* **ANNEX TO PARAGRAPH 2016-2.2.1 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_1)

3 May 2017

**Add a new parameter:**

in Code Table 4.2, Discipline 10 (Oceanographic products), Category 3 (Surface properties)

Number Parameter Units

2 Heat exchange coefficient -

* **ANNEX TO PARAGRAPH 2016-2.2.2 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_2)

**Add new templates:**

***Product definition template 4.70 – Post-processing 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)  
 12-13 Input process identifier (see Note 1)  
 14-15 Input originating centre (see common code table C-11 and Note 2)  
 16 Type of post-processing (see Note 3)

17 Type of generating process (see code table 4.3)

18 Background generating process identifier (defined by originating centre)

19 Analysis or forecast generating process identifier (defined by originating centre)

20–21 Hours of observational data cut-off after reference time (see Note 4)

22 Minutes of observational data cut-off after reference time

23 Indicator of unit of time range (see code table 4.4)

24–27 Forecast time in units defined by octet 23

28 Type of first fixed surface (see code table 4.5)

29 Scale factor of first fixed surface

30–33 Scaled value of first fixed surface

34 Type of second fixed surface (see code table 4.5)

35 Scale factor of second fixed surface

36-39 Scaled value of second fixed surface

Notes:

(1) The input process identifier shall have the value of the “analysis or forecast process identifier” of the original GRIB message used as input of the post-processing.

(2) The input originating centre shall have the value of the “originating centre” of the original GRIB message used as input of the post-processing.

(3) This identifies which post-processing technique was used. This is defined by the originating centre.

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

***Product definition template 4.71 – Post-processing 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)  
 12-13 Input process identifier (see Note 1)  
 14-15 Input originating centre (see common code table C-11 and Note 2)  
 16 Type of post-processing (see Note 3)

17 Type of generating process (see code table 4.3)

18 Background generating process identifier (defined by originating centre)

19 Forecast generating process identifier (defined by originating centre)

20–21 Hours after reference time of data cut-off (see Note 4)

22 Minutes after reference time of data cut-off

23 Indicator of unit of time range (see code table 4.4)

24–27 Forecast time in units defined by octet 23

28 Type of first fixed surface (see code table 4.5)

29 Scale factor of first fixed surface

30–33 Scaled value of first fixed surface

34 Type of second fixed surface (see code table 4.5)

35 Scale factor of second fixed surface

36–39 Scaled value of second fixed surface

40 Type of ensemble forecast (see code table 4.6)

41 Perturbation number

42 Number of forecasts in ensemble

Notes:

(1) The input process identifier shall have the value of the “analysis or forecast process identifier” of the original GRIB message used as input of the post-processing.

(2) The input originating centre shall have the value of the “originating centre” of the original GRIB message used as input of the post-processing.

(3) This identifies which post-processing technique was used. This is defined by the originating centre.

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

***Product definition template 4.72 – Post-processing 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***

Octet No. Contents

10 Parameter category (see code table 4.1)

11 Parameter number (see code table 4.2)

12-13 Input process identifier (see Note 1)

14-15 Input originating centre (see common code table C-11 and Note 2)  
 16 Type of post-processing (see Note 3)  
 17 Type of generating process (see code table 4.3)

18 Background generating process identifier (defined by originating centre)

19 Analysis or forecast generating process identifier (defined by originating centre)

20–21 Hours after reference time of data cut-off (see Note 4)

22 Minutes after reference time of data cut-off

23 Indicator of unit of time range (see code table 4.4)

24–27 Forecast time in units defined by octet 23 (see Note 5)

28 Type of first fixed surface (see code table 4.5)

29 Scale factor of first fixed surface

30–33 Scaled value of first fixed surface

34 Type of second fixed surface (see code table 4.5)

35 Scale factor of second fixed surface

36–39 Scaled value of second fixed surface

40–41 Year

42 Month

43 Day

Time of end of overall time interval

44 Hour

45 Minute

46 Second

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 6 and 7)

64–nn These octets are included only if n > 1, where nn = 51 + 12 x 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) The input process identifier shall have the value of the “analysis or forecast process identifier” of the original GRIB message used as input of the post-processing.

(2) The input originating centre shall have the value of the “originating centre” of the original GRIB message used as input of the post-processing.

(3) This identifies which post-processing technique was used. This is defined by the originating centre.

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

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

(6) 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.

(7) 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, 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 times.

***Product definition template 4.73 – Post-processing 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)  
 12-13 Input process identifier (see Note 1)  
 14-15 Input originating centre (see common code table C-11 and Note 2)  
 16 Type of post-processing (see Note 3)

17 Type of generating process (see code table 4.3)

18 Background generating process identifier (defined by originating centre)

19 Forecast generating process identifier (defined by originating centre)

20–21 Hours after reference time of data cut-off (see Note 4)

22 Minutes after reference time of data cut-off

23 Indicator of unit of time range (see code table 4.4)

24–27 Forecast time in units defined by octet 23 (see Note 5)

28 Type of first fixed surface (see code table 4.5)

29 Scale factor of first fixed surface

30–33 Scaled value of first fixed surface

34 Type of second fixed surface (see code table 4.5)

35 Scale factor of second fixed surface

36–39 Scaled value of second fixed surface

40 Type of ensemble forecast (see code table 4.6)

41 Perturbation number

42 Number of forecasts in ensemble

43–44 Year of end of overall time interval

45 Month of end of overall time interval

46 Day of end of overall time interval

47 Hour of end of overall time interval

48 Minute of end of overall time interval

49 Second of end of overall time interval

50 n – number of time range specifications describing the time intervals used to calculate the statistically processed field

51–54 Total number of data values missing in statistical process

55–66 Specification of the outermost (or only) time range over which statistical processing is done

55 Statistical process used to calculate the processed field from the field at each time increment during the time range (see code table 4.10)

56 Type of time increment between successive fields used in the statistical processing (see code table 4.11)

57 Indicator of unit of time for time range over which statistical processing is done (see code table 4.4)

58–61 Length of the time range over which statistical processing is done, in units defined by the previous octet

62 Indicator of unit of time for the increment between the successive fields used (see code table 4.4)

63–66 Time increment between successive fields, in units defined by the previous octet (see Note 6)

67–nn These octets are included only if n > 1, where nn = 54 + 12 x n

67–78 As octets 55 to 66, next innermost step of processing

79–nn Additional time range specifications, included in accordance with the value of n. Contents as octets 55 to 66, repeated as necessary

Notes:

(1) The input process identifier shall have the value of the “analysis or forecast process identifier” of the original GRIB message used as input of the post-processing.

(2) The input originating centre shall have the value of the “originating centre” of the original GRIB message used as input of the post-processing.

(3) This identifies which post-processing technique was used. This is defined by the originating centre.

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

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

(6) 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 56, 68, 80, ...). 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 times

**Add new entries:**

in code table 4.0,

Code Meaning

70 Post-processing analysis or forecast at a horizontal level or in a horizontal layer at a point in time  
 71 Post-processing individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time  
 72 Post-processing 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  
 73 Post-processing individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer, in a continuous or non-continuous time interval

* **ANNEX TO PARAGRAPH 2016-2.2.3 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_3)

**Add entries:**

in code table 4.2,

**Product Discipline 0 – Meteorological products, Parameter category 0: temperature**

|  |  |  |
| --- | --- | --- |
| number | parameter | units |
| 28 | Unbalanced component of temperature | K |

Description:

28: Residual resulting from subtracting from temperature an approximate "balanced" value derived from relevant variable(s).

**Product Discipline 0 – Meteorological products, Parameter category 1: Moisture**

|  |  |  |
| --- | --- | --- |
| number | parameter | units |
| 118 | Unbalanced component of specific humidity | kg kg-1 |
| 119 | Unbalanced component of specific cloud liquid water content | kg kg-1 |
| 120 | Unbalanced component of specific cloud ice water content | kg kg-1 |

Description:

* 118: Residual resulting from subtracting from specific humidity (mass of water vapour/mass of moist air) an approximate "balanced" value derived from relevant variable(s).
* 119: Residual resulting from subtracting from specific cloud liquid water content (mass of condensate/mass of moist air) an approximate "balanced" value derived from relevant variable(s).
* 120: Residual resulting from subtracting from specific cloud ice water content (mass of condensate/mass of moist air) an approximate "balanced" value derived from relevant variable(s).

**Product Discipline 0 – Meteorological products, Parameter category 2: momentum**

|  |  |  |
| --- | --- | --- |
| number | parameter | units |
| 45 | Unbalanced component of divergence | s-1 |

Description:

* 45: Residual resulting from subtracting from divergence an approximate "balanced" value derived from relevant variable(s).

**Product Discipline 0 – Meteorological products, Parameter category 3: mass**

|  |  |  |
| --- | --- | --- |
| number | parameter | units |
| 31 | Unbalanced component of logarithm of surface pressure | - |

Description:

* 31: Residual resulting from subtracting from logarithm of surface pressure an approximate "balanced" value derived from relevant variable(s). Note that this parameter is dimensionless.
* **ANNEX TO PARAGRAPH 2016-2.2.4 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_4)

**Add entries:**

in COMMON CODE TABLE C–14,

Code figure Meaning

62027–62099 Reserved

62100 **Alnus (Alder) pollen**

62101 **Betula (Birch) pollen**

62102 Castanea (Chestnut)pollen

62103 Carpinus (Hornbeam) pollen

62104 Corylus (Hazel) pollen

62105 Fagus (Beech) pollen

62106 Fraxinus (Ash) pollen

62107 Pinus (Pine) pollen

62108 Platanus (Plane) pollen

62109 Populus (Cottonwood, Poplar) pollen

62110 Quercus (Oak) pollen

62111 Salix (Willow) pollen

62112 Taxus (Yew) pollen

62113 Tilia (Lime, Linden) pollen

62114 Ulmus (Elm) pollen

62115-62199 Reserved

62200 **Ambrosia (Ragweed, Burr-ragweed )** pollen

62201 Artemisia (Sagebrush, Wormwood, Mugwort) pollen

62202 Brassica (Rape, Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collards, Kale, Kohlrabi, Mustard, Rutabaga) pollen

62203 Plantago (Plantain) pollen

62204 Rumex (Dock, Sorrel) pollen

62205 Urtica (Nettle) pollen

62206-62299 Reserved

62300 **Poaceae (Grass family)** pollen

62301-65534 Reserved

65535 Missing

*Editorial note: Information about pollen species is collected from* [*www.pollen.com*](http://www.pollen.com)*,* [*www.pollenflug.de*](http://www.pollenflug.de)*,* [*www.metoffice.gov.uk*](http://www.metoffice.gov.uk)*, www.polleninfo.org and* [*www.meteoswiss.admin.ch*](http://www.meteoswiss.admin.ch)*.*

**Add entries:**

in GRIB2 Table 4.2, discipline 0 (meteorological products), category 18 (nuclear/radiology),

17 Column-integrated air concentration Bq m-2

18 Column-averaged air concentration in layer Bq m-3

in GRIB2 Table 4.2, discipline 0 (meteorological products), category 20 (atmospheric chemical constituents),

63 Column-averaged mass density in layer kg m-3

in GRIB2 Table 4.5 – Fixed surface types and units,

21 Lowest level where mass density exceeds the specified value

(base for a given threshold of mass density) kg m-3

22 Highest level where mass density exceeds the specified

value (top for a given threshold of mass density) kg m-3

23 Lowest level where air concentration exceeds the specified

value (base for a given threshold of air concentration) Bq m-3

24 Highest level where air concentration exceeds the specified

value (top for a given threshold of air concentration) Bq m-3

* **ANNEX TO PARAGRAPH 2016-2.2.5 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_5)

Proposed new entries for common code table C-14 and code table 4.3

|  |  |  |
| --- | --- | --- |
|  | Proposed new entries for Common Code Table C-14 (Atmospheric chemical or physical constituent type) |  |
| Code Figure | Meaning | Chemical formula |
| 62026 | Particulate matter (PM) | none |

|  |  |
| --- | --- |
|  | Proposed new entries for Code Table 4.3  (Type of generating process) |
| Code Figure | Meaning |
| 18 | Difference between two forecasts |

* **ANNEX TO PARAGRAPH 2016-2.2.6 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_6) <[para 4.1](#A2016_4_1_grib)>

**Add templates:**

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

This template is only valid for Consultative Committee for Space Data Systems: Lossless Data Compression. CCSDS Recommendation for Space Data System Standards, CCSDS 121.0-B-2, Blue Book, May 2012.

|  |  |
| --- | --- |
| Data Representation Template 5.42 - Grid point and spectral data - CCSDS recommended lossless compression. | |
| 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 (see Note 1) |
| 21 | Type of original field values (see code table 5.1) |
| 22 | ​CCSDS compression options mask (see Note 3) |
| 23 | Block size |
| 24-25 | Reference sample interval |

Notes:

(1) The intent of this template is to scale the grid point data to obtain the desired precision, if appropriate, and then subtract the 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 encoded into the CCSDS recommended standard for lossless data compression code stream format. To unpack the data field, the CCSDS recommended standard for lossless data compression 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) recommended standard for lossless data compression is the standard used by space agencies for the compression of scientific data transmitted from satellites and other space instruments. CCSDS recommended standard for lossless data compression 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, the output of the marker of the selected coding method is encoded as ancillary information along with prediction errors.  
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

(3) Library flags governing data type, and storage and processing parameters. For further information, see Rosenhauer, Mathis. "Flags." libaec – Adaptive Entropy Coding library. German Climate Computing Centre (Deutsches Klimarechenzentrum, DKRZ), 12 May 2016. Web. 13 June 2016. <[http://gitlab.dkrz.de/k202009/libaec/blob/v0.3.3/README.md#flags](http://gitlab.dkrz.de/k202009/libaec/blob/v0.3.3/README.md" \l "flags" \t "_blank)>.

|  |  |
| --- | --- |
| Data Template 7.42 - Grid point and spectral data - CCSDS recommended lossless compression. | |
| Octet No. | Contents |
| 6 - nn | CCSDS recommended standard for lossless data compression code stream |

**Add an entry:**

in code table 5.0 – Data representation template number

|  |  |
| --- | --- |
| Code figure | Contents |
| 42 | Grid point and spectral data - CCSDS recommended lossless compression. |

* **ANNEX TO PARAGRAPH 2016-2.2.7 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_7)

**Add or amend entries:**

in code table 4.0: Product definition template number,

49 Individual ensemble forecast, control and perturbed, at a horizontal level or in a   
horizontal layer at a point in time for optical properties of aerosol

50 Reserved

56 Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for spatio-temporal changing tile parameters (deprecated)

58 Individual ensemble forecast, control and perturbed, at a horizontal level or in a   
horizontal layer at a point in time for atmospheric chemical constituents based on a distribution function

59 Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for spatio-temporal changing tile parameters

(corrected version of template 4.56)

**Add product definition templates:**

***Product definition template 4.49 – individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for optical properties of aerosol***

Octet No. Contents

10 Parameter category (see code table 4.1)

11 Parameter number (see code table 4.2)

12–13 Aerosol type (see common code table C–14)

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 metres

20 Scale factor of second size

21–24 Scaled value of second size in metres

25 Type of interval for first and second wavelength (see code table 4.91)

26 Scale factor of first wavelength

27–30 Scaled value of first wavelength in metres

31 Scale factor of second wavelength

32–35 Scaled value of second wavelength in metres

36 Type of generating process (see code table 4.3)

37 Background generating process identifier (defined by originating centre)

38 Analysis or forecast generating process identifier (defined by originating centre)

39–40 Hours of observational data cut-off after reference time (see Note)

41 Minutes of observational data cut-off after reference time

42 Indicator of unit of time range (see code table 4.4)

43–46 Forecast time in units defined by octet 42

47 Type of first fixed surface (see code table 4.5)

48 Scale factor of first fixed surface

49–52 Scaled value of first fixed surface

53 Type of second fixed surface (see code table 4.5)

54 Scale factor of second fixed surface

55–58 Scaled value of second fixed surface

59 Type of ensemble forecast (see code table 4.6)

60 Perturbation number

61 Number of forecasts in ensemble

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

***Product definition template 4.58 – individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents based on a distribution function***

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)

14–15 Number of mode (N) of distribution (see Note 2)

16–17 Mode number (l)

18–19 Type of distribution function (see code table 4.240)

20 Number of following function parameters (Np), defined by type given in octet 18–19 (Type of distribution function)

*Repeat the following 5 octets for the number of function parameters (n = 1,* *Np), if Np > 0*

21+5(n–1) List of scale factor of fixed distribution function parameter (p1–pNp), defined by type of distribution in octet 18–19

(22+5(n–1))–(25+5(n–1)) List of scaled value of fixed distribution function parameter (p1–pNp), defined by type of distribution in octet 18–19

21+5Np Type of generating process (see code table 4.3)

22+5Np Background generating process identifier (defined by originating centre)

23+5Np Analysis or forecast generating process identifier (defined by originating centre)

(24+5Np)–(25+5Np) Hours of observational data cut-off after reference time (see Note 1)

26+5Np Minutes of observational data cut-off after reference time

27+5Np Indicator of unit of time range (see code table 4.4)

(28+5Np)–(31+5Np) Forecast time in units defined by the previous octet

32+5Np Type of first fixed surface (see code table 4.5)

33+5Np Scale factor of first fixed surface

(34+5Np)–(37+5Np) Scaled value of first fixed surface

38+5Np Type of second fixed surface (see code table 4.5)

39+5Np Scale factor of second fixed surface

(40+5Np)–(43+5Np) Scaled value of second fixed surface

44+5Np Type of ensemble forecast (see code table 4.6)

45+5Np Perturbation number

46+5Np Number of forecasts in ensemble

Notes:

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

(2) If Number of mode (N) > 1, then between x N fields with mode number l = 1, …, N define the distribution function. x is the number of variable parameters in the distribution function.

(3) For more information, see Attachment III (Distribution functions in GRIB) in Part B of this volume (I.2 – Att.III/GRIB – 1 to 2).

***Product definition template 4.56 – individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for spatio-temporal changing tile parameters***

**Note: This template is deprecated. Template 4.59 should be used instead.**

Octet No. Contents

10 Parameter category (see code table 4.1)

11 Parameter number (see code table 4.2)

12 Tile classification (see code table 4.242)

13 Total number (NT) of tile/attribute pairs (see Notes 2 and 3)

14 Number of used spatial tiles (NUT) (see Notes 2 and 3)

15 Tile index (ITN = {1,…, NUT}) (see Note 2)

16 Number of used tile attributes (NAT) for tile ITN (see Note 2)

17 Attribute of tile (see Code table 4.241)) (A = {A(1),…, A(NAT(ITN))}) (see Note 2)

18 Type of generating process (see code table 4.3)

19 Background generating process identifier (defined by originating centre)

20 Analysis or forecast generating process identifier (defined by originating centre)

21–22 Hours of observational data cut-off after reference time (see Note 1)

23 Minutes of observational data cut-off after reference time

24 Indicator of unit of time range (see code table 4.4)

25–28 Forecast time in units defined by octet 24

29 Type of first fixed surface (see code table 4.5)

30 Scale factor of first fixed surface

31–34 Scaled value of first fixed surface

35 Type of second fixed surface (see code table 4.5)

36 Scale factor of second fixed surface

37–40 Scaled value of second fixed surface

41 Perturbation number

42 Number of forecasts in ensemble

Notes:

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

(2) See Note 2 under product definition template 4.55.

(3) For more information, see Attachment IV (Spatio-temporal changing tiles in GRIB) in Part B of this volume (I.2 – Att.IV/GRIB–1 to 3).

***Product definition template 4.59 – individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for spatio-temporal changing tile parameters***

Octet No. Contents

10 Parameter category (see code table 4.1)

11 Parameter number (see code table 4.2)

12 Tile classification (see code table 4.242)

13 Total number (NT) of tile/attribute pairs (see Notes 2 and 3)

14 Number of used spatial tiles (NUT) (see Notes 2 and 3)

15 Tile index (ITN = {1,…, NUT}) (see Note 2)

16 Number of used tile attributes (NAT) for tile ITN (see Note 2)

17 Attribute of tile (see code table 4.241)) (A = {A(1),…, A(NAT(ITN))}) (see Note 2)

18 Type of generating process (see code table 4.3)

19 Background generating process identifier (defined by originating centre)

20 Analysis or forecast generating process identifier (defined by originating centre)

21–22 Hours of observational data cut-off after reference time (see Note 1)

23 Minutes of observational data cut-off after reference time

24 Indicator of unit of time range (see code table 4.4)

25–28 Forecast time in units defined by octet 24

29 Type of first fixed surface (see code table 4.5)

30 Scale factor of first fixed surface

31–34 Scaled value of first fixed surface

35 Type of second fixed surface (see code table 4.5)

36 Scale factor of second fixed surface

37–40 Scaled value of second fixed surface

41 Type of ensemble forecast (see code table 4.6)

42 Perturbation number

43 Number of forecasts in ensemble

Notes:

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

(2) See Note 2 under product definition template 4.55.

(3) For more information, see Attachment IV (Spatio-temporal changing tiles in GRIB) in Part B of this volume (I.2 – Att.IV/GRIB–1 to 3).

* **ANNEX TO PARAGRAPH 2016-2.2.8 [Validation]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_8)

**Add templates:**

Grid definition template 3.13 - Mercator LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15-nn | Same as grid definition template 3.10 |
| [nn+1] - [nn+4] | Nux – Size of model forecast area C in X direction (number of grid points) |
| [nn+5] - [nn+8] | Ncx – Width of coupling area I in X direction (number of grid points) |
| [nn+9] - [nn+12] | Nuy – Size of model forecast area C in Y direction (number of grid points) |
| [nn+13] - [nn+16] | Ncy – Width of coupling area I in Y direction (number of grid points) |

Grid definition template 3.23 - Polar stereographic LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15-65 | Same as grid definition template 3.20 |
| 66-69 | Nux – Size of model forecast area C in X direction (number of grid points) |
| 70-73 | Ncx – Width of coupling area I in X direction (number of grid points) |
| 74-77 | Nuy – Size of model forecast area C in Y direction (number of grid points) |
| 78-81 | Ncy – Width of coupling area I in Y direction (number of grid points) |

Grid definition template 3.33 - Lambert conformal LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15-81 | Same as grid definition template 3.30 |
| 82-85 | Nux – Size of model forecast area C in X direction (number of grid points) |
| 86-89 | Ncx – Width of coupling area I in X direction (number of grid points) |
| 90-93 | Nuy – Size of model forecast area C in Y direction (number of grid points) |
| 94-97 | Ncy – Width of coupling area I in Y direction (number of grid points) |

Grid definition template 3.61 - Spectral Mercator LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15 | Spectral Representation type (see code table 3.6) |
| 16-19 | N – bi-Fourier Resolution Parameter |
| 20-23 | M – Bi-Fourier Resolution Parameter |
| 24 | Bi – Fourier Truncation Type (see code table 3.25) |
| 25-32 | Lx – Size in meters of the domain along X axis |
| 33-40 | Lux – Size in meters of model forecast area C along X axis |
| 41-48 | Lcx – Width in meters of coupling area I along X axis |
| 49-56 | Ly – Size in meters of the domain along Y axis |
| 57-64 | Luy – Size in meters of model forecast area C along Y axis |
| 65-72 | Lcy – Width in meters of coupling area I along Y axis |
| 73 | Shape of the Earth (see code table 3.2) |
| 74 | Scale factor of radius of spherical Earth |
| 75-78 | Scaled value of radius of spherical Earth |
| 79 | Scale factor of major axis of oblate spheroid Earth |
| 80-83 | Scaled value of major axis of oblate spheroid Earth |
| 84 | Scale factor of minor axis of oblate spheroid Earth |
| 85-88 | Scaled value of minor axis of oblate spheroid Earth |
| 89-92 | La1 – latitude of first grid point |
| 93-96 | Lo1 – longitude of first grid point |
| 97-100 | LaD – latitude(s) at which the Mercator projection intersects the Earth (Latitude(s) where Di and Dj are specified) |
| 101-104 | La2 – latitude of last grid point |
| 105-108 | Lo2 – longitude of last grid point |
| 109-112 | Orientation of the grid, angle between i direction on the map and the Equator (see Note 1) |

Notes:

(1) Limited to the range of 0 to 90 degrees.

Grid definition template 3.62 - Spectral polar stereographic LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15 | Spectral Representation type (see code table 3.6) |
| 16-19 | N – bi-Fourier Resolution Parameter |
| 20-23 | M – Bi-Fourier Resolution Parameter |
| 24 | Bi – Fourier Truncation Type (see code table 3.25) |
| 25-32 | Lx – Size in meters of the domain along X axis |
| 33-40 | Lux – Size in meters of model forecast area C along X axis |
| 41-48 | Lcx – Width in meters of coupling area I along X axis |
| 49-56 | Ly – Size in meters of the domain along Y axis |
| 57-64 | Luy – Size in meters of model forecast area C along Y axis |
| 65-72 | Lcy – Width in meters of coupling area I along Y axis |
| 73 | Shape of the Earth (see code table 3.2) |
| 74 | Scale factor of radius of spherical Earth |
| 75-78 | Scaled value of radius of spherical Earth |
| 79 | Scale factor of major axis of oblate spheroid Earth |
| 80-83 | Scaled value of major axis of oblate spheroid Earth |
| 84 | Scale factor of minor axis of oblate spheroid Earth |
| 85-88 | Scaled value of minor axis of oblate spheroid Earth |
| 89-92 | La1 – latitude of first grid point |
| 93-96 | Lo1 – longitude of first grid point |
| 97 | Resolution and component flags (see flag table 3.3) |
| 98-101 | LaD – latitude where Dx and Dy are specified |
| 102-105 | LoV – orientation of the grid |
| 106 | Projection centre flag (see flag table 3.5) |

Grid definition template 3.63 - Spectral Lambert conformal LAM with explicit boundary for bi-periodic field

|  |  |
| --- | --- |
| Octet No. | Contents |
| 15 | Spectral Representation type (see code table 3.6) |
| 16-19 | N – bi-Fourier Resolution Parameter |
| 20-23 | M – Bi-Fourier Resolution Parameter |
| 24 | Bi-Fourier Truncation Type (see code table 3.25) |
| 25-32 | Lx – Size in meters of the domain along X axis |
| 33-40 | Lux – Size in meters of model forecast area C along X axis |
| 41-48 | Lcx – Width in meters of coupling area I along X axis |
| 49-56 | Ly – Size in meters of the domain along Y axis |
| 57-64 | Luy – Size in meters of model forecast area C along Y axis |
| 65-72 | Lcy – Width in meters of coupling area I along Y axis |
| 73 | Shape of the Earth (see code table 3.2) |
| 74 | Scale factor of radius of spherical Earth |
| 75-78 | Scaled value of radius of spherical Earth |
| 79 | Scale factor of major axis of oblate spheroid Earth |
| 80-83 | Scaled value of major axis of oblate spheroid Earth |
| 84 | Scale factor of minor axis of oblate spheroid Earth |
| 85-88 | Scaled value of minor axis of oblate spheroid Earth |
| 89-92 | La1 – latitude of first grid point |
| 93-96 | Lo1 – longitude of first grid point |
| 97-100 | LaD – latitude where Dx and Dy are specified |
| 101-104 | LoV – longitude of meridian parallel to y-axis along which latitude increases as the y-coordinate increases |
| 105 | Projection centre flag (see flag table 3.5) |
| 106-109 | Latin 1 – first latitude from the pole at which the secant cone cuts the sphere |
| 110-113 | Latin 2 – second latitude from the pole at which the secant cone cuts the sphere |
| 114-117 | Latitude of the southern pole of projection |
| 118-121 | Longitude of the southern pole of projection |

Data representation template 5.53 - Spectral LAM data - complex packing

|  |  |
| --- | --- |
| 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 | Bi-Fourier Sub-Truncation Type (see Code table 5.25) |
| 22 | Packing mode for Axes (see Code table 5.26) |
| 23-26 | P - Laplacian scaling factor (expressed in 10-6 units) |
| 27-28 | NS - Bi-Fourier resolution parameter of the unpacked subset (see Note 1) |
| 29-30 | MS - Bi-Fourier resolution parameter of the unpacked subset (see Note 1) |
| 31-34 | TS – 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 NS and MS), 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 (n2 +m2)P, scaled and packed. The operator associated with this multiplication is derived from the Laplacian operator.

(3) The retrieval formula for a coefficient of wave number n is then: Y = (R + X x 2E ) x10–D x (m2 +n2)-P where X is the packed scaled value associated with the coefficient.

Data template 7.53 - Spectral LAM data - complex packing

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

**Add entries:**

in code table 3.1 – Grid definition template number,

|  |  |
| --- | --- |
| Code figure | Meaning |
| 13 | Mercator LAM with explicit boundary for bi-periodic field |
| 23 | Polar stereographic LAM with explicit boundary for bi-periodic field |
| 33 | Lambert conformal LAM with explicit boundary for bi-periodic field |
| 61 | Spectral Mercator LAM with explicit boundary for bi-periodic field |
| 62 | Spectral polar stereographic LAM with explicit boundary for bi-periodic field |
| 63 | Spectral Lambert conformal LAM with explicit boundary for bi-periodic field |

in code table 3.6 – Spectral data representation type,

|  |  |
| --- | --- |
| Code figure | Meaning |
| 2 | Bi-Fourier representation |

in code table 3.25 - Type of bi-Fourier truncation,

|  |  |
| --- | --- |
| Code figure | Meaning |
| 77 | Rectangular |
| 88 | Elliptic |
| 99 | Diamond |

in code table 5.0 - Data representation template number,

|  |  |
| --- | --- |
| Code figure | Meaning |
| 53 | Spectral LAM data - complex packing |

in code table 5.25 - Type of bi-Fourier subtruncation,

|  |  |
| --- | --- |
| Code figure | Meaning |
| 77 | Rectangular |
| 88 | Elliptic |
| 99 | Diamond |

in code table 5.26 – Packing mode for axes

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Spectral coefficients for axes are packed |
| 1 | Spectral coefficients for axes included in the unpacked subset |

* **ANNEX TO PARAGRAPH 2016-2.2.9 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_2_9)

**Add entries:**

in code table 4.2,

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

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Parameter | Units | Description |
| 29 | Temperature advection | K s-1 | Temperature advection is the advection of temperature by the wind. It refers to the change of temperature caused by movement of air by the wind. Warm advection (positive value) indicates the temperature is increasing, and cold advection (negative value) indicates the temperature is decreasing. |

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

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Parameter | Units | Description |
| 46 | Vorticity advection | s-2 | Vorticity advection is the advection of relative vorticity by the wind. It refers to the change in vorticity caused by the movement of air. A positive value corresponds to rising forcing, while negative value corresponds to sinking forcing. |

in code table 4.5,

|  |  |  |
| --- | --- | --- |
| Code figure | Meaning | Unit |
| 115 | Sigma height level (see Note 5) | – |

Notes:

(5) Sigma height level is the vertical model level of the height-based terrain-following coordinate (Gal-Chen and Somerville, 1975). The value of the level = (Height of the level – height of the terrain) / (height of the top level – height of the terrain), which is >=0 and <=1.

* **ANNEX I TO PARAGRAPH 2016-2.3.1 [CBS-16]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_3_1)

1. Motivation and requirements. Stressing the benefits of GRIB3.
   1. Address limitations of GRIB2 and lack of flexibility.
      1. Prescription of parameter units limits the flexibility to represent data in its native units.
      2. geometry is not flexible enough to accommodate the high resolution and complex geometry of NWP evolution. In this context a better harmonisation with OGC/ISO standards is desirable. The concept of GRID which is at the base of GRIB 2 is a limitation for the representation of some datasets.
      3. lack of a way of relating multi-dimensional data such as ensemble members, multiple levels.
      4. need create the possibility of overlaying information on a field as opposed to using a simple bitmap
      5. not possible to associate complex information to a field (e.g. quality control attributes)
   2. harmonisation with METCE, WIGOS metadata with the purpose of a better interoperability to reach a wider community
   3. model based design and harmonisation with the ISO standards will facilitate semantic and syntactic interoperability.
2. How requirements are implemented.
   1. GRIB 3 will be an evolution of GRIB 2 with the aim to minimise the impact of the implementation. Tables and terms shall be reused as much as possible.
   2. GRIB 3 structure is harmonised with the ISO19156 Observations & Measurements.
   3. A proposed structure is provided in IPET-DRMM-IV-2.3(1)
3. Plan on the experimental and operational status.
   1. The proposed document is submitted to the CBS in the appropriate form to get a resolution allowing experimental for bilateral exchange (to be confirmed by Atsushi the best way to do this).
   2. The experimental exchange will be used to further develop the new edition of GRIB to a fully operational code form.
   3. GRIB2 would remain valid for operational use for a long time, and even in parallel with any start of operational exchange of GRIB3. WMO will continue to support and maintain both formats for some amount of time.  At some point there will be a need to stop maintaining GRIB2 (i.e. supporting new features), but beyond that point GRIB2 will still be accepted for operational exchange.

