CHAPTER 10

GRIDDED DATA BLOCKS

10.1. Product Definition Block. The Gridded Data Product Definition Block shall be formatted as shown in Figure 10-1. Gridded data may be transmitted in packed or unpacked format, and as latitude/ longitude or I/J grid data, as determined by the product originator.

10.2. Data Description Block. The data description block for unpacked Gridded Data products shall be in the format shown for Formatted Binary Data products in Figure 6-2. No data description block is used for packed Gridded Data products. The following conventions shall apply to the Gridded Data data description block when used.

10.2.1. Length and Arrangement of Block. Each element being transmitted in the data block shall be described in the ninth through twentieth bytes and succeeding twelve byte sections. The sections shall be in the same order as the elements appear in the element sets of the data block. The length of the data description block shall be sufficient to describe one or more elements, as required by the originator of the product.

10.3. Data Blocks. Due to the significant differences in formal requirements for packed and unpacked Gridded Data products, different data blocks are used.

10.3.1. Unpacked Gridded Data Block. The unpacked Gridded Data data block(s) for both latitude/longitude Gridded Data products and I/J Gridded Data products shall be formatted as shown for Formatted Binary Data in Figure 6-4. The data field of the block shall be formatted as specified in Section 10.2.1 The data field within the data block shall contain element sets aligned end-to-end as shown in Figure 6-4.

10.3.2. Band Index Data Block. This block applies to packed Gridded Data products. Each data block will be used to transmit all grid points in a product for each parameter (e.g., temperature, pressure). One or more additional data blocks may be transmitted sequentially to define all parameters in the product. Blocks shall be formatted as shown in Figure 10-3.

10.3.2.1. Data Unpacking Method. In order to discuss unpacking the data, the method and terms involved in packing the scaled integer grid value must be defined. One constant is chosen and included for each type of data field. This constant is divided into each grid value during the packing process in order to reduce the number of least significant digits. Use of

this Multiplier Constant (termed MC in the explanation) produces a value called the Band Index (BI). Thus for any given grid point value (GV):

$$BI = (GV)/MC$$

A first order difference value is then calculated between consecutive Band Index Values:

$$\text{Delta } BI_n = BI_{n+1} - BI_n$$

Note that BI_1 and Delta BI_1 are given in the Gridded Data Product Definition Block. Now second order derivatives are computed from the first order differences:

$$\text{Delta}^2 BI = \text{Delta } BI_{n+1} - \text{Delta } BI_n$$

The data part of the data block consists entirely of Delta^2 BI ...., $\text{Delta}^2 BI_{p-2}$ for a data field with p data points. During packing, the Delta BI computed between the last element of each row and the first element of the next row is computed using the next element directly above rather than beginning at the left side of the next row. Therefore, the scanning computation proceeds left-to-right for the 1st, 3rd, ..., rows and right-to-left for the 2nd, 4th, ..., rows. Decoding grid point value n, then, is done as:

$$GV_n = (BI_{n-1} + \text{Delta } BI_{n-2} + \text{Delta}^2 BI_{n-2}) * MC$$

10.4. Grid Conventions. The three key agencies capable of producing gridded products in accordance with these formats are National Weather Service, the Air Force, and the Navy. Each uses the same basic grid system but employs different (I,J) indexing conventions. Thus, it is important to know the originator of the gridded product, the specific grid being employed, and its relative indexing convention. This information must be used to properly interpret data related to or defined by COORDINATE FLAG = 1 (see Figures 7-1, 7-2, and 10-1). The designation of the COORDINATE FLAG determines the units for all coordinate data in data blocks that follow it. The originator of the product can be determined from the FILE INDICATOR in the Product Identification Block. Specific details concerning gridded products and indexing conventions should be obtained from the agency originating the product.

