

WORLD METEOROLOGICAL ORGANIZATION

# Manual on Codes

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## International Codes

VOLUME I.2

(Annex II to WMO Technical Regulations)

Part B — Binary Codes

Part C — Common Features to Binary  
and Alphanumeric Codes

2001 edition



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**TABLE FOR NOTING SUPPLEMENTS RECEIVED**

<i>Supplement No.</i>	<i>Dated</i>	<i>Inserted in the publication</i>	
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## PREFACE

Coded messages are used for the international exchange of meteorological information comprising observational data provided by the WWW Global Observing System and processed data provided by the WWW Global Data-processing System. Coded messages are also used for the international exchange of observed and processed data required in specific applications of meteorology to various human activities and for exchanges of information related to meteorology.

The codes are composed of a set of CODE FORMS and BINARY CODES made up of SYMBOLIC LETTERS (or groups of letters) representing meteorological or, as the case may be, other geophysical elements. In messages, these symbolic letters (or groups of letters) are transcribed into figures indicating the value or the state of the elements described. SPECIFICATIONS have been defined for the various symbolic letters to permit their transcription into figures. In some cases, the specification of the symbolic letter is sufficient to permit a direct transcription into figures. In other cases, it requires the use of CODE FIGURES, the specifications of which are given in CODE TABLES. Furthermore, a certain number of SYMBOLIC WORDS and SYMBOLIC FIGURE GROUPS have been developed for use as code names, code words, symbolic prefixes or indicator groups.

Rules concerning the selection of code forms to be exchanged *for international purposes*, and the selection of their symbolic words, figure groups and letters, are laid down in the WMO *Technical Regulations*, Volume I, Chapter A.2.3 (Ed. 1988). These code forms are contained in Volume I of the *Manual on Codes*, issued (with separate covers) as Volume I.1 — Part A, and Volume I.2 — Part B and Part C .

Apart from these international codes, several sets of *regional codes* exist which are intended only for exchanges within a given WMO Region. These codes are contained in Volume II of the *Manual on Codes*. This volume also contains descriptions of:

- Regional coding procedures for the use of international code forms;
- National coding practices in the use of international or regional codes of which the Secretariat has been informed;
- National code forms.

A number of special codes which are used in messages exchanged over the WWW Global Telecommunication System circuits, and which comprise ice and satellite ephemeris codes, are included in Volume II as an Appendix.

This edition of Volume I.2 of the *Manual on Codes* replaces the 1995 edition.

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#### EDITORIAL NOTE

As a general rule, **standard coding practices** are printed in semi-bold roman in order to distinguish them from explanations.

**Regulations** are printed in semi-bold roman; explanatory notes relating to these regulations are printed in smaller type and preceded by the indication: NOTE.

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## INTRODUCTION

Volume I of the *Manual on Codes* contains WMO international codes for meteorological data and other geophysical data relating to meteorology; it constitutes Annex II of the WMO *Technical Regulations* and has therefore the status of a Technical Regulation. It is issued in two volumes with separate covers: Volume I.1, containing PART A, and Volume I.2, containing PART B and PART C.

**VOLUME I.1** (issued under separate cover):

**Part A — Alphanumeric Codes** consists of five sections.

**VOLUME I.2:**

**Part B — Binary Codes** consists of the list of binary codes with their specifications and associated code tables. The standard coding procedures are distinguished by the use of the term “shall” in the English text, and by suitable equivalent terms in the French, Russian and Spanish texts. Where national practices do not conform with these regulations, Members concerned shall formally notify the Secretary-General of WMO for the benefit of other Members. Explanatory notes are sometimes added to regulations.

**Part C — Common Features to Binary and Alphanumeric Codes** consists of the list of table-driven alphanumeric codes with their specifications and associated code tables, and of common code tables to binary and alphanumeric codes.

The Attachments to Volume I.2, which are printed on yellow paper, do not have the status of WMO *Technical Regulations* and are given for information only.

## PROCEDURES FOR AMENDING THE *MANUAL ON CODES*

### 1. General validation and implementation procedures

1.1 Amendments to the *Manual on Codes* must be proposed in writing to the WMO Secretariat. The proposal shall specify the needs, purposes and requirements and include information on a contact point for technical matters.

1.2 The Expert Team on Data Representation and Codes (ET/DR&C)\*, supported by the Secretariat, shall validate the stated requirements (unless it is consequential to an amendment to the WMO Technical Regulations) and develop a draft recommendation to respond to the requirements, as appropriate.

1.3 A draft recommendation developed by the ET/DR&C must be endorsed by the Implementation/Coordination Team (ITC) of the Open Programme Area Group on Information Systems and Services (OPAG/ISS) prior to its consideration by CBS, which subsequently submits it for approval to the Executive Council. Draft recommendations must have followed the procedures described in paragraph 5.4.31 of the *Abridged Final Report with Resolutions and Recommendations of the Extraordinary Session of the Commission for Basic Systems* (WMO-No. 815) before being submitted to a CBS session. These procedures are given in section 4 below. During inter-sessional periods, the “fast track” mechanism, described in section 2 below, is used to ensure the necessary flexibility in responding to urgent requirements of users.

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\* The ET/DR&C and the OPAG/ISS are, in the year 2000, the current bodies dealing with data representation and codes within CBS. If they were replaced by other bodies performing the same function, the same rules would apply, by replacing the means of the entities approximately.

- 1.4 Updates of the *Manual on Codes* shall be issued as supplements only once a year in August and include all changes implemented since the previous update and those approved for implementation on the first Wednesday following 1 November.
  - 2. Fast track mechanism for validation and implementation**
    - 2.1 Fast track mechanism shall be used during the inter-sessional periods of CBS for additions to BUFR or CREX Tables A, B, and D with associated code tables or flag tables and to code tables in GRIB, to common tables related to character codes, e.g. radiosonde entries, and to other simple additional table entries in character codes.
    - 2.2 Draft recommendations developed by the ET/DR&C must follow the validation procedures described in subsections 4.1, 4.2 and 4.3 below and must be endorsed by the chairperson of OPAG/ISS, the president of CBS on behalf of the Commission, and must be approved by the President of WMO on behalf of the Executive Council. However, the filling of reserved and unused entries in the existing code and flag tables are considered minor adjustments and will be effected by the Secretary-General in consultation with the president of CBS.
    - 2.3 The implementation of amendments approved through the fast track shall normally be limited to one per year and the implementation date should be fixed as the first Wednesday following 1 November. If the chairpersons of ET/DR&C and OPAG/ISS agree that an exceptional situation exists, a second fast track implementation can be initiated.
    - 2.4 WMO Members shall be notified of amendments approved through the fast track timely enough to allow a period of at least three months between the receipt of the notification and the date of implementation.
  - 3. Procedures for the correction of existing entries in the BUFR and CREX tables**
    - 3.1 If an erroneous specification of an entry is found in a BUFR or CREX table, a new descriptor should normally be added to the table through the fast track procedures and should be used instead of the old one for encoding (especially if it concerns data width). An appropriate explanation shall be added to the notes of the table to clarify the practice along with the date of the change.
    - 3.2 This situation is considered a minor adjustment according to subsection 2.2 above.
  - 4. Validation procedures with respect to proposed changes to WMO codes and data representation forms**
    - 4.1 The need for, and the purpose of, the proposed changes should be fully documented.
    - 4.2 This documentation must include the results of non-operational testing of the changes as described below.
    - 4.3 For new or modified WMO code and data representation forms, proposed changes should be tested by the use of at least two independently developed encoders and two independently developed decoders which incorporated the proposed change. Where the data originated from a necessarily unique source (for example the data stream from an experimental satellite), the successful testing of a single encoder with at least two independent decoders would be considered adequate. Results should be made available to the ET/DR&C with a view to verifying the technical specifications.
    - 4.4 Draft recommendations to be submitted to CBS sessions must be published as pre-session documents at least three months prior to the session.
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## DEFINITIONS

### *Actual time of observation*

- (1) In the case of a surface synoptic observation, the time at which the barometer is read.
- (2) In the case of upper-air observations, the time at which the balloon, parachute or rocket is actually released.

### *Alpine glow*

Pink or yellow colouring assumed by mountain tops opposite the Sun when it is only just below the horizon before it rises and after it sets. This phenomenon vanishes after a brief interval of blue colouring, when the Earth's shadow reaches these summits.

### *Anomalous propagation*

Propagation of radio energy in abnormal conditions of vertical distribution of refractive index, in association with abnormal distribution of atmospheric temperature and humidity. Use of the term is mainly confined to conditions in which abnormally large distances of propagation are attained.

### *Atmospheric — Sferic*

Electromagnetic wave resulting from an electric discharge (lightning) in the atmosphere.

### *Automatic station*

Meteorological station at which instruments make and transmit observations, the conversion to code form for international exchange being made either directly or at an editing station.

### *Aviation routine weather report*

A statement of the observed meteorological conditions related to a specified time and location, issued on a routine basis for use in international air navigation.

### *BUFR — Binary universal form for the representation of meteorological data*

BUFR is the name of a binary code for the exchange and storage of data.

### *BUFR message*

A single complete BUFR entity.

### *Category*

The lists of sequence descriptors tabulated in BUFR or CREX Table D are categorized according to their application; categories are provided for non-meteorological sequences, for various types of meteorological sequences, and for sequences which define reports, or major subsets of reports.

### *Class*

A set of elements tabulated together in BUFR/CREX Table B.

*Condensation trails (contrails)*

Clouds which form in the wake of an aircraft when the atmosphere at flying level is sufficiently cold and humid.

