[GDCNTR -6]	There are no grids in grid file.

4.3 PROGRAM GDCNVRT

GDCNVRT converts GEMPAK3 grid files to new grid files.

INPUT PARAMETERS

OLDGRD	*GEMPAK3 grid file
GDOUTF	*Output grid file
MAXGRD	*Maximum number of grids

PROGRAM DESCRIPTION

GDCNVRT converts GEMPAK3 grid files to the new GEMPAK format. It is necessary to use this program since the GEMPAK programs are incompatible with GEMPAK3 files.

Note that GEMPAK4 grid files do not need to be converted to be used in GEMPAK5 programs. However, because grid packing options have been added, GEMPAK5 grids cannot be used in GEMPAK4 programs.

MAXGRD is the maximum number of grids that can be stored in the new file. If MAXGRD is less than the number of grids in OLDGRD, the new file will be created with MAXGRD equal to the number of grids in OLDGRD.

EXAMPLES

1. Convert the GEMPAK3 grid file, SFC.GRD to the new GEMPAK grid file, NEWSFC.GRD, which can contain a maximum of 500 grids.

```
OLDGRD = sfc.grd
GDOUTF = newsfc.grd
MAXGRD = 500
```

ERROR MESSAGES

[GDCNVRT -1]	Fatal error initializing TAE.
[GDCNVRT -2]	Fatal error reading TAE parameters.
[GDCNVRT -3]	Old file ... cannot be opened.
[GDCNVRT -4]	New file ... cannot be created.

4.4 PROGRAM GDCROSS

GDCROSS draws vertical cross sections through a grid.

INPUT PARAMETERS

CXSTNS	*Cross-section station line
GDATTIM	*Grid date/time
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GVECT	*Grid vector function
WIND	*Wind symbol/siz/wdth/typ/hdsz
GDFILE	*Grid file
PTYPE	*Plot type/h:w ratio/margins
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
CINT	*Contour interval/min/max
SCALE	*Scaling factor
LINE	*Line color/dash/width/label
BORDER	*Background color/dash/width
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
DEVICE	*Graphics device
TEXT	*Text size/font/hw flag
PANEL	*Panel location/color/dash/width

PROGRAM DESCRIPTION

GDCROSS draws a vertical cross section between two points in a grid field. The cross-section path is a line segment on the grid projection plane joining the two points. Gridded data are interpolated to the cross-section plane at intervals corresponding to approximately one grid increment.

CXSTNS specifies the cross-section end points which must be separated by a >. Endpoints may be entered as grid coordinates separated by a semicolon and preceded with an @. Latitude and longitude specifications must be separated with a semicolon. Stations may be entered using either character identifiers or station numbers.

The vertical coordinate, set in GVCORD, can be PRES, THTA, or HGHT. The vertical axis scaling, set in PTYPE, can be LIN, LOG, KAP or STUVE. STUVE and KAP are the same; SKEWT may not be entered. The plot aspect ratio and margins may also be entered in PTYPE.

Both scalar and vector fields can be displayed in the cross-

section plane. Contour lines are drawn through the scalar field. Vector fields are depicted using arrows or barbs.

Circulations can be displayed in the cross-section plane by specifying GFUNC = CIRC (V, W), where V is a vector field and W is the scalar vertical motion in the GVCORD coordinate. The horizontal component of the circulation is the tangential component of V. The vertical component is W scaled up to account for the exaggerated aspect ratio of the display relative to that of the real atmosphere. For the CIRC operator, W is assumed to be pressure velocity in mb/s for PRES and THTA coordinates and cm/s for the HGHT coordinate. If the vertical component does not require scaling, the circulation can be specified explicitly in the form GVECT = VECR (TANG (V), W)/VERT, where VERT is a flag indicating that the vector components are not to be north relative.

EXAMPLES

1. Plot temperature in Celsius on a log P chart along the cross section from BWI to LAX. Plot the contours in color number 2, using thick, solid lines. Plot wind barbs for the observed wind. Plot the chart to 50 millibars using the default labels. Accept default values for the other parameters.

```
CXSTNS   =  bwi>lax
GDATTIM  =  last
GVCORD   =  pres
GFUNC    =  temp
GVECT    =  obs
WIND     =  bm1
GDFILE   =  ngm.grd
PTYPE    =  log
YAXIS    =  /50
CINT     =
SCALE    =
LINE     =  2/1/7
BORDER   =
TITLE    =
CLEAR    =  yes
DEVICE   =  qm
TEXT     =
PANEL    =
```

2. Now, using the same file, plot a log pressure cross section of the vorticity advection, scaled by 10**5. Also, plot the ageostrophic circulation using arrows.

```
Use a cross-section line from grid point (1,1) to grid
point (10,20).  Use a height-to-width plot ratio of 2.

GFUNC   =  adv(avor(obs);obs)
GVECT   =  circ(age;omeg)
GPOINT  =  @1;1>10;20
PTYPE   =  log/2
SCALE   =  5
WIND    =  am1
```

ERROR MESSAGES

```
[GDCROSS  +2]  Surface value of GVCORD is not available.
[GDCROSS  +1]  WARNING.  There are no contour levels.
[GDCROSS  -1]  Fatal error initializing TAE.
[GDCROSS  -2]  Fatal error reading TAE parameters.
[GDCROSS  -3]  Fatal error initializing GEMPLT.
[GDCROSS  -4]  Input for CXSTNS is invalid.
[GDCROSS  -5]  Input for GDATTIM is invalid.
[GDCROSS  -6]  Input for GVCORD is invalid.
[GDCROSS  -7]  Input for PTYPE is invalid.
[GDCROSS  -8]  Error defining graph coordinates.
[GDCROSS  -9]  No points found for cross section.
[GDCROSS -10]  LIN is not possible for this vertical coordinate.
[GDCROSS -11]  Invalid cross-section coordinates.
[GDCROSS -12]  No levels--check input for GDATTIM and GVCORD.
[GDCROSS -13]  @LEVEL in-line parameter is not allowed.
[GDCROSS -14]  %VCORD in-line parameter is not allowed.
[GDCROSS -18]  GVECT cannot be evaluated.
[GDCROSS -19]  GFUNC cannot be evaluated.
[GDCROSS -20]  Input for YAXIS is invalid.
```

4.5 PROGRAM GDDELT

GDDELT deletes grids from GEMPAK grid files.

INPUT PARAMETERS

GDFILE	*Grid file
GDNUM	*Grid numbers

PROGRAM DESCRIPTION

GDDELT deletes grids from GEMPAK grid files.

The variable GDNUM allows the user to specify the grids to be deleted. GDNUM can be either a range of grid numbers or a list of individual grids. If GDNUM = ALL, all the grids in the file will be deleted. If GDNUM = LIST, all the grids in the file will be listed and the user will be prompted to select the grids to be deleted. Note that if some grids are deleted, the grid numbers for the remaining grids may change.

EXAMPLES

1. Delete grids 3, 4, and 5 from a grid file.

   ```
   GDFILE  = ngm.grd
   GDNUM   = 3-5
   ```

2. Delete grids 3, 6, and 8 from SFC.GRD.

   ```
   GDNUM   = 3;6;8
   GDFILE  = sfc.grd
   ```

3. Delete all the grids from the file TODAY.GRD.

   ```
   GDNUM   = all
   GDFILE  = today.grd
   ```

ERROR MESSAGES

[GDDELT -1]	Fatal error initializing TAE.
[GDDELT -2]	Fatal error reading TAE parameters.
[GDDELT -3]	Invalid grid range entered.
[GDDELT -4]	Grid number ... is invalid.

```
[GDDELT   -5]    There are no grids in file ....
[GDDELT   -6]    No valid grids in list.
```

4.6 PROGRAM GDDIAG

GDDIAG computes a scalar diagnostic grid and adds it to the grid file.

INPUT PARAMETERS

GDFILE	*Grid file
GDOUTF	*Output grid file
GFUNC	*Grid function
GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GRDNAM	*Output parameter name
GPACK	*Number of bits/packing type

PROGRAM DESCRIPTION

GDDIAG computes a diagnostic grid and saves the result in a GEMPAK grid file.

The input grids for the computation must be in GDFILE. The resulting grid is added to the output file, GDOUTF. The input and output files may be the same.

The name of the output grid is given in GRDNAM. If this value is blank, the name generated by the grid diagnostic package will be used. GPACK defines grid packing. If GPACK is blank, no packing will be done. Grid packing details are documented in the GPACK variable documentation.

EXAMPLES

1. Compute the divergence of the observed wind at 850 mb from the 48-h forecast for the last model run and save the result in MYFILE.GRD. Use the default name for the grid. Do not pack the grid.

GDFILE	=	ngm.grd
GDOUTF	=	myfile.grd
GFUNC	=	div [obs]
GDATTIM	=	f48
GLEVEL	=	850
GVCORD	=	pres
GRDNAM	=	

```
GPACK    =
```

2. Compute the magnitude of the gradient of the dewpoint depression at 500 mb for the last time in the grid file and store the result in the input file. Name the output grid DEWGRAD. Use GRIB packing with 16 bits per grid point.

```
GDFILE   = ngm.grd
GDOUTF   = ngm.grd
GFUNC    = mag ( grad ( sub (temp,dwpt) ) )
GDATTIM  = last
GLEVEL   = 500
GVCORD   = pres
GRDNAM   = dewgrad
GPACK    = 16/grib
```

ERROR MESSAGES

```
[GDDIAG  -1]   Fatal error initializing TAE.
[GDDIAG  -2]   Fatal error reading TAE parameters.
[GDDIAG  -3]   Error initializing GEMPLT.
[GDDIAG  -4]   There is no input file specified.
[GDDIAG  -5]   Different navigation in input, output files.
[GDDIAG  -6]   Error opening input files.
[GDDIAG  -7]   Error writing output grid.
[GDDIAG  -8]   Only one output file is permitted.
[GDDIAG  -9]   Output file open failure.
[GDDIAG -10]   Grid files have different navigations.
```

4.7 PROGRAM GDEDIT

GDEDIT reads grids from a sequential edit file and adds them to a GEMPAK grid file.

INPUT PARAMETERS

GDEFIL	*Grid edit file
GDFILE	*Grid file
GPACK	*Number of bits/packing type

PROGRAM DESCRIPTION

GDEDIT reads grids from a sequential text edit file and adds them to a GEMPAK grid file. The input edit file can be created using a text editor or using the OUTPUT = F option in GDLIST.

Certain header information must be included before the grid data. Required information includes the grid size and the grid identifier. Scaling information may also be included.

The grid size must be included on a line:

```
COLUMNS: 1 33      ROWS: 1 14
```

The edit grid must begin at column = 1 and row = 1 and include the entire grid. WARNING: the edit grid size must match the size specified in the grid file. Otherwise, a fatal error is generated.

The grid identifier is found on a line such as:

```
841227/1200F48    850    PRES    DIVOBS
```

The first line containing a slash (/) is assumed to be a grid identifier. The order of values is: time 1, time 2 (optional), level 1, level 2 (optional), vertical coordinate, parameter name.

If the data were scaled before being listed, scaling information must be included. This is of the form:

```
Scale factor: 10**5
```

This information is found by searching for "factor" and "**".

Data follow this header information. The rows are assumed to read from the last (top) to the first. Each row of data contains:

```
ROW  14  0.27  . . .
```

The word ROW and the row number must be included. The row number is NOT checked to see that this is the correct row. Data for each row may wrap to the next line.

An example of a grid edit file follows:

```
Grid file: SMALL.GRD
GRID:        TIME1        TIME2     LEVEL1   LEVEL2    VCORD    PARM
       841225/0000                        0             PRES    TEMP
AREA: DSET                                    GRID SIZE:      7     6
COLUMNS:      1     7      ROWS:       1     6

Scale factor : 10**0

COLUMN:     1       2       3       4       5       6       7

ROW  6  -12.81  -12.40  -11.98  -11.30  -10.82  -11.18  -12.25

ROW  5   -9.89   -9.90   -9.41   -8.26   -7.00   -6.43   -6.80

ROW  4   -2.14   -2.94   -3.66   -3.43   -2.36   -1.29   -0.92

ROW  3    4.12    4.25    3.23    2.35    2.63    3.51    3.98

ROW  2    6.39    7.35    7.03    6.29    6.31    6.85    7.14

ROW  1    7.26    7.95    7.80    7.57    7.87    8.49    8.96
```

EXAMPLES:

1. Add the grids in the edit file GDLIST.FIL to the grid file 25DEC12Z.GRD. Do not pack the data.

```
GDEFIL  =  gdlist.fil
GDFILE  =  25dec12z.grd
GPACK   =
```

2. Add the grid in TMPC.FIL to the grid file NMC.GRD. Pack the data using the GRIB format. Select the number of bits so that two digits after the decimal place will be saved.

```
GDEFIL  =  tmpc.fil
GDFILE  =  nmc.grd
GPACK   =  +2/dec
```

ERROR MESSAGES

```
[GDEDIT  -1]   Fatal error initializing TAE.
[GDEDIT  -2]   Fatal error reading TAE parameters.
[GDEDIT  -3]   Valid grid identifier not found.
[GDEDIT  -4]   Grid size cannot be determined.
[GDEDIT  -5]   The grid size in the edit file is incorrect.
[GDEDIT  -6]   Error reading grid data.
[GDEDIT  -7]   The edit file ... is invalid.
[GDEDIT  -8]   The output grid file ... is invalid.
```

4.8 PROGRAM GDINFO

GDINFO lists information about GEMPAK grid files.

INPUT PARAMETERS

GDFILE	*Grid file
LSTALL	*Full list flag
OUTPUT	*Output device (TPF)

PROGRAM DESCRIPTION

GDINFO lists information about GEMPAK grid files.

The navigation information and grid analysis information will be listed. If requested, the grids in the file will also be listed. If LSTALL = YES, all the grids in the file will be listed. If LSTALL = NO, only the navigation and analysis information will be displayed.

EXAMPLES

1. List information about grid file NGM.GRD. All of the grids are to be listed. The listing is to be at the user's terminal and to a file named ngm.list.

   ```
   GDFILE  = ngm.grd
   LSTALL  = yes
   OUTPUT  = tf/ngm.list
   ```

ERROR MESSAGES

[GDINFO -1]	Fatal error initializing TAE.
[GDINFO -2]	Fatal error reading TAE parameters.

4.9 PROGRAM GDLIST

GDLIST lists data from a scalar grid field.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GDFILE	*Grid file
GAREA	*Graphics area
PROJ	*Map projection/angles/margins
SCALE	*Scaling factor
OUTPUT	*Output device (TPF)

PROGRAM DESCRIPTION

GDLIST lists a diagnostic grid computed from the grids in a GEMPAK grid file.

The data may be listed over a subgrid. The variables GAREA and PROJ specify the data subset area. This area is only approximate; the subgrid selected will cover the subset area. GAREA must be specified as a geographic area, as an area centered on a station, as latitude/longitude bounds or as DSET or GRID. If DSET or GRID is chosen, the entire grid will be printed.

If output is sent to the printer, the full 132 columns will be used. Output to the terminal or to a file will be 80 columns wide. If the output is sent to a file, the file will be named GDLIST.FIL by default.

EXAMPLES

1. List surface temperature from the April 5 00Z NGM cycle for the 0-h forecast time. The output will be to the terminal. The data subset area is a zoomed area centered on Colorado.

   GDATTIM = 0405/00f00
   GLEVEL = 0
   GVCORD = pres
   GFUNC = tmpf
   GDFILE = ngm.grd
   GAREA = co**

```
PROJ      = mer
SCALE     =
OUTPUT    = t
```

2. Compute the divergence and list the output over the US. Scale the data by 10**5 and write the output to a file called div.us.

```
GFUNC     = div(obs)
GAREA     = us
PROJ      = ced
SCALE     = 5
OUTPUT    = f/div.us
```

ERROR MESSAGES

```
[GDLIST  -1]    Invalid area type.
[GDLIST  -2]    Fatal error reading TAE parameters.
```

4.10 PROGRAM GDMAP

GDMAP plots data from a GEMPAK grid data file.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GDFILE	*Grid file
GAREA	*Graphics area
POINTS	*X1;y1;xinc;yinc
POSN	*Position
COLORS	*Color list
MARKER	*Marker color/type/size/width/hw
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
PANEL	*Panel location/color/dash/width
TITLE	*Title color/line/title
SCALE	*Scaling factor
DEVICE	*Graphics device
PROJ	*Map projection/angles/margins
CLEAR	*Clear screen flag
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

GDMAP plots data computed from GEMPAK grid files on a map.

The variable, POSN, is used to select the position for the data relative to the grid point using the following position numbers:

```
      7
1           3
2     0     4
5           6
      8
```

Position 0 will plot data centered at the station. If an invalid position number is entered, position 0 will be used.

The variable, SCALE, is used to scale the data by 10 ** SCALE. The data will be scaled and then rounded to the nearest integer before it is plotted.

POINTS allows the user to select points for plotting. Four numbers, separated with semicolons, may be entered: the first grid point in the x direction, the first grid point in the y direction, the increment in the x direction and the increment in the y direction. The points are numbered from the start of the grid, not the graphics area. If any number is not entered, a value of 1 is assumed. Thus, if POINTS = 1, all points will be plotted. Note the grid point (1,1) is the lower left corner of the grid.

A map and title may also be included.

EXAMPLES

1. The temperature field at 850 mb will be plotted in color 3 at position number 7 which is directly above the station. The data will be plotted at every point for an area centered on California. Marker number 5, a cross, will be plotted at the station. The title, "Temperature" will be written in color 6.

```
GDATTIM  =  303/12
GLEVEL   =  850
GVCORD   =  pres
GFUNC    =  temp
GDFILE   =  ngm.grd
GAREA    =  ca
POINTS   =  1
POSN     =  7
COLORS   =  3
MARKER   =  1/5
MAP      =  2/2
LATLON   =
PANEL    =  0
TITLE    =  6//Temperature
SCALE    =  0
DEVICE   =  sg
PROJ     =  mer
CLEAR    =  yes
TEXT     =
```

2. Add the dewpoint depression to the plot in position 8, which is directly below the grid point. The map, markers and title are turned off since they are already plotted.

```
GFUNC    =  sub[temp;dwpt]
POSN     =  8
MARKER   =  0
MAP      =  0
TITLE    =  0
```

```
CLEAR    = no
```

3. Now clear the screen and plot the relative vorticity of the observed wind, scaled by 10**5, centered at the station in color 1. Add a map and title in color 1. Omit the markers since the data will overlay them.

```
GFUNC    = vor[obs]
COLORS   = 1
MAP      = 1
SCALE    = 5
MARKER   = 0
CLEAR    = yes
POSN     = 0
```

ERROR MESSAGES

```
[GDMAP  -1]    Fatal error initializing TAE.
[GDMAP  -2]    Fatal error reading TAE parameters.
[GDMAP  -3]    Fatal error initializing GEMPLT.
```

4.11 PROGRAM GDMOD

GDMOD moves data from one GEMPAK grid file to another.

INPUT PARAMETERS

GDFILE	*Grid file
GDOUTF	*Output grid file
GDNUM	*Grid numbers
GPACK	*Number of bits/packing type

PROGRAM DESCRIPTION

GDMOD moves grids from an input grid file to an output file. The input grid file name is specified in GDFILE. The output grid file name is specified in GDOUTF. The input and output grid files must have the same navigation information.

The numbers of the grids to be moved are specified in GDNUM. Either a list of grid numbers, with semicolons separating the numbers, or a range of grid numbers, with the first and last numbers separated by a dash, may be entered.

The output grids will be packed using the information in GPACK.

EXAMPLES

1. Add grids 1, 4 and 7 from file, OLD.GRD, to file NEW.GRD. Pack the data using 16 bits for each data value.

```
GDFILE  =  old.grd
GDOUTF  =  new.grd
GDNUM   =  1;4;7
GPACK   =  16/grib
```

2. Copy all the grids in TODAY.GRD to DEC.GRD. Do not pack any data.

```
GDFILE  =  today.grd
GDOUTF  =  dec.grd
GDNUM   =  all
GPACK   =
```

ERROR MESSAGES

[GDMOD -1]	Fatal error initializing TAE.
[GDMOD -2]	Fatal error reading TAE parameters.
[GDMOD -3]	Invalid grid range entered.
[GDMOD -4]	Grid number ... is invalid.
[GDMOD -5]	There are no grids in file ....
[GDMOD -6]	No valid grids in list.
[GDMOD -7]	Error reading input grid.
[GDMOD -8]	Error writing output grid.
[GDMOD -9]	Error opening files.
[GDMOD -10]	Files contain different navigations.
[GDMOD -11]	Too many grids to transfer.

4.12 PROGRAM GDPROF

GDPROF draws profiles of gridded data.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GPOINT	*Grid point
GDFILE	*Grid file
GVECT	*Grid vector function
LINE	*Line color/dash/width/label
MARKER	*Marker color/type/size/width/hw
BORDER	*Background color/dash/width
PTYPE	*Plot type/h:w ratio/margins
SCALE	*Scaling factor
XAXIS	*Xstrt/xstop/xinc/lbl;gln;tck
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
WIND	*Wind symbol/siz/wdth/typ/hdsz
WINPOS	*Wind position
FILTER	*Filter data flag
TITLE	*Title color/line/title
PANEL	*Panel location/color/dash/width
CLEAR	*Clear screen flag
TEXT	*Text size/font/hw flag
DEVICE	*Graphics device
OUTPUT	*Output device (TPF)
THTALN	*THTA color/dash/width/mn/mx/inc
THTELN	*THTE color/dash/width/mn/mx/inc
MIXRLN	*MIXR color/dash/width/mn/mx/inc

PROGRAM DESCRIPTION

GDPROF draws vertical profiles at a point. Data from all levels in the grid file are interpolated to the point.

GPOINT specifies the point for the profile. It may be entered as a set of x and y grid points separated with a semicolon and preceded with an @, as a latitude and longitude separated with a semicolon, or as a station character identifier or station number.

The vertical coordinate, set in GVCORD, can be PRES, THTA, or HGHT. The vertical axis type, set in PTYPE, can be LIN, LOG, KAP, or SKEW. Only temperatures may be plotted on a skew T plot. The height-to-width ratio of the plot may

be specified in PTYPE following a /. If no value is entered a value of 0 will be used.

The value in GFUNC is computed at every level in the data set. No errors are returned if the function cannot be computed at any level, except at the surface. If data at the surface cannot be computed, an error message is written and plotting continues. GVECT specifies a vector to be plotted in the right margin.

If GFUNC is a temperature or dewpoint temperature, background lines of potential temperature, equivalent potential temperature and mixing ratio can be displayed by specifying THTALN, THTELN, and MIXRLN. If these background lines are requested and GFUNC is not a temperature, an error message is generated.

EXAMPLES

1. Plot temperature in Celsius on a log P chart at IAD for the latest time in the file. Use the default line, marker, title and background colors. Label the Y axis from 1000 mb to 100 mb in increments of 100 mb. Label the X axis from -40 degrees to +40 degrees in increments of 10 degrees. Add all the background lines as dotted lines. Plot wind barbs in the right margin.

```
GDATTIM  =  last
GVCORD   =  pres
GFUNC    =  temp
GPOINT   =  IAD
GDFILE   =  ngm.grd
GVECT    =  obs
LINE     =  1
MARKER   =  1
BORDER   =  1
PTYPE    =  LOG
SCALE    =  0
XAXIS    =  -40/40/10
YAXIS    =  1000/100/100
WIND     =  bm1
WINPOS   =
FILTER   =  YES
TITLE    =  1
PANEL    =  0
CLEAR    =  yes
TEXT     =
DEVICE   =  vt
OUTPUT   =  no
THTALN   =  1/10
```

```
THTELN  =  1/10
MIXRLN  =  1/10
```

2. Using the same file, plot the same parameters at HAT. The winds will be plotted to the right of the winds plotted above.

```
GPOINT  =  hat
BORDER  =  0
CLEAR   =  no
THTALN  =  0
THTELN  =  0
MIXRLN  =  0
```

3. Clear the screen and plot the relative humidity at BWI in color number 2 using a dotted line. Do not plot any winds.

```
GFUNC   =  relh
GVECT   =
LINE    =  2/10
GPOINT  =  bwi
```

ERROR MESSAGES

```
[GDPROF  +1]   Invalid parameter for background lines.
[GDPROF  -1]   Fatal error initializing TAE.
[GDPROF  -2]   Fatal error reading TAE parameters.
[GDPROF  -3]   Fatal error initializing GEMPLT.
[GDPROF  -4]   Input for GPOINT is invalid.
[GDPROF  -5]   Input for GDATTIM is invalid.
[GDPROF  -6]   Input for GVCORD is invalid.
[GDPROF  -7]   Input for PTYPE is invalid.
[GDPROF  -8]   Error defining graph coordinates.
[GDPROF  -9]   No points found for profile.
[GDPROF -10]   There are no levels at this time.
[GDPROF -11]   Input ... for y axis is invalid.
[GDPROF -12]   Input ... for x axis is invalid.
```

4.13 PROGRAM GDSTAT

GDSTAT computes statistics on a time series of grids.

