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| WORLD METEOROLOGICAL ORGANIZATIONCOMMISSION FOR BASIC SYSTEMS-----------------------------FIRST MEETING OFINTER-PROGRAMME EXPERT TEAM ONCODES MAINTENANCEGENEVA, SWITZERLAND, 24 - 28 JULY 2017 |  | IPET-CM-I / Doc. 2.6 (4) rev(12. 7. 2017)-------------------------ITEM 2.6ENGLISH ONLY |

GRIB edition 3

**Template for Gaussian and other grids.**

*Submitted by Enrico Fucile*

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**Summary and Purpose of Document**

Template and template components are proposed to represent complex grids for which a list of latitudes is defined. This type of grids include the Gaussian reduced and many others.

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**ACTION PROPOSED**

The Team is asked to review the proposal and accept it for validation.

**DISCUSSIONS**

There are two reasons to have a different representation of grids in GRIB-3.

1. In GRIB-2 the grid is defined with few parameters and the computation of the latitudes and longitudes for each point is left to the user. Due to the increased resolution and complexity of the grids the error associated with the computation of the latitudes, longitudes values can be significant and there is the need of a more precise description of the grid points.
2. Development of new grids is progressing very fast and there is the need from the research to have a flexible scheme to develop and test new grids.

The template components proposed are trying to provide a flexible way to describe a grid, while providing a way to associate with it an algorithm used for their construction. In this set of grids the latitudes are separate from the longitudes. This cannot describe all the grid types. More generic grids or meshes are considered in a different set of templates.

**PROPOSAL**

***Horizontal Domain Template Component 4.5 – Latitudes simple packing***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1-2 | Number of parallels (2) |
| 5 | Latitudes Generating algorithm (code table 4.x) |
| 6-13 | Latitude Reference Value. (IEEE 64-bit floating-point) |
| 14-15 | Latitude Binary scale factor  |
| 16-17 | Latitude Decimal scale factor  |
| 18 | Number of bits used for each latitude value |
| 19-20 | Nblat - Number of bytes of latitude encoded data |
| 21 – Nblat | Latitude simple packing encoded data |

Notes:

(1) The template provides an ordered list of latitudes (parallels) and shall be combined with a definition of the longitudes per parallel.

(2) Unsigned

**Code table 4.x** – *Latitudes generating algorithm*

Code figure Meaning

 0 Gaussian quadrature points

 1 Regular latitudes

 2 Shifted regular latitudes

 3 Chebyskev nodes

 255 Missing

***Horizontal Domain Template Component 4.6 –Periodic Longitudes with number of points per parallel***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1 - 8 | Longitude of first point (IEEE 64-bit floating point) |
| 9 - 10 | NP - Number of parallels (1) |
| 11 - 11+2\*NP  | Number of points per parallel |

Notes:

(1) unsigned

***Horizontal Domain Template Component 4.7 – Periodic Longitudes with number of points per parallel and Longitude of first point per parallel***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1 - 2 | NP - Number of parallels (1)  |
|  5 - 5+2\*NP  | Number of points per parallel |
| 6+NP - 6+16\*NP | Longitude of first point per parallel (IEEE 64-bit floating point) |

Notes:

(1) unsigned

***Horizontal Domain Template Component 4.8 – Non-periodic Longitudes with number of points per parallel***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1 - 2 | NP - Number of parallels (2) |
| 5 - 12 | Longitude of first point per parallel (IEEE 64-bits floating point) |
| 13 - 20 | Longitude of last point per parallel (IEEE 64-bits floating point) |
|  20 - 20 +2\*NP  | Number of points per parallel |

***Note:***

 (1) Longitude of first point per parallel shall not be equal to longitude of last point per parallel

(2) unsigned

***Horizontal Domain Template Component 4.9 – Regular Latitudes***

|  |  |
| --- | --- |
| **Byte No.** | **Contents** |
| 1-4 | Nj – number of points along a meridian |
| 5-8 | Basic angle of the initial production domain (see Note 1) |
| 9-12 | Subdivisions of basic angle used to define extreme latitudes, and direction increments (see Note 1) |
| 13-16 | La1 – latitude of first grid point (see Note 1) |
| 17 | Resolution and component flags (see Flag table 4.1) |
| 18-21 | La2 – latitude of last grid point (see Note 1) |
| 22-25 | Dj – j direction increment (see Notes 1 and 2) |

Notes:

(1) Basic angle of the initial production domain and subdivisions of this basic angle are provided to manage cases where the recommended unit of 10–6 degrees is not applicable to describe the extreme longitudes and latitudes, and direction increments. For these last six descriptors, the unit is equal to the ratio of the basic angle and the subdivisions number.
For ordinary cases, zero and missing values should be coded, equivalent to respective values of 1 and 106 (10–6 degrees unit).

