(4) To ensure that any new equipment is capable of handling TDCF and to implement available updates to existing equipment to allow it to process TDCF;

(5) In cases where the Member is still in the process of upgrading its systems and procedures to produce correctly formed reports in TDCF:

(a) To complete the upgrade as rapidly as possible;

(b) To continue to submit reports in TAC until such time as the Member is able to transmit reports in TDCF that are compliant with the appropriate regulations;

(6) To provide experts to assist other Members complete the migration to TDCF;

Urges all regional associations to establish regional working groups for providing training and assistance to Members on the transition to TDCF;

Reminds Members that the TAC are unable to represent WMO Integrated Global Observing System station identifiers, so that Members unable to process TDCF will need to make bilateral arrangements with other Members if they wish to transmit or receive observations from stations that do not have a World Weather Watch station identifier.

Decision 6 (CBS-16)

EXPERIMENTAL IMPLEMENTATION OF FM 92 GRIB (EDITION 3)

THE COMMISSION FOR BASIC SYSTEMS,

Recalling that FM 92-XII General Regularly Distributed Information in Binary Form (GRIB) (GRIB edition 2) took effect from 7 November 2001 (Resolution 4 (EC-LIII)) after two years of experimentation and validation tests,

Recognizing that introduction of GRIB edition 3 would satisfy the existing requirements from broader communities and facilitate their GRIB application,

Decides:

(1) To endorse experimental use of GRIB edition 3 as described in the annex to the present decision;

(2) To use the code identifier FM 92-16 GRIB to identify the constituent components of the version described in the annex to the present decision so that it can be distinguished from later versions;

(3) To review the effectiveness of GRIB edition 3 following a period of use by Members:

(a) To assess feedback from users on its effectiveness;

(b) To modify it to respond to concerns;

(c) To recommend the modified version to the Executive Council for inclusion in the *Manual on Codes* (WMO-No. 306), Volume I.2;

Urges Members to use GRIB edition 3 and provide feedback to the Open Programme Area Group on Information Systems and Services (OPAG-ISS) through their focal point for codes and data representation matters;

Requests OPAG-ISS to gather feedback on the effectiveness of GRIB edition 3 and to provide the revised version, including additions to tables and templates, for further experimental use or adoption by the Executive Council in 2019;

Requests its president to assess whether modifications proposed by OPAG-ISS following the review of use require a vote by correspondence before the revised version is released for experiment or recommended to the Executive Council for adoption;

Authorizes its president, subject to the outcome of any vote by correspondence, to endorse the modified version for experiment or to recommend it to the Executive Council;

Requests the Secretary-General:

(1) To publish on the WMO website as a reference document FM 92-16 GRIB as provided in the annex to the present decision;

(2) To make provision for that version to be available permanently so that archived information recorded in that version may be interpreted correctly.

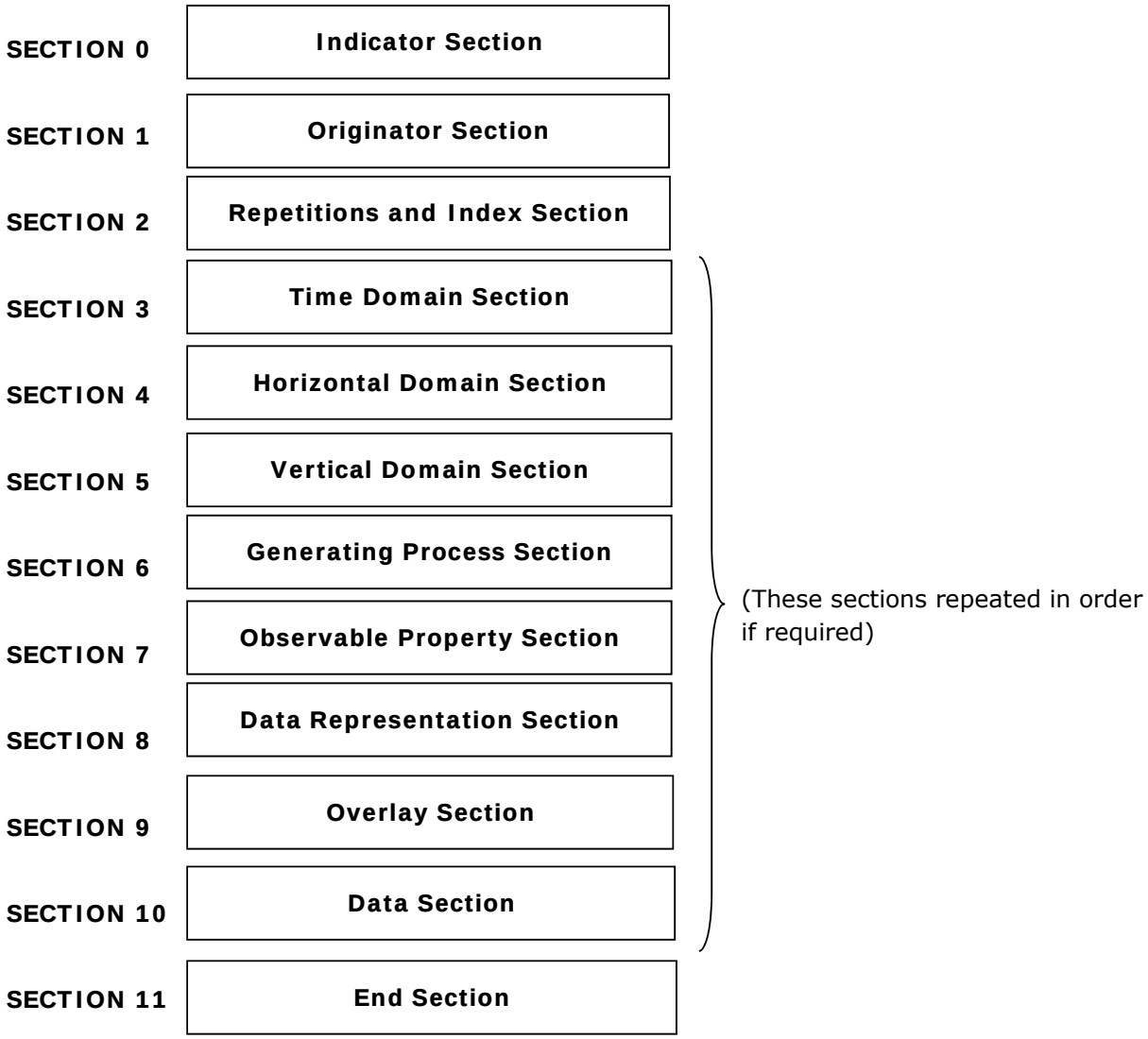
Annex to Decision 6 (CBS-16)

SPECIFICATION OF FM 92-16 FM 92 GRIB

FM 92–16 GRIB General Representation of fields In Binary

Binary representation of data resulting from an observation or a numerical model simulation of an observable property in a spatial and time domain on a geospatial or celestial reference system

CODE FORM:



Notes:

(1) GRIB is the name of a binary data representation form for fields resulting from an observation or a numerical model simulation of an observable property in a spatial and time domain on a geospatial or celestial reference system.

(2) Data encoded in GRIB consists of a continuous bit-stream made of a sequence of bytes (1 byte = 8 bits).

