WMO CODE FORM CHANGES

(Submitted by WMO)

Summary and purpose of document

There will be a meeting of the Expert Team on Evolution of Data Formats in Monterey, California, USA 4-9 October 1999. The following documents are input for discussion at the Monterey meeting and are included as information for CGMS Members who will not be attending the meeting.

ACTION PROPOSED

The meeting is invited to note the information contained in this document.

Appendices:

A. Aspects o a Standard Data Format For Exchange of Pixel Based Satellite Products

B. Representation Of Quikscat Scatterometer Data In BUFR

C. Representation Of Geostationary Satellite Radiance Data In BUFR

D. Satellite Derived Wind Computation Method In BUFRr

ASPECTS OF A STANDARD DATA FORMAT FOR EXCHANGE OF PIXEL BASED SATELLITE PRODUCTS

(Submitted by EUMETSAT)

Summary and Purpose of Document

There is a move towards satellite products being generated at increasingly higher resolution, even to the extent of pixel based products. This document describes some of the aspects of the use of the existing WMO binary data representation forms for the exchange of these high resolution satellite products. The requirements of an appropriate code form are identified, and the advantages and disadvantages of the existing forms are discussed. Finally, some potential modifications to the existing code forms, which would facilitate their use for satellite products, are described.

Action Proposed

The meeting is invited to consider the issues raised in this document, and to propose an appropriate method for the representation of high resolution satellite products. If changes to the existing code forms are necessary, the meeting is invited to prepare a suitable proposal for CBS.

Introduction

1. This paper concerns the choice of an appropriate code form for the representation of satellite products.

2. A typical satellite product contains data from a number of processing segments, each containing many pixels, and each considered as a separate, independent observation. Each observation typically contains many elements (100+), containing information about the generating center, spacecraft, location, time, computation method, quality control (critical) ... However, as the processing segments get smaller, the BUFR data begins to contain a vast number of observations. If one considers the case of a pixel based cloud mask or albedo product, then the choice of code form becomes unclear. BUFR can still be used, but the number of bulletins required becomes large and the memory requirements for encoding and decoding the data become significant. It is clear that GRIB can be used for satellite image data. GRIB2 might offer an alternative for such high resolution satellite products, if it is defined appropriately.

3. The data representation form used to represent this type of data needs to be able to handle irregularly spaced data with multiple parameter values per observation. It needs to allow the use of associated values such as quality control data as a addendum. It should also support efficient compression and be widely adopted by both the data provider and user communities.

Advantages of GRIB

4. GRIB was designed for gridded field type data, where a few parameters occur at every grid point of a clearly defined grid. It allows for efficient compression of data, and many centers are experienced in decoding and encoding GRIB. Furthermore, it is clear that GRIB can be and is used for storing satellite image data, as in MARS at ECMWF, although this relies on the use of the optional section 2.

Disadvantages of GRIB

5. Some of the short comings of GRIB Edition 1 for encoding satellite derived products have been identified in the report of the Expert Team on the Development of Edition 2 of WMO GRIB Code (Silver Spring, USA, 2-5 December 1997). The principle points can be summarized as follows:

- Lack of multiple parameters.

Satellite products have many elements per observation (typically100+) and this would require 100+ GRIB messages to hold the product. This is of course possible, but is unwieldy.

- Lack of missing values.

The coverage of satellite products typically has many data void regions, such as the gaps which would be present in a clear sky radiance product in cloud filled regions. There is no way to represent missing values in the current GRIB edition.

- No scope for associated values.

There is no way to append associated data, such as quality control information or statistical information, to the data in a GRIB message later in the processing.

- No WMO standard.

The fact that there is no standard WMO format for the representation of satellite imagery products in itself leads to a proliferation of various formats and practices being adopted by different centers.

Advantages of BUFR

6. BUFR is already in use for satellite products and is the *de facto* standard for new satellite products. BUFR is able to handle many elements to each observation and does not need these observations on any particular grid. The use of associated data such as quality control information and statistics is fully supported.

