## TEMPLATE DEFINITIONS

## TEMPLATE DEFINITIONS USED IN SECTION 3

**Grid Definition Template 3.0: Latitude/longitude (or equidistant cylindrical, or Plate Carrée)**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Ni - number of points along a parallel |
| 35-38 | Nj - number of points along a meridian |
| 39-42 | Basic angle of the initial production domain (see Note 1) |
| 43-46 | Subdivisions of basic angle used to define extreme longitudes and latitudes, and direction increments (see Note 1) |
| 47-50 | La1 - latitude of first grid point (see Note 1) |
| 51-54 | Lo1 - longitude of first grid point (see Note 1) |
| 55 | Resolution and component flags (see Flag Table 3.3) |
| 56-59 | La2 - latitude of last grid point (see Note 1) |
| 60-63 | Lo2 - longitude of last grid point (see Note 1) |
| 64-67 | Di - i direction increment (see Note 1) |
| 68-71 | Dj - j direction increment (see Note 1) |
| 72 | Scanning mode (flags - see Flag Table 3.4) |
| 73-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Notes 2 and 3) |

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, 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) For data on a quasi-regular grid, where all the rows or columns do not necessarily have the same number of grid points, either Ni (Octets 31-34) or Nj (Octets 35-38) and the corresponding Di (Octets 64-67) or Dj (Octets 68-71) shall be coded with all bits set to 1 (missing). The actual number of points along each parallel or meridian shall be coded in the octets immediately following the Grid Definition Template (Octets [xx+1] – nn), as described in the description of the Grid Definition Section.

(3) 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 or variable spacing. The first point in each row (column) shall be positioned at the meridian (parallel) indicated by Octets 47-54. The grid points shall be evenly spaced in latitude (longitude).

(4) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.1: Rotated Latitude/longitude (or equidistant cylindrical, or Plate Carrée)**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.0 (see Note 1) |
| 73-76 | Latitude of the southern pole of projection |
| 77-80 | Longitude of the southern pole of projection |
| 81-84 | Angle of rotation of projection |
| 85-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 3) |

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, 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) 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.

(3) See Note 3 under Grid Definition Template 3.0.

**Grid Definition Template 3.2: Stretched Latitude/longitude (or equidistant cylindrical, or Plate Carrée)**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.0 (see Note 1) |
| 73-76 | Latitude of the pole of stretching |
| 77-80 | Longitude of the pole of stretching |
| 81-84 | Stretching factor |
| 85-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 3) |

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, 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) 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"; 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 Y and latitude X1, where:

$$X1 = \sin^{-1} \frac{(1 - C^2) + (1 + C^2) \sin X}{(1 + C^2) + (1 - C^2) \sin X}$$

and Y and X 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 give enhanced resolution around the pole of stretching.

(3) See Note 3 under Grid Definition Template 3.0.

**Grid Definition Template 3.3: Stretched and Rotated Latitude/longitude (or equidistant cylindrical, or Plate Carrée)**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.0 (see Note 1) |
| 73-76 | Latitude of the southern pole of projection |
| 77-80 | Longitude of the southern pole of projection |
| 81-84 | Angle of rotation of projection |
| 85-88 | Latitude of the pole of stretching |
| 89-92 | Longitude of the pole of stretching |
| 93-96 | Stretching factor |

| | |
|---|---|
| 97-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 4) |

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, 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) See Note 2 under Grid Definition Template 3.1 - Rotated Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(3) See Note 2 under Grid Definition Template 3.2 - Stretched Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(4) See Note 3 under Grid Definition Template 3.0.

**Grid Definition Template 3.10: Mercator**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Ni - number of points along a parallel |
| 35-38 | Nj - number of points along a meridian |
| 39-42 | La1 - latitude of first grid point |
| 43-46 | Lo1 - longitude of first grid point |
| 47 | Resolution and component flags (see Flag Table 3.3) |
| 48-51 | LaD - Latitude(s) at which the Mercator projection intersects the Earth (Latitude(s) where Di and Dj are specified) |
| 52-55 | La2 - latitude of last grid point |
| 56-59 | Lo2 - longitude of last grid point |
| 60 | Scanning mode (flags - see Flag Table 3.4) |
| 61-64 | Orientation of the grid, angle between i direction on the map and the equator (see Note 1) |
| 65-68 | Di - longitudinal direction grid length (see Note 2) |
| 69-72 | Dj - latitudinal direction grid length (see Note 2) |
| 73-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Notes 2 and 3 of GDT 3.1) |

Notes:

(1) Limited to the range of 0 to 90 degrees; if the angle of orientation of the grid is neither 0 nor 90 degrees, Di and Dj must be equal to each other.

(2) Grid lengths are in units of $10^{-3}$ m, at the latitude specified by LaD.

(3) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.20: Polar stereographic projection**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Nx - number of points along X-axis |
| 35-38 | Ny - number of points along Y-axis |
| 39-42 | La1 - latitude of first grid point |

| | |
|---|---|
| 43-46 | Lo1 - longitude of first grid point |
| 47 | Resolution and component flag (see flag table 3.3 and Note 1) |
| 48-51 | LaD - Latitude where Dx and Dy are specified |
| 52-55 | LoV - orientation of the grid (see Note 2) |
| 56-59 | Dx - X-direction grid length (see Note 3) |
| 60-63 | Dy - Y-direction grid length (see Note 3) |
| 64 | Projection centre flag (See Flag Table 3.5) |
| 65 | Scanning mode (see flag table 3.4) |

Notes:

(1) The resolution flag (bit 3-4 of Flag table 3.3) is not applicable.

(2) LoV is 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).

(3) Grid length is in units of $10^{-3}$ m at the latitude specified by LaD.

(4) Bit 2 of the projection flag is not applicable to the polar stereographic projection.

(5) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.30: Lambert conformal**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Nx - number of points along the X-axis |
| 35-38 | Ny - number of points along the Y-axis |
| 39-42 | La1 - latitude of first grid point |
| 43-46 | Lo1 - longitude of first grid point |
| 47 | Resolution and component flags (see Flag table 3.3) |
| 48-51 | LaD - Latitude where Dx and Dy are specified |
| 52-55 | LoV - Longitude of meridian parallel to Y-axis along which latitude increases as the Y-coordinate increases |
| 56-59 | Dx - X-direction grid length (see Note 1) |
| 60-63 | Dy - Y-direction grid length (see Note 1) |
| 64 | Projection centre flag (see Flag table 3.5) |
| 65 | Scanning mode (see Flag table 3.4) |
| 66-69 | Latin 1 - first latitude from the pole at which the secant cone cuts the sphere |
| 70-73 | Latin 2 - second latitude from the pole at which the secant cone cuts the sphere |
| 74-77 | Latitude of the southern pole of projection |
| 78-81 | Longitude of the southern pole of projection |

Notes:

(1) Grid lengths are in units of $10^{-3}$ m, at the latitude specified by LaD.

(2) If Latin 1 = Latin 2, then the projection is on a tangent cone.

(3) The resolution flags (bits 3-4 of Flag table 3.3) are not applicable

(4) LoV is 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).

(5) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.31: Albers equal area**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |

| | |
|---|---|
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Nx - number of points along the X-axis |
| 35-38 | Ny - number of points along the Y-axis |
| 39-42 | La1 - latitude of first grid point |
| 43-46 | Lo1 - longitude of first grid point |
| 47 | Resolution and component flags (see Flag table 3.3) |
| 48-51 | LaD - Latitude where Dx and Dy are specified |
| 52-55 | LoV - Longitude of meridian parallel to Y-axis along which latitude increases as the Y-coordinate increases |
| 56-59 | Dx - X-direction grid length (see Note 1) |
| 60-63 | Dy - Y-direction grid length (see Note 1) |
| 64 | Projection centre flag (see Flag table 3.5) |
| 65 | Scanning mode (see Flag table 3.4) |
| 66-69 | Latin 1 - first latitude from the pole at which the secant cone cuts the sphere |
| 70-73 | Latin 2 - second latitude from the pole at which the secant cone cuts the sphere |
| 74-77 | Latitude of the southern pole of projection |
| 78-81 | Longitude of the southern pole of projection |

Notes:

(1) Grid lengths are in units of $10^{-3}$ m, at the latitude specified by LaD.

(2) If Latin 1 = Latin 2, then the projection is on a tangent cone.

(3) The resolution flags (bits 3-4 of Flag table 3.3) are not applicable

(4) LoV is 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).

(5) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.40: Gaussian latitude/longitude**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Ni - number of points along a parallel |
| 35-38 | Nj - number of points along a meridian |
| 39-42 | Basic angle of the initial production domain (see Note 1) |
| 43-46 | Subdivisions of basic angle used to define extreme longitudes and latitudes, and direction increments (see Note 1) |
| 47-50 | La1 - latitude of first grid point (see Note 1) |
| 51-54 | Lo1 - longitude of first grid point (see Note 1) |
| 55 | Resolution and component flags (see Flag Table 3.3) |
| 56-59 | La2 - latitude of last grid point (see Note 1) |
| 60-63 | Lo2 - longitude of last grid point (see Note 1) |
| 64-67 | Di - i direction increment (see Note 1) |
| 68-71 | N - number of parallels between a pole and the equator (see Note 2) |
| 72 | Scanning mode (flags - see Flag Table 3.4) |
| 73-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 4) |

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, 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) 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.

(3) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

(4) 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 47-54. The grid points shall be evenly spaced in latitude (longitude).

**Grid Definition Template 3.41: Rotated Gaussian latitude/longitude**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.40 (see Note 1) |
| 73-76 | Latitude of the southern pole of projection |
| 77-80 | Longitude of the southern pole of projection |
| 81-84 | Angle of rotation of projection |
| 85-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 4) |

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, 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) 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.

(3) See Note 2 under Grid Definition Template 3.1 - Rotated Latitude/longitude grid (or equidistant cylindrical, or Plate Carrée)

(4) See Note 4 under Grid Definition Template 3.40.

**Grid Definition Template 3.42: Stretched Gaussian latitude/longitude**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.40 (see Note 1) |
| 73-76 | Latitude of the pole of stretching |
| 77-80 | Longitude of the pole of stretching |
| 81-84 | Stretching factor |
| 85-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 4) |

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, 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) 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.

(3) See Note 2 under Grid Definition Template 3.2 -Stretched Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(4) See Note 4 under Grid Definition Template 3.40.

**Grid Definition Template 3.43: Stretched and rotated Gaussian latitude/longitude**

| Octet No. | Contents |
|---|---|
| 15-72 | Same as Grid Definition Template 3.40 (see Note 1) |

| | |
|---|---|
| 73-76 | Latitude of the southern pole of projection |
| 77-80 | Longitude of the southern pole of projection |
| 81-84 | Angle of rotation of projection |
| 85-88 | Latitude of the pole of stretching |
| 89-92 | Longitude of the pole of stretching |
| 93-96 | Stretching factor |
| 97-nn | List of number of points along each meridian or parallel (These octets are only present for quasi-regular grids as described in Note 5) |

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, 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) 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.

(3) See Note 2 under Grid Definition Template 3.1 -Rotated Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(4) See Note 2 under Grid Definition Template 3.2 -Stretched Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(5) See Note 4 under Grid Definition Template 3.40.

**Grid Definition Template 3.44: Latitude/Longitude with Data-sampling from a higher Resolution Latitude/Longitude Source Grid** -validation

| Octet No. | Contents |
|---|---|
| 15-72 | Same as grid definition template 3.0 (see Note) |
| 73-76 | Nis - number of points along a parallel in source grid |
| 77-80 | Njs - number of points along a meridian in source grid |
| 81-84 | Basic angle of the initial production domain for source grid (see Note) |
| 82-85 | Subdivisions of basic angle used to describe extreme latitudes and longitudes, direction increments and differencing of latitudes and longitudes for the source grid (see Note) |
| 86-89 | La1S Latitude of first grid point of source-grid (see Note) |
| 90-93 | Lo1S Longitude of first grid point of source-grid (see Note) |
| 94 | Resolution and component flags of source grid (see Table 3.3) |
| 95-98 | La2S Latitude of last grid point of source-grid (see Note) |
| 99-102 | Lo2S Longitude of last grid point of source-grid (see Note) |
| 103-106 | Dis - i direction increment of source grid (see Note) |
| 107-110 | Djs - j direction increment of source grid (see Note) |
| 111 | Type of sampling employed to select data from source grid (see Table 3.30) |
| 112-115 | For statistical sampling over a rectangular lat/long area, (latitude of top of rectangle - latitude of nominal point) (see Note). For statistical sampling over a rectangular surface area, distance in metres between top of rectangle and the nominal point |
| 116-119 | For statistical sampling over a rectangular lat/long area, (latitude of bottom of rectangle - latitude of nominal point) (see Note). For statistical sampling over a rectangular surface area, distance in metres between bottom of rectangle and the nominal point |
| 120-123 | For statistical sampling over a rectangular lat/long area, (longitude of right side of rectangle - longitude of nominal point) (see Note). For statistical sampling over a rectangular surface area, distance in metres between right side of rectangle and the nominal point |
| 124-127 | For statistical sampling over a rectangular lat/long area, (longitude of left side of rectangle - longitude of nominal point) (see Note). For statistical sampling over a rectangular surface area, distance in metres between left side of rectangle and the nominal point |

Note:

(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).

**Grid Definition Template 3.50: Spherical harmonic coefficients**

| Octet No. | Contents |
|---|---|
| 15-18 | J - pentagonal resolution parameter |
| 19-22 | K - pentagonal resolution parameter |
| 23-26 | M - pentagonal resolution parameter |
| 27 | Representation type indicating the method used to define the norm (see Code Table 3.6). |
| 28 | Representation mode indicating the order of the coefficients (see Code Table 3.7) |

Note: 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 |

**Grid Definition Template 3.51: Rotated spherical harmonic coefficients**

| Octet No. | Contents |
|---|---|
| 15-28 | Same as Grid Definition Template 3.50 |
| 29-32 | Latitude of the southern pole of projection |
| 33-36 | Longitude of the southern pole of projection |
| 37-40 | Angle of rotation of projection |

Notes:

(1) See Note 1 under Grid Definition Template 3.50 - Spherical harmonic coefficients

(2) See Note 2 under Grid Definition Template 3.1 - Rotated Latitude/longitude grid (or equidistant cylindrical, or Plate Carrée)

**Grid Definition Template 3.52: Stretched spherical harmonic coefficients**

| Octet No. | Contents |
|---|---|
| 15-28 | Same as Grid Definition Template 3.50 |
| 29-32 | Latitude of the pole of stretching |
| 33-36 | Longitude of the pole of stretching |
| 37-40 | Stretching factor |

Notes:

(1) See Note 1 under Grid Definition Template 3.50 - Spherical harmonic coefficients

(2) See Note 2 under Grid Definition Template 3.20 - Stretched Latitude/longitude grid (or equidistant cylindrical, or Plate Carrée)

**Grid Definition Template 3.53: Stretched and rotated spherical harmonic coefficients**

| Octet No. | Contents |
|---|---|
| 15-28 | Same as Grid Definition Template 3.50 |
| 29-32 | Latitude of the southern pole of projection |
| 33-36 | Longitude of the southern pole of projection |
| 37-40 | Angle of rotation of projection |
| 41-44 | Latitude of pole of stretching |
| 45-48 | Longitude of pole of stretching |
| 49-52 | Stretching factor |

Notes:

(1) See Note 1 under Grid Definition Template 3.50 - Spherical harmonic coefficients

(2) See Note 2 under Grid Definition Template 3.1 -Rotated Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

(3) See Note 2 under Grid Definition Template 3.2 -Stretched Latitude/longitude (or equidistant cylindrical, or Plate Carrée)

**Grid Definition Template 3.90: Space view perspective or orthographic**

| Octet No. | Contents |
|---|---|

| | |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Nx - number of points along X-axis (columns) |
| 35-38 | Ny - number of points along Y-axis (rows or lines) |
| 39-42 | Lap - latitude of sub-satellite point |
| 43-46 | Lop - longitude of sub-satellite point |
| 47 | Resolution and component flags (see Flag Table 3.3) |
| 48-51 | dx - apparent diameter of Earth in grid lengths, in X-direction |
| 52-55 | dy - apparent diameter of Earth in grid lengths, in Y-direction |
| 56-59 | Xp - X-coordinate of sub-satellite point (in units of 10-3 grid length expressed as an integer) |
| 60-63 | Yp - Y-coordinate of sub-satellite point (in units of 10-3 grid length expressed as an integer) |
| 64 | Scanning mode (flags - see Flag Table 3.4) |
| 65-68 | Orientation of the grid; i.e., the angle between the increasing Y-axis and the meridian of the sub-satellite point in the direction of increasing latitude (see Note 3) |
| 69-72 | Nr - altitude of the camera from the Earth's centre, measured in units of the Earth's (equatorial) radius multiplied by a scale factor of $10^6$ (see Notes 4 and 5) |
| 73-76 | Xo - X-coordinate of origin of sector image |
| 77-80 | Yo - Y-coordinate of origin of sector image |

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 69-72 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 0o if the sub-satellite point is the South Pole.

(4) The apparent angular size of the Earth will be given by 2 * Arcsin $(10^6)$/Nr).

(5) For orthographic view from infinite distance, the value of Nr should be encoded as missing (all bits set to 1).