INPUT PARAMETERS

GDFILE	*Grid file
GDOUTF	*Output grid file
GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GRDNAM	*Output parameter name

PROGRAM DESCRIPTION

GDSTAT computes the average, standard deviation, and number of reporting times at each grid point for a time series of grids. The output grids will be written to the output grid file.

The input grid files are given in GDFILE. The output file is given in GDOUTF. There may be one or two input files. The output file may also be an input file.

GFUNC specifies the grid diagnostic function to be computed. GDATTIM must be a time range. The output grid names will be the name in GRDNAM prefixed by AVG, STD, and CNT. If GRDNAM is blank, the default name from the grid diagnostic computation will be used.

EXAMPLES

1. Compute the grid statistics for the 850 mb vorticity field using all the times in the grid file. Name the output grids AVGVOR, STDVOR and CNTVOR and write them into the same file.

   Write the output grids into the same file.

   ```
   GDFILE   = ngm.grd
   GDOUTF   = ngm.grd
   GFUNC    = vor(obs)
   GVCORD   = pres
   GLEVEL   = 850
   GDATTIM  = all
   ```

```
GRDNAM   =  vor
```

2. Compute the grid statistics for the surface temperature data using the data for every 12 hours from Jan 1 to Jan 15. The input and output files are different. The default names will be used.

```
GDFILE   =  jan90sfc.grd
GDOUTF   =  stat.grd
GFUNC    =  tmpc
GVCORD   =  none
GLEVEL   =  0
GDATTIM  =  900101/0000-900115/0000-12
GRDNAM   =
```

ERROR MESSAGES

```
[GDSTAT  -1]    Fatal error initializing TAE.
[GDSTAT  -2]    Fatal error reading TAE parameters.
[GDSTAT  -3]    Fatal error initializing GEMPLT.
[GDSTAT  -4]    No valid times found in grid file.
[GDSTAT  -6]    There are fewer than four grids.
[GDSTAT  -7]    Error writing grid ... to output file.
```

4.14 PROGRAM GDSTREAM

GDSTREAM draws streamlines through a GEMPAK vector grid.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GVECT	*Grid vector function
GDFILE	*Grid file
GAREA	*Graphics area
LINE	*Line color/dash/width/label
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
TITLE	*Title color/line/title
PANEL	*Panel location/color/dash/width
TEXT	*Text size/font/hw flag
DEVICE	*Graphics device
PROJ	*Map projection/angles/margins
CLEAR	*Clear screen flag

PROGRAM DESCRIPTION

GDSTREAM draws streamlines through any vector grid computed by the grid diagnostics package.

The vector field is specified in GVECT. Streamlines are drawn using a modification of the NCAR streamline program.

The line color, dash pattern and line width are set in LINE. A map, title and latitude/longitude lines may also be included.

EXAMPLES

1. Draw streamlines through the observed wind field at 850 mb using color 3. Add a Mercator map in color 1 and linetype 2 and a title in color 2. Center the graphics area on Wisconsin.

   GDATTIM = last
   GLEVEL = 850
   GVCORD = pres
   GVECT = obs
   GDFILE = ngm.grd
   GAREA = wi

```
LINE     = 3
MAP      = 1/2
LATLON   =
TITLE    = 2
PANEL    = 0
TEXT     =
DEVICE   = vt
PROJ     = mer
CLEAR    = yes
```

2. Clear the screen and draw the streamlines of the gradient of the temperature.

```
GVECT    = grad(temp)
CLEAR    = yes
```

ERROR MESSAGES

```
[GDSTREAM  -1]  Fatal error initializing TAE.
[GDSTREAM  -2]  Fatal error reading TAE parameters.
[GDSTREAM  -3]  Fatal error initializing GEMPLT.
```

4.15 PROGRAM GDTSER

GDTSER draws a time series of a scalar at a single level.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GFUNC	*Grid function
GPOINT	*Grid point
GDFILE	*Grid file
PTYPE	*Plot type/h:w ratio/margins
TAXIS	*Time1-time2-tinc;lbl;gln;tck
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
BORDER	*Background color/dash/width
LINE	*Line color/dash/width/label
MARKER	*Marker color/type/size/width/hw
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
SCALE	*Scaling factor
PANEL	*Panel location/color/dash/width
DEVICE	*Graphics device
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

GDTSER draws a time series of a parameter at a fixed level. The variable may be any scalar computed by the grid diagnostics package.

GPOINT specifies the location for the time series. It may be entered as a set of x and y grid points separated with a semicolon and preceded with an @, as a latitude and longitude separated with a semicolon, or as a station character identifier or station number.

The times to plot are specified in GDATTIM. Only those times specified will be plotted. Lines will be drawn connecting the data points provided no more than two points are missing between segments. Note that the times may represent a series of base times with the same or no forecast time, or a series with the same base time and a list of forecast times.

The time axis is specified in TAXIS using the usual GEMPAK

date/time conventions, including FIRST and LAST. If TAXIS has no increment, a reasonable value is chosen. If TAXIS is blank, the limits are taken from the first and last valid times set in GDATTIM.

If the user desires multiple lines on the same graph, TAXIS and YAXIS should be explicitly set; then LINE, MARKER, and TITLE can be varied for successive combinations of GLEVEL, GVCORD, GPOINT, and GFUNC.

The height-to-width ratio of the plot and the margins may be specified in PTYPE following a /. Note that the first value in PTYPE, the axis type, is ignored.

EXAMPLES

1. Plot the 00 h forecast temperatures in Celsius at the 500 mb level at BWI initialized at times between 26/12 and 31/00 in the file. Use the default line, marker, title and background colors. Label the Y axis from -40 to 0 in increments of 10 degrees. Label the time axis from 26/00 to 31/12 in increments of 12 h. Make the plot half as high as wide.

```
GDATTIM  =  26/12f00-31/00f00
GLEVEL   =  500
GVCORD   =  pres
GFUNC    =  tmpc
GPOINT   =  bwi
GDFILE   =  ngm.grd
PTYPE    =  /.5
TAXIS    =  26/00-31/12-12
YAXIS    =  -40/0/10
BORDER   =  1
LINE     =  1
MARKER   =  1
TITLE    =  1
CLEAR    =  yes
SCALE    =  999
PANEL    =  0
DEVICE   =  vt
```

2. Using the same file, plot a time series of the 800 mb geostrophic wind speed at latitude and longitude of 39 and -77 for all forecasts initialized at 29/00. Plot the graph with the height/width ratio of 0.3 in the top half of the page and use internal scaling for both axes.

```
GDATTIM  =  29/00fall
```

```
TAXIS   =
GLEVEL  =  800
GFUNC   =  mag(geo)
GPOINT  =  39;-77
PTYPE   =  /.3
YAXIS   =
PANEL   =  t
```

ERROR MESSAGES

```
[GDTSER  -1]    Fatal error initializing TAE.
[GDTSER  -2]    Fatal error reading TAE parameters.
[GDTSER  -3]    Fatal error initializing GEMPLT.
[GDTSER  -4]    Input for GPOINT is invalid.
[GDTSER  -5]    Input for GLEVEL is invalid.
[GDTSER  -6]    Input for GVCORD is invalid.
[GDTSER  -7]    Input for PTYPE is invalid.
[GDTSER  -8]    Error defining graph coordinates.
[GDTSER  -9]    No points found for plot of ....
[GDTSER -10]    Some points missing for plot of ....
[GDTSER -11]    Input for ... in TAXIS is invalid.
[GDTSER -12]    Time range is size zero.
[GDTSER -13]    No grids found with times in GDATTIM.
```

4.16 PROGRAM GDWIND

GDWIND draws wind barbs or arrows at each grid point of a vector field.

INPUT PARAMETERS

GDATTIM	*Grid date/time
GLEVEL	*Grid level
GVCORD	*Grid vertical coordinate
GVECT	*Grid vector function
GDFILE	*Grid file
GAREA	*Graphics area
POINTS	*X1;y1;xinc;yinc
WIND	*Wind symbol/siz/wdth/typ/hdsz
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
PANEL	*Panel location/color/dash/width
TITLE	*Title color/line/title
DEVICE	*Graphics device
PROJ	*Map projection/angles/margins
CLEAR	*Clear screen flag
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

GDWIND draws wind barbs or arrows at each grid point of a vector field.

POINTS allows the user to select points for plotting. Four numbers, separated with semicolons, may be entered: the first grid point in the x direction, the first grid point in the y direction, the increment in the x direction and the increment in the y direction. The points are numbered from the start of the grid, not the graphics area. If any number is not entered, a value of 1 is assumed. Thus, if POINTS = 1, all points will be plotted. The grid point (1,1) is the lower left corner of the grid.

Note that in this program, a M or K entered in WIND to indicate meters/sec or knots will be ignored. By default, wind vectors will be computed in meters/sec. The operand KNOTV will convert the output to knots. Thus OBS will be computed in meters/sec while KNOTV (OBS) will be converted to knots.

EXAMPLES

1. Draw wind barbs at every grid point. The vector field is the observed wind at 850 mb on March 3 at 12Z. The plot is centered on Colorado.

```
GDATTIM  =  303/12f00
GLEVEL   =  850
GVCORD   =  pres
GVECT    =  obs
GDFILE   =  ngm.grd
GAREA    =  co
POINTS   =  1
WIND     =  bm1
MAP      =  1/10
LATLON   =  1/10
PANEL    =  0
TITLE    =  1
DEVICE   =  vt
PROJ     =  mer
CLEAR    =  yes
TEXT     =
```

2. Using the values of the variables supplied above, draw arrows at every other grid point. The vector to be used is the temperature gradient. The screen should not be cleared. The arrows are in color 7.

```
GVECT    =  grad(temp)
POINTS   =  1;1;2;2
WIND     =  am7
CLEAR    =  no
```

3. Plot wind barbs of the observed wind in knots. Note that WIND = BK1 and WIND = BM1 give the same results. The units can only be changed in GVECT.

```
GVECT    =  knotv(obs)
WIND     =  bk1
```

ERROR MESSAGES

```
[GDWIND  -1]    Fatal error initializing TAE.
[GDWIND  -2]    Fatal error reading TAE parameters.
[GDWIND  -3]    Fatal error initializing GEMPLT.
```

4.17 PROGRAM GPAOIM

GPAOIM sets up a view region for an AOIPS image.

INPUT PARAMETERS

GAREA *Graphics area

PROGRAM DESCRIPTION:

This program adjusts the view region to correspond to an image size on an International Imaging Systems (II) display device. This program must be run for images which are less than 512 x 512.

GAREA is the file name of the image to be displayed.

Note that after this program is run, PANEL must be set to blank, so that the view region will not be reset when plotting on the image.

ERROR MESSAGES

[GPAOIM -1]	Fatal error initializing TAE.
[GPAOIM -2]	Fatal error reading the TAE parameters.
[GPAOIM -3]	Fatal error initializing GEMPLT.
[GPAOIM -4]	Error reading image label.

4.18 PROGRAM GPAREA

GPAREA updates the user's geographic area table.

INPUT PARAMETERS

AREA	*Data area
GNAME	*Geographic abbreviation/name

PROGRAM DESCRIPTION

This program allows a user to create and update custom geographic files and to query the bounds of a particular area.

The user's geographic area table is a file call GEOG.TBL. If this file does not exist, it will be created. In order to access areas from this file in any GEMPAK program, a # must be prefixed to the area name.

In this program, AREA is entered as in any GEMPAK program. GNAME is the name to be associated with the area. This may be followed by a slash and a longer name which is only used for reference.

If GNAME is blank, this program will simply display the information about the area defined in AREA.

Note that the central latitude and longitude and the latitude and longitude range are the numbers actually stored in the file.

EXAMPLES

1. Get the area called EAST from the GEMPAK table and add this area to the individual table with the name EASTUS.

   GNAME = eastus
   AREA = east

2. Add the area BIGUS to the custom file.

   GNAME = bigus/large usa area
   AREA = 23;-124;52;-60

3. Query the bounds of BIGUS in the custom file.

```
GNAME  =
AREA   = #bigus
```

ERROR MESSAGES

```
[GPAREA  -1]    Fatal error initializing TAE.
[GPAREA  -2]    Fatal error reading TAE parameters.
```

4.19 PROGRAM GPBOX

GPBOX draws a box around a region.

INPUT PARAMETERS

LINE	*Line color/dash/width/label
REGION	*Type of region
DEVICE	*Graphics device

PROGRAM DESCRIPTION

This program draws a box around a region on the current graphics device. REGION can be specified as VIEW, PLOT, or DEVICE. VIEW is the view region of the graphics device. The view region may be changed in GEMPAK programs using the parameter PANEL. The PLOT region is the area used for the data plot, excluding margins. DEVICE is the entire device space.

EXAMPLES

1. Draw a solid line of width 1 around the view region on the VT device.

   ```
   LINE   = 1
   REGION = view
   DEVICE = vt
   ```

2. Draw a line around the device region in color 2, using line type 3 and width 5.

   ```
   LINE   = 2/3/5
   REGION = device
   ```

ERROR MESSAGES

[GPBOX -1]	Fatal error initializing TAE.
[GPBOX -2]	Fatal error in reading the TAE parameters.
[GPBOX -3]	Fatal error initializing GEMPLT.

4.20 PROGRAM GPCLEAR

GPCLEAR clears the current graphics device.

INPUT PARAMETERS

DEVICE *Graphics device

PROGRAM DESCRIPTION

This program clears the graphics device. On an interactive device, the screen is erased. On a hardcopy device, the next plot will be on a new page.

ERROR MESSAGES

[GPCLEAR -1] Fatal error initializing TAE.
[GPCLEAR -2] Fatal error reading TAE parameters.
[GPCLEAR -3] Fatal error initializing GEMPLT.

4.21 PROGRAM GPCLOSE

GPCLOSE closes the current graphics output file.

INPUT PARAMETERS

None

PROGRAM DESCRIPTION

This program closes the graphics output file, if the current device produces an intermediate plot file. The plot file commands may be sent to the device using GPOUT. It is not necessary to call GPCLOSE before calling GPOUT.

ERROR MESSAGES

[GPCLOSE -1] Fatal error initializing TAE.
[GPCLOSE -3] Fatal error initializing GEMPLT.

4.22 PROGRAM GPCOLOR

GPCOLOR changes the colors on a color device.

INPUT PARAMETERS

COLORS	*Color list
CTYPE	*Color type
CCOMP	*Color components or name
DEVICE	*Graphics device

PROGRAM DESCRIPTION

This program changes the color components of color numbers on color devices where the components can be set.

COLORS is the color number. CTYPE gives the method to use when the components are changed. If CTYPE = INIT, then all the colors are set to default values. In this case, the values of COLORS and CCOMP are ignored. If CTYPE = RGS, the red green and blue components must be specified. If CTYPE = HLS, the hue, lightness and saturation are required. If CTYPE = NAME, the color components will be read from the GEMPAK color tables. Note that only the first three letters of the name will be used.

CCOMP gives the color components in one of the following ways:

NAME: The color is given by name, where only the first 3 letters are used.

RGB: The red, green and blue components are given; the values must be separated with semicolons.

HLS: The hue, lightness and saturation are given; the values must be separated with semicolons.

The RGB and HLS numbers must be in the range 0 to 1.

The list of colors in the GEMPAK table with the corresponding red, green, blue, hue, lightness, and saturation values follows:

RED	RED	1.000	.000	.000	.000	.333	1.000
GREEN	GRE	.000	1.000	.000	.333	.333	1.000
BLUE	BLU	.000	.000	1.000	.667	.333	1.000
YELLOW	YEL	1.000	1.000	.000	.167	.667	1.000

CYAN	CYA	.000	1.000	1.000	.500	.667	1.000
MAGENTA	MAG	1.000	.000	1.000	.833	.667	1.000
WHITE	WHI	1.000	1.000	1.000	.000	1.000	.000
BLACK	BLA	.000	.000	.000	.000	.000	.000
!							
! Off whites							
GRAY	GRA	.500	.500	.500	.000	.500	.000
VANILLA	VAN	1.000	.900	.750	.102	.883	.320
!							
! Oranges							
ORANGE	ORA	1.000	.500	.000	.083	.500	.816
DKORANGE	DKO	.863	.471	.000	.092	.445	.710
!							
! Browns							
GBROWN	GBR	.500	.281	.281	.000	.354	.216
BROWN	BRO	.500	.294	.196	.051	.330	.269
BEIGE	BEI	1.000	.672	.500	.055	.724	.464
SAND	SAN	.851	.600	.298	.092	.583	.456
MUD	MUD	.395	.100	.160	.970	.218	.308
!							
! Blues							
AQUA	AQU	.000	.718	.718	.500	.479	.678
SKY	SKY	.000	.640	1.000	.558	.547	.831
LTBLUE	LTB	.000	.500	1.000	.583	.500	.816
NAVY	NAV	.000	.000	.500	.667	.167	.632
DKBLUE	DKB	.000	.000	.750	.667	.250	.816
INDIGO	IND	.578	.000	1.000	.764	.526	.821
!							
! Greens							
LTGREEN	LTG	.600	1.000	.000	.232	.533	.824
AVOCADO	AVO	.250	.500	.125	.280	.292	.343
DKGREEN	DKG	.000	.562	.000	.333	.187	.679
!							
! Yellows							
TAN	TAN	.750	.500	.000	.113	.416	.632
GOLD	GOL	1.000	.750	.000	.129	.583	.862
BLOND	BLO	.900	.820	.390	.143	.703	.490
LEMON	LEM	.900	1.000	.250	.186	.717	.738
!							
! Reds							
PINK	PIN	1.000	.600	.600	.000	.733	.426
DKPINK	DKP	1.000	.500	.500	.000	.667	.500
MAROON	MAR	.578	.000	.000	.000	.193	.691
APRICOT	APR	1.000	.700	.375	.000	.692	.553
VIOLET	VIO	.625	.250	.625	.833	.500	.354
PURPLE	PUR	.500	.000	.500	.833	.333	.500

EXAMPLES

1. Set color number 4 to violet.

```
COLORS  =  4
CCOMP   =  violet
CTYPE   =  name
```

2. Set color number 2 to yellow by specifying the red, green, and blue components.

```
COLORS  =  2
CCOMP   =  1;1;0
CTYPE   =  rgb
```

3. Set color number 3 to DKPINK by specifying the hue, lightness, and saturation components.

```
COLORS  =  3
CCOMP   =  0;.667;.5
CTYPE   =  hls
```

ERROR MESSAGES

```
[GPCOLOR  -1]   Fatal error initializing TAE.
[GPCOLOR  -2]   Fatal error reading TAE parameters.
[GPCOLOR  -3]   Fatal error initializing GEMPLT.
[GPCOLOR  -4]   ... is an invalid input for CTYPE.
[GPCOLOR  -5]   Invalid input for COLORS.  Enter one value.
[GPCOLOR  -6]   ... has fewer than 3 color components.
[GPCOLOR  -7]   ... has more than 3 color components.
```

4.23 PROGRAM GPEND

GPEND terminates the GEMPLT subprocesses.

INPUT PARAMETERS

None

PROGRAM DESCRIPTION

This program terminates the GEMPLT plotting package. It can be used to stop the GEMPLT subprocesses.

ERROR MESSAGES

[GPEND -1]	Fatal error initializing TAE.
[GPEND -3]	Fatal error initializing GEMPLT.

4.24 PROGRAM GPMAP

GPMAP defines a graphics area and draws a map and latitude/longitude lines.

INPUT PARAMETERS

MAP	*Map color/dash/width
DEVICE	*Graphics device
GAREA	*Graphics area
PROJ	*Map projection/angles/margins
PANEL	*Panel location/color/dash/width
TITLE	*Title color/line/title
LATLON	*Line color/dash/width/label/inc
CLEAR	*Clear screen flag

PROGRAM DESCRIPTION

This program defines a graphics area and device and draws a map and/or latitude/longitude lines.

EXAMPLES

1. Define a graphics area centered on WV on the SG device. Set the projection to North Polar Stereographic. Draw a map with solid lines in color 3. Draw latitude/longitude lines every 5 degrees in color 2 using a dotted dash pattern. Do not write a title on the map.

```
GAREA   = wv
PROJ    = nps
MAP     = 3
LATLON  = 2/10///5;5
PANEL   = 0
TITLE   = 0
CLEAR   = yes
DEVICE  = sg
```

ERROR MESSAGES

[GPMAP -1]	Fatal error initializing TAE.
[GPMAP -2]	Fatal error reading TAE parameters.
[GPMAP -3]	Fatal error initializing GEMPLT.

4.25 PROGRAM GPOUT

GPOUT sends GEMPLT graphics files to the output device.

INPUT PARAMETERS

None

PROGRAM DESCRIPTION

This program sends intermediate plot files to the graphics device. If a plot file is open, it will be closed and sent to the plotter. Otherwise, the most recent file for this device will be plotted.

ERROR MESSAGES

[GPOUT -1]	Fatal error initializing TAE.
[GPOUT -3]	Fatal error initializing GEMPLT.

4.26 PROGRAM GPREST

GPREST restores the graphics plot, saved by GPSAVE, to a graphics device having readback capability.

INPUT PARAMETERS

SAVFIL	*Graphics save file name
DEVICE	*Graphics device

PROGRAM DESCRIPTION

This program restores the graphics plot to a graphics device with readback capability. The file must have been created using GPSAVE.

EXAMPLES

1. Restore a surface map from a specified disk and directory.

   SAVFIL = sfcmap.sav
   DEVICE = ii

2. Restore a skew-t diagram from the default disk and directory.

   SAVFIL = skewt.sav

ERROR MESSAGES

[GPREST -1]	Fatal error initializing TAE.
[GPREST -2]	Fatal error in reading the TAE parameters.
[GPREST -3]	Fatal error initializing GEMPLT.
[GPREST -4]	Error restoring graphics from a file.

4.27 PROGRAM GPSAVE

GPSAVE saves the graphics plot currently displayed to a disk file.

INPUT PARAMETERS

SAVFIL	*Graphics save file name
DEVICE	*Graphics device

PROGRAM DESCRIPTION

This program saves the graphics plot displayed on DEVICE to a disk file. The graphics information saved can be restored using GPREST. These programs will only work on devices having a readback capability.

EXAMPLES

1. Save a surface map to a specified disk and directory.

   SAVFIL = sfcmap.sav

2. Save a skew-t diagram to the default disk and directory.

   SAVFIL = skewt.sav

ERROR MESSAGES

[GPSAVE -1]	Fatal error initializing TAE.
[GPSAVE -2]	Fatal error in reading TAE parameters.
[GPSAVE -3]	Fatal error initializing GEMPLT.
[GPSAVE -4]	Error saving graphics to a file.

4.28 PROGRAM OABOX

OABOX draws a box around an objective analysis region.

INPUT PARAMETERS

LINE	*Line color/dash/width/label
DEVICE	*Graphics device
REGION	*Type of region
GAREA	*Graphics area
PROJ	*Map projection/angles/margins
GDFILE	*Grid file

PROGRAM DESCRIPTION

This program draws a box around a region defined for the objective analysis programs. REGION can be specified as GRID, DATA, or EXTEND. The default is GRID.

The GRID region is the area used for the objective analysis. The DATA region is the area over which data for the analysis is extracted. The EXTEND region is the grid area extended in each direction for the first pass analysis.

EXAMPLES

1. Draw a solid line around the grid area in color 1 using a solid line of width 1.

```
LINE    = 1
REGION  = grid
GDFILE  = sample.grd
DEVICE  = vt
GAREA   = us
PROJ    = mer
```

2. Draw a line around the data region using color 2, line type 3, and line width 5.

```
LINE    = 2/3/5
REGION  = data
```

ERROR MESSAGES

[OABOX -1]	Fatal error initializing TAE.
[OABOX -2]	Fatal error reading TAE parameters.
[OABOX -3]	Fatal error initializing GEMPLT.
[OABOX -4]	No box will be drawn since the color is 0.
[OABOX -5]	Invalid input for REGION.

4.29 PROGRAM OABSFC

OABSFC performs a Barnes objective analysis on surface data.

