CGMS-XXXIV
WMO WP-8
Prepared by WMO
Agenda item: II/7

WMO CODE FORMS CHANGES

(Submitted by WMO)

Summary and purpose of document

This document explains the last additions to satellite data GRIB 2 and BUFR codes recommended by the CBS/Expert Team on Data Representation and Codes and to be approved by the next extraordinary session of CBS in November 2006 CBS for their immediate experimental use and with a view to their full operational implementation on 7 November 2007. It also contains a proposed set of additions for GHRSST data but these are still awaiting full validation.

ACTION PROPOSED

The Meeting is invited to take note of the information contained in this document and express any suggestion, remarks or request found necessary in the field of WMO Codes Forms used for exchange of satellite data.

Appendices: A. Additional GRIB 2 and BUFR Code Table entries for Satellite Data to be approved by CBS Ext. 06
B. New Allocated BUFR Entries for GHRSST Data awaiting Validation

References:

1. Meeting of the Expert Team on Data Representation and Codes (ET/DR&C) Muscat, Oman, 5-8 December 2005
2. Report of the joint Meeting of the Expert Team on Data Representation and Codes and Coordination Team of Migration to Table Driven Code Forms, Montreal 8-12 May 2006
3. WMO pub. No. 306, Manual on Codes, Volume I.2.

DISCUSSION

1. GRIB Edition 2

1.1 Additional Code table entries for METEOSAT data

In response to evolving user requirements, EUMETSAT had implemented two new products encoded in GRIB for fire detection and clear sky radiance data. EUMETSAT made a proposal for official code table entries to allow the standardization of the data representation.

1.2 Report on experimental and operational exchanges of fields in GRIB2

In order to make its data readily accessible to its users, EUMETSAT had decided that all image type products would be encoded in GRIB Edition 2 (GRIB2). A range of products was generated, and these were available variously via the EUMETCast DVB multicast service, via download from EUMETSAT's web site, via anonymous FTP and via offline delivery from EUMETSAT's archive.

When complex packing was used, the encoding was performed using NCEP's C GRIB2 encoding library available from NOAA's web site (http://www.nco.ncep.noaa.gov/pmb/docs/grib2/). This software packed the data very efficiently, but required enormous amounts of memory for encoding and decoding satellite data. When simple packing was sufficient, EUMETSAT's own software was used for the encoding.

EUMETSAT delivers products in GRIB2 format: Cloud Mask (CLM), Cloud Top Height (CTH), Cloud Analysis Image (CLAI), Clear Sky Reflectance Map (CRM), Multi Sensor Precipitation Estimate (MPE), Fire Detection Product (FIR). These products are described in detail in Annex to this paragraph. Some of the products use bit-maps and some do not. Some use complex packing and 3rd party software and some use simple packing. Some products are available via EUMETCast, and some via the Internet.

There had been considerable interest in these products. It had often been necessary to provide software for decoding the data. Some users were satisfied with simple product specific decoding examples, and others had been directed towards generic decoding software.

The Expert Team congratulated the EUMETSAT representative for this achievement.

2. Additions to BUFR

2.1 Issue of master table for satellite data

The Expert Team on Codes discussed the issue of making a new master table for satellite data. Three main problems were identified: the management of the new Master table, the respect of BUFR regulations, especially for additions, and the implementation of the process. Starting new Master Table would require some coordination and commitment from the parties concerned.

Whether the requirements for representing new satellite data in BUFR were met by the introduction of a new BUFR Master Table or by the allocation of specific classes of descriptors, the co-ordination of this process would be simplified by the involvement of an independent group of experts, in this case such a group could be a Working Group of CGMS.

2.2 Additional satellite identifiers

The Expert Team recommended the allocation of new entries in the Common Code Table C-5: Satellite identifier, as listed in Appendix A.

2.3 Additional Code table entry for satellite data

At present code figure 13 is reserved in the Height Assignment Method code table, 0-02-163. All other entries in the table are defined. The Team agreed to recommend the use of code figure 13 to represent the " IR / two WV channel ratioing method " as listed in Appendix A.

2.4 Additional entries for polar satellite data

The successful launch of NOAA 18 marked the start of the Initial Joint Polar System (IJPS), being operated by NOAA and EUMETSAT. On NOAA 18, the AMSU-B instrument previously in the ATOVS package has been replaced by MHS (the Mircowave Humidity Sounder), supplied by EUMETSAT. Within the context of the IJPS, EUMETSAT plans to launch the first of its polar spacecraft, METOP 2, in June 2006. In addition to EUMETSAT's instruments: GRAS (a radio occultation sounder), GOME2 (a high resolution spectrometer), IASI (a hyperspectral sounder), ASCAT (a scatterometer), and MHS, the spacecraft will also have AVHRR, AMSU-A and HIRS instruments from the USA.