*Coordinate class*

Classes 0–9 inclusive in BUFR/CREX Table B define elements which assist in the definition of elements from subsequent classes; each of these classes is referred to as a coordinate class.

*CREX — Character form for the representation and exchange of data*

CREX is the name of a table-driven alphanumeric code for the exchange and storage of data.

*Data description operator*

Operators which define replication or the operations listed in BUFR or CREX Table C.

*Data entity*

A single data item.

*Data subset*

A set of data corresponding to the data description in a BUFR or CREX message; for observational data, a data subset usually corresponds to one observation.

*Day darkness*

Sky covered with clouds with very strong optical thickness (dark clouds) having a threatening appearance.

*Descriptor*

An entity entered within the Data description section to describe or define data; a descriptor may take the form of an element descriptor, a replication operator, an operator descriptor, or a sequence descriptor.

*Dry thunderstorm*

A thunderstorm without precipitation reaching the ground (distinct from a nearby thunderstorm with precipitation reaching the ground but not at the station at the time of observation).

*Dust wall or sand wall*

Front of a duststorm or sandstorm, having the appearance of a gigantic high wall which moves more or less rapidly.

*Element descriptor*

A descriptor containing a code figure reference to BUFR/CREX Table B; the referenced entry defines an element, together with the units, scale factor, reference value and data width to be used to represent that element as data.

*Equatorial regions*

For the purpose of the analysis codes, the region between 30°N and 30°S latitudes.

*Geometric altitude*

Vertical distance (*Z*) of a level, a point or an object considered as a point, measured from mean sea level.

*Geopotential*

That potential with which the Earth's gravitational field is associated. It is equivalent to the potential energy of unit mass relative to a standard level (mean sea level by convention) and is numerically equal to

the work which would be done against gravity in raising the unit mass from sea level to the level at which the mass is located.

Geopotential  $\phi$  at geometric height  $z$  is given by

$$\phi = \int_0^z g \, dz$$

where  $g$  is the acceleration of gravity.

#### *Geopotential height*

Height of a point in the atmosphere expressed in units (geopotential metres) proportional to the geopotential at that height. Geopotential height expressed in geopotential metres is approximately equal to  $\frac{g}{9.8}$  times the geometric height expressed in (geometric) metres,  $g$  being the local acceleration of gravity.

#### *Haboob*

A strong wind and duststorm or sandstorm in the northern and central Sudan. Its average duration is three hours; the average maximum wind velocity is over  $15 \text{ m s}^{-1}$ . The dust or sand forms a dense whirling wall which may be 1000 m high; it is often preceded by isolated dust whirls. Haboobs usually occur after a few days of rising temperature and falling pressure.

#### *Ice crust (ice slick)*

- (1) A type of snow crust; a layer of ice, thicker than a film crust, upon a snow surface. It is formed by the freezing of melt water or rain water which has flowed into it.
- (2) See *Ice rind*.

#### *Ice rind*

A thin but hard layer of sea ice, river ice or lake ice. Apparently this term is used in at least two ways: (a) for a new encrustation upon old ice; and (b) for a single layer of ice usually found in bays and fjords where fresh water freezes on top of slightly colder sea water.

#### *Instrumental wave data*

Data on measured characteristics relating to period and height of the wave motion of the sea surface.

#### *Inversion (layer)*

Atmospheric layer, horizontal or approximately so, in which the temperature increases with increasing height.

#### *Isothermal layer*

Atmospheric layer through which there is no change of temperature with height.

#### *Jet stream*

Flat tubular current of air, quasi-horizontal, whose axis is along a line of maximum speed and which is characterized not only by great speeds but also by strong transverse gradients of speed.

#### *Line squall*

Squall which occurs along a squall line.

#### *Lithometeor*

Meteor consisting of an ensemble of particles most of which are solid and non-aqueous. The particles are more or less suspended in the air, or lifted by the wind from the ground.

*Mountain waves*

Oscillatory motions of the atmosphere induced by flow over a mountain; such waves are formed over and to the lee of the mountain or mountain chain.

*Normals*

Period averages computed for over a uniform and relatively long period comprising at least three consecutive 10-year periods.

*Obscured sky*

Occasions of hydrometeors or lithometeors which are so dense as to make it impossible to tell whether there is cloud above or not.

*Ocean weather station*

A station aboard a suitably equipped and staffed ship that endeavours to remain at a fixed sea position and that makes and reports surface and upper-air observations and may also make and report subsurface observations.

*Operator descriptor*

A descriptor containing a code figure reference to BUFR or CREX Table C, together with data to be used as an operand.

*Past weather*

Predominant characteristic of weather which had existed at the station during a given period of time.

*Persistent condensation trail*

Long-lived condensation trails which have spread to form clouds having the appearance of Cirrus or patches of Cirrocumulus or Cirrostratus. It is sometimes impossible to distinguish such clouds from other Cirrus, Cirrocumulus or Cirrostratus.

*Present weather*

Weather existing at the time of observation, or under certain conditions, during the hour preceding the time of observation.

*Purple light*

Glow with a hue varying between pink and red, which is to be seen in the direction of the Sun before it rises and after it sets and is about 3° to 6° below the horizon. It takes the form of a segment of a more or less large luminous disc which appears above the horizon.

*Reference value*

All data are represented within a BUFR or CREX message by positive integers; to enable negative values to be represented, suitable negative base values are specified as reference values. The true value is obtained by addition of the reference value and the data as represented.

*Replication descriptor*

A special descriptor is reserved to define the replication operation; it is used to enable a given number of subsequent descriptors to be replicated a given number of times.

*Runway visual range*

The range over which the pilot of an aircraft on the centre line of the runway can see the runway markings or the lights delineating the runway or identifying its centre line.

*Sea station*

An observing station situated at sea. Sea stations include ships, ocean weather stations and stations on fixed or drifting platforms (rigs, platforms, lightships and buoys).

*Section*

A logical subdivision of a BUFR or CREX message, to aid description and definition.

*Sequence descriptor*

A descriptor used as a code figure to reference a single entry in BUFR or CREX Table D; the referenced entry contains a list of descriptors to be substituted for the sequence descriptor.

*Severe line squall*

Severe squall which occurs along squall line (see *Line squall*).

*Snow haze*

A suspension in the air of numerous minute snow particles, considerably reducing the visibility at the Earth's surface (visibility in snow haze often decreases to 50 m). Snow haze is observed most frequently in Arctic regions, before or after a snow storm.

*Squall*

Atmospheric phenomenon characterized by a very large variation of wind speed: it begins suddenly, has a duration of the order of minutes and decreases rather suddenly in speed. It is often accompanied by a shower or thunderstorm.

*Squall line*

Fictitious moving line, sometimes of considerable extent, along which squall phenomena occur.

*Sun pillar*

Pillar of white light, which may or may not be continuous, which may be observed vertically above or below the Sun. Sun pillars are most frequently observed near sunrise or sunset; they may extend to about 20° above the Sun, and generally end in a point. When a sun pillar appears together with a well-developed parhelic circle, a sun cross may appear at their intersection.

*Synoptic hour*

Hour, expressed in terms of UTC, at which, by international agreement, meteorological observations are made simultaneously throughout the globe.

*Synoptic observation*

A surface or upper-air observation made at standard time.

*Synoptic surface observation*

Synoptic observation, other than an upper-air observation, made by an observer or an automatic weather station on the Earth's surface.

*Template*

Description of the standardized layout of a set of data entries.

*Tropical (Tropic)*

Pertaining to that region of the Earth's surface lying between the Tropic of Cancer and Tropic of Capricorn at 23°30'N and S, respectively.

*Tropical cyclone*

Cyclone of tropical origin of small diameter (some hundreds of kilometres) with minimum surface pressure in some cases less than 900 hPa, very violent winds and torrential rain; sometimes accompanied by thunderstorms. It usually contains a central region, known as the “eye” of the storm, with a diameter of the order of some tens of kilometres, and with light winds and more or less lightly clouded sky.

*Tropical revolving storm*

Tropical cyclone.

*Tropopause*

- (1) Upper limit of the troposphere. By convention, the “first tropopause” is defined as the lowest level at which the lapse rate decreases to  $2^{\circ}\text{C km}^{-1}$  or less, provided also the average lapse rate between this level and all higher levels within 2 km does not exceed  $2^{\circ}\text{C km}^{-1}$ .
- (2) If, above the first tropopause, the average lapse rate between any level and all higher levels within 1 km exceeds  $3^{\circ}\text{C km}^{-1}$ , then a “second tropopause” is defined by the same criterion as under (1). This second tropopause may be either within or above the 1 km layer.

*Twilight glow*

See *Purple light*.

*Twilight glow in the mountains (Alpenglühén)*

See *Alpine glow*.

*Unit of geopotential ( $H_m$ )*

1 standard geopotential metre = 0.980 665 dynamic metre

$$H_m = \frac{1}{9.806 65} \int_0^z g(z) dz$$

where  $g(z)$  = acceleration of gravity, in  $\text{m s}^{-2}$ , as a function of geometric height;

$z$  = geometric height, in metres;

$H_m$  = geopotential, in geopotential metres.

*Vertical visibility*

Maximum distance at which an observer can see and identify an object on the same vertical as himself, above or below.