Disadvantages of BUFR

7. Each pixel or segment is treated as a separate observation (or subset) and so many subsets are needed. The section 3 descriptor allows only 2 octets to store the number of subsets, hence only 65,535 subsets can be stored per BUFR message. Since a typical albedo product[†], for instance, would contain about 6,000,000 pixels, something like 100 BUFR messages would be required per product. This limit is important because it goes some way towards imposing a constraint on how much memory would be required to decode and encode data. It can, however, be circumvented, by defining each subset to contain repeated sets of observations from multiple pixels. Although this means there would be less overhead in the number of bulletins required, each bulletin would require more memory for encoding and decoding, as described in the following paragraph.

8. The commonly used software BUFREX from ECMWF allocates memory based on Total number of elements = the number of descriptors per subset * the number of subsets. Then 4 bytes are allocated per element into which the decoded information can be written. The use of Fortran and therefore static memory management means that a worst case, maximum chunk of memory must be set aside for decoding. Considering the example of the albedo data, we have 65,535 subsets, each with 30 elements, meaning a total of 1,966,050 elements, requiring about 7.8 Mb of memory to be available. If the clear sky radiance were produced at pixel resolution, then each subset would have 246 elements, meaning a total of 16,121,610 elements, requiring about 64.5 Mb of memory.

Potential for GRIB 2

9. The report of the Expert Team on the Development of Edition 2 of WMO GRIB Code clearly identified functional requirements of GRIB2, in order to make it widely applicable and to some extent “future proof”. If these are met by GRIB2, and the short comings of GRIB edition 1 discussed above are addressed, then GRIB2 could be the appropriate solution for representing satellite data.

Recommendation and Conclusion

10. The most important goal is the definition of a standard format for the representation of satellite products, especially those at a high resolution.

11. The most pragmatic approach would seem to be the modification of the definition of BUFR to this end. This might be achieved by introducing a new section containing data and descriptors, which are valid for all subsets in the bulletin, for example. Although this would not effect the size of the compressed data significantly, it would make a decoder with less demanding memory requirements easier to make. A constraint on memory could also be

[†] Tables 1, 2 and 3 show the details of the descriptors used locally by Eumetsat to encode the Surface Albedo product in BUFR. Table 1 contains the expanded descriptor list, as per Section 3. Table 2 contains the local code tables, which were introduced. Table 3 defines the local BUFR Table B entries which were introduced.

achieved by limiting the product of the number of subsets and the number of expanded descriptors per subset in BUFR. The problems of memory usage can, to a certain extent, be mitigated by the use of dynamic memory management in the application software. Although this does not solve the problem, it does mean that no more memory than that which is actually required is allocated to the process.

12. A second possibility is the modification of the definition of GRIB2 where necessary to meet the needs of the type of data in question. This may prove to be the least invasive approach, since GRIB2 is still not formally settled. The main issues are those of the irregular spacing of data, and of multiple parameter values per grid point.

13. A third possibility is the development and use of an entirely new code form for the representation of segmented and pixel based satellite derived products. Although this would be a significant undertaking, it would provide the opportunity to define a bespoke code form, fully able of handle the data. It would also remove the need to modify the definitions of BUFR or GRIB2.

Table 1: Sequence of BUFR Table B entries used for Meteosat Surface Albedo product

Table B entry	*Data element encoded*
001007	METEOSAT ID
001031	GENERATING CENTRE
002020	331
004001	YEAR OF START
004043	DAY OF START
004001	YEAR OF END
004043	DAY OF END
004004	PRODUCT TIME HR
004005	PRODUCT TIME MIN
004006	PRODUCT TIME SEC
049001	NUMBER OF PRODUCTS
004043	ACTUAL NUMBER OF DAYS
049002	SOFTWARE VERSION
049003	SOFTWARE PATCH LEVEL
049004	DAILY INTEGRATED DHR
049005	DIRECTIONAL HEMISPHERICAL REFLECTANCE
049006	OVERALL PRODUCT QUALITY FLAG
049007	NUMBER OF SOLUTIONS
049008	NUMBER OF INPUT SLOTS
049009	SURFACE INDEX PARAMETER
049010	ATMOSPHERIC OPTICAL INDEX
049011	SURFACE REFLECTIVITY INTENSITY
049012	STANDARD DEVIATION OF R0
049013	STANDARD DEVIATION OF R0 DURING ACCUMULATION PERIOD
049014	NUMBER OF DAYS AVAILABLE TO DERIVE THE PRODUCT
049015	BEST DAY OF THE TIME ACCUMULATION PERIOD
049016	COST OF THE ATMOSPHERIC SCATTERING MODEL
049017	COST OF THE DATA CONSISTENCY MODEL
005001	LATITUDE
006001	LONGITUDE