INPUT PARAMETERS

SFFILE	*Surface data file
GDFILE	*Grid file
SFPARM	*Surface parameter list
DATTIM	*Date/time
DTAAREA	*Data area for OA
GUESS	*Guess file*time
GAMMA	*Convergence parameter
SEARCH	*Search radius
NPASS	*Number of passes

PROGRAM DESCRIPTION

OABSFC performs a Barnes objective analysis on surface data. Multiple parameters may be analyzed at the same time. If more than one time is entered, the analyses will be performed sequentially.

The input surface file is specified in SFFILE. Two files may be entered by separating the names with a plus, +.

The projection and area for the grid are read from the navigation block in the output grid file. The extend grid area, the station spacing and the data subset area are read from the analysis block. The extend area is used to define a larger grid for the first pass, allowing data to be interpolated back to stations outside the grid area. The average station spacing is used to compute the weighting functions. The data subset area specifies the data which will be used in the analysis. If DTAAREA is blank or set to DATA, the data area defined in the analysis block will be used. This is the recommended procedure. However, DTAAREA may be specified in the same way as the AREA parameter used in other programs. This is especially useful to eliminate stations which are known to have bad data.

A first-guess field can be used in the analysis. The name of the grid file containing the guess field must be entered in GUESS. In addition, the time to be used to extract the guess field from the file must be entered as the second value in GUESS following a *. If a guess field is entered, the navigation information in the guess grid file must be

identical to that in the output grid file. When a guess field is used, it is inserted into the grid as the zeroth pass.

Each pass of the analysis interpolates data from stations to grid points using the weighting function:

```
WTFUNC = EXP [ -DIST ** 2 / WEIGHT ]
```

where:

```
DIST ** 2 = [ ( lat (grid) - lat (stn) ) ** 2 +
            ( lon (grid) - lon (stn) ) ** 2 * coslsq (grid) ]
COSLSQ = COS ( lat (grid) ) ** 2
WEIGHT = 5.051457 * ( DELTAN * 2 / PI ) ** 2
DELTAN = Station spacing read from grid file analysis block
```

GAMMA, the convergence parameter, is a multiplier for the weight for passes after the first pass. GAMMA must be within the range 0 - 1. Any value outside this range will default to a value of .3. If GAMMA is 0, the number of passes will be set to 1. The recommended value for GAMMA is .3.

SEARCH is used to control the search radius, which is the maximum distance that a station may be from a grid point to be used in the analysis for that point. The search radius will be set so that stations whose weighting factor would be less than EXP (-SEARCH) will not be used. SEARCH must be in the range 1 - 50. If it is not, a default value of 20 will be used. If a very small value is used, many grid points will not have 3 stations within the search area and will be set to the missing data value.

NPASS controls the number of passes. Valid values are in the range 1 - 5. Note that two passes are STRONGLY RECOMMENDED.

EXAMPLES

1. Analyze temperature, dewpoint and the wind components from the latest time in the surface file, SURFDAT. Add the computed grids to the file, TEST.GRD.

```
SFFILE  = surfdat
GDFILE  = test.grd
SFPARM  = tmpf;dwpf;uwnd,vwnd
DATTIM  = last
DTAAREA = data
GUESS   =
GAMMA   = .3
```

```
SEARCH  =  10
NPASS   =  2
```

2. Repeat the dewpoint analysis setting the convergence parameter to .25 and eliminating the data at stations DCA and BUF.

```
SFPARM  =  dwpf
DTAAREA =  data/-@dca;buf
GAMMA   =  .25
```

3. Repeat the wind analysis using the 24-hour forecast from the model data stored in model.ngm.

```
SFPARM  =  uwnd;vwnd
GUESS   =  model.ngm*f24
```

ERROR MESSAGES

```
[OABSFC  +9]   No data from ... will be used.
[OABSFC  +8]   Parameter ... is a character parameter.
[OABSFC  +7]   Parameter ... cannot be computed.
[OABSFC  +6]   WARNING:  Area is not DATA area in file.
[OABSFC  +5]   WARNING:  The recommended number of passes is 2.
[OABSFC  +4]   ... is invalid for NPASS.  It is set to 2.
[OABSFC  +3]   ... is invalid for search.  It is set to 20.
[OABSFC  +2]   WARNING:  GAMMA is 0.  There will be only 1 pass.
[OABSFC  +1]   ... is invalid for GAMMA.  It is set to .3.
[OABSFC  -1]   Fatal error initializing TAE.
[OABSFC  -2]   Fatal error reading TAE parameters.
[OABSFC  -3]   Fatal error initializing GEMPLT.
[OABSFC  -4]   Grid size is too large.
[OABSFC  -5]   Not enough buffer space; reduce number of grids.
[OABSFC  -6]   There are too many stations in data subset area.
[OABSFC  -7]   There are too few stations in data subset area.
[OABSFC  -8]   There are no times in the surface file.
[OABSFC  -9]   No valid parameters have been entered.
[OABSFC -10]   Surface file ... could not be opened.
[OABSFC -11]   Time cannot be found in ....
```

4.30 PROGRAM OABSND

OABSND performs a Barnes objective analysis on upper air data.

INPUT PARAMETERS

SNFILE	*Sounding data file
GDFILE	*Grid file
SNPARM	*Sounding parameter list
STNDEX	*Stability indices
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
DATTIM	*Date/time
DTAAREA	*Data area for OA
GUESS	*Guess file*time
GAMMA	*Convergence parameter
SEARCH	*Search radius
NPASS	*Number of passes

PROGRAM DESCRIPTION

OABSND performs a Barnes objective analysis on upper air data. Multiple parameters and levels may be analyzed at the same time. If more than one time is entered, the analyses will be performed sequentially.

The input sounding file is specified in SNFILE. Two files may be entered by separating the names with a plus, +.

The projection and area for the grid are read from the navigation block in the output grid file. The extend grid area, the station spacing and the data subset area are read from the analysis block. The extend area is used to define a larger grid for the first pass, allowing data to be interpolated back to stations outside the grid area. The average station spacing is used to compute the weighting functions. The data subset area specifies the data which will be used in the analysis. If DTAAREA is blank or set to DATA, the data area defined in the analysis block will be used. This is the recommended procedure. However, DTAAREA may be specified in the same way as the AREA parameter used in other programs. This is especially useful to eliminate stations which are known to have bad data.

A first-guess field can be used in the analyses. The name of the grid file containing the guess field must be entered in GUESS. In addition, the time to be used to extract the

guess field from the file must be entered as the second value in GUESS following a *. If a guess field is entered, the navigation information in the guess grid file must be identical to the that in the output grid file.

Each pass of the analysis interpolates data from stations to grid points using the weighting function:

```
WTFUNC = EXP [ -DIST ** 2 / WEIGHT ]
```

where:

```
DIST ** 2 = [ ( lat (grid) - lat (stn) ) ** 2 +
            ( lon (grid) - lon (stn) ) ** 2 * coslsq (grid) ]
COSLSQ = COS ( lat (grid) ) ** 2
WEIGHT = 5.051457 * ( DELTAN * 2 / PI ) ** 2
DELTAN = Station spacing read from grid file analysis block
```

GAMMA, the convergence parameter, is a multiplier for the weight for passes after the first pass. GAMMA must be within the range 0 - 1. Any value outside this range will default to a value of .3. If GAMMA is 0, the number of passes will be set to 1. The recommended value for GAMMA is .3.

SEARCH is used to control the search radius, which is the maximum distance that a station may be from a grid point to be used in the analysis for that point. The search radius will be set so that stations whose weighting factor would be less than EXP (-SEARCH) will not be used. SEARCH must be in the range 1 - 50. If it is not, a default value of 20 will be used. If a very small value is used, many grid points will not have 3 stations within the search area and will be set to the missing data value.

NPASS controls the number of passes. Valid values are in the range 1 - 5. Note that two passes are STRONGLY RECOMMENDED.

EXAMPLES

1. Analyze temperature, dewpoint and the wind components at 850 and 500 mb from the file, SNDDAT. Add the output grids to the file, TEST.GRD. Use default values in the analyses.

```
SNFILE  =  snddat
GDFILE  =  test.grd
SNPARM  =  tmpc;dwpc;uwnd,vwnd
STNDEX  =
LEVELS  =  850;500
```

```
VCOORD  = pres
DATTIM  = last
DTAAREA = data
GUESS   =
GAMMA   = .3
SEARCH  = 10
NPASS   = 2
```

2. Do the surface analysis for the same parameters. Include a pressure analysis also.

```
SNPARM  = tmpc;dwpc;uwnd;vwnd;pres
LEVELS  = 0
```

3. Repeat the wind analysis using the 24-hour forecast from the model data stored in model.ngm.

```
SNPARM  = uwnd;vwnd
GUESS   = model.ngm*f24
```

ERROR MESSAGES

[OABSND +10]	No data from ... will be used.
[OABSND +9]	Station parameter ... cannot be computed.
[OABSND +8]	Parameter ... is a character parameter.
[OABSND +7]	Parameter ... cannot be computed.
[OABSND +6]	WARNING: Area is not DATA area in file.
[OABSND +5]	WARNING: The recommended number of passes is 2.
[OABSND +4]	... is invalid for NPASS. It is set to 2.
[OABSND +3]	... is invalid for search. It is set to 20.
[OABSND +2]	WARNING: GAMMA is 0. There will be only 1 pass.
[OABSND +1]	... is invalid for GAMMA. It is set to .3 .
[OABSND -1]	Fatal error initializing TAE.
[OABSND -2]	Fatal error reading TAE parameters.
[OABSND -3]	Fatal error initializing GEMPLT.
[OABSND -4]	Grid size is too large.
[OABSND -5]	Not enough buffer space; reduce number of grids.
[OABSND -6]	There are too many stations in data subset area.
[OABSND -7]	There are too few stations in data subset area.
[OABSND -8]	There are no times in the surface file.
[OABSND -9]	No valid parameters have been entered.
[OABSND -10]	LEVELS cannot contain a range.
[OABSND -11]	Sounding file could not be opened.
[OABSND -12]	Time cannot be found in ... .

4.31 PROGRAM OAGRID

OAGRID creates a GEMPAK grid file which can be used in a Barnes objective analysis program.

INPUT PARAMETERS

GDFILE	*Grid file
DELTAN	*Station spacing
DELTAX	*X spacing
DELTAY	*Y spacing
GRDAREA	*Area covered by grid
EXTEND	*Points to extend grid
DTAAREA	*Data area for OA
SOURCE	*Data source (SN or SF)
SNFILE	*Sounding data file
SFFILE	*Surface data file
SNPARM	*Sounding parameter list
SFPARM	*Surface parameter list
DATTIM	*Date/time
LEVELS	*Vertical levels
MAXGRD	*Maximum number of grids

PROGRAM DESCRIPTION

This program allows the user to create a GEMPAK grid file which contains the information required to perform a Barnes objective analysis.

The output grids will be evenly spaced latitude/longitude (CED) grids. Three areas used by the objective analysis programs are defined in this program. GRDAREA defines a region for the output grid. The upper right corner specified will be moved toward the lower left in order to align it on a grid point.

The second area, defined by EXTEND, is used to extend the grid area outward by some number of grid points. This area is used as a first-pass grid area in the objective analysis. The default EXTEND values are 2,2,2,2.

DTAAREA defines the area over which station data will be input to the analysis. Only data within the EXTEND area are used for the second pass. If a value for DTAAREA is not specified, the EXTEND area will be used.

If values for the station spacing and grid spacings, DELTAN,

DELTAX, and DELTAY, are all specified by the user, they are stored in the grid file for use by the analysis programs. If any of these numbers is 0, a suggested station spacing is computed using the station data from the file specified. This station spacing will be used to compute values for DELTAX and DELTAY. The computed station spacing is the average of the average minimum station spacing and the uniform station spacing. These station spacing values are computed using the stations reporting data for the first DATTIM. The average minimum station spacing is the average of the distances from each station to its closest station. The uniform spacing is the spacing that would be found between stations if they were evenly spaced over the data area.

GDCFIL can also be used to create grid files. OAGRID creates only CED grids, but values for the grid spacing and station spacing are estimated from the input surface or upper air file. GDCFIL creates grid files for grids in any projection, but the grid spacing and station spacing must be input directly.

EXAMPLES

1. Create a grid file called TEST.GRD. Use the surface temperature data at the latest time from stations in the surface file SURFDAT to compute the station spacing. The grid area is WV; use defaults for the remaining parameters. Create a file which can contain up to 100 grids.

```
GDFILE   = test.grd
DELTAN   = 0.
DELTAX   = 0.
DELTAY   = 0.
GRDAREA  = wv
EXTEND   = 2;2;2;2
DTAAREA  =
SOURCE   = sf
SFFILE   = surfdat
SFPARM   = tmpf
DATTIM   = last
LEVELS   = 0
MAXGRD   = 100
```

2. Create a grid file called GRID.GRD with a station spacing of 5, x spacing of 3 and y spacing of 4. The grid area is over PA; the extended grid area should include 1 grid point in each direction; the data area is PA-.

```
GDFILE   = grid.grd
DELTAN   = 5.
DELTAX   = 3.
```

```
DELTAY   = 4.
GRDAREA  = pa
EXTEND   = 1;1;1;1
DTAAREA  = pa-
```

ERROR MESSAGES

[OAGRID -1]	Fatal error initializing TAE.
[OAGRID -2]	Fatal error reading TAE parameters.
[OAGRID -3]	... is invalid for GRDAREA.
[OAGRID -4]	... is invalid for DTAAREA.
[OAGRID -5]	No data file name specified.
[OAGRID -6]	Parameter input is invalid.
[OAGRID -7]	Parameter ... cannot be calculated.
[OAGRID -8]	Invalid value for DELTAX or DELTAY.
[OAGRID -9]	Too few stations to calculate DELTAN.
[OAGRID -10]	Source must be set to SN or SF.
[OAGRID -11]	Station data file is invalid.
[OAGRID -12]	Invalid time requested.
[OAGRID -13]	Invalid level requested.

4.32 PROGRAM SFCFIL

SFCFIL creates a new GEMPAK surface file.

INPUT PARAMETERS

SFOUTF	*Output surface file
SFPRMF	*Surface parameter packing file
STNFIL	*Station information file
SHIPFL	*Ship data file flag
TIMSTN	*Times/additional stations

PROGRAM DESCRIPTION

SFCFIL creates a GEMPAK surface file. The file may be a standard file or a ship format file.

If SHIPFL is set to YES, a ship format file is created. In this case, both station location and time are stored with each data entry. This capability is useful when the station location varies in time, such as for moving ships, aircraft or free-floating buoys.

If a standard file is to be created, the maximum number of times to be included in the file must be entered as the first value in TIMSTN. If a ship format file is being created, the maximum number of entries in the file is given by the first value in TIMSTN.

If STNFIL is not blank, information about all the stations in STNFIL will be added to the data set. Space will be left in the file for the additional number of stations specified as the second parameter in TIMSTN. Note that an error will result if STNFIL is blank and TIMSTN does not request more stations.

SFPRMF contains information about the parameters to be included in the file. SFPRMF may be either a list of parameters or the name of a packing file. If a list is entered, the parameters must be separated with semicolons; packing information may also be included after a slash with the minimum and maximum values and the resolution separated by dashes. For example, to include temperature and dewpoint in a file without packing, SFPRMF may be entered as :

SFPRMF = TMPC;DWPC

To pack the data, use:

```
SFPRMF = TMPC/-127-63-.1;DWPC/-63-63-1
```

SFPRMF may also contain the name of a packing file. A packing file for data which is not to be packed contains a list of parameters with one parameter per line. In a file for packed data, each line must include the parameter name, the minimum and maximum data values and the resolution, all separated with spaces. The default packing file for surface data is GEMTABL:SFPACK.TBL.

EXAMPLES

1. Create a surface file called SURF.DAT with a maximum of 15 times using the default station and parameter files. Leave room in the file for 100 stations in addition to the stations in STNFIL. Use the GEMPAK standard packing file and table file.

```
SFOUTF  =  surf.dat
SFPRMF  =  gemtabl:sfpack.tbl
STNFIL  =  gemtabl:stations.tbl
SHIPFL  =  NO
TIMSTN  =  15/100
```

2. Create a ship format file which can contain a maximum of 1000 ship reports. Use a locally developed parameter file named SHIP.PRM for packing.

```
SFOUTF  =  ship.dat
SFPRMF  =  ship.prm
STNFIL  =
SHIPFL  =  YES
TIMSTN  =  1000
```

ERROR MESSAGES

```
[SFCFIL  +2]   WARNING! ADDSTN was negative -- set to 0.
[SFCFIL  +1]   Cannot add stn to a ship file; STNFIL ignored.
[SFCFIL  -1]   Fatal error initializing TAE.
[SFCFIL  -2]   Fatal error reading TAE parameters.
[SFCFIL  -3]   Error opening station file ... .
[SFCFIL  -4]   File does not include room for any stations.
[SFCFIL  -5]   File does not include room for any times.
[SFCFIL  -6]   SFPRMF is incorrectly specified.
[SFCFIL  -7]   The output file name is blank.
```

4.33 PROGRAM SFCNVRT

SFCNVRT converts a GEMPAK3 surface file to a GEMPAK5 surface file.

INPUT PARAMETERS

OLDSFC	*GEMPAK3 surface file
SFOUTF	*Output surface file
DATTIM	*Date/time

PROGRAM DESCRIPTION

SFCNVRT creates a new GEMPAK surface data file and adds all the data at the requested times to the new file. All the stations in the original file will be included in the output file. No AREA subset is available. Since this program will create a new file each time that it is run, all the times to be converted must be specified in DATTIM. This program does not include a dynamic tutor, so new values cannot be input once SFCFIL is run.

There is no difference between GEMPAK4 and GEMPAK5 surface files. This program is used to convert GEMPAK3 files since later GEMPAK programs cannot be run with the GEMPAK3 files.

ERROR MESSAGES

[SFCNVRT -1]	Fatal error initializing TAE.
[SFCNVRT -2]	Fatal error reading TAE parameters.
[SFCNVRT -3]	Error opening old file ....
[SFCNVRT -4]	Error creating new file ....
[SFCNVRT -5]	Error reading times from old file.
[SFCNVRT -6]	Error finding times to process.

4.34 PROGRAM SFDELT

SFDELT deletes data from a surface data file.

INPUT PARAMETERS

SFFILE	*Surface data file
DATTIM	*Date/time
AREA	*Data area

PROGRAM DESCRIPTION

SFDELT deletes data from a surface data file. The stations to be deleted may be specified in AREA; the times to be deleted are given in DATTIM.

If AREA is set to DSET or ALL, all the data present at the times in DATTIM will be deleted, along with the headers for those times.

If AREA specifies a list of stations to be deleted, only the data for those stations at the specified times will be deleted. The station and time information in the file will remain unchanged.

EXAMPLES

1. Delete all the data at time 850722/1200.

```
SFFILE  =  85jul.sfc
DATTIM  =  850722/1200
AREA    =  dset
```

2. Delete data at BWI for the most recent time in the file.

```
SFFILE  =  realtime.sfc
DATTIM  =  last
AREA    =  @bwi
```

ERROR MESSAGES

[SFDELT -1]	Fatal error initializing TAE.
[SFDELT -2]	Fatal error reading TAE parameters.
[SFDELT -3]	Error deleting data at time ....

4.35 PROGRAM SFEDIT

SFEDIT adds or changes data in a surface file using a sequential text file.

INPUT PARAMETERS

SFEFIL	*Surface edit file
SFFILE	*Surface data file

PROGRAM DESCRIPTION

SFEDIT adds information from a sequential text file to an existing GEMPAK surface file. The program may be used to add new data to a file or to change existing values. The output file must already exist.

The data to be added must reside in a text file, SFEFIL. This file can be created by specifying F as the output device in GEMPAK program SFLIST or by generating the file with a text editor. A text editor may be used to change the file.

The parameters to be edited must be specified at the beginning of the edit file, for example: PARM=TMPF;DWPF. Only parameters stored in the output file can be edited. Parameters that have character values, such as WTHR, are stored as real numbers. Thus, the numeric weather code must be used. Station information, such as the latitude, SLAT, cannot be changed using this program. Rather, these changes can be made using the GEMPAK program, SFSTNS.

The data follow the parameter list. Each data listing must include the time, followed by the station character or numeric identifier followed by the data. If data are missing, the current missing data value, -9999., must be used. Blank fields will not be recognized.

If a station or time does not exist in the output file it will be added to the file. If stations are added, GEMPAK program SFSTNS should be used to add station latitudes, longitudes and elevations.

EXAMPLES

1. Change values of TMPF and DWPF in the file SFCDATA.DAT.

```
SFEFIL  = sflist.fil
SFFILE  = sfcdata.dat

The file SFLIST.FIL follows.  Note that the second line
containing titles is ignored.

PARM = TMPF;DWPF
STN   YYMMDD/HHMM       TMPF      DWPF
BWI   850426/0400      55.40     42.80
SBY   850426/0400      62.60     55.40
NHK   850426/0400      55.40     42.80
```

The program replaces the temperature and dewpoint for stations BWI, SBY and NHK at the given time values in output file SFCDATA.DAT.

ERROR MESSAGES

```
[SFEDIT  +2]    Station ... cannot be added to the file.
[SFEDIT  -1]    Fatal error initializing TAE.
[SFEDIT  -2]    Fatal error reading TAE parameters.
[SFEDIT  -3]    Edit file ... cannot be opened.
[SFEDIT  -5]    PARM keyword not found.
[SFEDIT  -6]    Too many parameters to edit.
[SFEDIT  -7]    Time ... cannot be added to data set.
[SFEDIT  -8]    Parameter ... is not in the data set.
[SFEDIT  -9]    SFEDIT cannot continue with invalid parameters.
```

4.36 PROGRAM SFGRAM

SFGRAM draws a meteogram for surface data.

INPUT PARAMETERS

SFFILE	*Surface data file
DATTIM	*Date/time
STATION	*Stations
TRACE1	*Parms/colors/range/witness
TRACE2	*Parms/colors/range/witness
TRACE3	*Parms/colors/range/witness
TRACE4	*Parms/colors/range/witness
TRACE5	*Parms/colors/range/witness
NTRACE	*Number of traces
TAXIS	*Time1-time2-tinc;lbl;gln;tck
BORDER	*Background color/dash/width
MARKER	*Marker color/type/size/width/hw
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
DEVICE	*Graphics device
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

SFGRAM draws a time series plot for surface data. Up to five traces may be drawn in a single plot. NTRACE determines the number of traces to draw. If NTRACE is 5, the plot area will be divided into fifths; if NTRACE is 4, the plot area will be divided into fourths, etc. If STATION is a single station, all the traces will be for that station. If STATION is a list of stations, TRACE1 will plot data from the first station, TRACE2 will plot data from the second station, etc.

Each TRACE parameter contains specifications for the parameters to be plotted in the corresponding trace. The format for each trace is:

parms/colors/range/witnes!parms/colors/range/witnes

The parameters before the ! will be plotted on the left of the plot; those after the ! will be plotted on the right. Any GEMPAK surface parameter may be entered. Real valued parameters will be drawn as a graph. Character valued parameters will be rotated 90 degrees and written on the plot. In addition to the standard surface parameters, the following are also valid:

BARB -- wind barbs
ARRW -- wind arrows
DARR -- directional arrows
WSYM -- weather symbols

For GUST and GUMS, the character, G, will be plotted.

Up to four parameters may be plotted along each axis. The parameters must be separated using semicolons. Character and weather symbol data may only be plotted in positions 1, 2 or 3, where position 1 is at the bottom of the trace, position 2 is in the middle and position 3 is at the top.

Each parameter name may be followed by an asterisk, the size or line dash type, a second asterisk, and the width. For example, WSYM*.5*5 will draw weather symbols half the default size with a line width of 5. TMPF*3 will plot a temperature line using dash pattern 3.

The colors for the parameters must also be separated using semicolons. If a single number is entered, all parameters are drawn in that color. If a zero is entered, the current default color is used.

The range specifies the scaling of the y axis. The format is:

start;stop;increment

Note that, in this program, the parts of range must be separated using semicolons. If no range is given, it is selected using the data values.

Witness lines are specified in witnes. These are horizontal dotted lines. A list of y values, separated by semicolons, may be entered. Alternatively, if the value of witnes is YES, a witness line will be centered on the plot.

The time axis is specified in TAXIS as a minimum time, a maximum time, and a time increment separated with dashes. If any or all of the parts of TAXIS is blank, reasonable values will be selected by the program.

