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NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

OFFICE NOTE 167

Encoding Grid Code at the National Meteorological Center

Robert Allard
Automation Division

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This is an unreviewed manuscript, primarily intended for informal exchange of information among NMC staff members.

Introduction

WMO Grid Code provides the essential guidelines for encoding grid-point data. Requests for large volumes of grid data demonstrated the need to (1) select a specific guideline for each data type, (2) use a single encoding program, and (3) devise a naming scheme for Grid Code bulletins. A fourth need has been to document the first three.

This Office Note describes the background of Grid Code use at NMC, selected encoding guidelines, the encoding program, and procedures for adding and naming new bulletins--and is intended for NMC use only.

Background

Directions for handling grid-point data have taken many turns. WMO and NMC guidelines have changed. Bulletin-naming conventions, headings and data representation schemes, grids, and bulletin sizes have varied. Now Office Note 100 limits a bulletin size. However, at NMC a bulletin based on previous conventions tends to retain its form even after new ones are adopted.

Since September 1963, the AHXN1-4 bulletins have used a primitive version of Grid Code and a specially designed 473-point hemispheric array to transmit five-day mean values of sea-level pressure, 500 mb height, and 500/1000 thickness. Each bulletin represents a Northern Hemisphere quadrant, and the word "GRID" appears as code form identification. (Gelhard 1976).

Another forerunner (Neilon and Terauchi 1969) guided two programs. The first, in late 1969, formatted the 12 hour PE 200 mb height forecast as the FUXN bulletin for Canada. The four parts of this bulletin form the 1977-point octagonal grid. Since 1972, the second has provided seventy-six bulletins in the LBUREC FUXXii series for the Bureau of Reclamation in Denver, Colorado. A 704-point rectangular subset of the LFM grid contains the 176 data points used in transmitting 12 and 24 hour multiple-level forecasts of height, temperature, dewpoint, wind direction, wind speed, and vertical motion. A new set of bulletins featuring delta-packed binary data and a pseudo-ASCII format will retire the LBUREC program described above (Howcroft 1977). Nothing in the bulletin world is constant except change.

The CBS (Commission for Basic Systems) Working Group on Codes proposed a new WMO Grid Code form that guided two more NMC programs and heralded the return of "GRID" as code form identification. The first program based on the early proposal (CBS 1971) extracts a 16X26 rectangular North Atlantic subset of the 00Z PE 72 hour sea-surface pressure forecast and formats the FSNT5 bulletin for Sweden. The second extracts a 00Z 27X20 rectangular North American grid for 500 and 1000 mb heights from the PE at 24, 48, and 72 hours and 500 mb only from the barotropic at 96 and 120 hours for transmitting the bulletins FUXN2-9 to Canada. An amended version of Grid Code (CBS 1973) now designated FM 47-V GRID in Volume I of the WMO Manual on Codes forms the basis for current NMC bulletin constructions.

In 1974, an NMC programming effort provided eight bulletins intended to support a ninety-day GATE project. These messages--36 and 48 hour wind and temperature forecasts at 200 and 700 mb on a five-degree latitude-longitude 8X30 Atlantic grid with a northern-biased straddle of the Equator--left the starting gate late and were scratched early. Although the bulletins achieved anonymity, the program pioneered techniques for tropical data and wind bulletins that were used in the future encoding program. The late Gate program had been one of the first programmed initially for the IBM 360/195 computer. Conversion of CDC 6600 programs delayed most new projects.

The Communications Division devised a global grid scheme (Neilon 1974) designed to accomodate requests for all future Grid Code bulletins. This grid geometry, shown in Appendix A, is published in WMO Publication No. 9, Volume B. Each of the twelve areas contains 285 grid-points and represents a bulletin size meeting Office Note 100 standards. By September 1975, a checked-out program for sending 32 Northern Hemisphere height and temperature analysis bulletins for Agematsu of the Japanese Meteorological Agency awaited for that which never appeared--bulletin names and catalog numbers. This unused program has provided useful subroutines for forming the 285-point grids. Meanwhile, the Kakizaki request for height, temperature, and wind analyses for both hemispheres increased the needed Japanese bulletin count to 232 and also the odds against receiving names and numbers. These events inspired the present bulletin-naming scheme and added impetus to the single-encoding-program project.

The Communications Division names bulletins and issues two sets of catalog numbers to meet internal and external requirements. A programmer must include the internal (MDL) number in the 40-character CCAP string preceding each bulletin. The GATE grid bulletins had been the first G-named and had used the form GWXTii for wind and GTXTii for temperature bulletins. The first i-digit represented the level in hundreds of millibars and the second the forecast hour in number of duodecimal units.

