|  |  |  |
| --- | --- | --- |
| WORLD METEOROLOGICAL ORGANIZATIONCOMMISSION FOR BASIC SYSTEMS-----------------------------THIRD MEETING OFINTER-PROGRAMME EXPERT TEAM ONCODES MAINTENANCEMARRAKECH, MOROCCO, 15 - 19 APRIL 2019 |  | IPET-CM-III / Doc. 2.2(8)11.04.2019-------------------------ITEM 2.2ENGLISH ONLY |

MANUAL ON CODES: TABLE-DRIVEN CODE FORMS

FM 92 GRIB

New GRIB2 parameters and templates for atmospheric composition modelling

*Submitted by Sébastien Villaume (ECMWF)*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Summary and Purpose of Document**

This document describes 2 alternatives for encoding new parameters in atmospheric composition modelling.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ACTION PROPOSED**

The team is requested to review the 2 proposed alternatives and approve one of them for implementation within the May 2019 fast-track (FT2019-2) update to the WMO Manual on Codes.

**ANNEXES:**

 1. (Title of annex)

**DISCUSSIONS**

Recent developments in atmospheric composition modelling includes the partitioning of the traditional modelled processes into contributions of several source sectors: biogenic and anthropogenic sources, natural events, etc.

One of the next steps to be taken at ECMWF will be the partitioning of the emission fluxes per sources as shown in the “option 1” of the proposal section below. The solution is relatively straightforward but it has the disadvantage to quickly fill the available entries in the Code table 4.2, discipline 0, category 20.

Considering that it is likely that the number of partitioned processes (emission, mass mixing ratio, etc.) and the number of sources will continue to grow, it is probably safer to use a new set of templates that introduces the possibility to specify a source and a new table containing the sources (see option 2 below).

We also propose that the new code table 4.238 could also be used to host “sinks” or chemical/physical processes. For instance, the vegetation can be considered as a source or a sink of chemical species, i.e. absorb/release dioxygen, carbon dioxide, etc.

The pair of entries from code table 4.2 and 4.238 will make clear if we are associating a source or sink: emissions will be associate with sources, sedimentations with sinks, etc.

**PROPOSAL**

**Option 1**

#### **Code table 4.2, Product discipline 0 –Meteorological products, parameter category 20: atmospheric chemical constituents**

**ADD** the following entries (in red)

|  |  |  |
| --- | --- | --- |
| Code | Name | Units |
| 76 |  Emission rate from aviation |  kg kg-1 s-1 |
| 77 |  Emission rate from lightning |  kg kg-1 s-1 |
| 78 |  Surface emission flux from biogenic sources |  kg m-2 s-1 |
| 79 |  Surface emission flux from anthropogenic sources |  kg m-2 s-1 |
| 80 |  Surface emission flux from wild fires |  kg m-2 s-1 |
| 81 |  Surface emission flux from natural sources |  kg m-2 s-1 |
| 82 |  Surface emission flux from volcanoes |  kg m-2 s-1 |
| 83 |  Surface emission flux from bio-fuel |  kg m-2 s-1 |
| 84 |  Surface emission flux from fossil-fuel |  kg m-2 s-1 |
| 85 |  Surface emission flux from wetlands |  kg m-2 s-1 |
| 86 |  Surface emission flux from oceans |  kg m-2 s-1 |
| 87-99 | Reserved |  |

**option 2**

#### **Code table 4.2, Product discipline 0 –Meteorological products, parameter category 20: atmospheric chemical constituents**

**ADD** the following entries (in red)

|  |  |  |
| --- | --- | --- |
| Code | Name | Units |
| 76 |  Emission  |  kg kg-1 s-1 |
| 77 |  Surface emission flux |  kg m-2 s-1 |
| 78-99 | Reserved |  |

#### **Code table 4.238 - source, sink or chemical/physical process**

|  |  |
| --- | --- |
| Code | Name |
| 0 | Reserved |
| 1 | aviation |
| 2 | lightning |
| 3 | biogenic sources |
| 4 | anthropogenic sources |
| 5 | wild fires |
| 6 | natural sources |
| 7 | volcanoes |
| 8 | bio-fuel |
| 9 | fossil-fuel |
| 10 | wetlands |
| 11 | oceans |
| 12-191 | Reserved |
| 192-254 | Reserved for local use |
| 255 | Missing |

The templates below are derived from the existing templates for chemical constituents and aerosols templates. They all have an extra octet (octet 14) to specify the source/sink defined in the Code Table 4.238.