EXAMPLES

1. Plot a meteogram for BWI using all the times in the file. Use the default time axis and background colors. Do not plot markers. TRACE1 plots TMPC and DWPC in colors 2 and 3 with a data range from -10 to 30 degrees and a witness line at 0 degrees. TRACE2 will plot VSBY using a

solid line connecting points with labels on the left and PMSL using a dashed line with labels on the right. TRACE3 plots directional arrows at the bottom of the plot along with the wind speed in knots and wind gusts. TRACE4 plots cloud cover codes at the bottom and weather symbols with size = .6 at the top. TRACE5 plots the ALTM.

```
SFFILE   = nws$data:sfdata.sfc
DATTIM   = all
STATION  = @bwi
TRACE1   = tmpc;dwpc/2;3/-10;30;10/0
TRACE2   = vsby!pmsl*3
TRACE3   = darr;sknt;gust
TRACE4   = clds;;wsym*.6
TRACE5   = altm
NTRACE   = 5
TAXIS    =
BORDER   = 1
MARKER   = 0
TITLE    = 1
CLEAR    = yes
DEVICE   = qm
TEXT     =
```

ERROR MESSAGES

[SFGRAM +3]	Hardware text cannot generally be rotated.
[SFGRAM -1]	Fatal error initializing TAE.
[SFGRAM -2]	Fatal error reading TAE parameters.
[SFGRAM -3]	Fatal error initializing GEMPLT.
[SFGRAM -4]	No stations have been entered.
[SFGRAM -5]	... cannot be plotted in position 4.
[SFGRAM -6]	The time range along the x axis is 0.
[SFGRAM -7]	The parameter ... cannot be computed.
[SFGRAM -8]	The graph coordinates are invalid.
[SFGRAM -9]	There is no data at station ....
[SFGRAM -10]	Station ... is invalid.
[SFGRAM -11]	There are no times in the file.
[SFGRAM -12]	The time ... is invalid.
[SFGRAM -14]	The file ... cannot be opened.
[SFGRAM -15]	There are no parameters specified.
[SFGRAM -16]	Error in specifying TAXIS.

4.37 PROGRAM SFL604

SFL604 lists data from a GEMPAK surface file in a fixed format.

INPUT PARAMETERS

SFFILE	*Surface data file
AREA	*Data area
DATTIM	*Date/time
OUTPUT	*Output device (TPF)
SKPMIS	*Skip missing data flag
IDNTYP	*STNM or STID
SFPARM	*Surface parameter list

PROGRAM DESCRIPTION

SFL604 lists data from a surface file in a format designed to display AIRWAYS data.

Data will be listed for the stations and times requested in AREA and DATTIM. If SKPMIS is YES, stations which are within the area requested, but which have not reported data, will not be listed. If SKPMIS is set to NO, then only the date and station identifier will be listed for nonreporting stations.

Stations may be identified in the output listing by character or numeric identifier. This is accomplished by setting IDNTYP to STID or STNM.

This program will list predefined parameters only. However, stations may be selected using conditions in SFPARM. For example, if SFPARM = WTHR=S+, then only those stations reporting heavy snow will be listed. The conditions specified in SFPARM can be for any computable parameter, not just those which will be listed.

EXAMPLES

1. List the data to a file for all the stations in Maryland at the most recent time.

```
SFFILE  =  nws$data:newsfc.dat
AREA    =  @md
DATTIM  =  last
OUTPUT  =  f
SKPMIS  =  yes
```

```
IDNTYP  =  stid
SFPARM  =
```

2. List the data at 12Z and 13Z at BWI and DCA. The following parameters must be changed from example 1:

```
DATTIM  =  /12-/13
AREA    =  @bwi;dca
```

3. List all stations in Delaware, including nonreporting stations. Identify the stations with a station number. The following parameters must be changed from example 1:

```
AREA    =  @de
SKPMIS  =  no
IDNTYP  =  stnm
```

4. List all stations reporting temperatures greater than or equal to 75 degrees. The following parameters must be changed from example 1:

```
SFPARM = tmpf>75
```

ERROR MESSAGES

```
[SFL604  +1]   Parameter ... cannot be computed.
[SFL604  -1]   Fatal error initializing TAE.
[SFL604  -2]   Fatal error reading TAE parameters.
[SFL604  -3]   No valid stations could be found.
[SFL604  -4]   No parameters can be computed.
```

4.38 PROGRAM SFLIST

SFLIST lists surface data from a GEMPAK surface data file.

INPUT PARAMETERS

SFFILE	*Surface data file
AREA	*Data area
DATTIM	*Date/time
SFPARM	*Surface parameter list
OUTPUT	*Output device (TPF)
IDNTYP	*STNM or STID

PROGRAM DESCRIPTION

SFLIST lists any parameters which can be derived from the data in a surface data file. The stations and times to be included are specified in AREA and DATTIM. If no data are reported for a station, that station will not be listed. The listings will be grouped by time.

Conditions can be specified for the parameters. The conditions are documented in the SFPARM documentation.

EXAMPLES

1. List the air and dewpoint temperatures in Fahrenheit and the mean sea-level pressure of the stations in Maryland for the latest time:

```
SFFILE  =  nws$data:newsfc.dat
AREA    =  @md
DATTIM  =  last
SFPARM  =  tmpf;dwpf;pmsl
OUTPUT  =  t
IDNTYP  =  stid
```

2. List the same parameters for DCA, and ORD at 0900 and 1000 GMT at the terminal and line printer. Identify stations by their station numbers.

```
AREA    =  @dca;ord
DATTIM  =  09-10
OUTPUT  =  tp
IDNTYP  =  stnm
```

3. List the temperature, dewpoint, weather and cloud cover for stations in Maryland which are reporting any snow.

```
AREA    = @md
DATTIM  = last
SFPARM  = tmpf;dwpf;wthr=s-/s/s+;clds
OUTPUT  = t
IDNTYP  = stid
```

ERROR MESSAGES

[SFLIST +1]	Parameter ... is not computable.
[SFLIST -1]	Fatal error initializing TAE.
[SFLIST -2]	Fatal error reading TAE parameters.
[SFLIST -3]	No stations reporting data.
[SFLIST -4]	No valid computable parameters.

4.39 PROGRAM SFMAP

SFMAP plots surface station data on a map.

INPUT PARAMETERS

AREA	*Data area
GAREA	*Graphics area
SFPARM	*Surface parameter list
DATTIM	*Date/time
SFFILE	*Surface data file
COLORS	*Color list
WIND	*Wind symbol/siz/wdth/typ/hdsz
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
MARKER	*Marker color/type/size/width/hw
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
PANEL	*Panel location/color/dash/width
DEVICE	*Graphics device
PROJ	*Map projection/angles/margins
FILTER	*Filter data flag
TEXT	*Text size/font/hw flag
SKPMIS	*Skip missing data flag

PROGRAM DESCRIPTION

SFMAP plots data at station locations on a map. Any parameter that can be computed from the parameters in the data set can be displayed.

The order of the input parameters determines their location on the plot. Parameters are separated by semicolons. A position may be skipped by entering two consecutive semicolons or entering the name SPAC or BLNK. A parameter will be plotted centered at the station if it is the last parameter in the list and the symbol @ is appended to the name. The following chart shows the location on the model of each position.

```
        7
  1     9     3
  2     +     4
  5    10     6
        8
```

If FILTER is set to YES, the stations will be filtered so that

overlapping stations will not be plotted. If a position is skipped using two semicolons or if the parameter is BLNK, the filter will not allocate the space. The parameter SPAC may be used to reserve the space with the filter option. Then later plots will plot the same stations after filtering, provided that the same parameter locations are specified.

Conditions can be specified for the parameters. The conditions are documented in the SFPARM documentation. Weather symbols can also be plotted. The size and width of the symbols can be specified by appending the numbers to the parameter name using a * as a separator. For example, WSYM*2*5 will plot weather symbols with size of 2. and line width of 5.

EXAMPLES

1. Plot a polar stereographic map with stations in the area centered on Maryland with temperature, dewpoint, and the character weather code for the latest time. Use positions 1, 2 and 4, and filter overlapping stations. Do not plot markers where data are missing. Plot wind barbs in knots using color 2.

```
AREA    = md
GAREA   = md
SFPARM  = tmpf;dwpf;;wthr
DATTIM  = last
SFFILE  = nws$data:newsfc.dat
COLORS  = 2;3;4
WIND    = bk2
MAP     = 2
MARKER  = 3
TITLE   = 5
SKPMIS  = yes
CLEAR   = yes
DEVICE  = ct
PROJ    = nps
FILTER  = yes
```

2. Plot a Mercator map of the Washington DC area with temperatures to the left of the station and mixing ratio to the right. Do not clear the screen prior to plotting. Draw the map using dash pattern 3. Do not plot any wind symbols. The changes from example 1 are:

```
AREA    = dca**
GAREA   = dca**
SFPARM  = ;tmpf;;mixr
WIND    = 0
MAP     = 1/3
```

```
CLEAR   = no
PROJ    = mer
```

3. Plot only weather symbols centered at the station. Change the size of the weather symbol to half the default size and the line width to 5.

```
MARKER  = 0
SFPARM  = wsym@*.5*5
```

ERROR MESSAGES

[SFMAP -1]	Fatal error initializing TAE.
[SFMAP -2]	Fatal error reading TAE parameters.
[SFMAP -3]	Fatal error initializing GEMPLT.
[SFMAP -4]	Parameter ... is not calculable.
[SFMAP -5]	Winds are not calculable.

4.40 PROGRAM SFMOD

SFMOD moves selected surface data from an input surface file to an output surface file.

INPUT PARAMETERS

SFFILE	*Surface data file
SFOUTF	*Output surface file
DATTIM	*Date/time
AREA	*Data area

PROGRAM DESCRIPTION

SFMOD takes data from an existing GEMPAK surface file, SFFILE, and writes the data into another existing surface file, SFOUTF. This program can be used to subset the original data set by time and/or stations.

This program will not create a new surface file. The GEMPAK program, SFCFIL, can be used to create a surface file. If the parameters in the output file are not the same as the parameters in the input file, the required parameter conversions will be done.

If a requested station or time is not in the output file, it will be added to the file if there is room. The number of times and stations that can be included in a file is specified by TIMSTN in SFCFIL.

EXAMPLES

1. Put the data for all stations at the latest time in file TEST.SFC into a file called LAST.SFC.

   SFFILE = test.sfc
   SFOUTF = last.sfc
   DATTIM = last
   AREA = dset

2. Put the data for stations in Maryland and Virginia for all times into the output data set.

   SFFILE = test.sfc
   SFOUTF = last.sfc
   DATTIM = all

AREA = @md/@va

ERROR MESSAGES

[SFMOD +3]	Some stations were not added to file.
[SFMOD +2]	Character parameter cannot be used: ...
[SFMOD +1]	Parameter ... cannot be calculated.
[SFMOD -1]	Fatal error initializing TAE.
[SFMOD -2]	Fatal error reading TAE parameters.
[SFMOD -3]	There are no parameters to be computed.
[SFMOD -4]	Time ... cannot be added.

4.41 PROGRAM SFRAWD

SFRAWD decodes raw surface data files and writes the output to a GEMPAK surface file.

INPUT PARAMETERS

```
SFFILE    *Surface data file
SFEFIL    *Surface edit file
DATTIM    *Date/time
ADDSTN    *Add station flag
CTLFLG    PARM NAME=CTLFLG     TYPE=(STRING,4)    DEFAULT=@$CTLFLG

          *Control character flag
OUTPUT    *Output device (TPF)
```

PROGRAM DESCRIPTION

SFRAWD decodes raw surface data stored in the text file, SFEFIL. The decoded data is stored in a GEMPAK surface data file, SFFILE. This file must already exist. It can be created using SFCFIL. The following parameters will be decoded:

PMSL ALTI TMPF DWPF SKNT DRCT GUST WNUM
CHC1 CHC2 CHC3 VSBY

If any of these parameters has not been included in the file, an error message will be written. A packing file for these parameters can be found in GEMTABL:SFPACK.TBL.

The raw input file must contain either whole bulletins as received from the Domestic Data Service or a series of station reports. If the data set contains bulletins, the records in the file must be 80 bytes each, and each bulletin must begin with a <CNTL>A in column 1. If the input contains reports, each report must be written on a single line. CTLFLG is a logical variable indicating whether control characters are present. If CTLFLG = YES, the input file must contain bulletins. If CTLFLG = NO, the file must have reports.

ADDSTN is a logical variable which determines whether stations not already in the file will be added to the file.

DATTIM is a range of times which will be included in the file. The range should consist of a start time and an end time separated with a dash. If only one time is included, 24 hours

of data will be saved. These times must be entered as full GEMPAK times. Note that if the input file has reports, rather than bulletins, the year, month and day will all be obtained from the last time. Thus the times cannot span days. If the input file contains bulletins, the day will be obtained from the bulletin header and the year and month from the last time.

OUTPUT specifies the output device for optional messages. These messages will include times and stations added to the file and stations which are not included in the file. If OUTPUT = N, no output will be written.

Note that this program will execute slowly. This is to be expected.

EXAMPLES

1. Decode the data from a surface archive file containing bulletins from the Domestic Data Service. Do not add any stations to the file. Process only the times from 05 UTC to 12 UTC. Write the output to a file called mar22.dat.

```
SFFILE  =  mar22.sfc
SFEFIL  =  mar22.surf
DATTIM  =  900322/0500-900322/1200
CTLFLG  =  yes
ADDSTN  =  no
OUTPUT  =  f/mar22.dat
```

2. Decode the reports from BWI which were entered by hand in a text file. Do not write any optional output.

```
SFFILE  =  bwi22.sfc
SFEFIL  =  bwi22.surf
DATTIM  =  900322/0000-900322/2300
CTLFLG  =  no
ADDSTN  =  no
OUTPUT  =  n
```

ERROR MESSAGES

[SFRAWD -1]	Fatal error initializing TAE.
[SFRAWD -2]	Fatal error reading TAE parameters.
[SFRAWD -3]	Parameter ... is not in the data set.
[SFRAWD -4]	The last time in ... is invalid.
[SFRAWD -5]	The first time in ... is invalid.

4.42 PROGRAM SFSTNS

SFSTNS modifies the station information in a surface file.

INPUT PARAMETERS

SFFILE	*Surface data file
STNFIL	*Station information file
ADDSTN	*Add station flag
IDNTYP	*STNM or STID

PROGRAM DESCRIPTION

SFSTNS updates the station information in a GEMPAK surface file. The station information includes the character station identifier, STID, the station number, STNM, the latitude, SLAT, the longitude, SLON, the elevation, SELV, the state, STAT, and the country, COUN.

This information must be stored in a fixed format in the table file specified in STNFIL. See the default table for an example of the required format. Station names may be included, but are not used. The current default GEMPAK surface station table for US and Canadian stations is GEMTABL:SFSTNS.TBL .

ADDSTN is a logical parameter that indicates whether stations which are in the table file but not already in the surface file will also be added to the surface file.

IDNTYP governs whether station numbers, STNM, or character identifiers, STID, will be used to identify stations in the table.

EXAMPLES

1. Update surface file called SURF.DAT with station information from MYSTN.DAT, adding stations that are not already in the surface file.

```
SFFILE  =  surf.dat
STNFIL  =  mystn.dat
ADDSTN  =  yes
IDNTYP  =  stid
```

ERROR MESSAGES

```
[SFSTNS  +1]   WARNING! No stations were updated.
[SFSTNS  -1]   Fatal error initializing TAE.
[SFSTNS  -2]   Fatal error reading TAE parameters.
[SFSTNS  -3]   Invalid input for IDNTYP; must be STID or STNM.
[SFSTNS  -4]   STNFIL ... cannot be opened.
```

4.43 PROGRAM SNCFIL

SNCFIL creates a new GEMPAK sounding file.

INPUT PARAMETERS

SNOUTF	*Output sounding file
SNPRMF	*Sounding parameter packing file
STNFIL	*Station information file
MRGDAT	*Merge data file flag/part type
TIMSTN	*Times/additional stations

PROGRAM DESCRIPTION

SNCFIL creates a GEMPAK sounding file. The file may be created to store merged or unmerged data. Merged data files may contain any meteorological parameters with all parameters included at each level. Unmerged files store the mandatory data and significant-level temperature and wind data as separate parts.

MRGDAT must be set to YES or NO. If YES, a merged file will be created. The parameters to be included in the file must be specified in SNPRMF. If MRGDAT is NO, an unmerged file will be created. In this case, the type of unmerged file file should be included following a slash. Type 1 will create a file with only mandatory data below 100 mb. Type 2 specifies a file with mandatory and significant-level data below 100 mb, and type 3, which is the default, specifies a file with mandatory and significant-level data below and above 100 mb.

SNPRMF contains information about the parameters to be included in a merged file. Either a list of parameters or the name of a packing file may be entered. If a list is entered, the parameters must be separated with semicolons; packing information may also be included after a slash with the minimum and maximum values and the resolution separated using dashes. For example, to include temperature and dewpoint in a file without packing, SNPRMF may be entered as:

```
SNPRMF = TMPC;DWPC
```

To pack the data, use:

```
SNPRMF = TMPC/-127-63-.1;DWPC/-63-63-1
```

SNPRMF may also contain the name of a packing file. A packing file for data which is not to be packed contains a list of parameters with one parameter per line. In a file for packed data, each line must include the parameter name, the minimum and maximum data values and the resolution, all separated with spaces. The default packing file for merged sounding data is GEMTABL:SNPACK.TBL.

If STNFIL is not blank, information about all the stations in STNFIL will be added to the data set. Space will be left in the file for the additional number of stations specified as the second parameter in TIMSTN. Note that an error will result if STNFIL is blank and TIMSTN does not request additional stations.

EXAMPLES

1. Create a sounding file called SOUND.DAT which will contain merged data. Use the standard station and parameter files. Leave room in the file for 100 stations in addition to the stations in STNFIL and allow 15 times to be added to the file.

```
SNOUTF  =  sound.dat
SNPRMF  =  gemtabl:snpack.tbl
STNFIL  =  gemtabl:snstns.tbl
MRGDAT  =  yes
TIMSTN  =  15/100
```

2. Create an unmerged sounding file called WEEKLY.SND which will store mandatory and significant-level data below and above 100 mb. Do not add any stations now. Leave room for 14 times and 300 stations.

```
SNOUTF  =  weekly.snd
SNPRMF  =
STNFIL  =
MRGDAT  =  no/3
TIMSTN  =  14/300
```

ERROR MESSAGES

```
[SNCFIL  +2]   Negative number of stations entered -- 0 used.
[SNCFIL  -1]   Fatal error initializing TAE.
[SNCFIL  -2]   Fatal error reading TAE parameters.
[SNCFIL  -3]   Error opening station file ... .
[SNCFIL  -4]   File does not include room for any stations.
[SNCFIL  -5]   File does not include room for any times.
[SNCFIL  -6]   SNPRMF is incorrectly specified.
[SNCFIL  -7]   The file name for the new file is blank.
```

4.44 PROGRAM SNCNVRT

SNCNVRT converts GEMPAK3 sounding files to GEMPAK5 sounding files.

INPUT PARAMETERS

OLDSND	*GEMPAK3 sounding file
SNOUTF	*Output sounding file
TIMSTN	*Times/additional stations

PROGRAM DESCRIPTION

SNCNVRT adds the data from a GEMPAK3 sounding file to a GEMPAK5 file. All the stations in the old file will be included in the output file. No AREA subset is available.

If the GEMPAK file is an existing file, data will be added to the file. If the file does not exist, a new file will be created. When a new file is created, the maximum number of times and stations that may be added to the file can be specified in TIMSTN. If the number of times and/or stations requested is smaller than the number of times/stations in the GEMPAK3 file, the numbers from the original file will be used.

There is no difference between GEMPAK4 and GEMPAK5 sounding files. This program is used to convert GEMPAK3 files since later GEMPAK programs cannot be run with these files.

EXAMPLES

1. Create a new file, GEMPAK.SND which can contain a maximum of 4 times and 175 stations. Convert the data in the GEMPAK3 file, 84DEC12Z.SND , which contains 1 time and 137 stations and write the converted data to GEMPAK.SND .

   ```
   OLDSND = 84dec12z.snd
   SNOUTF = gempak.snd
   TIMSTN = 4/175
   ```

2. Add the data in the GEMPAK3 file called 84DEC0Z.SND to the file GEMPAK.SND which was created in example 1. Note that the values in TIMSTN will not be used, since the file already exists.

   ```
   OLDSND = 84dec0z.snd
   ```

```
SNOUTF = gempak.snd
TIMSTN = 0
```

ERROR MESSAGES

[SNCNVRT +1]	Station ... cannot be added to file.
[SNCNVRT -1]	Fatal error initializing TAE.
[SNCNVRT -2]	Fatal error reading TAE parameters.
[SNCNVRT -3]	Error opening GEMPAK3 file ... .
[SNCNVRT -4]	Invalid vertical coordinate in data set.
[SNCNVRT -5]	GEMPAK5 output file ... cannot be opened.
[SNCNVRT -6]	Invalid parameters in existing output file.
[SNCNVRT -7]	Unmerged output file cannot be used.
[SNCNVRT -8]	Invalid number of times to create file.
[SNCNVRT -9]	Invalid number of stations to create file.
[SNCNVRT -10]	Time ... cannot be added to file.
[SNCNVRT -11]	Time ... is already in output file.

4.45 PROGRAM SNCROSS

SNCROSS draws cross sections through sounding data.

INPUT PARAMETERS

CXSTNS	*Cross-section station line
SNPARM	*Sounding parameter list
SNFILE	*Sounding data file
DATTIM	*Date/time
VCOORD	*Vertical coordinate type
PTYPE	*Plot type/h:w ratio/margins
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
TAXIS	*Time1-time2-tinc;lbl;gln;tck
LINE	*Line color/dash/width/label
BORDER	*Background color/dash/width
CINT	*Contour interval/min/max
WIND	*Wind symbol/siz/wdth/typ/hdsz
TITLE	*Title color/line/title
PANEL	*Panel location/color/dash/width
DEVICE	*Graphics device
CLEAR	*Clear screen flag
FILTER	*Filter data flag
CURVE	*Curve fit type
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

SNCROSS draws cross sections using upper air sounding data. The cross-section line, CXSTNS, must be specified as a list of stations separated with semicolons. Alternatively, a single station may be entered in CXSTNS and a list of times in DATTIM. In this case, a time section will be drawn.

Any parameter that can be computed from the data set parameters can be displayed. The parameter to be displayed is specified in SNPARM. If the value of SNPARM is ISEN, isentropes will be drawn. Note that SNPARM may also be THTA, in which case, potential temperature will be gridded and contoured. ISEN will fit splines to the station data in plot space and then check for tangled lines and untangle them if necessary. When SNPARM = ISEN, the results should be the same as in the GEMPAK4 version of SNCROSS.

The color, line dash and width of the contour lines are set in LINE. The contour interval or spacing of the isentropes is given in CINT. The curve type to be used for generating

the isentropes is set in CURVE. The current curve types are piecewise straight lines, cubic splines with linear ends, cubic splines with parabolic ends, and cubic splines with extrapolated ends. It is recommended that the curve type be set to 2 to use a general spline.

The plot background consists of a pressure axis, a horizontal axis with the station names, a hatched region indicating the part of the plot below the Earth's surface, and vertical lines at each station. The station lines are solid up to the level at which wind data stop, and are dashed from there to the level at which temperature data stop. The color for the entire background is given in BORDER.

The horizontal axis represents a straight line between the first and last stations. The positions of intervening stations are proportional to the perpendicular projections of the actual positions onto the section line. All of these calculations are done in lat/lon coordinates. If the plot is a time section, the times will be displayed on the x axis with the earliest time at the left. If the first character in TAXIS is an R, the earliest time will appear on the right. The rest of the TAXIS input is ignored.

The vertical coordinate may be specified as LIN, LOG, or STUVE; SKEWT is not valid in this program. The bottom and top limits for the y axis are specified in YAXIS, but the axis labelling specifications are ignored.