In cooperation with the Communications Division, Automation Division devised an expansion of this scheme, shown in Appendix B, for unique G-names based on data-type, grid-area, forecast-time, and millibar or special-level that is essentially the proposed amendment (CBS 1976) to the Manual on the Global Telecommunications System, Volume I-"Global Aspects." A program under data-card control generates G-names and lists them in tables based on data-type and ordered by level and forecast hour. These lists expedite the assignment of catalog numbers. Another set of G-named bulletins exists--using the form GFUSii, where ii ranges from 20 to 69. These FAA grid bulletins do not use Grid Code, and naming conventions have not yet conflicted.

As often is the case, Grid Code programming teamwork progressed serially until a parallel programming push produced the long-planned all-purpose encoding program in the first quarter of 1976. A larger group effort verified the code form and data values. In May 1976, the 232 Japanese bulletins finally became an NMC 12Z Final product. Two tropical-area satellite sea-surface analysis bulletins for India joined the set in October of the same year.

In June 1977, the WMO preference list of high priority analyses and forecast products for 00Z and 12Z introduced three runs per day by forcing the split of 12Z bulletins into two runs to lessen the impact on the communications system. With the addition of another tropical satellite sea-surface analysis bulletin for Brazil in August 1977, the total has reached the 343 bulletins listed in Appendix C. Available information has not linked other grid-point bulletins to WMO code forms, but such bulletins do exist--and the links may exist. WMO has floated an abbreviated form of FM 47-V GRID designated FM 49-VII GRAF intended to satisfy aeronautical needs. This is another set of Grid Code guidelines that NMC does not need.

Encoding Guidelines for GRID Bulletins

The bulletins use normal line scanning mode for the twelve 285-point (19X15) longitude-latitude grids in Appendix A. For the Northern Hemisphere grids the first data line, as dictated by the reference points, is 20N, and the left to right scans proceed northward. For the Tropical Belt and the Southern Hemisphere the left to right scans start at 35N and 20S, respectively, and proceed southward.

No spaces appear between data groups.

Each data group represents one grid point.

We do not encode Section 2 (grid geometry)--which appears in WMO Publication No. 9, Volume B--or Section 4 (checksums).

The NMC selections from FM 47-V GRID appear in Appendix D.

In Section 1, group 5 replaces group 2 for surface and tropopause levels. Forecast bulletins require group 8.

Group 3 scaling and the data sign conventions in Section 3 will be described later.

Currently we can encode GRID bulletins for the data types, levels (except maximum wind level) and reference times shown in Tables 1, 4 and 3 of Appendix B, respectively.

The input fields for either the 4225-point (65X65) grid or the 5365-point 2.5 degree (145X37) longitude-latitude grid must exist in one of the following files: ANL, ANL5, GANL, F00, F12, F24, F36, F48, F60, F72, F84, F96, GF12, or GF24. The number of files may be expanded to ninety-nine.

Tropical Belt bulletins require that both the Northern Hemisphere and Southern Hemisphere data fields be available.

The program encodes wind bulletins in two forms: direction and speed (dddff) and components (SUUVV). We have decided to use only the first. The second form is not included in the bulletin-naming scheme but uses the letter U as the data designator and WMO Code 3856 for the S-sign indicator in the data group. To satisfy the 69-character teletype line, the wind bulletin grid line splits into two data lines.

We have followed the British conventions (McIlveen 1974) for temperature bulletins. Temperatures above 500 mb are always minus and the signs are dropped. Positive temperatures at 500 mb are set to zero, and again the signs are dropped. Temperatures below 500 mb are signed using WMO Code 3856.

Relative humidity values greater than 99 are set to 99.

Table I summarizes data type attributes, and Table II additive constants for group 3 of Section 3. Appendix E contains sample bulletins.

Table I. Data-Type Attributes

Data Type	$a_1a_1a_2a_2$	No. of Digits Per Grid Point	Form	Units
Pressure	0100	3	PPP	mbs
Height	0200	3	hhh	decameters
Temperature	0400	2	TT	degrees C
		3 *	S_xTT	
Wind	2200	5	dddff	nearest 5^o, mps
	2324 **	5	S_xUUVV	mps, mps
Relative Humidity	1300	2	rr	percent

* temperatures below 500 mb

** not used

Table II. Constants Subtracted from Data to Preserve Three Digits

Data Type	Level	Constant	Unit
Pressure	Sea-level	200	millibars
Height	1000 mb	-100	decameters
	850 mb	0	
	700 mb	0	
	500 mb	0	
	400 mb	0	
	300 mb	700	decameters
	250 mb	800	decameters
	200 mb	900	decameters
	150 mb	1000	decameters
	100 mb	1000	decameters
	70 mb	1500	decameters
	50 mb	1500	decameters
	30 mb	2000	decameters
	20 mb	2000	decameters
	10 mb	2500	decameters

Encoding Program

The operational program (GRIDBUL) currently uses three control data sets (GRIDBUL1, GRIDBUL2, and GRIDBUL3) to select input-fields, input-files, and output-bulletins for its 00Z, 12Z, and 12Z Final runs, respectively.