* **ANNEX II TO PARAGRAPH 2016-2.3.1 [CBS-16]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_2_3_1)

<https://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRMM_Geneva2016/Report/GRIB3-proposal.zip>

* **ANNEX TO PARAGRAPH 2016-3.1.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_1_1)

**Further review:**

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE REFERENCE | OPERAND | OPERATOR NAME | OPERATION DEFINITION |
| F X |
| 2 26 | 000 | Characterization of operation and operands follows | This operator will cause the Data Present Bitmap immediately following to be interpreted as indicating all the element descriptors conveying a given operation and its operands. |
| 2 26 | 255 | Characterization of operation and operands marker operator | This operator shall signify a 1 bit wide data item containing the significance of an element descriptor. The element descriptor subject to the significance is obtained by the application of the data present bit-map associated with the characterization of operation and operands operator.  Data item value = 1 : Operator  Data item value = 0 : Operand |

* **ANNEX TO PARAGRAPH 2016-3.2.1 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_1)

**Add entries**:

in common code table C-2

|  |  |  |
| --- | --- | --- |
| Code figure for rara | Code figure for BUFR |  |
| 50 | 150 | Meteolabor SRS-C50/Argus (Switzerland) |
| 73 | 173 | МАRL-A (Russian Federation) – ASPAN-15 (Kazakhstan) |
| N/A | 190 | NCAR research dropsonde NRD94 with GPS and Vaisala RS92-based sensor module (United States) |
| N/A | 191 | NCAR research dropsonde NRD41 with GPS and Vaisala RS41-based sensor module (United States) |
| N/A | 192 | Vaisala/NCAR dropsonde RD94 with GPS and Vaisala RS92-based sensor module (Finland/USA) |
| N/A | 193 | Vaisala/NCAR dropsonde RD41 with GPS and Vaisala RS41-based sensor module (Finland/USA) |

* **ANNEX TO PARAGRAPH 2016-3.2.2 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_2)

**Add an entry:**

in BUFR Table B,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FXY | Element Name | BUFR Unit | BUFR Scale | BUFR reference value | BUFR width (bits) | CREX Unit | CREX Scale | CREX width (characters) |
| 0-02-087 | Parachute surface area | m2 | 4 | 0 | 15 | m2 | 4 | 5 |

* **ANNEX TO PARAGRAPH 2016-3.2.3 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_3)
* **ANNEX TO PARAGRAPH 2016-3.2.8 [FT2016-2]**

**Add entries:**

in common code table C-5,

|  |  |  |  |
| --- | --- | --- | --- |
| Code figure for I6I6I6 | Code figure for BUFR | Code figure for GRIB2 |  |
| 062 | 62 | 62 | Sentinel 1A |
| 063 | 63 | 63 | Sentinel 1B |
| 064 | 64 | 64 | Sentinel 5P |
| 270 | 270 | 270 | GOES 16 |
| 271 | 271 | 271 | GOES 17 |
| 272 | 272 | 272 | GOES 18 |
| 273 | 273 | 273 | GOES 19 |
| 523 | 523 | 523 | FY-3D |
| 812 | 812 | 812 | SCISAT-1 |
| 813 | 813 | 813 | ODIN |

in common code table C-8,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Code | Agency | Type | Short name | Long name |
| 92 | CSA | Limb-scanning sounder | ACE-FTS | Atmospheric Chemistry Experiment - Fourier Transform Spectrometer |
| 151 | ESA | Imaging radar | SAR-C | Synthetic Aperture Radar (C-band) |
| 152 | ESA | Cross-nadir scanning | SW | Sounder TROPOMI Tropospheric Monitoring Instrument |
| 959 | SNSB | Limb-scanning sounder | SMR | Sub-millimetre radiometer |

* **ANNEX TO PARAGRAPH 2016-3.2.4 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_4)

**Add entries:**

in BUFR table B,

Class 03 – BUFR/CREX Instrumentation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |  |
| F X Y | UNIT | SCALE | REF.  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char.) | Description |
| 0 03 025 | Cross-track estimation area size | m | 0 | 5000 | 16 | m | 0 | 5 | Ground range size of the estimation area [m]. |
| 0 03 026 | Along-track estimation area size | m | 0 | 5000 | 16 | m | 0 | 5 | Azimuth size of the estimation area [m]. |

Class 05 – BUFR/CREX Location (horizontal – 1)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REF. | ELEMENT  NAME | BUFR | | | | CREX | | |  |
| F X Y | UNIT | SCALE | REF.  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char.) | Description |
| 0 05 071 | Stripmap identifier | Numeric | 0 | 0 | 16 | Numeric | 0 | 5 | In the case of SM mode the product contained in a single netCDF file will be split in several BUFR messages. We need to have an identifier to rebuild the original product and to mark the single parts to belong to the same product. This is the function of Stripmat identifier |
| 0 05 072 | Number of spectra in range direction | Numeric | 0 | 0 | 8 | Numeric | 0 | 3 | Number of range swell wave spectra cells. For WV mode this dimension is set to 1 as there is 1 swell wave spectra per WV vignette. For SM this dimension is set to the number of cells in the range direction, nominally 4. This parameter does not apply to IW nor EW mode. |
| 0 05 073 | Number of spectra in azimuthal direction | Numeric | 0 | 0 | 8 | Numeric | 0 | 3 | Number of azimuth swell wave spectra cells. For WV mode this dimension is set to 1 as there is 1 swell wave spectra per WV vignette. For SM this dimension is set to the number of cells in the azimuth direction, nominally 4; although, this will vary with the length of the input image strip. This parameter does not apply to IW nor EW mode. |
| 0 05 074 | Index in range direction | Numeric | 0 | 0 | 8 | Numeric | 0 | 3 | Index of range swell wave spectra cell. |
| 0 05 075 | Index in azimuthal direction | Numeric | 0 | 0 | 8 | Numeric | 0 | 3 | Index of azimuth swell wave spectra cell. |

Class 25 – BUFR/CREX Processing information

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REF. | ELEMENT  NAME | BUFR | | | | CREX | | |  |
| F X Y | UNIT | SCALE | REF.  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char.) | Description |
| 0 25 189 | Range cut-off wavelength | m | 0 | 1 | 9 | m | 0 | 3 | The range cut-off wavelength [m] is the shortest wavelength in range direction that can be resolved in the swell wave spectra. The cut-off wavelength is computed from the slant range resolution (or range bandwidth, fsf) and the local incidence angle as: λrange(θ)=c/fsfsinθ |

Class 40 – BUFR/CREX Satellite data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REF. | ELEMENT  NAME | BUFR | | | | CREX | | |  |
| F X Y | UNIT | SCALE | REF.  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char.) | Description |
| 0 40 039 | Single Look Complex image intensity | Numeric | 0 | -25 | 5 | Numeric | 0 | 3 | The input Single Look Complex (SLC) image intensity estimated within each wave cell |
| 0 40 040 | Single Look Complex image skewness | Numeric | 2 | 1 | 13 | Numeric | 0 | 4 | The skewness of the input SLC image [dimensionless] estimated within each wave cell |
| 0 40 041 | Single Look Complex image kurtosis | Numeric | 2 | 1 | 13 | Numeric | 0 | 4 | The kurtosis of the input SLC image [dimensionless] estimated within each wave cell |
| 0 40 042 | Single Look Complex image variance | Numeric | 2 | 1 | 13 | Numeric | 0 | 4 | The variance of the input SLC image normalized by the square of the mean intensity [dimensionless] estimated within each wave cell. |

Class 42 – BUFR/CREX Oceanographic elements

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REF. | ELEMENT  NAME | BUFR | | | | CREX | | |  |
| F X Y | UNIT | SCALE | REF.  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char.) | Description |
| 0 42 001 | Dominant swell wave direction of spectral partition | degree | 0 | 0 | 9 | degree | 0 | 3 | Dominant wave direction [degree] for each partition of the swell wave spectra. |
| 0 42 002 | Significant swell wave height of spectral partition | m | 1 | 0 | 9 | m | 1 | 3 | Significant wave height [m] for each partition of the swell wave spectra |
| 0 42 003 | Dominant swell wavelength of spectral partition | m | 2 | 100 | 17 | m | 2 | 6 | Dominant wave length [m] for each partition of the swell wave spectra |
| 0 42 004 | Confidence of inversion for each partition of swell wave spectra | Code table | 0 | 0 | 4 | Code table | 0 | 2 | Confidence of inversion for each partition of swell wave spectra |
| 0 42 005 | Ambiguity removal factor for swell wave partition | Numeric | 5 | -100000 | 18 | Numeric | 5 | 6 | The ambiguity removal factor [dimensionless] for each wave partition |
| 0 42 006 | Wave age | Numeric | 2 | 1 | 8 | Numeric | 2 | 3 | The dimensionless parameter derived from the SAR data that describes the state of development of the wind sea component of the wave spectra. The dimensions of the matrix are oswAzSize x oswRaSize. |
| 0 42 007 | Shortest ocean wavelength on spectral resolution | m | 2 | 0 | 16 | m | 2 | 5 | The spectral resolution gives the shortest ocean wavelength [m] that can be detected. |
| 0 42 008 | Nonlinear inverse spectral width | m | 2 | 0 | 16 | m | 2 | 5 | Nonlinear inverse spectral width [m] describing non-linear spectral cut-off computed from the cross-spectra. |
| 0 42 009 | Partition number | Numeric | 0 | 1 | 4 | Numeric | 0 | 2 | Number of wave partitions |

**Add a code table:**

Code table 0 42 004 – Confidence of inversion for each partition of swell wave spectra

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Wave direction resolved |
| 1 | 180-degree ambiguity not resolve |
| 2-14 | Reserved |
| 15 | Missing |

* **ANNEX TO PARAGRAPH 2016-3.2.5**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_5)

**Questions:**

1) If 3 01 128 is not obligatory to report additional information on radiosonde ascent, Czech Republic prefers to use own sequence composed of parameters available,

A: Yes, it is allowable for the producer to use their own sequence for additional information about radiosonde ascent; yet using 3 01 128 is recommended as uniform practice facilitates the interpretation of data by users.

2) Relation of code table 0 02 011 (common code table C-2) to code table 0 02 015 and possibility of an entry, *PTU*, in code table 0 02 015,

A: The use of 0 02 015 is explained in the paper located at: <http://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRMM_Geneva2016/Documents/IPET-DRMM-IV_Doc3-2-12_RAOB_Meta3.docx>

The paper clarifies that entry 1 in code table 0 02 015 refers to “*PTU radiosonde*”.

3) Definition of *train regulator* in code table 0 02 016 (*unwinder*, *unwinding detainer* or *unwinding stabilizer*?),

A: Please refer to the paper mentioned above.

4) Definition of *high bay* and *low bay* in code table 0 02 083,

A: Please refer to the paper mentioned above.

5) The descriptor 2 05 YYY is more convenient to report reason for termination.

A: Yes, 2 05 YYY is simpler for producers; however it is much more difficult to interpret automatically for users. It is not recommended anymore.

**Additional entries:**

6) New entry, *Vaisala DigiCORA III*, in code table 0 02 066,

A: At this moment the use of Vaisala *DigiCORA III* is fully covered by 0 02 011 and there is no urgent need to put it into 0 02 066. The Team would prefer to populate 0 02 066 with new entries when it becomes necessary.

7) New entries, TA600, TA800 and TX1200, in code table 0 02 081,

A: The use of 0 02 081 is explained in the paper located at: <http://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRMM_Geneva2016/Documents/IPET-DRMM-IV_Doc3-2-12_RAOB_Meta3.docx> . The sounding balloon is fully characterized by 0 02 080, 0 02 081, and 0 02 083. In response to your request, as well as GRUAN’s, two new entries *Totex TA type balloon* and *Totex TX type balloon* were endorsed by the Team in 0 02 081 for fast track November 2016.

8) New entries, *Increasing pressure* and *Max. interpolation time exceeded*, in code table 0 35 035.

A: In response to your request, two new entries *Increasing pressure* and, as less instrument specific, *Invalid and/or missed data time limits exceeded* were endorsed by the Team in 0 35 035 for fast track November 2016.

* **ANNEX TO PARAGRAPH 2016-3.2.6 [FT2016-2/pre-operational]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_6)<[para 4.1](#A2016_4_1_bufr)>

**Add entries:**

in BUFR/CREX Table B,

Class 01 – BUFR/CREX Identification

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 01 | 114 | Encrypted ship or mobile land station identifier (base64 encoding) | CCITT IA5 | 0 | 0 | 352 | Character | 0 | 44 |

Class 03 – BUFR/CREX Instrumentation

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 03 | 001 | Surface station type | Code table | 0 | 0 | 5 | Code table | 0 | 2 |
| 0 | 03 | 003 | Thermometer/hygrometer housing | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 | 03 | 004 | Type of screen/shelter/radiation shield | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 | 03 | 005 | Horizontal width of screen or shield (x) | m | 3 | 0 | 16 | m | 3 | 5 |
| 0 | 03 | 006 | Horizontal depth of screen or shield (y) | m | 3 | 0 | 16 | m | 3 | 5 |
| 0 | 03 | 007 | Vertical height of screen or shield (z) | m | 3 | 0 | 16 | m | 3 | 5 |
| 0 | 03 | 008 | Artificially ventilated screen or shield | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 | 03 | 009 | Amount of forced ventilation at time of reading | m s–1 | 1 | 0 | 9 | m s–1 | 1 | 3 |
| 0 | 03 | 020 | Material for thermometer/hygrometer housing | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 | 03 | 021 | Hygrometer heating | Code table | 0 | 0 | 2 | Code table | 0 | 1 |
| 0 | 03 | 022 | Instrument owner | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 | 03 | 023 | Configuration of louvers for thermometer/hygrometer screen | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 | 03 | 024 | Psychrometric coefficient | K–1 | 6 | 0 | 10 | K–1 | 6 | 3 |

Class 10 – BUFR/CREX Non coordinate location (vertical)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 10 | 038 | Maximum height of deck cargo above summer load line | m | 0 | 0 | 6 | m | 0 | 2 |
| 0 | 10 | 039 | Departure of reference level (summer maximum load line) from actual sea level | m | 0 | –32 | 6 | m | 0 | 3 |

Class 11 – BUFR/CREX Wind and turbulence

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 11 | 007 | Relative wind direction (in degrees off bow) | ° | 0 | 0 | 9 | ° | 0 | 3 |
| 0 | 11 | 008 | Relative wind speed | m s–1 | 1 | 0 | 12 | m s–1 | 1 | 4 |

Class 15 – BUFR/CREX Physical/chemical constituents

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 15 | 028 | Mole fraction of atmospheric constituent/pollutant in dry air | ‰ | 5 | 0 | 16 | ‰ | 5 | 5 |

Class 25 – BUFR/CREX Processing information

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 25 | 185 | Encryption method | Code table | 0 | 0 | 8 | Code table | 0 | 3 |
| 0 | 25 | 186 | Encryption key version | CCITT IA5 | 0 | 0 | 96 | Character | 0 | 12 |
| 0 | 25 | 188 | Method for reducing pressure to sea level | Code table | 0 | 0 | 5 | Code table | 0 | 2 |

Class 41 – BUFR/CREX Oceanographic/bio-geochemical parameters

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 41 | 001 | pCO2 | Pa | 3 | 0 | 18 | Pa | 3 | 6 |
| 0 | 41 | 002 | Fluorescence | kg l–1 | 12 | 0 | 16 | kg l–1 | 12 | 5 |
| 0 | 41 | 003 | Dissolved nitrates | µmol kg–1 | 3 | 0 | 17 | µmol kg–1 | 3 | 5 |
| 0 | 41 | 005 | Turbidity | NTU | 2 | 0 | 12 | NTU | 2 | 4 |

in BUFR table D,

Category 01 – BUFR/CREX Location and identification sequences

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |  |  |
| 3 | 01 | 018 |  |  |  | (Encrypted ship's call sign and encryption method) | See Notes 1 – 3 |
|  |  |  | 0 | 01 | 114 | Encrypted ship or mobile land station identifier |  |
|  |  |  | 0 | 25 | 185 | Encryption method |  |
|  |  |  | 0 | 25 | 186 | Encryption key version |  |

Notes:

(1) The ship's call sign or WMO identifier should be reported using descriptor 0 01 011.

(2) However, if required by shipping companies when VOS ships are recruited or if subsequently requested, for ship reports using template 3 08 014 the Ship call sign or other identifier can be encrypted in BUFR reports using sequence 3 01 018 according to the following method:

* The normal callsign (i.e. descriptor 0 01 011) shall be encoded with missing value;
* The encryption method shall be indicated using the method indicated by 0 25 185;
* The version of the encryption key that is used shall be indicated by 0 25 186;

(3) The encryption keys will be managed by the JCOMM Focal Point on Ship Masking.

Category 02 – BUFR/CREX Meteorological sequences common to surface data

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
|  |  |  |  |  |  | (Ship “instantaneous” data) |  |
| 3 | 02 | 062 | 0 | 25 | 188 | Method for reducing pressure report to sea level |  |
|  |  |  | 3 | 02 | 001 | Pressure and 3-hour pressure change |  |
|  |  |  | 3 | 02 | 093 | Extended ship temperature and humidity data |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 053 | Ship visibility data |  |
|  |  |  | 0 | 07 | 032 | Height of sensor above local ground (or deck of marine platform) | Set to missing (cancel) |
|  |  |  | 0 | 07 | 033 | Height of sensor above water surface | Set to missing (cancel) |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 004 | General cloud information |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 001 | Delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 005 | Cloud layer |  |
|  |  |  | 0 | 08 | 002 | Vertical significance (surface observations) | Set to missing (cancel) |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 055 | Icing and ice |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 056 | Sea/water temperature |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 021 | Waves |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 024 | Wind and swell waves |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
|  |  |  |  |  |  | (Ship “period” data) |  |
| 3 | 02 | 063 | 3 | 02 | 038 | Present and past weather |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 040 | Precipitation measurement |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 034 | Precipitation past 24 hours |  |
|  |  |  | 0 | 07 | 032 | Height of sensor above local ground (or deck of marine platform) | Set to missing (cancel) |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 058 | Ship extreme temperature data |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 064 | Ship or other marine platform wind data |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
|  |  |  |  |  |  | (VOSClim data elements) |  |
| 3 | 02 | 092 | 0 | 11 | 104 | True heading of aircraft, ship or other mobile platform | Ship’s true heading |
|  |  |  | 0 | 01 | 012 | Direction of motion of moving observing platform | Ship’s course over ground |
|  |  |  | 0 | 01 | 013 | Speed of motion of moving observing platform | Ship’s speed over ground |
|  |  |  | 0 | 10 | 038 | Maximum height of deck cargo above summer load line |  |
|  |  |  | 0 | 10 | 039 | Departure of reference level (summer maximum load line) from actual sea level |  |
|  |  |  | 0 | 11 | 007 | Relative wind direction (in degrees off bow) |  |
|  |  |  | 0 | 11 | 008 | Relative wind speed |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | X | YYY |
|  |  |  |  |  |  | (Extended ship temperature and humidity data) |  |
| 3 | 02 | 093 | 0 | 07 | 032 | Height of sensor above local ground (or deck of marine platform) |  |
|  |  |  | 0 | 07 | 033 | Height of sensor above water surface |  |
|  |  |  | 3 | 03 | 099 | Metadata common to temperature/humidity sensors |  |
|  |  |  | 0 | 12 | 101 | Temperature/air temperature |  |
|  |  |  | 1 | 03 | 000 | Delayed replication of 3 descriptors |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor | Set to 0 if no change from previous values, 1 if changes |
|  |  |  | 0 | 07 | 032 | Height of sensor above local ground (or deck of marine platform) |  |
|  |  |  | 0 | 07 | 033 | Height of sensor above water surface |  |
|  |  |  | 3 | 03 | 099 | Metadata common to temperature/humidity sensors |  |
|  |  |  | 0 | 02 | 039 | Method of wet-bulb temperature measurement |  |
|  |  |  | 0 | 02 | 097 | Type of humidity sensor |  |
|  |  |  | 0 | 03 | 024 | Psychrometric coefficient | Set to missing if type of humidity sensor is not psychrometer |
|  |  |  | 0 | 03 | 021 | Hygrometer heating |  |
|  |  |  | 0 | 12 | 102 | Wet-bulb temperature |  |
|  |  |  | 0 | 12 | 103 | Dewpoint temperature |  |
|  |  |  | 0 | 13 | 003 | Relative humidity |  |
|  |  |  | 0 | 07 | 032 | Height of sensor above local ground (or deck of marine platform) | Cancel (set to missing) |
|  |  |  | 0 | 07 | 033 | Height of sensor above water surface | Cancel (set to missing) |
|  |  |  | 3 | 03 | 099 | Metadata common to temperature/humidity sensors | Cancel (set all elements in sequence to missing) |
|  |  |  | 0 | 02 | 039 | Method of wet-bulb temperature measurement | Cancel (set to missing) |
|  |  |  | 0 | 02 | 097 | Type of humidity sensor | Cancel (set to missing) |
|  |  |  | 0 | 03 | 021 | Hygrometer heating | Cancel (set to missing) |
|  |  |  | 0 | 03 | 024 | Psychrometric coefficient | Cancel (set to missing) |

Category 03 – BUFR/CREX Meteorological sequences common to vertical soundings data

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
|  |  |  |  |  |  | (Metadata common to temperature/humidity sensors) |  |
| 3 | 03 | 099 | 0 | 03 | 005 | Horizontal width of screen or shield (x) |  |
|  |  |  | 0 | 03 | 006 | Horizontal depth of screen or shield (y) |  |
|  |  |  | 0 | 03 | 007 | Vertical height of screen or shield (z) |  |
|  |  |  | 0 | 02 | 096 | Type of thermometer |  |
|  |  |  | 0 | 03 | 022 | Instrument owner |  |
|  |  |  | 0 | 03 | 003 | Thermometer/hygrometer housing |  |
|  |  |  | 0 | 03 | 020 | Material for thermometer/hygrometer housing |  |
|  |  |  | 0 | 03 | 004 | Type of screen/shelter/radiation shield |  |
|  |  |  | 0 | 03 | 023 | Configuration of louvers for thermometer/hygrometer screen |  |
|  |  |  | 0 | 03 | 008 | Artificially ventilated screen or shield |  |
|  |  |  | 0 | 03 | 009 | Amount of forced ventilation at time of reading |  |

Category 06 – BUFR/CREX Meteorological or oceanographic sequences common to oceanographic observations

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table references | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
| 3 | 06 | 043 |  |  |  | (Marine bio-geochemical and radiation observations) |  |
|  |  |  | 0 | 41 | 001 | pCO2 |  |
|  |  |  | 0 | 08 | 043 | Atmospheric chemical or physical constituent type | set to 3 (carbon dioxide) |
|  |  |  | 0 | 15 | 028 | Mole fraction of atmospheric constituent / pollutant in dry air |  |
|  |  |  | 0 | 08 | 043 | Atmospheric chemical or physical constituent type | Cancel |
|  |  |  | 0 | 13 | 080 | pH |  |
|  |  |  | 0 | 41 | 005 | Turbidity |  |
|  |  |  | 0 | 41 | 003 | Dissolved nitrates |  |
|  |  |  | 0 | 22 | 188 | Dissolved oxygen |  |
|  |  |  | 0 | 41 | 002 | Fluorescence |  |
|  |  |  | 1 | 06 | 000 | Delayed replication of 6 descriptors |  |
|  |  |  | 0 | 31 | 000 | Short delayed replication factor |  |
|  |  |  | 0 | 04 | 024 | Time period or displacement (hours) | Set to -1 (preceding hour) |
|  |  |  | 0 | 14 | 002 | Long-wave radiation, integrated over period specified | Downwelling longwave radiation |
|  |  |  | 0 | 14 | 002 | Long-wave radiation, integrated over period specified | Upwelling longwave radiation |
|  |  |  | 0 | 14 | 012 | Net long-wave radiation, integrated over period specified |  |
|  |  |  | 0 | 14 | 004 | Short-wave radiation, integrated over period specified |  |
|  |  |  | 0 | 04 | 024 | Time period or displacement (hours) | Cancel |

Category 08 – BUFR/CREX Surface report sequences (sea)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Table References | | | Element name | Element description |
| F | XX | YYY | F | XX | YYY |
|  |  |  |  |  |  | (Synoptic reports from sea stations suitable for VOS observation data) |  |
| 3 | 08 | 014 | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 01 | 018 | Encrypted ship’s call sign and encryption method |  |
|  |  |  | 0 | 03 | 001 | Surface station type |  |
|  |  |  | 3 | 01 | 093 | Ship identification, movement, date/time, horizontal and vertical coordinates |  |
|  |  |  | 2 | 08 | 032 | Change width of CCITT IA5 to 32 characters |  |
|  |  |  | 0 | 01 | 079 | Unique identifier for profile | Unique ID for report |
|  |  |  | 2 | 08 | 000 | Change width of CCITT IA5 | Cancel |
|  |  |  | 3 | 02 | 062 | Ship “instantaneous” data |  |
|  |  |  | 3 | 02 | 063 | Ship “period” data |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 02 | 092 | VOSClim data elements |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 06 | 033 | Surface salinity |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 06 | 034 | Surface current |  |
|  |  |  | 1 | 01 | 000 | Delayed replication of 1 descriptor |  |
|  |  |  | 0 | 31 | 000 | Short delayed descriptor replication factor |  |
|  |  |  | 3 | 06 | 043 | E-SURFMAR S-AWS Observations |  |

**Amend an element name:**

in BUFR/CREX Table B,

Class 11 – BUFR/CREX Wind and turbulence

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table Reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Unit | Scale | Data width (char) |
| 0 | 11 | 104 | True heading of aircraft, ship or other mobile platform | degree true | 0 | 0 | 9 | degree true | 0 | 3 |

**Add and amend entries:**

in code tables,

**0 02 096**

**Type of temperature sensor**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Rod thermistor |
| 1 | Bead thermistor |
| 2 | Capacitance bead |
| 3 | Capacitance wire |
| 4 | Resistive sensor |
| 5 | Chip thermistor |
| 6 | Mercury |
| 7 | Alcohol/glycol |
| 8–30 | Reserved (for future use) |
| 31 | Missing value |

**0 02 097**

**Type of humidity sensor**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | VIZ Mark II carbon hygristor |
| 1 | VIZ B2 hygristor |
| 2 | Vaisala A-Humicap |
| 3 | Vaisala H-Humicap |
| 4 | Capacitance sensor |
| 5 | Vaisala RS90 |
| 6 | Sippican Mark IIA carbon Hygristor |
| 7 | Twin alternatively heated Humicap capacitance sensor |
| 8 | Humicap capacitance sensor with active de-icing method |
| 9 | Carbon hygristor |
| 10 | Psychrometer |
| 11 | Capacitive (polymer) |
| 12 | Capacitive (ceramic, incl. metal oxide) |
| 13 | Resistive (generic) |
| 14 | Resistive (salt polymer) |
| 15 | Resistive (conductive polymer) |
| 16 | Thermal conductivity |
| 17 | Gravimetric |
| 18 | Paper-metal coil |
| 19 | Ordinary human hair |
| 20 | Rolled hair (torsion) |
| 21 | Goldbeater's skin |
| 22 | Chilled mirror hygrometer |
| 23 | Dew cell |
| 24 | Optical absorption sensor |
| 25–30 | Reserved for future use |
| 31 | Missing value |

**Add BUFR/CREX Code tables:**

**0 03 001**

**Surface station type**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Land station (synoptic network) |
| 1 | Shallow water station (fixed to sea/lake floor) |
| 2 | Ship |
| 3 | Rig/platform |
| 4 | Moored buoy |
| 5 | Drifting buoy (or drifter) |
| 6 | Ice buoy |
| 7 | Land station (local network) |
| 8 | Land vehicle |
| 9 | Autonomous marine vehicle |
| 10–30 | Reserved (for future use) |
| 31 | Missing value |

**0 03 003**

**Thermometer/hygrometer housing**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Screen |
| 1 | Sling / Whirling |
| 2 | Unscreened |
| 3 | Radiation shield |
| 4 | Aspirated (e.g. Assmann) |
| 5 | Other Shelter |
| 6 | Handheld |
| 7–14 | Reserved for future use |
| 15 | Missing value |

**0 03 004**

**Type of screen/shelter/radiation shield**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Stevenson screen |
| 1 | Marine Stevenson screen |
| 2 | Cylindrical section plate shield |
| 3 | Concentric tube |
| 4 | Rectangular section shield |
| 5 | Square section shield |
| 6 | Triangular section shield |
| 7 | Open covered lean to |
| 8 | Open covered inverted V roof |
| 9 | Integrated (e.g. Chilled Mirror) |
| 10–14 | Reserved for future use |
| 15 | Missing value |

**0 03 008**

**Artificially ventilated screen or shield**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Natural ventilation in use |
| 1 | Artificial aspiration in use: constant flow at time of reading |
| 2 | Artificial aspiration in use: variable flow at time of reading |
| 3–6 | Reserved |
| 7 | Missing value |

**0 03 020**

**Material for thermometer/hygrometer housing**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Wood |
| 1 | Metal alloy |
| 2 | Plastic/GRP |
| 3 | Reed/grass/leaf |
| 4–6 | Reserved for future use |
| 7 | Missing value |

**0 03 021**

**Hygrometer heating**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Unheated |
| 1 | Heated |
| 2 | Not applicable |
| 3 | Missing value |

**0 03 022**

**Instrument owner**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | National hydro meteorological/weather service |
| 1 | Other |
| 2 | Standards institute |
| 3–6 | Reserved for future use |
| 7 | Missing value |

**0 03 023**

**Configuration of louvers for thermometer/hygrometer screen**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Single v section louvers |
| 1 | Overlapping louvers |
| 2 | Double v section louvers |
| 3 | Non-overlapping louvers |
| 4 | Vented, non-louvered |
| 5 | Not applicable |
| 6 | Reserved for future use |
| 7 | Missing value |

**0 25 185**

**Encryption method**

|  |  |
| --- | --- |
| Code Figure | Meaning |
| 0 | AES 256 |
| 1–254 | Reserved |
| 255 | Missing value |

**0 25 188**

**Method for reducing pressure report to sea level**

|  |  |
| --- | --- |
| Code Figure | Meaning |
| 0 | Pressure adjusted to mean sea level following WMO 8 for low level (< 50m) stations |
| 1 | Pressure adjusted to mean sea level following WMO 8 for stations below 750 m |
| 2 | Pressure adjusted to sea level following national practice |
| 3 | Pressure adjusted to local water level following national practice |
| 4 | Pressure not corrected for height |
| 5–14 | Reserved |
| 15 | Missing value |

**Add an entry:**

in common code table C-6,

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Code figure |  | Conventional abbreviation | Abbreviation in IA5/ASCII | Abbreviation in IA2 | Definition in base units |
| 843 | Nephelometric turbidity units | NTU | NTU |  |  |

* **ANNEX TO PARAGRAPH 2016-3.2.7 [Validation]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_7)

**Add entries:**

in BUFR/CREX Table B,

Class 13 – Hydrographic and hydrological elements

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Units | Scale | Data width (characters) |
| 0 | 13 | 161 | pH scale | Code table | 0 | 0 | 3 | Code table | 0 | 1 |

Class 41 – Marine bio-geochemical data

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Units | Scale | Data width (characters) |
| 0 | 41 | 006 | Backscattering | m-1 | 5 | 0 | 19 | m-1 | 5 | 6 |

in BUFR Table D,

**Sequence 3-06-044 for chlorophyll-A profile data**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table Reference** | | | **Table References** | | | **Element Name** |  |
| F | X | Y |
| 3 | 06 | 044 |  |  |  | (Chlorophyll-A (fluorescence) profile data) |  |
|  | | | 1 | 09 | 000 | Delayed replication of 9 descriptors |  |
|  | | | 0 | 31 | 002 | Extended delayed descriptor replication factor | Gives number of depths |
|  | | | 0 | 07 | 062 | Depth below sea / water surface | Code as missing |
|  | | | 0 | 08 | 080 | Qualifier for quality class | Code as missing |
|  | | | 0 | 33 | 050 | GTSPP quality class | Code as missing |
|  | | | 0 | 07 | 065 | Water pressure |  |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 10, indicates pressure at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |
|  | | | 0 | 41 | 002 | Chlorophyll-A (fluorescence) | In kg l-1 (= 109 mg m-3) |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 21, chlorophyll-A at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |

Code depth related descriptors as missing as water pressure is used as the vertical axis

Chlorophyll-A specified in range 0 to 65.535 mg m-3 with a resolution of 0.001 mg m-3.