(6) The horizontal and vertical angular resolutions of the sensor (Rx and Ry), needed for navigation equation, can be calculated from the following:

$$Rx = 2 * \text{Arcsin} \ (10^6)/Nr)/\ dx$$
$$Ry = 2 * \text{Arcsin} \ (10^6)/Nr)/\ dy$$

(7) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

(8) General reference information pertaining to the projections used for satellite data can be found in Section 4.4 of "LRIT/HRIT Global Specification", Doc. No. CGMS 03, Issue 2.6, Date 12 August 1999 (http://www.eumetsat.int/Home/Main/AboutEUMETSAT/InternationalRelations/CGMS/groups/cps/documents/document/pdf_cgms_03.pdf, page 20 onwards) -operational

**Grid Definition Template 3.100: Triangular grid based on an icosahedron** *(see Attachment I.2-GRIB-Att.)*

| Octet No. | Contents |
|---|---|
| 15 | n2 - exponent of 2 for the number of intervals on main triangle sides |
| 16 | n3 - exponent of 3 for the number of intervals on main triangle sides |
| 17-18 | ni - number of intervals on main triangle sides of the icosahedron |
| 19 | nd - Number of diamonds |
| 20-23 | Latitude of the pole point of the icosahedron on the sphere |
| 24-27 | Longitude of the pole point of the icosahedron on the sphere |
| 28-331 | Longitude of the centre line of the first diamond of the icosahedron on the sphere |
| 32 | Grid point position (see Code table 3.8) |
| 33 | Numbering order of diamonds (flag - see Flag table 3.9) |
| 34 | Scanning mode for one diamond (flags - see Flag table 3.10) |
| 35-38 | nt - total number of grid points |

Notes:

(1) For more details see *Attachment I.2-GRIB-Att* to the Manual of Codes, Vol. I, Part B- definition of a triangular grid based on an icosahedron

(2) The origin of the grid is an icosahedron with 20 triangles and 12 vertices. The triangles are combined to nd quadrangles, the so-called diamonds (e.g. if nd = 10, two of the icosahedron triangles form a diamond, and if nd = 5, 4 icosahedron triangles form a diamond). There are two resolution values called n2 and n3 describing the division of each triangle side. Each triangle side is divided into ni equal parts where ni = 3**n3 * 2**n2 with n3 either equal to 0 or to 1. In the example of *Attachment I.2-GRIB-Att*, the numbering order of the rectangles is anti-clockwise with a view from the pole point on both hemispheres. Diamonds 1 to 5 are northern hemisphere and diamonds 6 to 10 are Southern Hemisphere.

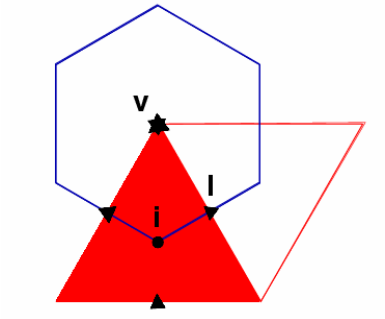
(3) The exponent of 3 for the number of divisions of triangle sides is used only with a value of either 0 or 1.

(4) The total number of grid points for one global field depends on the grid point position. If e.g. the grid points are located at the vertices of the triangles nt = (ni + 1) * (ni + 1) * nd since grid points at diamond edges are contained in both adjacent diamonds and for the same reason the pole points are contained in each of the five adjacent diamonds.

**Grid definition template 3.101 General Unstructured Grid** - validation

| Octet No. | Contents |
|---|---|
| 15 | Shape of the Earth (see Code Table 3.2) |
| 16 – 18 | Number of grid used (defined by originating centre) |
| 19 | Number of grid in reference (to allow annotating for Arakawa C-grid on arbitrary grid) (see Note 1) |

Note:
(1) The Number is associated with an attribute of the respective grid description which consists of the centre longitude/latitude and the longitude/latitude of the boundary polygon vertices.




Variables can be defined on different positions in the triangle.
This leads to different sets of geo locations, e.g.:
1. triangles (i) (pressure, temperature,..)
2. quads (l) (wind velocity ..)
3. hexagons respectively pentagons (v) (vorticity)

**Grid Definition Template 3.110: Equatorial azimuthal equidistant projection**

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Nx - number of points along X-axis |
| 35-38 | Ny - number of points along Y-axis |
| 39-42 | La1 - latitude of tangency point (centre of grid) |
| 43-46 | Lo1 - longitude of tangency point |
| 47 | Resolution and component flag (see flag table 3.3) |
| 48-51 | Dx - X-direction grid length in units of $10^{-3}$ m as measured at the point of the axis |
| 52-55 | Dy - Y-direction grid length in units of $10^{-3}$ m as measured at the point of the axis |
| 56 | Projection centre flag |
| 57 | Scanning mode (see flag table 3.4) |

Note: A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.120: Azimuth-range projection**

| Octet No. | Contents |
|---|---|
| 15-18 | Nb - number of data bins along radials (see Note 1) |
| 19-22 | Nr - number of radials |
| 23-26 | La1 - latitude of centre point |
| 27-30 | Lo1 - longitude of centre point |
| 31-34 | Dx - spacing of bins along radials |
| 35-38 | Dstart - offset from origin to inner bound |
| 39 | Scanning mode (flags - see Flag table 3.4) |
| 40 - (39+4Nr) | For each of Nr radials: |
| (40+4(X-1)) - (41+4(X-1)) | Azi - starting azimuth, degree x 10 (degrees as north) |
| (42+4(X-1)) - (43+4(X-1)) | Adelta - azimuthal width, degrees x 100, (+ clockwise, - counterclockwise) with X = 1 to Nr |

Note:

(1) A data bin is a data point representing the volume centred on it.

**Grid Definition Template 3.130: Irregular Latitude/longitude grid** -validation

| Octet Number(s) | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-(N*4*2) | Ordered list of latitude/longitude pairs for each grid point. The list of numbers are integer values of the valid latitudes in microdegrees (scaled by 106). Each integer value is represented in 4 octets and general regulations 92.1.7 and 92.1.8 apply. N is the number of data points defined in octets 7-10. |

**Grid Definition Template 3.1000: Cross-section grid, with points equally spaced on the horizontal**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-34 | Number of horizontal points |
| 35-38 | Basic angle of the initial production domain (see Note 1) |
| 39-42 | Subdivisions of basic angle used to define extreme longitudes and latitudes (see Note 1) |
| 43-46 | La1 - latitude of first grid point (see Note 1) |
| 47-50 | Lo1 - longitude of first grid point (see Note 1) |
| 51 | Scanning mode (flags – see Flag Table 3.4) |
| 52-55 | La2 - latitude of last grid point (see Note 1) |
| 56-59 | Lo2 - longitude of last grid point (see Note 1) |
| 60 | Type of horizontal line (see Code Table 3.20) |
| 61-62 | Number of vertical points |

| | |
|---|---|
| 63 | Physical meaning of vertical coordinate (see Code Table 3.15) |
| 64 | Vertical dimension coordinate values definition (see Code Table 3.21) |
| 65-66 | NC - Number of coefficients or values used to specify vertical coordinates |
| 67-(66+NC*4) | Coefficients to define vertical dimension coordinate values in functional form, or the explicit coordinate values (IEEE 32-bit floating-point values) |

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. For these last descriptors, 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) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.1100: Hovmöller diagram grid, with points equally spaced on the horizontal**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 15 | Shape of the earth (see Code Table 3.2) |
| 16 | Scale factor of radius of spherical earth |
| 17-20 | Scaled value of radius of spherical earth |
| 21 | Scale factor of major axis of oblate spheroid earth |
| 22-25 | Scaled value of major axis of oblate spheroid earth |
| 26 | Scale factor of minor axis of oblate spheroid earth |
| 27-30 | Scaled value of minor axis of oblate spheroid earth |
| 31-35 | Number of horizontal points |
| 35-38 | Basic angle of the initial production domain (see Note 1) |
| 39-42 | Subdivisions of basic angle used to define extreme longitudes and latitudes (see Note 1) |
| 43-46 | La1 - latitude of first grid point (see Note 1) |
| 47-50 | Lo1 - longitude of first grid point (see Note 1) |
| 51 | Scanning mode (flags – see Flag Table 3.4) |
| 52-55 | La2 - latitude of last grid point (see Note 1) |
| 56-59 | Lo2 - longitude of last grid point (see Note 1) |
| 60 | Type of horizontal line (see Code Table 3.20) |
| 61-64 | NT – Number of time steps |
| 65 | Unit of offset from reference time (see Code Table 4.4) |
| 66-69 | Offset from reference of first time (negative value when first bit set) |
| 70 | Type of time increment (see Code Table 4.11) |
| 71 | Unit of time increment (see Code Table 4.4) |
| 72-75 | Time increment (negative value when first bit set) |
| *76-82* | *Last date/time* |
| 76-77 | Year |
| 78 | Month |
| 79 | Day |
| 80 | Hour |
| 81 | Minute |
| 82 | Second |

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. For these last descriptors, 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) A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying appropriate scale factor to the value expressed in metres.

**Grid Definition Template 3.1200: Time section grid**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 15-18 | NT – Number of time steps |
| 19 | Unit of offset from reference time (see Code Table 4.4) |
| 20-23 | Offset from reference of first time (negative value when first bit set) |
| 24 | Type of time increment (see Code Table 4.11) |
| 25 | Unit of time increment (see Code Table 4.4) |
| 26-29 | Time increment (negative value when first bit set) |
| *30-36* | *Last date/time* |
| 30-31 | Year |
| 32 | Month |
| 33 | Day |
| 34 | Hour |
| 35 | Minute |
| 36 | Second |
| 37-38 | Number of vertical points |
| 39 | Physical meaning of vertical coordinate (see Code Table 3.15) |
| 40 | Vertical dimension coordinate values definition (see Code Table 3.21) |
| 41-42 | NC - Number of coefficients or values used to specify vertical coordinates |
| 43-(42+NC*4) | Coefficients to define vertical dimension coordinate values in functional form, or the explicit coordinate values (IEEE 32-bit floating-point values) |

**TEMPLATE DEFINITIONS USED IN SECTION 4**

**Product Definition Template 4.0: Analysis or forecast at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |

Note:

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

**Product Definition Template 4.1: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Type of ensemble forecast (see Code Table 4.6) |
| 36 | Perturbation number |
| 37 | Number of forecasts in ensemble |

Note:

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

**Product Definition Template 4.2:Derived forecast based on all ensemble members at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code Table 4.7) |
| 36 | Number of forecasts in ensemble |

Note:

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

**Product Definition Template 4.3:Derived forecasts based on a cluster of ensemble members over a rectangular area at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code Table 4.7) |
| 36 | Number of forecasts in the ensemble (N) |
| 37 | Cluster identifier |
| 38 | Number of cluster to which the high resolution control belongs |
| 39 | Number of cluster to which the low resolution control belongs |
| 40 | Total number of clusters |
| 41 | Clustering method (see Code Table 4.8) |
| 42-45 | Northern latitude of cluster domain |
| 46-49 | Southern latitude of cluster domain |
| 50-53 | Eastern longitude of cluster domain |
| 54-57 | Western longitude of cluster domain |
| 58 | $N_C$ - Number of forecasts in the cluster |
| 59 | Scale factor of standard deviation in the cluster |
| 60-63 | Scaled value of standard deviation in the cluster |
| 64 | Scale factor of distance of the cluster from ensemble mean |
| 65-68 | Scaled value of distance of the cluster from ensemble mean |
| 69-(68+$N_C$) | List of $N_C$ ensemble forecast numbers ($N_C$ is given in octet 58) |

Note:

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

**Product Definition Template 4.4: Derived forecasts based on a cluster of ensemble members over a circular area at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code Table 4.7) |
| 36 | Number of forecasts in the ensemble (N) |
| 37 | Cluster identifier |
| 38 | Number of cluster to which the high resolution control belongs |
| 39 | Number of cluster to which the low resolution control belongs |
| 40 | Total number of clusters |
| 41 | Clustering method (see Code Table 4.8) |
| 42-45 | Latitude of central point in cluster domain |
| 46-49 | Longitude of central point in cluster domain |
| 50-53 | Radius of cluster domain |
| 54 | $N_C$ - Number of forecasts in the cluster |
| 55 | Scale factor of standard deviation in the cluster |
| 56-59 | Scaled value of standard deviation in the cluster |
| 60 | Scale factor of distance of the cluster from ensemble mean |
| 61-64 | Scaled value of distance of the cluster from ensemble mean |
| 65-(64+$N_C$) | List of $N_C$ ensemble forecast numbers ($N_C$ is given in octet 54) |

Note:

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

**Product Definition Template 4.5: Probability forecasts at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |

| | |
|---|---|
| 35 | Forecast probability number |
| 36 | Total number of forecast probabilities |
| 37 | Probability type (see Code Table 4.9) |
| 38 | Scale factor of lower limit |
| 39-42 | Scaled value of lower limit |
| 43 | Scale factor of upper limit |
| 44-47 | Scaled value of upper limit |

Note:

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

**Product Definition Template 4.6: Percentile forecasts at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Percentile value (from 100% to 0%) |

Note:

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

**Product Definition Template 4.7: Analysis or forecast error at a horizontal level or in a horizontal layer at a point in time**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Analysis or forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |

Notes:

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

(2) This template should not be used. Product Definition Template 4.0 should be used instead.

**Product Definition Template 4.8: Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Analysis or Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35-36 | Year \| |
| 37 | Month \| |
| 38 | Day \|Time of end of overall time interval |
| 39 | Hour \| |
| 40 | Minute \| |
| 41 | Second |
| 42 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 43-46 | Total number of data values missing in statistical process. |
| | *47-58 Specification of the outermost (or only) time range over which statistical processing is done* |
| 47 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 48 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 49 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 50-53 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 54 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 55-58 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | *59-nn These octets are included only if n>1, where nn = 46 + 12 * n* |
| 59-70 | As octets 47 to 58, next innermost step of processing |
| 71-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 47 to 58, repeated as necessary. |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 48, 60, 72 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product Definition Template 4.9: Probability forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Forecast probability number |
| 36 | Total number of forecast probabilities |
| 37 | Probability type (see Code Table 4.9) |
| 38 | Scale factor of lower limit |
| 39-42 | Scaled value of lower limit |
| 43 | Scale factor of upper limit |
| 44-47 | Scaled value of upper limit |
| 48-49 | Year of end of overall time interval |
| 50 | Month of end of overall time interval |
| 51 | Day of end of overall time interval |
| 52 | Hour of end of overall time interval |
| 53 | Minute of end of overall time interval |
| 54 | Second of end of overall time interval |
| 55 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 56-59 | Total number of data values missing in statistical process. |
| | *60-71 Specification of the outermost (or only) time range over which statistical processing is done* |
| 60 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 61 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 62 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 63-66 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 67 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 68-71 | Time increment between successive fields, in units defined by the previous octet (see Note 3) |
| | *72-nn These octets are included only if n>1, where nn = 59 + 12*n* |
| 72-83 | As octets 60 to 71, next innermost step of processing |
| 84-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 60 to 71, repeated as necessary. |

Notes:

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

(2).The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3).An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 46, 58, 70 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product Definition Template 4.10: Percentile forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

*Preliminary Note:* *This template was not validated at the time of publication and should be used with caution. Please report any use to WMO Secretariat (World Weather Watch - Basic Systems Department) to assist for validation.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Forecast generating process identifier (defined by originating centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time for data cut-off |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by previous octet (see Note 2) |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Percentile value (from 100% to 0%) |
| 36-37 | Year of end of overall time interval |
| 38 | Month of end of overall time interval |
| 39 | Day of end of overall time interval |
| 40 | Hour of end of overall time interval |
| 41 | Minute of end of overall time interval |
| 42 | Second of end of overall time interval |
| 43 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 44-47 | Total number of data values missing in statistical process |
| | *48-59 Specification of the outermost (or only) time range over which statistical processing is done* |
| 48 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 49 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 50 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 51-54 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 55 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 56-59 | Time increment between successive fields, in units defined by the previous octet (see Note 3) |
| | *60-nn These octets are included only if n>1, where nn = 47 + 12 * n* |
| 60-71 | As octets 48-59, next innermost step of processing |
| 72-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 48 to 59, repeated as necessary. |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by rain gauge.

**Product definition template 4.11 - Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Forecast generating process identifier (defined by originating centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Type of ensemble forecast (see Code table 4.6) |
| 36 | Perturbation number |
| 37 | Number of forecasts in ensemble |
| 38-39 | Year of end of overall time interval |
| 40 | Month of end of overall time interval |
| 41 | Day of end of overall time interval |
| 42 | Hour of end of overall time interval |
| 43 | Minute of end of overall time interval |
| 44 | Second of end of overall time interval |
| 45 | n - number of time range specifications describing the time intervals used to calculate the statistically-processed field |
| 46-49 | Total number of data values missing in statistical process |
| | *50-61 Specification of the outermost (or only) time range over which statistical processing is done* |
| 50 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10) |
| 51 | Type of time increment between successive fields used in the statistical processing (see Code table 4.11) |
| 52 | Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4) |
| 53-56 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 57 | Indicator of unit of time for the increment between the successive fields used (see Code table 4.4) |
| 58-61 | Time increment between successive fields, in units defined by the previous octet (see Note 3) |
| | *62-nn These octets are included only if n>1, where nn = 49 + 12 x n* |
| 62-73 | As octets 50 to 61, next innermost step of processing |
| 74-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 50 to 61, repeated as necessary |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a raingauge. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 51, 63, 75 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product definition template 4.12 - Derived forecasts based on all ensemble members at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code table 4.7) |
| 36 | Number of forecasts in the ensemble (N) |
| 37-38 | Year of end of overall time interval |
| 39 | Month of end of overall time interval |
| 40 | Day of end of overall time interval |
| 41 | Hour of end of overall time interval |
| 42 | Minute of end of overall time interval |
| 43 | Second of end of overall time interval |
| 44 | n — number of time range specifications describing the time intervals used to calculate the statistically-processed field |
| 45-48 | Total number of data values missing in statistical process |
| | *49-60 Specification of the outermost (or only) time range over which statistical processing is done* |
| 49 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10) |
| 50 | Type of time increment between successive fields used in the statistical processing (see Code table 4.11) |
| 51 | Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4) |
| 52-55 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 56 | Indicator of unit of time for the increment between the successive fields used (see Code table 4.4) |
| 57-60 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | *61-nn These octets are included only if n>1, where nn = 48 + 12 x n* |
| 61-72 | As octets 49 to 60, next innermost step of processing |
| 73-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 49 to 60, repeated as necessary. |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a raingauge.

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 50, 62, 74 ...). For all but the innermost (last) time range, the next inner range is then processed using these references and forecast times as the initial reference and forecast time.