Table 2: Local Code Tables Used To Encode Meteosat Surface Albedo Product

```
049006 0005 0000 01 OKAY
            0001 01 NO VALID DAYS IN THE PERIOD
            0002 01 NO VALID SAMPLES IN THE PERIOD
            0003 01 NO LIKELY DAY
            0007 01 MISSING VALUE

049007 0009 0000 01 NUMBER OF SOLUTIONS 0
            0001 01 NUMBER OF SOLUTIONS 1 TO 4
            0002 01 NUMBER OF SOLUTIONS 5 TO 8
            0003 01 NUMBER OF SOLUTIONS 9 TO 12
            0004 01 NUMBER OF SOLUTIONS 13 TO 20
            0005 01 NUMBER OF SOLUTIONS 21 TO 30
            0006 01 NUMBER OF SOLUTIONS 31 TO 40
            0007 01 NUMBER OF SOLUTIONS 41 AND MORE
            0015 01 MISSING VALUE

049008 0009 0000 01 INPUT SLOTS 0
            0001 01 INPUT SLOTS 11 OR LESS
            0002 01 INPUT SLOTS 12 TO 13
            0003 01 INPUT SLOTS 14 TO 15
            0004 01 INPUT SLOTS 16 TO 17
            0005 01 INPUT SLOTS 18 TO 19
            0006 01 INPUT SLOTS 20 TO 21
            0007 01 INPUT SLOTS 22 OR MORE
            0015 01 MISSING VALUE

049009 0016 0000 01 R0HS 0.15 / THETA -0.20 / K 0.60
            0001 01 R0HS 0.15 / THETA -0.20 / K 0.70
            0002 01 R0HS 0.15 / THETA -0.20 / K 0.80
            0003 01 R0HS 0.15 / THETA -0.20 / K 0.90
            0004 01 R0HS 0.15 / THETA -0.20 / K 1.00
            0005 01 R0HS 0.15 / THETA -0.10 / K 0.60
            0006 01 R0HS 0.15 / THETA -0.10 / K 0.70
            0007 01 R0HS 0.15 / THETA -0.10 / K 0.80
            0008 01 R0HS 0.15 / THETA -0.10 / K 0.90
            0009 01 R0HS 0.15 / THETA -0.10 / K 1.00
            0010 01 R0HS 0.15 / THETA  0.00 / K 0.60
            0011 01 R0HS 0.15 / THETA  0.00 / K 0.70
            0012 01 R0HS 0.15 / THETA  0.00 / K 0.80
            0013 01 R0HS 0.15 / THETA  0.00 / K 0.90
            0014 01 R0HS 0.15 / THETA  0.00 / K 1.00
            0031 01 MISSING VALUE

049010 0005 0000 01 ATMOSPHERIC OPTICAL INDEX 0.2
            0001 01 ATMOSPHERIC OPTICAL INDEX 0.4
            0002 01 ATMOSPHERIC OPTICAL INDEX 0.6
            0003 01 ATMOSPHERIC OPTICAL INDEX 1.0
            0007 01 MISSING VALUE
```

Table 3: Local Table B entries used for Meteosat Surface Albedo product

Table B entry	*Description*	*Type*	*S*	*O*	*W*
049001	MSA - NUMBER OF PRODUCTS	NUMERIC	0	0	24
049002	MSA – VERSION	NUMERIC	0	0	10
049003	MSA - PATCH LEVEL	NUMERIC	0	0	7
049004	MSA - DAILY INTEGRATED DHR	NUMERIC	3	0	10
049005	MSA - DIRECTIONAL HEMISPHERICAL REFLECTANCE	NUMERIC	3	0	10
049006	MSA - OVERALL PRODUCT QUALITY FLAG	CODE TABLE	0	0	3
049007	MSA - NUMBER OF SOLUTIONS	CODE TABLE	0	0	4
049008	MSA - NUMBER OF INPUT SLOTS	CODE TABLE	0	0	4
049009	MSA - SURFACE INDEX PARAMETER	CODE TABLE	0	0	5
049010	MSA - ATMOSPHERIC OPTICAL INDEX	CODE TABLE	0	0	3
049011	MSA - SURFACE REFLECTIVITY INTENSITY	NUMERIC	3	0	10
049012	MSA - STANDARD DEVIATION OF R0	NUMERIC	3	0	10
049013	MSA - STANDARD DEVIATION OF R0 DURING ACCUMULATION PERIOD	NUMERIC	3	0	10
049014	MSA - NUMBER OF DAYS AVAILABLE TO DERIVE THE PRODUCT	NUMERIC	0	0	5
049015	MSA - BEST DAY OF THE TIME ACCUMULATION PERIOD	NUMERIC	0	0	5
049016	MSA - COST OF THE ATMOSPHERIC SCATTERING MODEL	NUMERIC	3	0	10
049017	MSA - COST OF THE DATA CONSISTENCY MODEL	NUMERIC	3	0	10