**Sequence 3-06-045 for dissolved nitrate profile data**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table Reference** | | | **Table References** | | | **Element Name** |  |
| F | X | Y |
| 3 | 06 | 045 |  |  |  | (Dissolved nitrate profile data) |  |
|  | | | 1 | 09 | 000 | Delayed replication of 9 descriptors |  |
|  | | | 0 | 31 | 002 | Extended delayed descriptor replication factor | Gives number of depths |
|  | | | 0 | 07 | 062 | Depth below sea / water surface | Code as missing |
|  | | | 0 | 08 | 080 | Qualifier for quality class | Code as missing |
|  | | | 0 | 33 | 050 | GTSPP quality class | Code as missing |
|  | | | 0 | 07 | 065 | Water pressure |  |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 10, indicates pressure at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |
|  | | | 0 | 41 | 003 | Dissolved nitrate | In μmol kg-1 |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 22, nitrate at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |

Code depth related descriptors as missing as water pressure is used as the vertical axis.

**Sequence 3-06-046 for pH profile data**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table Reference** | | | **Table References** | | | **Element Name** |  |
| F | X | Y |
| 3 | 06 | 046 |  |  |  | (pH profile data) |  |
|  | | | 1 | 09 | 000 | Delayed replication of 9 descriptors |  |
|  | | | 0 | 31 | 002 | Extended delayed descriptor replication factor | Gives number of depths |
|  | | | 0 | 07 | 062 | Depth below sea / water surface | Code as missing |
|  | | | 0 | 08 | 080 | Qualifier for quality class | Code as missing |
|  | | | 0 | 33 | 050 | GTSPP quality class | Code as missing |
|  | | | 0 | 07 | 065 | Water pressure |  |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 10, indicates pressure at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |
|  | | | 0 | 13 | 161 | pH scale |  |
|  | | | 0 | 13 | 080 | pH | dimensionless |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 23, pH at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |

Code depth related descriptors as missing as water pressure is used as the vertical axis.

**Sequence 3-06-047 for backscattering profile data**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table Reference** | | | **Table References** | | | **Element Name** |  |
| F | X | Y |
| 3 | 06 | 047 |  |  |  | (Backscatter profile data) |  |
|  |  |  | 0 | 02 | 071 | (Spectrographic) wavelength | m |
|  | | | 1 | 09 | 000 | Delayed replication of 9 descriptors |  |
|  | | | 0 | 31 | 002 | Extended delayed descriptor replication factor | Gives number of depths |
|  | | | 0 | 07 | 062 | Depth below sea / water surface | Code as missing |
|  | | | 0 | 08 | 080 | Qualifier for quality class | Code as missing |
|  | | | 0 | 33 | 050 | GTSPP quality class | Code as missing |
|  | | | 0 | 07 | 065 | Water pressure |  |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 10, indicates pressure at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |
|  | | | 0 | 41 | 006 | Backscattering | m-1 |
|  | | | 0 | 08 | 080 | Qualifier for quality class (set to 24, backscatter at a level) |  |
|  | | | 0 | 33 | 050 | GTSPP quality class |  |

Code depth related descriptors as missing as water pressure is used as the vertical axis.

in BUFR/CREX code tables,

**0 02 149**

**Type of data buoy**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 31 | Coastal sub-surface float |
| 32 | Deep sub-surface float |

**0 08 080**

**Qualifier for GTSPP Quality Flag**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 21 | Chlorophyll-A at a level |
| 22 | Nitrate at a level |
| 23 | pH at a level |
| 24 | Backscattering at a level |

**0 22 067**

**Instrument type for water temperature/salinity profile measurement**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 836 | PROVOR III |
| 872 | S2X |
| 869 | DOVA |
| 870 | NAMI |
| 871 | HM2000 |

**Add a code table:**

**0 13 161**

**pH scale**

|  |  |
| --- | --- |
| Code figure | Meaning |
| 0 | Seawater scale |
| 1 | Freescale |
| 2 | Total scale |
| 3-6 | Reserved |
| 7 | missing |

* **ANNEX TO PARAGRAPH 2016-3.2.9 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_9) <[para 4.1](#A2016_4_1_bufr)>

**Add entries:**

in BUFR/CREX Table B,

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | | |  | BUFR | | | | CREX | | |
| F | X | Y | ELEMENT NAME | UNIT | SCALE | REFERENCE VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char) |
| 0 | 01 | 152 | Semi-major axis of rotation ellipsoid | m | 2 | 0 | 31 | m | 2 | 11 |
| 0 | 01 | 153 | Semi-minor axis of rotation ellipsoid | m | 2 | 0 | 31 | m | 2 | 11 |
| 0 | 06 | 32 | X offset (see Note 6) | m | 2 | -1073741824 | 31 | m | 2 | 11 |
| 0 | 05 | 32 | Y offset (see Note 6) | m | 2 | -1073741824 | 31 | m | 2 | 11 |
| 0 | 29 | 14 | Optional list of parameters for an external map projection library | CCITT IA5 | 0 | 0 | 504 | Character | 0 | 63 |

**Add Notes:**

under Class 05 – BUFR/CREX Location (horizontal–1),

(6) Y offset is the distance between the projection origin and the upper left corner of the upper left pixel in a map as explained in the following drawing:



Projection origin

Upper left pixel

under Class 06 – BUFR/CREX Location (horizontal–2),

(6) X offset is the distance between the projection origin and the upper left corner of the upper left pixel in a map as explained in the following drawing:



Projection origin

Upper left pixel

**Add entries:**

in code table 0 08 091 – Coordinates significance,

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Satellite coordinates |
| 1 | Observations coordinates |
| 2 | Start of observation |
| 3 | End of observation |
| 4 | Horizontal centre of gravity of the observation |
| 5 | Top of the observation |
| 6 | Bottom of the observation |
| 7 | Vertical centre of gravity of the observation |
| 8 | Projection origin |
| 9 | Coordinates of true scale |
| 10 - 254 | Reserved |
| 255 | Missing value |

**Add entries:**

in BUFR Table B,

Class 8 – BUFR/CREX Significance qualifiers

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | | |  | BUFR | | | | CREX | | |
| F | X | Y | ELEMENT NAME | UNIT | SCALE | REFERENCE VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char) |
| 0 | 08 | 088 | Map significance | Code table | 0 | 0 | 6 | Code table | 0 | 2 |
| 0 | 20 | 129 | Lightning density (Stroke, flash or event) | m-2 | 6 | 0 | 10 | m-2 | 6 | 4 |

**Add a code table:**

Code table 0 08 088 – Map significance

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Top view (geographical longitude on X axis and latitude on Y axis) |
| 1 | North-South view (transect with geographical longitude on X axis and vertical height on Y axis) |
| 2 | East-West view (transect with geographical latitude on X axis and vertical height on Y axis) |
| 3-62 | Reserved |
| 63 | Missing |

<http://www.eumetnet.eu/sites/default/files/bufr_sw_desc.pdf>

* **ANNEX TO PARAGRAPH 2016-3.2.10 [ABC2017/FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_10) <[para 4.1](#A2016_4_1_bufr)>

**Add a note [ABC2017]:**

to Representation form of BUFR,

(10) Position can only be unambiguously interpreted if the coordinate reference system and, if required, fixed reference mean sea level, to which it is attributed, is known. If these are not specified it is assumed that the position shall be interpreted with respect to WGS84 geodetic system and Earth Geodetic Model EGM96.

**Add entries [FT2016-2]:**

in Class 01 – BUFR/CREX Identification,

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | | |  | BUFR | | | | CREX | | |
| F | X | Y | ELEMENT NAME | UNIT | SCALE | REFERENCE VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Char) |
| 0 | 01 | 150 | Coordinate reference system | Code table | 0 | 0 | 16 | Code table | 0 | 5 |
| 0 | 01 | 151 | Fixed mean sea level reference datum | Code table | 0 | 0 | 12 | Code table | 0 | 4 |

**Add code tables [FT2016-2]:**

Code table 0 01 150   Coordinate reference system

| Code figure |  |
| --- | --- |
| 0 | WGS84, as used by ICAO since 1998 |
| 1 | ETRS89, as defined by EPSG::4258 |
| 2 | NAD83, as defined by EPSG::4269 |
| 3 | DHDN, as defined by EPSG::4314 |
| 4 | Ellipsoidal datum using the International Reference Meridian maintained by the International Earth Rotation and Reference Systems Service (IERS) (see Note 2) |
| 5 - 65534 | Reserved |
| 65535 | Missing value |

Notes:

(1) EPSG is a dataset of coordinate system and coordinate system transformations, originally produced and maintained by the European Petroleum Survey Group. Now it is maintained by the Geodesy Subcommittee of the International Association of Oil and Gas Producers Geomatics Committee.

(2) If this coordinate reference system is specified, the semi-major and semi-minor axes must be specified (e.g. descriptors 0 01 152 and 0 01 153).

0 01 151   Fixed mean sea level reference datum

| Code figure |  |
| --- | --- |
| 0 | Earth Gravitational Model 1996 |
| 1 | Baltic height system 1977 |
| 2-4094 | Reserved |
| 4095 | Missing value |

* **ANNEX TO PARAGRAPH 2016-3.2.11 [FT2017-1]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_11)

**Add an entry:**

in BUFR Table D,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LIDAR Sequence** | | | | |
| TABLE  REFERENCE | TABLE  REFERENCE | TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME |
| F X Y | F X Y | F X Y | F X Y |
| **Header Section** | | | | |
| **3 09 023** |  |  |  |  |
|  | 3 01 001 |  |  | WMO block and station numbers |
|  |  | 0 01 001 |  | WMO Block Number |
|  |  | 0 01 002 |  | WMO Station Number |
|  | 0 05 001 |  |  | Latitude (High Accuracy) |
|  | 0 06 001 |  |  | Longitude (High Accuracy) |
|  | 0 07 030 |  |  | Height of station ground above mean sea level |
|  | 3 01 014 |  |  | Time Period |
|  |  | 1 02 002 |  | Replication of 2 descriptors (3 01 011 & 3 01 012) twice |
|  |  | 3 01 011 |  |  |
|  |  |  | 0 04 001 | Year |
|  |  |  | 0 04 002 | Month |
|  |  |  | 0 04 003 | Day |
|  |  | 3 01 012 |  |  |
|  |  |  | 0 04 004 | Hour |
|  |  |  | 0 04 005 | Minute |
|  | 0 02 003 |  |  | Type of measuring equipment used |
|  | **Cloud data section** | | | |
|  | 3 02 004 |  |  | ***General Cloud Information*** |
|  |  | 0 20 010 |  | Cloud cover (total) |
|  |  | 0 08 002 |  | Vertical significance (surface observations) |
|  |  | 0 20 011 |  | Cloud amount |
|  |  | 0 20 013 |  | Height of base of cloud |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 012 |  | Cloud Type |
|  | 3 02 005 |  |  | ***Cloud Layer*** |
|  |  | 0 08 002 |  | Vertical significance (surface observations) |
|  |  | 0 20 011 |  | Cloud amount |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 013 |  | Height of base of cloud |
|  | **Backscatter data section** | | | |
|  | 1 14 000 |  |  | Delayed replication of 14 descriptors |
|  | 0 31 000 |  |  | Delayed replication Factor |
|  | 0 07 007 |  |  | Height |
|  | 3 01 021 | 0 05 001 |  | Latitude High Accuracy |
|  |  | 0 06 001 |  | Longitude High Accuracy |
|  | 1 01 000 |  |  | Delayed replication dependent on number of wavelength measurements present in the data.(note b) |
|  | 0 31 000 |  |  | Delayed replication Factor (see note b) |
|  | 0 02 121 |  |  | Mean Frequency |
|  | 0 15 063 |  |  | Attenuated Backscatter |
|  | 0 15 064 |  |  | Uncertainty in Attenuated Backscatter |
|  | 0 15 065 |  |  | Particle Backscatter Coefficient |
|  | 0 15 066 |  |  | Uncertainty in Particle Backscatter Coefficient |
|  | 0 15 067 |  |  | Particle Extinction Coefficient |
|  | 0 15 068 |  |  | Uncertainty in Particle Extinction Coefficient |
|  | 0 15 069 |  |  | Particle LIDAR Ratio |
|  | 0 15 070 |  |  | Uncertainty in LIDAR Ratio |
|  | 0 15 071 |  |  | Particle Depolarization Ratio |
|  | 0 15 072 |  |  | Uncertainty in Depolarization Ratio |
|  | 0 33 002 |  |  | Quality Information |
|  | 0 10 071 |  |  | Vertical Resolution |
|  | 0 27 079 |  |  | Horizontal Width of sampled volume |

(a) We have a requirement for coding instruments operating at wavelengths between the following ranges;

100nm for UV Lidar’s to 30m for VHF radars\* (see RWP Template)

This corresponds to a range of between the following when measured in Hz

1e+7 – 1e+16

We intend to make use of the existing descriptor 0 02 121 and use modifiers to obtain the desired range.

\*We must also consider the ceilometers/lidar instruments as we plan to use a common header sequence – details in a separate proposal.

(b) The replication is included to allow for instruments with multiple wavelengths – for most instruments only one wavelength is reported, in which case this should be set to 1 (ie. Only the mean frequency should be included in this replication sequence).

**Add entries:**

in BUFR/CREX Table B,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | BUFR | | | | CREX | | |
| TABLE  REFERENCE |  |  |  |  | DATA |  |  | DATA |
| ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH | UNIT | SCALE | WIDTH |
| F\* X   Y |  |  |  | VALUE | (Bits) |  |  | (Characters) |
| 0 15 063 | Attenuated Backscatter | m‑1 Sr‑1 | 8 | 0 | 20 | m‑1 Sr‑1 | 8 | 7 |
| 0 15 064 | Uncertainty in Attenuated Backscatter | m‑1 Sr‑1 | 8 | 0 | 20 | m‑1 Sr‑1 | 8 | 7 |
| 0 15 065 | Particle Backscatter Coefficient | m‑1 Sr‑1 | 8 | 0 | 20 | m‑1 Sr‑1 | 8 | 7 |
| 0 15 066 | Uncertainty in Particle Backscatter Coefficient | m‑1 Sr‑1 | 8 | 0 | 20 | m‑1 Sr‑1 | 8 | 7 |
| 0 15 067 | Particle Extinction Coefficient | m‑1 | 8 | 0 | 20 | m‑1 | 8 | 7 |
| 0 15 068 | Uncertainty in Particle Extinction Coefficient | m‑1 | 8 | 0 | 20 | m‑1 | 8 | 7 |
| 0 15 069 | Particle LIDAR Ratio | Sr | 2 | 0 | 14 | Sr | 2 | 5 |
| 0 15 070 | Uncertainty in LIDAR Ratio | Sr | 2 | 0 | 14 | Sr | 2 | 5 |
| 0 15 071 | Particle Depolarization Ratio | % | 2 | 0 | 14 | % | 2 | 5 |
| 0 15 072 | Uncertainty in Depolarization Ratio | % | 2 | 0 | 14 | % | 2 | 5 |
| 0 27 079 | Horizontal Width of sampled volume | m | 0 | 0 | 18 | m | 0 | 6 |
| 0 10 071 | Vertical resolution | m | 0 | 0 | 14 | m | 0 | 5 |

**Add entries: (To be confirmed)**

in code table 0 02 003,

|  |  |
| --- | --- |
| 10 | Lidar |

* **ANNEX I TO PARAGRAPH 2016-3.2.12 [FT2016-2/FT2017-1]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_12)

**Add entries [FT2016-2]:**

in code table 0 02 013 “Solar and infrared radiation correction”,

8 Solar and infrared corrected as specified by GRUAN

9 Solar corrected as specified by GRUAN

in code table 0 02 017 “Correction algorithms for humidity measurements”,

7 GRUAN solar radiation and time lag correction

in code table 0 02 081 “Type of balloon”,

7 Totex TA type balloons

8 Totex TX type balloons

in code table 0 02 083 “Type of balloon shelter”,

4 Automated unmanned sounding system

in code table 0 35 035 “Reason for termination”,

16 Increasing pressure

17 Invalid and/or missed data time limits exceeded

**Add an element description to 0 35 035 “Reason for termination” [FT2016-2]:**

in Table D for 3 01 128,

Reason for ascent termination

**Add entries [FT2017-1]:**

in BUFR/CREX Table B,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FXY | Element Name | BUFR Unit | BUFR Scale | BUFR reference value | BUFR width (bits) | CREX Unit | CREX Scale | CREX width (characters) |
| 0 02 088 | Volume of gas used in balloon | m3 | 3 | 0 | 13 | m3 | 3 | 4 |
| 0 08 037 | Baseline check significance | Code table | 0 | 0 | 5 | Code table | 0 | 2 |
| 0 08 038 | Instrument data significance | Code table | 0 | 0 | 8 | Code table | 0 | 3 |
| 0 03 027 | Type of flight rig | Code table | 0 | 0 | 4 | Code table | 0 | 2 |

**Add Code tables [FT2017-1]:**

**0 08 037**

***Baseline check significance***

Code figure

0 Manufacturer’s baseline check unit

1 Weather screen

2 GRUAN Standard humidity chamber

3-30 Reserved

31 Missing value

**0 08 038**

***Instrument data significance***

Code figure

0 Verified instrument reading

1 Reference instrument reading

2-254 Reserved

255 Missing value

**0 03 027**

***Type of flight rig***

Code figures

0 Solo (single radiosonde)

1 Block

2 Bar

3 Cross

4 T-rig

5 Double T-rig

6 Complex

7-14 Reserved

15 Missing value

* **ANNEX II TO PARAGRAPH 2016-3.2.12**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_12)

**QUESTIONS:**

(1) Do we need to formalize in some way regulations how to populate in future 0 02 011 radiosonde type and 0 02 066 Radiosonde ground receiving system?

A: No consensus was seen on formalizing regulations how to populate the tables 0 02 011 and 0 02 066. The consensus was to increase bit width of 0 02 011 instead, which could be identified by tables versioning.

(2) Can we make a suggestion how to manage with clarifications of existing descriptors and Code tables and recommendation on reporting them (“best practice” guidance) or further liaison with CIMO, HMEI, CBS-TT-UAB, GRUAN is required?

A: A discipline specific approach to clarification is to be recommended rather than something like guides.

(3) Can IPET-DRMM agree with considering introducing new descriptor to signify sounding performed and processed according to GRUAN procedure and prepare respective proposal:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TABLE |  |  |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH |
| F X Y |  |  |  | VALUE | (Bits) |
| 0 03 xxx | Sounding procedure | Code table | 0 | 0 | 4 |

**0 03 xxx**

***Sounding procedure***

Code figure

0 As specified by manufacturer

1 As specified by GRUAN

2-14 Reserved

15 Missing value

or “dead” descriptor 0 02 012 Radiosonde computational method may hold this information?

A: Introducing the descriptor can be considered. Rename of 0 02 012 is an option, which has no entry.

* **ANNEX TO PARAGRAPH 2016-3.2.13 [FT2017-1]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_13)

**Add entries:**

in BUFR/CREX Table B,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FXY | Element Name | BUFR Unit | BUFR Scale | BUFR reference value | BUFR width (bits) | CREX Unit | CREX Scale | CREX width (characters) |
| 0 08 092 | Measurement uncertainty expression | Code table | 0 | 0 | 5 | Code table | 0 | 2 |
| 0 08 093 | Measurement uncertainty significance | Code table | 0 | 0 | 5 | Code table | 0 | 2 |

**Add code tables:**

0 08 092

*Measurement uncertainty expression*

Code figure

0 Standard uncertainty  
 1-30 Reserved  
 31 Missing value

0 08 093

*Measurement uncertainty significance*

Code figure

0 Total uncertainty  
 1 Systematic component of uncertainty  
 2 Random component of uncertainty  
 3-30 Reserved  
 31 Missing value

* **ANNEX TO PARAGRAPH 3.3.1 [CBS-16]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_3_1)

|  |  |
| --- | --- |
| Proposed Requirement | Proposed for further discussion |
| The development of a Logical Data Model (Application Schema) should be the initial activity in developing a new data exchange requirement. | It is proposed to issue a recommendation encouraging the use of LDM in developing new data exchange requirements. Even in the eventuality of this becoming mandatory, this is an overarching statement that should not be part of the BUFR regulations as such. A suitable location should be found for this recommendation in the WMO Technical Regulations.  The team concurs. |
| Enforced use of templates in product development | It is proposed to make the use of templates for new BUFR data products mandatory in the case where they are intended for exchange in the WMO framework. This is an overarching requirement that should not be part of the BUFR regulations as such. Therefore, a suitable location should be found to state this requirement in the WMO Technical Regulations.  The team considered that the concept of template needed to be better defined in the context of the above statement. It also recognized that the intention of maintaining and improving reporting consistency is beyond the scope of Edition 5. |
| Short and long names for Table B & D entries | It is proposed to add a "long name" column to Table B entries, and make the use of "short name" and "long name" mandatory in naming Table D sequences. Thought should be given to mechanisms ensuring backward compatibility of the Tables for the encoding and decoding of BUFR Edition 4.  The team concurs, noting that this is driven by UML interoperability. This could be accomplished within Edition 4. |
| Representation of values over extremely large dynamic range | A workable solution exists in BUFR Edition 4, and further debate on this matter would be unlikely to be fruitful.  The team concurs |
| Explicit separation of data types from units | This is relatively easy to implement in the tables. Some debate is required to hash out whether the pros outweigh the cons.  The team considered that the benefits of separating data type (i.e. scalar, vector, ordered list) from physical units were not sufficient to warrant departing from current practice. |
| Multilingual support for character strings | The specifics of the implementation are yet to be determined, as well as whether the pros outweigh the cons. But if this is deemed desirable, the current window of opportunity would seem like a good one. |
| Delayed sequence definition | 1. Create new type of descriptor with F=4 (this is made possible with the proposal immediately below).  2. Use a delayed mechanism similar to F=1 to indicate the number of descriptors to be retrieved from section 4 (in a similar manner to the existing delayed replication of descriptors).   3. The data associated with the delayed sequence would follow immediately in Section 4.  Whether there is a strong use case for this is open for discussion. One possibly compelling example is that it could replace the currently existing Data Present Bitmap mechanism in a manner that could seem better integrated with the Data Syntax as a whole.  The team considered some possible use cases for the proposed feature and agreed the concept could be useful. The team agreed that the concept should be examined toward a concrete proposal. |
| Increase name-space size for descriptor classes and descriptor numbers (XX and YYY in F-XX-YYY) | Increase descriptor size to 24 bits.   F-X-Y structure to be extended to 3-9-12 bits. Maintain numerical backward compatibility. That is to say: the meaning and interpretation of current Table B and D descriptors as per the numerical value of X and Y are unchanged. Table C descriptors need to be re-implemented in accordance with the new descriptor size. Maintain the current numerical ranges for local descriptors, while considering extending it by a reasonable extent.  The extension of F to 3 bits opens the possibility of new types of descriptors in BUFR edition 5 or beyond.  The team concurs with the above in the context of an incremental edition change. There was concern about the practical implementation of backward compatibility.  An edition change with a larger scope, such as including ISO compliance, might make it possible to re-implement the Tables B and D without concern for backward compatibility. |
| Allow for the description of the object of statistical (or other) operations when multiple possibilities exist. Example use case: specify which fields are the subject of correlation calculations in radar data. | Two possible options:  1. Add the required functionality as another variant of the Data Present Indicator (DPI) mechanism. This may be possible in BUFR Edition 4 without going to another edition if no new Table C descriptor is required.  2. Use the proposed Delayed Sequence as a means to indicate the fields which as subject to the correlation (or other operation). This would follow a similar pattern of operation as the DPB but without the need for at Table C operator.  This was discussed in plenary and an alternative proposal was discussed that would make this possible within the scope of Edition 4. This will be further developed in coming months. |
| Use industry standard bit order | Reverse the current order of bits ordained in note (2) of the section entitled "SPECIFICATIONS OF OCTET CONTENTS".  This was agreed upon in plenary. |
| Versioning and life-cycle of Table B and D entries | For the effective application of versioning information, two conditions have to be met: messages have to be encoded with accurate version information (of Master Table Version, etc). AND the decoder and its downstream processes have to make proper use of the information. For instance, in cases where the bit width of some Table B descriptors changed from one version to the next, having the correct version number is essential to fully decode the BUFR message.  There are Code Form regulations specifying how to convey the requisite information, but each Centre is ultimately responsible for its own actions in this regard. QA/QC processes, whether the Centre's own or in the WIGOS framework, should be concerned with a capacity for identifying and reporting various encoding issues, including issues of versioning. Thus, regulations concerning the application of versioning made possible in the BUFR Code Form would perhaps carry more weight if they were referred to in the Technical Regulations governing the production and transmission of messages.  With regard to the life-cycle of entries in Tables B/D, or more concretely a clean-up of flawed or obsolete entries, this is beyond the scope given to BUFR Ed. 5 by the discussions at the Beijing meeting.  The team concurs. |
| A new methodology is needed in the new editions of BUFR and GRIB to ensure that decoders are always using the exact same table information as encoders. | A mechanism for real-time authoritative table validation would alleviate or perhaps solve this issue. This could be developed outside the direct scope of BUFR Edition 5, since it does not necessarily have to involve a change in the encoding /decoding process.  The team concurs. |
| New data type: hybrid numerical and code table. This would enable, for instance, numerical ranges for precipitation, while also permitting code table entries such as “trace”. | This was proposed by Russia and added by the TT. The notes that the concept would render machine-readable some data elements that currently require footnotes for proper interpretation. However, the practical implementation of a hybrid data type requires investigation. |
| Inline compression | To allow compression in cases where delayed replication factors are not identical across subsets.  A concept for implementation involving a Table C operator was described by Russia. The team agreed this would be a useful feature. The practical implementation requires investigation. |

* **ANNEX TO PARAGRAPH 4.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_4_1)

Implementation of amendments during the intersessional period

1. [Rec. 6 and 7 (CBS Ext. (2014))](https://www.wmo.int/pages/prog/www/WMOCodes/Amendments/2015/CBS_Ext2014/2014_CBS_XV%20Ext_Rec-6-7.pdf) (4 November 2015)

2. [Pre-operational](http://www.wmo.int/pages/prog/www/WMOCodes/Amendments/2015/preOperational/PreOperational_2015-2.docx) (27 August 2015)

3. [Fast-track 2015-2](https://www.wmo.int/pages/prog/www/WMOCodes/Amendments/2015/fastTrack/FT2015-2_en.pdf) (11 November 2015)

4. [Fast-track 2016-1](https://www.wmo.int/pages/prog/www/WMOCodes/Amendments/2016/fastTrack/FT2016-1_en.pdf) (4 May 2016)

5. [*Adoption between CBS sessions 2016*](https://www.wmo.int/pages/prog/www/WMOCodes/Amendments/2016/betweenCBS/PR-6892-OBS-WIS-DRMM-DRC_en.pdf) *(2 November 2016)*