**Product definition template 4.13 - Derived forecasts based on a cluster of ensemble members over a rectangular area at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Forecast generating process identifier (defined by originating centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code table 4.7) |
| 36 | Number of forecasts in the ensemble (N) |
| 37 | Cluster identifier |
| 38 | Number of cluster to which the high resolution control belongs |
| 39 | Number of cluster to which the low resolution control belongs |
| 40 | Total number of clusters |
| 41 | Clustering method (see Code table 4.8) |
| 42-45 | Northern latitude of cluster domain |
| 46-49 | Southern latitude of cluster domain |
| 50-53 | Eastern longitude of cluster domain |
| 54-57 | Western longitude of cluster domain |
| 58 | $N_C$ - Number of forecasts in the cluster |
| 59 | Scale factor of standard deviation in the cluster |
| 60-63 | Scaled value of standard deviation in the cluster |
| 64 | Scale factor of distance of the cluster from ensemble mean |
| 65-68 | Scaled value of distance of the cluster from ensemble mean |
| 69-70 | Year of end of overall time interval |
| 71 | Month of end of overall time interval |
| 72 | Day of end of overall time interval |
| 73 | Hour of end of overall time interval |
| 74 | Minute of end of overall time interval |
| 75 | Second of end of overall time interval |
| 76 | n — number of time range specifications describing the time intervals used to calculate the statistically-processed field |
| 77-80 | Total number of data values missing in statistical process |
| | *81-92 Specification of the outermost (or only) time range over which statistical processing is done* |
| 81 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10) |
| 82 | Type of time increment between successive fields used in the statistical processing (see Code table 4.11) |
| 83 | Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4) |
| 84-87 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 88 | Indicator of unit of time for the increment between the successive fields used (see Code table 4.4) |
| 89-92 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | *93-nn These octets are included only if n>1, where nn = 80+ 12 x n* |
| 93-104 | As octets 81 to 92, next innermost step of processing |
| 105-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 81 to 92, repeated as necessary. |
| (nn+1)-(nn+ $N_C$) | List of $N_C$ ensemble forecast numbers ($N_C$ is given in octet 58) |

*Notes:*

(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a raingauge.
(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 82, 94, 106,....). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product definition template 4.14 - Derived forecasts based on a cluster of ensemble members over a circular area at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Forecast generating process identifier (defined by originating centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Derived forecast (see Code table 4.7) |
| 36 | Number of forecasts in the ensemble (N) |
| 37 | Cluster identifier |
| 38 | Number of cluster to which the high resolution control belongs |
| 39 | Number of cluster to which the low resolution control belongs |
| 40 | Total number of clusters |
| 41 | Clustering method (see Code table 4.8) |
| 42-45 | Latitude of central point in cluster domain |
| 46-49 | Longitude of central point in cluster domain |
| 50-53 | Radius of cluster domain |
| 54 | $N_C$ - Number of forecasts in the cluster |
| 55 | Scale factor of standard deviation in the cluster |
| 56-59 | Scaled value of standard deviation in the cluster |
| 60 | Scale factor of distance of the cluster from ensemble mean |
| 61-64 | Scaled value of distance of the cluster from ensemble mean |
| 65-66 | Year of end of overall time interval |
| 67 | Month of end of overall time interval |
| 68 | Day of end of overall time interval |
| 69 | Hour of end of overall time interval |
| 70 | Minute of end of overall time interval |
| 71 | Second of end of overall time interval |
| 72 | n — number of time range specifications describing the time intervals used to calculate the statistically-processed field |
| 73-76 | Total number of data values missing in statistical process |
| *77-88* | *Specification of the outermost (or only) time range over which statistical processing is done* |

| | |
|---|---|
| 77 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10) |
| 78 | Type of time increment between successive fields used in the statistical processing (see Code table 4.11) |
| 79 | Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4) |
| 80-83 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 84 | Indicator of unit of time for the increment between the successive fields used (see Code table 4.4) |
| 85-88 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | *89-nn These octets are included only if n>1, where nn = 76 + 12 x n* |
| 89-110 | As octets 77 to 88, next innermost step of processing |
| 111-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 77 to 88, repeated as necessary. |
| (nn+1)-(nn+$N_C$) | List of $N_C$ ensemble forecast numbers ($N_C$ is given in octet 54) |

*Notes:*

(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a raingauge.
(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 78, 90, 112...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product definition template 4.15: Average, accumulation, extreme values, or other statistically-processed values over a spatial area at a horizontal level or in a horizontal layer at a point in time** -preoperational

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | Statistical process used within the spatial area defined by octet 36 (see Code Table 4.10) |
| 36 | Type of spatial processing used to arrive at given data value from source data (see Code Table 4.15) |
| 37 | Number of data points used in spatial processing defined in octet 36 |

Note: Hours greater than 65534 will be coded as 65534.

**Product Definition Template 4.20: Radar product**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Number of radar sites used |
| 14 | Indicator of unit of time range |
| 15-18 | Site latitude (in $10^{-6}$ degree) |
| 19-22 | Site longitude (in $10^{-6}$ degree) |

| | |
|---|---|
| 23-24 | Site elevation (meters) |
| 25-28 | Site ID (alphanumeric) |
| 29-30 | Site ID (numeric) |
| 31 | Operating mode (see Code Table 4.12) |
| 32 | Reflectivity calibration constant (tenths of dB) |
| 33 | Quality control indicator (see Code Table 4.13) |
| 34 | Clutter filter indicator (see Code Table 4.14) |
| 35 | Constant antenna elevation angle (tenths of degree true) |
| 36-37 | Accumulation interval (minutes) |
| 38 | Reference reflectivity for echo top (dB) |
| 39-41 | Range bin spacing (meters) |
| 42-43 | Radial angular spacing (tenths of degree true) |

**Product Definition Template 4.30: Satellite Product**.

*Note: This template is deprecated. Template 4.31 should be used instead.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Observation generating process identifier (defined by originating Centres) |
| 14 | Number of contributing spectral bands (NB) |

*Repeat the following 10 octets for each contributing band (nb = 1,NB)*

| | |
|---|---|
| (15+10(nb-1)) - (16+10(nb-1)) | Satellite series of band nb (code table defined by originating/generating Centre) |
| (17+10(nb-1)) - (18+10(nb-1)) | Satellite numbers of band nb (code table defined by originating/generating Centre) |
| (19+10(nb-1)) | Instrument types of band nb (code table defined by originating/generating Centre) |
| (20+10(nb-1)) | Scale factor of central wave number of band nb |
| (21+10(nb-1)) - (24+10(nb-1)) | Scaled value of central wave number of band nb (units: $m^{-1}$) |

Note:

For "satellite series of band number", "satellite numbers of band number" and "instrument type of band number", it is recommended to encode the values as per BUFR code tables 0 02 020, 0 01 007 (common Code table C-5) and 0 02 019 (common Code table C-8), respectively.

**Product definition template 4.32: Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for synthetic satellite data** - validation

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating process identified |
| 15-16 | Hours of observational data cutoff after reference time (see Note) |
| 17 | Minutes of observational data cutoff after reference time (see Note) |
| 18 | Indicator of unit of time range (see Code table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Number of contributing spectral bands (NB) |

Repeat the following 11 octets for each contributing band (nb = 1, NB)

| | |
|---|---|
| (24+11(nb-1)) - (25+11(nb-1)) | Satellite series of band nb (code table defined by originating/generating centre) |
| (26+11(nb-1)) - (27+11(nb-1)) | Satellite number of band nb (code table defined by originating/generating centre) |
| (28+11(nb-1)) - (29+11(nb-1)) | Instrument types of band nb (code table defined by originating/generating centre) |
| (30 +11(nb-1)) | Scale factor of central wave number of band nb |
| (31+11(nb-1)) - (34+11(nb-1)) | Scaled value of central wave number of band nb (units: $m^{-1}$) |

Note:

(1) For "satellite series of band nb", "satellite numbers of band nb" and "instrument types of band nb", it is recommended to encode the values as per BUFR Code tables 0 02 020, 0 01 007 (Common Code Table C-5) and 0 02 019 (Common Code Table C-8), respectively.

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

**Product Definition Template 4.31: Satellite Product**.

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Observation generating process identifier (defined by originating Centres) |
| 14 | Number of contributing spectral bands (NB) |

*Repeat the following 11 octets for each contributing band (nb = 1,NB)*

| | |
|---|---|
| (15+11(nb-1)) - (16+11(nb-1)) | Satellite series of band nb (code table defined by originating/generating Centre) |
| (17+11(nb-1)) - (18+11(nb-1)) | Satellite number of band nb (code table defined by originating/generating Centre) |
| (19+11(nb-1)) – (20+11(nb-1)) | Instrument type of band nb (code table defined by originating/generating Centre) |
| (21+11(nb-1)) | Scale factor of central wave number of band nb |
| (22+11(nb-1)) - (25+11(nb-1)) | Scaled value of central wave number of band nb (units: $m^{-1}$) |

Note:

For "satellite series of band number", "satellite number of band number" and "instrument type of band number", it is recommended to encode the values as per BUFR code tables 0 02 020, 0 01 007 (common Code table C-5) and 0 02 019 (common Code table C-8), respectively.

**Product Definition Template 4.40 - Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Atmospheric chemical constituent type (see Code Table 4.230) |
| 14 | Type of generating process (see Code Table 4.3) |
| 15 | Background generating process identifier (defined by originating centre) |
| 16 | Analysis or forecast generating process identifier (defined by originating centre) |
| 17-18 | Hours of observational data cutoff after reference time (see Note 1) |
| 19 | Minutes of observational data cutoff after reference time |
| 20 | Indicator of unit of time range (see Code Table 4.4) |
| 21-24 | Forecast time in units defined by octet 20 |
| 25 | Type of first fixed surface (see Code Table 4.5) |
| 26 | Scale factor of first fixed surface |
| 27-30 | Scaled value of first fixed surface |
| 31 | Type of second fixed surface (see Code Table 4.5) |
| 32 | Scale factor of second fixed surface |
| 33-36 | Scaled value of second fixed surface |

Note:

Hours greater than 65534 will be coded as 65534.

**Product Definition Template 4.41- Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Atmospheric chemical constituent type (see Code Table 4.230) |
| 14 | Type of generating process (see Code Table 4.3) |
| 15 | Background generating process identifier (defined by originating centre) |
| 16 | Forecast generating process identifier (defined by originating centre) |
| 17-18 | Hours after reference time of data cutoff (see Note 1) |
| 19 | Minutes after reference time of data cutoff |
| 20 | Indicator of unit of time range (see Code Table 4.4) |
| 21-24 | Forecast time in units defined by octet 20 |

| | |
|---|---|
| 25 | Type of first fixed surface (see Code Table 4.5) |
| 26 | Scale factor of first fixed surface |
| 27-30 | Scaled value of first fixed surface |
| 31 | Type of second fixed surface (see Code Table 4.5) |
| 32 | Scale factor of second fixed surface |
| 33-36 | Scaled value of second fixed surface |
| 37 | Type of ensemble forecast (see Code Table 4.6) |
| 38 | Perturbation number |
| 39 | Number of forecasts in ensemble |

Note:

Hours greater than 65534 will be coded as 65534.

**Product Definition Template 4.42 - Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Atmospheric chemical constituent type (see Code Table 4.230) |
| 14 | Type of generating process (see Code Table 4.3) |
| 15 | Background generating process identifier (defined by originating centre) |
| 16 | Analysis or forecast generating process identifier (defined by originating centre) |
| 17-18 | Hours after reference time of data cutoff (see Note 1) |
| 19 | Minutes after reference time of data cutoff |
| 20 | Indicator of unit of time range (see Code Table 4.4) |
| 21-24 | Forecast time in units defined by octet 20 (see Note 2) |
| 25 | Type of first fixed surface (see Code Table 4.5) |
| 26 | Scale factor of first fixed surface |
| 27-30 | Scaled value of first fixed surface |
| 31 | Type of second fixed surface (see Code Table 4.5) |
| 32 | Scale factor of second fixed surface |
| 33-36 | Scaled value of second fixed surface |
| 37-38 | Year |
| 39 | Month |
| 40 | Day |
| 41 | Hour |
| 42 | Minute |
| 43 | Second |
| 44 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 45-48 | Total number of data values missing in statistical process |
| | *49-60 Specification of the outermost (or only) time range over which statistical processing is done* |
| 49 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 50 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 51 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 52-55 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 56 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 57-60 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | *61-nn These octets are included only if n>1, where nn = 48 + 12 * n* |
| 61-72 | As octets 49 to 60, next innermost step of processing |
| 73-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 49 to 60, repeated as necessary. |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the

temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 50, 62, 74 …). For all but the innermost (last) time range, the next inner range is then processed using these references and forecast times as the initial reference and forecast time.

**Product Definition Template 4.43 - Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Atmospheric chemical constituent type (see Code Table 4.230) |
| 14 | Type of generating process (see Code Table 4.3) |
| 15 | Background generating process identifier (defined by originating centre) |
| 16 | Forecast generating process identifier (defined by originating centre) |
| 17-18 | Hours after reference time of data cutoff (see Note 1) |
| 19 | Minutes after reference time of data cutoff |
| 20 | Indicator of unit of time range (see Code Table 4.4) |
| 21-24 | Forecast time in units defined by octet 20 (see Note 2) |
| 25 | Type of first fixed surface (see Code Table 4.5) |
| 26 | Scale factor of first fixed surface |
| 27-30 | Scaled value of first fixed surface |
| 31 | Type of second fixed surface (see Code Table 4.5) |
| 32 | Scale factor of second fixed surface |
| 33-36 | Scaled value of second fixed surface |
| 37 | Type of ensemble forecast (see Code Table 4.6) |
| 38 | Perturbation number |
| 39 | Number of forecasts in ensemble |
| 40-41 | Year of end of overall time interval |
| 42 | Month of end of overall time interval |
| 43 | Day of end of overall time interval |
| 44 | Hour of end of overall time interval |
| 45 | Minute of end of overall time interval |
| 46 | Second of end of overall time interval |
| 47 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 48-51 | Total number of data values missing in statistical process |
| | 52-63 Specification of the outermost (or only) time range over which statistical processing is done |
| 52 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 53 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 54 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 55-58 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 59 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 60-63 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | 64-nn These octets are included only if n>1, where nn = 51 + 12 * n |
| 64-75 | As octets 52 to 63, next innermost step of processing |
| 76-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 52 to 63, repeated as necessary. |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 53, 65, 77 …). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product Definition Template 4.44: Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for Aerosol** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12-13 | Aerosol type (see Code Table 4.233) |
| 14 | Type of interval for first and second size (see Code Table 4.91) |
| 15 | Scale factor of first size |
| 16-19 | Scaled value of first size in meters |
| 20 | Scale factor of second size |
| 21-24 | Scaled value of second size in meters |
| 25 | Type of generating process (see Code Table 4.3) |
| 26 | Background generating process identifier (defined by originating centre) |
| 27 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 28-29 | Hours of observational data cutoff after reference time (see Note 1) |
| 30 | Minutes of observational data cutoff after reference time |
| 31 | Indicator of unit of time range (see Code Table 4.4) |
| 32-33 | Forecast time in units defined by octet 18 |
| 34 | Type of first fixed surface (see Code Table 4.5) |
| 35 | Scale factor of first fixed surface |
| 36-39 | Scaled value of first fixed surface |
| 40 | Type of second fixed surface (see Code Table 4.5) |
| 41 | Scale factor of second fixed surface |
| 42-45 | Scaled value of second fixed surface |

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

**Product Definition Template 4.45: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for Aerosol** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Aerosol type (see Code Table 4.233) |
| 14 | Type of interval for first and second size (see Code Table 4.91) |
| 15 | Scale factor of first size |
| 16-19 | Scaled value of first size in meters |
| 20 | Scale factor of second size |
| 21-24 | Scaled value of second size in meters |
| 25 | Type of generating process (see Code Table 4.3) |
| 26 | Background generating process identifier (defined by originating Centre) |
| 27 | Forecast generating process identifier (defined by originating Centre) |
| 28-29 | Hours after reference time of data cutoff (see Note 1) |
| 30 | Minutes after reference time of data cutoff |
| 31 | Indicator of unit of time range (see Code Table 4.4) |
| 32-35 | Forecast time in units defined by octet 18 |
| 36 | Type of first fixed surface (see Code Table 4.5) |
| 37 | Scale factor of first fixed surface |
| 38-41 | Scaled value of first fixed surface |
| 42 | Type of second fixed surface (see Code Table 4.5) |
| 43 | Scale factor of second fixed surface |
| 44-47 | Scaled value of second fixed surface |
| 48 | Type of ensemble forecast (see Code Table 4.6) |
| 49 | Perturbation number |
| 50 | Number of forecasts in ensemble |

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

**Product Definition Template 4.46: Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for Aerosol** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12-13 | Aerosol type (see Code Table 4.233) |
| 14 | Type of interval for first and second size (see Code Table 4.91) |
| 15 | Scale factor of first size |
| 16-19 | Scaled value of first size in meters |
| 20 | Scale factor of second size |
| 21-24 | Scaled value of second size in meters |
| 25 | Type of generating process (see Code Table 4.3) |
| 26 | Background generating process identifier (defined by originating Centre) |
| 27 | Analysis or Forecast generating process identifier (defined by originating Centre) |
| 28-29 | Hours after reference time of data cut-off (see Note 1) |
| 30 | Minutes after reference time of data cut-off |
| 31 | Indicator of unit of time range (see Code Table 4.4) |
| 32-35 | Forecast time in units defined by octet 18 (see Note 2) |
| 36 | Type of first fixed surface (see Code Table 4.5) |
| 37 | Scale factor of first fixed surface |
| 38-41 | Scaled value of first fixed surface |
| 42 | Type of second fixed surface (see Code Table 4.5) |
| 43 | Scale factor of second fixed surface |
| 44-47 | Scaled value of second fixed surface |
| 48-49 | Year \| |
| 50 | Month \| |
| 51 | Day \|Time of end of overall time interval |
| 52 | Hour \| |
| 53 | Minute \| |
| 54 | Second \| |
| 55 | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| 56-59 | Total number of data values missing in statistical process. |
| | 60-71 Specification of the outermost (or only) time range over which statistical processing is done |
| 60 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 61 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 62 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 63-66 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 67 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 68-71 | Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4) |
| | 72-nn These octets are included only if n>1, where nn = 59 + 12 * n |
| 72-83 | As octets 60 to 71, next innermost step of processing |
| 72-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 60 to 71, repeated as necessary. |

Notes:
(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.
(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 61, 72 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

**Product definition template 4.47: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for Aerosol**

- validation

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code table 4.1) |
| 11 | Parameter number (see Code table 4.2) |
| 12 | Type of generating process (see Code table 4.3) |
| 12-13 | Aerosol type (see Code Table 4.233) |
| 14 | Type of interval for first and second size (see Code Table 4.91) |
| 15 | Scale factor of first size |
| 16-19 | Scaled value of first size in meters |
| 20 | Scale factor of second size |
| 21-24 | Scaled value of second size in meters |
| 25 | Background generating process identifier (defined by originating centre) |
| 26 | Forecast generating process identifier (defined by originating centre) |
| 27-28 | Hours after reference time of data cut-off (see Note 1) |
| 29 | Minutes after reference time of data cut-off |
| 30 | Indicator of unit of time range (see Code table 4.4) |
| 31-34 | Forecast time in units defined by octet 18 (see Note 2) |
| 35 | Type of first fixed surface (see Code table 4.5) |
| 36 | Scale factor of first fixed surface |
| 37-40 | Scaled value of first fixed surface |
| 41 | Type of second fixed surface (see Code table 4.5) |
| 42 | Scale factor of second fixed surface |
| 43-46 | Scaled value of second fixed surface |
| 47 | Type of ensemble forecast (see Code table 4.6) |
| 48 | Perturbation number |
| 49 | Number of forecasts in ensemble |
| 50-51 | Year of end of overall time interval |
| 52 | Month of end of overall time interval |
| 53 | Day of end of overall time interval |
| 54 | Hour of end of overall time interval |
| 55 | Minute of end of overall time interval |
| 56 | Second of end of overall time interval |
| 57 | n — number of time range specifications describing the time intervals used to calculate the statistically-processed field |
| 58-61 | Total number of data values missing in statistical process |
| | 62-73 Specification of the outermost (or only) time range over which statistical processing is done |
| 62 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10) |
| 63 | Type of time increment between successive fields used in the statistical processing (see Code table 4.11) |
| 64 | Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4) |
| 65-68 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 69 | Indicator of unit of time for the increment between the successive fields used (see Code table 4.4) |
| 70-73 | Time increment between successive fields, in units defined by the previous octet (see Note 3) |
| | 74-nn These octets are included only if n>1, where nn = 61 + 12 * n |
| 74-85 | As octets 62 to 73, next innermost step of processing |
| 74-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets 62 to 73, repeated as necessary |

Notes:

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

(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a raingauge. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 63, 75 ...). For all but the innermost (last) time range, the next inner range is then processed using these references and forecast times as the initial reference and forecast time.