Data from AMSU-A, MHS, HIRS, IASI, GRAS and ASCAT will be exchanged in BUFR. In order to represent data from the new instruments, new BUFR element descriptors, sequence descriptors, and code and flag table entries required. The Team agreed to recommend these entries. The Team insisted, however, that unclear abbreviations be replaced or supplemented by understandable names. The additions are found in Appendix B.

2.5 Exchange of SAREP data in BUFR

JMA has been producing tropical cyclone information in FM85 SAREP, which is derived from Japanese geostationary satellite. These products are being exchanged between the members of TC for disaster prevention and mitigation activities according to the Typhoon Committee Operational Manual, Meteorological Component (Report No. TCP-23). In accordance with the approval at the 37th Session of TC (Shanghai, China, Nov. 2004), BUFR templates for SAREP data were drafted by JMA with necessary descriptors and code tables. Validation tests were carried out with the kind help of ECMWF and successfully completed. Distribution of tropical cyclone information in BUFR from JMA started in November 2005.

ADDITIONAL GRIB 2 AND BUFR CODE TABLE ENTRIES FOR SATELLITE DATA

ADDITIONS TO FM 92-XIII GRIB

For Fire Detection from Space:

Code Table 4.2, Product Discipline 3 – Space products, Parameter category 0: image format products

Add: 9, Parameter = Fire detection indicator, Units = Code table (4.223)
Change: 9 – 191, Parameter = Reserved
to: 10 – 191, Parameter = Reserved

And add a new Code Table, 4.223 as follows:

Code Table 4.223 - Fire detection indicator

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

For Clear Sky Reflectance:

Code Table 4.2, Product Discipline 3 – Space products, Parameter category 1: quantitative products

Add: Number 6, Parameter = Number of pixels used, Units = numeric
Add: Number 7, Parameter = Solar zenith angle, Units = degrees
Add: Number 8, Parameter = Relative azimuth angle, Units = degrees
Add: Number 9, Parameter = Reflectance in 0.6 micron channel, Units = %
Add: Number 10, Parameter = Reflectance in 0.8 micron channel, Units = %
Add: Number 11, Parameter = Reflectance in 1.6 micron channel, Units = %
Add: Number 12, Parameter = Reflectance in 3.9 micron channel, Units = %
Change: Number 6 – 191, Parameter = Reserved
to: Number 13 – 191, Parameter = Reserved

ADDITIONS TO FM 94-XIII BUFR

For SAREP observations (Report of synoptic interpretation of cloud data obtained by a meteorological satellite):

Class 19 - Synoptic features

0	19	106	Identification number of tropical cyclone	Numeric	0	0	7	Numeric	0	3
0	19	107	Time interval of the tropical cyclone analysis	Code table	0	0	4	Code table	0	2
0	19	108	Accuracy of geographical position of the tropical cyclone	Code table	0	0	3	Code table	0	1
0	19	109	Mean diameter of the overcast cloud of the tropical cyclone	Code table	0	0	4	Code table	0	2
0	19	110	Apparent 24-hour change in intensity of the tropical cyclone	Code table	0	0	4	Code table	0	2
0	19	111	Current Intensity (CI) number of the tropical cyclone	Numeric	1	0	7	Numeric	1	3
0	19	112	Data tropical (DT) number of the tropical cyclone	Numeric	1	0	7	Numeric	1	3
0	19	113	Cloud pattern type of the DT-number	Code table	0	0	4	Code table	0	2
0	19	114	Model Expected tropical (MET) number of the tropical cyclone	Numeric	1	0	7	Numeric	1	3
0	19	115	Trend of past 24-hour change (+: Developed, -: Weakened)	Numeric	1	-30	6	Numeric	1	2
0	19	116	Pattern tropical (PT) number of the tropical cyclone	Numeric	1	0	7	Numeric	1	3
0	19	117	Cloud picture type of the PT-number	Code table	0	0	3	Code table	0	1
0	19	118	Final tropical (T) number of the tropical cyclone	Numeric	1	0	7	Numeric	1	3
0	19	119	Type of the final T-number	Code table	0	0	3	Code table	0	1
0	19	150	Typhoon International Common Number (Typhoon Committee)	CCITTIA5	0	0	32	Character	0	4

Class 25 - Processing information

0	25	150	Satellite intensity analysis method of tropical cyclone	Code table	0	0	4	Code table	0	2

Category 01 - Location and identification sequence

3	01	005	0 01 035 0 01 034	Originating centre Identification of originating/generating sub-centre

Code Tables:

0 19 107
Time interval of the tropical cyclone analysis

Code figure	
0	Less than 1 hour
1	1 to less than 2 hours
2	2 to less than 3 hours
3	3 to less than 6 hours
4	6 to less than 9 hours
5	9 to less than 12 hours
6	12 to less than 15 hours
7	15 to less than 18 hours
8	18 to less than 21 hours
9	21 to less than 30 hours
10-14	Not used
15	Missing value