REPRESENTATION OF QUIKSCAT SCATTEROMETER DATA IN BUFR

(Submitted by ECMWF)

Summary and Purpose of Document

NASA's QuikScat ocean-viewing satellite was launched on 19 June 1999 and has a scatterometer radar instrument to be used in mapping winds over the ocean. This document introduces the additional table entries required to encode the data in BUFR.

Action proposed

The meeting is invited to consider the sample template and prepare a proposal for approval by CBS.

PROPOSAL

Firstly, the QuikScat satellite needs to have a number allocated to it in the COMMON CODE TABLE C-5, Satellite identifier 281 is proposed as it is the number being used in the development of software and test data.

The QuikScat data should be represented with one Table D entry: 312026

These are the sequences needed for BUFR Table D:

```
312026  301046
        301011
        301013
        301023
        312031
        101004
        312030
        021110
        301023
        321027
        021111
        301023
        321027
        021112
        301023
        321027
        021113
        301023
        321027

301046  001007
        001012
        002048
        021119
        025060
        202124
        002026
        002027
        202000
        005040

312030  201130
        202129
        011012
        202000
        201000
        011052
        201135
        202130
        011011
        202000
        201000
        011053
        021104
```

312031	005034
	006034
	021109
	011081
	011082
	021101
	021102
	021103
321027	021118
	202129
	201132
	002112
	201000
	201131
	002111
	201000
	202000
	002104
	021105
	021106
	021107
	021114
	021115
	021116
	008018
	021117

Table B new entries required

005034	ALONG TRACK ROW NUMBER	NUMERIC	0	0	11
006034	CROSS TRACK CELL NUMBER	NUMERIC	0	0	7
008018	SEAWINDS LAND/ICE SURFACE TYPE	FLAG TABLE	0	0	17
011052	FORMAL UNCERTAINTY IN WIND SPEED	M/S	2	0	14
011053	FORMAL UNCERTAINTY IN WIND DIRECTION	DEGREE TRUE	2	0	15
011081	MODEL WIND DIRECTION AT 10 M	DEGREE TRUE	2	0	16
011082	MODEL WIND SPEED AT 10 M	M/S	2	0	13
021101	NUMBER OF VECTOR AMBIGUITIES	NUMERIC	0	0	3
021102	INDEX OF SELECTED WIND VECTOR	NUMERIC	0	0	3
021103	TOTAL NUMBER OF SIGMA-0 MEASUREMENTS	NUMERIC	0	0	5
021104	LIKELIHOOD COMPUTED FOR SOLUTION	NUMERIC	3	-30000	15
021105	NORMALIZED RADAR CROSS SECTION	dB	2	-10000	14
021106	Kp VARIANCE COEFFICIENT (ALPHA)	NUMERIC	3	0	14
021107	Kp VARIANCE COEFFICIENT (BETA)	NUMERIC	8	0	16
021109	SEAWINDS WIND VECTOR CELL QUALITY	FLAG TABLE	0	0	17
021110	NUMBER OF INNER-BEAM SIGMA-0 (FORWARD OF SATELLITE)	NUMERIC	0	0	6
021111	NUMBER OF OUTER-BEAM	NUMERIC	0	0	6