(3) A GRIB message is composed of the following sections:

Section	Section Name	Contents

Number		
0	Indicator Section	"GRIB", Master tables version number, total length of message, GRIB edition number.
1	Originator Section	Length of section, section number, local tables version number and information for use of the originator centre.
2	Repetitions and Index Section	Length of section, section number, total number of repetitions, number of distinct repetitions for each repeatable section and optional index.
3	Time Domain Section	Length of section, section number, section unique identifier and description of time domain of the field.
4	Horizontal Domain Section	Length of section, section number, section unique identifier and description of the horizontal domain of the field.
5	Vertical Domain Section	Length of section, section number, section unique identifier and description of the vertical domain of the field.
6	Generating Process Section	Length of section, section number, section unique identifier and description of the process generating the data.
7	Observable Property Section	Length of section, section number, section unique identifier and description of the observable property.
8	Data Representation Section	Length of section, section number, section unique identifier and description of how the data values are represented.
9	Overlay Section	Length of section, section number, section unique identifier and overlay field associating a property to the field. This can be used to indicate the presence or absence of data at each point of the domain by defining a bitmap.
10	Data Section	Length of section, section number, data values in binary format as specified in the data representation section.
11	End Section	"7777"

(4) Sequences of GRIB sections 3 to 10, may be repeated within a single GRIB message. The total number of repetitions is given in section 2. The total number of repetitions is also the number of fields encoded in the GRIB message. Multi-field messages contain more than one field while single field messages contain only one field. A GRIB message shall contain at least one field.

(5) The representation of data by means of a series of bits is independent of any particular machine representation.

(6) Message and section lengths are expressed in bytes.

(7) The content of each section is specified by providing the meaning of bytes numbered progressively starting from one at the beginning of the section.

(8) Sections are composed of Templates, which are specified in terms of Template Components.

(9) Templates Components are sequences of bytes with a specified meaning that can be used in the appropriate Template. In each Template Component bytes are numbered 1, 2, 3 etc., starting at the beginning of the Template Component.

(10) Template Components should be defined to be re-used in different Templates.

(11) Bit positions within bytes are referred to as bit 1 to bit 8, where bit 1 is the most significant and bit 8 is the least significant. Thus, a byte with only bit 8 set to 1 would have the integer value 1.

(12) As used in "GRIB", "International Alphabet No. 5" is regarded as an 8-bit alphabet with bit 1 set to zero.

(13) The IEEE single precision floating point representation occupies 4 bytes and is specified in the standard ISO/IEC 559–1985 and ANSI/IEEE 754–1985 (R1991).

REGULATIONS:

92.1 General

92.1.1 The GRIB code shall be used for the exchange and storage of fields representing an observable property in a geospatial and time domain, which is the result of an observation or a numerical model elaboration.

92.1.2 The beginning and the end of the code shall be identified by 4 bytes coded according to the International Alphabet No. 5 to represent the indicators "GRIB" and "7777" in Indicator section 0 and End section 11, respectively. All other bytes included in the code shall represent data in binary form.

92.1.3 Each section included in the code shall always end on a byte boundary. This rule shall be applied by appending bits set to zero to the section, where necessary.

92.1.4 All bits set to "1" for any value indicates that value is missing. This rule shall not apply to packed data.

92.1.5 Negative values shall be indicated by setting the most significant bit to "1". All integer values are to be considered signed except:

(a) values referring to code and flag tables, which are always unsigned, or

(b) values explicitly declared as unsigned in a note.

92.1.6 When a value V is encoded using a scale factor F and a scaled value V_S the following formula applies:

$$V \times 10^F = V_S$$

92.2 Section 0 – Indicator Section

92.2.1 Section 0 shall always be 16 bytes long. The first 4 bytes of the indicator section shall always be character coded according to the International Alphabet No. 5 as "GRIB".

92.3 Section 1 – Originator Section

92.3.1 The length of the section, in bytes, shall be expressed over the group of the first four bytes, i.e. over the first 32 bits.

92.3.2 The section number shall be expressed in the fifth byte.

92.4 Section 2 – Repetitions and Index section

92.4.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.5 Section 3 – Time Domain section

92.5.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.5.2 The Section Unique Identifier (SUI) shall be expressed in bytes 6 to 7. The SUI is a unique identifier within the message for the section. Repeated sections can just refer back to the first instance by using the same SUI, without the need to explicitly repeat the section in full. In this case, the total length of the repeated section will be 7 bytes.

92.6 Section 4 – Horizontal Domain Section

92.6.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.6.2 Latitude, longitude and angle values shall be in units of 10^{-6} degree, except for specific cases explicitly stated.

92.6.3 The latitude values shall be limited to the range –90 to 90 degrees inclusive. The orientation shall be north latitude positive, south latitude negative. Bit 1 is set to 1 to indicate south latitude.

92.6.4 The longitude values shall be limited to the range –360 to 360 degrees inclusive. The orientation shall be east longitude positive, west longitude negative. Bit 1 is set to 1 to indicate west longitude.

92.6.5 The latitude and longitude of the first grid point and the last grid point shall always be given for regular grids.

92.7 Section 5 – Vertical Domain Section

92.7.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.8 Section 6 – Generating Process Section

92.8.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.9 Section 7 – Observable Property Section

92.9.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.10 Section 8 – Data Representation Section

92.10.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.11 Section 9 – Overlay Section

92.11.1 Regulations 92.3.1, 92.3.2 and 92.5.2 shall apply.

92.12 Section 10 – Data Section

92.12.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.12.2 The data shall be packed by the method identified in section 8.

92.13 Section 11 – End section

92.13.1 The end section shall always be 4 bytes long, character coded according to the International Alphabet No. 5 as "7777".

CONTENT OF SECTIONS

Section 0 – Indicator Section

Byte No.	Contents
1–4	GRIB (coded according to the International Alphabet No. 5)
5–6	Reserved
7	Master tables version number (see Code table 0.0 and Note 1–3 in section 1)
8	Edition number (3)
9–16	Total length of GRIB message in bytes (including Section 0)

Section 1 – Originator Section

Byte No.	Contents
1–4	Length of section in bytes
5	Number of section (1)
6–7	Identification of originating/generating centre (see Common Code table C–11)
8–9	Identification of originating/generating subcentre (allocated by originating/generating centre)
10	Local tables version number (see Code table 1.0 and Notes 1-3)
11	Identification of Project (see Code table 1.1)
12	Production status of processed data in this GRIB message (see Code table 1.2)
13–14	Originator Local template number (see Note's 4 and 5)
15–16	Length of originator local template in bytes (see Note 5)
17–nn	Originator Local template (see Note 6)

(nn+1)–(nn+2) Project Local template number (see Notes 7 and 8)
(nn+3)–(nn+4) Length of project local template in bytes (see Note 8)
(nn+5)–mm Project Local template (see Note 9)

Notes:

(1) Local tables shall define those parts of the Master table that are reserved for local use except for the case described in Note 2. In any case, the use of Local tables in messages intended for non-local or international exchange is strongly discouraged.

(2) If master tables version number is 255 then only local tables are in use. The local tables version number must not be zero nor missing, and local tables may include entries from the entire range of the tables.

(3) If local tables version number is zero, master tables version number shall not be zero or missing and only those parts of the tables not reserved for local use may be used.

(4) Originator Local templates are defined and maintained by the Originating Centre.

(5) Originator Local template is optional. If local template is not present, the originator local template number shall be set to missing (all bits set to 1) and the length of local template shall be set to zero.

(6) Originator local template shall be selected using the originator local template number. The originator local templates are maintained and made available to the users by the originating centre.

(7) Project Local templates are defined and maintained by the Originating Centre.

(8) Project Local template is optional. If local template is not present, the project local template number shall be set to missing (all bits set to 1) and the length of project local template shall be set to zero.

(9) Project local template shall be selected using the project local template number. The project local templates are maintained and made available to the users by the project participants.