*Product definition template 4.76 – analysis or forecast at a horizontal level or in a horizontal
 layer at a point in time for atmospheric chemical constituents*

Octet No. Contents

 10 Parameter category (see Code table 4.1)

 11 Parameter number (see Code table 4.2)

 12–13 Atmospheric chemical constituent type (see Code table 4.230)

 14 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of generating process (see Code table 4.3)

 16 Background generating process identifier (defined by originating centre)

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

 18–19 Hours of observational data cut-off after reference time (see Note)

 20 Minutes of observational data cut-off after reference time

 21 Indicator of unit of time range (see Code table 4.4)

 22–25 Forecast time in units defined by octet 20

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

 27 Scale factor of first fixed surface

 28–31 Scaled value of first fixed surface

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

 33 Scale factor of second fixed surface

 34–37 Scaled value of second fixed surface

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

*Product definition template 4.77 – individual ensemble forecast, control and perturbed, at a**horizontal level or in a horizontal layer at a point in time for**atmospheric chemical constituents*

Octet No. Contents

 10 Parameter category (see Code table 4.1)

 11 Parameter number (see Code table 4.2)

 12–13 Atmospheric chemical constituent type (see Code table 4.230)

 14 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of generating process (see Code table 4.3)

 16 Background generating process identifier (defined by originating centre)

 17 Forecast generating process identifier (defined by originating centre)

 18–19 Hours after reference time of data cut-off (see Note)

 20 Minutes after reference time of data cut-off

 21 Indicator of unit of time range (see Code table 4.4)

 22–25 Forecast time in units defined by octet 20

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

 27 Scale factor of first fixed surface

 28–31 Scaled value of first fixed surface

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

 33 Scale factor of second fixed surface

 34–37 Scaled value of second fixed surface

 38 Type of ensemble forecast (see Code table 4.6)

 39 Perturbation number

 40 Number of forecasts in ensemble

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

*Product definition template 4.78 – average, accumulation, and/or extreme values or other statis-**tically processed values at a horizontal level or in a horizontal**layer in a continuous or non-continuous time interval for**atmospheric chemical constituents*

Octet No. Contents

 10 Parameter category (see Code table 4.1)

 11 Parameter number (see Code table 4.2)

 12–13 Atmospheric chemical constituent type (see Code table 4.230)

 14 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of generating process (see Code table 4.3)

 16 Background generating process identifier (defined by originating centre)

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

 18–19 Hours after reference time of data cut-off (see Note 1)

 20 Minutes after reference time of data cut-off

 21 Indicator of unit of time range (see Code table 4.4)

 22–25 Forecast time in units defined by octet 20 (see Note 2)

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

 27 Scale factor of first fixed surface

 28–31 Scaled value of first fixed surface

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

 33 Scale factor of second fixed surface

 34–37 Scaled value of second fixed surface

 38–39 Year

 40 Month

 41 Day

 42 Hour

 43 Minute

 44 Second

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

 46–49 Total number of data values missing in statistical process

 *50–61 Specification of the outermost (or only) time range over which statistical*
 *processing is done*

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

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

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

 53–56 Length of the time range over which statistical processing is done, in units defined by the
 previous octet

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

 58–61 Time increment between successive fields, in units defined by the previous octet (see
 Notes 3 and 4)

 *62–nn These octets are included only if n > 1, where nn = 49 + 12 x n*

 62–73 As octets 50 to 61, next innermost step of processing

 74–nn Additional time range specifications, included in accordance with the value of n. Contents
 as octets 50 to 61, repeated as necessary

Notes:

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

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

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

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 51, 63, 75, …). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast times.