EXAMPLES

1. Draw isentropes in color 5, line type 2, labelling every line. Plot the background in color 1. Use a logarithmic scale for the y axis and a 4 Kelvin interval for the isentropes. Draw wind barbs in color number 2 at the stations.

```
CXSTNS  =  sep;ggg;jan;ckl;ahn;chs
SNPARM  =  isen
SNFILE  =  sound.snd
DATTIM  =  last
VCOORD  =  pres
PTYPE   =  log
YAXIS   =
TAXIS   =
LINE    =  5/2/1
BORDER  =  1
CINT    =  4
WIND    =  bm2
TITLE   =
```

```
PANEL   = 0
DEVICE  = vt
CLEAR   = yes
FILTER  = yes
CURVE   = 2
TEXT    =
```

2. Draw a time section using all the data in the file for IAD.

```
CXSTNS  = iad
DATTIM  = all
```

ERROR MESSAGES

[SNCROSS -1]	Fatal error initializing TAE.
[SNCROSS -2]	Fatal error reading TAE parameters.
[SNCROSS -3]	GEMPLT initialization error.
[SNCROSS -4]	Vertical coordinate for isentropes must be PRES.
[SNCROSS -5]	There are no times in the file.
[SNCROSS -6]	Fewer than four stations/times were selected.
[SNCROSS -7]	Data buffer is too small.
[SNCROSS -8]	Temperature or pressure data not available.
[SNCROSS -9]	The station ... cannot be found in the data set.
[SNCROSS -10]	Error setting up graph; check invalid LOG axis.
[SNCROSS -11]	Input ... for PTYPE is invalid.
[SNCROSS -12]	Input ... for YAXIS is invalid.
[SNCROSS -13]	Parameter ... is not computable.
[SNCROSS -14]	Parameter ... is a character.
[SNCROSS -15]	The grid coordinates cannot be defined.
[SNCROSS -16]	The station has no data at time ....
[SNCROSS -17]	Data at time ... is not in the file.
[SNCROSS -18]	Wind data cannot be computed.

4.46 PROGRAM SNDELT

SNDELT deletes data from a sounding data file.

INPUT PARAMETERS

SNFILE	*Sounding data file
DATTIM	*Date/time
AREA	*Data area

PROGRAM DESCRIPTION

SNDELT deletes data from a sounding data file. The stations to be deleted are specified in AREA; the times to be deleted are given in DATTIM.

If AREA is set to DSET or ALL, all the data present at the times in DATTIM will be deleted, along with the headers for those times.

If AREA specifies a list of stations to be deleted, only the data for those stations at the specified times will be deleted. In this case, the station and time headers in the file remain unchanged.

EXAMPLES

1. Delete all the data at time 850722/1200.

```
SNFILE  =  85jul.snd
DATTIM  =  850722/1200
AREA    =  dset
```

2. Delete data at IAD for the most recent time in the file.

```
SNFILE  =  realtime.snd
DATTIM  =  last
AREA    =  @iad
```

ERROR MESSAGES

[SNDELT -1]	Fatal error initializing TAE.
[SNDELT -2]	Fatal error reading TAE parameters.
[SNDELT -3]	Error deleting data at time ....

4.47 PROGRAM SNEDIT

SNEDIT adds data in a sequential edit file to a sounding file.

INPUT PARAMETERS

SNEFIL	*Sounding edit file
SNFILE	*Sounding data file
TIMSTN	*Times/additional stations

PROGRAM DESCRIPTION

SNEDIT adds information from a sequential file to a GEMPAK sounding file. It can be used to add or replace data at a station. The program can now be used to add data to either merged or unmerged data sets.

The data to be added must be in a text file, SNEFIL. This file can be created using F as the output device in SNLIST. MRGDAT, which can be set in SNLIST, is a flag indicating whether the data to be written will be unmerged or written as separate parts. If the edit file contains unmerged data, the part name must be included and the parameters must be in the order expected by GEMPAK.

If SNFILE exists, the data will be added to the file. If it does not already exist, a new file will be created. A new file will be a merged or unmerged data set, depending on the type of data in SNEFIL. The maximum number of stations and times allocated in a new file will be read from TIMSTN.

For merged edit data files, the parameters to be edited must be specified at the beginning of the edit file. For example:

PARM=PRES;TMPC;DWPC;DRCT;SPED;HGHT

The parameter line must contain the string, PARM, and =. Note that SNLIST will write SNPARM = xxxx;yyyy;... which is valid. If the parameter list must be continued on the next line, the last character on the current line must be a semicolon. If SNFILE is an existing file, the parameters listed in the edit file must be exactly those in the data set. For unmerged data, information about the parameters is not necessary.

The information to be added to the sounding file consists of station information for a station, followed by station data,

followed by station information for the next station, etc. Station information must be listed as KEYWORD = value, where the valid keywords are STID, STNM, SLAT, SLON, SELV, and TIME. The TIME keyword must be found for each station. Either STID or STNM is also required. If the station is not already in the file, the station identifier, station number, latitude, longitude, and elevation found will be added to the file. If the station is already in the file, the station location and elevation will not be changed. Note that program SNSTNS can be used to modify station header values.

EXAMPLES

1. Add the data in the edit file, SNLIST.FIL, to the file, SOUND.DAT, which does not exist.

```
SNEFIL  = snlist.fil
SNOUTF  = sound.dat
TIMSTN  = 1/ 10

The file SNLIST.FIL follows:

SNPARM = PRES;TEMP;DWPT;DRCT;SPED;HGHT
STNPRM = SHOW;LIFT;KINX

STID = IAD        STNM =    72403   TIME = 841227/1200
SLAT =    38.98   SLON =   -77.46   SELV =    85.0

SHOW =    14.11   LIFT =    25.60   KINX =    11.50

     PRES      TEMP      DWPT      DRCT      SPED      HGHT
  1024.00      2.40     -1.40      0.00      0.00     85.00
  1000.00      2.20     -3.80  -9999.00  -9999.00    277.00
   850.00      5.60     -9.40  -9999.00  -9999.00   1592.00
   700.00     -1.90     -2.30  -9999.00  -9999.00   3167.00
   500.00    -15.70    -22.70  -9999.00  -9999.00   5790.00
   400.00    -28.90    -33.40  -9999.00  -9999.00   7430.00
   300.00    -44.30    -93.30  -9999.00  -9999.00   9420.00
   250.00    -55.30   -104.30  -9999.00  -9999.00  10620.00
   200.00    -66.50   -115.50  -9999.00  -9999.00  12000.00
   150.00    -65.90   -114.90  -9999.00  -9999.00  13750.00
   100.00    -66.90   -115.90  -9999.00  -9999.00  16220.00
```

The file SOUND.DAT will be created. It will contain the parameters PRES;TEMP;DWPT;DRCT;SPED;HGHT. Space for a maximum of 1 time and 10 stations will be allocated. The time 841227/1200 and station IAD will be added to the file and then the data for that time and station will be added. Note that the stability indices will be ignored.

2. Add the data in the edit file, IAD.FIL, to the file, REALTIME.SND, which already exists.

```
SNEFIL  = realtime.snd
SNOUTF  = iad.fil
TIMSTN  = 0
```

The file IAD.FIL follows:

```
STID = IAD         STNM =    72403   TIME = 900823/0000
SLAT =  38.98      SLON =   -77.46   SELV =    85.0

TTAA       0
    PRES        TMPC        DWPC        DRCT        SPED        HGHT
 1008.00       19.20       18.90        0.00        3.00    -9999.00
 1000.00       19.00       18.20    -9999.00    -9999.00      150.00
  850.00       14.40       13.30      160.00        8.00     1538.00
  700.00        5.40        4.30      240.00        6.00     3157.00
  500.00       -8.10       -9.80      215.00        7.00     5850.00
  400.00      -19.90      -49.90      225.00       11.00     7540.00
  300.00      -34.10      -64.10      235.00       18.00     9620.00
  250.00      -44.30    -9999.00      245.00       16.00    10870.00
  200.00      -54.30    -9999.00      250.00       22.00    12330.00
  150.00      -60.50    -9999.00      265.00       14.00    14140.00
  100.00      -64.50    -9999.00      235.00        2.00    16620.00

TTBB       0
    PRES        TMPC        DWPC
 1008.00       19.20       18.90
  850.00       14.40       13.30
  684.00        3.60        1.20
  602.00        0.00       -1.30
  481.00       -9.90      -12.50

PPBB       0
    HGHT        DRCT        SPED
    0.00        0.00        3.00
  914.00      120.00       12.00
 1219.00      130.00       10.00
 1829.00      180.00        7.00
 2134.00      195.00        6.00
 2438.00      210.00        6.00
```

ERROR MESSAGES

```
[SNEDIT  +1]    Data for ... has been added to the file.
[SNEDIT  -1]    Fatal error initializing TAE.
[SNEDIT  -2]    Fatal error reading the TAE parameters.
[SNEDIT  -3]    The edit file cannot be opened.
```

[SNEDIT -4]	List of parameters not found in edit file.
[SNEDIT -5]	Too many parameters in edit file.
[SNEDIT -6]	Edit file ... cannot be opened.
[SNEDIT -7]	Error creating new sounding file ....
[SNEDIT -8]	Edit file parms don't match those in data set.
[SNEDIT -9]	First parameter not a valid vertical coordinate.
[SNEDIT -10]	Error opening existing sounding file ....
[SNEDIT -11]	Cannot write merged data to unmerged data set.
[SNEDIT -12]	Sounding file can't be created with MAXTIM <= 0.
[SNEDIT -13]	Sounding file can't be created with MAXSTN <= 0.
[SNEDIT -14]	The time ... was not added to the file.
[SNEDIT -15]	The station ... was not added to the file.
[SNEDIT -16]	Error writing data to file.
[SNEDIT -17]	The part ... has invalid parameters.
[SNEDIT -18]	Edit file ... has an invalid format.
[SNEDIT -19]	Station ... has an invalid format.
[SNEDIT -20]	Cannot write unmerged data to merged data set.

4.48 PROGRAM SNHODO

SNHODO draws a hodograph of upper air data.

INPUT PARAMETERS

SNFILE	*Sounding data file
AREA	*Data area
LINE	*Line color/dash/width/label
MARKER	*Marker color/type/size/width/hw
BORDER	*Background color/dash/width
TITLE	*Title color/line/title
XAXIS	*Xstrt/xstop/xinc/lbl;gln;tck
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
DATTIM	*Date/time
CLEAR	*Clear screen flag
DEVICE	*Graphics device
PANEL	*Panel location/color/dash/width
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

SNHODO draws a hodograph which represents the vertical distribution of the horizontal wind at a station. The winds are plotted in meters/sec.

The line color, line type, and width are specified in LINE. The marker color, type, and size are specified in MARKER. The levels at which the line will be labeled are specified in LEVELS; VCOORD specifies the vertical coordinate for LEVELS.

The x and y axis limits are specified in XAXIS and YAXIS. If these values are blank, the axes will be scaled to the actual data.

EXAMPLES

1. Plot hodographs for stations in Texas at 1200 UTC of the last day in the data set. Label the hodograph every 50 mb from 1000 to 50 mb. Draw a solid line in color 3 with a width of 5. Plot markers in color 2; draw the background in color 1 and the title in color 4.

```
SNFILE  =  [nws.snfiles]sndata.snd
AREA    =  @tx
LINE    =  3//5
MARKER  =  2
BORDER  =  1
TITLE   =  4
XAXIS   =
YAXIS   =
LEVELS  =  1000-50-50
VCOORD  =  PRES
DATTIM  =  /12
CLEAR   =  yes
DEVICE  =  ct
PANEL   =  0
TEXT    =  1
```

2. Now plot the Denver hodograph for 1800 UTC on May 25 with labels every 2000 meters. Draw x and y axes from -50 to 50 meters/sec.

```
AREA    =  @den
LEVELS  =  1000-24000-2000
VCOORD  =  hght
DATTIM  =  0525/18
XAXIS   =  -50/50/10
YAXIS   =  -50/50/10
```

ERROR MESSAGES

```
[SNHODO  -1]   Fatal error initializing TAE.
[SNHODO  -2]   Fatal error reading TAE parameters.
[SNHODO  -3]   Fatal error initializing GEMPLT.
[SNHODO  -4]   The input for XAXIS is invalid.
[SNHODO  -5]   The input for YAXIS is invalid.
[SNHODO  -6]   Winds cannot be computed.
[SNHODO  -7]   The vertical coordinate ... cannot be computed.
[SNHODO  -8]   The range along the x or y axis is invalid.
[SNHODO  -9]   No winds can be plotted.
[SNHODO -10]   No valid stations were found.
```

4.49 PROGRAM SNLIST

SNLIST lists upper air data from a sounding file for specified vertical levels and stations.

INPUT PARAMETERS

SNFILE	*Sounding data file
AREA	*Data area
DATTIM	*Date/time
SNPARM	*Sounding parameter list
STNDEX	*Stability indices
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
OUTPUT	*Output device (TPF)
MRGDAT	*Merge data file flag/part type

PROGRAM DESCRIPTION

SNLIST lists parameters derived from an upper air data set for the requested stations and times.

Parameters which can be computed at various levels in the data set should be specified in SNPARM. Parameters which have a single value at the station, such as stability indices, should be specified in STNDEX.

Any parameters which can be computed from the data set parameters may be listed. If the vertical levels requested are not present in the data set, the data will be interpolated between existing levels. Data will also be interpolated to a new vertical coordinate system, if requested.

Data from an unmerged data set can now be listed without being merged if MRGDAT is set to NO. If unmerged data are listed, SNPARM, VCOORD and LEVELS will be ignored.

EXAMPLES

1. List at the terminal the parameters in the data set for the station IAD at the mandatory levels. Also list the Showalter, lifted and K indices.

```
SNFILE  =  gemdata:84dec.snd
AREA    =  @iad
DATTIM  =  27/12
```

```
SNPARM  =  dset
STNDEX  =  show;lift;kinx
LEVELS  =  man
VCOORD  =  pres
OUTPUT  =  t
```

2. List the pressure, mixing ratio, u and v wind components and the Montgomery stream function on the isentropic surfaces from 300 to 400 degrees in 10-degree increments. Change the station to SLO.

```
AREA    =  @slo
SNPARM  =  pres;mixr;uwnd;vwnd;psym
STNDEX  =
LEVELS  =  300-400-10
VCOORD  =  thta
```

3. List the unmerged data from IAD.

```
AREA    =  @iad
MRGDAT  =  no
```

ERROR MESSAGES

```
[SNLIST  -1]    Fatal error initializing TAE.
[SNLIST  -2]    Fatal error reading TAE parameters.
[SNLIST  -3]    There are no parameters to be listed.
[SNLIST  -4]    Level parameter ... cannot be computed.
[SNLIST  -5]    Parm ... is character; cannot be listed.
[SNLIST  -6]    Vertical coordinate ... cannot be computed.
[SNLIST  -7]    Station parameter ... cannot be computed.
[SNLIST  -8]    Parm ... is character; cannot be listed.
[SNLIST  -9]    No stations reported at these times.
[SNLIST -10]    Too many parameters; ... cannot be added.
[SNLIST -11]    The data set is merged.
[SNLIST -12]    No inputs for levels.
```

4.50 PROGRAM SNMAP

SNMAP plots sounding data on a map.

INPUT PARAMETERS

AREA	*Data area
GAREA	*Graphics area
SNPARM	*Sounding parameter list
DATTIM	*Date/time
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
SNFILE	*Sounding data file
COLORS	*Color list
WIND	*Wind symbol/siz/wdth/typ/hdsz
MAP	*Map color/dash/width
LATLON	*Line color/dash/width/label/inc
MARKER	*Marker color/type/size/width/hw
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
PANEL	*Panel location/color/dash/width
DEVICE	*Graphics device
PROJ	*Map projection/angles/margins
FILTER	*Filter data flag
TEXT	*Text size/font/hw flag

PROGRAM DESCRIPTION

SNMAP plots sounding data parameters at station locations on a map. Any level or station parameter that can be computed can be displayed.

The order of the input parameters determines the output location of the data. Parameters are separated by semicolons. A position may be skipped by entering two consecutive semicolons or entering parameter SPAC or BLNK. The following chart shows the placement of the data around the station. The number indicates the position of the parameter in the SNPARM list:

```
      7
1     9     3
2     +     4
5    10     6
      8
```

Station data will be filtered; i.e., overlapping stations will not be plotted, if FILTER is set to YES. If a parameter is BLNK, the filter will not allocate any space for that parameter. The parameter SPAC may be used to reserve the space with the FILTER option so that later calls will plot the same stations after filtering, provided that the same number of parameters is specified. Data will be centered on the station location for the last parameter listed if an @ is appended to the name.

Using WIND, either wind barbs or wind arrows can be plotted, the base being at the station location. Any valid marker type may be plotted at the stations using MARKER.

Conditions can be specified for the parameters. The conditions are documented in the SNPARM documentation. Note that individual parameters can be scaled using these conditional functions. For example, TMPC*10 will plot temperature multiplied by 10.

EXAMPLES

1. Plot a polar stereographic map of stations in the Maryland area with temperature, dewpoint, and height in positions 1, 2, and 3. Plot the data at 850 mb for the latest time in the file, MARCH.SND:

```
AREA    = md
GAREA   = md
SNPARM  = tmpc;dwpc;hght
DATTIM  = last
LEVELS  = 850
VCOORD  = pres
SNFILE  = march.snd
COLORS  = 2;3;4
WIND    = bk2
MAP     = 2
LATLON  =
MARKER  = 3
TITLE   = 5
CLEAR   = yes
PANEL   = 0
DEVICE  = vt
PROJ    = nps
FILTER  = no
TEXT    =
```

2. Plot a Mercator map of the USA with the 500-mb temperatures to the left of the station and height to the right. Plot the lifted index center below the station in position 8.

The data plotted is from February 12, 1985 at 1200 GMT. The VT100 terminal screen will not be cleared prior to plotting the map. Turn the wind barbs off.

```
AREA    = us
GAREA   = us
SNPARM  = ;tmpc;;hght;;;;lift
DATTIM  = 850225/1200
SNFILE  = 25feb12z.snd
WIND    = 0
CLEAR   = no
PROJ    = mer
```

ERROR MESSAGES

[SNMAP +1]	Parameter ... cannot be computed.
[SNMAP -1]	Fatal error initializing TAE.
[SNMAP -2]	Fatal error reading TAE parameters.
[SNMAP -3]	Fatal error initializing GEMPLT.
[SNMAP -4]	No valid levels have been input.
[SNMAP -5]	A range of levels is invalid in SNMAP.
[SNMAP -6]	Winds cannot be computed.

4.51 PROGRAM SNMOD

SNMOD moves selected sounding data from an input sounding file to an output sounding file.

INPUT PARAMETERS

SNFILE	*Sounding data file
SNOUTF	*Output sounding file
SNPARM	*Sounding parameter list
AREA	*Data area
DATTIM	*Date/time
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
TIMSTN	*Times/additional stations
MRGDAT	*Merge data file flag/part type
IDNTYP	*STNM or STID

PROGRAM DESCRIPTION

SNMOD takes data from a GEMPAK sounding file, SNFILE, and writes it to an output sounding file, SNOUTF. This program can be used to subset the original data set by time and/or stations and to change the levels and vertical coordinate.

The output data set may be either a merged or unmerged data set. If the output file does not exist, a new file will be created by this program. If a new file is created, MRGDAT will determine whether the output file will be a merged or unmerged data set. Note that an error will result if the input data set is merged and the output data set is unmerged.

The value of SNPARM will be ignored if the output data set is unmerged. If a merged data file is to be created, SNPARM will specify the parameters to be included. In this case, if SNPARM = DSET, the parameters in the input data set will be used. If the output file is an existing merged data set, the parameters specified in SNPARM must be in the data set. In this case, if SNPARM = DSET, the parameters in the output file will be used.

If the output file is to be created, the maximum number of times and stations which can be stored in the file must be specified in TIMSTN.

IDNTYP has been added to specify whether station numbers or station identifiers will be used in referring to stations.

Generally, IDNTYP should be set to STNM to use station numbers. However, in data sets which do not have station numbers, or which have a single invalid number, character station identifiers must be used and IDNTYP must be set to STID.

EXAMPLES

1. Put the mandatory data for stations in an area centered on IL at time 841227/1200 into a new unmerged sounding file, NEW.SND, which may contain 2 times and 150 stations.

```
SNFILE  =  gemdata:84dec.snd
SNOUTF  =  new.snd
SNPARM  =  dset
AREA    =  il
DATTIM  =  27/12
LEVELS  =  man
VCOORD  =  pres
TIMSTN  =  2/150
MRGDAT  =  no
IDNTYP  =  stnm
```

2. Add the stations at time 841227/00 to the file created in example 1.

```
DATTIM  =  27/00
```

3. Create an isentropic data set containing the specified parameters with levels every 5 degrees. Include all the US stations.

```
SNFILE  =  gemdata:84dec.snd
SNOUTF  =  thta.snd
SNPARM  =  thta;pres;mixr;uwnd;vwnd;psym
AREA    =  @us
DATTIM  =  all
LEVELS  =  250-450-5
VCOORD  =  thta
TIMSTN  =  4/150
```

ERROR MESSAGES

[SNMOD -1]	Fatal error initializing TAE.
[SNMOD -2]	Fatal error reading TAE parameters.
[SNMOD -3]	Output file cannot be unmerged type.
[SNMOD -4]	A new file cannot be created with no times.
[SNMOD -5]	A new file cannot be created with no stations.

[SNMOD -6]	Parameter ... cannot be computed.
[SNMOD -7]	... is character type; cannot be added to file.
[SNMOD -8]	Output vertical coordinate ... cannot be used.
[SNMOD -9]	No valid parameters were specified.
[SNMOD -10]	Time ... cannot be added to the output file.
[SNMOD -11]	Station ... cannot be added to output file.
[SNMOD -12]	Parms do not match those in output data set.
[SNMOD -13]	Output file name is blank.

4.52 PROGRAM SNPROF

SNPROF draws profiles of upper air data.

INPUT PARAMETERS

```
SNFILE    *Sounding data file
DATTIM    *Date/time
AREA      *Data area
SNPARM    *Sounding parameter list
LINE      *Line color/dash/width/label
PTYPE     *Plot type/h:w ratio/margins
VCOORD    *Vertical coordinate type
STNDEX    *Stability indices
STNCOL    *Stability index color
WIND      *Wind symbol/siz/wdth/typ/hdsz
WINPOS    *Wind position
MARKER    *Marker color/type/size/width/hw
BORDER    *Background color/dash/width
TITLE     *Title color/line/title
DEVICE    *Graphics device
YAXIS     *Ystrt/ystop/yinc/lbl;gln;tck
XAXIS     *Xstrt/xstop/xinc/lbl;gln;tck
FILTER    *Filter data flag
CLEAR     *Clear screen flag
PANEL     *Panel location/color/dash/width
TEXT      *Text size/font/hw flag
THTALN    *THTA color/dash/width/mn/mx/inc
THTELN    *THTE color/dash/width/mn/mx/inc
MIXRLN    *MIXR color/dash/width/mn/mx/inc
```

PROGRAM DESCRIPTION

SNPROF draws profiles of upper air data.

Any two parameters can be plotted; e.g., temperature and dewpoint temperature. These parameters are specified in SNPARM. The color, line type, and width are specified in LINE. Markers can be plotted by setting a color in MARKER.

The type of y axis is specified in PTYPE. LIN, LOG, STUVE, and SKEW are all valid. Note that SKEW is only valid when plotting temperature vs. pressure. The bottom and top of the axis, along with an increment for labels, are set in YAXIS. If the panel is changed to be less than the full screen, the default margins will often be too large. The

margins can be set explicitly in PTYPE.

Winds are plotted in the right margin and can be specified in WIND. There are three positions available for plotting winds. They are numbered 1 to 3, with 1 being the leftmost position. The location for the first wind to be plotted is specified in WINPOS. The winds in subsequent plots will be plotted in the next position, modulo 3, provided the screen is not cleared. These positions also apply to the station identifier, date/time and stability indices which are plotted above the diagram.

Dry adiabats, moist adiabats and mixing ratio background lines can be add to the diagram. The attributes of these lines are specified in THTALN, THTELN, and MIXRLN. The format for the specification is:

color / line type / width / start / stop / increment

If the color is set to 0, no lines will be plotted. If the start, stop and increment are not set, defaults will be supplied. Note that these lines can only be drawn on plots of pressure versus temperature.

FILTER in this program determines whether the wind barbs are filtered.