Section 2 – Repetitions and Index Section

Byte No.	Contents
1–4	Length of section in bytes
5	Number of section (2)
6–7	Total number of repetitions (or total number of fields) (see Note 1)
8–9	Number of distinct sections 3 with length greater than 7 bytes (see Notes 1 and 2)
10–11	Number of distinct sections 4 with length greater than 7 bytes (see Notes 1 and 2)
12–13	Number of distinct sections 5 with length greater than 7 bytes (see Notes 1 and 2)
14–15	Number of distinct sections 6 with length greater than 7 bytes (see Notes 1 and 2)
16–17	Number of distinct sections 7 with length greater than 7 bytes (see Notes 1 and 2)
18–19	Number of distinct sections 8 with length greater than 7 bytes (see Notes 1 and 2)
20–21	Number of distinct sections 9 with length greater than 7 bytes (see Notes 1 and 2)
22–23	Index template number
24–27	Length of Index template in bytes
28–nn	Index template (See Note 3) (see template 2.N, where N is the Index template number given in bytes 22-23)

Notes:

(1) A message with only one field shall have the total number of repetitions and each of the number of distinct sections set to 1.

(2) Two repeated sections shall never be identical. If two sections are identical because they have the same content, one of the two shall be coded with only 7 bytes (empty section with reference) and the SUI shall be coded with the same value of the identical section to which this section refers. Each section will therefore have content in it or refer to another section of the same section number. In the latter case, it will be made only of 7 bytes comprising section length (4 bytes), number of section (1 byte) and Section Unique Identifier–SUI (2 bytes).

(3) The inclusion of an Index template is optional. If index template is not present, the index template number (bytes 22-23) shall be set to missing (all bits set to 1) and the length of index template (bytes 24-27) shall be set to zero.

Section 3 – Time Domain Section

Byte No.	Contents	
1–4	Length of section in bytes (7 or nn)	
5	Number of section (3)	
6–7	Section Unique Identifier (SUI)	
8	Significance of reference date and time (see Code table 3.0)	
9	Type of Calendar (code table 3.1)	Reference date and time
10–13	Year (signed integer according to Reg. 92.1.5)	
14	Month	
15	Day	
16	Hour	
17	Minute	
18	Second	
19–20	Time Domain Template number (see code table 3.2)	
21–nn	Time Domain Template (see template 3.N, where N is the Time Domain Template number given in bytes 19-20)	

Note:

(1) The type of calendar used (byte 9) applies to the entire section including the Time Domain Template.

Section 4 – Horizontal Domain Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (4)
6–7	Section Unique Identifier (SUI)
8–11	Number of points in the domain
12–13	Horizontal Domain Template number (see Code table 4.0)
14–nn	Horizontal Domain Template (see template 4.N, where N is the Horizontal Domain Template number given in bytes 12-13)

Section 5 –Vertical Domain Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (5)
6–7	Section Unique Identifier (SUI)
8–9	Vertical Domain Template number (see Code table 5.0)
10–nn	Vertical Domain Template (see template 5.N, where N is the Vertical Domain Template number given in bytes 8-9)

Section 6 – Generating Process Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (6)
6–7	Section Unique Identifier (SUI)
8–9	Generating Process Template number (see Code table 6.0)
10–nn	Generating Process Template (see template 6.N, where N is the Generating Process Template number given in bytes 8-9)

Section 7 – Observable Property Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (7)
6–7	Section Unique Identifier (SUI)
8–9	Observable Property Template number (see Code table 7.0)
10–nn	Observable Property Template (see template 7.N, where N is the Observable Property Template number given in bytes 8-9)

Section 8 – Data Representation Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (8)
6–7	Section Unique Identifier (SUI)
8–11	Number of data values encoded in Section 10
12–13	Data Representation Template number (see Code table 8.0)
14–nn	Data Representation Template (see template 8.N, where N is the Data Representation Template number given in bytes 12-13)

Section 9 – Overlay Section

Byte No.	Contents
1–4	Length of section in bytes (7 or nn)
5	Number of section (9)
6–7	Section Unique Identifier (SUI)
8–9	Overlay Template number (see Code table 9.0)
10–nn	Overlay Template (see template 9.N, where N is the Overlay Template number given in bytes 8–9)

Section 10 – Data Section

Byte No.	Contents
1–4	Length of section in bytes (nn)
5	Number of section (10)
6–nn	Data in a format described by data template 10.X, where X is the Data Template number given in bytes 12–13 of Section 8.

Section 11 – End Section

Byte No.	Contents
1–4	"7777" (coded according to the International Alphabet No. 5)

TEMPLATES USED IN SECTION 3 (TIME DOMAIN SECTION)

Time Domain Template 3.0 – Forecast point in time

Component Code	Component Name
3.0	Forecast point in time

TEMPLATES USED IN SECTION 4 (HORIZONTAL DOMAIN SECTION)

Horizontal Domain Section Template 4.0 – Latitude/longitude regular grid on ellipsoidal planet

Component Code	Component Name
4.0	Ellipsoid of revolution defined with axis lengths
4.1	Latitude/longitude regular grid

Horizontal Domain Section Template 4.1 – Rotated latitude/longitude regular grid on ellipsoidal planet

Component Code	Component Name
4.0	Ellipsoid of revolution defined with axis lengths
4.1	Latitude/longitude regular grid
4.2	Rotation of latitude/longitude coordinate system

Horizontal Domain Section Template 4.2 – Stretched latitude/longitude regular grid on ellipsoidal planet

Component Code	Component Name
4.0	Ellipsoid of revolution defined with axis lengths
4.1	Latitude/longitude regular grid
4.3	Stretching of latitude/longitude coordinate system

Horizontal Domain Section Template 4.3 – Stretched and rotated latitude/longitude regular grid on ellipsoidal planet

Component Code	Component Name
4.0	Ellipsoid of revolution defined with axis lengths
4.1	Latitude/longitude regular grid
4.2	Rotation of latitude/longitude coordinate system
4.3	Stretching of latitude/longitude coordinate system

TEMPLATES USED IN SECTION 5 (VERTICAL DOMAIN SECTION)

Vertical Coordinate Template 5.0 – Vertical level

Component Code	Component Name	Description
5.0	Vertical level	Single level

Vertical Coordinate Template 5.1 – Vertical layer

Component Code	Component Name	Description
5.1	Vertical layer	

TEMPLATES USED IN SECTION 6 (GENERATING PROCESS SECTION)

Generating Process Template 6.0 – Forecast, analysis or observation

Component Code	Component Name	Description
6.0	Process type and identifier	

Generating Process Template 6.1 – Individual ensemble forecast or analysis

Component Code	Component Name	Description
6.0	Process type and identifier	
6.1	Ensemble size	
6.2	Ensemble member	

Generating Process Template 6.2 – Statistical post-processing of all ensemble members

Component Code	Component Name	Description
6.0	Process type and identifier	
6.1	Ensemble size	
6.3	Statistical post-processing of ensemble members	

TEMPLATES USED IN SECTION 7 (OBSERVABLE PROPERTY SECTION)

Observable Property Template 7.0 – Observable property by discipline, category and number

Component Code	Component Name	Description
7.0	Observable property by discipline, category and number	

Observable Property Template 7.1 –Observable Property with units conversion

Component Code	Component Name	Description
7.0	Observable property by discipline, category and number	
7.1	Units conversion	

Observable Property Template 7.2 – Atmospheric chemical or physical constituents

Component Code	Component Name	Description
7.0	Observable property by discipline, category number	
7.2	Chemical or physical constituents	

Observable Property Template 7.3 – Aerosol physical property

Component Code	Component Name	Description
7.0	Observable property by discipline, category number	
7.2	Chemical or physical constituents	
7.3	Aerosol size	

Observable Property Template 7.4 – Aerosol optical property

Component Code	Component Name	Description
7.0	Observable property by discipline, category and number	
7.2	Chemical or physical constituents	
7.3	Aerosol size	
7.4	Radiation wavelength interval	

TEMPLATES USED IN SECTION 8 (DATA REPRESENTATION SECTION)

Data Representation Template 8.0 – Simple packing

Component Code	Component Name	Description
8.0	Simple packing	

Data Representation Template 8.1 –IEEE floating point

Component Code	Component Name	Description
8.1	IEEE floating point	

TEMPLATES USED IN SECTION 9 (OVERLAY SECTION)

Overlay Template 9.0 – Bitmap

Component Code	Component Name	Description
9.0	Bitmap	

COMPONENTS USED IN TEMPLATES OF SECTION 3 (TIME DOMAIN SECTION)

Time Domain Section Template Component 3.0 – Forecast point in time

Byte No.	Contents
1–2	Hours of observational data cut-off after reference time (see Note 1)
3	Minutes of observational data cut-off after reference time
4	Indicator of unit of time range (see Code table 3.3)
5–8	Forecast time in units defined by byte 4

Note:

(1) Hours greater than 65534 will be coded as 65534.