*Product definition template 4.79 – individual ensemble forecast, control and perturbed, at a
 horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents*

Octet No. Contents

 10 Parameter category (see Code table 4.1)

 11 Parameter number (see Code table 4.2)

 12–13 Atmospheric chemical constituent type (see Code table 4.230)

 14 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of generating process (see Code table 4.3)

 16 Background generating process identifier (defined by originating centre)

 17 Forecast generating process identifier (defined by originating centre)

 18–19 Hours after reference time of data cut-off (see Note 1)

 20 Minutes after reference time of data cut-off

 21 Indicator of unit of time range (see Code table 4.4)

 22–25 Forecast time in units defined by octet 20 (see Note 2)

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

 27 Scale factor of first fixed surface

 28–31 Scaled value of first fixed surface

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

 33 Scale factor of second fixed surface

 34–37 Scaled value of second fixed surface

 38 Type of ensemble forecast (see Code table 4.6)

 39 Perturbation number

 40 Number of forecasts in ensemble

 41–42 Year of end of overall time interval

 43 Month of end of overall time interval

 44 Day of end of overall time interval

 45 Hour of end of overall time interval

 46 Minute of end of overall time interval

 47 Second of end of overall time interval

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

 49–52 Total number of data values missing in statistical process

 *53–64 Specification of the outermost (or only) time range over which statistical*
 *processing is done*

 53 Statistical process used to calculate the processed field from the field at each time incre-
 ment during the time range (see Code table 4.10)

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

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

 56–59 Length of the time range over which statistical processing is done, in units defined by the
 previous octet

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

 61–64 Time increment between successive fields, in units defined by the previous octet (see
 Notes 3 and 4)

 *65–nn These octets are included only if n > 1, where nn = 52 + 12 x n*

 65–76 As octets 53 to 64, next innermost step of processing

 77–nn Additional time range specifications, included in accordance with the value of n. Contents
 as octets 53 to 64, repeated as necessary

Notes:

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

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

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

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 54, 66, 78, …). 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 4.80 – analysis or forecast 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 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of interval for first and second size (see Code table 4.91)

 16 Scale factor of first size

 17–20 Scaled value of first size in metres

 21 Scale factor of second size

 22–25 Scaled value of second size in metres

 26 Type of interval for first and second wavelength (see Code table 4.91)

 27 Scale factor of first wavelength

 28–31 Scaled value of first wavelength in metres

 32 Scale factor of second wavelength

 33–36 Scaled value of second wavelength in metres

 37 Type of generating process (see Code table 4.3)

 38 Background generating process identifier (defined by originating centre)

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

 40–41 Hours of observational data cut-off after reference time (see Note)

 42 Minutes of observational data cut-off after reference time

 43 Indicator of unit of time range (see Code table 4.4)

 44–47 Forecast time in units defined by octet 42

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

 49 Scale factor of first fixed surface

 50–53 Scaled value of first fixed surface

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

 55 Scale factor of second fixed surface

 56–59 Scaled value of second fixed surface

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

*Product definition template 4.81 – 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 source, sink or chemical/physical process (see Code table 4.238)

 15 Type of interval for first and second size (see Code table 4.91)

 16 Scale factor of first size

 17–20 Scaled value of first size in metres

 21 Scale factor of second size

 22–25 Scaled value of second size in metres

 26 Type of interval for first and second wavelength (see Code table 4.91)

 27 Scale factor of first wavelength

 28–31 Scaled value of first wavelength in metres

 32 Scale factor of second wavelength

 33–36 Scaled value of second wavelength in metres

 37 Type of generating process (see Code table 4.3)

 38 Background generating process identifier (defined by originating centre)

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

 40–41 Hours of observational data cut-off after reference time (see Note)

 42 Minutes of observational data cut-off after reference time

 43 Indicator of unit of time range (see Code table 4.4)

 44–47 Forecast time in units defined by octet 42

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

 49 Scale factor of first fixed surface

 50–53 Scaled value of first fixed surface

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

 55 Scale factor of second fixed surface

 56–59 Scaled value of second fixed surface

 60 Type of ensemble forecast (see Code table 4.6)

 61 Perturbation number

 62 Number of forecasts in ensemble

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

*Product definition template 4.82 – average, accumulation, and/or extreme values or other*
*statistically processed values at a horizontal level or in a*
*horizontal layer in a continuous or non-continuous time*
*interval for aerosol*

Octet No.Contents

10Parameter category (see Code table 4.1)

11Parameter number (see Code table 4.2)

12–13Aerosol type (see Code table 4.233)

14source,sink or chemical/physical process (see Code table 2.238)

15Type of interval for first and second sizes (see Code table 4.91)