EXAMPLES

1. Plot a Skew T chart for stations ACY, IAD, and HAT for the latest time in the file. Display the Showalter index and the bulk Richardson number. Plot TMPC in color 1 using a solid line with width of 5. Plot DWPC in color 2 using a dashed line with width of 5. Include theta, theta-e, and mixing ratio lines. Plot filtered wind barbs in color 4 in position 3.

```
SNFILE  =  sound.snd
DATTIM  =  last
AREA    =  @acy;iad;hat
SNPARM  =  tmpc;dwpc
LINE    =  1;2/1;3/5
PTYPE   =  skewt
VCOORD  =  pres
STNDEX  =  show;brch
STNCOL  =  1
WIND    =  bm4
WINPOS  =  3
MARKER  =
BORDER  =  1
```

```
TITLE   = 4
DEVICE  = qm
YAXIS   =
XAXIS   =
FILTER  = yes
CLEAR   = yes
PANEL   = 0
TEXT    =
THTALN  = 3/4
THTELN  = 4/4
MIXRLN  = 5/4
```

2. Plot relative humidity with a logarithmic pressure axis. Plot markers at the sounding data points up to 10 mb. The theta, theta-e, and mixing ratio lines are turned off, and no stability indices are computed.

```
PTYPE   = log
STNDEX  =
SNPARM  = relh
YAXIS   = 1050/10
THTALN  = 0
THTELN  = 0
MIXRLN  = 0
```

3. Plot equivalent potential temperature on the x axis vs. potential temperature on the y axis.

```
PTYPE   = lin
SNPARM  = thte
VCOORD  = thta
YAXIS   = 250/450/50
```

ERROR MESSAGES

[SNPROF +5]	Stability indices are specified with color = 0
[SNPROF +4]	Parameter ... was requested with color set to 0.
[SNPROF +3]	Winds cannot be computed.
[SNPROF +2]	Parameter ... is a character type.
[SNPROF +1]	Parameter ... cannot be computed.
[SNPROF -1]	Fatal error initializing TAE.
[SNPROF -2]	Fatal error reading TAE parameters.
[SNPROF -3]	Fatal error initializing GEMPLT.
[SNPROF -4]	The plot type ... is invalid.
[SNPROF -5]	The the x-axis range must be specified in XAXIS.
[SNPROF -6]	The two parms use different temperature units.
[SNPROF -7]	The vertical coordinate ... cannot be computed.
[SNPROF -8]	The range along the x or y axis is invalid.
[SNPROF -9]	No valid stations were found.
[SNPROF -10]	SNPARM has not been specified.

4.53 PROGRAM SNRAOB

SNRAOB creates a GEMPAK sounding file from a raobs file created by the 604-line ingest program, TRAFIC.

INPUT PARAMETERS

RAOBFL	*Raw raob data file
SNOUTF	*Output sounding file

PROGRAM DESCRIPTION

This program creates a GEMPAK sounding data file from data collected from the NWS 604 line and archived at GSFC.

The program opens the raob file and displays the available times and the number of reporting stations. The user must enter the number corresponding to the desired time or exit the program.

If the sounding file exists, the data will be added to the file. Otherwise, a new file is created. If the file exists and contains merged upper air data, an error message will be written. Mandatory and significant-level temperature and wind data below 100 mb will be stored in the sounding file as separate parts.

EXAMPLE

1. Create a sounding file TEST.SND from data in the file, RAOBDAT, which is the logical name for the current realtime file.

```
RAOBFL = raobdat
SNFILE = test.snd
```

ERROR MESSAGES

[SNRAOB +1]	The sounding file ... has been created.
[SNRAOB -1]	Fatal error initializing TAE.
[SNRAOB -2]	Fatal error reading TAE parameters.
[SNRAOB -3]	Error opening raobs file.
[SNRAOB -4]	Error opening sounding file.
[SNRAOB -5]	Sounding file must contain unmerged data.
[SNRAOB -6]	Error reading raobs file.

```
[SNRAOB  -7]    Invalid time input.
[SNRAOB  -8]    No more stations can be added to the file.
[SNRAOB  -9]    No more times can be added to the file.
```

4.54 PROGRAM SNRAWD

SNRAWD decodes upper air data from a file of raw data and adds it to a sounding data set.

INPUT PARAMETERS

SNEFIL	*Sounding edit file
SNFILE	*Sounding data file
DATTIM	*Date/time
ADDSTN	*Add station flag

PROGRAM DESCRIPTION

SNRAWD decodes raw upper air data and adds it to a sounding data set.

The raw data should be included in a text file. The sounding data set must already exist and must be an unmerged data file. The individual reports are distinguished by searching for PP or TT.

DATTIM is used to specify the range of data to be included in the file. Both the earliest and latest times to be included must be specified with the complete date/time. If the earliest time is not included, data from a 24-hour period will be used. Since the year and month are not included in the report data, the year and month from the last time will be used. Therefore, the data may not span months, except that data from the last day of the previous month will be decoded if the last time is the first day of the month.

EXAMPLES

1. Decode the data archived on April 26 in the file APR26.UAIR and store it in the file APRIL.SND.

```
SNEFIL = apr26.uair
SNFILE = april.snd
DATTIM = 890426/0000-890427/0300
```

ERROR MESSAGES

[SNRAWD +2]	Time ... is not within specified range.
[SNRAWD -1]	Fatal error initializing TAE.

[SNRAWD	-2]	Fatal error reading TAE parameters.
[SNRAWD	-3]	An input bulletin is too long.
[SNRAWD	-4]	Time ... is an invalid last time.
[SNRAWD	-5]	Time ... is an invalid first time.
[SNRAWD	-6]	The sounding file is not an unmerged data set.

4.55 PROGRAM SNSTNS

SNSTNS modifies the station information in an upper air file.

INPUT PARAMETERS

SNFILE	*Sounding data file
STNFIL	*Station information file
ADDSTN	*Add station flag
IDNTYP	*STNM or STID

PROGRAM DESCRIPTION

SNSTNS updates the station information in a GEMPAK upper air file. The station information generally consists of the character station identifier, STID, the station number, STNM, the latitude, SLAT, the longitude, SLON, the elevation, SELV, the stat, STAT and the country, COUN.

This information, along with the station name, which is not used, must be stored in a fixed format in the table file specified in STNFIL. The current GEMPAK upper air station table for US and Canadian station is GEMTABL:SNSTNS.TBL. An upper air file containing stations for the world is GEMTABL:SNWORLD.TBL.

ADDSTN is a logical parameter which indicates whether stations which are in the table file but not already in the upper air file will also be added to the upper air file.

Either STID or STNM may be used to key on the desired station identifier by setting the desired value in IDNTYP.

EXAMPLES

1. Update upper air file called SOUNDINGS.DAT with station information from MYSTN.DAT adding stations that are not already in the file.

```
SNFILE  =  soundings.dat
STNFIL  =  mystn.dat
ADDSTN  =  yes
IDNTYP  =  stid
```

ERROR MESSAGES

```
[SNSTNS  +1]   WARNING! No stations were updated.
[SNSTNS  -1]   Fatal error initializing TAE.
[SNSTNS  -2]   Fatal error reading TAE parameters.
[SNSTNS  -3]   Invalid input for IDNTYP; must be STID or STNM.
[SNSTNS  -4]   STNFIL ... cannot be opened.
```

4.56 PROGRAM SNTSER

SNTSER draws a time series at a sounding station.

INPUT PARAMETERS

SNFILE	*Sounding data file
DATTIM	*Date/time
TAXIS	*Time1-time2-tinc;lbl;gln;tck
LEVELS	*Vertical levels
VCOORD	*Vertical coordinate type
SNPARM	*Sounding parameter list
STNDEX	*Stability indices
AREA	*Data area
PTYPE	*Plot type/h:w ratio/margins
YAXIS	*Ystrt/ystop/yinc/lbl;gln;tck
BORDER	*Background color/dash/width
LINE	*Line color/dash/width/label
MARKER	*Marker color/type/size/width/hw
TITLE	*Title color/line/title
CLEAR	*Clear screen flag
PANEL	*Panel location/color/dash/width
DEVICE	*Graphics device

PROGRAM DESCRIPTION

SNTSER draws a time series plot for a sounding station.

Only one parameter may be plotted at a time. This parameter may be a level parameter defined in SNPARM or a stability index defined in STNDEX. If both SNPARM and STNDEX have values, SNPARM will be used. If a level parameter is defined in SNPARM, a vertical level must also be set in LEVELS.

The type of y axis can be set in PTYPE. Either LIN or LOG is valid. The limits on the y axis can be set in YAXIS.

The times to plot are specified in DATTIM. Only those times specified will be plotted. Lines will be drawn connecting the data points, provided that no more than two points are missing between segments.

The time axis is specified in TAXIS using the usual GEMPAK date/time conventions, including FIRST and LAST. If TAXIS has no increment, a reasonable value is chosen. If TAXIS is blank, the limits are taken from the first and

last valid times set in DATTIM.

When the user desires multiple lines on the same graph, TAXIS and YAXIS should be explicitly set. Then LINE, MARKER, and TITLE can be varied for successive combinations of LEVELS, VCOORD, AREA, and SNPARM.

The height-to-width ratio of the plot may be specified in PTYPE following a /. If no value is entered, a value of 0.5 will be used.

EXAMPLES

1. Plot the temperature in Celsius at the 500-mb level over BWI for the times between 26/12 and 31/00 in the file. Use the default line, marker, title and background colors. Label the Y axis from -40 degrees to 0 degrees in increments of 10 degrees. Label the T axis from 26/00 to 31/12 with internally chosen increments.

```
SNFILE   =  gemdata:realtime.snd
DATTIM   =  26/12-31/00
TAXIS    =  26/00-31/12
LEVELS   =  500
VCOORD   =  pres
SNPARM   =  tmpc
STNDEX   =
AREA     =  @bwi
PTYPE    =  /.5
YAXIS    =  -40/0/10
BORDER   =  1
LINE     =  2/1/1
MARKER   =  1
TITLE    =  5
CLEAR    =  yes
PANEL    =  0
DEVICE   =  vt
```

2. Now, using the same file, plot a time series of the lifted index at OKC for all times in the file. Plot the line with a thick, short dash pattern and use internal scaling for both axes.

```
DATTIM   =  all
TAXIS    =
SNPARM   =
STNDEX   =  lift
AREA     =  @okc
YAXIS    =
```

LINE = 2/2/3

ERROR MESSAGES

[SNTSER +1]	WARNING, more than one parameter specified.
[SNTSER -1]	Fatal error initializing TAE.
[SNTSER -2]	Fatal error reading TAE parameters.
[SNTSER -3]	Fatal error initializing GEMPLT.
[SNTSER -4]	Input for LEVEL is invalid.
[SNTSER -5]	Error defining graph coordinates.
[SNTSER -6]	No points found for plot.
[SNTSER -7]	Session not interactive.
[SNTSER -8]	No parameters entered.
[SNTSER -9]	Parm ... not calculable.
[SNTSER -10]	Parm ... is a character.

APPENDIX A

GEMPAK PARAMETERS

This appendix contains a list of the GEMPAK parameters. Algorithms used in computing these parameters are also included. The following constants are used in the computations:

KAPPA	= Poisson's constant	= 2 / 7
G	= Gravitational constant	= 9.80616 m/sec/sec
GAMUSD	= Standard atmospheric lapse rate	= 6.5 K/km
RDGAS	= Gas constant for dry air	= 287.04 J/K/kg
PI	= Circumference / diameter	= 3.14159265

References for some of the algorithms:

Bolton, D., 1980: The computation of equivalent potential temperature., Monthly Weather Review, 108, pp 1046-1053.

Wallace, J.M., P.V. Hobbs, 1977: Atmospheric Science, Academic Press, 467 pp.

Miller, R.C., 1972: Notes on Severe Storm Forecasting Procedures of the Air Force Global Weather Central, AWS Tech. Report 200.

TEMPERATURE PARAMETERS

TMPC - Temperature in Celsius

TEMP - Temperature in Celsius

GEMPAK PARAMETERS

TMPF - Temperature in Fahrenheit

TMPK - Temperature in Kelvin

THTA - Potential temperature in Kelvin

STHA - Surface potential temperature in Kelvin

STHE - Surface equivalent potential temperature in Kelvin

TVRK - Virtual temperature in Kelvin

THTV - Virtual potential temperature in Kelvin

TVRC - Virtual temperature in Celsius

TVRF - Virtual temperature in Fahrenheit

TMAX - Maximum 24 hour temperature in Celsius

TMIN - Minimum 24 hour temperature in Celsius

SSTC - Sea surface temperature in Celsius

```
TMPC = ( TMPF - 32 ) * 5 / 9

TMPC = TMPK - 273.16

THTA = TMPK * ( 1000 / PRES ) ** KAPPA

STHA = TMPK * ( 1000 / PALT ) ** KAPPA

TVRK = TMPK * ( 1 + ( .001 * MIXR ) / .62197) ) /
               ( 1 + ( .001 * MIXR ) )

THTV = TVRK * ( 1000 / PRES ) ** KAPPA
```

MOISTURE PARAMETERS

DWPC - Dewpoint in Celsius

DWPT - Dewpoint in Celsius

DWPF - Dewpoint in Fahrenheit

DWPK - Dewpoint in Kelvin

DPDC - Dewpoint depression in Celsius

DPDF - Dewpoint depression in Fahrenheit

DPDK - Dewpoint depression in Kelvin

MIXR - Mixing ratio in g/kg

MIXS - Saturated mixing ratio in g/kg

SMXR - Surface mixing ratio in g/kg

SMXS - Surface saturated mixing ratio in g/kg

RELH - Relative humidity in percent

THTE - Equivalent potential temperature in Kelvin

VAPR - Vapor pressure in millibars

VAPS - Saturation vapor pressure in millibars

LHVP - Latent heat of vaporization in J/kg

```
DPDx = TMPx - DWPx

MIXR = .62197 * ( E / ( PRES - E ) ) * 1000
       E    = VAPR  * [ 1.001 + ( PRES - 100) /
              900 * .0034 ]
       VAPR = 6.112 * EXP ( ( 17.67 * DWPC ) /
              ( DWPC + 243.5 ) )
       Bolton, MWR (1980)

MIXS = .62197 * ( Es / ( PRES - Es ) ) * 1000
       Es   = VAPS  * [ 1.001 + ( PRES - 100 ) /
              900 * .0034 ]
       VAPS = 6.112 * EXP ( ( 17.67 * TMPC ) /
              ( TMPC + 243.5 ) )
       Bolton, MWR (1980)

SMXR = .62197 * ( E / ( PALT - E ) ) * 1000
       E    = VAPR  * [ 1.001 + ( PALT - 100 ) /
              900 * .0034 ]
       VAPR = 6.112 * EXP ( ( 17.67 * DWPC ) /
              ( DWPC + 243.5 ) )

SMXS = .62197 * ( Es / ( PALT - Es ) ) * 1000
       Es   = VAPS  * [ 1.001 + ( PALT - 100 ) /
              900 * .0034 ]
```

```
            VAPS = 6.112 * EXP ( ( 17.67 * TMPC ) /
                   ( TMPC + 243.5 ) )

      RELH = VAPR / VAPS * 100

      THTE = THTM * EXP [ ( 3.376 / TLCL - .00254 ) *
                   ( MIXR * ( 1 + .81 * .001 * MIXR ) ) ]
             THTM = potential temperature for moist air
                  = TMPK * ( 1000 / PRES ) ** E
             E    = 2. / 7. * ( 1 - ( .28 * .001 * MIXR ) )
             TLCL = temperature at the LCL in Kelvin
             Bolton, MWR (1980)

      VAPR = 6.112 * EXP [ ( 17.67 * DWPC ) /
                                          ( DWPC + 243.5 ) ]
             Bolton, MWR (1980)

      VAPS = 6.112 * EXP [ ( 17.67 * TMPC ) /
                                          ( TMPC + 243.5 ) ]
             Bolton, MWR (1980)

      LHVP = ( 2.501 - .00237 * TMPC ) * 10E6
             Bolton, MWR (1980)
```

HEIGHT PARAMETERS

HGHT - Height in meters

HGTM - Height in meters

HGTK - Height in kilometers

HGTD - Height in dekameters

HGFT - Height in feet (3.28084 * HGHT)

HGFH - Height in hundreds of feet

HGFK - Height in thousands of feet

HGML - Height in miles (6.2137E-04 * HGHT)

DHGT - Dry hydrostatic height in meters

MHGT - Moist hydrostatic height in meters

ZMSL, Z000, Z900, Z850, Z800 - Estimated height at a pressure level

DHGT and MHGT are computed using the hypsometric equation and integrating from the surface pressure to the desired level. DHGT (MHGT) is computed without (with) the influence of moisture.

DHGT = HB + (RDGAS / G) * LN (PBOT / PTOP) * TAVE
- HB = height of the bottom of layer
- PBOT = pressure at bottom of layer
- PTOP = pressure at the top the layer
- TAVE = average temperature of the layer

MHGT = HB + (RDGAS / G) * LN (PBOT / PTOP) * TVAVE
- HB = height of the bottom of layer
- PBOT = pressure at bottom of layer
- PTOP = pressure at the top the layer
- TVAVE = average virtual temperature of the layer

Zxxx = [To * (1 - (PRES / ALTM) ** (RDGAS * GAMUSD / G)] / GAMUSD
- Zxxx = height at the pressure level
  - ZMSL : 1013.25 mb
  - Z000 : 1000 mb
  - Z900 : 900 mb
  - Z850 : 850 mb
  - Z800 : 800 mb
- To = sea level temperature in U.S. Std. Atmos.
  = 288 K

PRESSURE AND ALTIMETER PARAMETERS

PRES - Station pressure in millibars

PRES is the actual pressure at a level as reported with upper air data.

PMSL - Mean sea level pressure

PMSL is reported with surface data.

PALT - Surface pressure in millibars from ALTI

ALTI - Altimeter setting in inches of mercury

ALTI is reported with surface data.

ALTM - Altimeter setting converted to millibars

SALT - Abbreviated standard altimeter setting

AMSL - Abbreviated mean sea level pressure

```
PMSL = PRES * EXP ( ( G * SELV ) / ( RDGAS * TVAVE ) )
       SELV  = station elevation
       TVAVE = average virtual temperature between
               station and sea level
             = TVRK + ( DELTV / 2 )
       DELTV = GAMUSD * SELV / 1000
       Wallace & Hobbs (1977)

PALT = ALTM *
       ( 1 - ( ( SELV / 1000 ) * GAMUSD / To ) ) **
       ( G / ( GAMUSD * RDGAS ) * 1000 )
       SELV  = station elevation in meters
       To    = sea level temperature in U.S. Std. Atmos.
             = 288 K
       Wallace & Hobbs (1977)

ALTM = ALTI * ( 1013.25 / 29.921 )

SALT = MOD ( ALTM * 10, 1000 )
```

WINDS

UWND - U-component of the wind in meters/second

VWND - V-component of the wind in meters/second

UKNT - U-component of the wind in knots

VKNT - V-component of the wind in knots

DRCT - Wind direction in degrees

SPED - Wind speed in meters/second

SKNT - Wind speed in knots

PSPD - Packed direction and speed in meters/second (ddfff)

PKNT - Packed direction and speed in knots (ddfff)

GUST - Wind gusts in knots

GUMS - Wind gusts meters/second

```
UWND = - SIN ( DRCT ) * SPED

VWND = - COS ( DRCT ) * SPED

DRCT = ATAN2 ( -UWND, -VWND ) * 180 / PI

SPED = SQRT ( UWND ** 2 + VWND ** 2 )

SPED = SKNT / 1.9438

PSPD = JDRCT * 100 + JSPED
       JDRCT = NINT ( DRCT / 5 )
       JSPED = NINT ( SPED )

PKNT = JDRCT * 100 + JSKNT
       JDRCT = NINT ( DRCT / 5 )
       JSKNT = NINT ( SKNT )
```

LIFTED CONDENSATION LEVEL (LCL)

TLCL - Temperature in Kelvin at the LCL

PLCL - Pressure in millibars at the LCL

```
TLCL = [1 / ( 1 / ( DWPK - 56 ) +
          LN ( TMPK / DWPK ) / 800 )] + 56
       Bolton, MWR (1980)

PLCL = PRES * ( TLCL / ( TMPC + 273.16 ) ) ** ( 1 / KAPPA )
       Poisson's equation
```

STABILITY INDICES

Note: Default depths given in the definitions below are preceded by an ! and may be changed using the in-line depth specification. dz in the definitions below defaults to the layer thickness in the sounding.

BRCH - Bulk Richardson number

```
BRCH = CAPE / ( 0.5 * U**2 )
       CAPE  = Convective Available Potential Energy
       U     = magnitude of shear ( u2 - u1, v2 - v1 )
       u1,v1 = average u,v in the lowest !500 m
```

u2,v2 = average u,v in the lowest !6000 m

BVFQ - Brunt-Vaisala frequency

BVFQ = SQRT ((G / THTA) * STAB)

BVPD - Brunt-Vaisala period

BVPD = 2. * PI / BVFQ

BVSQ - Brunt-Vaisala frequency squared

BVSQ = BVFQ ** 2

CAPE - Convective available potential energy

CAPE = GRAVTY * SUMP (DELZ * (THP - TH) / TH)
SUMP = sum over sounding layers for which (THP - TH) is greater than zero
THP = potential temperature of a parcel from the lowest !500 m of the atmosphere, raised dry adiabatically to the lcl and moist adiabatically thereafter
TH = potential temperature of the environment

CINS - Convective inhibition

CINS = - GRAVTY * SUMN (DELZ * (THP - TH) / TH)
SUMN = sum over sounding layers for which (THP - TH) is less than zero.
THP = potential temperature of a parcel from the lowest !500 m of the atmosphere, raised dry adiabatically to the lcl and moist adiabatically thereafter
TH = potential temperature of the environment

CTOT - Cross Totals index

CTOT = TD850 - T500
TD850 = Dewpoint in Celsius at 850 mb
T500 = Temperature in Celsius at 500 mb

EQLV - Equilibrium level

EQLV = level at which parcel undergoing moist adiabatic ascent ceases to be buoyant.

KINX - K index

KINX = (T850 - T500) + TD850 - (T700 - TD700)
T850 = Temperature in Celsius at 850 mb

T500 = Temperature in Celsius at 500 mb
TD850 = Dewpoint in Celsius at 850 mb
T700 = Temperature in Celsius at 700 mb
TD700 = Dewpoint in Celsius at 700 mb

LAPS - Temperature lapse rate in layer

LAPS = d (TMPK) / dz = d (TMPC) / dz

LFCV - Level of free convection

LFCV = level above which a parcel ascending moist adiabatically is buoyant.

LIFT - Lifted index

LIFT = T500 - Tparcel
T500 = Temperature in Celsius at 500 mb
Tparcel = 500 mb temperature in Celsius of a lifted parcel with the average pressure, temperature and dewpoint of the layer !100 mb above the surface

MLMR - Mean mixed layer MIXR

MLMR = Average MIXR in lowest !500 m

MLTH - Mean mixed layer THTA

MLTH = Average THTA in lowest !500 m

RICH - Richardson number in layer

RICH = BFVQ ** 2 / SHRM ** 2

SEPA - Isentropic layer pressure thicness

SEPA = Pressure difference over isentropic layer !5 K deep

SHOW - Showalter index

SHOW = T500 - Tparcel
T500 = Temperature in Celsius at 500 mb
Tparcel = Temperature in Celsius at 500 mb of parcel lifted from 850 mb

SHRD - Wind shear direction in layer

SHRD = direction of [du/dz, dv/dz]

SHRM - Wind shear magnitude in layer

```
        SHRM = magnitude of [ du/dz, dv/dz ]

STAB - THTA lapse rate in layer

        STAB = d (THTA) / dz

STAP - THTA change with pressure

        STAP = - d (THTA) / dp

SWET - SWEAT index

        SWET = 12 * TD850 + 20 * TERM2 + 2 * SKT850 +
               SKT500 + SHEAR
               TD850  = Dewpoint in Celsius at 850 mb
               TERM2  = MAX ( TOTL - 49, 0 )
               TOTL   = Total totals index
               SKT850 = 850 mb wind speed in knots
               SKT500 = 500 mb wind speed in knots
               SHEAR  = 125 * SIN ( DIR500 - DIR850 ) + .2
               DIR500 = 500 mb wind direction
               DIR850 = 850 mb wind direction

               If TD850 is negative, then TD850 is set to 0.
               SHEAR is set to 0 if any of the following
               conditions is met:
                   wind direction at 850mb is < 130 or > 250
                   wind direction at 500mb is < 210 or > 310
                   DIR500 - DIR850 < 0
                   SPD500 <= 15  or  SPD850 <= 15
             Miller (1972)

TOTL - Total Totals index

        TOTL = ( T850 - T500 ) + ( TD850 - T500 )
               T850  = Temperature in Celsius at 850 mb
               TD850 = Dewpoint in Celsius at 850 mb
               T500  = Temperature in Celsius at 500 mb

VTOT - Vertical Totals index

        VTOT = T850 - T500
               T850  = Temperature in Celsius at 850 mb
               T500  = Temperature in Celsius at 500 mb
```

CLOUD PARAMETERS

Cloud coverage may be defined using a cloud code, short code,

fractional coverage or numeric value. The valid values of these parameters ordered from least to greatest cloud coverage, are:

Cloud Coverage	Cloud Code xCLD	Short Code	Fractional xCLO	Numeric CLCx
missing			0.000	0
clear	CLR	$\overline{C}$	0.000	1
thin scattered	-SCT	-S	0.166	6
scattered	SCT	S	0.333	2
thin broken	-BKN	-B	0.500	7
broken	BKN	B	0.667	3
thin overcast	-OVC	-O	0.833	8
overcast	OVC	O	1.000	4
thin obscured	-X	-X	1.000	9
obscured	X	X	1.000	5

The following lists the GEMPAK parameter definitions with an example using the sample AIRWAYS cloud report:

22SCT 80-BKN 250OVC

Note that the character x may be replaced by L, M, or H, indicating low, mid or high clouds. Also note that the character T indicates the value of the parameter at the level of maximum cloud coverage.

xCLD - Character cloud coverage code
Examples: LCLD = SCT
MCLD = -BKN
HCLD = OVC

TCLD - xCLD at maximum cloud coverage
Example: TCLD = OVC

xCLO - Fractional cloud coverage
Examples: LCLO = 0.333
MCLO = 0.500
HCLO = 1.000

TCLO - xCLO at maximum cloud coverage
Example: TCLO = 1.00

CLCx - Numeric cloud coverage
Examples: CLCL = 2
CLCM = 7
CLCH = 4

CLCT - CLCx at maximum cloud coverage

Example: CLCT = 4

The next two parameters combine cloud coverage values from the three cloud levels.