	SIGMA-0 (FORWARD OF SATELLITE)				
021112	NUMBER OF INNER-BEAM SIGMA-0 (AFT OF SATELLITE)	NUMERIC	0	0	6
021113	NUMBER OF OUTER-BEAM SIGMA-0 (AFT OF SATELLITE)	NUMERIC	0	0	6
021114	Kp VARIANCE COEFFICIENT (GAMMA)	dB	3	-140000	18
021115	SEAWINDS SIGMA-0 QUALITY	FLAG TABLE	0	0	17
021116	SEAWINDS SIGMA-0 MODE	FLAG TABLE	0	0	17
021117	SIGMA-0 VARIANCE QUALITY CONTROL	NUMERIC	2	0	16
021118	ATTENUATION CORRECTION ON SIGMA-0	dB	2	-10000	14
021119	WIND SCATTEROMETER GEOPHYSICAL MODEL FUNCTION	CODE TABLE	0	0	6

New entries in existing Code Table 002048: Satellite sensor indicator

Add two new entries:

Code figure	Meaning
7	NSCAT
8	SEA WINDS

Flag Table 008018

Bit number	Meaning
1	LAND IS PRESENT
2	SURFACE ICE MAP INDICATES ICE IS PRESENT
3-10	RESERVED
11	ICE MAP DATA NOT AVAILABLE
12	ATTENUATION MAP DATA NOT AVAILABLE
13-16	RESERVED
All 17	MISSING VALUE

Flag Table 021109

Bit number	Meaning
1	NOT ENOUGH GOOD SIGMA-0 AVAILABLE FOR WIND RETRIEVAL
2	POOR AZIMUTH DIVERSITY AMONG SIGMA0- FOR WIND RETRIEVAL
3-7	RESERVED
8	SOME PORTION OF WIND VECTOR CELL IS OVER LAND
9	SOME PORTION OF WIND VECTOR CELL IS OVER ICE
10	WIND RETRIEVAL NOT PERFORMED FOR WIND VECTOR CELL
11	REPORTED WIND SPEED IS GREATER THAN 30 M/S
12	REPORTED WIND SPEED IS LESS THAN OR EQUAL TO 3 M/S
13-16	RESERVED
ALL 17	MISSING VALUE

Flag Table 021115

Bit number	Meaning
1	SIGMA-0 MEASUREMENT IS NOT USABLE

2	SIGNAL TO NOISE RATIO IS LOW
3	SIGMA-0 IS NEGATIVE
4	SIGMA-0 IS OUTSIDE OF ACCEPTABLE RANGE
5	SCATTEROMETER PULSE QUALITY IS NOT ACCEPTABLE
6	SIGMA-0 CELL LOCATION ALGORITHM DOES NOT CONVERGE
7	FREQUENCY SHIFT LIES BEYOND THE RANGE OF THE X FACTOR TABLE
8	SPACECRAFT TEMPERATURE IS BEYOND CALIBRATION COEFFICIENT RANGE
9	NO APPLICABLE ATITUDE RECORDS WERE FOUND FOR THIS SIGMA-0
10	INTERPOLATED IPHEMEORIS DATA ARE NOT ACCEPTABLE FOR THIS SIGMA-0
11-16	RESERVED
All 17	MISSING VALUE

Flag Table 021116

Bit number	Meaning
1	CALIBRATION/MEASUREMENT PULSE FLAG (1)
2	CALIBRATION/MEASUREMENT PULSE FLAG (2)
3	OUTER ANTENNA BEAM
4	SIGMA-0 CELL IS AFT OF SPACECRAFT
5	CURRENT MODE (1)
6	CURRENT MODE (2)
7	EFFECTIVE GATE WIDTH - SLICE RESOLUTION (1)
8	EFFECTIVE GATE WIDTH - SLICE RESOLUTION (2)
9	EFFECTIVE GATE WIDTH - SLICE RESOLUTION (3)
10	LOW RESOLUTION MODE - WHOLE PULSE DATA
11	SCATTEROMETER ELECTRONIC SUBSYSTEM B
12	ALTERNATE SPIN RATE - 19.8 RPM
13	RECEIVER PROTECTION ON
14	SLICES PER COMPOSITE FLAG(1)
15	SLICES PER COMPOSITE FLAG(2)
16	SLICES PER COMPOSITE FLAG(3)
ALL 17	MISSING VALUE

Code Table 021119

Code figure	Meaning
0	RESERVED
1	SASS
2	SASS2
3	NSCAT0
4	NSCAT1
5	NSCAT2
6	QSCAT0
7	QSCAT1
8 -30	RESERVED
31	CMOD1
32	CMOD2
33	CMOD3
34	CMOD4
35	CMOD5
36-63	RESERVED
64	MISSING VALUE