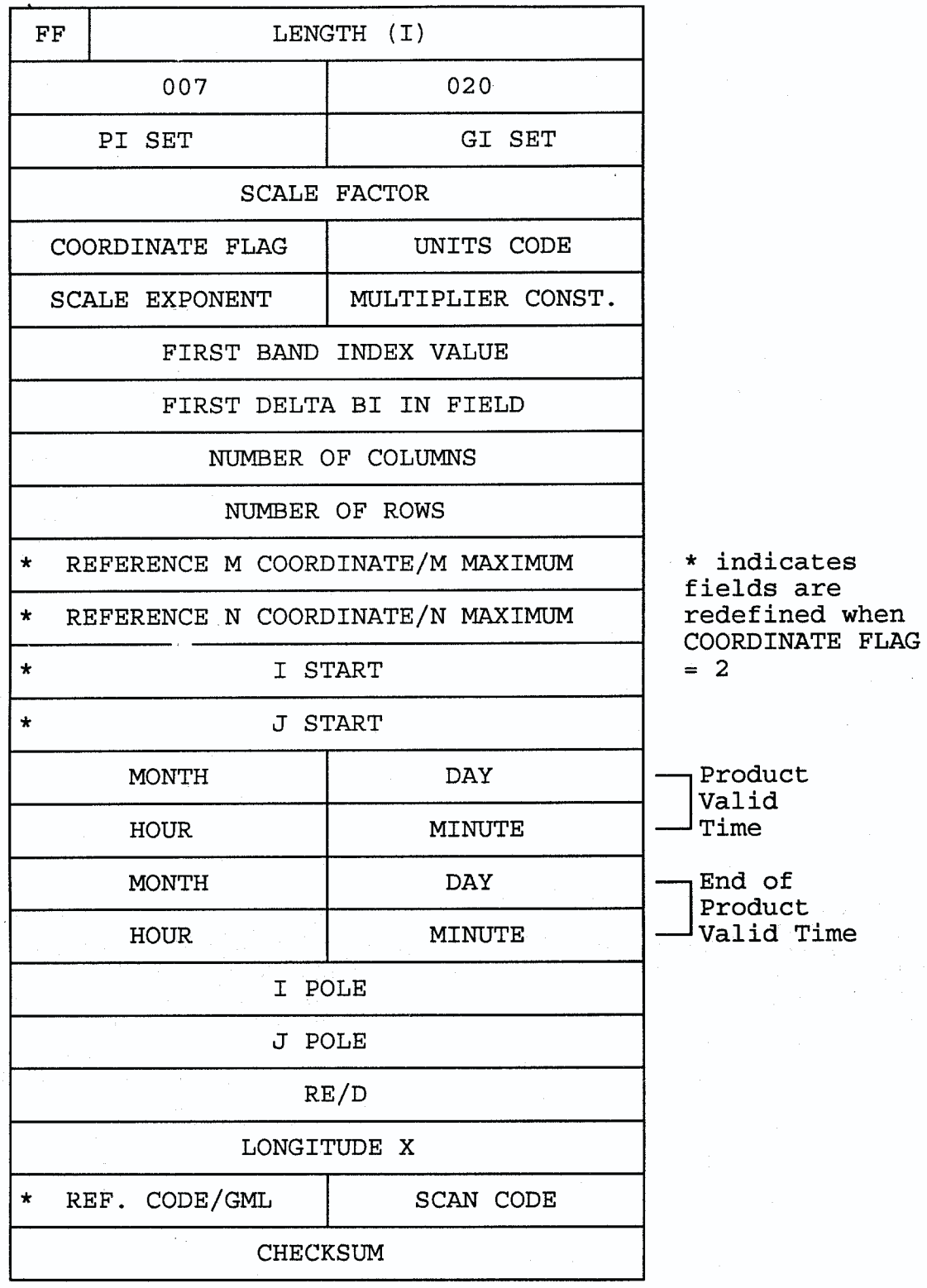


Figure 10-1. Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1 (Appendix C). If a product is not associated with a background, PI SET will be zero (0) filled.