**Product Definition Template 4.50: Analysis or forecast of a multi component parameter or matrix element at a point in time** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | First dimension physical significance (Code Table 5.3) (see Note 2) |
| 36 | Second dimension physical significance (Code Table 5.3) (see Note 2) |
| 37-40 | First dimension coordinate value (IEEE 32-bit floating-point value) |
| 41-44 | Second dimension coordinate value (IEEE 32-bit floating-point value) |
| 45-48 | First dimension (rows) of the complete matrix (see Note 3) |
| 49-52 | Second dimension (columns) of the complete matrix (see Note 3) |

Notes:
(1) Hours greater than 65534 will be coded as 65534.
(2) In case of ocean wave spectra e.g., according to Code Table 5.3, the physical significance values are 1 (Direction Degrees true) and 2 (Frequency ($s^{-1}$).
(3) The dimensions define the number of GRIBs needed for reconstruction of a complete matrix (e.g. wave spectrum) at one or more grid points. In case of vectors (1-dim-matrices), the second dimension must be set to 1 and the second dimension physical significance must be set to 255 (missing).
In case of multi component parameter (e.g. no matrix or vector element), first and second dimension are set to 1.

**Product Definition Template 4.51: Categorical forecasts at a horizontal level or in a horizontal layer at a point in time** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cutoff (see Note 1) |
| 17 | Minutes after reference time of data cutoff |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | NC - Number of categories |

Repeat the following 12 octets for each category ( i = 1,NC )

| | |
|---|---|
| (36+12(i-1)) | Code figure |
| (37+12(i-1)) | Type of interval for first and second limit (see Code Table 4.91) |
| (38+12(i-1)) | Scale factor of first limit |

| | |
|---|---|
| (39+12(i-1))- (42+12(i-1)) | Scaled value of first limit |
| (43+12(i-1)) | Scale factor of second limit |
| (44+12(i-1))- (47+12(i-1)) | Scaled value of second limit |

Note: Hours greater than 65534 will be coded as 65534.

**Product Definition Template 4.91: Categorical forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval** - validation

| Octet Number(s) | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1) |
| 11 | Parameter number (see Code Table 4.2) |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating Centre) |
| 14 | Forecast generating process identifier (defined by originating Centre) |
| 15-16 | Hours after reference time of data cut-off (see Note 1) |
| 17 | Minutes after reference time of data cut-off |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35 | NC - Number of categories |

| | |
|---|---|
| Repeat the following 12 octets for each category ( i = 1,NC ) | |
| (36+12(i-1)) | Code figure |
| (37+12(i-1)) | Type of interval for first and second limit (see Code Table 4.91) |
| (38+12(i-1)) | Scale factor of first limit |
| (39+12(i-1))- (42+12(i-1)) | Scaled value of first limit |
| (43+12(i-1)) | Scale factor of second limit |
| (44+12(i-1))- (47+12(i-1)) | Scaled value of second limit |
| | |
| (48+12(NC -1))- (49+12(NC -1)) | Year of end of overall time interval |
| (50+12(NC -1)) | Month of end of overall time interval |
| (51+12(NC -1)) | Day of end of overall time interval |
| (52+12(NC -1)) | Hour of end of overall time interval |
| (53+12(NC -1)) | Minute of end of overall time interval |
| (54+12(NC -1)) | Second of end of overall time interval |
| (55+12(NC -1)) | n - Number of time range specifications describing the time intervals used to calculate the statistically processed field |
| (56+12(NC -1))- (59+12(NC -1)) | Total number of data values missing in statistical process. |
| 60-71 | Specification of the outermost (or only) time range over which statistical processing is done |
| (60+12(NC -1)) | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| (61+12(NC -1)) | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| (62+12(NC -1)) | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| (63+12(NC -1))- (66+12(NC -1)) | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| (67+12(NC -1)) | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| (68+12(NC -1))- (71+12(NC -1)) | Time increment between successive fields, in units defined by the previous octet (see Note 3) |
| 72-nn | These octets are included only if n>1, where nn = 72 + 12*(n-1) + 12*(NC-1) |
| (72+12(NC -1))- (83+12(NC -1)) | As octets (60+12(NC -1)) to (71+12(NC -1)), next innermost step of processing |
| (84+12(NC -1))-nn | Additional time range specifications, included in accordance with the value of n. Contents as octets (60+12(NC -1)) to (71+12(NC -1)), repeated as necessary. |

Notes:
(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets (60+12(NC -1)), (73+12(NC -1)), (85+12(NC -1)) ...). For all but the innermost (last) time range, the next inner range is then processed using these references and forecast times as the initial reference and forecast time.

**Product Definition Template 4.254: CCITT IA5 character string**

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12-15 | Number of characters |

**Product Definition Template 4.1000: Cross section of analysis and forecast at a point in time**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |

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

**Product Definition Template 4.1001: Cross section of averaged or otherwise statistically processed analysis or forecast over a range of time**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23-26 | Total number of data values missing in statistical process. |
| | *27-38 Specification of the outermost (or only) time range over which statistical processing is done* |
| 27 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 28 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 29 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 30-33 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 34 | Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4) |
| 35-38 | Time increment between successive fields, in units defined by the previous octet (see Note 2) |

Notes:

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

(2) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.

**Product Definition Template 4.1002: Cross-section of analysis and forecast, averaged or otherwise statistically processed over latitude or longitude**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Horizontal dimension processed (see Code Table 4.220) |
| 24 | Treatment of missing data (e.g. below ground) (see Code Table 4.221) |
| 25 | Type of statistical processing (see Code Table 4.10) |
| 26-29 | Start of range |
| 30-33 | End of range |
| 34-35 | Number of values |

Note:

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

**Product Definition Template 4.1100: Hovmöller-type grid with no averaging or other statistical processing**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |

Note:

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

**Product Definition Template 4.1101: Hovmöller-type grid with averaging or other statistical processing**

*Preliminary Note: This template is simply experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests. (Octets 35-50 very similar to octets 43-58 of PDT 4.8, but meaning of some fields differs slightly)*

| Octet No. | Contents |
|---|---|
| 10 | Parameter category (see Code Table 4.1). |
| 11 | Parameter number (see Code Table 4.2). |
| 12 | Type of generating process (see Code Table 4.3) |
| 13 | Background generating process identifier (defined by originating centre) |
| 14 | Analysis or forecast generating processes identifier (defined by originating centre) |
| 15-16 | Hours of observational data cutoff after reference time (see Note 1) |
| 17 | Minutes of observational data cutoff after reference time |
| 18 | Indicator of unit of time range (see Code Table 4.4) |
| 19-22 | Forecast time in units defined by octet 18 (see Note 2) |
| 23 | Type of first fixed surface (see Code Table 4.5) |
| 24 | Scale factor of first fixed surface |
| 25-28 | Scaled value of first fixed surface |
| 29 | Type of second fixed surface (see Code Table 4.5) |
| 30 | Scale factor of second fixed surface |
| 31-34 | Scaled value of second fixed surface |
| 35-38 | Total number of data values missing in the statistical process |
| 39 | Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10) |
| 40 | Type of time increment between successive fields used in the statistical processing (see Code Table 4.11) |
| 41 | Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4) |
| 42-45 | Length of the time range over which statistical processing is done, in units defined by the previous octet |
| 46 | Indicator of unit of time for increment between the successive fields used (see Code Table 4.4) |

47-50 Time increment between successive fields, in units defined by the previous octet (see Note 3)

Notes:

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

(2) *Reference = reference time (section 1) + forecast range (PDT) + offset and increments from reference time (GDT).*

(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.

**TEMPLATE DEFINITIONS USED IN SECTION 5**

**Data Representation Template 5.0: Grid point data - simple packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits used for each packed value for simple packing, or for each group reference value for complex packing or spatial differencing |
| 21 | Type of original field values (see Code Table 5.1) |

Note: Negative values of E or D shall be represented according to Regulation 92.1.5.

**Data Representation Template 5.1: Matrix values at grid point -simple packing**

*Preliminary Note:* *This template was not validated at the time of publication and should be used with caution. Please report any use to WMO Secretariat (World Weather Watch - Basic Systems Department) to assist for validation.*

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-21 | Same as Data Representation Template 5.0 |
| 22 | 0, no matrix bit maps present; 1 matrix bit maps present. |
| 23-26 | Number of data values encoded in Section 7 |
| 27-28 | NR - first dimension (rows) of each matrix. |
| 29-30 | NC - second dimension (columns) of each matrix. |
| 31 | First dimension coordinate value definition (Code Table 5.2) |
| 32 | NC1 - number of coefficients or values used to specify first dimension coordinate function. |
| 33 | Second dimension coordinate value definition (Code Table 5.2) |
| 34 | NC2 - number of coefficients or values used to specify second dimension coordinate function |
| 35 | First dimension physical significance (Code Table 5.3) |
| 36 | Second dimension physical significance (Code Table 5.3) |
| 37-(36+NC1*4) | Coefficients to define first dimension coordinate values in functional form, or the explicit coordinate values (IEEE 32-bit floating-point value) |
| (37+NC1*4)- (36+4(NC1+NC2)) | Coefficients to define second dimension coordinate values in functional form, or the explicit coordinate values (IEEE 32-bit floating-point value) |

Notes:

(1) This form of representation enables a matrix of values to be depicted at each grid point; the two dimensions of the matrix may represent coordinates expressed in terms of two elemental parameters (e.g. direction and frequency for wave spectra). The numeric values of these coordinates, beyond that of simple subscripts, can be given in a functional form, or as a collection of explicit numbers.

(2) Some simple coordinate functional forms are tabulated in Code Table 5.2. Where a more complex coordinate function applies, the coordinate values shall be explicitly denoted by the inclusion of the actual set of values rather than the coefficients. This shall be indicated by a code figure 0 from Code Table 5.2; the number of explicit values coded shall be equal to the appropriate dimension of the matrix for which values are presented and they shall follow octet 36 in place of the coefficients.

(3) Matrix bit maps will be present only if indicated by octet 22. If present, there shall be one bit map for each grid point with data values, as defined by the primary bit map in Section 6, each of length (NR*NC) bits: a bit set to 1 will indicate a data element at the corresponding location within the matrix. Bit maps shall be represented end-to-end, without regard for octet boundaries; the last bit map shall, if necessary, be followed by bits set to zero to fill any partially used octet.

(4) Matrices restricted to scanning in the + i direction (left to right) and in the -j direction (top to bottom).

**Data Representation Template 5.2: Grid point data - complex packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-21 | Same as Data Representation Template 5.0 |
| 22 | Group splitting method used (see Code Table 5.4) |
| 23 | Missing value management used (see Code Table 5.5) |
| 24-27 | Primary missing value substitute |
| 28-31 | Secondary missing value substitute |
| 32-35 | NG - Number of groups of data values into which field is split |
| 36 | Reference for group widths (see Note 12) |
| 37 | Number of bits used for the group widths (after the reference value in octet 36 has been removed) |
| 38-41 | Reference for group lengths (see Note 13) |
| 42 | Length increment for the group lengths (see Note 14) |
| 43-46 | True length of last group |
| 47 | Number of bits used for the scaled group lengths (after subtraction of the reference value given in octets 38-41 and division by the length increment given in octet 42) |

Notes:

(1) Group lengths have no meaning for row by row packing, where groups are coordinate lines (so the Grid Description Section and possibly the Bit-map Section are enough); for consistency associated field width and reference should then be encoded as 0.

(2) For row by row packing with a bit-map, there should always be as many groups as rows. In case of rows with only missing values, all associated descriptors should be coded as zero.

(3) Management of widths into a reference and increments, together with management of lengths as scaled incremental values, are intended to save descriptor size (which is an issue as far as compression gains are concerned).

(4) Management of explicitly missing values is an alternative to bit-map use within Section 6; it is intended to reduce the whole GRIB message size.

(5) 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.

(6) 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).

(7) 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).

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

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

(10) A group containing only missing values (of either type) will be encoded as a constant group (null width, no associated data) and the group reference will have all bits set to 1 for primary type, and all bits set to 1, except the last bit set to 0, for secondary type.

(11) If necessary, group widths and/or field width of group references may be enlarged to avoid ambiguities between missing value indicator(s) and true data.

(12) The group width is the number of bits used for every value in a group.

(13) The group length (L) is the number of values in a group.

(14) The essence of the complex packing method is to subdivide a field of values into NG groups, where the values in each group have similar sizes. In this procedure, it is necessary to retain enough information to recover the group lengths upon decoding. The NG group lengths for any given field can be described by Ln = ref + Kn * len_inc, n = 1,NG, where ref is given by octets 38-41 and len_inc by octet 42. The NG values of K (the scaled group lengths) are stored in the Data Section, each with the number of bits specified by octet 47. Since the last group is a special case which may not be able to be specified by this relationship, the length of the last group is stored in octets 43-46.

(15) See Data Template 7.2 and associated Notes for complementary information.

**Data Representation Template 5.3: Grid point data - complex packing and spatial differencing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12- 47 | Same as Data Representation Template 5.2 |
| 48 | Order of spatial differencing (see Code Table 5.6) |
| 49 | Number of octets required in the Data Section to specify extra descriptors needed for spatial differencing (octets 6-ww in Data Template 7.3) |

Notes:

(1) Spatial differencing is a pre-processing before group splitting at encoding time. It is intended to reduce the size of sufficiently smooth fields, when combined with a splitting scheme as described in Data Representation Template 5.2. At order 1, an initial field of values f is replaced by a new field of values g, where $g_1 = f_1$, $g_2 = f_2 - f_1$, …, $g_n = f_n - f_{n-1}$. At order 2, the field of values g is itself replaced by a new field of values h, where $h_1 = f_1$, $h_2 = f_2$, $h_3 = g_3 - g_2$, …, $h_n = g_n - g_{n-1}$. To keep values positive, the overall minimum of the resulting field (either $g_{min}$ or $h_{min}$) is removed. At decoding time, after bit string unpacking, the original scaled values are recovered by adding the overall minimum and summing up recursively.

(2) For differencing of order n, the first n values in the array that are not missing are set to zero in the packed array. These dummy values are not used in unpacking.

(3) See Data Template 7.3 and associated Notes for complementary information.

**Data representation template 5.4: Grid point data – IEEE floating point data**

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| Octet No. | Content |
|---|---|
| 12 | Precision (See Code table 5.7) |

**Data Representation Template 5.40: Grid point data - JPEG 2000 Code Stream Format**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits required to hold the resulting scaled and referenced data values. (i.e. The depth of the grayscale image.) (see Note 2) |
| 21 | Type of original field values (see Code Table 5.1) |
| 22 | Type of Compression used. (see Code Table 5.40) |
| 23 | Target compression ratio, M:1 (with respect to the bit-depth specified in octet 20), when octet 22 indicates Lossy Compression. Otherwise, set to missing. (see Note 3) |

Notes:

(1) The intent of this template is to scale the grid point data to obtain desired precision, if appropriate, and then subtract out reference value from the scaled field as is done using Data Representation Template 5.0. After this, the resulting grid point field can be treated as a grayscale image and is then encoded into the JPEG 2000 code stream format. To unpack the data field, the JPEG 2000 code stream is decoded back into an image, and the original field is obtained from the image data as described in regulation 92.9.4, Note (4).

(2) The JPEG 2000 standard specifies that the bit-depth must be in the range of 1 to 38 bits.

(3) The compression ratio M:1 ( e.g. 20:1 ) specifies that the encoded stream should be less than ((1/M) x depth x number of data points) bits, where depth is specified in octet 20 and number of data points is specified in octets 6-9 of the Data Representation Section.

(4) The order of the data points should remain as specified in the scanning mode flags (Flag Table 3.4) set in the appropriate Grid Definition Template, even though the JPEG 2000 standard specifies that an image is stored starting at the top left corner. Assuming that the encoding software is expecting the image data in raster order (left to right across rows for each row), users should set the image width to Ni (or Nx) and the height to Nj (or Ny) if bit 3 of the scanning mode flag equals 0 (adjacent points in i (x) order), when encoding the "image". If bit 3 of the scanning mode flags equals 1 (adjacent points in j (y) order), it may be advantageous to set the image width to Nj (or Ny) and the height to Ni (or Nx).