COMPONENTS USED IN TEMPLATES OF SECTION 4 (HORIZONTAL DOMAIN SECTION)

Horizontal Domain Template Component 4.0 – Ellipsoid of revolution defined with axis lengths

Byte No.	Contents
1	Scale factor of length of semi-major axis
2–5	Scaled value of length of semi-major axis (equatorial radius)
6	Scale factor of prime meridian offset
7–10	Scaled value of prime meridian offset (see Note 1)
11	Scale factor of length of semi-minor axis
12–15	Scaled value of length of semi-minor axis (distance from ellipsoid centre to pole)

Horizontal Domain Template Component 4.1 – Latitude/longitude regular grid

Byte No.	Contents
1–4	Ni – number of points along a parallel
5–8	Nj – number of points along a meridian
9–12	Basic angle of the initial production domain (see Note 1)
13–16	Subdivisions of basic angle used to define extreme longitudes and latitudes, and direction increments (see Note 1)
17–20	La1 – latitude of first grid point (see Note 1)
21–24	Lo1 – longitude of first grid point (see Note 1)
25	Resolution and component flags (see Flag table 4.1)
26–29	La2 – latitude of last grid point (see Note 1)
30–33	Lo2 – longitude of last grid point (see Note 1)
34–37	Di – i direction increment (see Notes 1 and 2)
38–41	Dj – j direction increment (see Notes 1 and 2)
42	Scanning mode (flags – see Flag table 4.2)

Notes:

(1) Basic angle of the initial production domain and subdivisions of this basic angle are provided to manage cases where the recommended unit of 10^{-6} degrees is not applicable to describe the extreme longitudes and latitudes, and direction increments. For these last six descriptors, the unit is equal to the ratio of the basic angle and the subdivisions number. For ordinary cases, zero and missing values should be coded, equivalent to respective values of 1 and 10^6 (10^{-6} degrees unit).

(2) Direction increments are unsigned and direction of increment is represented in the scanning mode.

Horizontal Domain Template Component 4.2 – Rotation of latitude/longitude coordinates system

Byte No.	Contents
1–4	Latitude of the southern pole of projection
5–8	Longitude of the southern pole of projection
9–12	Angle of rotation of projection

Note:

(1) Three parameters define a general latitude/longitude coordinate system, formed by a general rotation of the sphere. One choice for these parameters is:

(a) The geographic latitude in degrees of the southern pole of the coordinate system, θ_p for example;

(b) The geographic longitude in degrees of the southern pole of the coordinate system, λ_p for example;

(c) The angle of rotation in degrees about the new polar axis (measured clockwise when looking from the southern to the northern pole) of the coordinate system, assuming the new axis to have been obtained by first rotating the sphere through λ_p degrees about the geographic polar axis, and then rotating through $(90 + \theta_p)$ degrees so that the southern pole moved along the (previously rotated) Greenwich meridian.

Horizontal Domain Template Component 4.3 – Stretching of latitude/longitude coordinates system

Byte No.	Contents
1–4	Latitude of the "pole of stretching"
5–8	Longitude of the "pole of stretching"
9–12	Stretching factor

Note:

(1) The stretching is defined by three parameters:

(a) The latitude in degrees (λ, measured in the model coordinate system) of the "pole of stretching";

(b) The longitude in degrees (θ, measured in the model coordinate system) of the "pole of stretching"; and

(c) The stretching factor C in units of 10^{-6} represented as an integer.

The stretching is defined by representing data uniformly in a coordinate system with longitude λ and latitude θ^1, where:

$$\theta^1 = \sin^{-1} \frac{(1 - C^2) + (1 + C^2) \sin \theta}{(1 + C^2) + (1 - C^2) \sin \theta}$$

and λ and θ are longitude and latitude in a coordinate system in which the "pole of stretching" is the northern pole. C = 1 gives uniform resolution, while C > 1 gives enhanced resolution around the pole of stretching.

COMPONENTS USED IN TEMPLATES OF SECTION 5 (VERTICAL DOMAIN SECTION)

Vertical Coordinate Template Component 5.0 – Vertical level

Byte No.	Contents
1	Type of first fixed surface (see Code table 5.1)
2	Scale factor of first fixed surface
3–6	Scaled value of first fixed surface

Vertical Coordinate Template Component 5.1 – Vertical layer

Byte No.	Contents
1	Type of first fixed surface (see Code table 5.1)
2	Scale factor of first fixed surface

3–6	Scaled value of first fixed surface
7	Type of second fixed surface (see Code table 5.1)
8	Scale factor of second fixed surface
9–12	Scaled value of second fixed surface

COMPONENTS USED IN TEMPLATES OF SECTION 6 (GENERATING PROCESS SECTION)

Generating Process Template Component 6.0 – Process type and identifier

Byte No.	Contents
1	Type of generating process (see Code table 6.1)
2	Generating Process Identifier (managed by the originating Centre)

Generating Process Template Component 6.1 – Ensemble size

Byte No.	Contents
1–2	Number of members in ensemble

Generating Process Template Component 6.2 – Ensemble member

Byte No.	Contents
1	Type of ensemble member (see Code table 6.2)
2–3	Member Number

Generating Process Template Component 6.3 – Statistical post-processing of all ensemble members

Byte No.	Contents
1	Type of statistical post-processing of ensemble members (see Code table 6.3)

COMPONENTS USED IN TEMPLATES OF SECTION 7 (OBSERVABLE PROPERTY SECTION)

Observable Property Template Component 7.0 – Observable property by discipline, category and number

Byte No.	Contents
1	Parameter Discipline (see Code table 7.1)
2	Parameter Category (see Code table 7.2)
3–4	Parameter Number (see Code table 7.3)

Observable Property Template Component 7.1 – Units conversion

Byte No.	Contents
1–4	Units conversion scale factor (ucs) (see Note 1)
5–8	Units conversion offset (uco) (see Note 1)

Notes:
(1) Units conversion scale factor (ucs) and offset (uco) shall be used to encode fields in units different from the units reported in table 7.3. If the values encoded in the GRIB message are v_e, the values v in the units provided in table 7.3 shall be: $v = ucs * v_e + uco$.
(2) Encoded as IEEE 32 bits floating point values.