0 19 108
Accuracy of geographical position of the tropical cyclone

Code figure	
0	Cyclone centre within 10 km of the transmitted position
1	Cyclone centre within 20 km of the transmitted position
2	Cyclone centre within 50 km of the transmitted position
3	Cyclone centre within 100 km of the transmitted position
4	Cyclone centre within 200 km of the transmitted position
5	Cyclone centre within 300 km of the transmitted position
6	Cyclone centre undetermined
7	Missing value

0 19 109
Mean diameter of the overcast cloud of the tropical cyclone

Code figure	
0	Less than 1° of latitude
1	1° to less than 2° of latitude
2	2° to less than 3° of latitude
3	3° to less than 4° of latitude
4	4° to less than 5° of latitude
5	5° to less than 6° of latitude
6	6° to less than 7° of latitude
7	7° to less than 8° of latitude
8	8° to less than 9° of latitude
9	9° of latitude or more
10	Undetermined
11-14	Not used
15	Missing value

0 19 110
Apparent 24-hour change in intensity of the tropical cyclone

Code figure	
0	Much weakening
1	Weakening
2	No change
3	Intensification
4	Strong Intensification
5-8	Reserved
9	Not observed previously
10	Undetermined
11-14	Not used
15	Missing value

0 19 113
Cloud pattern type of the DT-number

Code figure	Type
1	Curved Band
2	Shear
3	Eye
4	Banding Eye
	Central Dense Overcast (CDO)
6	Embedded Center
7	Center Cold Cover (CCC)
8-14	Reserved
15	Missing value

0 19 117
Cloud picture type of the PT-number

Code figure	Type
1	A (Curved Band)
2	B (CDO)
3	C (Shear)
4-6	Reserved
7	Missing value

0 19 119
Type of the final T-number

Code figure	Type
1	DT-number
2	PT-number
3	MET-number
4-6	Reserved
7	Missing value

0 25 150
Satellite intensity analysis method of tropical cyclone

Code figure	Method
1	The Dvorak's VIS (visual imagery) intensity analysis
2	The Dvorak's EIR (Enhanced Infrared imagery) intensity analysis
3-14	Reserved
15	Missing value

BUFR template

3 16 052	3 01 005	Originating centre/sub-centre
	3 01 011	Date
	3 01 012	Time
	0 01 007	Satellite identifier
	0 25 150	Satellite intensity analysis method of tropical cyclone
	1 22 000	Delayed replication of 22 descriptors
	0 31 001	Delayed descriptor replication factor
	0 01 027	WMO long storm name
	0 19 150	Typhoon International Common Number (Typhoon Committee)
	0 19 106	Identification number of tropical cyclone
	0 08 005	Meteorological attribute significance (=1)
	0 05 002	Latitude (coarse accuracy)
	0 06 002	Longitude (coarse accuracy)
	0 08 005	Cancel Meteorological attribute significance
	0 19 107	Time interval of the tropical cyclone analysis
	0 19 005	Direction of motion of feature
	0 19 006	Speed of motion of feature
	0 19 108	Accuracy of geographical position of the tropical cyclone
	0 19 109	Mean diameter of the overcast cloud of the tropical cyclone
	0 19 110	Apparent 24-hour change in intensity of the tropical cyclone
	0 19 111	Current Intensity (CI) number of the tropical cyclone
	0 19 112	Data tropical (DT) number of the tropical cyclone
	0 19 113	Cloud pattern type of the DT-number
	0 19 114	Model Expected tropical (MET) number of the tropical cyclone
	0 19 115	Trend of the past 24-hour change (+: Developed, -: Weakened)
	0 19 116	Pattern tropical (PT) number of the tropical cyclone
	0 19 117	Cloud picture type of the PT-number
	0 19 118	Final tropical (T) number of the tropical cyclone
	0 19 119	Type of the final T-number

CREX template

D 16 052	D 01 005	Originating centre/sub-centre
	D 01 011	Date
	D 01 012	Time
	B 01 007	Satellite identifier
	B 25 150	Satellite intensity analysis method of tropical cyclone
	R 22 000	Delayed replication of 22 descriptors
	B 01 027	WMO long storm name
	B 19 150	Typhoon International Common Number (Typhoon Committee)
	B 19 106	Identification number of tropical cyclone
	B 08 005	Meteorological attribute significance (=1)
	B 05 002	Latitude (coarse accuracy)
	B 06 002	Longitude (coarse accuracy)
	B 08 005	Cancel Meteorological attribute significance
	B 19 107	Time interval of the tropical cyclone analysis
	B 19 005	Direction of motion of feature
	B 19 006	Speed of motion of feature
	B 19 108	Accuracy of geographical position of the tropical cyclone
	B 19 109	Mean diameter of the overcast cloud of the tropical cyclone
	B 19 110	Apparent 24-hour change in intensity of the tropical cyclone
	B 19 111	Current Intensity (CI) number of the tropical cyclone
	B 19 112	Data tropical (DT) number of the tropical cyclone
	B 19 113	Cloud pattern type of the DT-number
	B 19 114	Model Expected tropical (MET) number of the tropical cyclone
	B 19 115	Trend of the past 24-hour change (+: developed, -: weakened)
	B 19 116	Pattern tropical (PT) number of the tropical cyclone
	B 19 117	Cloud picture type of the PT-number
	B 19 118	Final tropical (T) number of the tropical cyclone
	B 19 119	Type of the final T-number