CLDS - Combined cloud coverage short code from three levels
Example: CLDS = S-BO

CMBC - Combined cloud coverage numeric from three levels
Example: CMBC = 274

The next set of parameters are combined cloud height and cloud coverage.

CLHx - Cloud height in hundreds of feet
Examples: CLHL = 22.
CLHM = 80.
CLHH = 250.

CLDx - Combined cloud height and short code
Examples: CLDL = 22S
CLDM = 80-B
CLDH = 250O

CLDT - CLDx at maximum coverage level
Example: CLDT = 250O

COMx - Numeric combined cloud height and coverage combined as CLHx * 10 + CLCx
Examples: COML = 222.
COMM = 807.
COMH = 2504
Note: In the case when the sky is partially obscured, the value of 10000 is added on to the lowest reporting level. For example if AIRWAYS report is:
-X M5 BKN 19 BKN
COML would equal 10053

COMT - COMx at maximum coverage level
Example: COMT = 2504.

The next two parameters combine the cloud height and coverage allowing up to three reports which do not necessarily correspond to low, middle and high level clouds. These parameters allow a means of storing cloud reports where there may be more than one report at a single level.

CHCx - Numeric combined cloud height and coverage combined as CLHx * 10 + CLCx, where x is the cloud report group number from 1 to 3.
Examples: COM1 = 222.
COM2 = 807.
COM3 = 2504
Note: In the case when the sky is partially obscured, the value of 10000 is added on to the first reporting level. For example if AIRWAYS report is:
-X M5 BKN 19 BKN
CHC1 would equal 10053

CHDx - Combined cloud height and short code
Examples: CHD1 = 22S
CHD2 = 80-B
CHD3 = 250O

The following set of cloud parameters is the numeric WMO codes which are reported by airways data.

CFRC - Fraction of celestial dome covered by cloud from WMO Code 2700

CLFR - Fraction of celestial dome covered by all low and mid level clouds from WMO Code 2700

CTYL - Low-level cloud genera from WMO Code 0513

CTYM - Mid-level cloud genera from WMO Code 0513

CTYH - High-level cloud genera from WMO Code 0513

CBAS - Cloud base height from WMO Code 1000

WEATHER CODES

WCOD - Character weather code
WNUM - Numeric weather code

The weather code WCOD may also be accessed as WTHR. The weather number consists of 3 parts, A, B, C where
WNUM = A * 80 * 80 + B * 80 + C.
Each part corresponds to one of the values:

0		(no value)	
1	R	(mod rain)	41
2	L	(mod drizzle)	42
3	S	(mod snow)	43

4	A	(mod hail)
5	T	(thunder)
6	H	(haze)
7	K	(smoke)
8	D	(dust)
9	F	(fog)
10		
11		
12		
13	R-	(lt rain)
14	R+	(hvy rain)
15	ZR	(mod frz rain)
16	RW	(mod rain shwr)
17	L-	(lt drizzle)
18	L+	(hvy drizzle)
19	ZL	(frz drizzle)
20	S-	(lt snow)
21	S+	(hvy snow)
22	SW	(mod snow shwr)
23	IP	(mod ice pellet)
24	SG	(mod snow grain)
25	SP	(mod snow pellet)
26	A-	(lt hail)
27	A+	(hvy hail)
28	T-	(lt thunder)
29	T+	(hvy thunder)
30	IF	(ice fog)
31	GF	(ground fog)
32	BS	(blowing snow)
33	BD	(blowing dust)
34	BY	(blowing spray)
35	BN	(blowing sand)
36	IC	(mod ice crystals)
37	IN	(ice needles)
38	AP	(small hail)
39	KH	(smoke, haze)
40		
44		
45		
46		
47		
48		
49	ZR-	(lt frz rain)
50	ZR+	(hvy frz rain)
51	RW-	(lt rain shwr)
52	RW+	(hvy rain shwr)
53	ZL-	(lt freezing drizzle)
54	ZL+	(hvy freezing drizzle)
55	SW-	(lt snow shwr)
56	SW+	(hvy snow shwr)
57	IP-	(lt ice pellets)
58	IP+	(hvy ice pellets)
59	SG-	(lt snow grains)
60	SG+	(hvy snow grains)
61	SP-	(lt snow pellets)
62	SP+	(hvy snow pellets)
63	IPW	(mod ice pellet shwr)
64	IC-	(lt ice crystals)
65	IC+	(hvy ice crystals)
66	TRW	(mod thunder shwr)
67		
68		
69		
70		
71		
72		
73		
74		
75	IPW-	(lt ice pellet shwr)
76	IPW+	(hvy ice pellet shwr)
77	TRW-	(lt rain thunder shwr)
78	TRW+	(hvy rain thunder shwr)
79		

The following correspond to a single character code:

-1 TORNA (tornado)
-2 FUNNE (funnel cloud)
-3 WATER (water spout)

WTHR - Character weather codes for W604 data
W604 - Numeric weather codes used for 604 data

0 =	22 = L+	44 = R+S
1 = T	23 = SP	45 = RS-
2 = R	24 = SG	46 = RS+
3 = S	25 = BY	47 = ZL-
4 = F	26 = BN	48 = ZL+

5 = H	27 = BD	49 = TSW
6 = K	28 = IF	50 = TSW-
7 = L	29 = RS	51 = TSW+
8 = R+	30 = TRW	52 = TRW-
9 = R-	31 = TR-	53 = TRW+
10 = S+	32 = TR+	54 = TRWA
11 = S-	33 = TS-	55 = R-S-
12 = RW	34 = TS+	56 = R-S+
13 = SW	35 = ZR-	57 = R+S-
14 = TR	36 = ZR+	58 = R+S+
15 = TS	37 = SW-	59 = TRW+A
16 = ZL	38 = SW+	60 = TRW-A
17 = ZR	39 = SG-	61 = TORNA
18 = IP	40 = SG+	62 = FUNNE
19 = GF	41 = RW-	63 = WATER
20 = BS	42 = RW+	
21 = L-	43 = R-S	

WTMO - Character WMO weather code
WWMO - Numeric WMO weather code

The transformation is:

0 =	34 = BD+	67 = ZR
1 =	35 = BD+	68 = R-S-
2 =	36 = BS	69 = RS
3 =	37 = BS+	70 = S-
4 = K	38 = BS	71 = S-
5 = H	39 = BS+	72 = S
6 = D	40 =	73 = S
7 = BD	41= F	74 = S+
8 = BD	42 = F	75 = S+
9 = BD	43 = F	76 = IN
10 = F-	44 = F	77 = SG
11 = GF	45 = F	78 = S-
12 = GF	46 = F	79 = IP
13 =	47 = F	80 = RW-
14 =	48 = F	81 = RW
15 =	49 = F	82 = RW+
16 =	50 = L-	83 = RW-SW-
17 = T	51 = L-	84 = RWSW
18 = Q	52 = L-	85 = SW-
19 = FUNNE	53 = L	86 = SW
20 =	54 = L+	87 = SP-
21 =	55 = L+	88 = SP
22 =	56 = ZL-	89 = A-
23 =	57 = ZL	90 = A
24 =	58 = R-L-	91 = R-
25 =	59 = RL	92 = R
26 =	60 = R-	93 = RS
27 =	61 = R-	94 = R+S+

28 =	62 = R	95 = TRW-
29 =	63 = R	96 = TRW-A
30 = BD	64 = R+	97 = TRW+
31 = BD	65 = R+	98 = TD
32 = BD	66 = ZR-	99 = TRW+A
33 = BD+		

WASH - Asheville surface data weather code
RWSH - Numeric Asheville surface data

The data are stored using 7-digits as 1234.567. The column digits have the following translation:

Column 1:	Column 2:	Column 3:	Column 4:
0 = None	0 = None	0 = None	0 = None
1 = R-	1 = None	1 = S-	1 = SW-
2 = R	2 = None	2 = S	2 = SW
3 = R+	3 = None	3 = S+	3 = SW+
4 = RW-	4 = L-	4 = SP-	4 = None
5 = RW	5 = L	5 = SP	5 = None
6 = RW+	6 = L+	6 = SP+	6 = None
7 = ZR-	7 = ZL-	7 = none	7 = SG-
8 = ZR	8 = ZL	8 = IC	8 = SG
9 = ZR+	9 = ZL+		9 = SG+

Column 5:	Column 6:	Column 7:
0 = None	0 = None	0 = None
1 = IP-	1 = F	1 = K
2 = IP	2 = IF	2 = H
3 = IP+	3 = GF	3 = KH
4 = None	4 = BD	4 = D
5 = A	5 = BN	5 = BS
6 = None		6 = T
7 = None		7 = T+
8 = AP		8 = TOR
		9 = Q

PWTH - Character past weather WMO code
PWWM - Numeric past weather WMO code

The past weather WMO numeric codes are:

0 = Cloud covering less than 1/2 sky
1 = Cloud covering more than 1/2 during part of period and less than 1/2 sky during part
2 = Cloud covering more than 1/2 sky
3 = Sandstorm, duststorm or blowing snow
4 = Fog, ice fog, thick haze or thick smoke

5 = Drizzle
6 = Rain
7 = Snow, rain and snow mixed or ice pellets
8 = Showers
9 = Thunderstorm with or without precipitation

The translation is:

0 =	5 = L
1 =	6 = R
2 =	7 = S
3 = BD	8 = RW
4 = F	9 = T

STATION PARAMETERS

STID - Character station identifier

STNM - Station number

STNM is the 5-digit WMO identifier for upper air data; 6 digits for surface data, usually the WMO identifier with a zero appended.

SLAT - Station latitude in degrees

SLON - Station longitude in degrees; West longitude is negative

SELV - Station elevation in meters

RANG - Range in kilometers (specialized use)

AZIM - Azimuth in kilometers (specialized use)

LATI - Latitude in degrees from range/azimuth

LONG - Longitude in degrees from range/azimuth

LATI and LONG are calculated from the RANG and AZIM using equations developed for AOIPS/RADPAK.

DELT - Delta time in seconds (specialized use)

MISCELLANEOUS PARAMETERS

VSBY - Visibility in statute miles

VSBK - Visibility in kilometers

P06I - Precipitation over last 6 hours in hundreths of inches

P24I - Precipitation over last 24 hours in hundreths of inches

P06M - Precipitation over last 6 hours in millimeters

P24M - Precipitation over last 24 hours in millimeters

SNOW - Snow depth in inches

HAIL - Hail flag

HLSZ - Hail size in centimeters

WHGT - Wave height in meters

WPER - Wave period in seconds

DDEN - Density of dry air in kg/(m**3)

PSYM - Montgomery stream function in m**2/(100*s**2)

APPENDIX B

GRID DIAGNOSTIC FUNCTIONS

The following describes the computation of GEMPAK grid diagnostic functions.

Each grid in a grid file is identified by a parameter name, time, level, and vertical coordinate. A scalar grid is a single grid, while a vector grid is composed of two grids containing the u and v components.

The parameter name is used to retrieve a grid from the file, with a few exceptions: Certain special parameters will be computed from other data in the grid file if the parameter name itself is not found in the grid file. These special scalar parameters are

TMPK	THTA*	MIXR*	TVRK	DRCT
TMPC	STHA	MIXS	TVRC	SPED
TMPF	THTE*	SMXR		XVAL
DWPC	STHE	SMXS		YVAL
DWPF	RELH*			
DWPK				

where * indicates names which also may be used as operators. Other special scalar parameter names denote constant value grids:

DTR	Conversion factor for degrees to radians = PI / 180
E	Base of natural logarithms = 2.71828182
GRAVTY	Gravitational constant = 9.80616 (note spelling)
KAPPA	Gas constant/specific heat = 2/7
PI	3.14159265
RTD	Conversion factor for radians to degrees = 180 / PI
nnn	Any number (i.e., 2, -10.2, ...)

Another class of special parameter names provides information at grid points depending on the navigation of the grid file:

CORL	Coriolis force

CORL = 2. * OMEGA * SIN (LATR)

LATR	Latitude in radians
LONR	Longitude in radians
XVAL	Value of the x coordinate in graph coordinates
YVAL	Value of the y coordinate in graph coordinates

Finally, scalar grids may be identified by their location within the grid file. The grid number must be prefixed with the symbol #. Note that grids may be renumbered as grids are added to or deleted from the file.

Vector grids are two separate grids containing the u and v components. Special vector parameter names may be used to identify the following vectors:

OBS	Observed wind
GEO*	Geostrophic wind
AGE*	Ageostrophic wind
ISAL*	Isallobaric wind
THRM*	Thermal wind

where * indicates names that also may be used as operators. Note that all of these wind vectors will have u and v components in meters per second. The observed wind must be stored as UWND and VWND in the grid file if the components are north relative and as UGRD and VGRD if the components are grid relative.

Time, level, and vertical coordinate may be specified in GDATTIM, GLEVEL and GVCORD. However, any of these values may be overridden by in line parameters appended to an operand in the form of ^time@level%ivcord. In line parameters are only allowed for operands, since they modify parameters for individual grids.

Grid operators may be nested, allowing a complicated diagnostic function to be computed. One limitation is that layer and time range operators expect to work on operands read directly from the grid file or computed from special names.

In the following list of diagnostic operators, scalar operands are named Si and vector operands are Vi. Lower case u and v refer to the grid relative components of a vector. All meteorological output grids are in MKS units, except as noted. Operators using PR_ functions are described in the GEMPAK PARAMETER APPENDIX. All scalar and vector differential operators are valid in any map projection for which the map scale factors can be computed. At present, this applies for the stereographic, cylindrical and conic projections available in GEMPAK. In the definitions below, only the cartesian form of the operators is shown. The general curvilinear coordinate forms involving the scale factors are not given.

GRID DIAGNOSTIC FUNCTIONS

The operators which are designated for use in polar coordinates are specific to that coordinate system.

SCALAR OUTPUT GRID

Algebraic and trignometric functions
(angles are expressed in radians)

ABS	**Absolute value**	ABS (S)
ACOS	**Arc cosine function**	ACOS (S)
ASIN	**Arc sine function**	ASIN (S)
ATAN	**Arc tangent function**	ATAN (S)
ATN2	**Arc tangent function**	ATN2 (S1, S2) = ATAN (S1 / S2)
COS	**Cosine function**	COS (S)
EXP	**Exponential to real**	EXP (S1, S2) = S1 ** S2
EXPI	**Exponential to integer**	EXP (S1, S2) = S1 ** NINT (S2)
LN	**Natural logarithm**	LN (S) = LOG (S)
LOG	**Base 10 logarithm**	LOG (S) = LOG10 (S)
SIN	**Sine function**	SIN (S)
SQRT	**Square root**	SQRT (S)
TAN	**Tangent function**	TAN (S)
ADD	**Addition**	ADD (S1, S2) = S1 + S2
AVG	**Average**	AVG (S1, S2) = (S1 + S2) / 2
MUL	**Multiplication**	MUL (S1, S2) = S1 * S2
QUO	**Division**	QUO (S1, S2) = S1 / S2
SUB	**Subtraction**	SUB (S1, S2) = S1 - S2

ADV **Advection**
ADV (S, V) = - (u * DDX (S) + v * DDY (S))

AVOR **Absolute vorticity**
AVOR (V) = VOR (V) + CORL

DDEN **Density of dry air**
DDEN (PRES, TMPC) = PR_DDEN (PRES, TMPC)

DDR Partial derivative with respect to R
DDR (S) is computed using centered finite differences, with backward or forward differences at the boundary. Polar coordinates are assumed, and (R, THETA) maps into (X, Y).

DDT Time derivative
DDT (S) = (S (time1) - S (time2)) / (time1 - time2)
where the time difference is in seconds.

DDX Partial derivative with respect to X
DDX (S) is computed using centered finite differences, with backward or forward differences at the boundary.

GRID DIAGNOSTIC FUNCTIONS

DDY Partial derivative with respect to Y
DDX (S) is computed using centered finite differences, with backward or forward differences at the boundary.

DEF Total deformation
DEF (V) = (STR (V) ** 2 + SHR (V) ** 2) ** .5

DIRN North relative direction of a vector
DIRN (V) = PR_DRCT (UN (V), VN (V))

DIRR Grid relative direction of a vector
DIRR (V) = PR_DRCT (u, v)

DIV Divergence
DIV (V) = DDX (u) + DDY (v)

DOT Vector dot product
DOT (V1, V2) = u1 * u2 + v1 * v2

DTH Partial derivative with respect to THETA
DTH (S) is computed using centered finite differences, with backward or forward differences at the boundary. Polar coordinates are assumed, and (R, THETA) maps into (X, Y).

FCNT Coriolis force at the center of a polar coordinate grid
FCNT (S) can be computed only for lat/lon grids which have been mapped to polar (R,THETA) coordinates and for which the center lat/lon have been stored with each grid.

FRNT Frontogenesis
FRNT (THTA, V) = CONV * 1/2 * MAG (GRAD (THTA)) *
(DEF * COS (2 * BETA) - DIV)
CONV = unit conversion factor
= 1.08E4 * 1.E5
BETA = ASIN (-DDX (THTA) * COS (PSI) /
MAG (GRAD (THTA)))
PSI = 1/2 ATAN (SHR / STR)

JCBN Jacobian determinant
JCBN (S1, S2) = DDX (S1) * DDY (S2) - DDY (S1) * DDX (S2)

KNTS Convert meters / second to knots
KNTS (S) = PR_MSKN (S)
= S * 1.9438

LAP Laplacian operator
LAP (S) = DIV (GRAD (S))

LAV Layer average (2 levels)
LAV (S) = (S (level1) + S (level2)) / 2.

LDF Layer difference (2 levels)
LDF (S) = S (level1) - S (level2)

MAG Magnitude of a vector
MAG (V) = PR_SPED (u, v)

MASS Mass per unit volume in a layer
MASS = 100 * LDF (PRES) / (GRAVTY * (level1 - level2))
The 100 converts mb to Pascals. Level1 and level2 are also converted to Pascals when VCOORD=PRES. The volume is expressed in units of m * m * (units of the vertical coordinate). This is an operand.

MDIV Layer-average mass divergence
MDIV (V) = DIV ([MASS * LAV (u), MASS * LAV (v)])

MIXR Mixing ratio
MIXR (DWPC, PRES) = PR_MIXR (DWPC, PRES)
The units are g/g internally, but g/kg on output.

MSDV Layer-average mass-scalar flux divergence
MSDV (S, V) = DIV ([MASS * LAV (S) * LAV (u),
MASS * LAV (S) * LAV (v)])
Note: MASS is computed using the in-line parameter values for V rather than those for S.

NORM scalar vector component normal to a cross section
NORM (V) = DOT (V, unit normal vector)
If the starting point for the cross section is on the left, the unit normal vector points into the cross section plane.

PLAT Latitude at each point in polar coordinates
PLAT (S) Note: only the header, which contains the center latitude and longitude, is used.

PLON Longitude at each point in polar coordinates
PLON (S) Note: only the header, which contains the center latitude and longitude, is used.

POLF Coriolis force at each point in polar coordinates
POLF (S) Note: only the header, which contains the center latitude and longitude, is used.

PVOR Potential vorticity in a layer
PVOR (V) = - AVOR (VLAV (V)) * LDF (THTA) /

(100 * LDF (PRES))
The 100 converts millibars to Pascals.
Units are Kelvins / seconds / Pascals (note that GRAVTY is not included). PVOR works on a layer in PRES or THTA coordinates.

RELH Relative humidity
RELH (TEMP, DWPT) = PR_RELH (TEMP, DWPT)

RICH Richardson stability number in a layer
RICH (V) = GRAVTY * DZ * LDF (THTA) /
(LAV (THTA) * MAG (VLDF (V)) ** 2)
Note that DZ = change in height across the layer.
RICH can be evaluated in PRES, THTA or HGHT vertical coordinate.

ROSS Rossby number
ROSS (V1, V2) = MAG (INAD (V1, V2)) /
(CORL * MAG (V1))

SAVG Average over whole grid
SAVG (S) = average of all non-missing grid point values

SAVS Average over subset grid
SAVS (S) = average of all non-missing grid point values in the subset area

SDIV Flux divergence of a scalar
SDIV (S, V) = S * DIV (V) + DOT (V, GRAD (S))

SHR Shear deformation
SHR (V) = DDX (v) + DDY (u)

SM5S Smooth scalar grid using a 5-point smoother
SM5S (S) = .5 * S (i,j) + .125 * (S (i+1,j) + S (i,j+1) +
S (i-1,j) + S (i,j-1))

STAB Thermodynamic stability within a layer (lapse rate)
STAB (TMPC) = LDF (TMPC) / DZ
DZ = change in height across the layer
= - (RDGAS / GRAVTY) * LAV (THTA) *
(LAV (PRES) / 1000) ** KAPPA *
LDF (PRES) / LAV (PRES) in THTA coordinates
The units are degrees / kilometer.

STR Stretching deformation
STR (V) = DDX (u) - DDY (v)

TANG scalar vector component tangential to a cross section
TANG (V) = DOT (V, unit tangent vector)

If the starting point for the cross section is on the left, the unit tangent vector points to the right.

TAV Time average (2 times)
TAV (S) = (S (time1) + S (time2)) / 2.

TDF Time difference (2 times)
TDF (S) = S (time1) - S (time2)

THTA Potential temperature
THTA (TMPC, PRES) = PR_THTA (TMPC, PRES)

THTE Equivalent potential temperature
THTE (PRES, TMPC, DWPC) = PR_THTE (PRES, TMPC, DWPC)

UN North relative u component
UN (V) = zonal wind component

UR Grid relative u component
UR (V) = u

VN North relative v component
VN (V) = meridional wind component

VOR Vorticity
VOR (V) = DDX (v) - DDY (u)

VR Grid relative v component
VR (V) = v

XAV Average along a grid row
XAV (S) = (S (X1) + S (X2) + ... + S (KXD)) / KNT
KXD = number of points in row
KNT = number of non-missing points in row
XAV for a row is stored at every point in that row.
In polar coord. XAV is the average along a radial.

XSUM Sum along a grid row
XSUM (S) = (S (X1) + S (X2) + ... + S (KXD))
KXD = number of points in row
XSUM for a row is stored at every point in that row.
For polar coord., XSUM is the sum along a radial.

YAV Average value along a grid column
YAV (S) = (S (Y1) + S (Y2) + ... + S (KYD)) / KNT
KYD = number of points in column
KNT = number of non-missing points in column
YAV for a column is stored at every point in that column. For polar coordinates, YAV is the average around a circle. If the theta coordinate starts at

0 degrees and ends at 360 degrees, the first radial is not used in computing the average.

YSUM Sum along a grid column
YSUM (S) = (S (Y1) + S (Y2) + ... + S (KYD))
KYD = number of points in column
YSUM for a column is stored at every point in that column. For polar coordinates, YSUM is the sum around a circle. If the theta coordinate starts at 0 degrees and ends at 360 degrees, the first radial is not used in computing the sum.

VECTOR OUTPUT GRID

AGE Ageostrophic wind
AGE (S) = [u (OBS) - u (GEO(S)), v (OBS) - v (GEO(S))]

CIRC Circulation (for cross sections)
CIRC (V, S) = [TANG (V), S]

GEO Geostrophic wind
GEO (S) = [- DDY (S) * const / CORL, DDX (S) * const / CORL]

const	S	vert coord
GRAVTY	ZMSL	none
GRAVTY	HGHT	PRES
1	PSYM	THTA
100/RO	PRES	HGHT

RO = PR_DDEN (PRES, TMPC)

GRAD Gradient of a scalar
GRAD (S) = [DDX (S), DDY (S)]

INAD Inertial advective wind
INAD (V1, V2) = [DOT (V1, GRAD (u2)), DOT (V1, GRAD (v2))]

ISAL Isallobaric wind
ISAL (S) = [- DDT (v (GEO(S))) / CORL, DDT (u (GEO(S))) / CORL]

KNTV Convert meters / second to knots
KNTV (V) = [PR_MSKN (u), PR_MSKN (v)]

LTRN Layer-averaged transport of a scalar
LTRN (S, V) = [MASS * LAV (S) * LAV (u), MASS * LAV (S) * LAV (v)]

GRID DIAGNOSTIC FUNCTIONS

Note: MASS is computed using the in-line parameter values for V rather than those for S.