Observable Property Template Component 7.2 – Chemical or physical constituents

Byte No.	Contents
1–2	Atmospheric chemical or physical constituent type (see Common Code table C–14)

Observable Property Template Component 7.3 – Aerosol size

Byte No.	Contents

1	Type of interval for first and second size (see Code table 7.4)
2	Scale factor of first size
3–6	Scaled value of first size in metres
7	Scale factor of second size
8–11	Scaled value of second size in metres

Observable Property Template Component 7.4 – Radiation wavelength interval

Byte No.	Contents
1	Type of interval for first and second wavelength (see Code table 7.4)
2	Scale factor of first wavelength
3–6	Scaled value of first wavelength in metres
7	Scale factor of second wavelength
8–11	Scaled value of second wavelength in metres

COMPONENTS USED IN TEMPLATES OF SECTION 8 (DATA REPRESENTATION SECTION)

Data Representation Template Component 8.0 – Simple packing

Byte No.	Contents
1–4	Reference value (R) (IEEE 32-bit floating-point value)
5–6	Binary scale factor (E)
7–8	Decimal scale factor (D)
9	Number of bits used for each packed value for simple packing, or for each group reference value for complex packing or spatial differencing
10	Type of original field values (see Code table 8.1)
11	Missing value management (see Code table 8.2)
12–15	Primary missing value substitute
16–19	Secondary missing value substitute

Notes:

(1) Management of explicitly missing values is an alternative to bit-map use within Section 9; it is intended to reduce the whole GRIB message size and to provide better performance when decoding data with missing values.

(2) There may be two types of missing value(s), such as to make a distinction between static misses (for instance, due to a land/sea mask) and occasional misses.

(3) As an extra option, substitute value(s) for missing data may be specified. If not wished (or not applicable), all bits should be set to 1 for relevant substitute value(s).

(4) If substitute value(s) are specified, type of content should be consistent with original field values (floating-point - and then IEEE 32-bit encoded-, or integer).

(5) If primary missing values are used, such values are encoded with all bits set to 1 at packed data level.

(6) If secondary missing values are used, such values are encoded with all bits set to 1, except the last one set to 0, at packed data level.

Data Representation Template Component 8.1 –IEEE floating point

Byte No.	Contents
1	Precision (see Code table 8.3)

COMPONENTS USED IN TEMPLATES OF SECTION 9 (OVERLAY SECTION)

Overlay Template Component 9.0 – Bitmap

Byte No.	Contents
1–nn	Bitmap – Contiguous bits with a bit to data point correspondence, ordered as defined in Horizontal Domain Section. A bit set to 1 implies the presence of a data value at the corresponding data point, whereas a value of 0 implies the absence of such a value.

CODE TABLES USED IN SECTION 0 (INDICATOR SECTION)

Code table 0.0 – *GRIB master tables version number*

Code figure	Meaning
0	Experimental
1–254	Future versions
255	Missing. Local tables in use. Valid local tables version number shall be coded.

CODE TABLES USED IN SECTION 1 (ORIGINATOR SECTION)

Code table 1.0 – *GRIB local tables version number*

Code figure	Meaning
0	Local tables not used. Only table entries and templates from the current master table are valid
1–254	Local tables versions used
255	Missing

Code table 1.1 – *International Projects*

Code figure	Meaning
0	Reserved
1	THORPEX Interactive Grand Global Ensemble (TIGGE)
2	Subseasonal-to-Seasonal prediction (S2S)
3–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 1.2 – *Production status of data*

Code figure	Meaning
0	Operational products
1	Operational test products
2	Research products
3–191	Reserved
192–254	Reserved for local use
255	Missing

CODE TABLES USED IN SECTION 3 (TIME DOMAIN SECTION)

Code table 3.0 – *Significance of reference date and time*

Code figure	Meaning
0	Analysis
1	Start of forecast
2	Verifying time of forecast
3	Observation time
4–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 3.1 – *Type of calendar*

Code figure	Meaning	Comments
0	Gregorian	
1	360-day	
2	365-day	Essentially a non-leap year
3	Proleptic Gregorian	Extends the Gregorian calendar indefinitely in the past

4–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 3.2 – *Time domain template number*

Code figure	Meaning
0	Forecast point in time
1–32767	Reserved
32768–65534	Reserved for local use
65535	Missing

Code table 3.3– *Indicator of unit of time range*

Code figure	Meaning
0	Minute
1	Hour
2	Day
3	Month
4	Year
5	Decade (10 years)
6	Normal (30 years)
7	Century (100 years)
8–9	Reserved
10	3 hours
11	6 hours
12	12 hours
13	Second
14–191	Reserved
192–254	Reserved for local use
255	Missing

CODE AND FLAG TABLES USED IN SECTION 4 (HORIZONTAL DOMAIN SECTION)

Code table 4.0 – *Grid definition template number*

Code figure	Meaning
0	Latitude/longitude regular grid on an ellipsoidal planet
1	Rotated latitude/longitude regular grid on an ellipsoidal planet
2	Stretched latitude/longitude regular grid on an ellipsoidal planet
3	Stretched and rotated latitude/longitude regular grid on ellipsoidal planet
4–32767	Reserved
32768–65534	Reserved for local use
65535	Missing

Flag table 4.1 – *Resolution and component flags*

Bit No.	Value	Meaning
1–2		Reserved
3	0	i direction increments not given
	1	i direction increments given
4	0	j direction increments not given
	1	j direction increments given
5	0	Resolved u- and v- components of vector quantities relative to easterly and

		northerly directions
	1	Resolved u- and v- components of vector quantities relative to the defined grid in the direction of increasing x and y (or i and j) coordinates, respectively
6–8		Reserved – set to zero

Flag table 4.2 – *Scanning mode*

Bit No.	Value	Meaning
1	0	Points of first row or column scan in the +i (+x) direction
	1	Points of first row or column scan in the –i (–x) direction
2	0	Points of first row or column scan in the –j (–y) direction
	1	Points of first row or column scan in the +j (+y) direction
3	0	Adjacent points in i (x) direction are consecutive
	1	Adjacent points in j (y) direction is consecutive
4	0	All rows scan in the same direction
	1	Adjacent rows scans in the opposite direction
5	0	Points within odd rows are not offset in i (x) direction
	1	Points within odd rows are offset by Di/2 in i (x) direction
6	0	Points within even rows are not offset in i (x) direction
	1	Points within even rows are offset by Di/2 in i (x) direction
7	0	Points are not offset in j (y) direction
	1	Points are offset by Dj/2 in j (y) direction
8	0	Rows have Ni grid points and columns have Nj grid points
	1	Rows have Ni grid points if points are not offset in i direction
		Rows have Ni–1 grid points if points are offset by Di/2 in i direction
		Columns have Nj grid points if points are not offset in j direction
		Columns have Nj–1 grid points if points are offset by Dj/2 in j direction

Notes:

(1) i direction: west to east along a parallel or left to right along an x-axis.

(2) j direction: south to north along a meridian, or bottom to top along a y-axis.

(3) If bit number 4 is set, the first row scan is as defined by previous flags.

(4) La1 and Lo1 define the first row, which is an odd row.

(5) Di and Dj are assumed to be positive, with the direction of i and j being given by bits 1 and 2.

(6) Bits 5 through 8 may be used to generate staggered grids, such as Arakawa grids (see Part B, GRIB Attachment II).

(7) If any of bits 5, 6, 7 or 8 are set, Di and Dj are not optional.