FOR ENCODING MORE SATELLITE DATA:

Add class in BUFR Table B — Classification of elements:

0	40	Satellite data

Add a new Category of sequences in BUFR Table D:

3	40	Additional satellite report sequences

FOR DATA OF ENVISAT SATELLITE:

Add:

021093	Ku band peakiness	numeric	3	0	16
021094	S band peakines	numeric	3	0	16

Flag table 033047 " Measurement confidence data " should be amended with the addition of:

Bit number	Meaning
8	S band anomaly error detected

NEW CODE TABLE ENTRIES FOR POLAR SATELLITE DATA

1 MHS

The MHS instrument replaces the AMSU-B instrument in the ATOVS package operated by EUMETSAT and NOAA. The level 1b data from the MHS can be represented in BUFR using exactly the same sequence of descriptors, which was used for AMSU-B.

The following changes are required to standardize the representation of MHS data:

Code Table 0-02-048
- Add: 11, Parameter = MHS
- Change: 11 to 14, Parameter = Reserved
- to: 12 to 14, Parameter = Reserved

Code Table 0-02-150
- Change: 43, Parameter = AMSU-B 1
- to: 43, Parameter = AMSU-B 1 / MHS 1
- Change: 44, Parameter = AMSU-B 2
- to: 44, Parameter = AMSU-B 2 / MHS 2
- Change: 45, Parameter = AMSU-B 3
- to: 45, Parameter = AMSU-B 3 / MHS 3
- Change: 46, Parameter = AMSU-B 4
- to: 46, Parameter = AMSU-B 4 / MHS 4
- Change: 47, Parameter = AMSU-B 5
- to: 47, Parameter = AMSU-B 5 / MHS 5

Code Table 0-02-151
- Add: 9, Parameter = MHS
- Change: 8 to 2046, Parameter = Reserved
- to: 10 to 2046, Parameter = Reserved

Sequence Descriptor 3-10-010
- Change: Title = "ATOVS AMSU-B report"
- to: Title = "ATOVS AMSU-B / MHS report"

2. IASI

The IASI instrument is a hyperspectral sounder, which will fly on the Metop spacecraft operated by EUMETSAT. The level 1c data from IASI will be exchanged in BUFR. The details of the representation of the data have been discussed by many parties (ECMWF, UK Met Office, NOAA, MétéoFrance, DWD) in great detail and presented at several international meetings (including the 14th International TOVS Study Conference in Beijing). Synthetic IASI data are being generated in near real time by NOAA using the descriptors proposed here. These data have been successfully encoded and decoded by independent software.

The new element and sequence descriptors given here are from the range of local values and are shown in parentheses. It is proposed to assign descriptors from Classes and Categories 40, 41 and 42 of BUFR Tables B and D.

The following changes are required to standardize the representation of IASI data:

New Sequence Descriptor (3-40-001): " IASI Level 1c data"

0-01-007	Satellite identifier
0-01-031	Identification of originating/generating centre
0-02-019	Satellite instruments
0-02-020	Satellite classification
0-04-001	Year
0-04-002	Month
0-04-003	Day
0-04-004	Hour
0-04-005	Minute
2-02-131	Add 3 to scale
2-01-138	Add 10 to width
0-04-006	Second
2-01-000	Reset width
2-02-000	Reset scale
0-05-001	Latitude (high accuracy)
0-06-001	Longitude (high accuracy)
0-07-024	Satellite zenith angle
0-05-021	Bearing or azimuth
0-07-025	Solar zenith angle
0-05-022	Solar azimuth
0-05-043	Field of view number
0-05-040	Orbit number
2-01-133	Add 5 to width
0-05-041	Scan line number
2-01-000	Reset width
2-01-132	Add 4 to width
0-25-070	Major frame count
2-01-000	Reset width
2-02-126	Subtract 2 from scale
0-07-001	Height of station
2-02-000	Reset scale
(0-33-060)	GQisFlagQual
(0-33-061)	QGisQualIndex
(0-33-062)	QGisQualIndexLoc
(0-33-063)	QGisQualIndexRad
(0-33-064)	QGisQualIndexSpect
(0-33-065)	GQisSysTecSondQual
1-01-010	Repeat next 1 descriptor 10 times
(3-40-002)	IASI Level 1c band description
1-01-087	Repeat next 1 descriptor 87 times
(3-40-003)	IASI Level 1c 100 channel sequence
0-02-019	Satellite instruments
0-25-051	AVHRR channel combination
1-01-007	Repeat next 1 descriptor 7 times
(3-40-004)	IASI Level 1c AVHRR single scene sequence