NORMV Vector component normal to a cross section.
NORMV (V) = NORM (V) * unit normal vector

ROT Coordinate rotation
ROT (angle, V) = [u * COS (angle) + v * SIN (angle),
-u * SIN (angle) + v * COS (angle)]

SMUL Multiply a scalar with each component of a vector
SMUL (S, V) = [S * u, S * v]

SM5V Smooth vector grid using a 5-point smoother
SM5V (V) = .5 * V (i,j) + .125 * (V (i+1,j) + V (i,j+1) +
V (i-1,j) + V (i,j-1))

TANGV Vector component tangential to a cross section.
TANGV (V) = TANG (V) * unit tangent vector

THRM Thermal wind
THRM (S) = [u (GEO(S)) (level1) - u (GEO(S)) (level2),
v (GEO(S)) (level1) - v (GEO(S)) (level2)]

VADD Add the components of two vectors
VADD (V1, V2) = [u1+u2, v1+v2]

VAVG Average over whole grid
VAVG (V) = average of all non-missing grid point values

VAVS Average over subset grid
VAVS (V) = average of all non-missing grid point values in the subset area

VECN Create a vector grid from two north relative scalar components
VECN (S1, S2) = [S1, S2]

VECR Create a vector grid from two grid relative scalar components
VECR (S1, S2) = [S1, S2]

VLAV Layer average for a vector
VLAV (V) = [(u (level1) + u (level2)) / 2.,
(v (level1) + v (level2)) / 2.]

VLDF Layer difference for a vector
VLDF (V) = [u (level1) - u (level1),
v (level1) - v (level2)]

VMUL Multiply the components of two vectors
VMUL (V1, V2) = [u1*u2, v1*v2]

VQUO Divide the components of two vectors
VQUO (V1, V2) = [u1/u2, v1/v2]

VSUB Subtract the components of two vectors
VSUB (V1, V2) = [u1-u2, v1-v2]

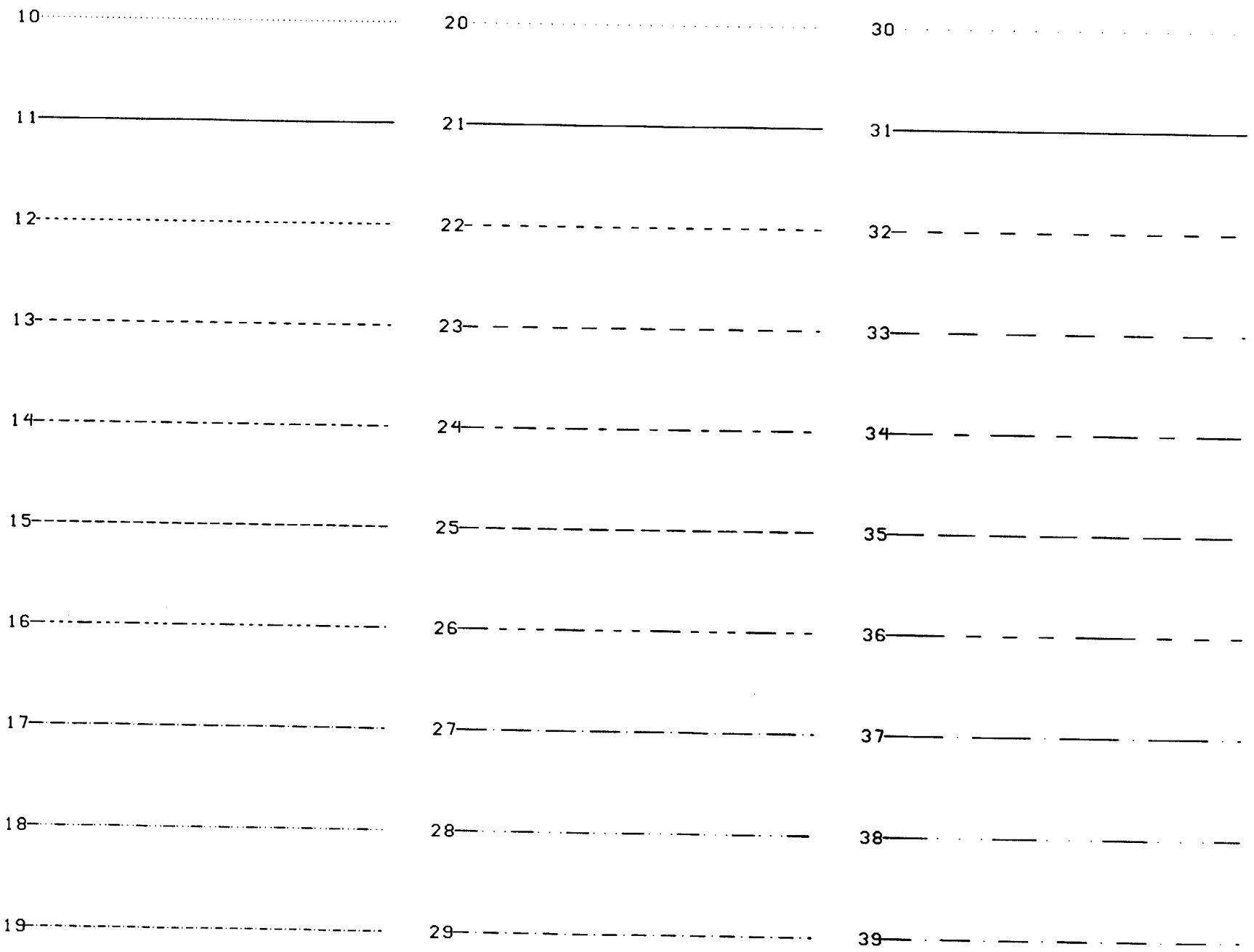
APPENDIX C

LINE TYPES AND WEATHER SYMBOLS

This appendix shows the line types and weather symbols which have been added to GEMPAK.
There are ten distinct line type:

1 - solid
2 - short dashed
3 - medium dashed
4 - long dash short dash
5 - long dash
6 - long dash three short dashes
7 - long dash dot
8 - long dash three dots
9 - medium dash dot
10 - dotted

These patterns can be expanded or compressed by prefixing the single digit with a number from 1 to 9. A prefix of 1 compresses the pattern, 2 is the default and prefixes 3 -- 9 expand the basic pattern. For example, 32 expands line type 2 while 12 compresses the same pattern.
These patterns are shown on the next page. On the following page, the weather symbols are shown.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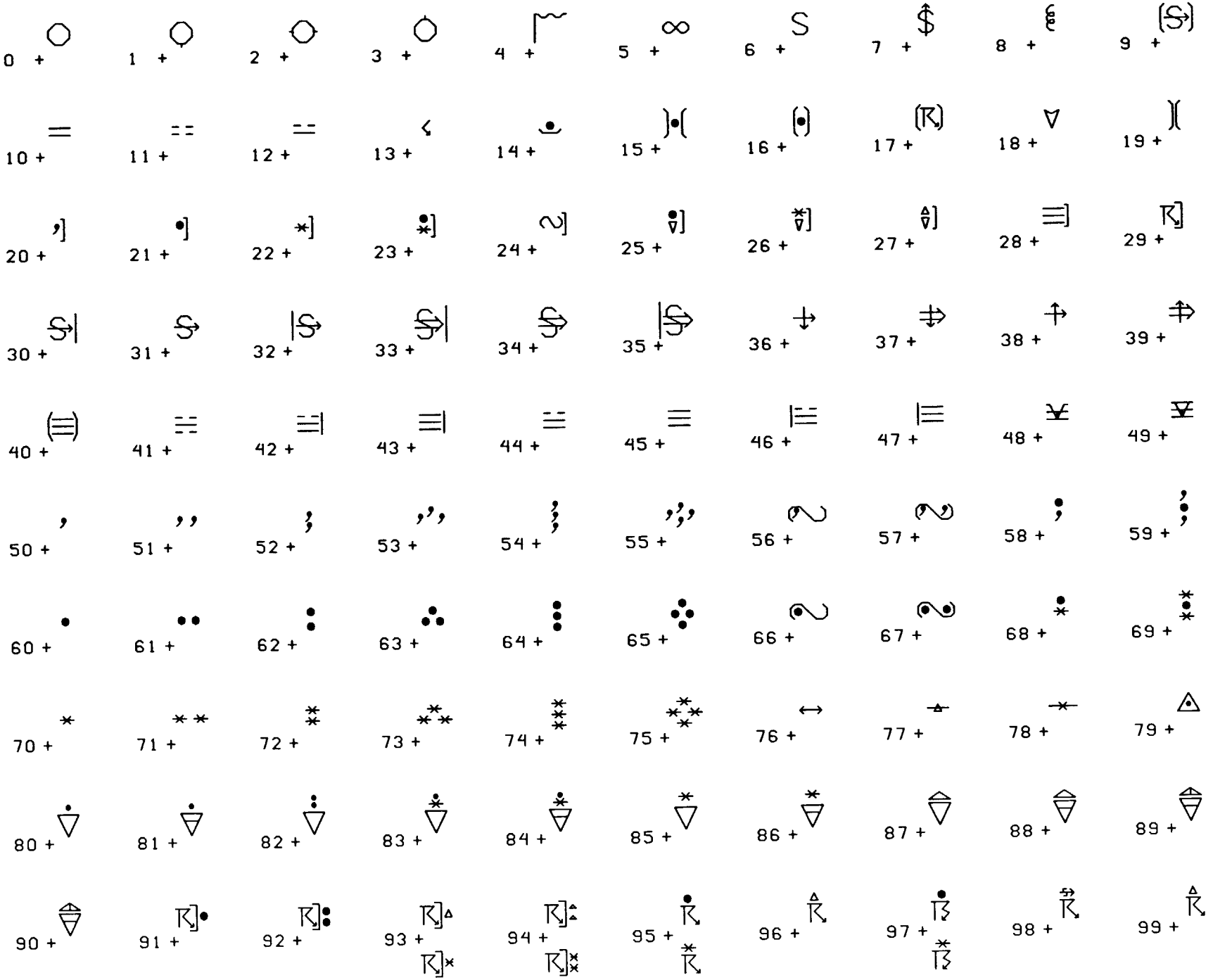
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APPENDIX D

CHANGES FROM GEMPAK4 TO GEMPAK5

This appendix describes some of the changes in GEMPAK5 from GEMPAK4. Many changes have been made in the programs and input parameters, and several new programs have been added.

TIME SERIES:
The following time series programs have been added:

SFGRAM	-	surface time series
SNTSER	-	sounding time series
GDTSER	-	grid time series

HODOGRAPH:
The new program, SNHODO, draws hodographs.

DECODER PROGRAMS:
SFRAWD and SNRAWD decode surface and upper air data from an archived text file. These programs may require modification to use with data archived in formats different than that used at Goddard Space Flight Center.

GDCROSS:
GDCROSS is a new program which draws a vertical cross section between two points in a grid field. Both scalar and vector quantities, including circulation, can be displayed.

GENERALIZED GRID DIAGNOSTICS:
The grid diagnostic functions have been generalized so that differential operators are valid for grids in any projection.

GRID DIAGNOSTIC FUNCTIONS:
Several new grid diagnostic functions have been added. New functions include:

JCBN	-	Jacobian determinant
SM5S	-	5-point smoother for scalars
SM5V	-	5-point smoother for vectors

Internally, all vectors are stored as grid relative components. Operators to specify grid relative or north relative vector components have also been defined.

GRID PACKING:
Grids stored in grid files can be packed in several ways. These include GRIB, the standard gridded binary format, and NMC, the standard format used for NMC history tapes.

GRID PROFILE:
GDPROF has been extensively modified to produce plots similar to SNPROF. Winds can be plotted in the right margin. Potential temperature, equivalent potential temperature, and mixing ratio background lines can be added to the plot. A listing of the quantity being profiled can also be obtained.

GRID POINT LOCATION:
Grid point locations for GPOINT in GDPROF and GDTSER and for CXSTNS in GDCROSS may be specified using surface or upper air character or integer station identifiers, as well as lat/lon coordinates or grid x and y coordinates.

LINE DASHING PATTERNS:
New line dashing patterns have been defined which include dotted patterns. The capability to scale these patterns has also been added.

CONTOUR ALGORITHM:
The contouring algorithm has been rewritten to eliminate spurious loops and overdrawn lines. In addition, the contours no longer overdraw the labels.

WEATHER SYMBOLS:
Weather symbols are plotted in SFGRAM and SFMAP when WSYM is specified.

LATITUDE/LONGITUDE LINES:
Latitude/longitude grid lines can be drawn in all the programs that plot data on a map.

COLORS:
A specific color may now be assigned to a color number by entering =NAME after the color number. For example, COLORS=1=red;2=blue, will set color number 1 to red and color number 2 to blue. If the last character in COLORS is a ?, then the current color names will be listed.

SYMBOL ATTRIBUTES:
All symbols, including text, arrows, barbs, markers, and weather symbols, have an additional attribute which specifies the line width.

CHANGES FROM GEMPAK4 TO GEMPAK5

STREAMLINES:
The algorithm for drawing streamlines has been rewritten. The arrow heads on the streamlines will no longer change size as the plot is zoomed. Also, GDSTREAM correctly passes grid relative winds to the streamline package.

GRAPHICS UTILITY PROGRAMS:
The GP programs have been modified and reorganized for GEMPAK5. A new program, GPMAP, can be used to define a coordinate system and add a map and latitude/longitude grid lines.

MAP FILES:
A US county map has been added. Maps containing only the Northern and Southern hemispheres have been created. With a stereographic map projection, these maps will not plot beyond the equator.

SNCROSS:
SNCROSS, the sounding cross section program now draws a cross section for any meterorological parmameter that can be computed. In addition, a time section is drawn if a single station and multiple times are entered.

CONDITIONAL PARAMETERS:
Parameters input in SFPARM and SNPARM may include conditions and arithmetic operations. Conditions include the operators <, >, =. Arithmetic operations include +, -, *, /, followed by a real number. For example, TMPF>100 selects those stations where the temperature is greater than or equal to 100 degrees. TMPF*10 multiplies the temperature by 10. This replaces the variable, SCALE, in SFMAP and SNMAP.

CENTERED PARAMETERS:
In SFMAP and SNMAP, a parameter is plotted centered at each station if it is the last parameter in the list and an @ is appended.

SURFACE DECODER:
The RA library, which decodes surface airways data, is included.

NON-TAE INTERFACE:
The following new features have been added to the user interface used when running programs outside the TAE:

- The user will be prompted for parameters before the program is executed. Previously, the program was executed with current global values first.
- A DISPLAY function has been added which displays the level 1 help along with values for the program parameters.
- SAVE and RESTORE functions have been added.
- If $RESPOND is NO, the first tutor will still be

displayed.
- IF $MAPFIL is changed, the new map file will be activated immediately. In the TAE and in earlier versions of the non-TAE, the value of $MAPFIL was not changed until after the program was started again.

MULTIPLE FILE INPUT:
The objective analysis programs can read data from two files. This allows ship data to be included in an objective analysis.

Multiple grid files can also be used in the grid diagnostic programs. This allows easy comparisons between two different models, although they must have the same navigations.

STATION REPORT TIME:
The station report time, STIM, is now a station parameter. The time will be printed as hours and minutes in the form HHMM.

BACKGROUND PROFILE LINES:
A minimum, maximum, and increment can be specified for the background lines on a profile in THTALN, THTELN, and MIXRLN.

UNMERGED DATA:
Data which have not been merged, i.e., data stored at mandatory and significant levels separately, can be listed in the separate parts in SNLIST, read from a text file in SNEDIT, and transferred to a new file in SNMOD. The choice between merged and unmerged data is specified in the parameter, MRGDAT.

LAYER QUANTITIES:
Several layer quantities can be computed in the sounding programs including:

RICH	-	Richardson number
BVFQ	-	Brunt-Vaisala frequency
BVSQ	-	Brunt-Vaisala frequency squared
BVPD	-	Brunt-Vaisala period
LAPS	-	Temperature lapse rate
STAB	-	Potential temperature lapse rate
STAP	-	Potential temperature change with pressure
SHRD	-	Wind shear direction
SHRM	-	Wind shear magnitude
SEPA	-	Pressure difference in isentropic layer

STATION DIAGNOSTIC QUANTITIES:
Several stability indicies can be computed at sounding stations. These new quantities, which can be specified in STNDEX, include:

BRCH	-	Bulk Richardson number
CAPE	-	Convective Available Potential Energy

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16. Abstract

GEMPAK is a general meteorological software package used to analyze and display conventional meteorological data as well as satellite derived parameters. This User's Guide describes the GEMPAK5 programs and input parameters and details the algorithms used for the meteorological computations.

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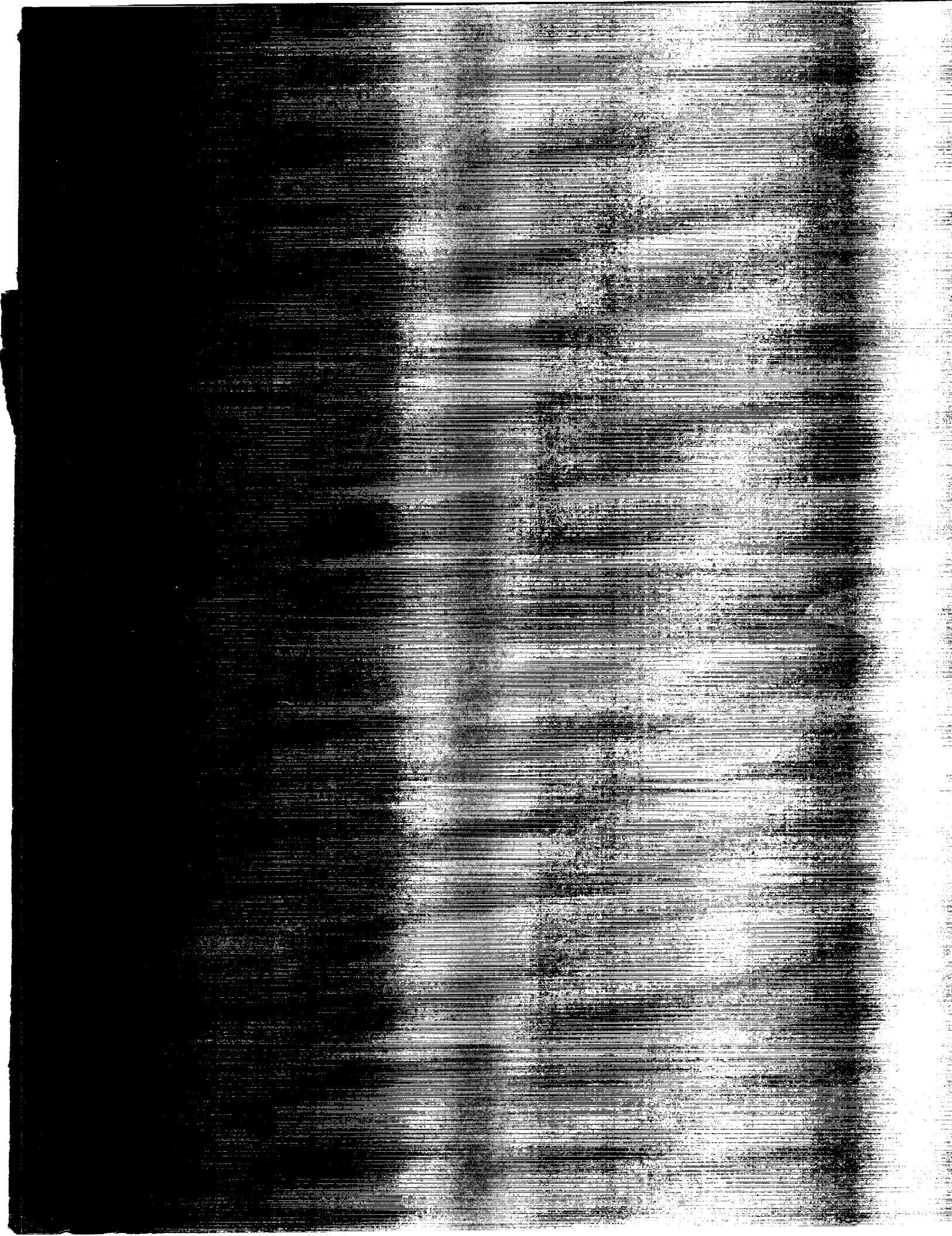

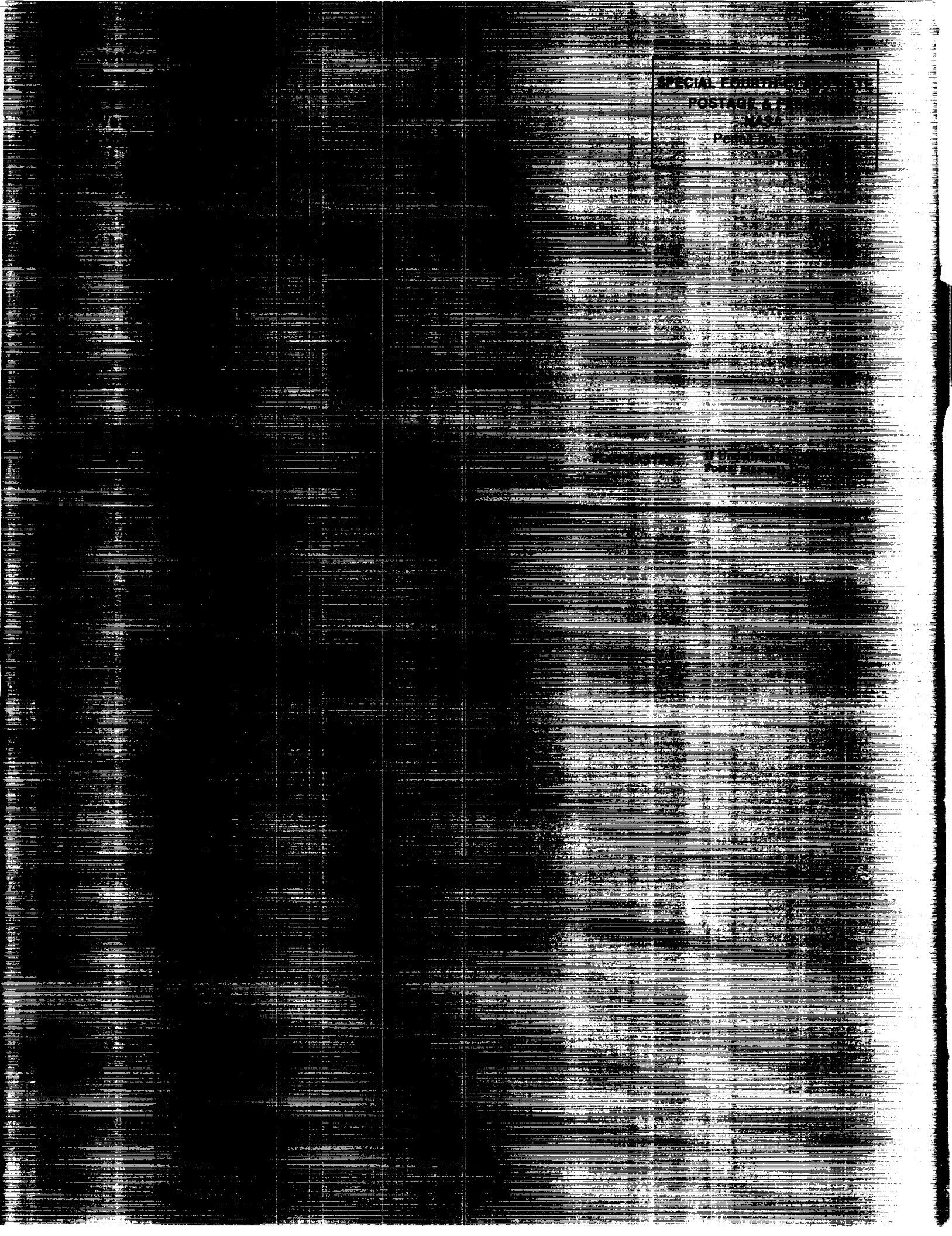
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