A control data set requires a three card subset for each data-type, level, and tau combination to output from 1-12 bulletins for the grid areas described in Appendix A.

Each three card subset contains eleven parameters--plus set and subset sequencing for visual checking only. The input field identification could supply much of the information, and internal tables the scaling constants; but under deadline pressure, the programmer, doubting the future of the bulletin-naming scheme and the assigned constants, made his program independent by making doubtful information data-card parameters. When we reprogram for a new computer, two card subsets containing three parameters (input-field identifiers, data-source-file indicator, and catalog numbers) can generate all the needed information including the bulletin names. We output too many bulletins to change now. Everything would have to be checked-out again.

The program feeds on data fields for either the 2.5 degree (145X37) longitude-latitude grid or the (65X65) grid. The data are transformed to the five degree (19X15) grids in Appendix A.

The control data set always specifies the Northern Hemisphere data field identifiers. The program supplies the Southern Hemisphere grid marker when needed. (See Office Note 84).

The program will open and close the input-data sets when necessary while processing a control card subset, but ordering the control card subsets in groups using the same input-data set achieves greater efficiency.

Adding New Bulletins

When the decision to add new Grid Code bulletins filters to the programmer, he must know the data-types, forecast-times, run-times, data-levels, grid-areas, and input-data sets.

First, he must verify that the input fields exist in current data file inventories. Adding new fields involves other personnel and could delay the target-date a month per person. Assigned project priorities will also affect this deadline.

Next, the programmer should punch data cards for the GNAMES program, generate the table(s) of new G-names, and forward a printout to the Communications Division for the assignment of catalog numbers. The same data cards may be added to the previous set to generate an updated list of all bulletins. (The GNAMES program documentation describes the data card format.)

After receiving the catalog numbers, the programmer may produce the control data set(s) needed for the new bulletins. This may require either new data sets or modifications to old sets. (The GRIDBUL program documentation describes the control data set format).

Since incorrect specification of control data set parameters causes most problems, the programmer should use the CDSPRT program to provide both a card image listing and a parameter listing of the control data set(s) for visual checking.

Now the programmer is ready to execute the GRIDBUL program for each new control data set and to print the bulletins in both blocked and unblocked format using the NWSTXPRT procedure. He checks the print to verify the number of bulletins, the names, the catalog numbers, and the data. Bad data usually means that in the control data set either the input field identifiers disagree with the bulletin specifications or a scaling constant is incorrect. A remote possibility of bad data in an input file also exists.

With the checkout completed the programmer submits the appropriate Job Implementation Form (JIF) for the new or modified control data set(s) to initiate action that results in the bulletins being produced in the operational networks. These actions require about two weeks to complete in routine situations.

For proper coordination of the new bulletins, the Communications Division and our CCAP personnel need advance notive of the implementation date.

The Operators Section adds the new bulletin names to the <u>NMC Teletype Transmission List</u>.

<u>Acknowledgments</u>

Limited sources and time do not permit the background chapter of this Office Note to be a complete history of Grid Code at NMC, but a background demands an acknowledgment of roles that people played in this project.

While we groped for guidelines, and he was still a COOP-student, Michael Boczenowski performed many Grid Code experiments.

Barry Damiano, another COOP-student, wrote the Agematsu program that provided six useful subroutines.

Robert Gelhard designed the control data sets, wrote the control program that performs the I/O and links the subroutines, checked-out the Japanese bulletins, and bequeathed through his retirement the program maintenance and documentation efforts to others.

James Howcroft promoted the single-encoding-program approach, established guidelines, helped to verify the original set of bulletins, and coordinated all data requests.

Lena Loman guided the COOP-students, verified the original set of bulletins, and coordinated assignments and operational implementations.

Finally, James R. Neilon of the Communications Division, between world trips, furnished the grid scheme, participated in the bulletin-naming scheme, and stacked the data requests.

Others, seen from the top of the hill, may have played roles; but they, unobserved from the trenches, will remain anonymous.

REFERENCES

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Gelhard, Robert H., 1976: AHXN Transmission Data Content and Code Form. For the Record Memorandum. W3421, p. 1.