New Sequence Descriptor: (3-40-002) "IASI Level 1c band description"

(0-25-140)	Start channel
(0-25-141)	End channel
(0-25-142)	Channel scale factor

New Sequence Descriptor: (3-40-003) " IASI Level 1c 100 channel sequence"

1-04-100 Repeat next 4 descriptor 100 times
2-01-136 Add 8 to width
0-05-042 Channel number
2-01-000 Reset width
(0-14-046) Scaled IASI radiance

New Sequence Descriptor: (3-40-004) " IASI Level 1c AVHRR single scene sequence"

(0-05-060) Y angular position from centre of gravity
(0-05-061) Z angular position from centre of gravity
0-25-085 Fraction of clear pixels in HIRS FOV
1-05-006 Repeat next 5 descriptor 6 times
0-05-042 Channel number
(0-25-142) Channel scale factor
(0-14-047) Scaled mean AVHRR radiance
(0-25-142) Channel scale factor
(0-14-048) Scaled std dev AVHRR radiance

New Element Descriptors:

Descriptor	Name	Units	Scale	Reference	Width
(0-05-060)	Y angular position from centre of gravity	Degree	6	-8000000	24
(0-05-061)	Z angular position from centre of gravity	Degree	6	-8000000	24
(0-14-046)	Scaled IASI radiance	$Wm^{-2}sr^{-1}m^{-1}$	0	-5000	16
(0-14-047)	Scaled mean AVHRR radiance	$Wm^{-2}sr^{-1}m^{-1}$	0	0	31
(0-14-048)	Scaled std dev AVHRR radiance	$Wm^{-2}sr^{-1}m^{-1}$	0	0	31
(0-25-140)	Start channel	Numeric	0	0	14
(0-25-141)	End channel	Numeric	0	0	14
(0-25-142)	Channel scale factor	Numeric	0	0	6
(0-33-060)	GqisFlagQual - individual IASI-System quality flag	Code Table	0	0	2
(0-33-061)	GqisQualIndex - indicator for instrument noise performance (contributions from spectral and radiometric)	%	0	0	7
(0-33-062)	GqisQualIndexLoc - indicator for geometric quality index	%	0	0	7
(0-33-063)	GqisQualIndexRad - indicator for instrument noise performance (contributions from radiometric calibration)	%	0	0	7
(0-33-064)	GqisQualIndexSpect - indicator for instrument noise performance (contributions from spectral calibration)	%	0	0	7
(0-33-065)	GqisSysTecSondQual - output of system TEC (Technical Expertise Centre) quality function	Numeric	0	0	24

New Code Table (0-33-060) "GQisFlagQual - individual IASI-System quality flag"

0, Parameter = Good
1, Parameter = Bad
2, Parameter = Reserved
3, Parameter = Missing

3 ASCAT

EUMETSAT will produce level 1b ASCAT products at its headquarters in Darmstadt, Germany. These data will be encoded in BUFR and disseminated via EUMETCast (DVB satellite multicast service) and on the GTS. EUMETSAT's Ocean and Sea Ice Satellite Application Facility (OSI-SAF), hosted by KNMI, will produce level 2 products from the level 1b data. It is also foreseen to add soils moisture to the level 2 ASCAT product in the future.

The new element and sequence descriptors given here have been developed by close co-operation between EUMETSAT, the OSI-SAF and the ASCAT Science Advisory Group (SAG). The proposed sequence will accommodate both the level 1b and the level 2 data simultaneously. When the level 1b data leave EUMETSAT, the parts of the sequence relating to level 2 processing will be set to "missing". This approach will allow users to ingest the same sequence, whether they are receiving level 1b data or level 2 data.

The new element and sequence descriptors are from the range of local values and are shown in parentheses. It is proposed to assign descriptors from Classes and Categories 40, 41 and 42 of BUFR Tables B and D within Master Tables 0, as per Section 3.5 of the Final Report of the 2004 meeting of the ET/DR&C.