CODE TABLES USED IN SECTION 5 (VERTICAL DOMAIN SECTION)

Code table 5.0 – *Vertical domain template number*

Code figure	Meaning
0	Vertical level
1	Vertical layer
2–32767	Reserved
32768–65534	Reserved for local use
65535	Missing

Code table 5.1 – Fixed surface types and units

Code figure	Meaning	Unit
0	Reserved	
1	Ground or water surface	–
2	Cloud base level	–

3	Level of cloud tops	–
4	Level of 0 °C isotherm	–
5	Level of adiabatic condensation lifted from the surface	–
6	Maximum wind level	–
7	Tropopause	–
8	Nominal top of the atmosphere	–
9	Sea bottom	–
10	Reserved	–
11	Cumulonimbus (CB) base	m
12	Cumulonimbus (CB) top	m
13–19	Reserved	
20	Isothermal level	K
21–99	Reserved	
100	Isobaric surface	Pa
101	Mean sea level	
102	Specific altitude above mean sea level	m
103	Specified height level above ground	m
104	Sigma level	"sigma" value
105	Hybrid level	–
106	Depth below land surface	m
107	Isentropic (theta) level	K
108	Level at specified pressure difference from ground to level	Pa
109	Potential vorticity surface	K m^2 kg^{-1} s^{-1}
110	Reserved	
111	Eta level	–
112	Reserved	
113	Logarithmic hybrid level	
114	Snow level	Numeric
115–116	Reserved	
117	Mixed layer depth	m
118	Hybrid height level	–
119	Hybrid pressure level	–
120–159	Reserved	–
160	Depth below sea level	m
161	Depth below water surface	m
162	Lake or river bottom	–
163	Bottom of sediment layer	–
164	Bottom of thermally active sediment layer	–
165	Bottom of sediment layer penetrated by thermal wave	–
166	Mixing layer	–
167	Bottom of root zone	–
168–173	Reserved	
174	Top surface of ice on sea, lake or river	–
175	Top surface of ice, under snow cover, on sea, lake or river	–
176	Bottom surface (underside) ice on sea, lake or river	–
177	Deep soil (of indefinite depth)	–
178	Reserved	
179	Top surface of glacier ice and inland ice	–
180	Deep inland or glacier ice (of indefinite depth)	–
181	Grid tile land fraction as a model surface	–
182	Grid tile water fraction as a model surface	–

183	Grid tile ice fraction on sea, lake or river as a model surface	–
184	Grid tile glacier ice and inland ice fraction as a model surface	–
185–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Notes:

(1) The Eta vertical coordinate system involves normalizing the pressure at some point on a specific level by the mean sea level pressure at that point.

(2) Hybrid height level (Code figure 118) can be defined as:

$z(k) = A(k) + B(k) \times orog$

(k = 1,...,NLevels; orog = orography; z(k) = height in metres at level k)

(3) Hybrid pressure level, for which Code figure 119 shall be used instead of 105, can be defined as:

$p(k) = A(k) + B(k) \times sp$

(k = 1,...,NLevels; sp = surface pressure; p(k) = pressure at level k)

CODE TABLES USED IN SECTION 6 (GENERATING PROCESS SECTION)

Code table 6.0 – Generating *process template number*

Code figure	Meaning
0	Forecast, analysis or observation
1	Individual ensemble forecast or analysis, control and perturbed
2	Statistical post-processing of all ensemble members
3–32767	Reserved
32768–65534	Reserved for local use
65535	Missing

Code table 6.1 – *Type of generating process*

Code figure	Meaning
0	Analysis
1	Initialization
2	Forecast
3	Bias corrected forecast
4	Ensemble forecast
5	Probability forecast
6	Forecast error
7	Analysis error
8	Observation
9	Climatological
10	Probability-weighted forecast
11	Bias-corrected ensemble forecast
12	Post-processed analysis (see Note 1)
13	Post-processed forecast (see Note 1)
14	Nowcast
15	Hindcast
16	Physical retrieval
17	Regression analysis
18–191	Reserved
192–254	Reserved for local use
255	Missing

Note:

(1) Code figures 12 and 13 are intended in cases where code figures 0 and 2 may not be sufficient to indicate that significant post-processing has taken place on an initial analysis or forecast output.

Code table 6.2 – *Type of ensemble member*

Code figure	Meaning
0	Unperturbed high-resolution control forecast
1	Unperturbed low-resolution control forecast
2	Negatively perturbed forecast
3	Positively perturbed forecast
4–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 6.3 – Type of statistical post-processing of ensemble members

Code figure	Meaning
0	Unweighted mean
1	Weighted mean
2	Spread
3	Large anomaly index (see Note 1)
4	Interquartile range (range between the 25th and 75th quantile)
5	Minimum
6	Maximum
7–191	Reserved
192–254	Reserved for local use
255	Missing

Note:

(1) Large anomaly index is defined as {(number of members whose anomaly is higher than 0.5 x SD) – (number of members whose anomaly is lower than –0.5 x SD)} / (number of members) at each grid point, where SD is defined as observed climatological standard deviation.

CODE TABLES USED IN SECTION 7 (OBSERVABLE PROPERTY SECTION)

Code table 7.0 – *Observable property template number*

Code figure	Meaning
0	Observable property by discipline, category and number
1	Observable property with units conversion
2	Atmospheric chemical or physical constituent
3	Aerosol physical property
4	Aerosol optical property
5–32767	Reserved
32768–65534	Reserved for local use
65535	Missing

Code table 7.1 – *Discipline*

Code figure	Meaning
0	Meteorological products
1	Hydrological products
2	Land surface products
3	Space products
4–9	Reserved
10	Oceanographic products

11–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 7.2 – *Parameter category by discipline*

Product discipline 0 – Meteorological products

Category	Description
0	Temperature
1	Moisture
2	Momentum
3	Mass
4	Short-wave radiation
5	Long-wave radiation
6	Cloud
7	Thermodynamic stability indices
8	Kinematic stability indices
9–12	Reserved
13	Aerosols
14	Trace gases (e.g. ozone, CO_2)
15	Radar
16	Forecast radar imagery
17	Electrodynamics
18	Reserved
19	Physical atmospheric properties
20	Atmospheric chemical constituents
21–191	Reserved
192–254	Reserved for local use
255	Missing

Note:

(1) When a new category is to be added to Code table 7.1 and more than one discipline applies, the choice of discipline should be made based on the intended use of the product.

Product discipline 1 – Hydrological products

Category	Description
0	Hydrology basic products
1	Reserved
2	Inland water and sediment properties
3–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 2 – Land surface products

Category	Description
0	Vegetation/biomass
1	Agri-/aquacultural special products
2	Transportation-related products
3	Soil products
4	Fire weather products
5–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 3 – Space products

Category	Description
0	Reserved
1	Reserved
2	Cloud properties
3	Flight rule conditions
4	Volcanic ash
5	Sea-surface temperature
6–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 10 – Oceanographic products

Category	Description
0	Waves
1	Currents
2	Ice
3	Surface properties
4	Subsurface properties
5–190	Reserved
191	Miscellaneous
192–254	Reserved for local use
255	Missing

Code table 7.3 – *Parameter number by product discipline and parameter category*

Note:
(1) By convention, the flux sign is positive if downwards.

Product discipline 0 – Meteorological products, parameter category 0: temperature

Number	Parameter	Units
0	Temperature	K
1	Virtual temperature	K
2	Potential temperature	K
3	Pseudo-adiabatic potential temperature or equivalent potential temperature	K
4–5	Reserved	
6	Dewpoint temperature	K
7	Dewpoint depression (or deficit)	K
8	Lapse rate	K m^{-1}
9	Temperature anomaly	K
10	Latent heat net flux	W m^{-2}
11	Sensible heat net flux	W m^{-2}
12	Heat index	K
13	Wind chill factor	K
14	Reserved	
15	Virtual potential temperature	K
16–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 1: moisture

Number	Parameter	Units
0	Specific humidity	kg kg^{-1}
1	Relative humidity	%
2	Humidity mixing ratio	kg kg^{-1}
3	Precipitable water	kg m^{-2}
4	Vapour pressure	Pa
5–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 2: momentum

Number	Parameter	Units
0	Wind direction (from which blowing)	degree true
1	Wind speed	m s^{-1}
2	u-component of wind	m s^{-1}
3	v-component of wind	m s^{-1}
4	Stream function	m^2 s^{-1}
5	Velocity potential	m^2 s^{-1}
6	Montgomery stream function	m^2 s^{-2}
7–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 3: mass