Howcroft, James G., 1977: Delta-packing of Binary Data for Transmission in Pseudo-ASCII Format. W342. (Unpublished, unnamed, and unwritten document).

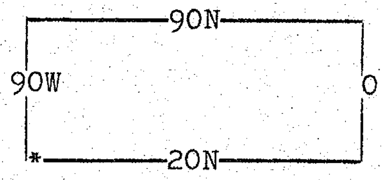
McIlveen, W. A., 1974: "On the Use of the W.M.O. Grid Code in the Meteorological Office. I: Encoding." Technical Note No. 1. Met O 2b, England, pp. 1-10.

Neilon, James R., 1974: Geographical Areas for Use with Grid Code Messages. For the Record Memorandum. W53, pp. 1-2.

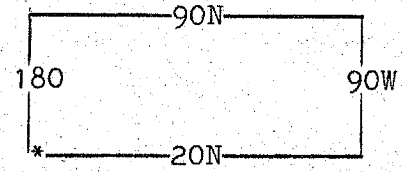
Neilon, J. R. and Terauchi, E., 1969: Standards and Procedures for the Presentation of Processed Data in Digital Form. World Weather Watch Planning Report No. 29. Secretariat of the World Meteorological Organization, Geneva, Switzerland, Appendix B.

APPENDIX A: Grid Geometry and Catalog Numbers of Grids

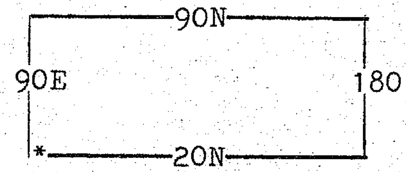
NORTHERN HEMISPHERE



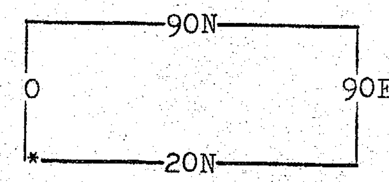
NNN=001



NNN=002

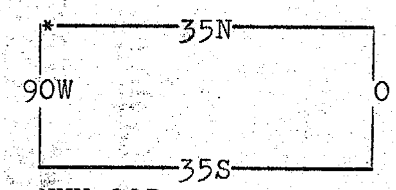


NNN=003

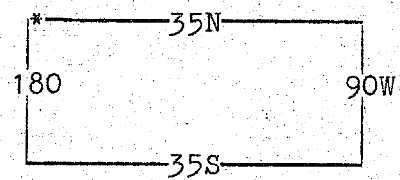


NNN=004

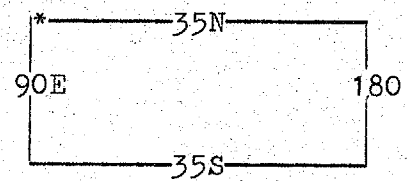
TROPICAL



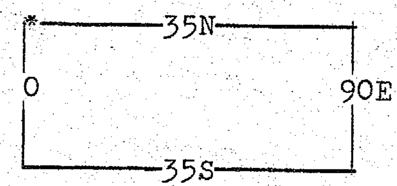
NNN=005



NNN=006

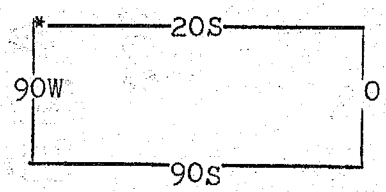


NNN=007

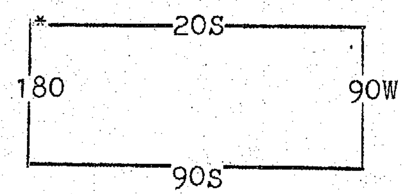


NNN=008

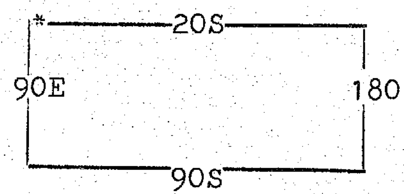
SOUTHERN HEMISPHERE



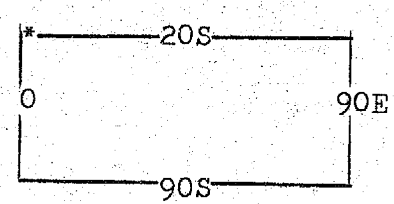
NNN=009



NNN=010



NNN=011



NNN=012

* = Reference point

Grid points at five degree latitude/longitude intersections

The table below describes the grid geometry as published in <u>WMO Publication No. 9</u>, Volume B. This permitted the Grid Code section 2 heading to be omitted.