(5) This template should not be used when the data points are not available on a rectangular grid, such as occurs if some data points are bit-mapped out or if section 3 describes a quasi-regular grid. If it is necessary to use this template on

such a grid, the data field can be treated as a one dimensional image where the height is set to 1 and the width is set to the total number of data points specified in octets 6-9.

(6) Negative values of E or D shall be represented according to Regulation 92.1.5.

**Data Representation Template 5.41: Grid point data - Portable Network Graphics (PNG) Format**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits required to hold the resulting scaled and referenced data values. (i.e. The depth of the image.) (see Note 2) |
| 21 | Type of original field values (see Code Table 5.1) |

Notes:

(1) The intent of this template is to scale the grid point data to obtain desired precision, if appropriate, and then subtract out reference value from the scaled field, as is done using Data Representation Template 5.0. After this, the resulting grid point field can be treated as an image and is then encoded into PNG format. To unpack the data field, the PNG stream is decoded back into an image, and the original field is obtained from the image data as described in regulation 92.9.4, Note (4).

(2) PNG does not support all bit-depths in an image, so it is necessary to define which depths can be used and how they are to be treated. For grayscale images, PNG supports depths of 1, 2, 4, 8 or 16 bits. Red-Green-Blue (RGB) color images can have depths of 8 or 16 bits with an optional alpha sample. Valid values for octet 20 can be:

| | |
|---|---|
| 1, 2, 4, 8, or 16 | - treat as grayscale image |
| 24 | - treat as RGB color image (each component having 8 bit depth) |
| 32 | - treat as RGB w/ alpha sample color image (each component having 8 bit depth) |

(3) The order of the data points should remain as specified in the scanning mode flags (Flag Table 3.4) set in the appropriate Grid Definition Template, even though the PNG standard specifies that an image is stored starting at the top left corner and scans across each row from left to right starting with the top row. Users should set the image width to Ni (or Nx) and the height to Nj (or Ny) if bit 3 of the scanning mode flag equals 0 (adjacent points in i (x) order), when encoding the "image". If bit 3 of the scanning mode flags equals 1 (adjacent points in j (y) order), it may be advantageous to set the image width to Nj (or Ny) and the height to Ni (or Nx).

(4) This template should not be used when the data points are not available on a rectangular grid, such as occurs if some data points are bit-mapped out or if section 3 describes a quasi-regular grid. If it is necessary to use this template on such a grid, the data field can be treated as a one dimensional image where the height is set to 1 and the width is set to the total number of data points specified in octets 6-9.

(5) Negative values of E or D shall be represented according to Regulation 92.1.5.

**Data Representation Template 5.42: Grid point and spectral data - CCSDS szip** - validation

*Preliminary note: For most templates, details of the packing process are described in regulation 92.9.4*

| Octet Number(s) | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits required to hold the resulting scaled and referenced data values. |
| 21 | Type of original field values (see Code Table 5.1) |
| 22 | szip options mask |
| 23 | szip bits per pixel |
| 27-28 | szip pixels per block |

29-30 szip pixels per scan line

Notes:

(1) The intent of this template is to scale the grid point data to obtain desired precision, if appropriate, and then subtract out reference value from the scaled field as is done using Data Representation Template 5.0. After this, the resulting grid point field can be treated as a grayscale image and is then encoded into the CCSDS szip code stream format. To unpack the data field, the CCSDS szip code stream is decoded back into an image, and the original field is obtained from the image data as described in regulation 92.9.4, Note (4).
(2) The Consultative Committee for Space Data Systems (CCSDS) szip is the standard used by space agencies for the compression of scientific data transmitted from satellites and other space instruments. CCSDS szip is a very fast predictive compression algorithm based on the extended-Rice algorithm, it uses Golomb-Rice codes for entropy coding. The sequence of prediction errors is divided into blocks. Each block is compressed using a two-pass algorithm. In the first pass the best coding method for the whole block is determined. In the second pass, output of the marker of the selected coding method as a side information is done along with prediction errors encoded.
The coding methods include:
- Golomb-Rice codes of a chosen rank
- Unary code for transformed pairs of prediction errors
- Fixed-length natural binary code if the block is found to be incompressible
- Signaling to the decoder empty block if all prediction errors are zeroes

A detailed description can be found in:

Consultative Committee for Space Data Systems: Lossless Data Compression.
CCSDS Recommendation for Space System Data Standards,
CCSDS 121.0-B-1, Blue Book, May 1997.


CCSDS121.0b1.pdf


CCSDS120.0g2.pdf

***Note:*** *CCSDS szip is often confused with a general-purpose compression utility by Schindler, which is also called szip.*

**Data Representation Template 5.50: Spectral data - simple packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits used for each packed value (field width) |
| 21-24 | Real part of (0,0) coefficient (IEEE 32-bit floating-point value) |

Notes:

(1) Removal of the real part of (0,0) coefficient from packed data is intended to reduce the variability of the coefficients, in order to improve packing accuracy.
(2) For some spectral representations, the (0,0) coefficient represents the mean value of the parameter represented.
(3) Negative values of E or D shall be represented according to Regulation 92.1.5.

**Data Representation Template 5.51: Spherical harmonics data - complex packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 12-20 | Same as Data Representation Template 5.50 |
| 21-24 | P - Laplacian scaling factor (expressed in $10^{-6}$ units) |
| 25-26 | $J_S$ - pentagonal resolution parameter of the unpacked subset (see Note 1) |
| 27-28 | $K_S$ - pentagonal resolution parameter of the unpacked subset (see Note 1) |
| 29-30 | $M_S$ - pentagonal resolution parameter of the unpacked subset (see Note 1) |
| 31-34 | $T_S$ - total number of values in the unpacked subset (see Note 1) |

| | |
|---|---|
| 35 | Precision of the unpacked subset (see Code Table 5.7) |

Notes:

(1) The unpacked subset is a set of values defined in the same way as the full set of values (on a spectrum limited to $J_S$ , $K_S$ and $M_S$), but on which scaling and packing are not applied. Associated values are stored in octets 6 onwards of Section 7.

(2) The remaining coefficients are multiplied by $(n*(n+1))^P$, scaled and packed. The operator associated with this multiplication is derived from the laplacian operator on the sphere.

(3) The retrieval formula for a coefficient of wave number n is then:
$Y = (R+X*2^E)*10^{-D}* (n*(n+1))^{-P}$ where X is the packed scaled value associated with the coefficient

**Data Representation Template 5.61: Grid point data - simple packing with logarithm pre-processing**

*Preliminary Note: This template is experimental, was not validated at the time of publication and should be used only for bi-lateral previously agreed tests.*

| Octet No. | Contents |
|---|---|
| 12-15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16-17 | Binary scale factor (E) |
| 18-19 | Decimal scale factor (D) |
| 20 | Number of bits used for each packed value |
| 21-24 | Pre-processing parameter (B) (IEEE 32- bit floating-point value) |

Notes:

(1) This template is appropriately designed for data sets with all non-negative values and a wide variability range (more then 5 orders of magnitude). It must not be used for data sets with negative values or smaller variability range.

(2) A logarithm pre-processing algorithm is used to fit the variability range into one or two order of magnitudes before using the simple packing algorithm. It requires a parameter (B) to assure that all values passed to the logarithm function are positive. Thus scaled values are Z=ln(Y+B), where Y are the original values, ln is the natural logarithm function and B is chosen so that Y+B>0.

(3) Best practice follows for choosing the B pre-processing parameter.
   1 If the data set minimum value is positive, B can be safely put to zero.
   2 If the data set minimum is zero, all values must be scaled to become greater than zero and B can be equal to the minimum positive value in the data set.

Data shall be packed using Data template 7.

**Data Representation Template 5.200 Grid point data - Run length packing with level values**

| Octet No. | Contents |
|---|---|
| 12 | Number of bits used for each packed value in the run length packing with level values |
| 13-14 | MV - Maximum value within the levels that are used in the packing |
| 15-16 | MVL - Maximum value of level (Predefined) |
| 17 | Decimal scale factor of representative value of each level |
| 18-19+2*(lv-1) | List of MVL scaled representative values of each level from lv=1 to MVL |

**TEMPLATE DEFINITIONS USED IN SECTION 7**

**Data Template 7.0: Grid point data - simple packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-nn | Binary data values - binary string, with each (scaled) data value |

**Data Template 7.1: Matrix values at grid point -simple packing**

*Preliminary Note: This template was not validated at the time of publication and should be used with caution. Please report any use to WMO Secretariat (World Weather Watch - Basic Systems Department) to assist for validation*

Note : For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-nn | Binary data values - binary string, with each (scaled) data value |

Note:
(1) Group descriptors mentioned above may not be physically present; if associated field width is 0.

**Data Template 7.2: Grid point data - complex packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-xx | NG group reference values (XI in the decoding formula), each of which is encoded using the number of bits specified in octet 20 of Data Representation Template 5.0. Bits set to zero shall be appended as necessary to ensure this sequence of numbers ends on an octet boundary. |
| [xx+1]-yy | NG group widths, each of which is encoded using the number of bits specified in octet 37 of Data Representation Template 5.2. Bits set to zero shall be appended as necessary to ensure this sequence of numbers ends on an octet boundary. |
| [yy+1]-zz | NG scaled group lengths, each of which is encoded using the number of bits specified in octet 47 of Data Representation Template 5.2. Bits set to zero shall be appended as necessary to ensure this sequence of numbers ends on an octet boundary. (see Note 14 of Data Representation Template 5.2) |
| [zz+1]-nn | Packed values (X2 in the decoding formula), where each value is a deviation from its respective group reference value. |

Notes:
(1) Group descriptors mentioned above may not be physically present; if associated field width is 0.
(2) Group lengths have no meaning for row by row packing; for consistency associated field width should then be encoded as 0. So no specific test for row by row case is mandatory at decoding software level to handle encoding/decoding of group descriptors.
(3) Scaled group lengths, if present, are encoded for each group. But the true last group length (unscaled) should be taken from Data Representation Template.
(4) For groups with a constant value, associated field width is 0, and no incremental data are physically present.

**Data Template 7.3**: **Grid point data - complex packing and spatial differencing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-ww | First value(s) of original (undifferenced) scaled data values, followed by the overall minimum of the differences. The number of values stored is 1 greater than the order of differentiation, and the field width is described at octet 49 of Data Representation Template 5.3. (see Note 1) |
| [ww+1]-xx | NG group reference values (X1 in the decoding formula), each of which is encoded using the number of bits specified in octet 20 of Data Representation Template 5.0. Bits set to zero shall be appended where necessary to ensure this sequence of numbers ends on an octet |

| | |
|---|---|
| | boundary. |
| [xx+1]-nn | Same as for Data Representation Template 7.2. |

Notes:

(1) Referring to the notation in Note 1of Data Representation Template 5.3, at order 1, the values stored in octets 6-ww are $g_1$ and $g_{min}$. At order 2, the values stored are $h_1$, $h_2$, and $h_{min}$.

(2) Extra descriptors related to spatial differencing are added before the splitting descriptors, to reflect the separation between the 2 approaches. It enables to share software parts between cases with and without spatial differencing.

(3) The position of overall minimum after initial data values is a choice that enables less software management.

(4) Overall minimum will be negative in most cases. First bit should indicate the sign: 0 if positive, 1 if negative.

**Data template 7.4: Grid point data - IEEE floating point data**

---

| Octet No. | Content |
|---|---|
| 6-nn | Binary data values |

**Data Template 7.40: Grid point data - JPEG 2000 Code Stream Format**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-nn | JPEG 2000 Code Stream as described in Part1 of the JPEG 2000 standard. (ISO/IEC 15444-1:2000) |

Note:

For simplicity, image data should be packed specifying a single component (i.e. grayscale image) instead of a multi-component color image.

**Data Template 7.41: Grid point data - Portable Network Graphics (PNG) Format**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-nn | PNG encoded image |

Note:

If octet 20 of Data Representation Template 5.41 specifies the data is packed into either 1, 2, 4, 8, or 16 bits, then encode the "image" as a grayscale image. If octet 20 specifies 24 bits, encode the "image" as an Red-Green-Blue (RGB) color image with 8 bit depth for each color component, and finally if octet 20 is 32, encode the "image" as a RGB color image with an alpha sample using an 8 bit depth for each of the four components.

**Data Template 7.50: Spectral data - simple packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-nn | Binary data values - binary string, with each (scaled) data value |

**Data Template 7.51: Spherical harmonics - complex packing**

Note: For most templates, details of the packing process are described in regulation 92.9.4

| Octet No. | Contents |
|---|---|
| 6-(5+I*$T_S$) | Data values from the unpacked subset (IEEE floating-point values on I octets) |
| (6+I*$T_S$)-nn | Binary data values - binary string, with each (scaled) data value out of the unpacked subset |

Notes:

(1) Values ordering within the unpacked subset is defined according to the source of grid definition associated with the data

(2) Number of octets associated with each value of the unpacked subset (I) is defined in Code Table 5.7, according to the actual value in octet 35 of Data Representation Template 5.51

(3) Values ordering within the packed data is done according to the source of grid definition, skipping the values processed in the unpacked subset

**CODE AND FLAG TABLES**

**CODE TABLES USED IN SECTION 0**

**Code Table 0.0: Discipline of processed data in the GRIB message, number of GRIB Master Table**

| 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 TABLES USED IN SECTION 1**

**Code Table 1.0: GRIB Master Tables Version Number**

| Code figure | Meaning |
|---|---|
| 0 | Experimental |
| 1 | Version implemented on 7 November 2001 |
| 2 | Version implemented on 4 November 2003 |
| 3 | Version implemented on 2 November 2005 |
| 4 | Version implemented on 7 November 2007 |
| 5 | Version implemented on 4 November 2009 |
| 6 | Pre-operational to be implemented by next amendment |
| 7-254 | Future versions |
| 255 | Missing value |

**Code Table 1.1: 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 | Number of local tables version used |
| 255 | Missing |

**Code Table 1.2: Significance of Reference 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 1.3: Production status of data**

| Code figure | Meaning |
|---|---|
| 0 | Operational products |
| 1 | Operational test products |
| 2 | Research products |
| 3 | Re-analysis products |
| 4 | THORPEX Interactive Grand Global Ensemble (TIGGE) |
| 5 | THORPEX Interactive Grand Global Ensemble (TIGGE) test |
| 6-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 1.4: Type of data**

| Code figure | Meaning |
|---|---|
| 0 | Analysis products |
| 1 | Forecast products |
| 2 | Analysis and forecast products |
| 3 | Control forecast products |
| 4 | Perturbed forecast products |
| 5 | Control and perturbed forecast products |
| 6 | Processed satellite observations |
| 7 | Processed radar observations |
| 8 | Event Probability |
| 9-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

Note: An initialized analysis is considered a zero-hour forecast

**CODE AND FLAG TABLES USED IN SECTION 3**

**Code Table 3.0: Source of Grid Definition**

| Code figure | Meaning | Comments |
|---|---|---|
| 0 | Specified in Code table 3.1 | |
| 1 | Predetermined grid definition | Defined by originating centre |
| 2-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | A grid definition does not apply to this product | |

**Code Table 3.1: Grid Definition Template Number**

| Code figure | Meaning | Comments |
|---|---|---|
| 0 | Latitude/longitude | Also called equidistant cylindrical, or Plate Carrée. |
| 1 | Rotated latitude/longitude | |
| 2 | Stretched latitude/longitude | |
| 3 | Stretched and rotated latitude/longitude | |
| 4-9 | Reserved | |
| 10 | Mercator | |
| 11-19 | Reserved | |
| 20 | Polar stereographic | can be south or north. |
| 21-29 | Reserved | |
| 30 | Lambert Conformal | can be secant or tangent, conical or bipolar. |
| 31 | Albers equal-area | |
| 32-39 | Reserved | |
| 40 | Gaussian latitude/longitude | |
| 41 | Rotated Gaussian latitude/longitude | |
| 42 | Stretched Gaussian latitude/longitude | |
| 43 | Stretched and rotated Gaussian latitude/longitude | |
| 44-49 | Reserved | |
| 50 | Spherical harmonic coefficients | |
| 51 | Rotated spherical harmonic coefficients | |
| 52 | Stretched spherical harmonic coefficients | |
| 53 | Stretched and rotated spherical harmonic coefficients | |
| 54-89 | Reserved | |
| 90 | Space view perspective orthographic. | |
| 91-99 | Reserved | |
| 100 | Triangular grid based on an icosahedron | |
| 101 | General Unstructured Grid | - validation |
| 102-109 | Reserved | |
| 110 | Equatorial azimuthal equidistant projection | |
| 111-119 | Reserved | |
| 120 | Azimuth-range projection | |
| 121- 129 | Reserved | |
| 130 | Irregular Latitude/longitude grid | -validation |
| 131- 999 | Reserved | |
| 1000 | Cross-section grid, with points equally spaced on the horizontal | |
| 1001-1099 | Reserved | |
| 1100 | Hovmöller diagram grid, with points equally spaced on the horizontal | |
| 1101- 1199 | Reserved | |
| 1200 | Time section grid | |
| 1201-32767 | Reserved | |
| 32768-65534 | Reserved for local use | |
| 65535 | Missing | |

**Code Table 3.2: Shape of the Earth**

| Code figure | Meaning |
|---|---|
| 0 | Earth assumed spherical with radius = 6,367,470.0 m |
| 1 | Earth assumed spherical with radius specified (in m) by data producer |
| 2 | Earth assumed oblate spheroid with size as determined by IAU in 1965 (major axis = 6,378,160.0 m, minor axis = 6,356,775.0 m, f = 1/297.0) |
| 3 | Earth assumed oblate spheroid with major and minor axes specified (in km) by data producer |
| 4 | Earth assumed oblate spheroid as defined in IAG-GRS80 model (major axis = 6,378,137.0 m, minor axis = 6,356,752.314 m, f = 1/298.257222101) |
| 5 | Earth assumed represented by WGS84 (as used by ICAO since 1998) |
| 6 | Earth assumed spherical with radius of 6,371,229.0 m |
| 7 | Earth assumed oblate spheroid with major and minor axes specified (in m) by data producer |
| 8 | Earth model assumed spherical with radius 6371200 m, but the horizontal datum of the resulting latitude/longitude field is the WGS84 reference frame |
| 9-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

Note:

WGS84 is a geodetic system that uses IAG-GRS80 as basis.

**Flag Table 3.3: Resolution and Component Flags**

| Bit Number | 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 3.4: Scanning Mode**

| Bit Number | 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 |
| 5-8 | | Reserved |

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.