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

***Horizontal Domain Template Component 4.10 – Regular longitudes***

|  |  |
| --- | --- |
| **Byte No.** | **Contents** |
| 1-4 | Ni – number of points along a parallel |
| 9-12 | Basic angle of the initial production domain (see Note 1) |
| 13-16 | Subdivisions of basic angle used to define extreme longitudes, and direction increments (see Note 1) |
| 21-24 | Lo1 – longitude of first grid point (see Note 1) |
| 30-33 | Lo2 – longitude of last grid point (see Note 1) |
| 34-37 | Di – i direction increment (see Notes 1 and 2) |

Notes:

(1) Basic angle of the initial production domain and subdivisions of this basic angle are provided to manage cases where the recommended unit of 10–6 degrees is not applicable to describe the extreme longitudes and latitudes, and direction increments. For these last six descriptors, the unit is equal to the ratio of the basic angle and the subdivisions number.
For ordinary cases, zero and missing values should be coded, equivalent to respective values of 1 and 106 (10–6 degrees unit).

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

***Horizontal Domain Template Component 4.9 – Selection of latitudes***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1 - 2 | First latitude rank |
| 3 - 4 | Last latitude rank |

***Horizontal Domain Template Component 4.10 – Selection of points per parallel***

|  |  |
| --- | --- |
| Byte No. | Contents |
| 1 - 2 | NP - Number of parallels (1) |
|  5 - 5+NP  | Parallel first point ranks |
|  5+NP - 5+2\*NP  | Parallel last point ranks |

Note:

(1) unsigned

**Proposed Templates**

***Horizontal Domain Template 4.x1 – Latitudes simple packing, Periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.6 | Periodic longitudes with number of points per parallel |

***Horizontal Domain Template 4.x2 – Latitudes simple packing, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |

***Horizontal Domain Template 4.x3 – Latitudes simple packing, non-periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.8 | Non-periodic longitudes with number of points per parallel |

***Horizontal Domain Template 4.x4 – Latitudes simple packing, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.10 | Regular longitudes |

***Horizontal Domain Template 4.x5 – Regular Latitudes, Periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.6 | Periodic longitudes with number of points per parallel |

***Horizontal Domain Template 4.x6 – Regular Latitudes, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |

***Horizontal Domain Template 4.x7 – Regular Latitudes, non-periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.8 | Non-periodic longitudes with number of points per parallel |

***Horizontal Domain Template 4.x8 – Regular Latitudes, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.10 | Regular longitudes  |

***Horizontal Domain Template 4.x9 – Latitudes simple packing, Periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x10 – Latitudes simple packing, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x11 – Latitudes simple packing, non-periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x12 – Latitudes simple packing, regular Longitudes on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.10 | Regular longitudes |
| 4.11 | Selection of latitudes |
| 4.13 | Selection of longitudes |

***Horizontal Domain Template 4.x13 – Regular Latitudes, Periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x14 – Regular Latitudes, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x15 – Regular Latitudes, non-periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |

***Horizontal Domain Template 4.x16 – Regular Latitudes, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.10 | Regular longitudes  |
| 4.11 | Selection of latitudes |
| 4.13 | Selection of longitudes |

***Horizontal Domain Template 4.y1 – Rotated Latitudes simple packing, Periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y2 – Rotated Latitudes simple packing, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y3 – Rotated Latitudes simple packing, non-periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y4 – Rotated Latitudes simple packing, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.10 | Regular longitudes |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y5 – Rotated Regular Latitudes, Periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y6 – Rotated Regular Latitudes, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y7 – Rotated Regular Latitudes, non-periodic Longitudes with number of points per parallel on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y8 – Rotated Regular Latitudes, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.10 | Regular longitudes  |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y9 – Rotated Latitudes simple packing, Periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y10 – Rotated Latitudes simple packing, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y11 – Rotated Latitudes simple packing, non-periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y12 – Rotated Latitudes simple packing, regular Longitudes on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.5 | Latitudes simple packing |
| 4.10 | Regular longitudes |
| 4.11 | Selection of latitudes |
| 4.13 | Selection of longitudes |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y13 – Rotated Regular Latitudes, Periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.6 | Periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y14 – Rotated Regular Latitudes, Periodic Longitudes with number of points per parallel and longitude of first point per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.7 | Periodic longitudes with number of points per parallel and longitude of first point per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y15 – Rotated Regular Latitudes, non-periodic Longitudes with number of points per parallel on ellipsoidal planet, sub-grid***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.8 | Non-periodic longitudes with number of points per parallel |
| 4.11 | Selection of latitudes |
| 4.12 | Selection of points per parallel |
| 4.2 | Rotation of latitude/longitude coordinate system |

***Horizontal Domain Template 4.y16 – Rotated Regular Latitudes, regular Longitudes on ellipsoidal planet***

|  |  |
| --- | --- |
| Component Code | Component Name |
| 4.0 | Ellipsoid of revolution defined with axis lengths |
| 4.9 | Regular Latitudes |
| 4.10 | Regular longitudes  |
| 4.11 | Selection of latitudes |
| 4.13 | Selection of longitudes |
| 4.2 | Rotation of latitude/longitude coordinate system |