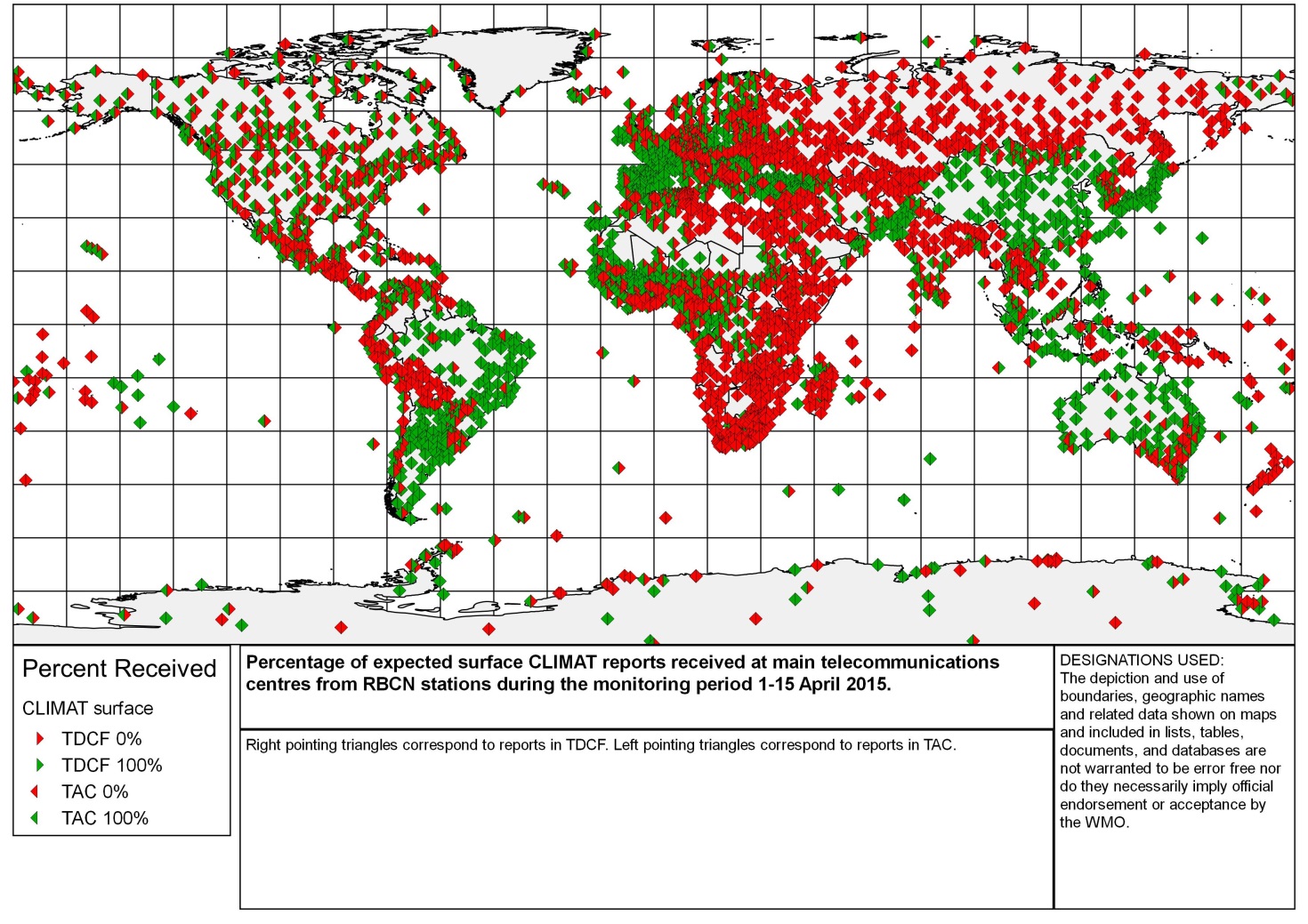
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STATUS OF PROPOSALS**  1. The following tables are to show the proposals under validation for facilitating validation exercise and to note those implemented or adopted after the previous meeting of IPET-DRMM.  2. Proposals at validation stage have no status of the Manual on Codes (WMO-No. 306) and MAY NOT be applied in operational data and products.  3. It should be noted proposals at validation stage may be modified during validation exercise.  It is recommended to update the proposals whenever modified.  Information updated: 2 November 2016  **FM 92 GRIB**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | ID | Approval for Validation | Proposals | Status | Remarks | | PFC2016-2-2 | | [New GRIB2 entry in code table 4.2](#P2016_2_2) | FT2017-1 |  | | PFC2016-2-4 | | [New GRIB2 templates related to distribution functions and associated table entries](#P2016_2_4) | FT2017-1 |  | |  | |  |  |  | | PFC2015-2-1 | | [GRIB2 parameters for NCEP forecast products](#P2015_2_1) | FT2016-1 |  | | PFC2015-2-2 | | [GRIB2 parameters and level type for the uncertainties in ensembles of regional reanalyses project](#P2015_2_2) | FT2016-1 |  | | PFC2015-2-3 | | [GRIB2 parameters for new forecast and post-processing products](#P2015_2_3) | FT2016-1 |  | |  |  |  |  |  | | 2015-2.1.1 | DRMM-III | [Complete encoding of information required for georeferencing grid points in GRIB](#A2015_2_1_1) | ABC2016 |  | | 2015-2.1.2 | DRMM-III | [New GRIB2 Regulations and notes to make it clear that forecast times may be negative](#A2015_2_1_2) | ABC2017 |  | | 2015-2.2.1/2.2.2 | DRMM-III | [New parameters in GRIB2 Code table 4.2/New GRIB2 parameters and product definition template for observational satellite data](#A2015_2_2_1) | Val | prev. 2013-2.1.1/2.2.5  Ongoing interested by MSC and EUMETSAT | | 2015-2.2.8 | DRMM-III | [New parameters in GRIB2 Code Table 4.2 for moisture, radiation and clouds](#A2015_2_2_8) | ~~FT2015-2,~~ FT2016-1 (Code table 4.5) |  | |  |  |  |  |  | | 2014-2.2.2 | DRMM-II | [A product definition template for statistics over an ensemble](#A2014_2_2_2) | Val | Ongoing | |  |  |  |  |  | | 2012-2.2.9 | DRC-IV | [GRIB template for 4-D Trajectory grid definition](#A2012_2_2_9) | Val | To be confirmed |   **FM 94 BUFR/FM 95 CREX**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | ID | Approval for Validation | Proposals | Status | Confirmed at meeting | | PFC2016-2-1 | | [New entry in common code table C-8](#P2016_2_1) | FT2017-1 |  | | PFC2016-2-3 | | [New entry in common code table C-12](#P2016_2_3) | FT2017-1 |  | | PFC2016-2-5 | | [Clarification of an entry in code table 0 01 150](#P2016_2_5) | FT2017-1 |  | |  |  |  |  |  | | 2015-3.2.4 | DRMM-III | [BUFR sequence and elements for Atmospheric Laser Doppler Instrument (ALADIN)](#A2015_3_2_4) | FT2016-1 |  | | 2015-3.2.6 | DRMM-III | [Modification to wave spectra observation template (3 08 015 and 3 08 016)](#A2015_3_2_6) | FT2016-1 | prev. 2008-3.1.15 | | 2015-3.2.13 | DRMM-III | [BUFR elements and sequence for international exchange of road weather information](#A2015_3_2_13) | FT2016-1 |  | | 2015-5.1 | DRMM-III | [Clarifications of B/C 30 and B/C 32 Regulations](#A2015_5_1) | ABC2016 |  | | 2015-5.2 | DRMM-III | [Strategy for amending Annex II to B/C 25 Regulations](#A2015_5_2) | ~~FT2015-2  (3 01 128),~~ ABC2016 |  | | 2015-5.3 | DRMM-III | [Clarification of upper-air wind reporting nearby the Poles](#A2015_5_3) | ABC2016 |  | |  |  |  |  |  | | 2014-3.2.7 | DRMM-II | [BUFR template for n-minute AWS data (3 07 092)](#A2014_3_2_7) | Val | Ongoing | | 2014-3.2.9 | DRMM-II | [Proposed BUFR sequence for reporting observations from offshore platforms](#A2014_3_2_9) | Val | Ongoing | | 2014-11.2 | DRMM-II | [WIGOS Station Identifier](#A2014_11_2) | FT2017-1 |  | |  |  |  |  |  | | 2013-3.2.2 | DRMM-I | [Proposal for a BUFR template for radar wind profiler](#A2013_3_2_2) | Val | Ongoing | | 2013-3.2.4 | DRMM-I | [Satellite-derived winds in BUFR](#A2013_3_2_4) | Val | Ongoing | |

* **ANNEX TO PARAGRAPH 7.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_1)

Figure 1: Surface BUFR reports for RBSN stations captured by the SMM exercise during 1-15 January 2016 shown as a percentage of the expected number of reports.

Figure 2: Upper-air BUFR reports for RBSN stations captured by the SMM exercise during 1-15 January 2016 shown as a percentage of the expected number of reports.

Figure 3: Climate BUFR reports for RBSN stations captured by the SMM exercise during 1-15 January 2016 shown as a percentage of the expected number of reports.

Table 1: Average by country of the number of surface and upper-air reports from RBSN stations and climate reports from RBCN stations recorded in BUFR messages during the SMM of 1-15 January 2016. The number of reports expected from each station is 60 (surface), 30 (upper-air) and 1 (climate), respectively.

**Surface RBSN**

| **Region/Country/Area** | **TAC %** | **TDCF %** |
| --- | --- | --- |
| **1** |  |  |
| ALGERIA | 92 | 91 |
| ANGOLA | 17 | 0 |
| BENIN | 95 | 0 |
| BOTSWANA | 46 | 0 |
| BOUVET ISLAND (NORWAY) | 0 | 0 |
| BURKINA FASO | 95 | 90 |
| BURUNDI | 35 | 0 |
| CABO VERDE | 94 | 94 |
| CAMEROON | 26 | 0 |
| CANARY ISLANDS (SPAIN) | 100 | 100 |
| CENTRAL AFRICAN REPUBLIC | 17 | 16 |
| CEUTA AND MELILLA (SPAIN) | 100 | 73 |
| CHAD | 52 | 44 |
| COMOROS | 97 | 42 |
| CONGO | 81 | 67 |
| COTE D'IVOIRE | 98 | 80 |
| DEMOCRATIC REPUBLIC OF THE CONGO | 6 | 0 |
| DJIBOUTI | 8 | 0 |
| EGYPT | 91 | 72 |
| EQUATORIAL GUINEA | 0 | 94 |
| ERITREA | 0 | 0 |
| ETHIOPIA | 43 | 0 |
| GABON | 60 | 54 |
| GAMBIA | 84 | 21 |
| GHANA | 69 | 0 |
| GUINEA | 7 | 0 |
| GUINEA-BISSAU | 46 | 43 |
| KENYA | 78 | 58 |
| LESOTHO | 1 | 0 |
| LIBERIA | 3 | 3 |
| LIBYA | 33 | 0 |
| MADAGASCAR | 62 | 12 |
| MADEIRA | 100 | 83 |
| MALAWI | 16 | 0 |
| MALI | 64 | 55 |
| MAURITANIA | 54 | 41 |
| MAURITIUS | 93 | 100 |
| MOROCCO | 49 | 0 |
| MOZAMBIQUE | 39 | 0 |
| NAMIBIA | 49 | 0 |
| NIGER | 85 | 0 |
| NIGERIA | 11 | 0 |
| OCEAN ISLANDS | 56 | 40 |
| RWANDA | 48 | 0 |
| SENEGAL | 81 | 64 |
| SEYCHELLES | 32 | 30 |
| SIERRA LEONE | 0 | 0 |
| SOMALIA | 0 | 0 |
| SOUTH AFRICA | 92 | 58 |
| SOUTH SUDAN | 0 | 0 |
| SUDAN | 0 | 0 |
| SWAZILAND | 50 | 0 |
| TOGO | 94 | 2 |
| TUNISIA | 90 | 78 |
| UGANDA | 31 | 0 |
| UNITED REPUBLIC OF TANZANIA | 74 | 30 |
| WESTERN SAHARA | 40 | 0 |
| ZAMBIA | 7 | 0 |
| ZIMBABWE | 63 | 39 |
| **2** | **91** | **61** |
| AFGHANISTAN, ISLAMIC STATE OF | 0 | 0 |
| BAHRAIN | 16 | 14 |
| BANGLADESH | 53 | 16 |
| CAMBODIA | 8 | 9 |
| CHINA | 99 | 66 |
| DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA | 100 | 81 |
| HONG KONG, CHINA | 100 | 65 |
| INDIA | 95 | 95 |
| IRAN, ISLAMIC REPUBLIC OF | 97 | 0 |
| IRAQ | 55 | 0 |
| JAPAN | 100 | 57 |
| KAZAKHSTAN | 100 | 81 |
| KUWAIT | 98 | 43 |
| KYRGYZSTAN | 100 | 0 |
| LAO PEOPLE'S DEMOCRATIC REPUBLIC | 79 | 0 |
| MACAO, CHINA | 100 | 0 |
| MALDIVES | 80 | 73 |
| MONGOLIA | 100 | 57 |
| MYANMAR | 38 | 30 |
| NEPAL | 70 | 0 |
| OMAN | 95 | 21 |
| PAKISTAN | 72 | 55 |
| QATAR | 82 | 73 |
| REPUBLIC OF KOREA | 100 | 74 |
| RUSSIAN FEDERATION (IN ASIA) | 96 | 79 |
| SAUDI ARABIA | 76 | 42 |
| SRI LANKA | 85 | 0 |
| TAJIKISTAN | 95 | 0 |
| THAILAND | 100 | 95 |
| TURKMENISTAN | 100 | 0 |
| UNITED ARAB EMIRATES | 81 | 55 |
| UZBEKISTAN | 100 | 0 |
| VIET NAM | 96 | 72 |
| YEMEN | 1 | 0 |
| **3** | **63** | **32** |
| ARGENTINA | 98 | 0 |
| BOLIVIA | 46 | 0 |
| BRAZIL | 61 | 55 |
| CHILE | 58 | 32 |
| COLOMBIA | 64 | 43 |
| ECUADOR | 56 | 2 |
| FRENCH GUIANA | 75 | 100 |
| GUYANA | 36 | 0 |
| ISLANDS (88: 800 - 998) | 0 | 97 |
| PARAGUAY | 69 | 51 |
| PERU | 71 | 67 |
| SURINAME | 25 | 0 |
| URUGUAY | 66 | 46 |
| VENEZUELA | 31 | 0 |
| **4** | **84** | **58** |
| ANTIGUA AND BARBUDA | 63 | 0 |
| BAHAMAS | 14 | 0 |
| BARBADOS | 0 | 0 |
| BELIZE | 50 | 0 |
| BERMUDA | 100 | 100 |
| CANADA | 94 | 63 |
| CAYMAN ISLANDS | 72 | 0 |
| CLIPPERTON | 0 | 0 |
| COLOMBIA (SAN ANDRES AND PROVIDENCIA ISLANDS) | 80 | 58 |
| COSTA RICA | 62 | 0 |
| CUBA | 63 | 0 |
| CURACAO, ST MAARTEN AND ARUBA (NL) | 98 | 0 |
| DOMINICA | 70 | 0 |
| DOMINICAN REPUBLIC | 82 | 0 |
| EL SALVADOR | 21 | 0 |
| GRENADA | 100 | 0 |
| GUADELOUPE, ST MARTIN, ST BARTHELEMY AND OTHER FRENCH ISLANDS IN THE VICINITY | 33 | 0 |
| GUATEMALA | 42 | 0 |
| HAITI | 0 | 0 |
| HONDURAS | 63 | 0 |
| JAMAICA | 94 | 0 |
| MARTINIQUE | 72 | 50 |
| MEXICO | 64 | 19 |
| NICARAGUA | 0 | 0 |
| PANAMA | 10 | 0 |
| PUERTO RICO AND US POSSESSIONS IN THE CARIBBEAN AREA | 100 | 98 |
| SAINT LUCIA | 86 | 70 |
| ST EUSTATIUS AND BONAIRE (NL) | 0 | 100 |
| ST. PIERRE AND MIQUELON (FRANCE) | 100 | 0 |
| TRINIDAD AND TOBAGO | 98 | 0 |
| UNITED STATES OF AMERICA | 96 | 92 |
| UNITED STATES OF AMERICA (ALASKA) | 82 | 78 |
| VENEZUELA (ISLA DE AVES) | 0 | 0 |
| **5** | **75** | **64** |
| AMERICAN SAMOA | 25 | 0 |
| AUSTRALIA | 84 | 77 |
| BRUNEI DARUSSALAM | 97 | 0 |
| CHINA | 47 | 46 |
| COOK ISLANDS | 36 | 35 |
| DETACHED ISLANDS (91 : 753, 754) | 99 | 0 |
| DETACHED ISLANDS (91: 960 - 998) | 0 | 0 |
| FIJI | 83 | 73 |
| FRENCH POLYNESIA (AUSTRAL ISLANDS) | 99 | 100 |
| FRENCH POLYNESIA (MARQUESAS ISLANDS) | 97 | 97 |
| FRENCH POLYNESIA (SOCIETY ISLANDS) | 100 | 99 |
| FRENCH POLYNESIA (TUAMOTU ISLANDS AND GAMBIER ISLANDS) | 100 | 75 |
| INDONESIA | 96 | 86 |
| ISLANDS (96: 995, 996) | 100 | 91 |
| ISLANDS IN THE PACIFIC OCEAN NORTH OF THE EQUATOR | 34 | 10 |
| KIRIBATI | 85 | 0 |
| MALAYSIA | 100 | 100 |
| NAURU | 0 | 0 |
| NEW CALEDONIA | 80 | 60 |
| NEW ZEALAND | 100 | 98 |
| NIUE | 18 | 18 |
| PAPUA NEW GUINEA | 9 | 7 |
| PHILIPPINES | 87 | 78 |
| PHOENIX ISLANDS | 28 | 0 |
| SAMOA | 26 | 0 |
| SINGAPORE | 100 | 100 |
| SOLOMON ISLANDS | 82 | 74 |
| TIMOR-LESTE | 0 | 0 |
| TOKELAU (AND SWAINS IS.) | 0 | 0 |
| TONGA | 88 | 88 |
| TUVALU | 43 | 0 |
| VANUATU | 84 | 56 |
| **6** | **95** | **79** |
| ARMENIA | 100 | 98 |
| AUSTRIA | 100 | 96 |
| AZERBAIJAN | 100 | 10 |
| BELARUS | 100 | 90 |
| BELGIUM | 100 | 69 |
| BOSNIA AND HERZEGOVINA | 97 | 97 |
| BULGARIA | 100 | 0 |
| CROATIA | 92 | 79 |
| CYPRUS | 98 | 48 |
| CZECH REPUBLIC | 100 | 97 |
| DENMARK AND FAROE ISLANDS | 98 | 76 |
| ESTONIA | 100 | 91 |
| FINLAND | 100 | 100 |
| FRANCE | 100 | 100 |
| GEORGIA | 89 | 64 |
| GERMANY | 83 | 100 |
| GIBRALTAR | 100 | 100 |
| GREECE | 92 | 88 |
| GREENLAND (DENMARK) | 94 | 45 |
| HUNGARY | 100 | 100 |
| ICELAND | 60 | 57 |
| IRELAND | 100 | 100 |
| ISRAEL | 100 | 57 |
| ITALY | 93 | 100 |
| JORDAN | 57 | 0 |
| KAZAKHSTAN (IN EUROPE) | 100 | 79 |
| LATVIA | 85 | 83 |
| LEBANON | 97 | 0 |
| LITHUANIA | 100 | 100 |
| LUXEMBOURG | 100 | 50 |
| MALTA | 100 | 0 |
| MONTENEGRO | 91 | 46 |
| NETHERLANDS | 100 | 93 |
| NORWAY | 94 | 88 |
| POLAND | 100 | 100 |
| PORTUGAL | 97 | 90 |
| REPUBLIC OF MOLDOVA | 100 | 0 |
| ROMANIA | 100 | 100 |
| RUSSIAN FEDERATION (IN EUROPE) | 99 | 59 |
| SERBIA | 93 | 91 |
| SLOVAKIA | 100 | 100 |
| SLOVENIA | 100 | 93 |
| SPAIN | 96 | 96 |
| SWEDEN | 99 | 99 |
| SWITZERLAND AND LIECHTENSTEIN | 100 | 90 |
| SYRIAN ARAB REPUBLIC | 40 | 0 |
| THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA | 100 | 95 |
| TURKEY | 91 | 90 |
| UKRAINE | 94 | 6 |
| UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND | 98 | 98 |
| **Antarctic** | **48** | **36** |
| STATIONS IN THE ANTARCTIC | 48 | 36 |

**Upper air**

| **Region/Country/Area** | **TAC %** | **TDCF %** |
| --- | --- | --- |
| **1** | **21** | **5** |
| ALGERIA | 80 | 0 |
| ANGOLA | 0 | 0 |
| BENIN | 40 | 0 |
| BOTSWANA | 0 | 0 |
| BURKINA FASO | 47 | 0 |
| CABO VERDE | 27 | 0 |
| CAMEROON | 18 | 0 |
| CANARY ISLANDS (SPAIN) | 97 | 100 |
| CENTRAL AFRICAN REPUBLIC | 10 | 0 |
| CHAD | 0 | 0 |
| CONGO | 20 | 0 |
| COTE D'IVOIRE | 43 | 0 |
| DEMOCRATIC REPUBLIC OF THE CONGO | 0 | 0 |
| EGYPT | 38 | 0 |
| ERITREA | 0 | 0 |
| ETHIOPIA | 17 | 0 |
| GABON | 20 | 0 |
| GHANA | 0 | 0 |
| GUINEA | 0 | 0 |
| LIBYA | 0 | 0 |
| MADAGASCAR | 0 | 0 |
| MADEIRA | 50 | 50 |
| MALAWI | 0 | 0 |
| MALI | 14 | 0 |
| MAURITANIA | 8 | 0 |
| MAURITIUS | 0 | 0 |
| MOROCCO | 22 | 0 |
| MOZAMBIQUE | 0 | 0 |
| NAMIBIA | 43 | 0 |
| NIGER | 63 | 0 |
| NIGERIA | 0 | 0 |
| OCEAN ISLANDS | 33 | 35 |
| SENEGAL | 22 | 18 |
| SOMALIA | 0 | 0 |
| SOUTH AFRICA | 77 | 77 |
| SUDAN | 0 | 0 |
| TUNISIA | 27 | 0 |
| UNITED REPUBLIC OF TANZANIA | 0 | 0 |
| ZAMBIA | 0 | 0 |
| ZIMBABWE | 37 | 0 |
| **2** | **80** | **45** |
| AFGHANISTAN, ISLAMIC STATE OF | 32 | 0 |
| BANGLADESH | 40 | 0 |
| CHINA | 100 | 95 |
| DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA | 30 | 0 |
| HONG KONG, CHINA | 100 | 100 |
| INDIA | 46 | 48 |
| IRAN, ISLAMIC REPUBLIC OF | 60 | 0 |
| IRAQ | 23 | 0 |
| JAPAN | 98 | 98 |
| KAZAKHSTAN | 100 | 0 |
| KUWAIT | 73 | 0 |
| MALDIVES | 43 | 43 |
| MONGOLIA | 32 | 32 |
| MYANMAR | 0 | 0 |
| OMAN | 72 | 0 |
| PAKISTAN | 57 | 0 |
| QATAR | 0 | 0 |
| REPUBLIC OF KOREA | 100 | 32 |
| RUSSIAN FEDERATION (IN ASIA) | 91 | 0 |
| SAUDI ARABIA | 58 | 51 |
| SRI LANKA | 0 | 0 |
| TAJIKISTAN | 0 | 0 |
| THAILAND | 20 | 20 |
| TURKMENISTAN | 37 | 0 |
| UNITED ARAB EMIRATES | 93 | 0 |
| VIET NAM | 100 | 100 |
| **3** | **58** | **41** |
| ARGENTINA | 60 | 2 |
| BOLIVIA | 0 | 0 |
| BRAZIL | 79 | 71 |
| CHILE | 45 | 17 |
| COLOMBIA | 50 | 23 |
| ECUADOR | 7 | 0 |
| FRENCH GUIANA | 100 | 100 |
| GUYANA | 0 | 0 |
| ISLANDS (88: 800 - 998) | 47 | 47 |
| PERU | 0 | 0 |
| VENEZUELA | 0 | 0 |
| **4** | **93** | **79** |
| BAHAMAS | 53 | 50 |
| BARBADOS | 100 | 97 |
| BELIZE | 87 | 77 |
| BERMUDA | 87 | 73 |
| CANADA | 99 | 45 |
| CAYMAN ISLANDS | 80 | 60 |
| COLOMBIA (SAN ANDRES AND PROVIDENCIA ISLANDS) | 50 | 37 |
| COSTA RICA | 0 | 0 |
| CURACAO, ST MAARTEN AND ARUBA (NL) | 95 | 93 |
| DOMINICAN REPUBLIC | 0 | 0 |
| GUADELOUPE, ST MARTIN, ST BARTHELEMY AND OTHER FRENCH ISLANDS IN THE VICINITY | 77 | 77 |
| JAMAICA | 77 | 73 |
| MEXICO | 68 | 68 |
| NICARAGUA | 0 | 0 |
| PANAMA | 47 | 40 |
| PUERTO RICO AND US POSSESSIONS IN THE CARIBBEAN AREA | 100 | 100 |
| TRINIDAD AND TOBAGO | 67 | 63 |
| UNITED STATES OF AMERICA | 98 | 98 |
| UNITED STATES OF AMERICA (ALASKA) | 100 | 97 |
| **5** | **67** | **54** |
| AMERICAN SAMOA | 100 | 100 |
| AUSTRALIA | 48 | 48 |
| BRUNEI DARUSSALAM | 13 | 0 |
| COOK ISLANDS | 0 | 0 |
| FIJI | 90 | 83 |
| FRENCH POLYNESIA (AUSTRAL ISLANDS) | 0 | 0 |
| FRENCH POLYNESIA (MARQUESAS ISLANDS) | 50 | 50 |
| FRENCH POLYNESIA (SOCIETY ISLANDS) | 100 | 100 |
| FRENCH POLYNESIA (TUAMOTU ISLANDS AND GAMBIER ISLANDS) | 50 | 50 |
| INDONESIA | 99 | 95 |
| ISLANDS (96: 995, 996) | 47 | 43 |
| ISLANDS IN THE PACIFIC OCEAN NORTH OF THE EQUATOR | 89 | 89 |
| KIRIBATI | 50 | 3 |
| MALAYSIA | 98 | 0 |
| NAURU | 0 | 0 |
| NEW CALEDONIA | 100 | 100 |
| NEW ZEALAND | 86 | 88 |
| PAPUA NEW GUINEA | 0 | 0 |
| PHILIPPINES | 93 | 27 |
| SINGAPORE | 100 | 100 |
| TUVALU | 43 | 20 |
| VANUATU | 7 | 0 |
| **6** | **81** | **54** |
| ARMENIA | 43 | 23 |
| AUSTRIA | 100 | 100 |
| BELGIUM | 53 | 0 |
| BULGARIA | 50 | 50 |
| CROATIA | 100 | 77 |
| CYPRUS | 17 | 0 |
| CZECH REPUBLIC | 100 | 100 |
| DENMARK AND FAROE ISLANDS | 100 | 100 |
| ESTONIA | 50 | 50 |
| FINLAND | 50 | 50 |
| FRANCE | 99 | 97 |
| GERMANY | 100 | 100 |
| GIBRALTAR | 0 | 0 |
| GREECE | 46 | 13 |
| GREENLAND (DENMARK) | 96 | 94 |
| HUNGARY | 100 | 50 |
| ICELAND | 70 | 7 |
| IRELAND | 100 | 100 |
| ISRAEL | 100 | 100 |
| ITALY | 99 | 98 |
| JORDAN | 50 | 50 |
| LATVIA | 23 | 0 |
| LEBANON | 0 | 0 |
| LITHUANIA | 0 | 0 |
| NETHERLANDS | 60 | 60 |
| NORWAY | 73 | 73 |
| POLAND | 100 | 100 |
| PORTUGAL | 45 | 47 |
| ROMANIA | 100 | 97 |
| RUSSIAN FEDERATION (IN EUROPE) | 99 | 11 |
| SERBIA | 100 | 97 |
| SLOVAKIA | 100 | 100 |
| SLOVENIA | 0 | 0 |
| SPAIN | 84 | 82 |
| SWEDEN | 74 | 73 |
| SWITZERLAND AND LIECHTENSTEIN | 100 | 100 |
| THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA | 0 | 0 |
| TURKEY | 100 | 98 |
| UKRAINE | 31 | 0 |
| UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND | 91 | 33 |
| **Antarctic** | **48** | **37** |
| STATIONS IN THE ANTARCTIC | 48 | 37 |

* **ANNEX TO PARAGRAPH 7.2.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_1)

**Summary of survey on the migration status in RA I for SYNOP, TEMP and CLIMAT based on Nairobi RTH transmission monitoring**

| **No** | **COUNTRY** | **CCCC** | **SYNOP** | | **TEMP** | | **PILOT** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **TAC** | **BUFR** | **TAC** | **BUFR** | **TAC** | **BUFR** |
|  | Algeria AL | DAMM | √ | √ | √ | √ |  |  |
|  | Burkina Faso HV | DFFD | √ |  | √ |  | √ |  |
|  | Ghana GH | DGAA | √ |  |  |  |  |  |
|  | Cote d'Ivoire IV | DIAP | √ |  | √ |  | √ |  |
|  | Benin BJ | DBBB | √ |  | √ |  | √ |  |
|  | Nigeria NI | DNKN | √ |  | √ |  |  |  |
|  | Niger NR | DRRN | √ |  | √ |  | √ |  |
|  | Tunisia TS | DTTA | √ |  | √ |  | √ |  |
|  | Togo TG | DXXX | √ |  |  |  |  |  |
|  | South Africa ZA | FAPR | √ |  | √ |  | √ |  |
|  | Botswana BC | FBSK | √ |  | √ |  | √ |  |
|  | Congo CG | FCBB | √ | √ | √ |  | √ |  |
|  | Swaziland SV | FDMS | √ |  |  |  |  |  |
|  | Central African Republic CE | FEFF | √ | √ | √ |  |  |  |
|  | Guinea GQ | FGSL |  | √ |  |  |  |  |
|  | Mauritius MA | FIMP | √ | √ | √ |  | √ |  |
|  | Cameroon CM | FKKD | √ |  | √ |  | √ |  |
|  | Zambia ZB | FLLS |  |  |  |  |  |  |
|  | Comoros IC | FMCH | √ |  |  |  |  |  |
|  | Reunion RE | FMEE | √ | √ | √ | √ |  |  |
|  | Madagascar MG | FMMI | √ |  | √ |  | √ |  |
|  | Angola AN | FNLU | √ |  |  |  |  |  |
|  | Gabon GO | FOOL | √ | √ | √ |  | √ |  |
|  | Mozambique MZ | FQMA | √ |  |  |  |  |  |
|  | Seychelles SC | FSIA | √ |  | √ |  |  |  |
|  | Chad CD | FTTJ | √ | √ | √ |  | √ |  |
|  | Zimbabwe ZW | FVHA | √ |  | √ |  | √ |  |
|  | Malawi MW | FWCL | √ |  | √ |  |  |  |
|  | Lesotho LS | FXMM | √ |  |  |  |  |  |
|  | Namibia NM | FYWW | √ |  | √ |  | √ |  |
|  | Congo ZR | FZAA | √ |  | √ |  | √ |  |
|  | Mali MI | GABS | √ |  | √ |  | √ |  |
|  | Gambia GB | GBYD | √ |  |  |  |  |  |
|  | Sierra Leone SL | GFLL |  |  |  |  |  |  |
|  | Guinea-Bissau GW | GGOV | √ |  |  |  |  |  |
|  | Liberia LI | GLRB |  |  |  |  |  |  |
|  | Morocco MC | GMMC | √ |  | √ |  |  |  |
|  | Senegal SG | GOOY | √ | √ | √ |  | √ |  |
|  | Mauritania MT | GQNN | √ |  | √ |  | √ |  |
|  | Guinea GN | GUCY | √ |  |  |  |  |  |
|  | Ethiopia ET | HAAB | √ | √ | √ |  | √ |  |
|  | Burundi BI | HBBA | √ |  |  |  |  |  |
|  | Somalia SI | HCMM |  |  |  |  |  |  |
|  | Djibouti DJ | HDAM | √ |  |  |  |  |  |
|  | Egypt EG | HECA | √ |  | √ |  |  |  |
|  | Eritrea | HHAS |  |  |  |  |  |  |
|  | Kenya KN | HKNC | √ | √ | √ | √ |  |  |
|  | Libya LY | HLLT | √ |  | √ |  |  |  |
|  | Rwanda RW | HRYR | √ |  |  |  |  |  |
|  | South Sudan SS | HSSJ | √ |  |  |  |  |  |
|  | Sudan SU | HSSS | √ |  |  |  |  |  |
|  | Tanzania TN | HTDA | √ | √ |  |  |  |  |
|  | Uganda UG | HUEN | √ | √ | √ |  |  |  |
| Total | |  | 47 | **13** |  | **3** | 20 |  |

**PROPOSAL:**

**(i) TDCF awareness and training**

Cameroon and The Gambia reported not to have had any training on TDCF. The meeting is requested to suggest how these two countries can be urgently assisted with TDCF training and encoding software. Although Somalia is yet to install data transmission infrastructure it can be assisted with sensitisation on TDCF requirements.

**(ii) Encoding software**

This is the biggest challenge in most countries. It is proposed that a list of the WMO recommended TDCF encoding software be made available to PRs and TDCF focal points in RA I. They may be requested to indicate where funding is required.

**(iii) GTS connectivity**

Burundi reported to have no GTS connectivity on top of not having encoding software. It is proposed that Nairobi RTH be requested to look into what is required to establish the link between Nairobi and Bujumbura.

**(iv) TDCF focal points**

It was established that a number of the TDCF listed focal points no longer serve in the met services or they may have been assigned different roles. As a result less than 10 countries responded to questionnaire sent to 50 countries. It is therefore proposed that the list of the TDCF focal points in RA I be revised the soonest.

* **ANNEX TO PARAGRAPH 7.2.2**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_2)

**Monitoring and Analysis of Migration Status:**

1. Monitoring method

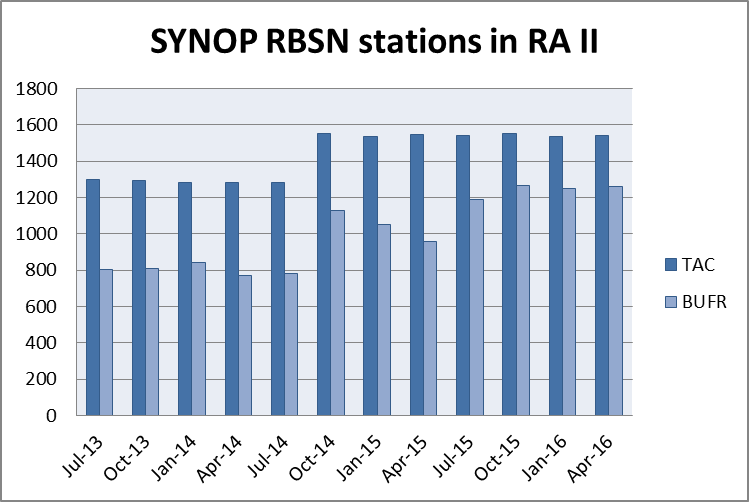
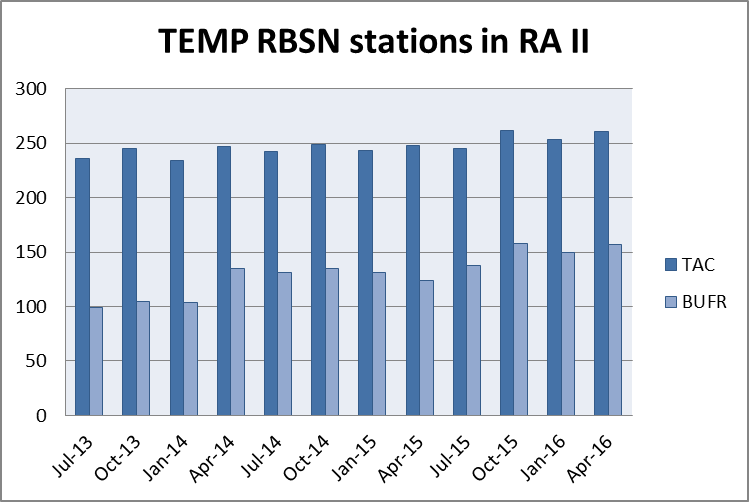
Statistics were collected for the period of 1 through 15 of January, April, July and October, 2013-2016 (till April 2016). Resources were derived from the results of Special MTN Monitoring (SMM) pre-analysis and Integrated WWW Monitoring (IWM) created by WMC Melbourne/RTH Tokyo and from the latest version of the surface and upper-air (RBSN) station list of Regional Basic Synoptic Networks at the time of analysis.