**Flag Table 3.5: Projection Centre**

| Bit Number | Value | Meaning |
|---|---|---|
| 1 | 0 | North Pole is on the projection plane |
| | 1 | South Pole is on the projection plane |
| 2 | 0 | Only one projection centre is used |
| | 1 | Projection is bi-polar and symmetric |

**Code Table 3.6: Spectral data representation type**

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

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

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

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

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

where λ is the longitude,
μ the sine of latitude,
and $F_n^{-m}$ the complex conjugate of $F_n^m$

**Code Table 3.7: Spectral data representation mode**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | The complex numbers $F_n^m$ (see code figure 1 in Code Table 3.6 above) are stored for m≥0 as pairs of real numbers $Re(F_n^m)$, $Im(F_n^m)$ ordered with n increasing from m to N(m), first for m=0 and then for m=1, 2, ... M. (see Note 1) |
| 2-254 | Reserved |
| 255 | Missing |

Note:

(1) Values of N(m) for common truncations cases:

| | | |
|---|---|---|
| Triangular | M = J = K, | N(m) = J |
| Rhomboidal | K = J + M, | N(m) = J+m |
| Trapezoidal | K = J, K > M, | N(m) = J |

**Code table 3.8: Grid point position**

| Code Figure | Meaning |
|---|---|
| 0 | Grid points at triangle vertices |
| 1 | Grid points at centres of triangles |
| 2 | Grid points at midpoints of triangle sides |
| 3-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Flag table 3.9: Numbering order of diamonds as seen from the corresponding pole**

| Bit No. | Value | Meaning |
|---|---|---|
| 1 | 0 | Clockwise orientation |
| | 1 | Anti-clockwise (i.e., counter-clockwise) orientation |
| 2-8 | | Reserved |

**Flag table 3.10: Scanning mode for one diamond**

| Bit No. | Value | Meaning |
|---|---|---|
| 1 | 0 | Points scan in +i direction, i.e. from pole to equator |
| | 1 | Points scan in -i direction, i.e. from equator to pole |
| 2 | 0 | Points scan in +j direction, i.e. from west to east |
| | 1 | Points scan in -j direction, i.e. from east to west |
| 3 | 0 | Adjacent points in i direction are consecutive |
| | 1 | Adjacent points in j direction is consecutive |
| 4-8 | | Reserved |

**Code table 3.11 Interpretation of list of numbers at end of section 3**

| Code figure | Meaning |
|---|---|
| 0 | There is no appended list |
| 1 | Numbers define number of points corresponding to full coordinate circles (i.e. parallels), coordinate values on each circle are multiple of the circle mesh, and extreme coordinate values given in grid definition (i.e. extreme longitudes) may not be reached in all rows |
| 2 | Numbers define number of points corresponding to coordinate lines delimited by extreme coordinate values given in grid definition (i.e. extreme longitudes) which are present in each row |
| 3 | Numbers define the actual latitudes for each row in the grid. The list of numbers are integer values of the valid latitudes in microdegrees (scaled by $10^6$) or in unit equal to the ratio of the basic angle and the subdivisions number for each row, in the same order as specified in the "scanning mode flag" (bit no. 2). (see Note 2) |
| 4-254 | Reserved |
| 255 | Missing |

Notes:
(1) For entry 1, it should be noted that depending on values of extreme (first/last) coordinates, and regardless of bit-map, effective number of points per row may be less than the number of points on the current circle.
(2) The value for the constant direction increment Di (or Dx) in the accompanying Grid Definition Template should be set to all ones (missing).

**Code table 3.15 Physical meaning of vertical coordinate**

| Code Figure | Meaning | Unit |
|---|---|---|
| 0-19 | Reserved | |
| 20 | Temperature | K |
| 21-99 | Reserved | |
| 100 | Pressure | Pa |
| 101 | Pressure deviation from mean sea level | Pa |
| 102 | Altitude above mean sea level | m |
| 103 | Height above ground (see Note 1) | m |
| 104 | Sigma coordinate | |
| 105 | Hybrid coordinate | |
| 106 | Depth below land surface | m |
| 107 | Potential temperature (theta) | K |
| 108 | Pressure deviation from ground to level | Pa |
| 109 | Potential vorticity | K $m^{-2}$ $kg^{-1}$ $s^{-1}$ |
| 110 | Geometrical height | m |
| 111 | Eta coordinate (see Note 2) | |
| 112 | Geopotential height | gpm |
| 113-159 | Reserved | |
| 160 | Depth below sea level | m |
| 161-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Notes:

(1) Negative values associated to this coordinate will indicate depth below ground surface. If values are all below surface, use of entry 106 is recommended, with positive coordinate values instead.

(2) 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 3.20: Type of horizontal line**

| Code figure | Meaning |
|---|---|
| 0 | Rhumb |
| 1 | Great circle |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 3.21: Vertical dimension coordinate values definition**

| Code Figure | Meaning |
|---|---|
| 0 | Explicit coordinate values set |
| 1 | Linear coordinates<br>f(1)=C1<br>f(n)=f (n-1)+C2 |
| 2-10 | Reserved |
| 11 | Geometric coordinates<br>f (1)=C1<br>f(n)=C2*f(n-1) |
| 12-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 3.30: Type of sampling employed to select data from source grid** -validation

| Code figure | Meaning |
|---|---|
| 0 | Bilinear Interpolation using the 4 source grid grid-point values surrounding the nominal grid-point |
| 1 | Using the value from the source grid grid-point which is nearest to the nominal grid-point |
| 2 | The Mean of the source grid grid-point values from within the rectangular latitude/longitude area defined by Octets 112-127 of Template 3.xx |
| 3 | The Maximum of the source grid grid-point values from within the rectangular latitude/longitude area defined by Octets 112-127 of Template 3.xx |
| 4 | The Minimum of the source grid grid-point values from within the rectangular latitude/longitude area defined by Octets 112-127 of Template 3.xx |
| 5 | The Mean of the source grid grid-point values from within the rectangular area of the Earth's surface defined by Octets 112-127 of Template 3.xx |
| 6 | The Maximum of the source grid grid-point values from within the rectangular area of the Earth's surface defined by Octets 112-127 of Template 3.xx |
| 7 | The Minimum of the source grid grid-point values from within the rectangular area of the Earth's surface defined by Octets 112-127 of Template 3.xx |
| 8-191 | Reserved |
| 192 - 254 | Reserved for local use |
| 255 | Missing |

**CODE AND FLAG TABLES USED IN SECTION 4**

**Code Table 4.0: Product Definition Template Number**

| Number | Description |
|---|---|
| 0 | Analysis or forecast at a horizontal level or in a horizontal layer at a point in time |
| 1 | Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time |
| 2 | Derived forecast based on all ensemble members at a horizontal level or in a horizontal layer at a point in time |
| 3 | Derived forecasts based on a cluster of ensemble members over a rectangular area at a horizontal level or in a horizontal layer at a point in time |
| 4 | Derived forecasts based on a cluster of ensemble members over a circular area at a horizontal level or in a horizontal layer at a point in time |
| 5 | Probability forecasts at a horizontal level or in a horizontal layer at a point in time |
| 6 | Percentile forecasts at a horizontal level or in a horizontal layer at a point in time |
| 7 | Analysis or forecast error at a horizontal level or in a horizontal layer at a point in time |
| 8 | Average, accumulation, extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval |
| 9 | Probability forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval |
| 10 | Percentile forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval |
| 11 | Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval |
| 12 | Derived forecasts based in all ensemble members at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval |
| 13 | Derived forecasts based on a cluster of ensemble members over a rectangular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval |
| 14 | Derived forecasts based on a cluster of ensemble members over a circular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval |
| 15 | Average, accumulation, extreme values, or other statistically-processed values over a spatial area at a horizontal level or in a horizontal layer at a point in time -preoperational |
| 16-19 | Reserved |
| 20 | Radar product |
| 21-29 | Reserved |
| 30 | Satellite product *(deprecated)* |
| 31 | Satellite product |
| 32 | Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for simulated (synthetic) satellite data - validation |
| 33-39 | Reserved |
| 40 | Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents |
| 41 | Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents |
| 42 | Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents |
| 43 | Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents |
| 44 | Aerosol analysis or forecast at a horizontal level or in a horizontal layer at a point in time - validation |
| 45 | Aerosol individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time - validation |
| 46 | Aerosol average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval - validation |
| 47 | Aerosol individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non continuous time interval for Aerosol - validation |
| 48-49 | Reserved |
| 50 | Analysis or forecast of a multi component parameter or matrix element at a point in time - validation |
| 51 | Categorical forecasts at a horizontal level or in a horizontal layer at a point in time - validation |
| 52-90 | Reserved |
| 91 | Categorical forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval - validation |

| | |
|---|---|
| 92-253 | Reserved |
| 254 | CCITT IA5 character string |
| 255-999 | Reserved |
| 1000 | Cross section of analysis and forecast at a point in time |
| 1001 | Cross section of averaged or otherwise statistically processed analysis or forecast over a range of time |
| 1002 | Cross-section of analysis and forecast, averaged or otherwise statistically processed |
| 1003-1099 | Reserved |
| 1100 | Hovmöller-type grid with no averaging or other statistical processing |
| 1101 | Hovmöller-type grid with averaging or other statistical processing |
| 1102-32767 | Reserved |
| 32768-65534 | Reserved for local use |
| 65535 | Missing |

**Code Table 4.1: Category of parameters by product discipline**

Note: In the context of addition of a new parameter entry for Code Table 4.1, when more than one discipline applies, the choice of discipline should be made based on the intended use of the product.

**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 | Temperature Probabilities* |
| 10 | Moisture Probabilities* |
| 11 | Momentum Probabilities* |
| 12 | Mass Probabilities* |
| 13 | Aerosols |
| 14 | Trace gases (e.g., ozone, CO2) |
| 15 | Radar |
| 16 | Forecast Radar Imagery |
| 17 | Electro-dynamics |
| 18 | Nuclear/radiology |
| 19 | Physical atmospheric properties |
| 20 | Atmospheric chemical constituents |
| 21-189 | Reserved |
| 190 | CCITT IA5 string |
| 191 | Miscellaneous |
| 192-254 | Reserved for local use |
| 255 | Missing |

Note: Entries 9, 10, 11 and 12 are deprecated.

**Product Discipline 1: Hydrological products**

| Category | Description |
|---|---|
| 0 | Hydrology basic products |
| 1 | Hydrology probabilities |
| 2-191 | 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 -validation |
| 5-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Product Discipline 3: Space Products**

| Category | Description |
|---|---|
| 0 | Image format products (see Note 1) |
| 1 | Quantitative products (see Note 2) |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |

| | |
|---|---|
| 255 | Missing |

Notes:

(1) Data are numeric without units, although they might be given quantitative meaning through a code table defined external to this document. The emphasis is on a displayable "picture" of some phenomenon, perhaps with certain enhanced features. Generally, each datum is an unsigned, one octet integer, but some image format products might have another datum size. The size of a datum is indicated in Section 5.

(2) Data are in specified physical units.

**Product Discipline 10 - Oceanographic products**

| Category | Description |
|---|---|
| 0 | Waves |
| 1 | Currents |
| 2 | Ice |
| 3 | Surface Properties |
| 4 | Sub-surface Properties |
| 5-190 | Reserved |
| 191 | Miscellaneous |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.2 Parameter number by product discipline and parameter category**

*Note: 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 | Maximum temperature* | K | |
| 5 | Minimum temperature* | K | |
| 6 | Dew point temperature | K | |
| 7 | Dew point 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 | Minimum dew point depression* | K | |
| 15 | Virtual potential temperature | K | |
| 16 | Snow phase change heat flux | W $m^{-2}$ | |
| 17 | Skin temperature | K | |
| 18 | Snow temperature (top of snow) | K | - validation |
| 19 | Turbulent transfer coefficient for heat | Numeric | - validation |
| 20 | Turbulent diffusion coefficient for heat | $m^2$ $s^{-1}$ | - validation |
| 21-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Note: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

**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 | Saturation deficit | Pa |
| 6 | Evaporation | kg $m^{-2}$ |
| 7 | Precipitation rate(1) | kg $m^{-2}$ $s^{-1}$ |
| 8 | Total precipitation(1) | kg $m^{-2}$ |
| 9 | Large scale precipitation (non-convective)(1) | kg $m^{-2}$ |
| 10 | Convective precipitation(1) | kg $m^{-2}$ |
| 11 | Snow depth | m |
| 12 | Snowfall rate water equivalent(1) | kg $m^{-2}$ $s^{-1}$ |
| 13 | Water equivalent of accumulated snow depth(1) | kg $m^{-2}$ |
| 14 | Convective snow(1) | kg $m^{-2}$ |
| 15 | Large scale snow(1) | kg $m^{-2}$ |
| 16 | Snow melt | kg $m^{-2}$ |
| 17 | Snow age | day |
| 18 | Absolute humidity | kg $m^{-3}$ |
| 19 | Precipitation type | code table (4.201) |
| 20 | Integrated liquid water | kg $m^{-2}$ |
| 21 | Condensate | kg $kg^{-1}$ |
| 22 | Cloud mixing ratio | kg $kg^{-1}$ |
| 23 | Ice water mixing ratio | kg $kg^{-1}$ |
| 24 | Rain mixing ratio | kg $kg^{-1}$ |
| 25 | Snow mixing ratio | kg $kg^{-1}$ |
| 26 | Horizontal moisture convergence | kg $kg^{-1}$ $s^{-1}$ |
| 27 | Maximum relative humidity(1) | % |

| | | | |
|---|---|---|---|
| 28 | Maximum absolute humidity[1] | kg $m^{-3}$ | |
| 29 | Total snowfall[1] | m | |
| 30 | Precipitable water category | code table (4.202) | |
| 31 | Hail | m | |
| 32 | Graupel (snow pellets) | kg $kg^{-1}$ | |
| 33 | Categorical rain | (Code table 4.222) | |
| 34 | Categorical freezing rain | (Code table 4.222) | |
| 35 | Categorical ice pellets | (Code table 4.222) | |
| 36 | Categorical snow | (Code table 4.222) | |
| 37 | Convective precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 38 | Horizontal moisture divergence | kg $kg^{-1}$ $s^{-1}$ | |
| 39 | Percent frozen precipitation | % | |
| 40 | Potential evaporation | kg $m^{-2}$ | |
| 41 | Potential evaporation rate | W $m^{-2}$ | |
| 42 | Snow cover | % | |
| 43 | Rain fraction of total cloud water | Proportion | |
| 44 | Rime factor | Numeric | |
| 45 | Total column integrated rain | kg $m^{-2}$ | |
| 46 | Total column integrated snow | kg $m^{-2}$ | |
| 47 | Large scale water precipitation (non-convective) [1] | kg $m^{-2}$ | |
| 48 | Convective water precipitation [1] | kg $m^{-2}$ | |
| 49 | Total water precipitation [1] | kg $m^{-2}$ | |
| 50 | Total snow precipitation [1] | kg $m^{-2}$ | |
| 51 | Total column water (Vertically integrated total water (vapour + cloud water/ice)) | kg $m^{-2}$ | |
| 52 | Total[2] precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 53 | Total[2] snowfall rate water equivalent | kg $m^{-2}$ $s^{-1}$ | |
| 54 | Large scale precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 55 | Convective snowfall rate water equivalent | kg $m^{-2}$ $s^{-1}$ | |
| 56 | Large scale snowfall rate water equivalent | kg $m^{-2}$ $s^{-1}$ | |
| 57 | Total snowfall rate | m $s^{-1}$ | |
| 58 | Convective snowfall rate | m $s^{-1}$ | |
| 59 | Large scale snowfall rate | m $s^{-1}$ | |
| 60 | Snow depth water equivalent | kg $m^{-2}$ | |
| 61 | Snow density | kg $m^{-3}$ | |
| 62 | Snow evaporation | kg $m^{-2}$ | |
| 63 | Reserved | | |
| 64 | Total column integrated water vapour | kg $m^{-2}$ | |
| 65 | Rain precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 66 | Snow precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 67 | Freezing rain precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 68 | Ice pellets precipitation rate | kg $m^{-2}$ $s^{-1}$ | |
| 69 | Total column integrated cloud water | kg $m^{-2}$ | - validation |
| 70 | Total column integrated cloud ice | kg $m^{-2}$ | - validation |
| 71 | Hail mixing ratio | kg $kg^{-1}$ | - validation |
| 72 | Total column integrated hail | kg $m^{-2}$ | - validation |
| 73 | Hail precipitation rate | kg $m^{-2}$ $s^{-1}$ | - validation |
| 74 | Total column integrated graupel | kg $m^{-2}$ | - validation |
| 75 | Graupel (snow pellets) precipitation rate | kg $m^{-2}$ $s^{-1}$ | - validation |
| 76 | Convective rain rate | kg $m^{-2}$ $s^{-1}$ | - validation |
| 77 | Large scale rain rate | kg $m^{-2}$ $s^{-1}$ | - validation |
| 78 | Total column integrated water (all components incl. precipitation) | kg $m^{-2}$ | - validation |
| 79 | Evaporation rate | kg $m^{-2}$ $s^{-1}$ | - validation |
| 80 | Total Condensate | kg $kg^{-1}$ | - validation |
| 81 | Total Column-Integrated Condensate | kg $m^{-2}$ | - validation |
| 82 | Cloud Ice Mixing-Ratio | kg $kg^{-1}$ | - validation |
| 83 | Specific cloud liquid water content | kg $kg^{-1}$ | |
| 84 | Specific cloud ice water content | kg $kg^{-1}$ | |
| 85 | Specific rain water content | kg $kg^{-1}$ | |
| 86 | Specific snow water content | kg $kg^{-1}$ | |
| 87-191 | Reserved | | |
| 192-254 | Reserved for local use | | |

| | | |
|---|---|---|
| 255 | Missing | |

Notes: (1) Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.
(2) Total precipitation/snowfall rate stands for the sum of convective and large-scale precipitation/snowfall rate.