*Whiteout*

Uniformly white appearance of the landscape when the ground is snow covered and the sky is uniformly covered with clouds. An atmospheric optical phenomenon of the polar regions in which the observer appears to be engulfed in a uniformly white glow. Neither shadows, horizon, nor clouds are discernible; sense of depth and orientation are lost; only very dark, nearby objects can be seen. Whiteout occurs over an unbroken snow cover and beneath a uniformly overcast sky, when, with the aid of the snowblink effect, the light from the sky is about equal to that from the snow surface. Blowing snow may be an additional cause. The phenomenon is experienced in the air as well as on the ground.

*Wind (mean wind, spot wind)*

Air motion relative to the Earth's surface. Unless it is otherwise specified, only the horizontal component is considered.

- (1) *Mean wind*: For the purpose of upper air reports from aircraft, mean wind is derived from the drift of the aircraft when flying from one fixed point to another or obtained by flying on a circuit around a fixed observed point and an immediate wind deduced from the drift of the aircraft.
- (2) *Spot wind*: For the purpose of upper-air reports from aircraft, the wind velocity, observed or predicted, for a specified location, height and time.

*Zodiacal light*

White or yellowish light which spreads out, in the night sky, more or less along the zodiac from the horizon on the side on which the Sun is hidden. It is observed when the sky is sufficiently dark and the atmosphere sufficiently clear.

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**PART B**  
**BINARY CODES**

- a. FM system of numbering binary codes
- b. List of binary codes with their specifications and associated code tables

ATTACHMENT: Definition of FM 94 BUFR using Backus-Naur Form

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## a. FM SYSTEM OF NUMBERING BINARY CODES

Each binary code bears a number, preceded by the letters FM. This number is followed by a Roman numeral to identify the session of CBS which either approved the binary code as a new one or made the latest amendment to its previous version. A binary code approved or amended by correspondence after a session of CBS receives the number of that session.

Furthermore, an indicator term is used to designate the binary code colloquially and is therefore called a "code name".

NOTES on nomenclature:

- (a) Changes and augmentations to the structure of the GRIB data representation shall be identified as different "GRIB edition numbers". The current edition number is 2. However, GRIB edition 1 (FM92-XI Ext. GRIB) remains in use and is listed in this *Manual*.

Changes to the content of any of the tables, including the grid definitions, shall be identified as different "table versions". Previous tables did not exist; the version described in this edition is "Tables Version 1".

Further GRIB editions and table versions may be generated independently of one another in the future as requirements dictate;

- (b) Changes and augmentations to the structure of the BUFR data representation shall be identified as different "BUFR edition numbers". The current edition number is 3.

Changes to the content of the parameter Tables A, B, C and D shall be identified as different "table versions". The previous tables were Version 9; the changes described in this edition will become "Tables A, B, C and D, Version 10".

Further BUFR editions and table versions may be generated independently of one another in the future as requirements dictate.

Important note: The CBS recommendation number defining the last amendments is added at the bottom of the pages. Side bars indicate where the last amendments affect binary codes, regulations or tables.

The FM system of numbering the binary codes, together with the corresponding code names and their reference list of CBS approved decision, is the following:

### FM SYSTEM OF BINARY CODES

**FM 92-XI Ext. GRIB edition 1 (gridded binary)**

**Processed data in the form of grid-point values expressed in binary form**

Res. 4 (EC-XXXVIII), Res. 1 (EC-XL), Rec. 23 (CBS-89), approved by the President of WMO, Rec. 22 (CBS-91), approved by the President of WMO, Rec. 15 (CBS-93), approved by the President of WMO, Rec. 16 (CBS-94), approved by the President of WMO, Res. 4 (EC-XLVII), Rec. 14 (CBS-95), approved by the President of WMO, Rec. 15 (CBS-96), approved by the President of WMO and Res. 8 (EC-LI)

**FM 92-XII GRIB**

**General regularly-distributed information in binary form**

Res. 4 (EC-LIII) and Rec. 9 (CBS-01), approved by the President of WMO

**FM 94-XI Ext. BUFR**

**Binary universal form for the representation of meteorological data**

Res. 1 (EC-XL), Rec. 23 (CBS-89), approved by the President of WMO, Rec. 22 (CBS-91), approved by the President of WMO, Rec. 15 (CBS-93), approved by the President of WMO, Rec. 16 (CBS-94), approved by the President of WMO, Res. 4 (EC-XLVII), Rec. 14 (CBS-95), approved by the President of WMO, Rec. 15 (CBS-96), approved by the President of WMO, Res. 4 (EC-XLIX), Rec. 9 (CBS-97), approved by the President of WMO, Rec. 10 (CBS-98), approved by the President of WMO,

FM SYSTEM OF NUMBERING BINARY CODES

Res. 8 (EC-LI), Rec. 8 (CBS-99), Rec. 9 (CBS-00), approved by the President of WMO, Res. 4 (EC-LIII) and Rec. 9 (CBS-01), approved by the President of WMO

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## b. LIST OF BINARY CODES WITH THEIR SPECIFICATIONS AND ASSOCIATED CODE TABLES

**FM 92–XI Ext. GRIB edition 1  
(gridded binary)**

**Processed data in the form of grid-point values  
expressed in binary form**

**CODE FORM :**

SECTION 0	Indicator section
SECTION 1	Product definition section
SECTION 2	( <span style="border: 1px solid black; padding: 2px 10px; text-align: center;">Grid description section</span> )
SECTION 3	( <span style="border: 1px solid black; padding: 2px 10px; text-align: center;">Bit-map section</span> )
SECTION 4	Binary data section
SECTION 5	7777

**NOTES :**

- (1) GRIB is the name of the binary code for the exchange of processed data.
- (2) The GRIB coded analysis or forecast consists of a continuous bit-stream made of a sequence of octets (1 octet = 8 bits).
- (3) The octets of a GRIB message are grouped in sections:

<i>Section number</i>	<i>Name</i>	<i>Contents</i>
0	Indicator section	"GRIB", length of message, GRIB edition number
1	Product definition section	Length of section, identification of the coded analysis or forecast
2	Grid description section (optional)	Length of section, grid geometry, as necessary
3	Bit-map section (optional)	Length of section; the bit per grid point, placed in suitable sequence, indicates omission (bit 0) or inclusion (bit 1) of data at respective points
4	Binary data section	Length of section and data values
5	End section	7777

- (4) Although the Grid description section is indicated as optional, it is strongly urged that it be included in all GRIB messages.
- (5) It will be noted that the GRIB code is not suitable for visual data recognition without computer interpretation.

- (6) The representation of data by means of series of bits is independent of any particular machine representation.
- (7) Message and section lengths are expressed in octets. Section 0 has a fixed length of 8 octets; Section 5 has a fixed length of 4 octets. Sections 1, 2, 3 and 4 have a variable length which is included in the first three octets of each section.
- (8) In the GRIB message, the bit length of "International Alphabet No. 5" is regarded as 8-bit, adding one bit "0" to the 7-bit of IA5 as the most significant bit.

**REGULATIONS :**

**92.1 General**

- 92.1.1 The GRIB code shall be used for the exchange of processed data expressed in binary form.
- 92.1.2 The GRIB code shall always contain an even number of octets.
- 92.1.3 The beginning and the end of the code shall be identified by 4 octets coded according to the International Alphabet No. 5 to represent, respectively, the indicators GRIB and 7777 in Indicator section 0 and End section 5. All other octets included in the code shall represent data in binary form.
- 92.1.4 Each section included in the code shall always contain an even number of octets. This rule shall be applied by appending bits set to zero to the section where necessary.

**92.2 Section 0 — Indicator section**

- 92.2.1 Section 0 shall always be 8 octets long.
- 92.2.2 The first four octets shall always be character coded according to the International Alphabet No. 5 as GRIB.
- 92.2.3 The remainder of the section shall contain the length of the entire GRIB message (including the Indicator section) expressed in binary form over the left-most 3 octets (i.e. 24 bits), followed by the GRIB edition number, in binary, in the remaining octet.

**92.3 Section 1 — Product definition section**

- 92.3.1 The length of the section, in units of octets, shall be expressed in binary form over the group of the first three octets of the section, that is, over 24 bits.
- 92.3.2 Octet 8 of the section shall be used to indicate the inclusion or the omission of Sections 2 or 3 or of both of them.
- 92.3.3 Octets 29–40 are reserved for future use and need not be present. Octets 41 and following are set aside for use by the originating centre.

**92.4 Section 2 — Grid description section**

Regulation 92.3.1 shall apply.

**92.5 Section 3 — Bit-map section**

- 92.5.1 Regulation 92.3.1 shall apply.

92.5.2 Octets 5 and 6 shall be used to indicate that the bit-map is either predetermined and *not* explicitly included, or that the bit-map follows.

92.6 **Section 4 — Binary data section**

92.6.1 Regulation 92.3.1 shall apply.

92.6.2 Data shall be coded using the minimum number of bits necessary to provide for the accuracy required by international agreement. This required accuracy/precision shall be achieved by scaling the data by multiplication by an appropriate power of 10 (which may be 0) prior to forming the non-negative differences, and then using the binary scaling to select the precision of the transmitted value.

92.6.3 Data shall be coded in the form of non-negative scaled differences from a reference value.

NOTES :

- (1) The reference value is normally the minimum value of the data set which is represented.
- (2) The actual value Y (in the units of Code table 2) is linked to the coded value X, the reference value R, the binary scale factor E and the decimal scale factor D by means of the following formula:

$$Y \times 10^D = R + X \times 2^E$$

- (3) When second-order grid-point packing is indicated, the actual value Y (in the units of Code table 2) is linked to the coded values  $X_i$  and  $X_j$ , the reference value R, the binary scale factor E and the decimal scale factor D by means of the following formula:

$$Y \times 10^D = R + (X_i + X_j) \times 2^E$$

92.6.4 The reference value shall be represented over 4 octets as a single precision floating point number, consisting of a leading sign bit, a 7-bit characteristic and a 24-bit binary fraction.