In addition to WWW monitoring, the status of TDCF data communication is also monitored based on a catalogue created by GISC Tokyo (available at <http://www.wis-jma.go.jp/csv/catalog.csv>).

2. Migration progress and status

(1) SYNOP, TEMP and PILOT reports

The figures below show numerical representations of the progress of stations issuing BUFR-format bulletins equivalent to SYNOP and TEMP reports over the past three years. In the latest monitoring period from April 1 to 15, 2016, RTH Tokyo received (i) at least one surface synoptic observation report (excluding NIL reports) in BUFR format from 77% of RA II observation stations registered as part of RBSN (TAC format from 94%), and (ii) at least one upper-air sounding report in BUFR format from 55% of registered stations (TAC format from 91%). Eighteen BUFR reports equivalent to PILOT reports were received by RTH Tokyo in the monitoring period, while TAC bulletins were received from 16r stations.

Number of RA-II RBSN stations issuing surface synoptic observation (SYNOP) and upper-air sounding (TEMP) reports in TAC and BUFR format from July 2013 to April 2016

(2) CLIMAT reports

As of May 2016, ten Members were reporting CLIMAT data in BUFR format: China; India; Mongolia; Saudi Arabia; Pakistan; Japan; Bangladesh; Hong Kong, China; Macao, China and Thailand.

(3) Marine reports

As of May 2016, India (TESAC), Hong Kong, China (SHIP), Japan (TESAC, TRACKOB, SHIP) and Republic of Korea (TESAC) were routinely disseminating marine observation data in BUFR format. Adoption of new templates for TESAC and BATHY is limited.

3. RA-II Member activities related to TDCF

Several activities related to TDCF were reported by RA-II Members since the last meeting in July 2015:

(1) Kazakhstan

Kazakhstan started dissemination of surface data in BUFR format in September 2015 with GTS bulletin headings of ISMD[01|20|21] UAAA (00, 06, 12, 18UTC), ISID[20|30|31] UAAA (03, 09, 15, 21UTC).

(2) Laos

Laos started dissemination of surface data in BUFR format in April 2016 with GTS bulletin headings of ISMD01 VLIV (00, 06, 12, 18UTC) and ISIC20 VLIV (03, 09, 15, 21UTC).

(3) Sri Lanka

Sri Lanka started dissemination of surface data in BUFR format in September 2016 with GTS bulletin headings of ISME01 TLPC (00, 06, 12, 18UTC), ISIE01 TLPC (03, 09, 15, 21UTC), ISME01 TLPL (00, 06, 12, 18UTC) and ISIE[01|20] TLPL (03, 09, 15, 21UTC).

(4) Bhutan

GTS connection between Bhutan and RTH (GISC) New Delhi, India was established in June 2015 and started disseminating AWS data of one station in BUFR format in April 2016. (AWS data in CREX format is collected through satellite data collection system, brought back to the met office and reformatted to BUFR and put into GTS.)

* **ANNEX TO PARAGRAPH 7.2.3**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_3)

[Chile] The National Centre has ceased the production of SYNOP and CLIMAT reports. Only BUFR bulletins are issued to report surface observations.

[Peru] The National Centre reported they are coding the observation from 28 manned meteorological stations in BUFR as well as 10 automatic weather stations. They do not produce SYNOP bulletins but still generate the CLIMAT reports.

[Paraguay] The National Centre reported they were suffering with some retards and they still using alphanumerical codes.

[Uruguay] The National Centre does not make use of TDCF data. The production of BUFR bulletins was postponed to a more suitable date.

[Colombia] The National Centre said they had to postpone their migration process due to administrative constraints. On the other hand, they had upgraded their upper-air network stations which are able now to exchange their data in BUFR format.

The National Centers in Bolivia, Suriname and Guyana could not be contacted and do not answered the request for information. It´s hard to say the status.

[GISC Brasilia] generates BUFR bulletins for upper-air sounding, CLIMAT, TEMP, PILOT, SYNOP from automatic and manned weather stations as well as provides the same information in TAC bulletins. Other centres in Brazil are not 100% ready to use TDCF data only, like the Navy and the Air Force. Other centres can make full use of the TDCF data for their dally duties.

[DCPC Argentina] generates BUFR bulletins for upper-air sounding (TEMP, PILOT), CLIMAT and SYNOP from automatic and manned weather stations as well as provides the same information in TAC bulletins.

[GISC Brasilia and DCPC Buenos Aires] do convert TAC bulletins into TDCF for those centres which are not able yet to complete their migration work.

* **ANNEX TO PARAGRAPH 7.2.4**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_4)

**STATUS OF BUFR MIGRATION IN NORTH, CENTRAL AMERICA AND THE CARIBBEAN**

**23 May 2016**

|  |  |  |
| --- | --- | --- |
| **RA IV Members** | | |
| **Country** | **Status** | **Comments** |
| Antigua and Barbuda | Migrated SYNOP transmission should start by end of July |  |
| Bahamas | No Information available |  |
| Barbados | Migrated SYNOP, TEMP and CLIMAT |  |
| Belize | No Information available |  |
| British Caribbean Territories | Migrated SYNOP |  |
| Canada | SYNOP almost completed; TEMP migration progressing | TEMP migration involves infrastructure renewal. |
| Colombia | Implementation started for SYNOP and CLIMAT |  |
| Costa Rica | Completed migration |  |
| Cuba | In progress 86% completed |  |
| Curaçao and Sint Maarten | Implementation started in Sint Maarten, No information for Curacao |  |
| Dominica | Migrated SYNOP |  |
| Dominican Republic | Migrated SYNOP |  |
| El Salvador | In progress 91% completed |  |
| Guatemala | In progress 73% completed |  |
| Haiti | No Information available |  |
| Honduras | In progress 73% completed |  |
| Jamaica | Migrated SYNOP and TEMP |  |
| Mexico | Completed migration |  |
| Nicaragua | In progress 59% completed |  |
| Panama | In progress 86% completed |  |
| Saint Lucia | Migrated SYNOP |  |
| Trinidad and Tobago | Migrated SYNOP and TEMP |  |
| United States of America | SYNOP migration completed;  TEMP migration almost completed. |  |
| Venezuela | No Information available |  |
|  |  |  |
| **Countries which are not RA IV Members** | | |
| **Country** | Status | **Comments** |
| Grenada | Implementation not started |  |
| Guyana | Migrated SYNOP |  |
| St. Kitts/Nevis | Migrated SYNOP |  |
| St. Vincent and the Grenadines | Implementation not started |  |

* **ANNEX TO PARAGRAPH 7.2.6**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_6)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Survey on the migration status in RA VI, 01.05-23.05.2016, Moscow WMC/RTH** | | | | | |
|  | **Legend:** | TDCF available (x - no TAC) | Testing in progress or there are some problems | TDCF not available | Not applicable (X) |
| **Country** | **NHMS** | **SYNOP** | **CLIMAT** | **PILOT** | **TEMP** |
| Albania | The Hydrometeorological Institute | + | - | x | x |
| Armenia | Armenian State Hydrometeorological and Monitoring Service | + | - | x | + |
| Austria | Central Institute for Meteorology and Geodynamics | + | + | x | + |
| Azerbaijan | National Hydrometeorological Department | - | - | x | - |
| Belarus | Department of Hydrometeorology | + | + | x | + |
| Belgium | Institut Royal Météorologique | + | - | x | + |
| Bosnia and Herzegovina | Meteorological Institute | + | - | x | x |
| Bulgaria | National Institute of Meteorology and Hydrology | - | - | - | + |
| Croatia | Meteorological and Hydrological Service | + | + | x | + |
| Cyprus | Meteorological Service | + | + | + | + |
| Czech Republic | Czech Hydrometeorological Institute | + | + | x | + |
| Denmark and Faroe Islands | Danish Meteorological Institute | + | - | x | + |
| Estonia | Estonian Meteorological and Hydrological Institute | + | - | x | + |
| Finland | Finnish Meteorological Institute | + | - | x | + |
| France | Météo-France | + | - | x | + |
| Georgia | Department of Hydrometeorology | + | - | x | x |
| Germany | Deutscher Wetterdienst | + | + | x | + |
| Greece | Hellenic National Meteorological Service | + | - | - | + |
| Hungary | Meteorological Service of Hungary | + | + | x | + |
| Iceland | Icelandic Meteorological Office | + | - | x | - |
| Ireland | The Irish Meteorological Service | + | + | x | + |
| Israel | Israel Meteorological Service | + | + | + | + |
| Italy | Servizio Meteorologico | + | + | x | + |
| Jordan | Jordan Meteorological Department | - | - | x | + |
| Kazakhstan | Kazhydromet | + | - | x | - |
| Latvia | Latvian Environment, Geology and Meteorology Agency | + | + | x | - |
| Lebanon | Service Météorologique | - | - | - | - |
| Lithuania | Lithuanian Hydrometeorological Service | + | + | x | - |
| Luxembourg | Administration de l'Aéroport de Luxembourg | + | - | x | x |
| Malta | Meteorological Office | - | - | x | x |
| Montenegro | Hydrometeorological Institute of Montenegro | + | - | x | x |
| Netherlands | Royal Netherlands Meteorological Institute | + | + | x | + |
| Norway | Norwegian Meteorological Institute | + | + | x | + |
| Poland | Institute of Meteorology and Water Management | + | + | x | + |
| Portugal | Instituto de Meteorologia | + | + | x | + |
| Republic of Moldova | Serviciul Hidrometeorologic de Stat Moldova | - | - | x | x |
| Romania | National Meteorological Administration | + | + | + | + |
| Russian Federation | Russian Federal Service for Hydrometeorology and Environmental Monitoring | + | - | x | + |
| Serbia | Republic Hydrometeorological Service of Serbia | + | + | x | + |
| Slovakia | Slovak Hydrometeorological Institute | + | + | x | + |
| Slovenia | Meteorological Office | + | - | x | + |
| Spain | Agencia Estatal de Meteorología | + | + | x | + |
| Sweden | Swedish Meteorological and Hydrological Institute | + | + | x | + |
| Switzerland | MeteoSwiss | + | + | x | + |
| Syrian Arab Republic | Ministry of Defence Meteorological Department | - | - | x | - |
| The former Yugoslav Republic of Macedonia | Republic Hydrometeorological Institute | + | - | x | - |
| Turkey | Turkish State Meteorological Service | + | + | x | + |
| Ukraine | Ukrainian Hydrometeorological Center | - | - | x | - |
| United Kingdom of Great Britain and Northern Ireland | Met Office | + | + | x | - |
|  | Totally migrated for particular data | 41 | 24 | 3 | 32 |
|  |  | 8 | 25 | 3 | 10 |
|  |  | 0 | 0 | 43 | 7 |
|  |  | 84% | 49% | 50% | 76% |
|  |  |  |  |  |  |
|  | Fully migrated | 21 | 43% |  |  |
|  | Partially migrated | 43 | 88% |  |  |
|  | Not started | 6 | 12% |  |  |

* **ANNEX TO PARAGRAPH 7.2.7**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_7_2_7)

**status of BUFR templates for marine data AS REPORTED TO THE IPET-DRMM-IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***TAC*** | ***Description*** | ***Current template(s)*** | ***Status*** | ***Plans/comments*** |
| **FM13-XIV SHIP** | **VOS data** | [B/C10 - Regulations for reporting SHIP data in TDCF](http://www.wmo.int/pages/prog/www/WMOCodes/BC_Regulations/BC10-SHIP.doc) | Operational (TM308009) |  |
| **VOS data** | [Synoptic reports from sea stations suitable for SHIP observation data from VOS stations](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/SHIP_VOSobs.doc) (see Appendix B) | Validated | Due to become operational FT2016-2 |
| **FM18-XII BUOY** | **Drifting buoy data** | Template for the representation from drifting buoys | Operational (TM 315009) | Simplified template specific to drifting buoys |
| **Moored buoy data** | Template for the representation of data from moored buoys | Operational (TM 315008) | Simplified template specific to moored buoys, including directional and non-directional wave data |
| **Wave buoy data** | Template for the representation of data from moored buoys | Operational (TM 315008) | Simplified template specific to moored buoys, including directional and non-directional wave data |
| **Argo data** | [Sub-surface profiling floats](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/BUOYTESACBATHY.doc) | Operational (TM315003) | No specific plan for this template |
| **FM36-XI Ext. TEMP SHIP** | **ASAP data** | [B/C25 - Regulations for reporting TEMP, TEMP SHIP, TEMP MOBIL data in TDCF](http://www.wmo.int/pages/prog/www/WMOCodes/BC_Regulations/BC25-TEMP.pdf) | Operational (TM309052) | No specific plan for this template |
| **ASAP data** | UKMO template for representation of radiosonde data with geopotential height as the vertical coordinate | Operational (revisited in July 2010) |  |
| **FM62-VIII Ext. TRACKOB** | **TRACKOB data** | [TRACKOB data](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/TRACKOB_TM308010.doc) – ThermoSalinoGraph (TSG) data and metadata | Operational (TM308010) | No specific plan for this template |
| **FM63-XI Ext. BATHY** | **XBT data** | [New BUFR template for XBT Temperature Profile data](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/NEW_Proposed_XBT_Template_revJA_ver10.2.doc) | Operational (TM315004) |  |
| **FM64-XI Ext. TESAC** | **CTD / TESAC** | Template for the representation of data derived from a ship based lowered instrument measuring subsurface seawater temperature, salinity and current profiles. | Operational (TM 315007) |  |
| **FM65-XI Ext. WAVEOB** | **Wave buoy data** | [Templates for the wave observations from different platforms suitable for WAVEOB data](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/WAVEOB_TM308015_r3.doc) | Operational FT 2016-1 (TM 308015 and 308016) |  |
| **N/A** | **Sea-level data** | [BUFR/CREX templates for tsunameter data and dart buoy system messages](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/TSUNAMETER_TM306027.doc) | Operational (TM306027) | No specific plan for this template |
| **Sea-level data** | [BUFR/CREX templates for reporting time series of tide data](http://www.wmo.int/pages/prog/www/WMOCodes/Ref_Templates/TIDE_timeseries.doc) | Validation | Template should undergo validation |

* **ANNEX TO PARAGRAPH 8.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_8_1)

**Decision by the EC-68:**

## Annex 1 to draft Resolution 19.2(2)/1 (EC-68)

### Text for inclusion in Manuals for which the Simple Procedure is permitted

### 1. PROCEDURES FOR AMENDING WMO MANUALS THAT ARE THE RESPONSIBILITY OF THE COMMISSION FOR BASIC SYSTEMS

#### 1.1 Designation of responsible committees

### 1.2 General validation and implementation procedures

### 1.3 Simple (fast-track) procedure

#### 1.3.1 Scope

The simple (fast-track) procedure shall be used only for changes ~~that impact only on those Members wishing to exploit the change~~ to components of the Manual that have been designated and marked as “technical specifications to which the simple procedure may be applied”.

Note: an example would be the addition of code list items in the *Manual on Codes*.

#### 1.3.2 Endorsement

#### 1.3.3 Approval

1.3.3.1 Minor adjustments

Correcting typographic errors in descriptive text is considered a minor adjustment, and will be done by the Secretariat in consultation with the president of CBS. See Figure 1.

Note: Figure 1 copied from 1.3.3.3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Designated Committee |  | chairperson of OPAG |  | president of CBS (in consultation with presidents of technical commissions) |  |  |

Figure 1 – Adoption of amendments to a Manual by minor adjustment

1.3.3.2 Other types of amendments

For other types of amendments, the English version of the draft recommendation, including a date of implementation, should be distributed to the focal points for matters concerning the relevant Manual for comments, with a deadline of two months for the reply. It should then be submitted to the president of CBS for consultation with presidents of technical commissions affected by the change. If endorsed by the president of CBS the change should be passed to the President of WMO for consideration and adoption on behalf of the Executive Council (EC).

1.3.3.3 Frequency

The implementation of amendments approved through the fast track procedure can be twice a year in May and November. See Figure 2.

~~or~~

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Designated Committee |  | chairperson of OPAG |  | Focal points for matters concerning the Manual |  | president of CBS (in consultation with presidents of technical commissions) and then to President WMO |

Figure ~~1~~ 2 – Adoption of amendments to a Manual by simple (fast-track) procedure

### 1.4 Standard (procedure for the adoption of amendments between CBS sessions)

#### 1.5 Complex (procedure for the adoption of amendments during CBS sessions)

#### 1.6 Procedure for the correction of existing Manual contents

### 1.7 Validation procedure

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## Annex 2 to draft Resolution 19.2(2)/1 (EC-68)

## Text to be AMENDED IN the TECHNICAL REGULATIONS (WMO-No. 49), VOLUME I

**Remove** following paragraph 15 with note in General Provisions:

15. If a recommendation for an amendment is made by the appropriate technical commission and the implementation of the new regulation is urgent, the President of the Organization may, on behalf of the Executive Council, take action as provided by Regulation 9 (5) of the General Regulations.

Note: A fast-track procedure can be applied for additions to certain codes and associated code tables, contained in Annex II (*Manual on Codes* (WMO-No. 306)). Application of the fast-track procedure is described in detail in Annex II.

**Insert** following paragraph at the same place:

15. If a recommendation for an amendment is made by the appropriate technical commission and the implementation of the new regulation is urgent, the President of the Organization may, on behalf of the Executive Council, take action as provided by Regulation 9 (5) of the General Regulations.

Note: A simple (fast‑track) procedure may be used for~~For an~~ amendments ~~with minor financial implication~~ to technical specifications in Annexes II (*Manual on Codes* (WMO-No.306), III (*Manual on the Global Telecommunication System* (WMO-No.386)), IV (*Manual on the Global Data-processing and Forecasting System* (WMO-No.485)), V (*Manual on the Global Observing System* (WMO-No.544)), VII (*Manual on the WMO Information System* (WMO-No.1060)), and VIII (Manual on the WMO Integrated Global Observing System (WMO-No.1160)). Application of the simple (fast-track) procedure is defined in those Annexes.~~the President of the Commission for the Basic Systems may approve it on behalf of Executive Council, as described in Appendix F.~~

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## Annex 3 to draft Resolution 19.2(2)/1 (EC-68)

## Text to be removed from the Manual on Codes (WMO-No. 306) and the Manual on the WMO Information System (WMO-No. 1060)

Remove the following paragraphs from the Introduction of Part I to Volume I.1 of WMO-No. 306 the *Manual on Codes*: Sections numbers 1 to 6 under the heading "PROCEDURES FOR AMENDING THE MANUAL ON CODES".

Remove the text and diagrams from WMO-No. 1060 the *Manual on the WMO Information System*: Section C.2 of Appendix C.

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## Annex 4 to draft Resolution 19.2(2)/1 (EC-68)

## Aspects of manuals managed by the Commission for Basic Systems designated as technical specifications and that may be updated using the simple procedure.

The following components of Manuals and Guides are designated as technical specifications to which the simple procedure may be applied.

*Manual on the WMO Information System* (WMO‑No. 1060): Appendix A, Appendix C Part 2 section 3 (Data Dictionary)

*Guide to the WMO Information* *System* (WMO–No. 1061). Part V (Metadata guidance), Annex D (Training and Learning guide).

*Manual on the Global Telecommunications System* (WMO‑No. 386). Attachment I-1 (Arrangements for the collection of Ships weather reports and oceanographic reports (BATHY/TESAC)), Attachment I-2 (Configuration of the Main Telecommunications Network), Attachment II-5 (Data Designators T1T2A1A2ii in abbreviated headings).

*Guide to Information Technology Security* (WMO‑No. 1115). Whole document

*Guide to Virtual Private Networks (VPN) via the internet between GTS centres* (WMO‑No. 1116). Whole document.

*Manual on Codes*. Volume I.2 all tables and templates (WMO‑No. 306). Volume I.3 All tables.

*Manual on the WMO Integrated Global Observing System* (WMO-No. 1160). Appendix 2.4 (The WIGOS metadata standard)

* **ANNEX TO PARAGRAPH 9.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_9_1)

**Amend:** table B7 of WMO-No. 386 Manual on the GTS as shown in the Table. Added text is shown in green dashed underline font.

|  |  |  |  |
| --- | --- | --- | --- |
| *Designator* | *Data Type* | *GTS Priority* | *Code Form Name* |
| A | Aviation routine reports (“METAR”) | 2 |  |
| C | Aerodrome Forecast (“TAF”) (VT<12 hours) | 3 |  |
| K | Tropical cyclone advisories | 3 |  |
| P | Special aviation weather reports (“SPECI”) | 2 |  |
| S | Aviation general warning (“SIGMET”) | 1 |  |
| T | Aviation aerodrome forecast (“TAF”) (VT <= 12hours) | 3 |  |
| U | Volcanic ash advisory | 3 |  |
| V | Aviation volcanic ash warning (”SIGMET”) | 1 |  |
| W | AIRMET | 1 |  |
| Y | Aviation tropical cyclone warning (“SIGMET”) | 1 |  |

* **ANNEX TO PARAGRAPH 10.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_10_1)

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### Inter-Programme Expert Team on Codes Maintenance (IPET-CM)

Note: IPET-CM is expected to deliver its responsibilities through task teams that work by correspondence.

(a) Review and maintain the Table Driven Code Forms by defining descriptors, common sequences, data templates and the regulations supporting these, including data representation of regional practices, so they meet the requirements of all Members, WMO Programmes and other concerned international organizations, such as ICAO;

(b) Review and update guidance to Members and technical commissions on data representation, including national practices, and invite, coordinate and assist Members to validate modified or new data representations;

(c) Review, develop and update the Manual on Codes (WMO-No 306) and associated reference and guidance material as required, and publish these in suitable electronic formats for human and automated use including codes.wmo.int;

(d) Review and develop procedures and guidance to enable the interoperability of metadata and data between WMO standards and formats used within other communities, such as NetCDF, using the WMO Logical Data Model as a tool to achieve this;

(e) Monitor conformance of data exchanged within the WIS and metadata records published to the WIS DAR catalogue with WMO data representation standards for utility and conformance with the guidance and WMO Core Metadata Profile, and develop action plans, including capacity-building, to address issues identified by monitoring;

(f) Review and update the procedures used to maintain WMO data representations, taking into account opportunities presented by the WMO Logical Data Model;

(g) Monitor progress towards and coordinate actions to implement migration to Table Driven Codes Forms;

(h) Identify implementation issues requiring the urgent consideration of the OPAG on ISS;

(i) Contribute to the maintenance of WIS competencies related to use of codes and associated training and learning guides and facilitate training.

* **ANNEX TO PARAGRAPH 11.1**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_11_1)

1) The semantics of GRIB2 are not affected

2) GRIB2 data is transported wrapped in a semantic layer describing the data in web coverage semantics so that it is discoverable and transferable as a web coverage

3) GRIB2 data exchanged via WCS must fully follow the GRIB2 specification by WMO

4) The grid definition provided in the GRIB2 must be accurately described in the wrapping layer using the semantics of web coverages

5) The data representation template provided in the GRIB2 must be described in the wrapping layer in the semantics of web coverages

6) Meaningful exceptions are provided if invalid requests are made or if data is not available as requested

7) Conformance tests are provided to prove that client and server applications implementing the standard conform to the standard’s requirements

* **ANNEX TO PARAGRAPH 11.2**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_11_2)

**Principles for managing code lists:**

These principles are intended to encourage consistency between code lists (also known as controlled vocabularies) used in WMO data representations. The should be applied to all new code lists.

1) Do not create a new term if there is an existing term with the same definition. Terms in a code list should be drawn from existing code lists, provided the term being defined is the same in both lists. The URI of the term in the new list must be the same as in the original list (or if the data representation does not permit URIs, the definition must refer to the URI). The definition must be the same as in the original list. *This allows applications to extend or restrict the values permitted for a particular application while retaining a clear link between the meaning of terms in different code lists.*

2) Do not create a new code list if there is an existing code list that meets the requirement. *Though it may be necessary to create a synonym for the list to conform with the naming conventions used in that context.*

3) Each term in a code list must have a URI that permanently identifies it.

4) Each code list must have a URI that permanently identifies it.

5) When introducing a new term that is related to an existing term, use known relationships to link the two terms to indicate whether the new term is broader or narrower than the existing one. Known relationships should also be used to note that two terms are synonyms when updating existing code lists.

6) Once approved for inclusion in a code list, a term must never be removed from that list, though it may be marked as not permitted for use in that list. *This is to ensure that information records created before the term was taken out of use remain meaningful, and that the term definition remains available for any code lists that re-use it.*

7) The meaning of terms must not be changed to be more restrictive. If a term has to be made more restrictive (for example because a single category had to be divided into several sub-categories), then new terms should be defined that have new URIs. *Making a term more restrictive could lead to inappropriate interpretation of pre-existing information records. Broadening the definition of a term may in some cases be permissible, but could cause difficulties in code lists other than the one that proposed the change.*

8) WMO terms may use URIs provided by other organizations (such as ISO) provided that organization uses the principles 1, 6 and 7.

* **ANNEX TO PARAGRAPH 11.3**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_11_3)

**Tasks of TT and responsible sub-group:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tasks** | **Deliverable** | **Deadline** | **Sub-group members** |
| a1) to summarize general issues related to BUFR and requests on how to promote TDCF migration from the viewpoint of NWP centres and report them to IPET-DRMM; | Catalogue  (document or wiki page?). Pull all the information into one place to avoid duplication of effort |  | Sasha  Bruce  Ota  (Pat) |
| a2) to advise IPET-DRMM on a method by which NWP centres report every issue they find in BUFR messages; | Recommendation to IPET-DRMM  (short document) | Draft to DRMM by end July, draft changes to structures for CBS by end August | Bruce  Pat  Richard |
| a3) to advise to IPET-DRMM on the role of NWP centres in the process for checking the quality of BUFR messages. | Recommendation to IPET-DRMM  (short document) | End December | Warren  (Pat) |
| b) Coordinate with Members and their Centres to resolve identified problems. | Day-to-day monitoring and error tracking, contacting Members… | Continuous,  but identify how the work is going to be continued after the end of this group | Sasha (both globally and on behalf of RAVI)  Ota  (Pat) |
| c) Assess the additional costs to user centres of maintaining their systems to process upper air observations continuing to be being sent in TAC, and assess the costs of accelerating migration of observing systems to produce information in correctly formatted BUFR. | Document | For consideration by IPET-DRMM in May (?) 2017 alongside | Sasha (from observing systems’ prospect) |
| d) Summarize the benefits of using TDCF in preference to TAC from the perspective of NWP centres. Collate information into a (short) form that can be used in discussions with high level managers to help convince them of the need to migrate properly. | Document | End May 2016 | Stefan  Pat  Adam |

**Summary of benefits (Task d):**

* **Higher precision of observations**

With BUFR encoding radiosonde temperatures can now be reported with a precision of at least 0.1 K. This was different for temperatures in TEMP messages, where the precision was 0.2 K because of restrictions in telecommunication speed and costs at the time when TEMP was introduced. Furthermore, this rounding can introduce a small bias during encoding/decoding (see Ingleby and Edwards 2015). In TEMP code wind direction was stored to a precision of just 5° and dew point depressions larger than 5 K were stored to a precision of 1 K (see Ingleby et al. 2016). In BUFR wind direction can be made available with a precision of up to 1°, wind speed with a precision of 0.1ms-1, and dewpoint temperature with a precision of 0.1K (if RH is reported, its precision can be up to 0.1%). Geopotential height is another important measurement for which precision is improved in BUFR reports. In TEMP messages the height was coded to nearest decametre (10m) above 500hPa, with BUFR the precision is 1m throughout the whole profile.

* **More data because of more levels**

Typically radiosondes provide measurement data in intervals of 1 or 2 seconds to their ground stations. For a two hour ascent this provides up to 3600 or 7200 levels. As long as the TAC code TEMP was used, only a very limited number of about 50-100 levels was exchanged internationally. The availability of more levels is beneficial for NWP models, even those having comparatively few vertical levels, as the improved representation of structures within a profile allow for more accurate vertical averaging. Other users of radiosonde data (e.g. climatologists, forecasters) will also benefit from high-resolution data, now and even more in the long run when NMHS start exchanging and archiving such high-resolution data.

* **Better usage of data because of accurate time and position information for all levels**

Radiosonde balloons can drift 200 km or more when winds are strong. The TAC codes used for radiosonde data (TEMP and PILOT) make no allowance for reporting drift times or locations; drift in this context can only be estimated from the low-resolution wind data and an assumed ascent rate for the balloon. On the other hand, BUFR accommodates observations of time and position at each level, which are more accurate than drift estimates based on low-resolution TAC winds. Using radiosonde drift in NWP has shown promising results (Laroche and Sarrazin, 2013; Ingleby and Edwards, 2015; Choi et al, 2015). Knowing the precise time and location of observations is essential for the accurate numerical predication of mesoscale weather systems or mesoscale features embedded within larger-scale systems.

* **More sophisticated quality control and bias corrections possible**

With BUFR encoding it is now possible to not only send the observational data but also relevant metadata. And, this can be more than just station identifier, location and observation time. For example, the radiosonde type, serial number, and software version number used for a particular sounding can be reported with the BUFR message, and therefore NWP centres can now make more reliable automated decisions on a case-by-case basis about usage of data of a particular variable in a certain height range. For example, NWP centres do not use radiosonde humidity measurements from all radiosonde types in the upper troposphere. Furthermore, this information can also provide information about any radiation correction that was applied prior to transmission of the data. If corrections haven’t been applied by the data providers then NWP centres have to do it before actual usage of the measurements. It is important to avoid that either no correction is applied at all or that a correction is applied twice. With BUFR the opportunity exists to report much more up-to-date metadata than can be provided via the historically maintained separate metadata files, such as the WMO Pub9 VolA flatfiles.

* **All data in one report makes usage simpler**

Before actual assimilation of radiosonde data, they have to undergo some preparatory treatment, e.g. vertical consistency checks and quality control. For that purpose NWP centres usually merge the different TEMP parts. In BUFR format radiosonde data shall be sent when 100 hPa have been reached and all data shall be sent again, when the sounding has reached the burst height. Ingleby et al. 2016 state that having all the data in a single BUFR report is a significant advantage. To achieve most benefits especially for km-scale models having shorter cut-off times than global models, BUFR reports up to 100 hPa ideally should be created and transmitted with same high-resolution as the BUFR reports of the entire sounding.

**Final remark:  
With a simple conversion of TEMP reports to BUFR, yielding reformatted TEMP reports, NONE of the aforementioned benefits can be achieved.**

[END OF ANNEX TO THE REPORT]

**[NEW PROPOSALS THROUGH PFC]**

The following lists new amendments proposed through the practice between meetings of IPET-DRMM.