					Origin						If geographical grid, or cartesian grid on Mercator projection, is used — Boundaries of the grid system			
	NNN	Code Figure	Grid Type	Map Proj.	Coord. of Pole	Geo. Coord.Orig.	N_iN_i	N_jN_j	$d_id_id_id_i$	$d_jd_jd_jd_j$	$2Q_cL_aL_aL_a$	$3L_oL_oL_oL_o$	$4Q_cL_aL_aL_a$	$5L_oL_oL_oL_o$
WMC Washington	001	01	G	N/A		Yes	19	15	0050	0050	27900	30900	47200	59999
	002	01	G	N/A		Yes	19	15	0050	0050	27900	31800	47200	59999
	003	01	G	N/A		Yes	19	15	0050	0050	21900	30900	41200	59999
	004	01	G	N/A		Yes	19	15	0050	0050	21900	30000	41200	59999
	005	01	G	N/A		Yes	19	15	0050	0050	27350	30900	45350	50000
	006	01	G	N/A		Yes	19	15	0050	0050	27350	31800	45350	50900
	007	01	G	N/A		Yes	19	15	0050	0050	21350	30900	43350	51800
	008	01	G	N/A		Yes	19	15	0050	0050	21350	30000	43350	50900
	009	01	G	N/A		Yes	19	15	0050	0050	25200	30900	45900	59999
	010	01	G	N/A		Yes	19	15	0050	0050	25200	31800	45900	59999
	011	01	G	N/A		Yes	19	15	0050	0050	23200	30900	43900	59999
	012	01	G	N/A		Yes	19	15	0050	0050	23200	30000	43900	59999

APPENDIX B: Grid Code Bulletin Naming Conventions

GENERIC FORM: $T_1T_2A_1A_2ii$

T_1 = G indicator that text is in grid-point format

T_2 = Data designator (see Table 1)

A_1 = Geographical designator (see Table 2)

A_2 = Reference time of information (see Table 3)

ii = Atmospheric level indicator (see Table 4)

Table 1. Data Designator (T_2)

Designator	Data Type
H	Height
P	Pressure
R	Relative Humidity
T	Temperature
W	Wind

Table 2. Geographical Area Designator (A_1)

Designator	Geographical Area
A	0 - 90W Northern Hemisphere
B	90W - 180 " "
C	180 - 90E " "
D	90E - 0 " "
E	0 - 90W Tropical Belt
F	90W - 180 " "
G	180 - 90E " "
H	90E - 0 " "
I	0 - 90W Southern Hemisphere
J	90W - 180 " "
K	180 - 90E " "
L	90E - 0 " "
M-Z	Not assigned

Table 3. Reference Time Designators (A_2)

Designator	Reference Time		
A	Analysis (00 hours)		
B	6 hours forecast		
C	12 "	"	
D	18 "	"	
E	24 "	"	
F	30 "	"	
G	36 "	"	
H	42 "	"	
I	48 "	"	
J	60 "	"	
K	72 "	"	
L	84 "	"	
M	96 "	"	
N	108 "	"	
O	120 "	"	(5 days)
P	132 "	"	
Q	144 "	"	
R	156 "	"	
S	168 "	"	(7 days)
T	10 days	"	
U	15 days	"	
V	30 days	"	
W-Z	Not assigned		

Table 4. Level Designators (ii)

Designator	Level
99	1000 mb
98	Surface of the earth or ocean
97	Tropopause
96	Maximum wind
95-91	Not assigned
85	850 mb
70	700 mb
50	500 mb
40	400 mb
30	300 mb
25	250 mb
20	200 mb
15	150 mb
10	100 mb
07	70 mb
05	50 mb
03	30 mb
02	20 mb
01	10 mb

H[illegible]T:

HOUR	LEVEL	NORTHERN HEMISPHERE				TROPICAL BELT				SOUTHERN HEMISPHERE			
		QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4
ANAL	1000	GHAA99	GHBA99	GHCA99	GHDA99	GHEA99	GHFA99	GHGA99	GHHA99	GHIA99	GHJA99	GHKA99	GHLA99
	850	GHAA85	GHBA85	GHCA85	GHDA85								
	700	GHAA70	GHBA70	GHCA70	GHDA70	GHEA70	GHFA70	GHGA70	GHHA70	GHIA70	GHJA70	GHKA70	GHLA70
	500	GHAA50	GHBA50	GHCA50	GHDA50	GHEA50	GHFA50	GHGA50	GHHA50	GHIA50	GHJA50	GHKA50	GHLA50
	300	GHAA30	GHBA30	GHCA30	GHDA30								
	200	GHAA20	GHBA20	GHCA20	GHDA20	GHEA20	GHFA20	GHGA20	GHHA20	GHIA20	GHJA20	GHKA20	GHLA20
	100	GHAA10	GHBA10	GHCA10	GHDA10	GHEA10	GHFA10	GHGA10	GHHA10	GHIA10	GHJA10	GHKA10	GHLA10
	50	GHAA05	GHBA05	GHCA05	GHDA05	GHEA05	GHFA05	GHGA05	GHHA05	GHIA05	GHJA05	GHKA05	GHLA05
	30	GHAA03	GHBA03	GHCA03	GHDA03								
12	1000	GHAC99	GHBC99	GHCC99	GHDC99								
	850	GHAC85	GHBC85	GHCC85	GHDC85								
	500	GHAC50	GHBC50	GHCC50	GHDC50								
	300	GHAC30	GHBC30	GHCC30	GHDC30								
	100	GHAC10	GHBC10	GHCC10	GHDC10								
24	1000	GHAE99	GHBE99	GHCE99	GHDE99								
	850	GHAE85	GHBE85	GHCE85	GHDE85								
	500	GHAE50	GHBE50	GHCE50	GHDE50								
	300	GHAE30	GHBE30	GHCE30	GHDE30								
	100	GHAE10	GHBE10	GHCE10	GHDE10								
36	1000	GHAG99	GHBG99	GHCG99	GHDG99								
	850	GHAG85	GHBG85	GHCG85	GHDG85								
	500	GHAG50	GHBG50	GHCG50	GHDG50								
	300	GHAG30	GHBG30	GHCG30	GHDG30								
	100	GHAG10	GHBG10	GHCG10	GHDG10								
48	1000	GHAI99	GHBI99	GHCI99	GHDI99								
	850	GHAI85	GHBI85	GHCI85	GHDI85								
	500	GHAI50	GHBI50	GHCI50	GHDI50								
	300	GHAI30	GHBI30	GHCI30	GHDI30								
	100	GHAI10	GHBI10	GHCI10	GHDI10								
72	1000	GHAK99	GHBK99	GHCK99	GHDK99								
	500	GHAK50	GHBK50	GHCK50	GHDK50								

HEIGHT:

HOUR	LEVEL	NORTHERN HEMISPHERE				TROPICAL BELT				SOUTHERN HEMISPHERE			
		QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4
96	1000	GHAM99	GHBM99	GHCM99	GHDM99								
	500	GHAM50	GHBM50	GHCM50	GHDM50								
120	1000	GHAO99	GHBO99	GHCO99	GHDO99								
	500	GHAO50	GHBO50	GHCO50	GHDO50								

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TEMPERATURE:

HOUR	LEVEL	NORTHERN HEMISPHERE				TROPICAL BELT				SOUTHERN HEMISPHERE			
		QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4
ANAL	SFC					GTEA98		GTGA98	GTHA98				
	1000	GTAA99	GTBA99	GTCA99	GTDA99	GTEA99	GTFA99	GTGA99	GTHA99	GTIA99	GTJA99	GTKA99	GTLA99
	700	GTAA70	GTBA70	GTCA70	GTDA70	GTEA70	GTFA70	GTGA70	GTHA70	GTIA70	GTJA70	GTKA70	GTLA70
	500	GTAA50	GTBA50	GTCA50	GTDA50	GTEA50	GTFA50	GTGA50	GTHA50	GTIA50	GTJA50	GTKA50	GTLA50
	300	GTAA30	GTBA30	GTCA30	GTDA30								
	200	GTAA20	GTBA20	GTCA20	GTDA20	GTEA20	GTFA20	GTGA20	GTHA20	GTIA20	GTJA20	GTKA20	GTLA20
	100	GTAA10	GTBA10	GTCA10	GTDA10	GTEA10	GTFA10	GTGA10	GTHA10	GTIA10	GTJA10	GTKA10	GTLA10
	50	GTAA05	GTBA05	GTCA05	GTDA05	GTEA05	GTFA05	GTGA05	GTHA05	GTIA05	GTJA05	GTKA05	GTLA05
	30	GTAA03	GTBA03	GTCA03	GTDA03								

83 BULLETINS

WIND:

HOUR	LEVEL	NORTHERN HEMISPHERE				TROPICAL BELT				SOUTHERN HEMISPHERE			
		QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4	QUAD 1	QUAD 2	QUAD 3	QUAD 4
ANAL	1000	GWAA99	GWBA99	GWCA99	GWDA99	GWEA99	GWFA99	GWGA99	GWHA99	GWIA99	GWJA99	GWKA99	GWLA99
	700	GWAA70	GWBA70	GWCA70	GWDA70	GWEA70	GWFA70	GWGA70	GWHA70	GWIA70	GWJA70	GWKA70	GWLA70
	500	GWAA50	GWBA50	GWCA50	GWDA50	GWEA50	GWFA50	GWGA50	GWHA50	GWIA50	GWJA50	GWKA50	GWLA50
	200	GWAA20	GWBA20	GWCA20	GWDA20	GWEA20	GWFA20	GWGA20	GWHA20	GWIA20	GWJA20	GWKA20	GWLA20
	100	GWAA10	GWBA10	GWCA10	GWDA10	GWEA10	GWFA10	GWGA10	GWHA10	GWIA10	GWJA10	GWKA10	GWLA10
	50	GWAA05	GWBA05	GWCA05	GWDA05	GWEA05	GWFA05	GWGA05	GWHA05	GWIA05	GWJA05	GWKA05	GWLA05

72 BULLETINS

TOTAL NUMBER OF BULLETIN NAMES: 343

APPENDIX D: NMC Group Selection from FM 47-V GRID

SECTION 0 GRID F_1F_2NNN $1nnn_tn_t$

SECTION 1 111 $1a_1a_1a_2a_2$ $(2p_1p_1p_2p_2)$ $(5b_1b_1b_2b_2)$ 6JJMM $7YYG_cG_c$ $(8u_tttt)$ $0mmg_rg_r$

SECTION 3 333 $1n_an_an_pi_s$ $2n_1n_2q_1q_2$ $(3us_nrr\ rrrrr)$

$k_1k_1n_gn_g$ $i_ai_ai_aj_aj_aj_a$ $(s_x)II...I$ .... $(s_x)II...I$

....

....

....

$k_1k_1n_gn_g$ $i_ai_ai_aj_aj_aj_a$ $(s_x)II...I$ .... $(s_x)II...I$

SECTION 5 555 F_1F_2NNN $1nnn_tn_t$

777

Specification of Symbolic Letters

F_1F_2	07; originating centre identifier for U.S.
NNN	001, 002, ..., 012; catalog number of grid as described in Appendix A.
nn	01; serial number of part.
n_tn_t	01; total number of parts (always 1 at NMC).
a_1a_1	Type of parameter; (WMO Code Table 0291); see Table I.
a_2a_2	00 (unless U,V wind components); (WMO Code Table 0291); see Table I.
p_1p_1	Pressure level in tens of millibars; (1000 mb = 00).
p_2p_2	99; (always = 99 when group 2 Of Section 1 is used).
b_1b_1	Special levels: 01 (surface of earth or sea-level); 07 (tropopause).
b_2b_2	00; (always = 00 when group 5 of Section 1 is used for a special level).
JJ	Tens and units digit of year (GMT).
MM	Month of the year (GMT): 01, 02, ..., 12.
YY	Day of month (GMT): 01, 02, ..., 31.
G_cG_c	Synoptic hour (GMT) of observation of data.
u_t	1; unit of time for ttt; (WMO Code Table 4252).
ttt	Forecast hour; group 8 of Section 1 is omitted for analyses.
mm	Procedure or model used to generate data field:

10 - Cressman analysis
11 - Global Hough analysis
30 - Barotropic
32 - Barotropic mesh
41 - Baroclinic (PE) 6 layer model
42 - 8 L 2.5X2.5 Global
99 - None of the above

g_rg_r 99; indicator that Section 2 is not included.

n_an_a 15; number of grid lines in bulletin.

n_p 1; number of grid points per data group.

i_s Sign indicator for Section 3 data; (WMO Code Table 1851).

n_1 Number of digits in which the value of a parameter a_1a_1 for a level is coded for each grid point; see Table I.

n_2 Usually 0; associated with a_2a_2; see Table I.

q_1 2; message contraction and data scanning indicator; (WMO Code 3462).

q_2 0; data contraction indicator; (WMO Code 3463).

u 0; scale factor indicator; (WMO Code 4200).

s_n Sign of the reference value indicated by rrrrrrr; (0 = positive and 1 = negative).

rrrrrrr Reference value used as new zero for the parameter a_1a_1 in the same units used for the parameter; see Table II.

k_1k_1 Serial number of the grid line: 01, 02, ..., 15; but,

k_1k_1 = 99 for North Pole

k_1k_1 = 98 for South Pole

n_gn_g 19; number of grid points per grid line.

$i_ai_ai_a$ 000; difference between longitude of the point of reference and longitude of first grid point of the grid line, in units of half degrees.

$j_aj_aj_a$ Ranges from 000 to 140 by 010 increments; difference between latitude of the point of reference and latitude of the first grid point of the grid line, in units of half degrees.

s_x Sign indicator of data group that follows; (WMO Code Table 3856).