NOTES :

- (1) The characteristic is convertible to a power of 16 by subtracting 64 from its 7-bit representation.
- (2) The reference value R is linked to the binary numbers s, A, B, representing the sign (1 bit) positive coded as "0", negative coded as "1", a biased exponent (exponent + 64) (7 bits), and the mantissa (24 bits), by means of the following formula:

$$R = (-1)^s \times 2^{(-24)} \times B \times 16^{(A-64)}$$

92.7 **Section 5 — End section**

The End section shall always be 4 octets long, character coded according to the International Alphabet No. 5 as 7777.

**SPECIFICATIONS OF OCTET CONTENTS**

Notes :

- (1) Octets are numbered 1, 2, 3, etc., starting at the beginning of each section.
- (2) In the following, bit positions within octets are referred to as bit 1 to bit 8, where bit 1 is the most significant and bit 8 is the least significant bit. Thus, an octet with only bit 8 set to 1 would have the integer value 1.

**Section 0 — Indicator section**

Octet No.	Contents
1-4	GRIB (coded according to the CCITT International Alphabet No. 5)
5-7	Total length of GRIB message (including Section 0)
8	GRIB edition number (currently 1)

**Section 1 — Product definition section**

Octet No.	Contents
1-3	Length of section
4	GRIB tables Version No. (currently 3 for international exchange) — Version numbers 128-254 are reserved for local use
5	Identification of originating/generating centre (see Code table 0 = Common Code table C-1 in Part C/c.)
6	Generating process identification number (allocated by originating centre)
7	Grid definition (Number of grid used — from catalogue defined by originating centre)
8	Flag (see Regulation 92.3.2 and Code table 1)
9	Indicator of parameter (see Code table 2)
10	Indicator of type of level (see Code table 3)
11-12	Height, pressure, etc. of levels (see Code table 3)
13	Year of century
14	Month
15	Day
16	Hour
17	Minute
18	Indicator of unit of time range (see Code table 4)
19	P1 — Period of time (number of time units) (0 for analyses or initialized analyses). Units of time given by octet 18
20	P2 — Period of time (number of time units); or Time interval between successive analyses, initialized analyses or forecasts, undergoing averaging or accumulation. Units of time given by octet 18
21	Time range indicator (see Code table 5)
22-23	Number included in average, when octet 21 (Code table 5) indicates an average or accumulation; otherwise set to zero
24	Number missing from averages or accumulations
25	Century of reference time of data
26	Sub-centre identification (see common Code table C-1 in Part C/c., Note (3))
27-28	Units decimal scale factor (D)
29-40	Reserved: need not be present
41-nn	Reserved for originating centre use

} Reference time of data — date and time of start of averaging or accumulation period

**Notes:**

- (1) Inclusion of the Section 2 — Grid description section (GDS) — is the preferred method of defining a grid.
- (2) Where octet 7 defines a catalogued grid, that grid should also be defined in Section 2, provided the flag in octet 8 indicates inclusion of Section 2.
- (3) Octet 7 must be set to 255 to indicate a non-catalogued grid, in which case the grid will be defined in Section 2.
- (4) A negative value of D shall be indicated by setting the high-order bit (bit 1) in the left-hand octet to 1 (on).
- (5) If a Grid description section is not included, then any u- or v-components of vector quantities in the message are to be resolved relative to the specified grid in the direction of increasing x and y (or i and j) coordinates respectively.  
If a Grid description section is included in the message, which is the preferred option, then octet 17 of the GDS and Code table 7 will contain component resolution information.
- (6) To specify year 2000, octet 13 of the section (year of the century) shall contain a value equal to 100 and octet 25 of the section (Century of reference time data) shall contain a value equal to 20. To specify year 2001, octet 13 of the section shall contain a value equal to 1 and octet 25 of the section shall contain a value equal to 21 (by International Convention, the date of 1 January 2000 is the first day of

the hundredth year of the twentieth century and the date of 1 January 2001 is the first day of the first year of the twenty-first century); it is to be noted also that year 2000 is a leap year and that 29 February 2000 exists.

## Section 2 — Grid description section

Octet No.	Contents
1-3	Length of section (octets)
4	NV — number of vertical coordinate parameters
5	PV — location (octet number) of the list of vertical coordinate parameters, if present; or PL — location (octet number) of the list of numbers of points in each row (if no vertical coordinate parameters are present), if present; or 255 (all bits set to 1) if neither are present
6	Data representation type (see Code table 6)
7-32	Grid definition (according to data representation type — octet 6 above)
33-42	Extensions of grid definition for rotation or stretching of the coordinate system or Lambert conformal projection or Mercator projection
33-44	Extensions of grid definition for space view perspective projection
33-52	Extensions of grid definition for stretched and rotated coordinate system
PV	List of vertical coordinate parameters (length = $NV \times 4$ octets); if present, then $PL = 4NV + PV$
PL	List of numbers of points in each row (length = $NROWS \times 2$ octets, where $NROWS$ is the total number of rows defined within the grid description)

### Notes:

- (1) Vertical coordinate parameters are used in association with hybrid vertical coordinate systems.
- (2) Hybrid systems, in the context, employ a means of representing vertical coordinates in terms of a mathematical combination of pressure and sigma coordinates. When used in conjunction with a surface pressure field and an appropriate mathematical expression, the vertical coordinate parameters may be used to interpret the hybrid vertical coordinate.
- (3) Each vertical coordinate parameter is represented in 4 octets, using the scheme for representing floating point numbers described in Regulation 92.6.4.

### *Grid definition — latitude/longitude grid (or equidistant cylindrical, or Plate Carrée)*

Octet No.	Contents
7-8	$N_i$ — number of points along a parallel
9-10	$N_j$ — number of points along a meridian
11-13	$La_1$ — latitude of first grid point
14-16	$Lo_1$ — longitude of first grid point
17	Resolution and component flags (see Code table 7)
18-20	$La_2$ — latitude of last grid point
21-23	$Lo_2$ — longitude of last grid point
24-25	$Di$ — i direction increment
26-27	$Dj$ — j direction increment
28	Scanning mode (flags — see Flag/Code table 8)
29-32	Set to zero (reserved)
33-35	Latitude of the southern pole in millidegrees (integer) Latitude of pole of stretching in millidegrees (integer)
36-38	Longitude of the southern pole in millidegrees (integer) Longitude of pole of stretching in millidegrees (integer)
39-42	Angle of rotation (represented in the same way as the reference value) Stretching factor (representation as for the reference value)

Octet No.	Contents
43–45	Latitude of pole of stretching in millidegrees (integer)
46–48	Longitude of pole of stretching in millidegrees (integer)
49–52	Stretching factor (representation as for the reference value)

## Notes :

- (1) Latitude, longitude and increments are in millidegrees.
- (2) Latitude values are limited to the range 0–90 000; bit 1 is set to 1 to indicate south latitude.
- (3) Longitude values are limited to the range 0–360 000; bit 1 is set to 1 to indicate west longitude.
- (4) The latitude and longitude of the last grid point and the first grid point should always be given for regular grids.
- (5) Where items are not given, the appropriate octet(s) should have all bits set to 1.
- (6) 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,  $\theta_p$  for example;
  - (b) The geographic longitude in degrees of the southern pole of the coordinate system,  $\lambda_p$  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  $\lambda_p$  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.
- (7) For rotated grids, the vertical coordinate parameters start at octet 43 instead of 33.
- (8) The stretching is defined by three parameters:
  - (a) The latitude in degrees (measured in the *model* coordinate system) of the “pole of stretching”;
  - (b) The longitude in degrees (measured in the *model* coordinate system) of the “pole of stretching”;
  - (c) The stretching factor C.

The stretching is defined by representing data uniformly in a coordinate system with longitude  $\lambda$  and latitude  $\theta^1$ , where:

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

and  $\lambda$  and  $\theta$  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.

- (9) For stretched grids, the vertical coordinate parameters start at octet 43 instead of 33.
- (10) For stretched and rotated latitude/longitude grids, the vertical coordinate parameters start at octet 53.
- (11) The first and last grid points may not necessarily correspond to the first and last data points, respectively, if the bit-map section is used.
- (12) For data on a quasi-regular grid, in which all the rows or columns do not necessarily have the same number of grid points, either  $N_i$  (octets 7–8) or  $N_j$  (octets 9–10) and the corresponding  $D_i$  (octets 24–25) or  $D_j$  (octets 26–27) shall be coded with all bits set to 1 (missing); the actual number of points along each parallel or meridian shall be coded.
- (13) A quasi-regular grid is only defined for appropriate grid scanning modes. Either rows or columns, but not both simultaneously, may have variable numbers of points. The first point in each row (column) shall be positioned at the meridian (parallel) indicated by octets 11–16. The grid points shall be evenly spaced in latitude (longitude).