**Product Discipline 0: Meteorological products, Parameter Category 2: Momentum**

| Number | Parameter | Units |
|---|---|---|
| 0 | Wind direction (from which blowing) | deg 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 | Sigma coordinate vertical velocity | $s^{-1}$ |
| 8 | Vertical velocity (pressure) | Pa $s^{-1}$ |
| 9 | Vertical velocity (geometric) | m $s^{-1}$ |
| 10 | Absolute vorticity | $s^{-1}$ |
| 11 | Absolute divergence | $s^{-1}$ |
| 12 | Relative vorticity | $s^{-1}$ |
| 13 | Relative divergence | $s^{-1}$ |
| 14 | Potential vorticity | K $m^2$ $kg^{-1}$ $s^{-1}$ |
| 15 | Vertical u-component shear | $s^{-1}$ |
| 16 | Vertical v-component shear | $s^{-1}$ |
| 17 | Momentum flux, u component | N $m^{-2}$ |
| 18 | Momentum flux, v component | N $m^{-2}$ |
| 19 | Wind mixing energy | J |
| 20 | Boundary layer dissipation | W $m^{-2}$ |
| 21 | Maximum wind speed* | m $s^{-1}$ |
| 22 | Wind speed (gust) | m $s^{-1}$ |
| 23 | u-component of wind (gust) | m $s^{-1}$ |
| 24 | v-component of wind (gust) | m $s^{-1}$ |
| 25 | Vertical speed shear | $s^{-1}$ |
| 26 | Horizontal momentum flux | N $m^{-2}$ |
| 27 | U-component storm motion | m $s^{-1}$ |
| 28 | V-component storm motion | m $s^{-1}$ |
| 29 | Drag coefficient | Numeric |
| 30 | Frictional velocity | m $s^{-1}$ |
| 31 | Turbulent diffusion coefficient for momentum | $m^2$ $s^{-1}$ |
| 32 | eta coordinate vertical velocity | $s^{-1}$ |
| 33 -191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Note: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

**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 | Altimeter setting | Pa |

| | | |
|---|---|---|
| 12 | Thickness | m |
| 13 | Pressure altitude | m |
| 14 | Density altitude | m |
| 15 | 5-wave geopotential height | gpm |
| 16 | Zonal flux of gravity wave stress | N $m^{-2}$ |
| 17 | Meridional flux of gravity wave stress | N $m^{-2}$ |
| 18 | Planetary boundary layer height | m |
| 19 | 5-wave geopotential height anomaly | gpm |
| 20 | Standard deviation of sub-grid scale orography | m |
| 21 | Angle of sub-gridscale orography | rad |
| 22 | Slope of sub-gridscale orography | Numeric |
| 23 | Gravity wave dissipation | $Wm^{-2}$ |
| 24 | Anisotropy of sub-gridscale orography | Numeric |
| 25 | Natural logarithm of pressure in Pa | Numeric |
| 26 -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 | Radiance (with respect to wave number) | W $m^{-1}$ $sr^{-1}$ |
| 6 | Radiance (with respect to wave length) | W $m^{-3}$ $sr^{-1}$ |
| 7 | Downward short-wave radiation flux | W $m^{-2}$ |
| 8 | Upward short-wave radiation flux | W $m^{-2}$ |
| 9 | Net short wave radiation flux | W $m^{-2}$ |
| 10 | Photosynthetically active radiation | W $m^{-2}$ |
| 11 | Net short-wave radiation flux, clear sky | W $m^{-2}$ |
| 12 | Downward UV radiation | W $m^{-2}$ |
| 13-49 | Reserved | |
| 50 | UV index **(under clear sky) | Numeric |
| 51 | UV index ** | Numeric |
| 52-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Notes:

* Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

** The Global Solar UVI is formulated using the International Commission on Illumination (CIE) reference action spectrum for UV-induced erythema on the human skin (ISO 17166:1999/CIE S 007/E-1998). It is a measure of the UV radiation that is relevant to and defined for a horizontal surface. The UVI is a unitless quantity defined by the formula:

$$I_{UV} = k_{er} \cdot \int_{250\ nm}^{400\ nm} E_{\lambda} \cdot s_{er}(\lambda) d\lambda$$

where $\mathbf{E_{\lambda}}$ is the solar spectral irradiance expressed in W·/ ($m^2$·nanometer) at wavelength $\boldsymbol{\lambda}$ and $\mathbf{d\lambda}$ is the wavelength interval used in the summation. $\mathbf{S_{er}\lambda}$ is the erythema reference action spectrum, and $\mathbf{k_{er}}$ is a constant equal to 40 $m^2$ / W.

**Product Discipline 0: Meteorological products, Parameter Category 5: Long-wave Radiation**

| Number | Parameter | Units |
|---|---|---|

| | | |
|---|---|---|
| 0 | Net long wave radiation flux (surface)* | W $m^{-2}$ |
| 1 | Net long wave radiation flux (top of atmosphere)* | W $m^{-2}$ |
| 2 | Long wave radiation flux* | W $m^{-2}$ |
| 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 $m^{-2}$ |
| 7-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Note: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

**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 | Cloud type | code table (4.203) | |
| 9 | Thunderstorm maximum tops | m | |
| 10 | Thunderstorm coverage | code table (4.204) | |
| 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 | Total condensate * | kg $kg^{-1}$ | |
| 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 | Cloud cover | % | |
| 23 | Cloud ice mixing ratio * | kg $kg^{-1}$ | |
| 24 | Sunshine | Numeric | |
| 25 | Horizontal extent of cumulonimbus (CB) | % | |
| 26 | Height of convective cloud base | m | -validation |
| 27 | Height of convective cloud top | m | -validation |
| 28 | Number concentration of cloud droplets | $kg^{-1}$ | -validation |
| 29 | Number concentration of cloud ice | $kg^{-1}$ | -validation |
| 30 | Number density of cloud droplets | $m^{-3}$ | -validation |
| 31 | Number density of cloud ice | $m^{-3}$ | -validation |
| 26-31 | Reserved | | |
| 32 | Fraction of cloud cover | Numeric | |
| 33 | Sunshine duration | s | - validation |
| 33-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Note:

(1) * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

Adding 17-20, 23 - validation

(2) This category should be used to report cloud characteristics not involving moisture. Any moisture parameters pertaining to clouds should be reported using Discipline 0, Category 1 (Moisture)

**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 | - validation |
| 14-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

**Product Discipline 0: Meteorological products, Parameter Category 13: Aerosols**

| Number | Parameter | Units |
|---|---|---|
| 0 | Aerosol type | code table (4.205) |
| 1-191 | 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 | Dobson |
| 1 | Ozone mixing ratio | kg $kg^{-1}$ |
| 2 | Total column integrated ozone | Dobson |
| 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 | kg $m^{-1}$ | |
| 4 | Layer-maximum base reflectivity | dB | |
| 5 | Precipitation | kg $m^{-2}$ | |
| 6 | Radar spectra (1) | - | |
| 7 | Radar spectra (2) | - | |
| 8 | Radar spectra (3) | - | |
| 9 | Reflectivity of cloud droplets | dB | - validation |
| 10 | Reflectivity of cloud ice | dB | - validation |
| 11 | Reflectivity of snow | dB | - validation |
| 12 | Reflectivity of rain | dB | - validation |
| 13 | Reflectivity of graupel | dB | - validation |
| 14 | Reflectivity of hail | dB | - validation |
| 15-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

**Product Discipline 0: Meteorological products, Parameter category 16: Forecast radar imagery** - validation

| 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 |

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 AMS Glossary of Meteorology)

**Product Discipline 0: Meteorological products, Parameter Category 18: Nuclear/radiology**

| Number | Parameter | Units |
|---|---|---|
| 0 | Air concentration of Caesium 137 | $Bq\ m^{-3}$ |
| 1 | Air concentration of Iodine 131 | $Bq\ m^{-3}$ |
| 2 | Air concentration of radioactive pollutant | $Bq\ m^{-3}$ |
| 3 | Ground deposition of Caesium 137 | $Bq\ m^{-2}$ |
| 4 | Ground deposition of Iodine 131 | $Bq\ m^{-2}$ |
| 5 | Ground deposition of radioactive pollutant | $Bq\ m^{-2}$ |
| 6 | Time-integrated air concentration of caesium pollutant* | $Bq\ s\ m^{-3}$ |
| 7 | Time-integrated air concentration of iodine pollutant* | $Bq\ s\ m^{-3}$ |
| 8 | Time-integrated air concentration of radioactive pollutant* | $Bq\ s\ m^{-3}$ |
| 9-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Note: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

**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 | Volcanic ash | code table (4.206) | |
| 5 | Icing top | m | |
| 6 | Icing base | m | |
| 7 | Icing | code table (4.207) | |
| 8 | Turbulence top | m | |
| 9 | Turbulence base | m | |
| 10 | Turbulence | code table (4.208) | |
| 11 | Turbulent kinetic energy | $J\ kg^{-1}$ | |
| 12 | Planetary boundary layer regime | code table (4.209) | |
| 13 | Contrail intensity | code table (4.210) | |
| 14 | Contrail engine type | code table (4.211) | |
| 15 | Contrail top | m | |
| 16 | Contrail base | m | |
| 17 | Maximum snow albedo* | % | |
| 18 | Snow free albedo | % | |
| 19 | Snow albedo | % | |
| 20 | Icing | % | |
| 21 | In-cloud turbulence | % | |
| 22 | Clear air turbulence (CAT) | % | |
| 23 | Supercooled large droplet probability (see Note 4) | % | |
| 24 | Convective turbulent kinetic energy | $J\ kg^{-1}$ | - validation |
| 25 | Weather Interpretation ww (WMO) | - | - validation |
| 26-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Note: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.

**Product Discipline 0: Meteorological products, Parameter Category 20: Atmospheric chemical constituents**

| Number | Parameter | Units |
|---|---|---|
| 0 | Mass density (concentration) | kg $m^{-3}$ |
| 1 | Column-integrated mass density (see Note 1) | kg $m^{-2}$ |
| 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 | Surface dry deposition mass flux | kg $m^{-2}$ $s^{-1}$ |
| 7 | Surface wet deposition mass flux | kg $m^{-2}$ $s^{-1}$ |
| 8 | Atmosphere re-emission mass flux | kg $m^{-2}$ $s^{-1}$ |
| 9-49 | Reserved | |
| 50 | Amount in atmosphere | mol |
| 51 | Concentration in air | mol $m^{-3}$ |
| 52 | Volume mixing ratio (fraction in air) | mol $mol^{-1}$ |
| 53 | Chemical gross production rate of concentration | mol $m^{-3}$ $s^{-1}$ |
| 54 | Chemical gross destruction rate of concentration | mol $m^{-3}$ $s^{-1}$ |
| 55 | Surface flux | mol $m^{-2}$ $s^{-1}$ |
| 56 | Changes of amount in atmosphere (see Note 1) | mol $s^{-1}$ |
| 57 | Total yearly average burden of the atmosphere | mol |
| 58 | Total yearly averaged atmospheric loss (see Note 1) | mol $s^{-1}$ |
| 59-99 | Reserved | |
| 100 | Surface area density (aerosol) | $m^{-1}$ |
| 101 | Atmosphere optical thickness | m |
| 102-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Note:
(1) FirstFixedSurface and SecondFixedSurface of Code Table 4.5 (Fixed surface types and units) to define the vertical extent, i.e. FirstFixedSurface can be set to 1 (Ground or water surface) and SecondFixedSurface set to 7 (Tropopause) for a restriction to the troposphere.

**Product Discipline 0: Meteorological products, Parameter Category 190: CCITT IA5 string**

| Number | Parameter | Units |
|---|---|---|
| 0 | Arbitrary text string | CCITTIA5 |
| 1-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**Product Discipline 0: Meteorological products, Parameter Category 191: Miscellaneous**

| Number | Parameter | Units | |
|---|---|---|---|
| 0 | Seconds prior to initial reference time (defined in Section 1) | s | |
| 1 | Geographical latitude | deg N | -validation |
| 2 | Geographical longitude | deg E | -validation |
| 3-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

**Product Discipline 1: Hydrologic products, Parameter Category 0: Hydrology basic products**

| Number | Parameter | Units |
|---|---|---|
| 0 | Flash flood guidance<br>*(Encoded as an accumulation over a floating subinterval of time between the reference time and valid time)* | kg $m^{-2}$ |

| | | |
|---|---|---|
| 1 | Flash flood runoff<br>*(Encoded as an accumulation over a floating subinterval of time)* | kg $m^{-2}$ |
| 2 | Remotely sensed snow cover | (code table 4.215) |
| 3 | Elevation of snow covered terrain | (code table 4.216) |
| 4 | Snow water equivalent percent of normal | % |
| 5 | Baseflow-groundwater runoff | kg $m^{-2}$ |
| 6 | Storm surface runoff | kg $m^{-2}$ |
| 7-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

Notes:

(1) Remotely sensed snow cover is expressed as a field of dimensionless, thematic values. The currently accepted values are for no-snow/no-cloud, 50, for clouds, 100, and for snow, 250. See code table 4.215.

(2) A data field representing snow coverage by elevation portrays at which elevations there is a snow pack. The elevation values typically range from 0 to 90 in 100 m increments. A value of 253 is used to represent a no-snow/no-cloud data point. A value of 254 is used to represent a data point at which snow elevation could not be estimated because of clouds obscuring the remote sensor (when using aircraft or satellite measurements).

(3) Snow water equivalent percent of normal is stored in percent of normal units. For example, a value of 110 indicates 110 percent of the normal snow water equivalent for a given depth of snow.

(4) Supercooled large droplets (SLD) are defined as those with a diameter greater than 50 microns.

**Product Discipline 1: Hydrologic products, Parameter Category 1: Hydrology probabilities**

| Number | Parameter | Units |
|---|---|---|
| 0 | Conditional percent precipitation amount fractile for an overall period (*Encoded as an accumulation).* | kg $m^{-2}$ |
| 1 | Percent precipitation in a sub-period of an overall period (*Encoded as per cent accumulation over the sub-period)* | % |
| 2 | Probability of 0.01 inch of precipitation (POP) | % |
| 3-191 | 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 (1=land, 0=sea) | Proportion |
| 1 | Surface roughness | m |
| 2 | Soil temperature * | K |
| 3 | Soil moisture content* | kg $m^{-2}$ |
| 4 | Vegetation | % |
| 5 | Water runoff | kg $m^{-2}$ |
| 6 | Evapotranspiration | kg $^{-2}$ $s^{-1}$ |
| 7 | Model terrain height | m |
| 8 | Land use | code table (4.212) |
| 9 | Volumetric soil moisture content** | Proportion |
| 10 | Ground heat flux* | W $m^{-2}$ |
| 11 | Moisture availability | % |
| 12 | Exchange coefficient | kg $m^{-2}$ $s^{-1}$ |
| 13 | Plant canopy surface water | kg $m^{-2}$ |
| 14 | Blackadar's mixing length scale | m |
| 15 | Canopy conductance | m $s^{-1}$ |
| 16 | Minimal stomatal resistance | s $m^{-1}$ |
| 17 | Wilting point** | Proportion |
| 18 | Solar parameter in canopy conductance | Proportion |
| 19 | Temperature parameter in canopy conductance | Proportion |
| 20 | Soil moisture parameter in canopy conductance | Proportion |
| 21 | Humidity parameter in canopy conductance | Proportion |
| 22 | Soil moisture * | kg $m^{-3}$ |

| | | | |
|---|---|---|---|
| 23 | Column-integrated soil water * | kg $m^{-2}$ | |
| 24 | Heat flux | W $m^{-2}$ | |
| 25 | Volumetric soil moisture | $m^3$ $m^{-3}$ | |
| 26 | Wilting point | kg $m^{-3}$ | |
| 27 | Volumetric wilting point | $m^3$ $m^{-3}$ | |
| 28 | Leaf area index | Numeric | - validation |
| 29 | Evergreen forest | Numeric | - validation |
| 30 | Deciduous forest | Numeric | - validation |
| 31 | Normalized differential vegetation index (NDVI) | Numeric | - validation |
| 32 | Root depth of vegetation | M | - validation |
| 33-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Notes: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.
** It is not recommended to use this parameter, but to use another one with a more descriptive unit.

**Product Discipline 2: Land surface products, Parameter Category 3: Soil Products**

| Number | Parameter | Units | |
|---|---|---|---|
| 0 | Soil type | code table (4.213) | |
| 1 | Upper layer soil temperature* | K | |
| 2 | Upper layer soil moisture* | kg $m^{-3}$ | |
| 3 | Lower layer soil moisture* | kg $m^{-3}$ | |
| 4 | Bottom layer soil temperature* | K | |
| 5 | Liquid volumetric soil moisture (non-frozen)** | Proportion | |
| 6 | Number of soil layers in root zone | Numeric | |
| 7 | Transpiration stress-onset (soil moisture)** | Proportion | |
| 8 | Direct evaporation cease (soil moisture)** | Proportion | |
| 9 | Soil porosity** | Proportion | |
| 10 | Liquid volumetric soil moisture (non-frozen) | $m^3$ $m^{-3}$ | |
| 11 | Volumetric transpiration stress-onset (soil moisture) | $m^3$ $m^{-3}$ | |
| 12 | Transpiration stress-onset (soil moisture) | kg $m^{-3}$ | |
| 13 | Volumetric direct evaporation cease (soil moisture) | $m^3$ $m^{-3}$ | |
| 14 | Direct evaporation cease (soil moisture) | kg $m^{-3}$ | |
| 15 | Soil porosity | $m^3$ $m^{-3}$ | |
| 16 | Volumetric saturation of soil moisture | $m^3$ $m^{-3}$ | |
| 17 | Saturation of soil moisture | kg $m^{-3}$ | |
| 18 | Soil Temperature | K | - validation |
| 19 | Soil moisture | kg $m^{-3}$ | - validation |
| 20 | Column-integrated soil moisture | kg $m^{-2}$ | - validation |
| 21 | Soil ice | kg $m^{-3}$ | - validation |
| 22 | Column-integrated soil ice | kg $m^{-2}$ | - validation |
| 23-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Notes: * Parameter deprecated - See Regulation 92.6.2 and use another parameter instead.
** It is not recommended to use this parameter, but to use another one with a more descriptive unit.