Number	Parameter	Units
0	Pressure	Pa
1	Pressure reduced to MSL	Pa
2	Pressure tendency	Pa s^{-1}
3	ICAO Standard Atmosphere Reference Height	m
4	Geopotential	m^2 s^{-2}
5	Geopotential height	gpm
6	Geometric height	m
7	Standard deviation of height	m
8	Pressure anomaly	Pa
9	Geopotential height anomaly	gpm
10	Density	kg m^{-3}
11–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 4: short-wave radiation

Number	Parameter	Units
0	Net short-wave radiation flux (surface)*	W m^{-2}
1	Net short-wave radiation flux (top of atmosphere)*	W m^{-2}
2	Short-wave radiation flux*	W m^{-2}
3	Global radiation flux	W m^{-2}

4	Brightness temperature	K
5–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 5: long-wave radiation

Number	Parameter	Units
0	Reserved	
1	Reserved	
2	Reserved	
3	Downward long-wave radiation flux	W m^{-2}
4	Upward long-wave radiation flux	W m^{-2}
5	Net long-wave radiation flux	W m^{-2}
6	Net long-wave radiation flux, clear sky	W m^{-2}
7	Brightness temperature	K
8–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 6: cloud

Number	Parameter	Units
0	Cloud ice	kg m^{-2}
1	Total cloud cover	%
2	Convective cloud cover	%
3	Low cloud cover	%
4	Medium cloud cover	%
5	High cloud cover	%
6	Cloud water	kg m^{-2}
7	Cloud amount	%
8	Reserved	
9	Thunderstorm maximum tops	m
10	Reserved	
11	Cloud base	m
12	Cloud top	m
13	Ceiling	m
14	Non-convective cloud cover	%
15	Cloud work function	J kg^{-1}
16	Convective cloud efficiency	Proportion
17	Reserved	
18	Total column-integrated cloud water*	kg m^{-2}
19	Total column-integrated cloud ice*	kg m^{-2}
20	Total column-integrated condensate*	kg m^{-2}
21	Ice fraction of total condensate	Proportion
22–191	Cloud cover	%
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 7: thermodynamic stability indices

Number	Parameter	Units
0	Parcel lifted index (to 500 hPa)	K

1	Best lifted index (to 500 hPa)	K
2	K index	K
3	KO index	K
4	Total totals index	K
5	Sweat index	Numeric
6	Convective available potential energy	J kg^{-1}
7	Convective inhibition	J kg^{-1}
8	Storm relative helicity	J kg^{-1}
9	Energy helicity index	Numeric
10	Surface lifted index	K
11	Best (4-layer) lifted index	K
12	Richardson number	Numeric
13	Showalter index	K
14	Reserved	
15	Updraught helicity	m^2 s^{-2}
16	Bulk Richardson number	Numeric
17	Gradient Richardson number	Numeric
18	Flux Richardson number	Numeric
19–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 13: aerosols

Number	Parameter	Units
0–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 14: trace gases

Number	Parameter	Units
0	Total ozone	DU
1	Ozone mixing ratio	kg kg^{-1}
2	Total column integrated ozone	DU
3–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 15: radar

Number	Parameter	Units
0	Base spectrum width	m s^{-1}
1	Base reflectivity	dB
2	Base radial velocity	m s^{-1}
3	Vertically integrated liquid water (VIL)	kg m^{-2}
4	Layer-maximum base reflectivity	dB
5	Precipitation	kg m^{-2}
6–8	Reserved	
9	Reflectivity of cloud droplets	dB
10	Reflectivity of cloud ice	dB
11	Reflectivity of snow	dB
12	Reflectivity of rain	dB
13	Reflectivity of graupel	dB

14	Reflectivity of hail	dB
15	Hybrid scan reflectivity	dB
16	Hybrid scan reflectivity height	m
17–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product Discipline 0 – Meteorological products, parameter category 16: forecast radar imagery

Number	Parameter	Units
0	Equivalent radar reflectivity factor for rain	$mm^6\ m^{-3}$
1	Equivalent radar reflectivity factor for snow	$mm^6\ m^{-3}$
2	Equivalent radar reflectivity factor for parameterized convection	$mm^6\ m^{-3}$
3	Echo top	m
4	Reflectivity	dB
5	Composite reflectivity	dB
6–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Note:

(1) Decibel (dB) is a logarithmic measure of the relative power, or of the relative values of two flux densities, especially of sound intensities and radio and radar power densities. In radar meteorology, the logarithmic scale (dBZ) is used for measuring radar reflectivity factor (obtained from the American Meteorological Society *Glossary of Meteorology*).

Product discipline 0 – Meteorological products, parameter category 17: electrodynamics

Number	Parameter	Units
0	Lightning strike density	$m^{-2}\ s^{-1}$
1–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 19: physical atmospheric properties

Number	Parameter	Units
0	Visibility	m
1	Albedo	%
2	Thunderstorm probability	%
3	Mixed layer depth	m
4–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 0 – Meteorological products, parameter category 20: atmospheric chemical constituents

Number	Parameter	Units
0	Mass density (concentration)	$kg\ m^{-3}$
1	Reserved	
2	Mass mixing ratio (mass fraction in air)	$kg\ kg^{-1}$
3	Atmosphere emission mass flux	$kg\ m^{-2}\ s^{-1}$
4	Atmosphere net production mass flux	$kg\ m^{-2}\ s^{-1}$
5	Atmosphere net production and emission mass flux	$kg\ m^{-2}\ s^{-1}$

6–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 1 – Hydrological products, parameter category 0: hydrology basic products

Number	Parameter	Units
0	Flash flood guidance (Encoded as an accumulation over a floating subinterval of time between the reference time and valid time)	kg m^{-2}
1	Flash flood runoff (Encoded as an accumulation over a floating subinterval of time)	kg m^{-2}
2	Reserved	
3	Reserved	
4	Snow water equivalent per cent of normal	%
5	Baseflow-groundwater runoff	kg m^{-2}
6	Storm surface runoff	kg m^{-2}
7	Discharge from rivers or streams	m^3 s^{-1}
8	Groundwater upper storage	kg m^{-2}
9	Groundwater lower storage	kg m^{-2}
10	Side flow into river channel	m^3 s^{-1} m^{-1}
11	River storage of water	m^3
12	Floodplain storage of water	m^3
13	Depth of water on soil surface	kg m^{-2}
14	Upstream accumulated precipitation	kg m^{-2}
15	Upstream accumulated snow melt	kg m^{-2}
16–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 1 – Hydrological products, parameter category 2: inland water and sediment properties

Number	Parameter	Units
0	Water depth	m
1	Water temperature	K
2	Water fraction	Proportion
3	Sediment thickness	m
4	Sediment temperature	K
5	Ice thickness	m
6	Ice temperature	K
7	Ice cover	Proportion
8	Land cover (0 = water, 1 = land)	Proportion
9	Shape factor with respect to salinity profile	–
10	Shape factor with respect to temperature profile in thermocline	–
11	Attenuation coefficient of water with respect to solar radiation	m^{-1}
12	Salinity	kg kg^{-1}
13	Cross-sectional area of flow in channel	m^2

14–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 2 – Land surface products, parameter category 0: vegetation / biomass

Number	Parameter	Units
0	Land cover (0 = sea, 1 = land)	Proportion
1	Surface roughness	m
2–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 2 – Land surface products, parameter category 4: fire weather products

Number	Parameter	Units
0	Fire outlook	Code table 6.224
1	Fire outlook due to dry thunderstorm	Code table 6.224
2	Haines index	Numeric
3	Fire burned area	%
4	Fosberg index*	Numeric
5	Forest Fire Weather Index (Canadian Forest Service)	Numeric
6	Fine Fuel Moisture Code (Canadian Forest Service)	Numeric
7	Duff Moisture Code (Canadian Forest Service)	Numeric
8	Drought Code (Canadian Forest Service)	Numeric
9	Initial Fire Spread Index (Canadian Forest Service)	Numeric
10	Fire Buildup Index (Canadian Forest Service)	Numeric
11	Fire Daily Severity Rating (Canadian Forest Service)	Numeric
12–191	Reserved	
192–254	Reserved for local use	
255	Missing	

* The Fosberg index denotes the potential influence of weather on a wildland fire. It takes into account the combined effects of temperature, wind speed, relative humidity and precipitation. Higher values indicate a higher potential impact.