**Grid definition — Gaussian latitude/longitude grid (including rotated, stretched or stretched and rotated)**

Octet No.	Contents
7–8	N <sub>i</sub> — number of points along a parallel
9–10	N <sub>j</sub> — number of points along a meridian
11–13	La <sub>1</sub> — latitude of first grid point
14–16	Lo <sub>1</sub> — longitude of first grid point
17	Resolution and component flags (see Code table 7)
18–20	La <sub>2</sub> — latitude of last grid point
21–23	Lo <sub>2</sub> — longitude of last grid point
24–25	D <sub>i</sub> — i direction increment
26–27	N — number of parallels between a pole and the equator
28	Scanning mode (flags — see Flag/Code table 8)
29–32	Set to zero (reserved)
33–35	Latitude of the southern pole in millidegrees (integer) Latitude of pole of stretching in millidegrees (integer)
36–38	Longitude of the southern pole in millidegrees (integer) Longitude of pole of stretching in millidegrees (integer)
39–42	Angle of rotation (represented in the same way as the reference value) Stretching factor (representation as for the reference value)
43–45	Latitude of pole of stretching in millidegrees (integer)
46–48	Longitude of pole of stretching in millidegrees (integer)
49–52	Stretching factor (representation as for the reference value)

**Notes :**

- (1) Latitude, longitude and increments are in millidegrees.
- (2) Latitude values are limited to the range 0–90 000; bit 1 is set to 1 to indicate south latitude.
- (3) Longitude values are limited to the range 0–360 000; bit 1 is set to 1 to indicate west longitude.
- (4) The number of parallels between a pole and the equator is used to establish the variable (Gaussian) spacing of the parallels; this value must always be given.
- (5) The latitude and longitude of the last grid point and the first grid point should always be given for regular grids.
- (6) Where items are not given, the appropriate octet(s) should have all bits set to 1.
- (7) See Notes (6) to (11) under Grid definition — latitude/longitude grid (or equidistant cylindrical, or Plate Carrée) — page I.2 – Bi — 8.
- (8) Quasi-regular Gaussian latitude/longitude grids are defined only for subsets of global grids containing full latitude rows (360°).
- (9) For data on a quasi-regular grid, in which all the rows do not necessarily have the same number of grid points, N<sub>i</sub> (octets 7–8) and the corresponding D<sub>i</sub> (octets 24–25) shall be coded with all bits set to 1 (missing); the actual number of points along each parallel shall be coded.
- (10) A quasi-regular Gaussian latitude/longitude grid is only defined for the grid scanning mode with consecutive points on parallels (bit 3 set to zero in Code table 8). The first point in each row shall be positioned at the meridian indicated by octets 14–16 and the last shall be positioned at the meridian indicated by octets 21–23. The grid points along each parallel shall be evenly spaced in longitude.

**Grid definition — spherical harmonic coefficients (including rotated, stretched or stretched and rotated)**

Octet No.	Contents
7-8	J — pentagonal resolution parameter
9-10	K — pentagonal resolution parameter
11-12	M — pentagonal resolution parameter
13	Representation type (see Code table 9)
14	Representation mode (see Code table 10)
15-32	Set to zero (reserved)
33-35	Latitude of the southern pole in millidegrees (integer) Latitude of pole of stretching in millidegrees (integer)
36-38	Longitude of the southern pole in millidegrees (integer) Longitude of pole of stretching in millidegrees (integer)
39-42	Angle of rotation (represented in the same way as the reference value) Stretching factor (representation as for the reference value)
43-45	Latitude of pole of stretching in millidegrees (integer)
46-48	Longitude of pole of stretching in millidegrees (integer)
49-52	Stretching factor (representation as for the reference value)

**Notes :**

- (1) The pentagonal representation of resolution is general. Some common truncations are special cases of the pentagonal one:
 

Triangular	$M = J = K$
Rhomboidal	$K = J + M$
Trapezoidal	$K = J, K > M$
- (2) The representation type (octet 13) indicates the method used to define the norm.
- (3) The representation mode (octet 14) indicates the order of the coefficients, whether global or hemispheric data are depicted, and the nature of the parameter stored (symmetric or antisymmetric).
- (4) See Notes (6) to (11) under Grid definition — latitude/longitude grid (or equidistant cylindrical, or Plate Carrée) — page I.2 - Bi — 8.

**Grid definition — polar stereographic**

Octet No.	Contents
7-8	N <sub>x</sub> — number of points along x-axis
9-10	N <sub>y</sub> — number of points along y-axis
11-13	La <sub>1</sub> — latitude of first grid point
14-16	Lo <sub>1</sub> — longitude of first grid point
17	Resolution and component flags (see Code table 7)
18-20	LoV — orientation of the grid; i.e. the longitude value of the meridian which is parallel to the y-axis (or columns of the grid) along which latitude increases as the Y-coordinate increases (the orientation longitude may or may not appear on a particular grid)
21-23	D <sub>x</sub> — X-direction grid length (see Note (2))
24-26	D <sub>y</sub> — Y-direction grid length (see Note (2))
27	Projection centre flag (see Note (5))
28	Scanning mode (flags — see Flag/Code table 8)
29-32	Set to zero (reserved)

**Notes :**

- (1) Latitude and longitude are in millidegrees (thousandths of a degree).
- (2) Grid lengths are in units of metres, at the 60-degree parallel nearest to the pole on the projection plane.
- (3) Latitude values are limited to the range 0–90 000; bit 1 is set to 1 to indicate south latitude.
- (4) Longitude values are limited to the range 0–360 000; bit 1 is set to 1 to indicate west longitude.
- (5) Octet 27 (projection centre flag):  
 bit 1 set to 0 if North Pole is on the projection plane  
 bit 1 set to 1 if South Pole is on the projection plane  
 (to be set up as flag table).
- (6) Where items are not given, the appropriate octet(s) should have all bits set to 1.
- (7) See Note (11) under Grid definition — latitude/longitude grid (or equidistant cylindrical, or Plate Carrée) — page I.2 – Bi — 8.
- (8) The resolution flag (bit 1 of Code table 7) is not applicable.

**Grid definition — Mercator**

Octet No.	Contents
7–8	Ni — number of points along a parallel
9–10	Nj — number of points along a meridian
11–13	La <sub>1</sub> — latitude of first grid point
14–16	Lo <sub>1</sub> — longitude of first grid point
17	Resolution and component flags (see Code table 7)
18–20	La <sub>2</sub> — latitude of last grid point
21–23	Lo <sub>2</sub> — longitude of last grid point
24–26	Latin — latitude(s) at which the Mercator projection cylinder intersects the Earth
27	Set to zero (reserved)
28	Scanning mode (flags — see Flag/Code table 8)
29–31	Di — longitudinal direction grid length (see Note (2))
32–34	Dj — latitudinal direction grid length (see Note (2))
35–42	Set to zero (reserved)

**Notes :**

- (1) Latitude and longitude are in millidegrees (thousandths of a degree).
- (2) Grid lengths are in units of metres, at the parallel specified by Latin.
- (3) Latitude values are limited to the range 0–90 000; bit 1 is set to 1 to indicate south latitude.
- (4) Longitude values are limited to the range 0–360 000; bit 1 is set to 1 to indicate west longitude.
- (5) The latitude and longitude of the last grid point from the first grid point should always be given.
- (6) Where items are not given, the appropriate octet(s) should have all bits set to 1, the “missing” indicator.
- (7) The first and last grid points may not necessarily correspond to the first and last data points, respectively, if the bit-map section is used.

**Grid definition — Lambert conformal, secant or tangent, conic or bi-polar (normal or oblique), or Albers equal-area, secant or tangent, conic or bi-polar (normal or oblique), projection**

Octet No.	Contents
7-8	Nx — number of points along x-axis
9-10	Ny — number of points along y-axis
11-13	La <sub>1</sub> — latitude of first grid point
14-16	Lo <sub>1</sub> — longitude of first grid point
17	Resolution and component flags (see Code table 7)
18-20	LoV — orientation of the grid; i.e. the east longitude value of the meridian which is parallel to the y-axis (or columns of the grid) along which latitude increases as the y-coordinate increases (the orientation longitude may or may not appear on a particular grid)
21-23	Dx — x-direction grid length (see Note (2))
24-26	Dy — y-direction grid length (see Note (2))
27	Projection centre flag (see Note (5))
28	Scanning mode (flags — see Flag/Code table 8)
29-31	Latin 1 — first latitude from the pole at which the secant cone cuts the sphere
32-34	Latin 2 — second latitude from the pole at which the secant cone cuts the sphere
35-37	Latitude of the southern pole in millidegrees (integer)
38-40	Longitude of the southern pole in millidegrees (integer)
41-42	Set to zero (reserved)

**Notes :**

- (1) Latitude and longitude are in millidegrees (thousandths of a degree).
- (2) Grid lengths are in units of metres, at the secant cone intersection parallel nearest to the pole on the projection plane.
- (3) Latitude values are limited to the range 0–90 000; bit 1 is set to 1 to indicate south latitude.
- (4) Longitude values are limited to the range 0–360 000; bit 1 is set to 1 to indicate west longitude.
- (5) Octet 27 (projection centre flag):
  - bit 1 set to 0 if North Pole is on the projection plane
  - bit 1 set to 1 if South Pole is on the projection plane
  - bit 2 set to 0 if only one projection centre is used
  - bit 2 set to 1 if projection is bi-polar and symmetric.
- (6) If Latin 1 = Latin 2, then the projection is on a tangent cone.
- (7) The resolution flag (bit 1 of Code table 7) is not applicable.