2. GI SET: The Grid Indicator defines the grid on which the data is valid. Currently defined codes are shown in Table C2-3. If a product is not associated with a GI SET, the field will be zero (0) filled.

3. SCALE FACTOR and SCALE FACTOR FRACTION: The real world map scale in millions. The first byte contains the integer part, the second byte contains the fraction.

4. COORDINATE FLAG: Coordinate System Indicator as follows:

Flag	M =	N =	
0	Latitude	Longitude	(An earth surface grid in latitude and longitude coordinates.)
1	I	J	(Cartesian coordinates of the earth's surface.)
2	X	Y	(Pixel coordinates of the product background projection.)

5. UNITS CODE: A code specifying the units of the data elements. The list of units codes is found in Table C2-4 (Appendix C).

*6. SCALE EXPONENT: The number of binary digits scaling which the unpacked integer carries. For example, the Fortran statement GV = FLOAT(IGRID(J)/2**SE will convert an unpacked grid value from IGRID(J) into the real parameter value GV.*

*7. MULTIPLIER CONSTANT (MC): The value that each grid value has been divided by to reduce the number of least significant digits. For Example, if SE = Scale Exponent, and MC = Multiplier Constant, the FORTRAN statement GV = FLOAT(IGRID(J)/2**SE)*MC will convert an unpacked grid value from IGRID(J) into the real parameter GV.*

*8. FIRST BAND INDEX VALUE (BI): This is the Band Index Value at the first grid point. BI(1) = FIX(GV(1)/FLOAT(MC))/2**SE. In other words, the value of the first grid point is modified by the Multiplier Constant and Scale Exponent to reduce the number of bits required to store the number in integer format.*

Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1 (Cont.):

9. FIRST DELTA BI IN FIELD (DI): The difference between the first two BI's.
Delta BI(1) = BI(2) - BI(1).
The variables BI, MC and SE are described in Notes 6, 7, and 8. The theory is described in Section 10.3.2.1. When unpacking the grid, the value (GV) of the first grid point is given by the FORTRAN statement:
*GV(1) = FLOAT(BI/2**SE)*MC*
and the first DELTA BI value is given by the FORTRAN statement:
*DBI(1) = FLOAT(D1/2**SE)*MC.*
The second grid point is
GV(2) = GV(1) + DBI(1).
The second DELTA BI value is
*DBI(2) = DBI(1) + FLOAT(D2BI(1)/2**SE)*MC.*
The third grid point is
GV(3) = GV(2) + DBI(2).
From then on
*DBI(n-1) = DBI(n-2) + FLOAT(D2BI(n-2)/2**SE)*MC and*
GV(n) = GV(n-1) + DBI(n-1)
where DBI is the computed DELTA BI value and D2BI is the DELTA squared BI value from Mode 7, Submode 1.

10. NUMBER OF COLUMNS: The number of horizontal grids in the grid data area.

11. NUMBER OF ROWS: The number of vertical grids in the grid data area.

12. REFERENCE M and N COORDINATE/M and N MAXIMUM: For COORDINATE FLAG = 0 or 1, these reference coordinates shall specify the first grid point for which data is transmitted and may represent any point in the grid system, usually one of the four corners. M and N are determined by the REFERENCE CODE. For COORDINATE FLAG = 2, these reference coordinates specify the M and N maximum pixel values respectively of the graphic background area within which the data grid is to be superimposed. See Figure 10-2.

13. ISTART, JSTART: For COORDINATE FLAG = 0 or 1, these values designate the starting grid coordinate of the first grid point in the first row. If COORDINATE FLAG = 2, ISTART will be the number of pixels from the left edge of the displayable graphic area to the left-most column of the gridded data field. JSTART will be the number of pixels from the bottom edge of the graphic area to the lower-most row of the gridded field. See Figure 10-2. The grid points proceed row-wise left-to-right NCOLS, then to the next row above and proceed right-to-left and so on up to NROWS.