Data descriptors (unexpanded)

1 312026

Data descriptors (expanded)

		Element name	Unit	
1	001007	SATELLITE IDENTIFIER	CODE TABLE	1007
2	001012	DIRECTION OF MOTION OF MOVING OBSERVING	DEGREE TRUE	
3	002048	SATELLITE SENSOR INDICATOR	CODE TABLE	2048
4	021119	WIND SCATTEROMETER GEOPHYSICAL MODEL FUN	CODE TABLE	21119
5	025060	SOFTWARE INDENTIFICATION	NUMERIC	
6	002026	CROSS TRACK RESOLUTION	M	
7	002027	ALONG TRACK RESOLUTION	M	
8	005040	ORBIT NUMBER	NUMERIC	
9	004001	YEAR	YEAR	
10	004002	MONTH	MONTH	
11	004003	DAY	DAY	
12	004004	HOUR	HOUR	
13	004005	MINUTE	MINUTE	
14	004006	SECOND	SECOND	
15	005002	LATITUDE (COARSE ACCURACY)	DEGREE	
16	006002	LONGITUDE (COARSE ACCURACY)	DEGREE	
17	005034	ALONG TRACK ROW NUMBER	NUMERIC	
18	006034	CROSS TRACK CELL NUMBER	NUMERIC	
19	021109	SEAWINDS WIND VECTOR CELL QUALITY	FLAG TABLE	21109
20	011081	MODEL WIND DIRECTION AT 10 M	DEGREE TRUE	
21	011082	MODEL WIND SPEED AT 10 M	M/S	
22	021101	NUMBER OF VECTOR AMBIGUITIES	NUMERIC	
23	021102	INDEX OF SELECTED WIND VECTOR	NUMERIC	
24	021103	TOTAL NUMBER OF SIGMA-0 MEASUREMENTS	NUMERIC	
25	011012	WIND SPEED AT 10 M	M/S	
26	011052	FORMAL UNCERTAINTY IN WIND SPEED	M/S	
27	011011	WIND DIRECTION AT 10 M	DEGREE TRUE	