**1.** **PFC2015-2-1 GRIB2 parameters for NCEP forecast products [FT2016-1]** <[para 4.1](#A2016_4_1_grib)>

**Add entries:**

In GRIB Code table 4.2,

**Discipline 0 (Meteorological products), Category 19 (Physical atmospheric properties)**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Unit |

29 Clear air turbulence (CAT) m2/3 s–1

**Discipline 0 (Meteorological products), Category 20 (Atmospheric chemical constituents)**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Unit |

111 Angstrom exponent Numeric

**2.** **PFC2015-2-2 GRIB2 parameters and level type for the uncertainties in ensembles of regional reanalyses project [FT2016-1]** <[para 4.1](#A2016_4_1_grib)>

**Add entries:**

In GRIB Code table 4.2,

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

| Number | Parameter | Units | *Description* |
| --- | --- | --- | --- |
| 52 | Downward short-wave radiation flux, clear sky | W m–2 | *Downward short-wave radiation flux computed under actual atmospheric conditions but assuming zero cloudiness.* |
| 53 | Upward short-wave radiation flux, clear sky | W m–2 | *Upward short-wave radiation flux computed under actual atmospheric conditions but assuming zero cloudiness.* |

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

| Number | Parameter | Units | *Description* |
| --- | --- | --- | --- |
| 8 | Downward long-wave radiation flux, clear sky | W m–2 | *Downward long-wave radiation flux computed under actual atmospheric conditions but assuming zero cloudiness.* |

**Product discipline 2 – Land surface products, parameter category 3: soil products**

| Number | Parameter | Units | *Description* |
| --- | --- | --- | --- |
| 26 | Soil heat flux | W m–2 | *The soil heat flux is the energy receive by the soil to heat it per unit of surface and time. The Soil heat flux is positive when the soil receives energy (warms) and negative when the soil loses energy (cools).* |

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

| Number | Parameter | Units | *Description* |
| --- | --- | --- | --- |
| 16 | Percolation rate | kg m–2 s–1 | *The percolation is the downward movement of water under hydrostatic pressure in the saturated zone. This water might still end up in rivers and lakes as discharge but it is a slower process than water runoff or drainage. Such defined percolation is an input for hydrological models together with e.g. water runoff.* |

**Product discipline 2 – Land surface products, parameter category 3: soil products**

| Number | Parameter | Units | *Description* |
| --- | --- | --- | --- |
| 27 | Soil depth | m | *Soil depth, positive downward. It is meant to be used together with the type of level "soil level" to encode the depth of the level at each grid point.* |

In GRIB Code table 4.5,

| Code figure | Meaning | Units | *Description* |
| --- | --- | --- | --- |
| 151 | Soil level (see Note 5) | Numeric | *This level represents a soil model level. The aim of this type of the level is to encode a field referred to a soil level that has variable depth across the model domain. The non-constant depth is then encoded as a parameter "soil depth" discipline 2, category 3 and parameter number 27.* |

**Add a Note:**

In GRIB Code table 4.5,

Notes:

(5) The soil level represents a model level for which the depth is not constant across the model domain. The depth in metres of the level is provided by another GRIB message with the parameter "soil depth" with discipline 2, category 3 and parameter number 27.

**3.** **PFC2015-2-3 GRIB2 parameters for new forecast and post-processing products [FT2016-1]** <[para 4.1](#A2016_4_1_grib)>

**Add entries:**

In GRIB Code table 4.2,

**Product Discipline 0 – Meteorological products, Parameter category 1: moisture**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Units |
| 109 | Mass density of liquid water coating on hail expressed as mass of liquid water per unit volume of air | kg m–3 |
| 110 | Specific mass of liquid water coating on hail expressed as mass of liquid water per unit mass of moist air | kg kg–1 |
| 111 | Mass mixing ratio of liquid water coating on hail expressed as mass of liquid water per unit mass of dry air | kg kg–1 |
| 112 | Mass density of liquid water coating on graupel expressed as mass of liquid water per unit volume of air | kg m–3 |
| 113 | Specific mass of liquid water coating on graupel expressed as mass of liquid water per unit mass of moist air | kg kg–1 |
| 114 | Mass mixing ratio of liquid water coating on graupel expressed as mass of liquid water per unit mass of dry air | kg kg–1 |
| 115 | Mass density of liquid water coating on snow expressed as mass of liquid water per unit volume of air | kg m–3 |
| 116 | Specific mass of liquid water coating on snow expressed as mass of liquid water per unit mass of moist air | kg kg–1 |
| 117 | Mass mixing ratio of liquid water coating on snow expressed as mass of liquid water per unit mass of dry air | kg kg–1 |

**Product Discipline 0 – Meteorological products, Parameter category 17: electrodynamics**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Units |
| 1 | Lightning potential index (LPI) (see Note) | J kg–1 |

Note: Definition of LPI after Lynn et. al.:

Lynn, B., and Y. Yair, 2010: Prediction of lightning flash density with the WRF model, Adv. Geosci., 23, 11-16

Yair, Y., B. Lynn, C. Price, V. Kotroni, K. Lagouvardos, E. Morin, A. Mugnai, and M. Llasat, 2010:

Predicting the potential for lightning activity in Mediterranean storms based on the Weather

Research and Forecasting (WRF) model dynamic and microphysical fields, JGR, 115, D04205,

doi:10.1029/2008JD010868

**Product Discipline 0 – Meteorological products, Parameter category 20: atmospheric chemical constituents**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Units |
| 59 | Aerosol number concentration (see Note 2) | m–3 |
| 60 | Aerosol specific number concentration (see Note 2) | kg–1 |
| 61 | Maximum of mass density in layer (see Note 1) | kg m–3 |
| 62 | Height of maximum mass density | m |

Notes:

(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.

(2) The term “number density” is used as well for “number concentration” (code number 59); conversion factor between “number density” (59) and “specific number concentration” (60) is “mass density” [kg m–3].

**Amend entries:**

In parameter numbers 1, 56 and 58 in Product Discipline 0 – Meteorological products, Parameter category 20: atmospheric chemical constituents of GRIB Code table 4.2,

"see Note" to "see Note 1"

**Add a note to parameter number 10 and add entries:**

In GRIB Code table 4.2,

**Product Discipline 0 – Meteorological products, Parameter category 18: nuclear/radiology**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Units |
| 10 | Air concentration (see Note 3) | Bq m–3 |
| 14 | Specific activity concentration (see Note 3) | Bq kg–1 |
| 15 | Maximum of air concentration in layer | Bq m–3 |
| 16 | Height of maximum air concentration | m |

Notes:

(3) Conversion factor between “Specific activity concentration” (14) and “Air concentration” (10) is “mass density” [kg m–3].

**Product Discipline 0 – Meteorological products, Parameter category 19: physical atmospheric properties**

|  |  |  |
| --- | --- | --- |
| Number | Parameter | Units |
| 30 | Eddy dissipation parameter (see Note 3) | m2/3 s–1 |
| 31 | Maximum of Eddy dissipation parameter in layer | m2/3 s–1 |

Notes:

(3) Eddy dissipation parameter is third root of eddy dissipation rate [m2 s–3].

In GRIB Code table 4.5,

|  |  |  |
| --- | --- | --- |
| Code figure | Meaning | Unit |
| 13 | Level of free convection (LFC) | - |
| 14 | Convective condensation level (CCL) | - |
| 15 | Level of neutral buoyancy or equilibrium level (LNB) | - |

**4.** **PFC2016-2-1 New entry in common code table C-8 [FT2017-1]** <[para 4.1](#A2016_4_1_bufr)>

**Add an entry:**

in common code table C-8,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Code | Agency | Type | Short name | Long name |
| 617 | NOAA | Imaging multi-spectral radiometer | ABI | Advanced baseline imager |
| 618 | NOAA | High-resolution optical imager | GLM | Geostationary lightning mapper |

**5.** **PFC2016-2-2 New entry in GRIB2 code table 4.2 [FT2017-1]** <[para 4.1](#A2016_4_1_grib)>

**Add an entry:**

in GRIB2 code table 4.2,

**Product discipline 0 – Meteorological products, Parameter category 7: thermodynamical stability**

19 Convective available potential energy – shear m2 s–2

Description:

CAPE-shear parameter is a product of wind shear and sqrt(CAPE):

CAPE-shear parameter = wind shear\*sqrt(CAPE)

Wind shear denotes the deep layer shear defined as the absolute value of the wind vector difference between two levels and the second term sqrt(CAPE) is the square root of the standard convective available potential energy.

**6.** **PFC2016-2-3 New entry in common code table C-12 [FT2017-1]** <[para 4.1](#A2016_4_1_bufr)>

**Add an entry:**

in common code table C-12,

under 254 "EUMETSAT Operation Centre",

125 Ford Island, Hawaii

**7.** **PFC2016-2-4 New GRIB2 templates related to distribution functions and associated table entries [FT2017-1]** <[para 4.1](#A2016_4_1_grib)>

**Add entries:**

in code table 4.240,

8 No distribution function. The encoded variable is derived from variables characterized by type of distribution function of type no. 7 (see above) with fixed variance σ (p1) and fixed particle density ρ (p2)

in code table 4.0,

67 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 based on a distribution function

68 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 based on a distribution function

**Add product definition templates 4.67 and 4.68:**

***Product definition template 4.67 – 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 based on a distribution function***

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)

14–15 Number of mode (N) of distribution (see Note 2)

16–17 Mode number (l)

18–19 Type of distribution function (see Code table 4.240, see Note 3)

20 Number of following function parameters (Np), defined by type given in octets 18–19 (Type of distribution function)

*Repeat the following 5 octets for the number of function parameters (n = 1,* *Np), if Np > 0*

21+5(n–1) List of scale factor of fixed distribution function parameter (p1–pNp), defined by type of distribution in octets 18–19

(22+5(n–1))–(25+5(n–1)) List of scaled value of fixed distribution function parameter (p1–pNp), defined by type of distribution in octets 18–19

21+5Np Type of generating process (see Code table 4.3)

22+5Np Background generating process identifier (defined by originating centre)

23+5Np Analysis or forecast generating process identifier (defined by originating centre)

(24+5Np)–(25+5Np) Hours of observational data cut-off after reference time (see Note 1)

26+5Np Minutes of observational data cut-off after reference time

27+5Np Indicator of unit of time range (see Code table 4.4)

(28+5Np)–(31+5Np) Forecast time in units defined by the previous octet (see Note 4)

32+5Np Type of first fixed surface (see Code table 4.5)

33+5Np Scale factor of first fixed surface

(34+5Np)–(37+5Np) Scaled value of first fixed surface

38+5Np Type of second fixed surface (see Code table 4.5)

39+5Np Scale factor of second fixed surface

(40+5Np)–(43+5Np) Scaled value of second fixed surface

(44+5Np)–(45+5Np) Year

(46+5Np) Month

(47+5Np) Day Time of end of overall time interval

(48+5Np) Hour

(49+5Np) Minute

(50+5Np) Second

(51+5Np) n – number of time range specifications describing the time intervals used to calculate the statistically processed field

(52+5Np)–(55+5Np) Total number of data values missing in statistical process   
*(56+5Np)–(67+5Np) Specification of the outermost (or only) time range over which statistical processing is done*

(56+5Np) Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10)

(57+5Np) Type of time increment between successive fields used in the statistical processing (see Code table 4.11)

(58+5Np) Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4)

(59+5Np)–(62+5Np) Length of the time range over which statistical processing is done, in units defined by the previous octet

(63+5Np) Indicator of unit of time for the increment between the successive fields used (see Code table 4.4)

(64+5Np)–(67+5Np) Time increment between successive fields, in units defined by the previous octet (see Notes 5 and 6)  
*(68+5Np)–nn These octets are included only if n > 1, where nn =* (55+5Np) *+ 12 x n*

(68+5Np)–(79+5Np) As octets (56+5Np) to (67+5Np), next innermost step of processing

(80+5Np)–nn Additional time range specifications, included in accordance with the value of n. Contents as octets (56+5Np) to (67+5Np), repeated as necessary

Notes:

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

(2) If Number of mode (N) > 1, then between x N fields with mode number l = 1, …, N define the distribution function. x is the number of variable parameters in the distribution function.

(3) For more information, see Attachment III (Distribution functions in GRIB) in Part B of this volume (I.2 – Att.III/GRIB – 1 to 2).

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

(5) 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.

(6) 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. 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 times.

***Product definition template 4.*** ***68 - 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 based on a distribution function***

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)

14–15 Number of mode (N) of distribution (see Note 2)

16–17 Mode number (l)

18–19 Type of distribution function (see Code table 4.240, see Note 3)

20 Number of following function parameters (Np), defined by type given in octets 18–19 (Type of distribution function)

*Repeat the following 5 octets for the number of function parameters (n = 1,* *Np), if Np > 0*

21+5(n–1) List of scale factor of fixed distribution function parameter (p1–pNp), defined by type of distribution in octets 18–19

(22+5(n–1))–(25+5(n–1)) List of scaled value of fixed distribution function parameter (p1–pNp), defined by type of distribution in octets 18–19

21+5Np Type of generating process (see Code table 4.3)

22+5Np Background generating process identifier (defined by originating centre)

23+5Np Analysis or forecast generating process identifier (defined by originating centre)

(24+5Np)–(25+5Np) Hours of observational data cut-off after reference time (see Note 1)

26+5Np Minutes of observational data cut-off after reference time

27+5Np Indicator of unit of time range (see Code table 4.4)

(28+5Np)–(31+5Np) Forecast time in units defined by the previous octet (see Note 4)

32+5Np Type of first fixed surface (see Code table 4.5)

33+5Np Scale factor of first fixed surface

(34+5Np)–(37+5Np) Scaled value of first fixed surface

38+5Np Type of second fixed surface (see Code table 4.5)

39+5Np Scale factor of second fixed surface

(40+5Np)–(43+5Np) Scaled value of second fixed surface

44+5Np Type of ensemble forecast (see code table 4.6)

45+5Np Perturbation number

46+5Np Number of forecasts in ensemble

(47+5Np)–(48+5Np) Year

(49+5Np) Month

(50+5Np) Day Time of end of overall time interval

(51+5Np) Hour

(52+5Np) Minute

(53+5Np) Second

(54+5Np) n – number of time range specifications describing the time intervals used to calculate the statistically processed field

(55+5Np)–(58+5Np) Total number of data values missing in statistical process  
(59+5Np)–(70+5Np) Specification of the outermost (or only) time range over which statistical processing is done

(59+5Np) Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10)

(60+5Np) Type of time increment between successive fields used in the statistical processing (see Code table 4.11)

(61+5Np) Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4)

(62+5Np)–(65+5Np) Length of the time range over which statistical processing is done, in units defined by the previous octet

(66+5Np) Indicator of unit of time for the increment between the successive fields used (see Code table 4.4)

(67+5Np)–(70+5Np) Time increment between successive fields, in units defined by the previous octet (see Notes 5 and 6)

(71+5Np)–nn These octets are included only if n > 1, where nn = (58+5Np) + 12 x n

(71+5Np)–(82+5Np) As octets (59+5Np) to (70+5Np), next innermost step of processing

(83+5Np)–nn Additional time range specifications, included in accordance with the value of n. Contents as octets (59+5Np) to (70+5Np), repeated as necessary

Notes:

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

(2) If Number of mode (N) > 1, then between x N fields with mode number l = 1, …, N define the distribution function. x is the number of variable parameters in the distribution function.

(3) For more information, see Attachment III (Distribution functions in GRIB) in Part B of this volume (I.2 – Att.III/GRIB – 1 to 2).

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

(5) 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.

(6) 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. 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 times.

**8.** **PFC2016-2-5 Clarification of an entry in code table 0 01 150 [FT2017-1]** <[para 4.1](#A2016_4_1_grib)>

**Amend the entry 4 and Note 2:**

In code table 0 01 150,

| Code figure |  |
| --- | --- |
| 4 | Ellipsoidal datum using the International Reference Meridian and the International Reference Pole as the prime meridian and prime pole, respectively, and the origin of the International Terrestrial Reference System (ITRS) (see Note 2). International Reference Meridian, International Reference Pole and ITRS are maintained by the International Earth Rotation and Reference Systems Service (IERS) |

Notes:

(2) When Code figure 4 is used to specify a custom coordinate reference system, the ellipsoidal datum shall be an oblate ellipsoid of revolution, where the major axis is uniplanar with the equatorial plane and the minor axis traverses the prime meridian towards the prime pole. North corresponds to the direction from the equator to the prime pole. East corresponds to the counter-clockwise direction from the prime meridian as viewed from above the North Pole. In this case, the semi-major and semi-minor axes must be specified (e.g. by descriptors 0 01 152 and 0 01 153).

**9.** **PFC2016-2-6** New entry in common code table C-5 **[FT2017-1]** <[para 4.1](#A2016_4_1_grib)>

**Add an entry:**

in Common Code table C-5,

|  |  |  |  |
| --- | --- | --- | --- |
| Code figure for I6I6I6 | Code figure for BUFR | Code figure for GRIB | Short name |
| 422 | 422 | 422 | ScatSat-1 |

**[REVISIONS AND ADDITIONS IN RELATION TO IPET-DRMM-IV]**

The following lists amendments revised or additionally proposed in relation to the IPET-DRMM-IV for approval.

Some amendments editorially corrected may not be shown here, e.g. center to centre, sea surface to sea-surface, dew point to dewpoint.

**1. New entries in Common Code Table C-5 [FT2016-2]**[**⮈**](Report_IPET-DRMM-IV_Geneva_summary.docx#S2016_3_2_3)

**Add entries:**

in common code table C-5,

|  |  |  |  |
| --- | --- | --- | --- |
| Code figure for I6I6I6 | Code figure for BUFR | Code figure for GRIB2 |  |
| 225 | 225 | 225 | NOAA 20 |
| 226 | 226 | 226 | NOAA 21 |

**[PROPOSALS UNDER VALIDATION]**

**FM 92 GRIB**

* **2015-2.1.1(DRMM-III) Complete encoding of information required for georeferencing grid points in GRIB [ABC2016]** <[para 4.1](#A2016_4_1_grib)>

**Add a new note:**

(2) With respect to the Code figures 0, 1, 3, 6, and 7, coordinates can only be unambiguously interpreted, if the coordinate reference system, in which they are embedded, is known. Therefore, defining the shape of the Earth alone without coordinate system axis origins is ambiguous. Generally, the prime meridian defined in the geodetic system WGS84 can be safely assumed to be the longitudinal origin. However, because these code figures do not specify the longitudinal origin explicitly, it is suggested to contact the originating centre, if high precision coordinates are needed in order to obtain the precise details of the coordinate system used.

* **2015-2.1.2(DRMM-III) New GRIB2 Regulations and notes to make it clear that forecast times may be negative [ABC2017]** <[para 4.1](#A2016_4_1_grib)>

**Add a regulation:**

92.6.3 In product definition templates that refer to a forecast time or offset from reference time, this may be negative to refer to times or intervals that begin before the reference time, if this is applicable.

* **2015-2.2.1/2.2.2(DRMM-III)** [**New parameters in GRIB2 Code table 4.2/New GRIB2 parameters and product definition template for observational satellite data**](#A2015_2_2_1) **[Validation]** <[para 4.1](#A2016_4_1_grib)>

**Add entries:**

In Code table 4.1,

Discipline 3 (Space products)

191 Miscellaneous

In Code Table 4.2:

Discipline 3 (Space products), category 1 (Quantitative products)

18 Water temperature K

Discipline 3 (Space products), Category 191 (Miscellaneous)

0 Seconds prior to initial reference time (defined in Section 1) s

**Add a code table:**

Code table 4.16 – Quality value associated with parameter

Code figure Meaning

0 Confidence index (see Note 2)

1 Quality indicator (see Note 3 and Code table 4.244)

2 Correlation of product with used calibration product (see Note 4)

3 Standard deviation of product from calibration product (see Note 5)

4-191 Reserved

192-254 Reserved for local use

255 Missing

Notes:

(1) When a non-missing value is used from this code table, the original data value is a quality value associated with the parameter defined by octets 10 and 11 of the product definition template.

(2) The original data value is a non-dimensional number from 0 to 1, where 0 indicates no confidence and 1 indicates maximal confidence.

(3) The original data value is defined by Code table 4.244.

(4) The original data value is a non-dimensional number without units.

(5) The original data value is in the same units as the parameter defined by octets 10 and 11 of the product definition template.

Code table 4.244 – Quality indicator

Code figure Meaning

0 No quality information available

1 Failed

2 Passed

3-191 Reserved

192-254 Reserved for local use

255 Missing

**Add a template:**

Product definition template 4.35 – satellite product with or without associated quality values

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 Quality value associated with parameter (see Code Table 4.16)

15 Number of contributing spectral bands (NB)

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

(16+11(nb–1))–(17+11(nb–1)) Satellite series of band nb (code table defined by originating/generating centre)

(18+11(nb–1))–(19+11(nb–1)) Satellite numbers of band nb (code table defined by originating/generating centre)

(20+11(nb–1))–(21+11(nb–1)) Instrument types of band nb (code table defined by originating/generating centre)

(22+11(nb–1)) Scale factor of central wave number of band nb

(23+11(nb–1))–(26+11(nb–1)) Scaled value of central wave number of band nb (units: m–1)

Note: 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.

* **2015-2.2.8(DRMM-III) New parameters in GRIB2 Code Table 4.2 for moisture, radiation and clouds [FT2015-2 except for Code table 4.5 (FT2016-1)]** <[para 4.1](#A2016_4_1_grib)>

**~~Add entries:~~**

~~In Code table 4.2,~~

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ~~Domain~~ | ~~Parameter Category~~ | ~~Parameter Number~~ | ~~Description~~ | ~~Units~~ | ~~Comment or note~~ |
| ~~0~~ | ~~0~~ | ~~027~~ | ~~Wet bulb temperature~~ | ~~K~~ |  |
| ~~0~~ | ~~4~~ | ~~013~~ | ~~Direct short wave radiation flux~~ | ~~W m~~~~-2~~ |  |
| ~~0~~ | ~~4~~ | ~~014~~ | ~~Diffuse short wave radiation flux~~ | ~~W m~~~~-2~~ |  |
| ~~0~~ | ~~6~~ | ~~040~~ | ~~Mass density of convective cloud water droplets~~ | ~~kg m~~~~-3~~ |  |
| ~~0~~ | ~~6~~ | ~~047~~ | ~~Volume fraction of cloud water droplets~~ | ~~Numeric~~ | ~~Note x~~ |
| ~~0~~ | ~~6~~ | ~~048~~ | ~~Volume fraction of cloud ice particles~~ | ~~Numeric~~ | ~~Note x~~ |
| ~~0~~ | ~~6~~ | ~~049~~ | ~~Volume fraction of cloud (ice and/or water)~~ | ~~Numeric~~ | ~~Note x~~ |

~~Note:~~

~~(x) The sum of the water and ice fractions may exceed the total due to overlap between the volumes containing ice and those containing liquid water.~~

**Add an entry to GRIB2 Code table 4.5 Fixed surface type for cloud base fields [FT2016-1]**

|  |  |  |
| --- | --- | --- |
| Code figure | Meaning | Unit |
| 013 | Lowest level where vertically integrated cloud cover exceeds the specified percentage (cloud base for a given percentage cloud cover) | % |

* **2014-2.2.2(DRMM-II)/A product definition template for statistics over an ensemble**

**[Validation]** <[para 4.1](#A2016_4_1_grib)>

**Add a new template:**

Product definition template 4.62 – Statistics over an ensemble reforecast, 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 Indicator of unit of time range (see Code table 4.4)

16-19 Forecast time in units defined by octet 15 (see Note 1)

20 Type of first fixed surface (see Code table 4.5)

21 Scale factor of first fixed surface

22-25 Scaled value of first fixed surface

26 Type of second fixed surface (see Code table 4.5)

27 Scale factor of second fixed surface

28-31 Scaled value of second fixed surface

32 Type of ensemble forecast (see Code table 4.6)

33 Number of forecasts in ensemble

34 Number of years in the ensemble reforecast period (see Note 2)

35 First year of ensemble reforecast period

36 Last year of ensemble reforecast period

37 Total number of data values possible (or expected) in statistical process over the  
 ensemble reforecast

38-39 Total number of data values missing in statistical process over the ensemble  
 reforecast

40 Statistical process used to calculate the processed field over the ensemble reforecast  
 (see Code table 4.10)

41-42 Year of model version date (see Note 3)

43 Month of model version date

44 Day of model version date

45 Hour of model version date

46 Minute of model version date

47 Second of model version date

48 Month of end of overall time interval (see Note 5)

49 Day of end of overall time interval

50 Hour of end of overall time interval

51 Minute of end of overall time interval

52 Second of end of overall time interval

53 n - number of time range specifications describing the time intervals used

to calculate the statistically processed field

54-57 Total number of data values missing in statistical process

58-69 Specification of the outermost (or only) time range over which statistical

processing is done

58 Statistical process used to calculate the processed field from the field at

each time increment during the time range (see Code table 4.10)

59 Type of time increment between successive fields used in the statistical

processing (see Code table 4.11)

60 Indicator of unit of time for time range over which statistical processing is

done (see Code table 4.4)

61-64 Length of the time range over which statistical processing is done, in units

defined by the previous octet

65 Indicator of unit of time for the increment between the successive fields

used (see Code table 4.4)

66-69 Time increment between successive fields, in units defined by the previous

octet (see Note 3)

70-nn These octets are included only if n>1, where nn=69 + 12 x n

70-81 As octets 58 to 69, next innermost step of processing

82-nn Additional time range specifications, included in accordance with the value

of n. Contents as octets 58 to 69, repeated as necessary

Notes:

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

(2) Octets 34-40 define a statistical process over both time and ensemble.

(3) This is the date to identify the model version that is used to generate the reforecast.

(4) 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 59, 71. 83 ...). 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.

* **2012-2.2.9(DRC-IV)/**[**GRIB template for 4-D Trajectory grid definition**](https://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRC_Exeter2012/Documents/IPETDRC-IV_Doc2-2_9_4Dtrajectory.doc) **[Validation]** <[para 4.1](#A2016_4_1_grib)>

**Validate templates:**

Grid definition template 3.1010 – 4-D trajectory grid definition

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

31–32 Number of horizontal points in slice (see Note 1)

33–34 Number of vertical points in slice (see Note 1)

35–38 Di – slice horizontal grid length (see Note 2)

39–42 Dj – slice vertical grid length (see Note 2)

43–46 Pi – horizontal location of trajectory point within slice (see Note 3)

47–50 Pj – vertical location of trajectory point within slice (see Note 3)

51 Scanning mode (flags – see Flag table 3.4) (see Note 1)

52–53 NW – Number of way points (see Note 4)

54–(53+NW×24) Waypoint descriptions to define 4-D coordinates

Waypoint descriptions:

30+(N×24+0–N×24+3) LaN – latitude of Nth trajectory way point

30+(N×24+4–N×24+7) LoN – longitude of Nth trajectory way point

30+(N×24+8) Type of Nth’s trajectory way point surface (see Code table 4.5) (see  
 Note 5)

30+(N×24+9) Scale factor of Nth’s trajectory way point surface

30+(N×24+10–N×24+13) Scaled value of Nth’s trajectory way point surface

30+(N×24+14) Indicator of unit of time range (see Code table 4.4)

30+(N×24+15–N×24+18) Waypoint time in units defined by octet N×24+14 (see Note 6)

30+(N×24+19–N×24+22) Number of slices per trajectory segment (see Note 7)

30+(N×24+23) Number of additional leading and trailing slices (see Note 8)

Notes:

(1) Horizontal and vertical points in slice indicate orthogonal grid slice perpendicular to point along the trajectory segment. Therefore scanning mode describes scanning within single slice.

(2) Grid lengths are in units of 10–3 m. Trajectory is always positioned in the centre of the slice.

(3) Location of trajectory point within slice is in units of 10–3 m relative from first grid point of this slice.

(4) Type of line for way segments is assumed to be Great Circle.

(5) Each of waypoints can be in different types of surface coordinates. For the purpose of light transition level, point of transition can be repeated in both meters above surface and isobaric level equivalent to height reduction based on QNH valid for FIR at that moment. Waypoint can be also repeated for stopover on the trajectory with same 3-D coordinates but different waypoint time. First point of transition level or stopover description can have MISSING slices in this case.

(6) Waypoint time is relative to reference time of data defined in Section 1.

(7) Slices are defined as perpendicular planes which are equidistantly spaced along the trajectory segment. First slice is always located in first point of trajectory segment and last slice in last point of trajectory segment. Therefore minimum number of slices is 2, unless set to MISSING (for last point of trajectory or for transition level repeated point).

*Figure 3: Example of trajectory segment with 5 slices (circles represent trajectory waypoints)*

(8) Number of leading slices is same as number of trailing slices, and represents additional slices outside the trajectory segment but within its direction using same equidistant spacing as for corresponding trajectory segment itself.