14. Product/End of Product Valid Time. The Product Valid Time is the time for which the transmitted data is valid or the start time of the valid period. If the 'DAY' element of the End of Product Valid Time is zero (0), the product is valid only at the Product Valid Time. For observed data, the valid time approximates, or may be identical to, the product generation time.

Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20

NOTES: Figure 10.1 (Cont.):

15. IPOLE/JPOLE: For Polar Stereographic projections, the IPOLE/JPOLE fields define the horizontal and vertical grid distances respectively, from the pole to the lower left corner of the product. For Mercator projections, the IPOLE defines the East-West grid system distance from the Greenwich meridian to the meridian that passes through the lower left corner of the product, and JPOLE defines the North-South grid system from the equator to the bottom of the product. For both Polar Stereographic and Mercator projections, the IPOLE/JPOLE grid distances are the number of grid mesh intervals for the product's mesh indicated by the GI Set code.

*16. RE/D: For gridded products on polar stereographic background projections, this specifies the effective number of grid lengths from the pole to the equator on the plane of the projection. It is derived by dividing the distance from the pole to the equator by the length. The grid length depends on the product's grid mesh, indicated by the GI Set code. For gridded products on Mercator background projections, RE/D will be set to zero. The actual entry is scaled by 2**6.*

17. LONGITUDE X: This is the longitude of the meridian perpendicular to the base of the product and extending from the base of the product to the pole. Longitude X may be outside of the product boundaries. Table C2-1 shows the Longitude X for the defined PI Sets (map projection).

18. REFERENCE CODE: If COORDINATE FLAG = 0 or 1, this code indicates where, in the grid, the reference coordinates are located. The currently used reference codes are:

1 - Reference coordinates are located in the upper left corner of the grid.
2 - Reference coordinates are located in the lower left corner of the grid.

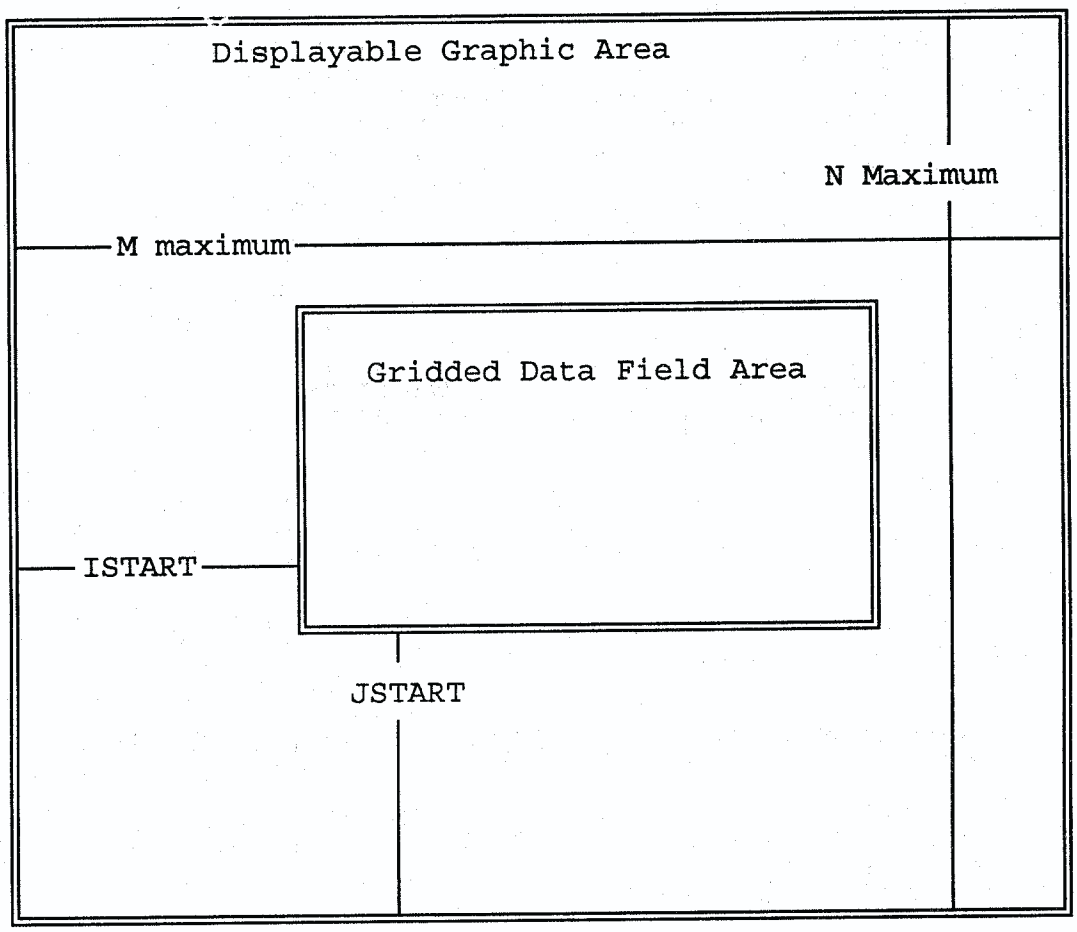
If COORDINATE FLAG = 2, this single byte field will specify the GRID MESH LENGTH (GML) of the grid field. GML is defined to be the number of pixels between adjacent grid points along all columns and rows. All pixel distances reference the displayable graphic area.