28	011053	FORMAL UNCERTAINTY IN WIND DIRECTION	DEGREE TRUE	
29	021104	LIKELIHOOD COMPUTED FOR WIND SOLUTION	NUMERIC	
30	011012	WIND SPEED AT 10 M	M/S	
31	011052	FORMAL UNCERTAINTY IN WIND SPEED	M/S	
32	011011	WIND DIRECTION AT 10 M	DEGREE TRUE	
33	011053	FORMAL UNCERTAINTY IN WIND DIRECTION	DEGREE TRUE	
34	021104	LIKELIHOOD COMPUTED FOR WIND SOLUTION	NUMERIC	
35	011012	WIND SPEED AT 10 M	M/S	
36	011052	FORMAL UNCERTAINTY IN WIND SPEED	M/S	
37	011011	WIND DIRECTION AT 10 M	DEGREE TRUE	
38	011053	FORMAL UNCERTAINTY IN WIND DIRECTION	DEGREE TRUE	
39	021104	LIKELIHOOD COMPUTED FOR WIND SOLUTION	NUMERIC	
40	011012	WIND SPEED AT 10 M	M/S	
41	011052	FORMAL UNCERTAINTY IN WIND SPEED	M/S	
42	011011	WIND DIRECTION AT 10 M	DEGREE TRUE	
43	011053	FORMAL UNCERTAINTY IN WIND DIRECTION	DEGREE TRUE	
44	021104	LIKELIHOOD COMPUTED FOR WIND SOLUTION	NUMERIC	
45	021110	NUMBER OF INNER-BEAM SIGMA-0 (FORWARD OF	NUMERIC	
46	005002	LATITUDE (COARSE ACCURACY)	DEGREE	
47	006002	LONGITUDE (COARSE ACCURACY)	DEGREE	
48	021118	ATTENUATION CORRECTION ON SIGMA-0	dB	
49	002112	RADAR LOOK ANGLE	DEGREE	
50	002111	RADAR INCIDENCE ANGLE	DEGREE	
51	002104	ANTENNA POLARISATION	CODE TABLE	2104
52	021105	NORMALIZED RADAR CROSS SECTION	dB	
53	021106	Kp VARIANCE COEFFICIENT (ALPHA)	NUMERIC	
54	021107	Kp VARIANCE COEFFICIENT (BETA)	NUMERIC	
55	021114	Kp VARIANCE COEFFICIENT (GAMMA)	dB	
56	021115	SEAWINDS SIGMA-0 QUALITY	FLAG TABLE	21115
57	021116	SEAWINDS SIGMA-0 MODE	FLAG TABLE	21116
58	008018	SEAWINDS LAND/ICE SURFACE TYPE	FLAG TABLE	8018
59	021117	SIGMA-0 VARIANCE QUALITY CONTROL	NUMERIC	
60	021111	NUMBER OF OUTER-BEAM SIGMA-0 (FORWARD OF	NUMERIC	
61	005002	LATITUDE (COARSE ACCURACY)	DEGREE	
62	006002	LONGITUDE (COARSE ACCURACY)	DEGREE	
63	021118	ATTENUATION CORRECTION ON SIGMA-0	dB	
64	002112	RADAR LOOK ANGLE	DEGREE	
65	002111	RADAR INCIDENCE ANGLE	DEGREE	
66	002104	ANTENNA POLARISATION	CODE TABLE	2104
67	021105	NORMALIZED RADAR CROSS SECTION	dB	
68	021106	Kp VARIANCE COEFFICIENT (ALPHA)	NUMERIC	
69	021107	Kp VARIANCE COEFFICIENT (BETA)	NUMERIC	
70	021114	Kp VARIANCE COEFFICIENT (GAMMA)	dB	
71	021115	SEAWINDS SIGMA-0 QUALITY	FLAG TABLE	21115
72	021116	SEAWINDS SIGMA-0 MODE	FLAG TABLE	21116
73	008018	SEAWINDS LAND/ICE SURFACE TYPE	FLAG TABLE	8018
74	021117	SIGMA-0 VARIANCE QUALITY CONTROL	NUMERIC	
75	021112	NUMBER OF INNER-BEAM SIGMA-0 (AFT OF SAT	NUMERIC	
76	005002	LATITUDE (COARSE ACCURACY)	DEGREE	
77	006002	LONGITUDE (COARSE ACCURACY)	DEGREE	
78	021118	ATTENUATION CORRECTION ON SIGMA-0	dB	
79	002112	RADAR LOOK ANGLE	DEGREE	
80	002111	RADAR INCIDENCE ANGLE	DEGREE	
81	002104	ANTENNA POLARISATION	CODE TABLE	2104
82	021105	NORMALIZED RADAR CROSS SECTION	dB	
83	021106	Kp VARIANCE COEFFICIENT (ALPHA)	NUMERIC	
84	021107	Kp VARIANCE COEFFICIENT (BETA)	NUMERIC	
85	021114	Kp VARIANCE COEFFICIENT (GAMMA)	dB	
86	021115	SEAWINDS SIGMA-0 QUALITY	FLAG TABLE	21115
87	021116	SEAWINDS SIGMA-0 MODE	FLAG TABLE	21116
88	008018	SEAWINDS LAND/ICE SURFACE TYPE	FLAG TABLE	8018

89	021117	SIGMA-0 VARIANCE QUALITY CONTROL	NUMERIC	
90	021113	NUMBER OF OUTER-BEAM SIGMA-0 (AFT OF SAT	NUMERIC	
91	005002	LATITUDE (COARSE ACCURACY)	DEGREE	
92	006002	LONGITUDE (COARSE ACCURACY)	DEGREE	
93	021118	ATTENUATION CORRECTION ON SIGMA-0	dB	
94	002112	RADAR LOOK ANGLE	DEGREE	
95	002111	RADAR INCIDENCE ANGLE	DEGREE	
96	002104	ANTENNA POLARISATION	CODE TABLE	2104
97	021105	NORMALIZED RADAR CROSS SECTION	dB	
98	021106	Kp VARIANCE COEFFICIENT (ALPHA)	NUMERIC	
99	021107	Kp VARIANCE COEFFICIENT (BETA)	NUMERIC	
100	021114	Kp VARIANCE COEFFICIENT (GAMMA)	dB	
101	021115	SEAWINDS SIGMA-0 QUALITY	FLAG TABLE	21115
102	021116	SEAWINDS SIGMA-0 MODE	FLAG TABLE	21116
103	008018	SEAWINDS LAND/ICE SURFACE TYPE	FLAG TABLE	8018
104	021117	SIGMA-0 VARIANCE QUALITY CONTROL	NUMERIC	

REPRESENTATION OF GEOSTATIONARY SATELLITE RADIANCE DATA IN BUFR

(Submitted by EUMETSAT)

Summary and Purpose of Document

A number of requirements for EUMETSAT's new radiance products and future Meteosat Second Generation radiance products have been identified. This document introduces the additional table entries required to encode the data in BUFR.