**Grid definition — Space view perspective or orthographic**

Octet No.	Contents
7-8	Nx — number of points along x-axis (columns)
9-10	Ny — number of points along y-axis (rows or lines)
11-13	Lap — latitude of sub-satellite point
14-16	Lop — longitude of sub-satellite point
17	Resolution and component flags (see Code table 7)
18-20	dx — apparent diameter of Earth in grid lengths, in x-direction

Octet No.	Contents
21–23	dy — apparent diameter of Earth in grid lengths, in y-direction
24–25	Xp — x-coordinate of sub-satellite point
26–27	Yp — y-coordinate of sub-satellite point
28	Scanning mode (flags — see Flag/Code table 8)
29–31	Orientation of the grid; i.e. the angle in millidegrees between the increasing y-axis and the meridian of the sub-satellite point in the direction of increasing latitude (see Note (3))
32–34	Nr — altitude of the camera from the Earth's centre, measured in units of the Earth's (equatorial) radius (see Note (4))
35–36	Xo — x-coordinate of origin of sector image
37–38	Yo — y-coordinate of origin of sector image
39–44	Set to zero (reserved)

#### Notes:

- (1) It is assumed that the satellite is at its nominal position, i.e. it is looking directly at its sub-satellite point.
- (2) Octets 32–34 shall be set to all ones (missing) to indicate the orthographic view (from infinite distance).
- (3) It is the angle between the increasing y-axis and the meridian 180°E if the sub-satellite point is the North Pole; or the meridian 0° if the sub-satellite point is the South Pole.
- (4) The apparent angular size of the Earth will be given by  $2 \times \text{Arcsin}(1/Nr)$ .
- (5) The horizontal and vertical angular resolutions of the sensor ( $R_x$  and  $R_y$ ), needed for navigation equations, can be calculated from the following:

$$R_x = 2 \times \text{Arcsin}(1/Nr) / dx$$

$$R_y = 2 \times \text{Arcsin}(1/Nr) / dy$$

### Section 3 — Bit-map section

Octet No.	Contents
1–3	Length of section
4	Number of unused bits at end of Section 3
5–6	Table reference: If the octets contain zero, a bit-map follows If the octets contain a number, it refers to a predetermined bit-map provided by the centre
7–	The bit-map — contiguous bits with a bit to data point correspondence, ordered as defined in the grid definition

### Section 4 — Binary data section

Octet No.	Contents
1–3	Length of section
4	Flag (see Code table 11) (first 4 bits). Number of unused bits at end of Section 4 (last 4 bits)
5–6	Scale factor (E)
7–10	Reference value (minimum of packed values)
11	Number of bits containing each packed value
12–	Variable, depending on the flag value in octet 4

Note: A negative value of E shall be indicated by setting the high-order bit (bit 1) in the left-hand octet to 1 (on).

*Grid-point data — simple packing*

Octet No.	Contents
12–	Binary data

*Spherical harmonic coefficients — simple packing*

Octet No.	Contents
12–15	Real part of (0.0) coefficient (stored in the same manner as the reference value (octets 7–10))
16–	Binary data

*Grid-point data — second-order packing*

Octet No.	Contents
12–13	N1 — octet number at which first-order packed data begin
14	Extended flags (see Code table 11)
15–16	N2 — octet number at which second-order packed data begin
17–18	P1 — number of first-order packed values
19–20	P2 — number of second-order packed values
21	Reserved
22–(xx–1)	Width(s) in bits of second-order packed values; each width is contained in 1 octet
xx–(N1–1)	Secondary bit-map, at least P2 bits long, padded to a whole number of octets with binary 0
N1–(N2–1)	P1 first-order packed values, padded to a whole number of octets with binary 0
N2– . . .	P2 second-order packed values

## Notes:

- (1) The binary data shall consist of P1 first-order packed values, of width given by the contents of octet 11, followed by P2 second-order packed values; there shall be one second-order packed value for each point of the defined grid, as modified by application of the bit-map in Section 3 — Bit-map section, if present.
- (2) The width of the second-order packed values shall be indicated by the values of W<sub>2j</sub>:
  - (a) If bit 8 of the extended flags (Code table 11) is 0, all second-order packed values will have the same width, indicated by a single value W<sub>21</sub>;
  - (b) If bit 8 of the extended flags (Code table 11) is 1, P1 values of the widths of second-order packed values (W<sub>2j</sub>, j = 1..P1) will be given.
- (3) The secondary bit-map, starting at octet xx, shall define with corresponding 1 bits the location where the use of the first-order packed values begins with reference to the defined grid (as modified by the bit-map, Section 3, if present); the first point of the grid, as modified by the bit-map in Section 3 if present, will always be present, and a corresponding 1 shall be set in the first bit of the secondary bit-map.
- (4) Where bit 7 of the extended flags (Code table 11) is 0, the secondary bit-map shall be omitted; and implied secondary bit-map shall be inferred such that a 1 bit is set for the first point of each row (or column) of the defined grid (row by row packing).
- (5) The original represented data at any point shall be obtained by scanning the points in the order defined by the grid description, as modified by the (optional) bit-map section; each first-order packed value shall remain defined until the point at which the use of a subsequent first-order packed value begins, as defined by the secondary bit-map; the unpacked value shall be obtained by applying the reference value, the binary and the decimal scales to the sum of the first- and second-order values for each point, by the following formula:

$$Y \times 10^D = R + (X_i + X_j) \times 2^E$$

where X<sub>i</sub> is the appropriate first-order packed value;  
X<sub>j</sub> is the appropriate second-order packed value.

- (6) If the number of bits  $W2_j$ , for the appropriate subset, is zero, no values for that subset are represented; i.e. the actual value for that subset is a constant given by  $R + (X_i \times 2^E)$ . This is a form of run-length encoding in which a string of identical values is represented by one value; the replication count for that value is, implicitly, in the secondary bit-map.

**Spherical harmonics — complex packing**

Octet No.	Contents
12-13	N
14-15	IP (where IP = int (1000 x P))
16	J <sup>1</sup>
17	K <sup>1</sup>
18	M <sup>1</sup>
19	Binary data
·	} Unpacked binary data represented in 004 octets in the same way as the reference value (pairs of coefficients)
·	
·	
·	
N	Packed binary data

**Notes :**

- (1) Removal of the real (0.0) coefficient considerably reduces the variability of the coefficients and results in better packing.
- (2) For some spherical harmonic representations, the (0.0) coefficient represents the mean value of the parameter represented.
- (3) For spherical harmonics — complex packing, J<sup>1</sup>, K<sup>1</sup>, M<sup>1</sup> are the pentagonal resolution parameters specifying the truncation of a subset of the data, which shall be represented unpacked (as is the reference value) and shall precede the packed data.

P defines a scaling factor by which is packed not the field itself, but the modulus of  $\nabla^{2P}$  of the field, where  $\nabla^2$  is the Laplacian operator. Thus the coefficients  $\phi_n^m$  will be multiplied by  $(n(n+1))^P$  before packing, and divided by this factor after unpacking.

N is a pointer to the start of the packed data (i.e. gives octet number)

$$(J^1, K^1, M^1 > 0 \text{ and } P \geq 0, + \text{ or } -)$$

The representation mode (Code figure = 2 in Code table 10) in Section 2 shall indicate this type of packing, but as Section 2 is optional, the flag field in Section 4 may also be used to indicate the more complex method.

**Section 5 — End section**

7777 End of message (coded according to the CCITT International Alphabet No. 5)

**CODE TABLES RELATIVE TO SECTION 1****Code table 0 — Identification of originating/generating centre***(See common Code table C-1 in Part C/c.)***Code table 1 — Flag indication relative to Sections 2 and 3**

Bit No.	Value	Meaning
1	0	Section 2 omitted
	1	Section 2 included
2	0	Section 3 omitted
	1	Section 3 included
3-8	0	

N o t e : Bits enumerated from left to right.

**Code table 2 — Indicator of parameter**

Code figure	Field parameter	Unit
000	Reserved	
001	Pressure	Pa
002	Pressure reduced to MSL	Pa
003	Pressure tendency	Pa s <sup>-1</sup>
004	Potential vorticity	K m <sup>2</sup> kg <sup>-1</sup> s <sup>-1</sup>
005	ICAO Standard Atmosphere reference height	m
006	Geopotential	m <sup>2</sup> s <sup>-2</sup>
007	Geopotential height	gpm
008	Geometrical height	m
009	Standard deviation of height	m
010	Total ozone	Dobson
011	Temperature	K
012	Virtual temperature	K
013	Potential temperature	K
014	Pseudo-adiabatic potential temperature	K
015	Maximum temperature	K
016	Minimum temperature	K
017	Dew-point temperature	K
018	Dew-point depression (or deficit)	K
019	Lapse rate	K m <sup>-1</sup>
020	Visibility	m
021	Radar spectra (1)	-
022	Radar spectra (2)	-
023	Radar spectra (3)	-
024	Parcel lifted index (to 500 hPa)	K
025	Temperature anomaly	K