The following changes are required to standardize the representation of ASCAT data:

New Sequence Descriptor: (3-12-061) "ASCAT Level 1b and level 2 data sequence"

(3-12-058)	ASCAT level 1b data
(3-12-060)	Scatterometer soil moisture data
(3-12-059)	Scatterometer wind data

New Sequence Descriptor: (3-12-058) "ASCAT level 1b data sequence"

(3-01-125)	ASCAT header information
3-01-011	Date information
3-01-013	Time information
3-01-021	Position information
(3-12-055)	ASCAT level 1b cell information
(0-21-150)	Beam co-location
1-01-003	Repeat next 1 descriptor 3 times
(3-21-030)	ASCAT sigma-0 information

New Sequence Descriptor: (3-12-060) "Scatterometer soil moisture data sequence"

0-25-060	Software identification
(0-25-062)	Database identification
(0-40-001)	Surface soil moisture (ms)
(0-40-002)	Estimated error in surface soil moisture
0-21-062	Extrapolated backscatter at 40deg incidence angle (sigma0_40)
(0-21-151)	Estimated error in sigma0 at 40deg incidence angle
(0-21-152)	Slope at 40deg incidence angle
(0-21-153)	Estimated error in slope at 40deg incidence angle
(0-21-154)	Soil moisture sensitivity
0-21-062	Dry backscatter
(0-21-088)	Wet backscatter
(0-40-003)	Mean surface soil moisture
(0-40-004)	Rain fall detection

(0-40-005) Soil moisture correction flag
(0-40-006) Soil moisture processing flag
(0-40-007) Soil moisture quality
0-20-065 Snow cover
(0-40-008) Frozen land surface fraction
(0-40-009) Inundation and wetland fraction
(0-40-010) Topographic complexity

New Sequence Descriptor: (3-12-059) "Scatterometer wind data sequence"

(3-12-056) Scatterometer wind cell information
1-01-000 Delayed replication of next 1 descriptor
0-31-001 Delayed replication factor
(3-12-057) Ambiguous wind data

New Sequence Descriptor: (3-01-125) "ASCAT header information sequence"

0-01-033 Identification of originating/generating centre
0-01-034 Identification of originating/generating sub-centre
0-25-060 Software identification
0-01-007 Satellite identifier
0-02-019 Satellite instruments
0-01-012 Direction of motion of moving observing platform

New Sequence Descriptor: (3-12-055) " ASCAT level 1b cell information"

0-05-033 Pixel size on horizontal-1
0-05-040 Orbit number
0-06-034 Cross track cell number
(0-10-095) Height of atmosphere used
(0-21-157) Loss per unit length of atmosphere used

New Sequence Descriptor: (3-21-030) "ASCAT sigma-0 information"

(0-08-085) Beam identifier
2-02-129 Increase scaling by 10^1
2-01-131 Increase data width by 3 bits
0-02-111 Radar incidence angle
2-01-000 Cancel change data width
2-02-000 Cancel change scaling
0-02-134 Antenna beam azimuth
0-21-062 Backscatter
0-21-063 Radiometric resolution (noise value)
(0-21-158) ASCAT kp estimate quality
(0-21-159) ASCAT sigma-0 usability
(0-21-160) ASCAT synthetic data quality
(0-21-161) ASCAT synthetic data quantity
(0-21-162) ASCAT satellite orbit and attitude quality
(0-21-163) ASCAT solar array reflection contamination
(0-21-164) ASCAT telemetry presence and quality
(0-21-165) ASCAT extrapolated reference function
(0-21-166) ASCAT land fraction

New Sequence Descriptor: (3-12-056) "Scatterometer wind cell information sequence"

0-25-060 Software identification
0-01-032 Generating application
0-11-082 Model wind speed at 10 m
0-11-081 Model wind direction at 10 m
(0-20-095) Ice probability
(0-20-096) Ice age (a-parameter)
(0-21-155) Wind vector cell quality
2-01-133 Increase data width by 5 bits
0-21-101 Number of vector ambiguities
0-21-102 Index of selected wind vector
2-01-000 Cancel change data width

New Sequence Descriptor: (3-12-057) "Ambiguous wind data"

2-01-130 Increase data width by 2 bits
2-02-129 Increase scaling by 10^1
0-11-012 Wind speed at 10 m
2-02-000 Cancel change scaling
2-01-000 Cancel change data width
2-01-131 Increase data width by 3 bits
2-02-129 Increase scaling by 10^1
0-11-011 Wind direction at 10 m
2-02-000 Cancel change scaling
2-01-000 Cancel change data width
(0-21-156) Backscatter distance
0-21-104 Likelihood computed for solution

New Element Descriptors:

Descriptor	Name	Units	Scale	Reference	Width
(0-10-095)	Height of atmosphere used	m	0	0	16
(0-08-085)	Beam identifier	Code table	0	0	3
(0-20-095)	Ice probability	Numeric	3	0	10
(0-20-096)	Ice age ("A" parameter)	dB	2	-4096	13
(0-21-088)	Wet backscatter	dB	2	-5000	13
(0-21-150)	Beam collocation	Code table	0	0	2
(0-21-151)	Estimated error in sigma0 at 40deg incidence angle	dB	2	0	9
(0-21-152)	Slope at 40deg incidence angle	dB/Deg	2	-80	7
(0-21-153)	Estimated error in slope at 40deg incidence angle	dB/Deg	2	-40	6
(0-21-154)	Soil moisture sensitivity	dB	2	0	12
(0-21-155)	Wind vector cell quality	Flag table	0	0	24
(0-21-156)	Backscatter distance	Numeric	1	-4096	13
(0-21-157)	Loss per unit length of atmosphere used	dB m-1	10	0	22
(0-21-158)	ASCAT kp estimate quality	Code table	0	0	2
(0-21-159)	ASCAT sigma-0 usability	Code table	0	0	2
(0-21-160)	ASCAT use of synthetic data	Numeric	3	0	10
(0-21-161)	ASCAT synthetic data quality	Numeric	3	0	10
(0-21-162)	ASCAT satellite orbit and attitude quality	Numeric	3	0	10
(0-21-163)	ASCAT solar array reflection contamination	Numeric	3	0	10
(0-21-164)	ASCAT telemetry presence and	Numeric	3	0	10

Descriptor	Name	Units	Scale	Reference	Width
	quality				
(0-21-165)	ASCAT extrapolated reference function presence	Numeric	3	0	10
(0-21-166)	ASCAT land fraction	Numeric	3	0	10
(0-25-062)	Database identification	Numeric	0	0	14
(0-40-001)	Surface soil moisture (ms)	%	1	0	10
(0-40-002)	Estimated error in surface soil moisture	%	1	0	10
(0-40-003)	Mean surface soil moisture	Numeric	3	0	10
(0-40-004)	Rain fall detection	Numeric	3	0	10
(0-40-005)	Soil moisture correction flag	Flag table	0	0	8
(0-40-006)	Soil moisture processing flag	Flag table	0	0	16
(0-40-007)	Soil moisture quality	%	1	0	10
(0-40-008)	Frozen land surface fraction	%	1	0	10
(0-40-009)	Inundation and wetland fraction	%	1	0	10
(0-40-010)	Topographic complexity	%	1	0	10

New Code Table (0-08-085) "Beam identified"

0,	Parameter = Fore beam
1,	Parameter = Mid beam
2,	Parameter = Aft beam
3 to 6,	Parameter = Reserved
7,	Parameter = Missing

New Code Table (0-21-150) "Beam co-location"

0,	Parameter = Data from single ground station (no co-location)
1,	Parameter = Data from multiple ground station (co-located data)
2,	Parameter = Reserved
3,	Parameter = Missing

New Flag Table (0-21-155) "Wind vector cell quality"

Bit 1:	Not enough good sigma-0 available for wind retrieval
Bit 2:	Poor azimuth diversity among sigma-0 for wind retrieval
Bit 3:	Any beam noise content above threshold
Bit 4:	Product monitoring not used
Bit 5:	Product monitoring flag
Bit 6:	KNMI quality control fails
Bit 7:	Variational quality control fails
Bit 8:	Some portion of wind vector cell is over land
Bit 9:	Some portion of wind vector cell is over ice
Bit 10:	Wind retrieval not performed for wind vector cell
Bit 11:	Reported wind speed is greater than 30 m/s
Bit 12:	Reported wind speed is less than or equal to 3 m/s
Bit 13:	Rain flag for the wind vector cell is not usable
Bit 14:	Rain flag algorithm detects rain
Bit 15:	No meteorological background used
Bit 16:	Data are redundant
Bit 17-23:	Reserved
All 24:	Missing

New Code Table (0-21-158) "ASCAT KP quality estimate"

0,	Parameter = Acceptable
1,	Parameter = Not acceptable
2,	Parameter = Reserved
3,	Parameter = Missing

New Code Table (0-21-159) "ASCAT sigma-0 usability"

0,	Parameter = Good
1,	Parameter = Usable
2,	Parameter = Bad
3,	Parameter = Missing

New Flag Table (0-40-005) "Soil moisture correction flags"

Bit 1:	Soil moisture between -20% and 0%
Bit 2:	Soil moisture between 100% and 120%
Bit 3:	Correction of wet backscatter reference
Bit 4:	Correction of dry backscatter reference
Bit 5:	Correction of volume scattering in sand
Bits 6-7:	Reserved
All 8:	Missing

New Flag Table (0-40-006) "Soil moisture processing flags"

Bit 1:	Not soil
Bit 2:	Sensitivity to soil moisture below limit
Bit 3:	Azimuthal noise above limit
Bit 4:	Backscatter Fore-Aft beam out of range
Bit 5:	Slope Mid-Fore beam out of range
Bit 6:	Slope Mid-Aft beam out of range
Bit 7:	Soil moisture below -20%
Bit 8:	Soil moisture above 120%
Bits 9-16:	Reserved