19. SCAN CODE: This code is used to indicate the order in which the data for the grid points appear in the data block. The currently used scan codes are:

1 - Data are arranged in the data block such that the grid is defined row by row (raster scan) from the upper left corner.

2 - Data are arranged in the data block such that the grid is defined row by row (bottom up raster scan) from the lower left corner.

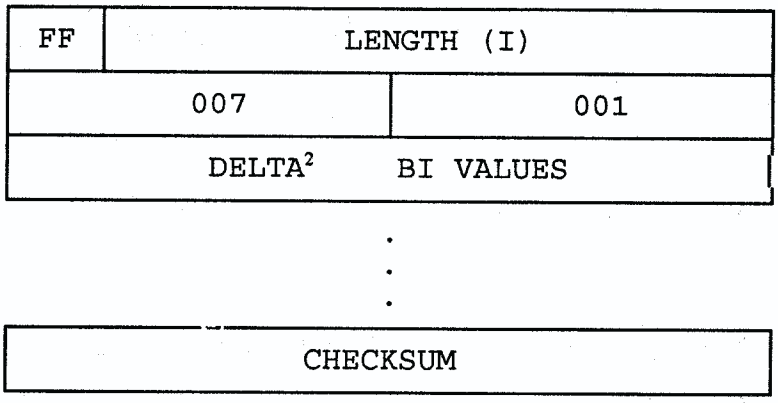
Figure 10-1. (Cont.) Gridded Data Product Definition Block; Mode 7, Submode 20



Notes:

M Maximum and N Maximum, as used here, are encoded in the Gridded Data Product Definition Block as the Reference M and N coordinate, respectively. These values represent the width and height, respectively, of the entire graphic display area in pixels. Two parameters may link the pixel resolution (size) with actual distance on the earth's surface. The first is PI SET, which may define the Displayable Graphic Area (M Maximum by N Maximum) as being a precise geographical background. The second link is the SCALE FACTOR, which defines the Displayable Graphic Area in terms of an actual map scale. Note that when COORDINATE FLAG is 2, the ISTART, JSTART, REFERENCE M, REFERENCE N, and REFERENCE CODE (GML) are all given in terms of pixel values.

Figure 10-2. Gridded Data Definition Block Parameters when COORDINATE FLAG = 2



NOTES:

1. DELTA² BI VALUES: These values are the second derivative of the Band Index Values. The field width is set by the Define Datawidth/Fieldwidth Block (Mode 1, Submode 5). The default is 8 bits (one byte).

Figure 10-3. Band Index Data Block; Mode 7, Submode 1