II...I Data group as specified in WMO Code Table 0291 and indicators n_p, n_1, and n_2; also see Table I.

APPENDIX E: Sample Bulletins

1. 00Z 1000 mb Height Analysis for a N. H. Quadrant

```
GHAA99 KWBC 110000
GRID 07001 10101
111 10200 20099 67705 71100 01199
333 11512 23020 30100 00100
0119 000000 105106108109110112114116116117117117117117114111111112111
0219 000010 106107108108110112115117118120121121119116114113113110112
0319 000020 109109110111111111111115119122123124123120117114111111114
0419 000030 113113113111108106106110116120121122123122120118116116116
0519 000040 115113112109102097098103109115118118119120120120119118118
0619 000050 115113111109104099099104108111114114114115115116117118117
0719 000060 113114112111111111111113115113109106106105104106109110112
0819 000070 114115115115115116116116116114109103099096095097102105106
0919 000080 109107106106107109110111110110111112112111111110108106103
1019 000090 104103102103104106107108108109110111113114114113111109106
1119 000100 104103102103104106107108108109110111113114114113111109106
1219 000110 105104103103104104105106106107108110111112113113112111110
1319 000120 107106106106106106106107107108109110110111111111111111111
1419 000130 109108108108108108108108108108109109109109109109109
9901 000140 111
555 07001 10101
777
```

2. 12Z 500 mb 24-hr. Height Forecast for a N. H. Quadrant

```
GHCE50 KWBC 241200
GRID 07003 10101
111 10200 25099 67707 72412 81024 04199
333 11512 23020
0119 000000 582584585584583582582586589588587587587586585585585587
.... ...... .....................................................
.... ...... .....................................................
.... ...... .....................................................
1419 000130 548547547547547547547547548548548549549549550550550550
9901 000140 546
555 07003 10101
777
```

3. 12Z 700 mb 24-hr. Temperature Forecast for a S. H. Quadrant

```
GTLE70 KWBC 201200
GRID 07012 10101
111 10400 27099 67707 72012 81024 04299
333 11511 23020
0119 000000 007008008011007006005005006006006007008007007006005004003
0219 000010 007008009010009006005004005004003004004004004003001000000
0319 000020 005006007008008006004003002003003001000001000000000000000
0419 000030 001003004004003003002001000101103104104103102101101101102
0519 000040 103101001002002002000104107110111113113110107104102102103
0619 000050 114110108105103103107112115116118120119118114109104104105
0719 000060 118118116113111113117120122120119120120120119117112107106
0819 000070 121121121119119120121123124123122121119118118117114109107
0919 000080 122122122123124124124125126125122119118117115113113113115
1019 000090 122123124125126125125126125123120120121122122122123124127
1119 000100 125127128128128127126125125129132133134134130130135141146
1219 000110 135135136138138137136137136136137140140139140145149152155
1319 000120 135137138138139140140140139139140143147150151150150150150
1419 000130 136136137138139139140140141141142142143144145146147148148
9801 000140 147
555 07012 10101
777
```

(The above example uses the $S_x TT$ form where 0 is positive and 1 is a negative indicator.)

4. 12Z 150 mb 24-hr. Temperature Forecast for a Tropical Belt Quadrant

```
GTHE15 KWBC 201200
GRID 07008 10101
111 10400 21599 67707 72012 81024 04299
333 11513 22020
0119 000000 585858575758585657596059595756545555555
.... ...... ...................................
.... ...... ...................................
.... ...... ...................................
1519 000140 626061646662626464636060576163635960 60
555 07008 10101
777
```

(In the above example all temperatures are negative and the signs are omitted.)

5. 12Z 200 mb 24-hr. Wind Forecast for a S. H. Quadrant

```
GWIE20 KWBC 201200
GRID 07009 10101
111 12200 22099 67707 72012 81024 04299
333 11512 25020
0119 000000 2400130506310061550226521280342803028032275292452524525
3051727519285312902726519315142900629011
.... ...... .......................................................
.........................................
.... ...... .......................................................
.........................................
.... ...... .......................................................
.........................................
1419 000130 2700826507265052550424503225021900216003145041350513006
1250612007115061100510004095030950308502
9801 000140 00000
555 07009 10101
777
```

6. 12Z 1000 mb 24-hr Relative Humidity Forecast for a N. H. Quadrant

```
GRDE99 KWBC 201200
GRID 07004 10101
111 11300 20099 67707 72012 81024 04299
333 11512 22020
0119 000000 67502430243344675112010577787774496487
.... ...... ......................................
.... ...... ......................................
.... ...... ......................................
1419 000130 42444545444442413937353230272523212020
9901 000140 22
555 07004 10101
777
```