Code Table 0-02-048

Add:	12, Parameter = ASCAT
Change:	12 to 14, Parameter = Reserved
to:	13 to 14, Parameter = Reserved

ADDITION IN CODE TABLE 0 02 152 SATELLITE INSTRUMENT DATA USED IN PROCESSING

12	Multi-channel scanning radiometer

Common Code Table C-5: Satellite identifier

172	MTSAT-2
257	GOES 13
258	GOES 14
259	GOES 15
283	CORIOLIS
785	AURA

In Common Table C-12:

Add the following 2 new sub-centres to existing Common Code Table C-12 for originating center number 254 (EUMETSAT):

140	Lannion, France
150	Svalbard, Norway

Add the following 2 new sub-centres to existing Common Code Table C-12 for originating center number 7 (U.S/NCEP):

15	North American Regional Reanalysis Project
16	Space Environment Center

NEW ALLOCATED BUFR ENTRIES FOR GHRSST DATA AWAITING VALIDATION

DESCRIPTORS TO BE USED WHEN EXCHANGING GHRSST DATA:

Table Reference	*Element name*	*BUFR*				*CREX*		
F X Y		*Unit*	*Scale*	*Ref. value*	*Data width (bits)*	*Unit*	*Scale*	*Data width (chars)*
0 25 037	SST bias	K	2	-127	8	K	2	3
0 14 035	Solar Radiation Flux	W m^{-2}	1	0	14	W m^{-2}	1	5
0 25 022	GHRSST Rejection Flag	Flag table	0	0	9	Flag table	0	3
0 25 023	GHRSST Confidence Flag	Flag table	0	0	9	Flag table	0	3
0 25 024	GHRSST data quality.	Code table	0	0	4	Code table	0	2
0 01 028	Aerosol optical Depth (AOD) source	Code table	0	0	5	Code table	0	2
0 01 024	Wind Speed source	Code Table	0	0	5	Code Table	0	2
0 01 029	SSI Source	Code Table	0	0	5	Code Table	0	2
0 01 038	Source of Sea Ice Fraction	Code Table	0	0	5	Code Table	0	2
0 25 038	Difference between SST and analysis	K	1	-127	8	K	1	3
0 22 046	Sea Ice Fraction	Numeric	2	0	7	Numeric	2	3

Table 1. Proposed BUFR and CREX descriptors

0 25 022 - GHRSST Rejection Flag

Bit No.	
1	Unprocessed
2	Land suspected.
3	Wind speed too large
4	Ice detected.
5	Rain detected (Microwave retrievals only)
6	Cloudy detected (Infra-red retrievals only)
7	Cosmetic value
8	SST out of range
All 9	Missing value

0 25 023 - GHRSST Confidence Flag

Bit No.	
1	Default confidence value has been used.
2	Default bias and standard deviation has been used.
3	Sun glint suspected
4	Sea ice retrieval for microwave data
5	High wind speed retrieval
6	Inaccurate SST due to low SST (< 285K). (Only applies to the TMI instrument).
7	Relaxed rain contamination suspected
8	Potential side lobe contamination
All 9	Missing value

0 25 024 – GHRSST proximity confidence.

Code figure	
0	Unprocessed infrared retrieval
1	Cloudy retrievals.
2	Bad: Data that are probably contaminated by cloud.
3	Suspect data.
4	Acceptable data.
5	Excellent data.
6	Cool skin suspected.
7-9	Reserved
10	Unprocessed microwave retrieval.
11	Questionable microwave retrieval that may be contaminated.
12	Acceptable microwave retrieval.
13	High probability of diurnal variability.
14	Reserved
15	Missing value

0 01 028 - Aerosol optical Depth (AOD) source

Code figure	
0	No AOD data available
1	NESDIS
2	NAVOCEANO
3	NAAPS
4	MERIS
5	AATSR
6-30	Reserved for future use
31	Missing value

0 01 024 - Wind Speed source

Code figure	
0	No wind speed data available
1	AMSR-E data
2	TMI data
3	NWP: ECMWF
4	NWP: UK Met Office
5	NWP: NCEP
6	Reference climatology
7	ERS_Scatterometer
8-30	Reserved for future use
31	Missing value

0 01 029 - SSI Source

Code figure	
0	No SSI data available
1	MSG_SEVIRI
2	GOES East
3	GOES West
4	ECMWF
5	NCEP
6	UK Met Office
7-30	Reserved for future use
31	Missing value

0 01 038 - Source of Sea Ice Fraction

Code figure	
0	No sea ice set
1	NSIDC SSM/I Cavalieri et al (1992)
2	AMSR-E
3	ECMWF
4	CMS (France) cloud mask used by Medspiration
5	EUMETSAT OSI-SAF
6-30	Reserved for future use
31	Missing value