*(Code table 2 — continued)*

Code figure	Field parameter	Unit
026	Pressure anomaly	Pa
027	Geopotential height anomaly	gpm
028	Wave spectra (1)	-
029	Wave spectra (2)	-
030	Wave spectra (3)	-
031	Wind direction	Degree true
032	Wind speed	m s <sup>-1</sup>
033	u-component of wind	m s <sup>-1</sup>
034	v-component of wind	m s <sup>-1</sup>
035	Stream function	m <sup>2</sup> s <sup>-1</sup>
036	Velocity potential	m <sup>2</sup> s <sup>-1</sup>
037	Montgomery stream function	m <sup>2</sup> s <sup>-2</sup>
038	Sigma coordinate vertical velocity	s <sup>-1</sup>
039	Vertical velocity	Pa s <sup>-1</sup>
040	Vertical velocity	m s <sup>-1</sup>
041	Absolute vorticity	s <sup>-1</sup>
042	Absolute divergence	s <sup>-1</sup>
043	Relative vorticity	s <sup>-1</sup>
044	Relative divergence	s <sup>-1</sup>
045	Vertical u-component shear	s <sup>-1</sup>
046	Vertical v-component shear	s <sup>-1</sup>
047	Direction of current	Degree true
048	Speed of current	m s <sup>-1</sup>
049	u-component of current	m s <sup>-1</sup>
050	v-component of current	m s <sup>-1</sup>
051	Specific humidity	kg kg <sup>-1</sup>
052	Relative humidity	%
053	Humidity mixing ratio	kg kg <sup>-1</sup>
054	Precipitable water	kg m <sup>-2</sup>
055	Vapour pressure	Pa
056	Saturation deficit	Pa
057	Evaporation	kg m <sup>-2</sup>
058	Cloud ice	kg m <sup>-2</sup>
059	Precipitation rate	kg m <sup>-2</sup> s <sup>-1</sup>
060	Thunderstorm probability	%
061	Total precipitation	kg m <sup>-2</sup>
062	Large scale precipitation	kg m <sup>-2</sup>
063	Convective precipitation	kg m <sup>-2</sup>
064	Snowfall rate water equivalent	kg m <sup>-2</sup> s <sup>-1</sup>
065	Water equivalent of accumulated snow depth	kg m <sup>-2</sup>
066	Snow depth	m
067	Mixed layer depth	m
068	Transient thermocline depth	m

*(continued)*

*(Code table 2 — continued)*

Code figure	Field parameter	Unit
069	Main thermocline depth	m
070	Main thermocline anomaly	m
071	Total cloud cover	%
072	Convective cloud cover	%
073	Low cloud cover	%
074	Medium cloud cover	%
075	High cloud cover	%
076	Cloud water	kg m <sup>-2</sup>
077	Best lifted index (to 500 hPa)	K
078	Convective snow	kg m <sup>-2</sup>
079	Large scale snow	kg m <sup>-2</sup>
080	Water temperature	K
081	Land cover (1 = land, 0 = sea)	Proportion
082	Deviation of sea level from mean	m
083	Surface roughness	m
084	Albedo	%
085	Soil temperature	K
086	Soil moisture content	kg m <sup>-2</sup>
087	Vegetation	%
088	Salinity	kg kg <sup>-1</sup>
089	Density	kg m <sup>-3</sup>
090	Water run-off	kg m <sup>-2</sup>
091	Ice cover (1 = ice, 0 = no ice)	Proportion
092	Ice thickness	m
093	Direction of ice drift	Degree true
094	Speed of ice drift	m s <sup>-1</sup>
095	u-component of ice drift	m s <sup>-1</sup>
096	v-component of ice drift	m s <sup>-1</sup>
097	Ice growth rate	m s <sup>-1</sup>
098	Ice divergence	s <sup>-1</sup>
099	Snow melt	kg m <sup>-2</sup>
100	Significant height of combined wind waves and swell	m
101	Direction of wind waves	Degree true
102	Significant height of wind waves	m
103	Mean period of wind waves	s
104	Direction of swell waves	Degree true
105	Significant height of swell waves	m
106	Mean period of swell waves	s
107	Primary wave direction	Degree true
108	Primary wave mean period	s
109	Secondary wave direction	Degree true
110	Secondary wave mean period	s
111	Net short-wave radiation flux (surface)	W m <sup>-2</sup>
112	Net long-wave radiation flux (surface)	W m <sup>-2</sup>

(Code table 2 — continued)

Code figure	Field parameter	Unit
113	Net short-wave radiation flux (top of atmosphere)	W m <sup>-2</sup>
114	Net long-wave radiation flux (top of atmosphere)	W m <sup>-2</sup>
115	Long-wave radiation flux	W m <sup>-2</sup>
116	Short-wave radiation flux	W m <sup>-2</sup>
117	Global radiation flux	W m <sup>-2</sup>
118	Brightness temperature	K
119	Radiance (with respect to wave number)	W m <sup>-1</sup> sr <sup>-1</sup>
120	Radiance (with respect to wave length)	W m <sup>-3</sup> sr <sup>-1</sup>
121	Latent heat flux	W m <sup>-2</sup>
122	Sensible heat flux	W m <sup>-2</sup>
123	Boundary layer dissipation	W m <sup>-2</sup>
124	Momentum flux, u-component	N m <sup>-2</sup>
125	Momentum flux, v-component	N m <sup>-2</sup>
126	Wind mixing energy	J
127	Image data	
128–254	Reserved for originating centre use	
255	Missing value	

## Notes :

- (1) SI units only are used for GRIB; the accuracy or precision with which the data are represented is a function of the range of the values, the decimal and/or binary scaling, and the number of bits used; GRIB enables suitable scaling factors to be selected to obviate the need to define parameters in non-SI units.
- (2) The code figures 0 to 127 are used to represent parameters which are exchanged between a number of centres; since the products generated by centres can be extremely diverse, code figures 128 to 254 are reserved for definition by the originating centre and may differ from centre to centre.
- (3) **By convention, downward fluxes of radiation or other quantities shall be assigned negative values; upward fluxes of radiation or other quantities shall be assigned positive values.**
- (4) The u- and v-components of vector quantities are defined in Code table 7.
- (5) Provision is made for three types of spectra:
  - (1) direction and frequency;
  - (2) direction and radial number;
  - (3) radial number and radial number.
- (6) The "parcel lifted index" (as defined in the *International Meteorological Vocabulary* (WMO–No. 182) under the listing "lifted index") is defined as the temperature difference between the ambient 500 hPa temperature (T500) and that of a parcel of air lifted from the surface (Tparcel) following the dry and moist adiabatic process. Negative values of (T500 – Tparcel) suggest instability. The "best lifted index" is defined as the most unstable of a collection of parcel lifted indices, with parcel initial conditions defined for a collection of 30 hPa thick layers stacked one upon the other with the lowest resting on the ground. Commonly four to six such layers are used in the calculation.

**Code table 3 — Fixed levels or layers for which the data are included**

Note: For reserved values, or if not defined, octets 11 and 12 shall contain zero.

Code figure	Meaning	Octet 11	Octet 12
00	Reserved		
01	Ground or water surface		
02	Cloud base level		
03	Level of cloud tops		
04	Level of 0°C isotherm		
05	Level of adiabatic condensation lifted from the surface		
06	Maximum wind level		
07	Tropopause		
08	Nominal top of atmosphere		
09	Sea bottom		
10–19	Reserved		
20	Isothermal level	Temperature in 1/100 K	
21–99	Reserved		
100	Isobaric surface	Pressure in hPa (2 octets)	
101	Layer between two isobaric surfaces	Pressure of top in kPa	Pressure of bottom in kPa
102	Mean sea level		
103	Specified altitude above mean sea level	Altitude in metres (2 octets)	
104	Layer between two specified altitudes above mean sea level	Altitude of top in hm	Altitude of bottom in hm
105	Specified height level above ground	Height in metres (2 octets)	
106	Layer between two specified height levels above ground	Height of top in hm	Height of bottom in hm
107	Sigma level	Sigma value in 1/10 000 (2 octets)	
108	Layer between two sigma levels	Sigma value of top in 1/100	Sigma value of bottom in 1/100
109	Hybrid level	Level number (2 octets)	
110	Layer between two hybrid levels	Level number of top	Level number of bottom
111	Depth below land surface	Depth in centimetres (2 octets)	
112	Layer between two depths below land surface	Depth of upper surface in cm	Depth of lower surface in cm
113	Isentropic (theta) level	Potential temperature in K (2 octets)	
114	Layer between two isentropic levels	475 K minus theta of top in K	475 K minus theta of bottom in K
115	Level at specified pressure difference from ground to level	Pressure difference in hPa (2 octets)	
116	Layer between two levels at specified pressure differences from ground to level	Pressure difference from ground to top level in hPa	Pressure difference from ground to bottom level in hPa
117	Potential vorticity surface	$10^{-9} \text{ K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$	
118	Reserved		

*(Code table 3 — continued)*

Code figure	Meaning	Octet 11	Octet 12
119	ETA* level	ETA value in 1/10000 (2 octets)	
120	Layer between two ETA* levels	ETA value at top of layer in 1/100	ETA value at bottom of layer in 1/100
121	Layer between two isobaric surfaces (high precision)	1100 hPa minus pres- sure of top in hPa	1100 hPa minus pres- sure of bottom in hPa
122–124	Reserved		
125	Specified height level above ground (high precision)	Height in centimetres (2 octets)	
126–127	Reserved		
128	Layer between two sigma levels (high precision)	1.1 minus sigma of top, in 1/1000 of sigma	1.1 minus sigma of bottom, in 1/1000 of sigma
129–140	Reserved		
141	Layer between two isobaric surfaces (mixed precision)	Pressure of top in kPa	1100 hPa minus pressure of bottom in hPa
142–159	Reserved		
160	Depth below sea level	Depth in metres (2 octets)	
161–199	Reserved		
200	Entire atmosphere (considered as a single layer)		
201	Entire ocean (considered as a single layer)		
202–254	Reserved		

\* 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.