*Figure 4: Example of trajectory segment with 5 slices and 1 leading and trailing slice (circles represent trajectory waypoints)*

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

Product definition template 4.1010 – 4-D trajectory

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 of observational data cutoff after reference time (see Note)

17 Minutes of observational data cutoff after reference time

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

Product definition template 4.1011 – 4-D trajectory ensemble forecast, control and perturbed

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)

17 Minutes after reference time of data cutoff

18 Type of ensemble forecast (see Code table 4.6)

19 Perturbation number

20 Number of forecasts in ensemble

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

Product definition template 4.1015 – 4-D trajectory probability forecasts

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)

17 Minutes after reference time of data cutoff

18 Forecast probability number

19 Total number of forecast probabilities

20 Probability type (see Code table 4.9)

21 Scale factor of lower limit

22–25 Scaled value of lower limit

26 Scale factor of upper limit

27–30 Scaled value of upper limit

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

**FM 94 BUFR/FM 95 CREX**

* **2015-3.2.4(DRMM-III) BUFR sequence and elements for Atmospheric Laser Doppler Instrument (ALADIN) [FT2016-1]** <[para 4.1](#A2016_4_1_bufr)>

In BUFR/CREX table B,

Class 05 - BUFR/CREX Location (horizontal)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Characters) |
| 0 05 068 | Profile number | Numeric | 0 | 0 | 32 | Numeric | 0 | 10 |
| 0 05 069 | Observation identifier | Numeric | 0 | 0 | 32 | Numeric | 0 | 10 |
| 0 05 070 | Receiver channel | Code table | 0 | 0 | 2 | Code table | 0 | 1 |

Class 07 - BUFR/CREX Location (vertical)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Characters) |
| 0 07 071 | Height (high resolution) | m | 3 | -10000000 | 26 | **m** | 3 | 8 |

Class 08 – BUFR/CREX Significance qualifiers

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Characters) |
| 0 08 091 | Coordinates significance | Code table | 0 | 0 | 8 | Code table | 0 | 3 |

*Editorial note: This is operational as of 11 November 2015 (FT2015-2).*

Class 25 - BUFR/CREX Processing information

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Characters) |
| 0 25 187 | Confidence flag | Code table | 0 | 0 | 4 | Code table | 0 | 2 |

Class 40 – BUFR/CREX Satellite data

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH  (Characters) |
| 0 40 029 | Horizontal observation integration length | m | 0 | 0 | 26 | m | 0 | 8 |
| 0 40 030 | Horizontal line of sight wind | m s-1 | 2 | -32767 | 16 | m s-1 | 2 | 5 |
| 0 40 031 | Error estimate of horizontal line of sight wind | m s-1 | 2 | 0 | 15 | m s-1 | 2 | 5 |
| 0 40 032 | Derivative wind to pressure | m s-1 Pa-1 | 3 | -100000 | 18 | m s-1 Pa-1 | 3 | 6 |
| 0 40 033 | Derivative wind to temperature | m s-1 K-1 | 3 | -100000 | 18 | m s-1 K-1 | 3 | 6 |
| 0 40 034 | Derivative wind to backscatter ratio | m s-1 | 3 | -200000 | 19 | m s-1 | 3 | 6 |
| 0 40 035 | Satellite range | m | 0 | 380000 | 18 | m | 0 | 6 |
| 0 40 036 | Lidar classification type | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 40 037 | Backscatter ratio | Numeric | 3 | 500 | 20 | Numeric | 3 | 7 |

In BUFR Table D,

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE REFERENCE | TABLE  REFERENCES | Element name |  |
| 3 40 013 | (NAME) | | |
| 0 01 007 | Satellite identifier |  |
| 0 02 019 | Satellite instruments |  |
| 0 01 033 | Identification of originating/generating centre |  |
| 0 01 034 | Identification of originating/generating sub-centre |  |
| 0 04 001 | Year |  |
| 0 04 002 | Month |  |
| 0 04 003 | Day |  |
| 0 04 004 | Hour |  |
| 0 04 005 | Minute |  |
| 0 04 007 | Seconds within a minute (microsecond accuracy) |  |
| 0 05 068 | Profile number |  |
| 0 05 069 | Observation identifier |  |
| 0 05 070 | Receiver channel |  |
| 0 40 036 | Lidar l2b classification type |  |
| 0 08 091 | Coordinates significance | 2 -> Start of observation |
| 0 05 001 | Latitude (high accuracy) |  |
| 0 06 001 | Longitude (high accuracy) |  |
| 0 04 016 | Time increment |  |
| 0 08 091 | Coordinates significance | 3 -> End of observation |
| 0 05 001 | Latitude (high accuracy) |  |
| 0 06 001 | Longitude (high accuracy) |  |
| 0 04 016 | Time increment |  |
| 0 08 091 | Coordinates significance | 4 -> Centre of gravity of observation |
| 0 05 001 | Latitude (high accuracy) |  |
| 0 06 001 | Longitude (high accuracy) |  |
| 0 04 016 | Time increment |  |
| 0 08 091 | Coordinates significance | 5 -> Top of observation |
| 0 07 070 | Height (high resolution) |  |
| 0 05 021 | Bearing or azimuth |  |
| 0 07 021 | Elevation |  |
| 0 40 035 | Satellite range |  |
| 0 08 091 | Coordinates significance | 6 -> Bottom of observation |
| 0 07 070 | Height (high resolution) |  |
| 0 05 021 | Bearing or azimuth |  |
| 0 07 021 | Elevation |  |
| 0 40 035 | Satellite range |  |
| 0 08 091 | Coordinates significance | 7 -> Vertical centre of Gravity of the observation |
| 0 07 070 | Height (high resolution) |  |
| 0 05 021 | Bearing or azimuth |  |
| 0 07 021 | Elevation |  |
| 0 40 035 | Satellite range |  |
| 0 40 029 | Horizontal observation integration length |  |
| 0 40 030 | Horizontal line of sight wind |  |
| 0 40 031 | Error estimate of horizontal line of sight wind |  |
| 0 25 187 | Confidence flag |  |
| 0 10 004 | Pressure |  |
| 0 12 001 | Temperature/air temperature |  |
| 0 40 037 | Backscatter ratio |  |
| 0 40 032 | Derivative wind to pressure |  |
| 0 40 033 | Derivative wind to temperature |  |
| 0 40 034 | Derivative wind to backscatter ratio |  |

Code table 0 08 091 – Coordinates significance

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Satellite coordinates |
| 1 | Observations coordinates |
| 2 | Start of observation |
| 3 | End of observation |
| 4 | Horizontal centre of gravity of the observation |
| 5 | Top of the observation |
| 6 | Bottom of the observation |
| 7 | Vertical centre of gravity of the observation |
| 8-254 | Reserved |
| 255 | Missing value |

*Editorial note: 0 08 091 and the associated code table are seen in 2015-3.2.2 (DRMM-III). This is operational as of 11 November 2015 (FT2015-2).*

Code table 0 05 070 – Receiver channel

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Mie |
| 1 | Rayleigh |
| 2 | Reserved |
| 3 | Missing |

Code table 0 25 187 – Confidence flag

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Valid |
| 1 | Invalid |
| 2-14 | Reserved |
| 15 | Missing |

Code table 0 40 036 – Lidar classification type

|  |  |
| --- | --- |
| Code figure |  |
| 0 | Clear |
| 1 | Cloud |
| 2-14 | Reserved |
| 15 | Missing |

* **2015-3.2.6(DRMM-III) BUFR templates for WAVEOB data [FT2016-1]** <[para 4.1](#A2016_4_1_bufr)>

**Add entries:**

In BUFR table B,

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table Reference |  |  |  |  |  |
| F X Y | Element name | Unit | Scale | Reference | Data width |
| 0 22 102 | Scaled maximum non-directional spectral wave density by frequency (Note 1) | m2 s | 0 | 0 | 14 |
| 0 22 103 | Scaled maximum non-directional spectral wave density by wavenumber (Note 1) | m3 | 0 | 0 | 14 |
| 0 22 104 | Scaled non-directional spectral wave density by frequency (Note 1) | m2 s | 0 | 0 | 14 |
| 0 22 105 | Scaled non-directional spectral wave density by wavenumber (Note 1) | m3 | 0 | 0 | 14 |
| 0 22 106 | Scaled directional spectral wave density by frequency (Note 1) | m2 s rad-1 | 0 | 0 | 14 |
| 0 22 107 | Scaled directional spectral wave density by wavenumber (Note 1) | m4 | 0 | 0 | 14 |

*Editorial note: CREX part should be included.*

Notes

1. Must be preceded by 0 08 090, possibly with intervening operators. The value is 10x multiplied by the encoded value, where x is the value associated with the preceding 0 08 090 descriptor. The encoded value is the actual value multiplied by 10-x.

With the above values, the representable range of values for the scale is -127 to +127 and the representable values for the spectral energy densities range from 0 with a precision of 10-127 through to (214-2)\*10127 (1.6382\*10131) with a precision of 10127 (approximately 4 decimal digits), far in excess of requirements. Of course other values could be chosen to reduce BUFR message size, including a narrower width version of 0 08 090. Reducing the decimal scale to 4 bits with a reference of -7 would give 0 with a precision of 10-7 through 1.6382\*1011 with a precision of 107 (still approximately 4 decimal digits), which would still be adequate. Reducing the data width for the spectral energy densities would reduce the precision below 4 decimal digits. We believe that each use of 0 08 090 will have to be followed (after the affected descriptors) with another use with the scale set to zero or missing as class 8 descriptors remain in effect until reset.

**Add entries:**

In Table D,

|  |  |  |  |
| --- | --- | --- | --- |
| Table reference |  |  |  |
| F X Y | Table reference | Element name | Note or WAVEOB ref |
|  |  | *Identification (WAVEOB Section 0)* |  |
| 3 08 015 | 0 01 003 | WMO Region number/geographical area | A1 |
|  | 0 01 020 | WMO Region sub-area | bw |
|  | 0 01 005 | Buoy/platform identifier | nbnbnb |
|  | 0 01 011 | Ship or mobile land station identifier | D…D |
|  | 0 01 007 | Satellite identifier | I6I6I6 |
|  | 0 01 001 | WMO block number | II |
|  | 0 01 002 | WMO station number | Iii |
|  | 0 02 044 | Indicator for method of calculating spectrum | Im |
|  | 0 02 045 | Indicator for type of platform | Ip |
|  | 3 01 011 | Year, month, day | JMMYY |
|  | 3 01 012 | Hour, minute | GGgg |
|  | 3 01 021 | Latitude/longitude (high accuracy) | QcLaLaLaLa LoLoLoLoLo |
|  |  | *Basic data (WAVEOB Section 0)* |  |
|  | 0 22 063 | Total water depth | 1hhhh |
|  | 0 22 076 | Direction of coming dominant waves | 9dddd |
|  | 0 22 077 | Directional spread of dominant wave | dsds |
|  | 0 22 094 | Total number of wave bands | 111BTBT |
|  | 0 25 044 | Wave sampling interval | SSSS |
|  | 0 22 079 | Length of wave record | D’D’D’D’ |
|  | 1 07 002 | Replicate 5 descriptors 2 times | Over sensor type |
|  | 0 02 046 | Wave measurement instrumentation |  |
|  | 0 22 070 | Significant wave height | 2Hs HsHsHs or 6HseHseHseHse |
|  | 0 22 072 | Spectral peak wave length | 3PpPpPpPp or 7PspPspPspPsp |
|  | 0 22 073 | Maximum wave height | 4HmHmHmHm |
|  | 0 22 075 | Average wave period | 5PaPaPaPa or 8PsaPsaPsaPsa |
|  |  | *Spectral data (WAVEOB Sections 1-5)* |  |
|  | 1 24 000 | Delayed replication of 24 descriptors | Note 1 |
|  | 0 31 001 | Replication factor | 0, 1 or 2; normally 1 |
|  | 0 02 046 | Wave measurement instrumentation | 2222 or 3333 |
|  | 0 08 090 | Scale to be applied to following element descriptors | x |
|  | 0 22 102 | Maximum non-directional spectral wave density by frequency m2 s | x CmCmCmCm or  x CsmCsmCsmCsm |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 084 | Band containing maximum non-directional spectral wave density | nmnm or nsmnsm |
|  | 1 18 000 | Delayed replication of 18 descriptors |  |
|  | 0 31 001 | Delayed descriptor replication factor | 111BTBT |
|  | 0 22 080 | Waveband central frequency | BB/// 1f1f1f1x 1fdfdfdx… |
|  | 0 22 085 | Spectral wave density ratio | 1c1c1c2c2 or 1cs1cs1cs2cs2 … |
|  | 0 02 086 | Mean direction from which waves are coming | 1da1da1 … |
|  | 0 02 087 | Principal direction from which waves are coming | da2da2… |
|  | 0 22 088 | First normalized polar coordinate from Fourier coefficients | 1r1r1 … |
|  | 0 22 089 | Second normalized polar coordinate from Fourier coefficients | r2r2… |
|  | 1 04 000 | Delayed replication of 4 descriptors | Note 2 |
|  | 0 31 001 | Delayed descriptor replication factor | Ib Note 2 |
|  | 0 08 090 | Scale to be applied to following element descriptors | x |
|  | 0 22 104 | Non-directional spectral estimate by frequency | 1A1A1A1x … |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 186 | Direction from which waves are coming | Note 3 |
|  | 0 22 187 | Directional spread of wave | Note 3 |
|  | 1 04 000 | Delayed replication of 4 descriptors | Note 4 |
|  | 0 31 001 | Delayed descriptor replication factor | Ib Note 4 |
|  | 0 08 090 | Scale to be applied to following element descriptors | x |
|  | 0 22 106 | Directional spectral estimate by frequency | 1A1A1A1x … |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 186 | Direction from which waves are coming | 1d1d1 … |
|  | 0 22 187 | Directional spread of wave | dsds … |

Notes:

1. Normally 1, may be 2 if both heave and slope sensors are in use, or 0 if no spectral data.
2. Non-directional spectra, (Ib=0 in WAVEOB) or partial directional spectra (Ib=1 in WAVEOB with one direction per wavenumber). Count=0 (full directional spectra) or 1 (non-directional spectra or partial directional spectra). Partial directional spectra have only one direction per wavenumber band.
3. Missing for non-directional spectra.
4. Full directional spectra (Ib=1 in WAVEOB with more than one direction per wavenumber band). The replication count is the number of directions per wavenumber band which should normally cover the full circle.

|  |  |  |  |
| --- | --- | --- | --- |
| Table reference |  |  |  |
| F X Y | Table reference | Element name | Note or WAVEOB ref |
|  |  | *Identification (WAVEOB Section 0)* |  |
| 3 08 016 | 0 01 003 | WMO Region number/geographical area | A1 |
|  | 0 01 020 | WMO Region sub-area | bw |
|  | 0 01 005 | Buoy/platform identifier | nbnbnb |
|  | 0 01 011 | Ship or mobile land station identifier | D…D |
|  | 0 01 007 | Satellite identifier | I6I6I6 |
|  | 0 01 001 | WMO block number | II |
|  | 0 01 002 | WMO station number | iii |
|  | 0 02 044 | Indicator for method of calculating spectrum | Im |
|  | 0 02 045 | Indicator for type of platform | Ip |
|  | 3 01 011 | Year, month, day | JMMYY |
|  | 3 01 012 | Hour, minute | GGgg |
|  | 3 01 021 | Latitude/longitude (high accuracy) | QcLaLaLaLa LoLoLoLoLo |
|  |  | *Basic data (WAVEOB Section 0)* |  |
|  | 0 22 063 | Total water depth | 1hhhh |
|  | 0 22 076 | Direction of coming dominant waves | 9dddd |
|  | 0 22 077 | Directional spread of dominant wave | dsds |
|  | 0 22 094 | Total number of wave bands | 111BTBT |
|  | 0 25 044 | Wave sampling interval | SSSS |
|  | 0 22 079 | Length of wave record | D’D’D’D’ |
|  | 1 07 002 | Replicate 5 descriptors 2 times | Over sensor type |
|  | 0 02 046 | Wave measurement instrumentation |  |
|  | 0 22 070 | Significant wave height | 2Hs HsHsHs or 6HseHseHseHse |
|  | 0 22 072 | Spectral peak wave length | 3PpPpPpPp or 7PspPspPspPsp |
|  | 0 22 073 | Maximum wave height | 4HmHmHmHm |
|  | 0 22 075 | Average wave period | 5PaPaPaPa or 8PsaPsaPsaPsa |
|  |  | *Spectral data (WAVEOB Sections 1-5)* |  |
|  | 1 24 000 | Delayed replication of 24 descriptors | Note 1 |
|  | 0 31 001 | Replication factor | 0, 1 or 2; normally 1 |
|  | 0 02 046 | Wave measurement instrumentation | 2222 or 3333 |
|  | 0 08 090 | Scale to be applied to following element descriptors | x |
|  | 0 22 103 | Maximum non-directional spectral wave density by wavenumber | x CmCmCmCm or  x CsmCsmCsmCsm |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 084 | Band containing maximum non-directional spectral wave density | nmnm or nsmnsm |
|  | 1 18 000 | Delayed replication of 18 descriptors |  |
|  | 0 31 001 | Delayed descriptor replication factor | 111BTBT |
|  | 0 22 081 | Waveband central wave number | BB/// 1f1f1f1x 1fdfdfdx… |
|  | 0 22 085 | Spectral wave density ratio | 1c1c1c2c2 or 1cs1cs1cs2cs2 … |
|  | 0 02 086 | Mean direction from which waves are coming | 1da1da1 … |
|  | 0 02 087 | Principal direction from which waves are coming | da2da2… |
|  | 0 22 088 | First normalized polar coordinate from Fourier coefficients | 1r1r1 … |
|  | 0 22 089 | Second normalized polar coordinate from Fourier coefficients | r2r2… |
|  | 1 03 000 | Delayed replication of 5 descriptors | Note 2 |
|  | 0 31 001 | Delayed descriptor replication factor | Ib Note 2 |
|  | 0 08 090 | Scale to be applied to next element descriptor | x |
|  | 0 22 105 | Non-directional spectral estimate by wave number | 1A1A1A1x … |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 186 | Direction from which waves are coming | Note 3 |
|  | 0 22 187 | Directional spread of wave | Note 3 |
|  | 1 03 000 | Delayed replication of 5 descriptors | Note 4 |
|  | 0 31 001 | Delayed descriptor replication factor | Ib Note 4 |
|  | 0 08 090 | Scale to be applied to next element descriptor | x |
|  | 0 22 107 | Directional spectral estimate by wave number | 1A1A1A1x … |
|  | 0 08 090 | Scale to be applied to following descriptors | Missing |
|  | 0 22 186 | Direction from which waves are coming | 1d1d1 … |
|  | 0 22 187 | Directional spread of wave | dsds … |

*Editorial note: Names should be consistent with the table B descriptors.*

Notes:

Refer to notes for template 3 08 015.

* **2015-3.2.13(DRMM-III) BUFR elements and sequence for international exchange of road weather information [FT2016-1]** <[para 4.1](#A2016_4_1_bufr)>

The following new BUFR table B entries and corresponding code tables are proposed:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TABLE  REFERENCE | ELEMENT  NAME | BUFR | | | | CREX | | |
| F X Y | UNIT | SCALE | REFERENCE  VALUE | DATA  WIDTH  (Bits) | UNIT | SCALE | DATA  WIDTH |
| 0 01 104 | State / federal state identifier | CCITT IA5 | 0 | 0 | 32 | CCITT IA5 | 0 | 4 |
| 0 01 105 | Highway designator | CCITT IA5 | 0 | 0 | 40 | CCITT IA5 | 0 | 5 |
| 0 01 106 | Location along highway as indicated by position markers | m | -2 | 0 | 14 | m | -2 | 5 |
| 0 03 016 | Position of road sensors | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 03 017 | Extended type of station | Flag table | 0 | 0 | 6 | Flag table | 0 | 2 |
| 0 03 018 | Type of road | Code table | 0 | 0 | 5 | Code table | 0 | 2 |
| 0 03 019 | Type of construction | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 12 128 | Road surface temperature | K | 2 | 0 | 16 | C | 2 | 5 |
| 0 12 129 | Road sub-surface temperature | K | 2 | 0 | 16 | C | 2 | 5 |
| 0 13 116 | Water film thickness | m | 3 | 0 | 7 | m | 3 | 2 |
| 0 20 138 | Road surface condition | Code table | 0 | 0 | 4 | Code table | 0 | 2 |

**Code and Flag-tables:**

0 03 016   Position of road sensors

| Code figure |  |
| --- | --- |
| 0 | Fast lane between the wheel tracks |
| 1 | Fast lane between the wheel tracks in the opposite direction |
| 2 | Fast lane in the wheel tracks |
| 3 | Fast lane in the wheel tracks in the opposite direction |
| 4 | Slow lane between the wheel tracks |
| 5 | Slow lane between the wheel tracks in the opposite direction |
| 6 | Slow lane in the wheel tracks |
| 7 | Slow lane in the wheel tracks in the opposite direction |
| 8 - 14 | Reserved |
| 15 | Missing value |

0 03 017   Extended type of station

| Bit No. |  |
| --- | --- |
| 1 | Automatic |
| 2 | Manned |
| 3 | Event triggered |
| 4 | Longer time period than the standard |
| 5 | Reserved |
| all 6 | Missing value |

0 03 018   Type of road

| Code figure |  |
| --- | --- |
| 0 | Free track without further information |
| 1 | Free track, embankment |
| 2 | Free track, flat relative to surroundings |
| 3 | Free track, water basin(s) in vicinity |
| 4 | Free track, forest |
| 5 | Free track, cleft |
| 6 | Free track, on hilltop |
| 7 | Free track, on hilltop, forest |
| 8 | Free track, in valley |
| 9 | Free track, in valley, forest |
| 10 | Free track, north inclination |
| 11 | Free track, north inclination, forest |
| 12 | Free track, south inclination |
| 13 | Free track, south inclination, forest |
| 14-19 | Reserved |
| 20 | Bridge without further information |
| 21 | Bridge across a valley in a urban area |
| 22 | Bridge across a valley with forest/meadows/fields |
| 23 | Bridge across street/track |
| 24 | Bridge across big river/canal |
| 25 | Bridge across river/canal of medium size |
| 26 | Bridge across a small stream/loading canal |
| 27-30 | Reserved |
| 31 | Missing value |

0 03 019   Type of construction

| Code figure |  |
| --- | --- |
| 0 | Asphalt |
| 1 | Concrete |
| 2 | Concrete construction |
| 3 | Steel-girder construction |
| 4 | Box girder bridge |
| 5 | Orthotrope slab |
| 6 | Drain asphalt |
| 7-14 | Reserved |
| 15 | Missing value |

0 20 138   Road surface condition

| Code figure |  |
| --- | --- |
| 0 | Dry |
| 1 | Moist |
| 2 | Wet |
| 3 | Rime |
| 4 | Snow |
| 5 | Ice |
| 6 | Glaze |
| 7 | Not dry |
| 8-14 | Reserved |
| 15 | Missing value |

**Add new BUFR sequence in BUFR table D:**

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  |  |  |
|  |  | (Road weather information) |  |
|  |  | *Station identification* |  |
| 3 07 102 | 3 01 089 | National station identification |  |
|  | 0 01 018 | Short station or site name | For identification of the road weather monitoring site |
|  | 0 01 015 | Station or site name |  |
|  | 0 01 104 | State / federal state identifier |  |
|  | 0 01 105 | Highway designator |  |
|  | 0 01 106 | Routes kilometre of highway |  |
|  | 0 03 017 | Extended type of station |  |
|  | 0 03 018 | Type of road |  |
|  | 0 03 019 | Type of construction |  |
|  | 3 01 011 | Year, month, day |  |
|  | 3 01 012 | Hour, minute |  |
|  | 3 01 021 | Latitude/longitude (high accuracy) |  |
|  | 0 07 030 | Height of station ground above mean sea level |  |
|  |  | *Temperature, humidity and visibility data* |  |
|  | 0 07 032 | Height of sensor above local ground |  |
|  | 0 12 101 | Temperature/dry-bulb temperature |  |
|  | 0 12 103 | Dew-point temperature |  |
|  | 0 13 003 | Relative humidity |  |
|  | 0 07 032 | Height of sensor above local ground | Set to missing (cancel) |
|  | 0 20 001 | Horizontal visibility |  |
|  |  | *Road temperature and other data* |  |
|  | 1 09 000 | Delayed replication of 9 descriptors |  |
|  | 0 31 001 | Delayed descriptor replication factor |  |
|  | 0 03 016 | Position of road sensors |  |
|  | 0 12 128 | Road surface temperature |  |
|  | 1 02 000 | Delayed replication of 2 descriptors |  |
|  | 0 31 001 | Delayed descriptor replication factor |  |
|  | 0 07 061 | Depth below land surface | = 0.30 m in the first replication,  = e.g. 0.15 or 0.07 m in the second replication |
|  | 0 12 129 | Road sub-surface temperature |  |
|  | 0 07 061 | Depth below land surface | Set to missing (cancel) |
|  | 0 13 116 | Water film thickness |  |
|  | 0 20 138 | Road surface condition |  |
|  |  | *Precipitation data* |  |
|  | 0 04 025 | Time period | = - 15 minutes |
|  | 0 20 024 | Intensity of phenomena | Intensity (light, moderate, heavy) of precipitation |
|  | 0 13 055 | Intensity of precipitation |  |
|  | 0 20 021 | Type of precipitation |  |
|  | 0 13 011 | Total precipitation / total water equivalent of snow |  |
|  |  | *Wind data* |  |
|  | 0 07 032 | Height of sensor above local ground |  |
|  | 0 08 021 | Time significance | = 2 Time averaged |
|  | 0 04 025 | Time period | = –10 minutes |
|  | 0 11 001 | Wind direction |  |
|  | 0 11 002 | Wind speed |  |
|  | 0 08 021 | Time significance | Set to missing (cancel) |
|  |  | *Maximum wind gust* |  |
|  | 0 04 025 | Time period in minutes |  |
|  | 0 11 043 | Maximum wind gust direction |  |
|  | 0 11 041 | Maximum wind gust speed |  |
|  |  | *State of functionality* |  |
|  | 0 33 005 | Quality information (AWS data) |  |
|  |  |  |  |

**Remarks:**

1. To represent Intensity of precipitation, type of precipitation and state of functionality,   
   0 20 024 (Code table), 0 20 021(Flag table) and 0 33 005 (Flag table) are used, respectively.
2. Some more descriptors are required to reduce the workload with respect to the station database, e.g. for identification of the federal state, identification of the highway, etc.
3. The majority of stations has only one position on the road and one sub-surface temperature sensor. Delayed replications have been introduced to increase flexibility and volume efficiency.
4. Each position of road sensors includes the measurements of
   * road surface temperature
   * road sub-surface temperatures
   * water film thickness
   * road surface condition

Some types of station do not have the ability to identify the surface condition accurately. They can only report conditions such as "not dry" or "glazed". The code table for road surface conditions has been adjusted accordingly.

* **2015-5.1(DRMM-III) Clarifications of B/C30 and B/C32 Regulations [ABC2016]** <[para 4.1](#A2016_4_1_bufr)>

**Add a B/C 30.4.4:**

**B/C 30.4 Regional or national reporting practices**

**B/C 30.4.1 Data required by regional or national reporting practices**

No additional data are currently required by regional or national reporting practices for CLIMAT data in Manual on Codes, WMO-No. 306, Volume II.

**B/C 30.4.2 Reference period for the data of the month**

If the regional or national reporting practices require reporting monthly data (with the exception of precipitation data) for one-month period different from the local time month as recommended in B/C 30.2.2.1, short time displacement (0 04 074) shall be adjusted accordingly.

**B/C 30.4.3 Date/time (of beginning of the period for monthly precipitation data)**

If the regional or national reporting practices require reporting monthly precipitation data for period different from the period recommended in Note (1) to B/C 30.2.6.1, then hour (0 04 004) shall be adjusted accordingly. This regulation does not apply if the beginning of the period for monthly precipitation data starts on the last day of the previous month in UTC.

**B/C 30.4.4** **Date/time (of beginning of the one-month period for precipitation data** **on the last day of the previous month)**

If the regional or national reporting practices require reporting monthly precipitation data for period which starts on the last day of the previous month in UTC, template TM 307078 should be used. The beginning of the period for monthly precipitation data shall be specified by short time displacement (0 04 074) set to a relevant negative value.The beginning of one-month period for which the normals of precipitation are reported, shall be specified in a similar way.

**Add a B/C 32.4.4:**

**B/C 32.4 Regional or national reporting practices**

**B/C 32.4.1 Data required by regional or national reporting practices**

No additional data are currently required by regional or national reporting practices for CLIMAT SHIP data in Manual on Codes, WMO-No. 306, Volume II.

**B/C 32.4.2 Reference period for the data of the month**

If the regional or national reporting practices require reporting monthly data (with the exception of precipitation data) for one-month period different from the local time month as recommended in B/C 32.2.2.1, short time displacement (0 04 074) shall be adjusted accordingly.

**B/C 32.4.3 Date/time (of beginning of the one-month period for precipitation data)**

If the regional or national reporting practices require reporting monthly precipitation data for one-month period different from the period recommended in Note (1) to B/C 32.2.3.1, then hour (0 04 004) shall be adjusted accordingly. This regulation does not apply if the beginning of the period for monthly precipitation data starts on the last day of the previous month in UTC.

**B/C 32.4.4 Date/time (of beginning of the one-month period for precipitation data on the last day of the previous month)**

If the regional or national reporting practices require reporting monthly precipitation data for period which starts on the last day of the previous month in UTC, template TM 308023 should be used. The beginning of the period for monthly precipitation data shall be specified by short time displacement (0 04 074) set to a relevant negative value.The beginning of one-month period for which the normals of precipitation are reported, shall be specified in a similar way.

* **2015-5.2(DRMM-III) Amendment to Annex II to B/C25 Regulations [ABC2016 except for 3 01 128 Additional information on radiosonde ascent (FT2015-2)]** <[para 4.1](#A2016_4_1_bufr)>

Editorial note: corrections to the Notes 4 and 5 were agreed as specified [**here**](#AA2015_5_2).

**Amend the notes to 3 09 052 in B/C25:**

Notes:

(1) Time of launch 3 01 013 shall be reported with the highest possible accuracy available. If the launch time is not available with second accuracy, the entry for seconds shall be put to zero.

(2) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds).

(3) Latitude displacement 0 05 015 represents the latitude offset from the latitude of the launch site. Longitude displacement 0 06 015 represents the longitude offset from the longitude of the launch site.

(4) If additional information on sounding is available, the sequence <3 09 052> shall be preceded by sequences suitable for reporting additional information on sounding systems.

(5) If the sounding data are obtained from upper-air systems where pressure is derived from geopotential height by integration of hydrostatic equation, the geopotential calculation method shall be recorded using 0 02 191 within the preceding sequences.

**Delete B/C25.11.**

**Amend Annex II to B/C25 as follows**

Additional information on radiosonde ascent

|  |  |  |
| --- | --- | --- |
| **3 01 128** |  | **Additional information on radiosonde ascent** |
|  | 0-01-081 | Radiosonde serial number |
|  | 0-01-082 | Radiosonde ascension number |
|  | 0-01-083 | Radiosonde release number |
|  | 0-01-095 | Observer identification |
|  | 0-02-015 | Radiosonde completeness |
|  | 0-02-016 | Radiosonde configuration |
|  | 0-02-017 | Correction algorithms for humidity measurements |
|  | 0-02-066 | Radiosonde ground receiving system |
|  | 0-02-067 | Radiosonde operating frequency |
|  | 0-02-080 | Balloon manufacturer |
|  | 0-02-081 | Type of balloon |
|  | 0-02-082 | Weight of balloon |
|  | 0-02-083 | Type of balloon shelter |
|  | 0-02-084 | Type of gas used in balloon |
|  | 0-02-085 | Amount of gas used in balloon |
|  | 0-02-086 | Balloon flight train length |
|  | 0-02-095 | Type of pressure sensor |
|  | 0-02-096 | Type of temperature sensor |
|  | 0-02-097 | Type of humidity sensor |
|  | 0-02-103 | Radome |
|  | 0-02-191 | Geopotential height calculation |
|  | 0-25-061 | Software identification and version number |
|  | 0-35-035 | Reason for termination |

**~~Add the entry 3 01 128 in BUFR Table D [FT2015-2]~~**

* **2015-5.3(DRMM-III) Clarification of upper-air wind reporting nearby the Poles [ABC2016]** <[para 4.1](#A2016_4_1_bufr)>

1. To amend B/C 20.5.2.5 Regulation as follows:

**B/C 20.5.2.5 Wind direction** **and speed**

The wind direction (0 11 001) shall be reported in degrees true and the wind speed (0 11 002) shall be reported in meters per second (with precision in tenths of a meter per second).

Note:

1. Wind direction measured at a station within 1° of the North Pole or within 1° of the South Pole shall be reported in such a way that the azimuth ring shall be aligned with its zero coinciding with the Greenwich 0° meridian.
2. To amend B/C 25.7.2.8 Regulation as follows:

**B/C 25.7.2.8 Wind direction** **and speed**

The wind direction (0 11 001) shall be reported in degrees true and the wind speed (0 11 002) shall be reported in meters per second (with precision in tenths of a meter per second).

Note:

1. Wind direction measured at a station within 1° of the North Pole or within 1° of the South Pole shall be reported in such a way that the azimuth ring shall be aligned with its zero coinciding with the Greenwich 0° meridian.
2. To amend B/C 26.5.2.8 Regulation as follows:

**B/C 26.5.2.8 Wind direction** **and speed**

The wind direction (0 11 001) shall be reported in degrees true and the wind speed (0 11 002) shall be reported in meters per second (with precision in tenths of a meter per second).

Note:

1. Wind direction measured in sounding originated from a launch site within 1° of the North Pole or within 1° of the South Pole shall be reported in such a way that the azimuth ring shall be aligned with its zero coinciding with the Greenwich 0° meridian.

* **2014-3.2.7(DRMM-II)/BUFR template for n-minute AWS data (3 07 092)** <combined with 2013-3.2.1(DRMM-I)> **[Validation]** <[para 4.1](#A2016_4_1_bufr)>

**Add new entries:**

**BUFR Table D --- Check availability of element descriptors**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | (Temperature and humidity instrumentation) |  |
| 3 01 130 | 0 03 002 | Generic type of humidity instrument |  |
|  | 0 03 003 | Configuration of sensors |  |
|  | 0 03 004 | Type of shield or screen |  |
|  | 0 03 005 | Horizontal width of screen or shield (x) |  |
|  | 0 03 006 | Horizontal depth of screen or shield (y) |  |
|  | 0 03 007 | Vertical height of screen or shield (z) |  |
|  | 0 03 008 | Artificially ventilated screen or shield |  |
|  | 0 03 009 | Amount of forced ventilation at time of reading |  |

**BUFR/CREX Table B --- Check availability of element descriptors**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| F X Y | Element Name | BUFR Units | BUFR Scale | BUFR Ref. | BUFR Width | CREX Units | CREX Scale | CREX Width |
| 0 03 001 | Surface station type | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 03 002 | Generic type of humidity instrument | Code table | 0 | 0 | 4 | Code table | 0 | 2 |
| 0 03 003 | Configuration of sensors | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 03 004 | Type of shield or screen | Code table | 0 | 0 | 5 | Code table | 0 | 2 |
| 0 03 005 | Horizontal width of screen or shield (x) | m | 2 |  |  | m | 2 |  |
| 0 03 006 | Horizontal depth of screen or shield (y) | m | 2 |  |  | m | 2 |  |
| 0 03 007 | Vertical height of screen or shield (z) | m | 2 |  |  | m | 2 |  |
| 0 03 008 | Artificially ventilated screen or shield | Code table | 0 | 0 | 3 | Code table | 0 | 1 |
| 0 03 009 | Amount of forced ventilation at time of reading | m-3 s-1 | 1 |  |  | m-3 s-1 | 1 |  |

**Code tables --- Check availability of code tables**

**0 03 001 Surface station type**

Code figure

0 Land station (synoptic network)

1 Shallow water station (fixed to sea/lake floor)

2 Ship

3 Rig/platform

4 Moored buoy

5 Drifting buoy (or drifter)

6 Ice buoy

7 Land station (local network)

8 Land vehicle

9 Autonomous marine vehicle

10-14 Reserved

15 Missing value

Notes:

(1) The last three categories are for possible future use.