16Scale factor of first size

17–20Scaled value of first size in metres

21Scale factor of second size

22–25Scaled value of second size in metres

26Type of generating process (see Code table 4.3)

27Background generating process identifier (defined by originating centre)

28Analysis or forecast generating process identifier (defined by originating centre)

29–30Hours after reference time of data cut-off (see Note 1)

31Minutes after reference time of data cut-off

32Indicator of unit of time range (see Code table 4.4)

33–36Forecast time in units defined by octet 31 (see Note 2)

37Type of first fixed surface (see Code table 4.5)

38Scale factor of first fixed surface

39–42Scaled value of first fixed surface

43Type of second fixed surface (see Code table 4.5)

44Scale factor of second fixed surface

45–48Scaled value of second fixed surface

49–50Year

51Month

52Day

53Hour

54Minute

55Second

56n – number of time range specifications describing the time intervals used to calculate
the statistically processed field

57–60Total number of data values missing in statistical process

*61–72 Specification of the outermost (or only) time range over which statistical*
 *processing is done*

61Statistical process used to calculate the processed field from the field at each
time increment during the time range (see Code table 4.10)

62Type of time increment between successive fields used in the statistical
processing (see Code table 4.11)

63Indicator of unit of time for time range over which statistical processing is done
(see Code table 4.4)

64–67Length of the time range over which statistical processing is done, in units defined
by the previous octet

68Indicator of unit of time for the increment between the successive fields used (see
 Code table 4.4)

69–72Time increment between successive fields, in units defined by the previous octet
(see Notes 3 and 4)

*73–nn These octets are included only if n > 1, where nn = 60 + 12 x n*

73–84As octets 61 to 72, next innermost step of processing

85–nnAdditional time range specifications, included in accordance with the value of n.
Contents as octets 61 to 72, repeated as necessary

Notes:

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

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

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

(4)The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 62, 74, ...). 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 4.83 – individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for aerosol*

Octet No.Contents

10Parameter category (see Code table 4.1)

11Parameter number (see Code table 4.2)

12–13Aerosol type (see Code table 4.233)

14source, sink or chemical/physical process (see Code table 4.238)

15Type of interval for first and second sizes (see Code table 4.91)

16Scale factor of first size

17–20Scaled value of first size in metres

21Scale factor of second size

22–25Scaled value of second size in metres

26Background generating process identifier (defined by originating centre)

27Forecast generating process identifier (defined by originating centre)

28–29Hours after reference time of data cut-off (see Note 1)

30Minutes after reference time of data cut-off

31Indicator of unit of time range (see Code table 4.4)

32–35Forecast time in units defined by octet 31 (see Note 2)

36Type of first fixed surface (see Code table 4.5)

37Scale factor of first fixed surface

38–41Scaled value of first fixed surface

42Type of second fixed surface (see Code table 4.5)

43Scale factor of second fixed surface

44–47Scaled value of second fixed surface

48Type of ensemble forecast (see Code table 4.6)

49Perturbation number

50Number of forecasts in ensemble

51–52Year of end of overall time interval

53Month of end of overall time interval

54Day of end of overall time interval

55Hour of end of overall time interval

56Minute of end of overall time interval

57Second of end of overall time interval

58n – number of time range specifications describing the time intervals used to
calculate the statistically processed field

59–62Total number of data values missing in statistical process

*63–74 Specification of the outermost (or only) time range over which statistical*
 *processing is done*

63Statistical process used to calculate the processed field from the field at each
time increment during the time range (see Code table 4.10)

64Type of time increment between successive fields used in the statistical
processing (see Code table 4.11)

65Indicator of unit of time for time range over which statistical processing is done
(see Code table 4.4)

66–69Length of the time range over which statistical processing is done, in units defined
by the previous octet

70Indicator of unit of time for the increment between the successive fields used (see
Code table 4.4)

71–74Time increment between successive fields, in units defined by the previous octet
(see Notes 3 and 4)

*75–nn These octets are included only if n > 1, where nn = 62 + 12 x n*

75–86As octets 63 to 74, next innermost step of processing

87–nnAdditional time range specifications, included in accordance with the value of n.
Contents as octets 63 to 74, repeated as necessary

Notes:

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

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

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

(4)The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 63, 75, ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast times.