Action proposed

The meeting is invited to consider the proposed template and prepare a proposal for approval by CBS.

PROPOSAL

EUMETSAT currently generates radiance data from its Meteosat 5 and Meteosat 7 spacecraft. These data should be represented with a Table D entry (310015). A similar Table D entry is also required to represent the equivalent radiance data from the Meteosat Second Generation (MSG) spacecraft (310016). The MSG radiance data will come from more spectral channels and so will a slightly different Table D entry.

The proposed Table B entries for radiance spectral radiance (012075) and radiance (012076) will make the existing wrongly defined entry for radiance, 012072, redundant. Although 012072 is defined called ‘radiance’ its units are actually those of a spectral radiance. The scale factor for 012072 is in any case not sufficient for spectral radiance data.

The radiance data from Meteosat 5 and 7 have been exchanged between EUMETSAT and ECMWF since January 1999 on the GTS, using the descriptors given.

These are the sequences needed for BUFR Table D:

Meteosat radiance data

```
310015  301072
        007024
        010002
        303041
        101003
        304032
        002152
        002024
        007004
        007004
        013003
        101003
        304033
```

Meteosat Second Generation (MSG) radiance data

```
310016  301072
        007024
        010002
        303041
        101012
        304032
        002152
        002024
        007004
        007004
        013003
        101012
        304033
```

Cloud fraction

```
304032  002153
        002154
        020081
        020082
        020012
```

Clear sky radiance

```
304033  002152
        002166
        002167
        002153
        002154
        012075
        012076
        012063
```

Table B new entries required

012075	SPECTRAL RADIANCE	W/M**2*STER*M**(-1)	10	0	31
012076	RADIANCE	W/M**2*STER	3	0	16

SATELLITE DERIVED WIND COMPUTATION METHOD IN BUFR

(Submitted by EUMETSAT)

Summary and Purpose of Document

The descriptions of the BUFR code table entries for satellite derived wind computation method are unclear for winds observed in the water vapour channel. This paper describes a potential update to the code table to resolve this situation.

Action proposed

The meeting is invited to consider the proposed modifications to the code table, and prepare a proposal for approval by CBS.

PROPOSAL

The water vapour channel can be used to compute satellite derived winds both in cloudy regions and in clear sky regions. For this reason, separate code figures were required for the following three cases:

- Wind derived from cloud motion observed in the water vapour channel
- Wind derived from motion observed in the water vapour channel in clear air
- Wind derived from motion observed in water vapour channel (cloudy or clear air not specified)

The BUFR code table for Satellite Derived Wind Computation Method, 002023, currently contains the following entries concerning water vapour winds:

Code Figure	Description
3	Wind derived from motion observed in the water vapour channel
5	Wind derived from motion observed in the water vapour channel in clear air
7	Wind derived from cloud motion observed in water vapour channel (cloudy or clear air not specified)

There are two problems with the descriptive text as it is. Firstly, the meaning of code figure 3 is ambiguous. Is it to be used for water vapour motion observed in cloudy air, clear air, or could it be used for both? Secondly the use of the word “cloud” in the description of code figure 7 is inconsistent with the parenthesis. There can not be cloud motion in clear air.

In an attempt to work around this ambiguity, EUMETSAT use the “not used” code figure 0 to mean “Wind derived from cloud motion observed in the water vapour channel”. This is clearly not a satisfactory situation.

The following measures are suggested as a means to clarify the use of the code table:

1. Deprecate code figure 3.
2. Clarify the description of code figure 7 to say “Wind derived from motion observed in water vapour channel (cloudy or clear air not specified)”.
3. Add a new code figure, 8, to the table to be defined as “Wind derived from cloud motion observed in the water vapour channel”.