**Product discipline 2: Land surface products, Parameter Category 4: Fire Weather Products** -validation

| Number | Parameter | Units |
|---|---|---|
| 0 | Fire Outlook Critical Risk Area | % |
| 1 | Fire Outlook Extreme Critical Risk Area | % |
| 2 | Fire Outlook Dry Lightning Area | % |

**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 | Cloud mask | Code table 4.217 |
| 8 | Pixel scene type | Code table 4.218 |
| 9 | Fire detection indicator | Code table 4.223 |
| 10-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**Product Discipline 3: Space products, Parameter Category 1: Quantitative products**

| Number | Parameter | Units | |
|---|---|---|---|
| 0 | Estimated precipitation | kg $m^{-2}$ | |
| 1 | Instantaneous rain rate | kg $m^{-2}$ $s^{-1}$ | |
| 2 | Cloud top height | m | |
| 3 | Cloud top height quality indicator | Code table 4.219 | |
| 4 | Estimated u component of wind | m $s^{-1}$ | |
| 5 | Estimated v component of wind | m $s^{-1}$ | |
| 6 | Number of pixels used | Numeric | |
| 7 | Solar zenith angle | Degree | |
| 8 | Relative azimuth angle | Degree | |
| 9 | Reflectance in 0.6 micron channel | % | |
| 10 | Reflectance in 0.8 micron channel | % | |
| 11 | Reflectance in 1.6 micron channel | % | |
| 12 | Reflectance in 3.9 micron channel | % | |
| 13 | Atmospheric divergence | $s^{-1}$ | |
| 14 | Cloudy brightness temperature | K | -validation |
| 15 | Clear-Sky brightness temperature | K | -validation |
| 16 | Cloudy radiance (with respect to wave number) | W $m^{-1}$ $sr^{-1}$ | -validation |
| 17 | Clear-Sky radiance (with respect to wave number) | W $m^{-1}$ $sr^{-1}$ | -validation |
| 18 | Reserved | | |
| 19 | Wind speed | $ms^{-1}$ | -preoperational |
| 20 | Aerosol optical thickness at 0.635 um | - | -preoperational |
| 21 | Aerosol optical thickness at 0.810 um | - | -preoperational |
| 22 | Aerosol optical thickness at 1.640 um | - | -preoperational |
| 23 | Angstrom coefficient | - | -preoperational |
| 24-191 | 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 |

| | |
|---|---|
| 14-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**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 |
| 9-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**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: Sub-surface Properties**

| Number | Parameter | Units |
|---|---|---|
| 0 | Main thermocline depth | m |
| 1 | Main thermocline anomaly | m |
| 2 | Transient thermocline depth | m |
| 3 | Salinity | kg $kg^{-1}$ |
| 4-191 | 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 | $m^3$ $s^{-1}$ | -preoperational |
| 2-191 | Reserved | | |
| 192-254 | Reserved for local use | | |

| | |
|---|---|
| 255 | Missing |

**Code table 4.3: 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 | |
| 8 | Observation | |
| 9 | Climatological | |
| 10 | Probability-weighted forecast | |
| 11 | Bias-corrected ensemble forecast | -preoperational |
| 12-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**Code Table 4.4: 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 table 4.5: Fixed surface types and units**

| Code Figure | Meaning | Units |
|---|---|---|
| 0 | Reserved | |
| 1 | Ground or water surface | - |
| 2 | Cloud base level | - |
| 3 | Level of cloud tops | - |
| 4 | Level of $0^{o}$ 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 | Entire atmosphere | - |
| 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 | - | |
| 112-116 | Reserved | | |
| 117 | Mixed layer depth | m | |
| 118 | Hybrid height level | - | -preoperational |
| 119 | Hybrid pressure level | - | -preoperational |
| 120 | Pressure Thickness | Pa | -validation |
| 121-159 | Reserved | | |
| 160 | Depth below sea level | m | |
| 161-191 | Reserved | | |
| 192-254 | Reserved for local use | | |
| 255 | Missing | | |

Note:

(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:

$z(k) = A(k) + B(k) * orog$

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

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

$p(k) = A(k) + B(k) * sp$

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

**Code Table 4.6: Type of ensemble forecast**

| Code figure | Meaning | |
|---|---|---|
| 0 | Unperturbed high-resolution control forecast | |
| 1 | Unperturbed low-resolution control forecast | |
| 2 | Negatively perturbed forecast | |
| 3 | Positively perturbed forecast | |
| 4 | Multi-model forecast | -preoperational |
| 5-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**Code Table 4.7: Derived forecast**

| Code figure | Meaning | |
|---|---|---|
| 0 | Unweighted mean of all members | |
| 1 | Weighted mean of all members | |
| 2 | Standard deviation with respect to cluster mean | |
| 3 | Standard deviation with respect to cluster mean, normalized | |
| 4 | Spread of all members | |
| 5 | Large anomaly index of all members (see Note) | |
| 6 | Unweighted mean of the cluster members | |
| 7 | Interquartile range | -validation |
| 8 | Minimum of all ensemble members | -validation |
| 9 | Maximum of all ensemble members | -validation |
| 10-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

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

**Code Table 4.8: Clustering Method**

| Code figure | Meaning |
|---|---|
| 0 | Anomaly correlation |
| 1 | Root mean square |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.9: Probability Type**

| Code figure | Meaning |
|---|---|
| 0 | Probability of event below lower limit |
| 1 | Probability of event above upper limit |
| 2 | Probability of event between lower and upper limits. The range includes the lower limit but not the upper limit. |
| 3 | Probability of event above lower limit |
| 4 | Probability of event below upper limit |
| 5-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.10: Type of statistical processing**

| Code figure | Meaning |
|---|---|
| 0 | Average |
| 1 | Accumulation |
| 2 | Maximum |
| 3 | Minimum |
| 4 | Difference (Value at the end of time range minus value at the beginning) |
| 5 | Root mean square |
| 6 | Standard deviation |
| 7 | Covariance (Temporal variance) |
| 8 | Difference (Value at the start of time range minus value at the end) |
| 9 | Ratio |
| 10-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.11: Type of time intervals**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Successive times processed have same forecast time, start time of forecast is incremented |
| 2 | Successive times processed have same start time of forecast, forecast time is incremented |
| 3 | Successive times processed have start time of forecast incremented and forecast time decremented so that valid time remains constant |
| 4 | Successive times processed have start time of forecast decremented and forecast time incremented so that valid time remains constant |
| 5 | Floating subinterval of time between forecast time and end of overall time interval |
| 6-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

Note: Code figure 5 applies to instances where a single time subinterval was used to calculate the statistically processed field. The exact starting and ending times of the subinterval are not given, but it is known that it is contained inclusively between the beginning time and the ending time of the overall interval.

**Code Table 4.12: Operating Mode**

| Code figure | Meaning |
|---|---|
| 0 | Maintenance Mode |
| 1 | Clear air |
| 2 | Precipitation |
| 3 -191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.13: Quality Control Indicator**

| Code figure | Meaning |
|---|---|
| 0 | No quality control applied |
| 1 | Quality control applied |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.14: Clutter Filter Indicator**

| Code figure | Meaning |
|---|---|
| 0 | No clutter filter used |
| 1 | Clutter filter used |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code table 4.15: Type of spatial processing used to arrive at given data value from the source data** -preoperational

| Code figure | Meaning |
|---|---|
| 0 | Data is calculated directly from the source grid with no interpolation (see Note 1) |
| 1 | Bilinear interpolation using the 4 source grid grid-point values surrounding the nominal grid-point |
| 2 | Bicubic interpolation using the 4 source grid grid-point values surrounding the nominal grid-point |
| 3 | Using the value from the source grid grid-point which is nearest to the nominal grid-point |
| 4 | Budget interpolation using the 4 source grid grid-point values surrounding the nominal grid-point (see Note 2) |
| 5 | Spectral interpolation using the 4 source grid grid-point values surrounding the nominal grid-point |
| 6 | Neighbour-budget interpolation using the 4 source grid grid-point values surrounding the nominal grid-point (see Note 3) |
| 7-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

Notes:

(1) This method assumes that each field really represents box averages/maxima/minima where each box extends halfway to its neighbouring grid point in each direction to represent averages/maxima/minima of values from the source grid with no interpolation.

(2) Budget interpolation means a low-order interpolation method that quasi-conserves area averages. It would be appropriate for interpolating budget fields such as precipitation. This method assumes that the field really represents box averages/maxima/minima where each box extends halfway to its neighbouring grid point in each direction. The method actually averages bilinearly interpolated values in a square array of points distributed within each output grid box.

(3) Performs a budget interpolation at the grid point nearest to the nominal grid point.

**Code Table 4.91: Type of Interval** - validation

| 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 Table 4.201: Precipitation Type**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Rain |
| 2 | Thunderstorm |
| 3 | Freezing rain |
| 4 | Mixed/ice |
| 5 | Snow |
| 6-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.202: Precipitable water category**

| Code figure | Meaning |
|---|---|
| 0-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.203: Cloud type**

| Code figure | Meaning |
|---|---|
| 0 | Clear |
| 1 | Cumulonimbus |
| 2 | Stratus |
| 3 | Stratocumulus |
| 4 | Cumulus |
| 5 | Altostratus |
| 6 | Nimbostratus |
| 7 | Altocumulus |
| 8 | Cirrostratus |
| 9 | Cirrocumulus |
| 10 | Cirrus |
| 11 | Cumulonimbus - ground based fog beneath the lowest layer |
| 12 | Stratus - ground based fog beneath the lowest layer |
| 13 | Stratocumulus - ground based fog beneath the lowest layer |
| 14 | Cumulus - ground based fog beneath the lowest layer |
| 15 | Altostratus - ground based fog beneath the lowest layer |
| 16 | Nimbostratus - ground based fog beneath the lowest layer |
| 17 | Altocumulus - ground based fog beneath the lowest layer |
| 18 | Cirrostratus - ground based fog beneath the lowest layer |
| 19 | Cirrocumulus - ground based fog beneath the lowest layer |
| 20 | Cirrus - ground based fog beneath the lowest layer |
| 21-190 | Reserved |
| 191 | Unknown |
| 192-254 | Reserved for local use |
| 255 | Missing |

Note: Code figures 11-20 indicate all four layers were used and a ground-based fog is beneath the lowest layer.

**Code Table 4.204: Thunderstorm coverage**

| Code figure | Meaning |
|---|---|
| 0 | None |
| 1 | Isolated (1% - 2%) |
| 2 | Few (3% - 15%) |
| 3 | Scattered (16% - 45%) |
| 4 | Numerous (> 45%) |
| 5-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.205: Aerosol type** name change --> "Presence of aerosol" - validation

| Code figure | Meaning |
|---|---|
| 0 | Aerosol not present |
| 1 | Aerosol present |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.206: Volcanic ash**

| Code figure | Meaning |
|---|---|
| 0 | Not present |
| 1 | Present |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.207: Icing**

| Code figure | Meaning |
|---|---|
| 0 | None |
| 1 | Light |
| 2 | Moderate |
| 3 | Severe |
| 4 | Trace |
| 5 | Heavy |
| 6-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.208: Turbulence**

| Code figure | Meaning |
|---|---|
| 0 | None (smooth) |
| 1 | Light |
| 2 | Moderate |
| 3 | Severe |
| 4 | Extreme |
| 5-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.209: Planetary boundary layer regime**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Stable |

| | |
|---|---|
| 2 | Mechanically driven turbulence |
| 3 | Forced convection |
| 4 | Free convection |
| 5-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.210: Contrail intensity**

| Code figure | Meaning |
|---|---|
| 0 | Contrail not present |
| 1 | Contrail present |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.211: Contrail engine type**

| Code figure | Meaning |
|---|---|
| 0 | Low bypass |
| 1 | High bypass |
| 2 | Non bypass |
| 3-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.212: Land Use**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Urban land |
| 2 | Agriculture |
| 3 | Range land |
| 4 | Deciduous forest |
| 5 | Coniferous forest |
| 6 | Forest/wetland |
| 7 | Water |
| 8 | Wetlands |
| 9 | Desert |
| 10 | Tundra |
| 11 | Ice |
| 12 | Tropical forest |
| 13 | Savannah |
| 14-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.213: Soil type**

| Code figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Sand |
| 2 | Loamy sand |
| 3 | Sandy loam |
| 4 | Silt loam |
| 5 | Organic (redefined) |
| 6 | Sandy clay loam |
| 7 | Silt clay loam |
| 8 | Clay loam |

| | | |
|---|---|---|
| 9 | Sandy clay | |
| 10 | Silty clay | |
| 11 | Clay | |
| 12 | Loam | - validation |
| 13 | Peat | - validation |
| 14 | Rock | - validation |
| 15 | Ice | - validation |
| 16 | Water | - validation |
| 17-191 | Reserved | |
| 192-254 | Reserved for local use | |
| 255 | Missing | |

**Code Table 4.215: Remotely Sensed Snow Coverage**

| Code Figure | Meaning |
|---|---|
| 0-49 | Reserved |
| 50 | No-snow/no-cloud |
| 51-99 | Reserved |
| 100 | Clouds |
| 101-249 | Reserved |
| 250 | Snow |
| 251-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.216: Elevation of Snow Covered Terrain**

| Code Figure | Meaning |
|---|---|
| 0-90 | Elevation in increments of 100 m |
| 91-253 | Reserved |
| 254 | Clouds |
| 255 | Missing |

**Code table 4.217 Cloud mask type**

| Code figure | Meaning |
|---|---|
| 0 | Clear over water |
| 1 | Clear over land |
| 2 | Cloud |
| 3 | No data |
| 4-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.218 - Pixel scene type**

| Code figure | Meaning |
|---|---|
| 0 | No scene identified |
| 1 | Green needle leafed forest |
| 2 | Green broad-leafed forest |
| 3 | Deciduous needle leafed forest |
| 4 | Deciduous broad-leafed forest |
| 5 | Deciduous mixed forest |
| 6 | Closed shrub-land |
| 7 | Open shrub-land |
| 8 | Woody savannah |
| 9 | Savannah |
| 10 | Grassland |
| 11 | Permanent wetland |
| 12 | Cropland |

| | |
|---|---|
| 13 | Urban |
| 14 | Vegetation / crops |
| 15 | Permanent snow / ice |
| 16 | Barren desert |
| 17 | Water bodies |
| 18 | Tundra |
| 19-96 | Reserved |
| 97 | Snow / ice on land |
| 98 | Snow / ice on water |
| 99 | Sun-glint |
| 100 | General cloud |
| 101 | Low cloud / fog / Stratus |
| 102 | Low cloud / Stratocumulus |
| 103 | Low cloud / unknown type |
| 104 | Medium cloud / Nimbostratus |
| 105 | Medium cloud / Altostratus |
| 106 | Medium cloud / unknown type |
| 107 | High cloud / Cumulus |
| 108 | High cloud / Cirrus |
| 109 | High cloud / unknown |
| 110 | Unknown cloud type |
| 111-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.219 - Cloud top height quality indicator**

| Code figure | Meaning |
|---|---|
| 0 | Nominal cloud top height quality |
| 1 | Fog in segment |
| 2 | Poor quality height estimation |
| 3 | Fog in segment and poor quality height estimation |
| 4-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.220: Horizontal dimension processed**

| Code figure | Meaning |
|---|---|
| 0 | Latitude |
| 1 | Longitude |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.221: Treatment of missing data**

| Code figure | Meaning |
|---|---|
| 0 | Not included |
| 1 | Extrapolated |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code table 4.222: Categorical result**

| Code figure | Meaning |
|---|---|
| 0 | No |
| 1 | Yes |

| | |
|---|---|
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 4.223 - Fire detection indicator**

| Code figure | Meaning |
|---|---|
| 0 | No fire detected |
| 1 | Possible fire detected |
| 2 | Probable fire detected |
| 3 | Missing |

**Code Table 4.230: Atmospheric chemical constituent type**
(see Common Code Table C-14)

**Code Table 4.233: Aerosol type** - validation
(see Common Code Table C-14)

## CODE AND FLAG TABLES USED IN SECTION 5

**Code Table 5.0: Data Representation Template Number**

| Code figure | Meaning |
|---|---|
| 0 | Grid point data - simple packing |
| 1 | Matrix value - simple packing |
| 2 | Grid point data - complex packing |
| 3 | Grid point data - complex packing and spatial differencing |
| 4 | Grid point data – IEEE floating point data |
| 5-39 | Reserved |
| 40 | Grid point data – JPEG 2000 Code Stream Format |
| 41 | Grid point data – Portable Network Graphics (PNG) |
| 42 | Grid point and spectral data - CCSDS szip - validation |
| 43-49 | Reserved |
| 50 | Spectral data -simple packing |
| 51 | Spherical harmonics data - complex packing |
| 52-60 | Reserved |
| 61 | Grid point data - simple packing with logarithm pre-processing |
| 62-199 | Reserved |
| 200 | Run length packing with level values |
| 201-49151 | Reserved |
| 49152-65534 | Reserved for local use |
| 65535 | Missing |

**Code Table 5.1: 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 5.2: Matrix coordinate value function definition**.

| Code Figure | Meaning |
|---|---|
| 0 | Explicit coordinate values set |
| 1 | Linear coordinates<br>f(1)=C1<br>f(n)=f (n-1)+C2 |
| 2-10 | Reserved |
| 11 | Geometric coordinates<br>f (1)=C1<br>f(n)=C2*f(n-1) |
| 12-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 5.3: Matrix coordinate parameter**

| Code Figure | Meaning |
|---|---|
| 1 | Direction Degrees true |
| 2 | Frequency ($s^{-1}$) |
| 3 | Radial number (2pi/lambda) ($m^{-1}$) |
| 4-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 5.4: Group Splitting Method**

| Code figure | Meaning |
|---|---|
| 0 | Row by row splitting |
| 1 | General group splitting |
| 2-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 5.5: Missing Value Management for Complex Packing**

| 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 5.6: Order of Spatial Differencing**

| Code Figure | Meaning |
|---|---|
| 0 | Reserved |
| 1 | First-order spatial differencing |
| 2 | Second-order spatial differencing |
| 3-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

**Code Table 5.7: 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 Table 5.40: Type of Compression**

| Code figure | Meaning |
|---|---|
| 0 | Lossless |
| 1 | Lossy |
| 2-254 | Reserved |
| 255 | Missing |

**CODE AND FLAG TABLES USED IN SECTION 6**

**Code Table 6.0: Bit Map Indicator**

| Code figure | Meaning |
|---|---|
| 0 | A bit map applies to this product and is specified in this Section |
| 1 - 253 | A bit map pre-determined by the originating/generating Centre applies to this product and is not specified in this Section. |
| 254 | A bit map defined previously in the same "GRIB" message applies to this product. |
| 255 | A bit map does not apply to this product. |