#### Code table 4 — *Unit of time*

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
13–253	Reserved
254	Second

**Code table 5 — Time range indicator**

Code figure	Meaning
0	Forecast product valid for reference time + P1 ( $P1 > 0$ ), or Uninitialized analysis product for reference time ( $P1 = 0$ ), or Image product for reference time ( $P1 = 0$ )
1	Initialized analysis product for reference time ( $P1 = 0$ )
2	Product with a valid time ranging between reference time + P1 and reference time + P2
3	Average (reference time + P1 to reference time + P2)
4	Accumulation (reference time + P1 to reference time + P2) product considered valid at reference time + P2
5	Difference (reference time + P2 minus reference time + P1) product considered valid at reference time + P2
6–9	Reserved
10	P1 occupies octets 19 and 20; product valid at reference time + P1
11–112	Reserved
113	Average of N forecasts (or initialized analyses); each product has forecast period of P1 ( $P1 = 0$ for initialized analyses); products have reference times at intervals of P2, beginning at the given reference time
114	Accumulation of N forecasts (or initialized analyses); each product has forecast period of P1 ( $P1 = 0$ for initialized analyses); products have reference times at intervals of P2, beginning at the given reference time
115	Average of N forecasts, all with the same reference time; the first has a forecast period of P1, the remaining forecasts follow at intervals of P2
116	Accumulation of N forecasts, all with the same reference time; the first has a forecast period of P1, the remaining forecasts follow at intervals of P2
117	Average of N forecasts; the first has a forecast period of P1, the subsequent ones have forecast periods reduced from the previous one by an interval of P2; the reference time for the first is given in octets 13 to 17, the subsequent ones have reference times increased from the previous one by an interval of P2. Thus all the forecasts have the same valid time, given by the initial reference time + P1
118	Temporal variance, or covariance, of N initialized analyses; each product has forecast period of $P1 = 0$ ; products have reference times at intervals of P2, beginning at the given reference time
119	Standard deviation of N forecasts, all with the same reference time with respect to the time average of forecasts; the first forecast has a forecast period of P1, the remaining forecasts follow at intervals of P2
120–122	Reserved
123	Average of N uninitialized analyses, starting at the reference time, at intervals of P2
124	Accumulation of N uninitialized analyses, starting at the reference time, at intervals of P2
125–254	Reserved

**Notes :**

- (1) For analysis products, or the first of a series of analysis products, the reference time (octets 13 to 17) indicates the valid time.
- (2) For forecast products, or the first of a series of forecast products, the reference time indicates the valid time of the analysis upon which the (first) forecast is based.
- (3) Initialized analysis products are allocated code figures distinct from those allocated to uninitialized analysis products.
- (4) Code figure 10 allows the period of a forecast to be extended over two octets; this is to assist with extended range forecasts.

(Code table 5 — continued)

- (5) Where products or a series of products are averaged or accumulated, the number involved is to be represented in octets 22 and 23 of Section 1, while any number missing is to be represented in octet 24.
- (6) Forecasts of the accumulation or difference of some quantity (e.g. quantitative precipitation forecasts), indicated by values of 4 or 5 in octet 21, have a product valid time given by the reference time + P2; the period of accumulation, or difference, can be calculated as P2 – P1.
- (7) A few examples may help to clarify the use of Code table 5:  
 For analysis products, P1 will be zero and the time range indicator will also be zero; for initialized products (sometimes called “zero hour forecasts”), P1 will be zero, but octet 21 will be set to 1.  
 For forecasts, typically, P1 will contain the number of hours of the forecast (the unit indicator given in octet 18 would be 1) and octet 21 would contain a zero.  
 Code value 115 would be used, typically, for multiple day mean forecasts, all derived from the same initial conditions.  
 Code value 117 would be used, typically, for Monte Carlo type calculations: many forecasts valid at the same time from different initial (reference) times.  
 Averages, accumulations and differences get a somewhat specialized treatment. If octet 21 (Code table 5) has a value between 2 and 5 (inclusive), then the reference time + P1 is the initial date/time and the reference time + P2 is the final date/time of the period over which averaging or accumulation takes place. If, however, octet 21 has a value of 113, 114, 115, 116, 117, 123 or 124, then P2 specifies the time interval between each of the fields (or the forecast initial times) that have been averaged or accumulated. These latter values of octet 21 require the qualities averaged to be equally separated in time; the former values, 3 and 4 in particular, allow for irregular or unspecified intervals of time between the fields that are averaged or accumulated.

## CODE TABLES RELATIVE TO SECTION 2

### Code table 6 — *Data representation type*

Code figure	Meaning
0	Latitude/longitude grid — equidistant cylindrical or Plate Carrée projection
1	Mercator projection
2	Gnomonic projection
3	Lambert conformal, secant or tangent, conic or bi-polar, projection
4	Gaussian latitude/longitude grid
5	Polar stereographic projection
6	Universal Transverse Mercator (UTM) projection
7	Simple polyconic projection
8	Albers equal-area, secant or tangent, conic or bi-polar, projection
9	Miller’s cylindrical projection
10	Rotated latitude/longitude grid
11–12	Reserved
13	Oblique Lambert conformal, secant or tangent, conic or bi-polar, projection
14	Rotated Gaussian latitude/longitude grid
15–19	Reserved
20	Stretched latitude/longitude grid
21–23	Reserved
24	Stretched Gaussian latitude/longitude grid
25–29	Reserved

(continued)

*(Code table 6 — continued)*

Code figure	Meaning
30	Stretched and rotated latitude/longitude grids
31–33	Reserved
34	Stretched and rotated Gaussian latitude/longitude grids
35–49	Reserved
50	Spherical harmonic coefficients
51–59	Reserved
60	Rotated spherical harmonic coefficients
61–69	Reserved
70	Stretched spherical harmonics
71–79	Reserved
80	Stretched and rotated spherical harmonic coefficients
81–89	Reserved
90	Space view, perspective or orthographic
91–191	Reserved
192–254	Reserved for local use

*Code tables relative to grid definition***Code table 7 — Resolution and component flags**

Bit No.	Value	Meaning
1	0	Direction increments not given
	1	Direction increments given
2	0	Earth assumed spherical with radius 6367.47 km
	1	Earth assumed oblate spheroidal with size as determined by IAU in 1965 (6378.160 km, 6356.775 km, $f = 1/297.0$ )
3–4		Reserved
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	0	Reserved — set to zero

**Flag/Code table 8 — Scanning mode**

Bit No.	Value	Meaning
1	0	Points scan in +i direction
	1	Points scan in -i direction
2	0	Points scan in -j direction
	1	Points scan in +j direction
3	0	Adjacent points in i direction are consecutive
	1	Adjacent points in j direction are consecutive

## 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.

**Code table 9 — Spectral data representation type**

Code figure	Meaning
1	The Associated Legendre Functions of the first kind are defined by:

$$P_n^m(\mu) = \sqrt{(2n+1) \frac{(n-m)!}{(n+m)!}} \frac{1}{2^n n!} (1-\mu^2)^{m/2} \frac{d^{n+m}}{d\mu^{n+m}} (\mu^2-1)^n, \quad m \geq 0,$$

$$P_n^{-m}(\mu) = P_n^m(\mu)$$

A field  $X(\lambda, \mu)$  is represented by:

$$X(\lambda, \mu) = \sum_{m=-M}^M \sum_{n=|m|}^{N(m)} X_n^m P_n^m(\mu) e^{im\lambda}$$

where  $\lambda$  is the longitude,  
 $\mu$  the sine of latitude,  
 and  $X_n^{-m}$  the complex conjugate of  $X_n^m$ .

**Code table 10 — Spectral data representation mode**

Code figure	Meaning
1	The complex numbers $X_n^m$ (see code figure 1, Code table 9 above) are stored for $m \geq 0$ as pairs of real numbers $\text{Re}(X_n^m)$ , $\text{Im}(X_n^m)$ ordered with $n$ increasing from $m$ to $N(m)$ , first for $m = 0$ and then for $m = 1, 2, \dots, M$ . The real part of the (0.0) coefficient is stored in octets 12–15 of the Binary data section. The imaginary part of the (0.0) coefficient and the remaining coefficients are packed, and are stored in octets 16 onwards of the Binary data section.
2	Indicates spherical harmonics — complex packing

**CODE TABLES RELATIVE TO SECTION 4**

**Code table 11 — Flag**

Bit No.	Value	Meaning
1	0	Grid-point data
	1	Spherical harmonic coefficients
2	0	Simple packing
	1	Complex or second-order packing
3	0	Floating point values (in the original data) are represented
	1	Integer values (in the original data) are represented
4	0	No additional flags at octet 14
	1	Octet 14 contains additional flag bits

(continued)

(Code table 11 — continued)

The following gives the meaning of the bits in octet 14 ONLY if bit 4 is set to 1. Otherwise octet 14 contains regular binary data.

Bit No.	Value	Meaning
5		Reserved — set to zero
6	0	Single datum at each grid point
	1	Matrix of values at each grid point
7	0	No secondary bit-maps
	1	Secondary bit-maps present
8	0	Second-order values constant width
	1	Second-order values different widths
9–12		Reserved for future use

Notes :

- (1) Bit 4 shall be set to 1 to indicate that bits 5 to 12 are contained in octet 14 of the Binary data section.
- (2) Bit 3 shall be set to 1 to indicate that the data represented are integer values; where integer values are represented, any reference values, if not zero, should be rounded to integer before being applied.
- (3) Where secondary bit-maps are present in the data (used in association with second-order packing and, optionally, with a matrix of values at each point), this shall be indicated by setting bit 7 to 1.
- (4) The indicated meaning of bit 6 shall be retained in anticipation of the future reintroduction of a system to define a matrix of values at each grid point.