Product discipline 2 – Land surface products, parameter category 5: glaciers and inland ice

Number	Parameter	Units
1	Glacier temperature	K
2–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 3 – Space products, parameter category 0: image format products

Number	Parameter	Units
0	Scaled radiance	Numeric
1	Scaled albedo	Numeric
2	Scaled brightness temperature	Numeric
3	Scaled precipitable water	Numeric
4	Scaled lifted index	Numeric
5	Scaled cloud top pressure	Numeric
6	Scaled skin temperature	Numeric

7–191	Reserved
192–254	Reserved for local use
255	Missing

Product discipline 10 – Oceanographic products, parameter category 0: waves

Number	Parameter	Units
0	Wave spectra (1)	–
1	Wave spectra (2)	–
2	Wave spectra (3)	–
3	Significant height of combined wind waves and swell	m
4	Direction of wind waves	degree true
5	Significant height of wind waves	m
6	Mean period of wind waves	s
7	Direction of swell waves	degree true
8	Significant height of swell waves	m
9	Mean period of swell waves	s
10	Primary wave direction	degree true
11	Primary wave mean period	s
12	Secondary wave direction	degree true
13	Secondary wave mean period	s
14	Direction of combined wind waves and swell	degree true
15	Mean period of combined wind waves and swell	s
16	Coefficient of drag with waves	–
17	Friction velocity	m s^{-1}
18	Wave stress	N m^{-2}
19	Normalized wave stress	–
20	Mean square slope of waves	–
21	u-component surface Stokes drift	m s^{-1}
22	v-component surface Stokes drift	m s^{-1}
23	Period of maximum individual wave height	s
24	Maximum individual wave height	m
25	Inverse mean wave frequency	s
26	Inverse mean frequency of wind waves	s
27	Inverse mean frequency of total swell	s
28	Mean zero-crossing wave period	s
29	Mean zero-crossing period of wind waves	s
30	Mean zero-crossing period of total swell	s
31	Wave directional width	–
32	Directional width of wind waves	–
33	Directional width of total swell	–
34	Peak wave period	s
35	Peak period of wind waves	s
36	Peak period of total swell	s
37	Altimeter wave height	m
38	Altimeter corrected wave height	m
39	Altimeter range relative correction	–
40	10-metre neutral wind speed over waves	m s–1
41	10-metre wind direction over waves	°
42	Wave energy spectrum	m^2 s rad^{-1}
43	Kurtosis of the sea-surface elevation due to waves	–

44	Benjamin–Feir index	–
45	Spectral peakedness factor	s^{-1}
46–191	Reserved	
192–254	Reserved for local use	
255	Missing	

* Further information concerning the wave parameters can be found in the *Guide to Wave Analysis and Forecasting* (WMO-No. 702).

Product discipline 10 – Oceanographic products, parameter category 1: currents

Number	Parameter	Units
0	Current direction	degree true
1	Current speed	m s^{-1}
2	u-component of current	m s^{-1}
3	v-component of current	m s^{-1}
4–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 10 – Oceanographic products, parameter category 2: ice

Number	Parameter	Units
0	Ice cover	Proportion
1	Ice thickness	m
2	Direction of ice drift	degree true
3	Speed of ice drift	m s^{-1}
4	u-component of ice drift	m s^{-1}
5	v-component of ice drift	m s^{-1}
6	Ice growth rate	m s^{-1}
7	Ice divergence	s^{-1}
8	Ice temperature	K
9	Module of ice internal pressure*	Pa m
10	Zonal vector component of vertically integrated ice internal pressure	Pa m
11	Meridional vector component of vertically integrated ice internal pressure	Pa m
12	Compressive ice strength	N m^{-1}
13–191	Reserved	
192–254	Reserved for local use	
255	Missing	

* Ice internal pressure or stress (Pa m) is the integrated pressure across the vertical thickness of a layer of ice. It is produced when concentrated ice reacts to external forces such as wind and ocean currents.

Product discipline 10 – Oceanographic products, parameter category 3: surface properties

Number	Parameter	Units
0	Water temperature	K
1	Deviation of sea level from mean	m
2–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 10 – Oceanographic products, parameter category 4: subsurface properties

Number	Parameter	Units
0	Main thermocline depth	m

1	Main thermocline anomaly	m
2	Transient thermocline depth	m
3	Salinity	kg kg^{-1}
4	Ocean vertical heat diffusivity	m^2 s^{-1}
5	Ocean vertical salt diffusivity	m^2 s^{-1}
6	Ocean vertical momentum diffusivity	m^2 s^{-1}
7	Bathymetry	m
8–10	Reserved	
11	Shape factor with respect to salinity profile	–
12	Shape factor with respect to temperature profile in thermocline	–
13	Attenuation coefficient of water with respect to solar radiation	m^{-1}
14	Water depth	m
15	Water temperature	K
16–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Product discipline 10 – Oceanographic products, parameter category 191: miscellaneous

Number	Parameter	Units
0	Seconds prior to initial reference time (defined in Section 1)	s
1	Meridional overturning stream function	m^3 s^{-1}
2	Reserved	
3	Days since last observation	d
4–191	Reserved	
192–254	Reserved for local use	
255	Missing	

Code table 7.4 – *Type of Interval*

Code figure	Meaning
0	Smaller than first limit
1	Greater than second limit
2	Between first and second limit. The range includes the first limit but not the second limit
3	Greater than first limit
4	Smaller than second limit
5	Smaller or equal first limit
6	Greater or equal second limit
7	Between first and second. The range includes the first limit and the second limit
8	Greater or equal first limit
9	Smaller or equal second limit
10	Between first and second limit. The range includes the second limit but not the first limit
11	Equal to first limit
12–191	Reserved
192–254	Reserved for local use
255	Missing

CODE TABLES USED IN SECTION 8 (DATA REPRESENTATION SECTION)

Code table 8.0 – *Data representation template number*

Code figure	Meaning
0	Simple packing

1	IEEE floating point
2–49151	Reserved
49152–65534	Reserved for local use
65535	Missing

Code table 8.1 – *Type of original field values*

Code figure	Meaning
0	Floating point
1	Integer
2–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 8.2 – *Missing value management*

Code figure	Meaning
0	No explicit missing values included within data values
1	Primary missing values included within data values
2	Primary and secondary missing values included within data values
3–191	Reserved
192–254	Reserved for local use
255	Missing

Code table 8.3 – *Precision of floating-point numbers*

Code figure	Meaning
0	Reserved
1	IEEE 32-bit (I=4 in section 7)
2	IEEE 64-bit (I=8 in section 7)
3	IEEE 128-bit (I=16 in section 7)
4–254	Reserved
255	Missing

CODE TABLES USED IN SECTION 9 (OVERLAY SECTION)

Code table 9.0 –*Overlay template number*

Code figure	Meaning
0	Bitmap
1–49151	Reserved
49152–65534	Reserved for local use
65535	Missing

Decision 7 (CBS-16)

REMOVAL OF FM 92-XI EXT. GRIB FROM THE *MANUAL ON CODES* (WMO-No. 306)

THE COMMISSION FOR BASIC SYSTEMS,

Recalling:

(1) That the Commission for Basic Systems (CBS) at its twelfth session noted, when FM 92-XII General Regularly Distributed Information in Binary Form (GRIB) (GRIB edition 2)