(2) "Land station (local network)" distinguishes "non-synoptic" stations these aren't currently distributed on the GTS but might be stored in BUFR in the future.

(3) There could be separate tables for marine and land stations but there are marginal cases (shallow water fixed stations in the southern North Sea and some rigs reporting in SYNOP code).

**0 03 002 Generic type of humidity instrument**

Code figure

0 Psychrometer [too generic]

1 Capacitive sensor (unheated)

2 Capacitive sensor (heated)

3 Resistive sensor [too generic]

4 Ordinary human hair

5 Rolled hair

6 Goldbeater’s skin

7 Chilled mirror hygrometer

8 Dew cell

9 Optical absorption sensor

10-14 Reserved

15 Missing value

**0 03 003 Configuration of Sensors [already full]**

Code figure

0 Solar radiation shield or screen (double v section louvers)

1 No solar radiation shield or screen

2 Solar radiation shield or screen (single v section louvers)

3 Solar radiation shield or screen (overlapping louvers)

4 Solar radiation shield or screen (non-overlapping louvers)

5 Solar radiation shield or screen (not louvered)

6 Integrated e.g. chilled mirror

7 Missing value

**0 03 004 Type of Shield or Screen [entries need to be checked]**

Code figure

0 Within Stevenson screen (wooden)

1 Within Stevenson screen (plastic)

2 Within marine Stevenson screen (wooden)

3 Within marine Stevenson screen (plastic)

4 Within cylindrical section plate shield (metal)

5 Within cylindrical section plate shield (wooden)

6 Within cylindrical section plate shield (plastic)

7 Within concentric tube (metal)

8 Within concentric tube (wooden)

9 Within concentric tube (plastic)

10 Within rectangular section shield (metal)

11 Within rectangular section shield (wooden)

12 Within rectangular section shield (plastic)

13 Within rectangular section shield (metal)

14 Within square section shield (wooden)

15 Within square section shield (plastic)

16 Within square section shield (metal)

17 Within triangular section shield (wooden)

18 Within triangular section shield (plastic)

19 Within triangular section shield (metal)

20 Within open covered lean-to (reed/grass/leaf)

21 Within open covered inverted v roof (reed/grass/leaf)

22-29 Reserved

30 Not Applicable, e.g. chilled mirror manufacturers enclosure

31 Missing value

**0 03 008 Artificially Ventilated Screen or Shield**

Code figure

0 Natural ventilation in use

1 Artificial aspiration in use: constant flow at time of reading

2 Artificial aspiration in use: variable flow at time of reading

3 -6 Reserved

7 Missing value

**Add a template**:

**BUFR template for surface observations from n-minute period**

**TM 307092**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | National station identification |  |
| 3 01 089 | 0 01 101 | State identifier (1) | Code table, 0 |
|  | 0 01 102 | National station number (1) | Numeric, 0 |
|  |  | **Fixed surface station identification; time, horizontal and vertical co-ordinates** |  |
| **3 01 090** | 3 01 004 | Surface station identification |  |
|  |  | WMO block number | Numeric, 0 |
|  |  | WMO station number | Numeric, 0 |
|  |  | Station or site name | CCITT IA5, 0 |
|  |  | Type of station | Code table, 0 |
|  | 3 01 011 | Year(2) | Year, 0 |
|  |  | Month(2) | Month, 0 |
|  |  | Day(2) | Day, 0 |
|  | 3 01 012 | Hour(2) | Hour, 0 |
|  |  | Minute(2) | Minute, 0 |
|  | 3 01 021 | Latitude (high accuracy) | Degree, 5 |
|  |  | Longitude (high accuracy) | Degree, 5 |
|  | 0 07 030 | Height of station ground above mean sea level | m, 1 |
|  | 0 07 031 | Height of barometer above mean sea level | m, 1 |
| 0 03 001 |  | Surface station type | Code table, 0 |
| 0 08 010 |  | Surface qualifier (for temperature data) | Code table, 0 |
| 3 01 091 |  | Surface station instrumentation |  |
|  | 0 02 180 | Main present weather detecting system | Code table, 0 |
|  | 0 02 181 | Supplementary present weather sensor | Flag table, 0 |
|  | 0 02 182 | Visibility measurement system | Code table, 0 |
|  | 0 02 183 | Cloud detection system | Code table, 0 |
|  | 0 02 184 | Type of lightning detection sensor | Code table, 0 |
|  | 0 02 179 | Type of sky condition algorithm | Code table, 0 |
|  | 0 02 186 | Capability to detect precipitation phenomena | Flag table, 0 |
|  | 0 02 187 | Capability to detect other weather phenomena | Flag table, 0 |
|  | 0 02 188 | Capability to detect obscuration | Flag table, 0 |
|  | 0 02 189 | Capability to discriminate lightning strikes | Flag table, 0 |
| 0 04 015 |  | Time increment (= - n minutes) | Minute, 0 |
| 0 04 065 |  | Short time increment ( = 1 minute) | Minute, 0 |
| 1 33 000 |  | Delayed replication of 33 descriptors |  |
| 0 31 001 |  | Delayed descriptor replication factor (= n) | Numeric, 0 |
| 0 10 004 |  | Pressure | Pa, –1 |
| 1 03 000 |  | Delayed replication of 3 descriptors |  |
| 0 31 001 |  | Delayed descriptor replication factor | Numeric, 0 |
| 3 02 070 |  | Wind data |  |
|  | 0 07 032 | Height of sensor above local ground | m, 2 |
|  | 0 07 033 | Height of sensor above water surface | m, 1 |
|  | 0 11 001 | Wind direction | Degree true, 0 |
|  | 0 11 002 | Wind speed | m s-1, 1 |
|  | 0 11 043 | Maximum wind gust direction | Degree true, 0 |
|  | 0 11 041 | Maximum wind gust speed | m s-1, 1 |
|  | 0 11 016 | Extreme counterclockwise wind direction of a variable wind | Degree true, 0 |
|  | 0 11 017 | Extreme clockwise wind direction of a variable wind | Degree true, 0 |
|  |  | Temperature and humidity instrumentation |  |
| 3 01 130 | 0 03 002 | Generic type of humidity instrument | Code table, 0 |
|  | 0 03 003 | Configuration of sensors | Code table, 0 |
|  | 0 03 004 | Type of Shield or Screen | Code table, 0 |
|  | 0 03 005 | Horizontal Width of Screen or Shield (x) | m, 2 |
|  | 0 03 006 | Horizontal Depth of Screen or Shield (y) | m, 2 |
|  | 0 03 007 | Vertical Height of Screen or Shield (z) | m, 2 |
|  | 0 03 008 | Artificially Ventilated Screen or Shield | Code table, 0 |
|  | 0 03 009 | Degree of Forced Ventilation at time of reading | m-3 s-1, 1 |
|  | 0 33 003 | Quality of humidity measurement | Code table, 0 |
|  |  | Temperature and humidity data |  |
| 3 02 072 | 0 07 032 | Height of sensor above local ground | m, 2 |
|  | 0 07 033 | Height of sensor above water surface | m, 1 |
|  | 0 12 101 | Temperature/Air-temperature (scale 2) | K, 2 |
|  | 0 12 103 | Dew-point temperature (scale 2) | K, 2 |
|  | 0 13 003 | Relative humidity | %, 0 |
| 1 03 000 |  | Delayed replication of 3 descriptors |  |
| 0 31 001 |  | Delayed descriptor replication factor | Numeric, 0 |
| 0 07 032 |  | Height of sensor above local ground(6) | m, 2 |
| 0 08 010 |  | Surface qualifier | Code table, 0 |
| 0 12 120 |  | Ground temperature | K, 2 |
| 0 07 032 |  | Height of sensor above local ground (set to missing to cancel the previous value) | m, 2 |
| 0 08 010 |  | Surface qualifier (set to missing to cancel the previous value) | Code table, 0 |
| 1 03 000 |  | Delayed replication of 3 descriptors |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 1 01 005 |  | Replicate 1 descriptor five times |  |
| 3 07 063 | 0 07 061 | Depth below land surface | m, 2 |
|  | 0 12 130 | Soil temperature (scale 2) | K, 2 |
| 0 07 061 |  | Depth below land surface  (set to missing to cancel the previous value) | m, 2 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 069 |  | Visibility data |  |
|  | 0 07 032 | Height of sensor above local ground | m, 2 |
|  | 0 07 033 | Height of sensor above water surface | m, 1 |
|  | 0 33 041 | Attribute of following value | Code table, 0 |
|  | 0 20 001 | Horizontal visibility | m, –1 |
| 0 07 032 |  | Height of sensor above local ground (set to missing to cancel the previous value) | m, 2 |
| 0 07 033 |  | Height of sensor above water surface  (set to missing to cancel the previous value) | m, 1 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 073 |  | Cloud data |  |
|  | 0 20 010 | Cloud cover (total) | %, 0 |
|  | 1 05 004 | Replicate 5 descriptors four times |  |
|  | 0 08 002 | Vertical significance | Code table, 0 |
|  | 0 20 011 | Cloud amount | Code table, 0 |
|  | 0 20 012 | Cloud type | Code table, 0 |
|  | 0 33 041 | Attribute of following value | Code table, 0 |
|  | 0 20 013 | Height of base of cloud | m, –1 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 076 |  | Precipitation, obscuration and other phenomena |  |
|  | 0 20 021 | Type of precipitation | Flag table, 0 |
|  | 0 20 022 | Character of precipitation | Code table, 0 |
|  | 0 26 020 | Duration of precipitation(3) | Minute, 0 |
|  | 0 20 023 | Other weather phenomena | Flag table, 0 |
|  | 0 20 024 | Intensity of phenomena | Code table, 0 |
|  | 0 20 025 | Obscuration | Flag table, 0 |
|  | 0 20 026 | Character of obscuration | Code table, 0 |
| 1 02 000 |  | Delayed replication of 2 descriptors |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 0 13 155 |  | Intensity of precipitation | kgm-2s-1, 4 |
| 0 13 058 |  | Size of precipitation element | m, 4 |
|  |  | *(end of the replicated sequence)* |  |
| 1 02 000 |  | Delayed replication of 2 descriptors |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 0 20 031 |  | Ice deposit (thickness) | m, 2 |
| 0 20 032 |  | Rate of ice accretion | Code table, 0 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 078 |  | State of ground and snow depth measurement |  |
|  | 0 02 176 | Method of state of ground measurement | Code table, 0 |
|  | 0 20 062 | State of ground (with or without snow) | Code table, 0 |
|  | 0 02 177 | Method of snow depth measurement | Code table, 0 |
|  | 0 13 013 | Total snow depth | m, 2 |
| 1 02 000 |  | Delayed replication of 2 descriptors |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 079 |  | Precipitation measurement |  |
|  | 0 07 032 | Height of sensor above local ground | m, 2 |
|  | 0 02 175 | Method of precipitation measurement | Code table, 0 |
|  | 0 02 178 | Method of liquid water content measurement of  Precipitation | Code table, 0 |
|  | 0 04 025 | Time period (= - n minutes) | Minute, 0 |
|  | 0 13 011 | Total precipitation / total water equivalent of snow | kg m-2, 1 |
| 0 07 032 |  | Height of sensor above local ground (set to missing to cancel the previous value) | m, 2 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 080 |  | Evaporation measurement |  |
|  | 0 02 185 | Method of evaporation measurement | Code table, 0 |
|  | 0 04 025 | Time period or displacement ( = - n minutes) | Minute, 0 |
|  | 0 13 033 | Evaporation /evapotranspiration | kg m-2, 1 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 081 |  | Total sunshine data |  |
|  | 0 04 025 | Time period (= - n minutes) | Minute, 0 |
|  | 0 14 031 | Total sunshine | Minute, 0 |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 082 |  | Radiation data |  |
|  | 0 04 025 | Time period (= - n minutes) | Minute, 0 |
|  | 0 14 002 | Long-wave radiation, integrated over period specified | J m-2, -3 |
|  | 0 14 004 | Short-wave radiation, integrated over period specified | J m-2, -3 |
|  | 0 14 016 | Net radiation, integrated over period specified | J m-2, -4 |
|  | 0 14 028 | Global solar radiation (high accuracy),  integrated over period specified | J m-2, -2 |
|  | 0 14 029 | Diffuse solar radiation (high accuracy),  integrated over period specified | J m-2, -2 |
|  | 0 14 030 | Direct solar radiation (high accuracy),  integrated over period specified | J m-2, -2 |
| 1 02 000 |  | Delayed replication of 2 descriptors |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 0 04 025 |  | Time period (= - n minutes) | Minute |
| 0 13 059 |  | Number of flashes | Numeric |
| 1 01 000 |  | Delayed replication of 1 descriptor |  |
| 0 31 000 |  | Short delayed descriptor replication factor | Numeric, 0 |
| 3 02 083 |  | First order statistics of P, W, T, U data |  |
|  | 0 04 025 | Time period (= - n minutes) | Minute, 0 |
|  | 0 08 023 | First order statistics  (= 9; best estimate of standard deviation) (4) | Code table, 0 |
|  | 0 10 004 | Pressure | Pa, –1 |
|  | 0 11 001 | Wind direction | Degree true, 0 |
|  | 0 11 002 | Wind speed | m s-1, 1 |
|  | 0 12 101 | Temperature/air temperature (scale 2) | K, 2 |
|  | 0 13 003 | Relative humidity | %, 0 |
|  | 0 08 023 | First order statistics (= missing value) | Code table, 0 |
| 0 33 005 |  | Quality information (AWS data) | Flag table, 0 |
| 0 33 006 |  | Internal measurement status information (AWS) | Code table, 0 |

**Notes:**

(1) 0 01 101 (WMO Member State identifier) and 0 01 102 (National AWS number) shall be used to identify a station within the national numbering system that is completely independent of the WMO international numbering system. The WMO international identification 0 01 001 (WMO block number) and 0 01 002 (WMO station number) shall be reported if available for the particular station.

(2) The time identification refers to the end of the n-minute period.

(3) Duration of precipitation (in minutes) represents number of minutes in which any precipitation was registered.

(4) Best estimate of standard deviation is counted out of a set of samples (signal measurements) recorded within the period specified; it should be reported as a missing value, if the measurements of the relevant element are not available from a part of the period specified by 0 04 025.

(5) If reporting nominal values is required, the template shall be supplemented with 3 07 093.

(6) The height above local ground 0 07 032 referring to ground temperature shall be considered as a variable. After a snowfall, the sensor is placed at the top of the snow layer and the changed value of 0 07 032 shall indicate this procedure (total snow depth is reported in 0 13 013).

* **2014-3.2.9(DRMM-II)/Proposed BUFR sequence for reporting observations from offshore platforms [Validation]** <[para 4.1](#A2016_4_1_bufr)>

**Add new entries:**

BUFR/CREX Table B

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table reference | | | Element name | BUFR | | | | CREX | | |
| F | XX | YYY | Unit | Scale | Ref. value | Data width (bits) | Units | Scale | Data width (characters) |
| 0 | 02 | 008 | Type of offshore platform | Code table | 0 | 0 | 4 | Code table | 0 | 2 |

Editorial note: this descriptor may be replaced by 0 03 001.

BUFR Table D

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | (Sequence for platform identification, type, time and location of the observation report) | |
| **3 01 056** | 0 01 087 | WMO marine observing platform extended identifier | WMO number (extended 7 digit identifier) |
|  | 0 01 011 | Ship or mobile land station identifier | Call sign (where allocated) |
|  | 0 01 015 | Station or site name | Platform name |
|  | 0 02 008 | Type of offshore platform |  |
|  | 0 02 001 | Type of station |  |
|  | 3 01 011 | Year, month, day |  |
|  | 3 01 012 | Hour, minute |  |
|  | 3 01 021 | Latitude/longitude (high accuracy) |  |
|  | 0 07 030 | Height of station ground above mean sea level | Height of station platform above mean sea level |
|  | 0 07 031 | Height of barometer above mean sea level |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | (Sequence for reporting observations from offshore platforms) | |
| **3 08 017** | 3 01 056 | Sequence for platform identification, type, time and location of the observation report |  |
|  | 3 02 001 | Pressure and 3-hour pressure change |  |
| 3 02 052 | Ship temperature and humidity data |  |
| 1 01 000 | Delayed replication of 1 descriptor |  |
| 0 31 000 | Short delayed descriptor replication factor |  |
| 3 02 056 | Sea/water temperature | Optional |
| 3 02 064 | Ship wind data (see Note) |  |
| 3 02 053 | Ship visibility data |  |
| 1 01 000 | Delayed replication of 1 descriptor |  |
| 0 31 000 | Short delayed descriptor replication factor |  |
| 3 02 004 | General cloud information | Optional |
| 1 01 000 | Delayed replication of 1 descriptor |  |
| 0 31 000 | Short delayed descriptor replication factor |  |
| 3 02 005 | Cloud layer | Optional |
| 1 01 000 | Delayed replication of 1 descriptor |  |
| 0 31 000 | Short delayed descriptor replication factor |  |
| 3 02 038 | Present and past weather | Optional |
| 1 01 000 | Delayed replication of 1 descriptor |  |
| 0 31 000 | Short delayed descriptor replication factor |  |
| 3 06 039 | Sequence for representation of basic wave measurements | Optional |

Note: Sequence 3 02 064 has previously been approved for validation and is also used in the sequence for synoptic reports from sea stations suitable for VOS data.

**Add new code tables:**

**0 02 008**

**Type of offshore platform**

|  |  |
| --- | --- |
| **Code figure** | **Meaning** |
| 0 | Fixed platform |
| 1 | Mobile offshore drill ship |
| 2 | Jack-up rig |
| 3 | Semi-submersible platform |
| 4 | FPSO (floating production storage and offloading unit) |
| 5 | Light vessel |
| 6 – 14 | Reserved |
| 15 | Missing value (or not known)  ["or not known" to be separated from missing value] |

* **2014-11.2(DRMM-II)/WIGOS Station Identifier [FT2017-1]** <[para 4.1](#A2016_4_1_bufr)>

**Add entries in BUFR/CREX Table B.**

**Class 01 – BUFR/CREX Identification**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | BUFR | | | | CREX | | |
| TABLE |  |  |  |  | DATA |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH | UNIT | SCALE | WIDTH |
| F X Y |  |  |  | VALUE | (Bits) |  |  | (Characters) |
| 0 01 125 | WIGOSIdentifier Series | Numeric | 0 | 0 | 4 | Numeric | 0 | 2 |
| 0 01 126 | WIGOS Issuer of Identifier | Numeric | 0 | 0 | 16 | Numeric | 0 | 5 |
| 0 01 127 | WIGOS Issue Number | Numeric | 0 | 0 | 16 | Numeric | 0 | 5 |
| 0 01 128 | WIGOS Local Identifier (Character) | CCITT IA5 | 0 | 0 | 128 | Character | 0 | 16 |

**Add entries in BUFR/CREX Table D.**

**Category 01 – Location and identification sequences**

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  | (WIGOS Identifier) |  |
| 3 01 150 | 0 01 125 | WIGOS Identifier Series |  |
|  | 0 01 126 | WIGOS Issuer of Identifier |  |
|  | 0 01 127 | WIGOS Issue Number |  |
|  | 0 01 128 | WIGOS Local Identifier (Character) |  |

* **2013-3.2.2(DRMM-I)/**[**Proposal for a BUFR template for radar wind profiler**](https://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRMM_Tokyo2013/Documents/IPETDRMM-I_Doc3-2_2_RWP_BUFR_r2.doc) **[FT2017-1]** <[para 4.1](#A2016_4_1_bufr)>

**Add templates**:

Radar Wind Profiler Data Sequence:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | TABLE  REFERENCES | TABLE  REFERENCES | ELEMENT NAME |
| 3 09 021 |  |  |  | RWP Wind data (product data) NEW |
|  | 3 01 001 |  |  | WMO block and station numbers |
|  |  | 0 01 001 |  | WMO Block Number |
|  |  | 0 01 002 |  | WMO Station Number |
|  | 0 05 001 |  |  | Latitude (high accuracy) |
|  | 0 06 001 |  |  | Longitude (high accuracy) |
|  | 0 07 030 |  |  | Height of station ground above mean sea level |
|  | 3 01 014 |  |  | Time period |
|  |  | 1 02 002 |  | Replicate 2 descriptors 2 times |
|  |  | 3 01 011 |  | Year, month, day |
|  |  |  | 0 04 001 | Year |
|  |  |  | 0 04 002 | Month |
|  |  |  | 0 04 003 | Day |
|  |  | 3 01 012 |  | Hour, minute |
|  |  |  | 0 04 004 | Hour |
|  |  |  | 0 04 005 | Minute |
|  | 0 02 003 |  |  | Type of measuring equipment used |
|  | 0 02 121 |  |  | Mean frequency (see note a) |
|  | 1 12 000 |  |  | Delayed replication of 12 descriptors |
|  | 0 31 001 |  |  | Delayed descriptor replication factor |
|  | 0 07 007 |  |  | Height |
|  | 3 01 021 |  |  | Latitude/longitude (high accuracy) |
|  |  | 0 05 001 |  | Latitude (high accuracy) |
|  |  | 0 06 001 |  | Longitude (high accuracy) |
|  | 0 11 003 |  |  | u-component |
|  | 0 11 110 |  |  | Uncertainty in u-component NEW |
|  | 0 11 004 |  |  | v-component |
|  | 0 11 111 |  |  | Uncertainty in v-component NEW |
|  | 0 33 002 |  |  | Quality information |
|  | 0 11 006 |  |  | w-component |
|  | 0 11 112 |  |  | Uncertainty in w-component NEW |
|  | 0 33 002 |  |  | Quality information |
|  | 0 10 071 |  |  | Vertical resolution NEW |
|  | 0 27 079 |  |  | Horizontal width of sampled volume NEW |

RASS Data Sequence:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | TABLE  REFERENCES | TABLE  REFERENCES | ELEMENT NAME |
| 3 09 022 |  |  |  | RASS virtual temperature (product data) NEW |
|  | 3 01 001 |  |  | WMO block and station numbers |
|  |  | 0 01 001 |  | WMO Block Number |
|  |  | 0 01 002 |  | WMO Station Number |
|  | 0 05 001 |  |  | Latitude (high accuracy) |
|  | 0 06 001 |  |  | Longitude (high accuracy) |
|  | 0 07 030 |  |  | Height of station ground above mean sea level |
|  | 3 01 014 |  |  | Time period |
|  |  | 1 02 002 |  | Replicate 2 descriptors 2 times |
|  |  | 3 01 011 |  | Year, month, day |
|  |  |  | 0 04 001 | Year |
|  |  |  | 0 04 002 | Month |
|  |  |  | 0 04 003 | Day |
|  |  | 3 01 012 |  | Hour, minute |
|  |  |  | 0 04 004 | Hour |
|  |  |  | 0 04 005 | Minute |
|  | 0 02 003 |  |  | Type of measuring Equipment used |
|  | 0 02 121 |  |  | Mean frequency (see note a) |
|  | 1 10 000 |  |  | Delayed replication of 10 descriptors |
|  | 0 31 001 |  |  | Delayed descriptor replication factor |
|  | 0 07 007 |  |  | Height |
|  | 3 01 021 |  |  | Latitude/longitude (high accuracy) |
|  |  | 0 05 001 |  | Latitude (high accuracy) |
|  |  | 0 06 001 |  | Longitude (high accuracy) |
|  | 0 12 007 |  |  | Virtual temperature |
|  | 0 12 008 |  |  | Uncertainty in virtual temperature NEW |
|  | 0 33 002 |  |  | Quality information |
|  | 0 11 006 |  |  | w-component |
|  | 0 11 112 |  |  | Uncertainty in w-component NEW |
|  | 0 33 002 |  |  | Quality information |
|  | 0 10 071 |  |  | Vertical resolution NEW |
|  | 0 27 079 |  |  | Horizontal width of sampled volume NEW |

Add descriptors:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | BUFR | | | | CREX | | |
| TABLE |  |  |  |  | DATA |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH | UNIT | SCALE | WIDTH |
| F\* X Y |  |  |  | VALUE | (Bits) |  |  | (Characters) |
| 0 11 110 | Uncertainty in u-component | m s-1 | 1 | -4096 | 13 | m s-1 | 1 | 4 |
| 0 11 111 | Uncertainty in v-component | m s-1 | 1 | -4096 | 13 | m s-1 | 1 | 4 |
| 0 11 112 | Uncertainty in w-component | m s-1 | 2 | -4096 | 13 | m s-1 | 2 | 4 |
| 0 12 008 | Uncertainty in virtual temperature | K | 1 | 0 | 12 | C | 1 | 4 |

* **2013-3.2.4(DRMM-I)/**[**Satellite-derived winds in BUFR**](https://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-DRMM_Tokyo2013/Documents/IPETDRMM-I_Doc3-2_4_SatelliteWind.docx) **[Validation]** <[para 4.1](#A2016_4_1_bufr)>

**Add an entry:**

|  |  |  |
| --- | --- | --- |
|  |  | (Satellite-derived winds) |
| **3 10 067** | 0 01 007 | Satellite identifier |
|  | 0 01 033 | Identification of originating/generating centre |
|  | 0 01 034 | Identification of originating/generating sub-centre |
|  | 0 02 019 | Satellite instruments |
|  | 0 02 020 | Satellite classification |
|  | 3 01 011 | Year, month, day |
|  | 3 01 012 | Hour, minute |
|  | 2 07 003 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 04 006 | Second |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | 3 01 021 | Latitude~~, L~~/longitude (high accuracy) |
|  | 0 07 024 | Satellite zenith angle |
|  | 0 02 153 | Satellite channel centre frequency |
|  | 0 02 014 | Tracking technique/status of system used |
|  | 0 02 023 | Satellite derived wind computation method |
|  | 0 08 072 | Pixel(s) type (target type) |
|  | 0 02 028 | Segment size at nadir in ~~X~~ x-direction (target scene width) |
|  | 0 02 029 | Segment size at nadir in ~~Y~~ y-direction (target scene height) |
|  | 0 04 025 | Time period or displacement (in minutes) |
|  | 0 10 004 | Pressure |
|  | 0 12 101 | Temperature/air temperature |
|  | 2 07 002 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 001 | Wind direction |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | 0 33 007 | Per cent confidence (for wind direction) |
|  | 2 07 001 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 002 | Wind speed |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | 0 33 007 | Per cent confidence (for wind speed) |
|  | 0 08 041 | Data significance (14 = Expected error) |
|  | 0 11 002 | Wind speed |
|  | 0 08 041 | Data significance (15 = Representative error) |
|  | 0 10 004 | Pressure |
|  | 0 12 101 | Temperature/air temperature |
|  | 0 08 041 | Data significance (Missing = Cancel) |
|  | 0 08 021 | Time significance (4 = Forecast) |
|  | 0 04 004 | Hour |
|  | 0 04 005 | Minute |
|  | 0 04 006 | Second |
|  | 2 07 002 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 001 | Wind direction |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | 2 07 001 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 002 | Wind speed |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | 0 08 021 | Time significance (28 = Start of scan) |
|  | 0 04 004 | Hour |
|  | 0 04 005 | Minute |
|  | 0 04 006 | Second |
|  | 3 01 021 | Latitude~~, L~~/longitude (high accuracy) |
|  | 2 07 001 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 003 | u-component |
|  | 0 11 004 | v-component |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | ~~0 11 110~~  0 11 113 | Tracking correlation of vector |
|  | 0 08 023 | First order statistics (10 = Standard deviation) |
|  | 0 11 002 | Wind speed |
|  | 0 08 023 | First order statistics (Missing = Cancel) |
|  | 0 25 147 | Size of largest cluster (in pixels) |
|  | 0 08 021 | Time significance (29 = End of scan or time of ending) |
|  | 0 04 004 | Hour |
|  | 0 04 005 | Minute |
|  | 0 04 006 | Second |
|  | 3 01 021 | Latitude~~, L~~/longitude (high accuracy) |
|  | 2 07 001 | Increase scale, reference value and ~~bit~~ data width |
|  | 0 11 003 | u-component |
|  | 0 11 004 | v-component |
|  | 2 07 000 | Cancel increase scale, reference value and ~~bit~~ data width |
|  | ~~0 11 110~~  0 11 113 | Tracking correlation of vector |
|  | 0 08 023 | First order statistics (10 = Standard deviation) |
|  | 0 11 002 | Wind speed |
|  | 0 08 023 | First order statistics (Missing = Cancel) |
|  | 0 25 147 | Size of largest cluster (in pixels) |
|  | 0 08 021 | Time significance (Missing = Cancel) |
|  | 0 04 004 | Hour |
|  | 0 04 005 | Minute |
|  | 0 04 006 | Second |
|  | 0 08 003 | Vertical significance (satellite observations) (2=Cloud top) |
|  | 0 08 023 | First order statistics (2=Maximum value) |
|  | 0 10 004 | Pressure (Maximum cloud top pressure in target scene) |
|  | 0 12 101 | Temperature/air temperature (Maximum cloud top temperature in target scene) |
|  | 0 08 023 | First order statistics (3=Minimum value) |
|  | 0 10 004 | Pressure (Minimum cloud top pressure in target scene) |
|  | 0 12 101 | Temperature/air temperature (Minimum cloud top temperature in target scene) |
|  | 0 08 023 | First order statistics (10 = Standard deviation) |
|  | 0 10 004 | Pressure (Standard deviation of cloud top pressure in target scene) |
|  | 0 08 023 | First order statistics (Missing = Cancel) |
|  | 0 08 003 | Vertical significance (satellite observations) (Missing = Cancel) |
|  | 0 20 056 | Cloud phase (Dominant cloud phase of target scene) |
|  | 0 12 133 | NWP vertical temperature gradient (+/- 200hpa about pressure assignment of tracer) |
|  | ~~0 11 111~~  0 11 114 | NWP vertical wind shear (+/- 200hpa about pressure assignment of tracer) |
|  | 0 12 134 | Low-level inversion flag |

**Add entries:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **F X Y** | Element name | BUFR Unit | BUFR Scale | BUFR Refval | BUFR Bits | CREX Unit | CREX Scale | CREX Bytes |
| ~~0 11 110~~  0 11 113 | Tracking correlation of vector | Numeric | 3 | -1000 | 12 | Numeric | 3 | 4 |
| ~~0 11 111~~  0 11 114 | NWP vertical wind shear (+/- 200hPa about pressure assignment of tracer) | m/s | 2 | -8192 | 14 | m/s | 2 | 5 |
| 0 12 133 | NWP vertical termperature gradient (+/- 200hPa about pressure assignment of tracer) | K | 2 | 0 | 16 | C | 2 | 4 |
| 0 12 134 | Low-level inversion flag | Code table | 0 | 0 | 2 | Code table | 0 | 1 |
| 0 25 147 | Size of largest cluster (in pixels) | Numeric | 0 | 0 | 10 | Numeric | 0 | 4 |

**Add entries:**

**Code table 0 02 014/Common Code table C-7 (Tracking technique/status of system used)**

71 Nested tracking disabled

**Code table 0 20 056 (Cloud phase)**

5 Supercooled liquid water

**Code table 0 08 041 (Data significance)**

14 Expected error

15 Representative error

**0 12 134 – Low-level inversion flag**

|  |  |
| --- | --- |
| Code figure | DESCRIPTION |
| 0 | No inversion |
| 1 | Inversion |
| 2 | Reserved |
| 3 | Missing value |