WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INFORMATION SYSTEMS AND SERVICES

EXPERT TEAM ON
DATA REPRESENTATION AND CODES

KUALA LUMPUR, 21-26 JUNE 2004

FINAL REPORT

EXECUTIVE SUMMARY

The meeting of the Expert Team Data Representation and Codes (ET/DR&C) was held, at the kind invitation of Malaysia in Kuala Lumpur, from 21 to 26 June 2004. The Team reviewed the status of validation tests for FM 92 GRIB Edition 2. Further validation tests were recommended for some templates: PDT 4.10 and 4.14 , GDT 3.1000/1100/1200 and PDT 4.1000/1001/1002/1100/1101. The Team proposed, for preoperational status, two new compression schemes based on JPEG 2000 and PNG. More testing and validation were requested for the Weather-Huffman compression. The Team defined mandatory criteria for the addition of new compression schemes. The Team agreed to additions of new parameters in particular for image-like products, variable spacing grid and earth surface information.

Several Centres reported on experimental and operational exchanges of fields in GRIB2. EUMETSAT used GRIB2 to disseminate cloud mask products and soon cloud analysis image products. EUMETSAT had decided to use GRIB2 for all future image-like products. NCEP made available half-degree global output of its global model to AFWA (US Air Force Weather Agency), and should shortly send high-resolution output from Eta model to national forecast offices. JMA had started using GRIB2 for radar data, analysis/nowcast/very short-range forecast for precipitations, 3-month forecast and warm/cold season forecast. ECMWF aimed to provide GRIB2-coded probabilistic products for GTS in 2004. Centres reported on the available GRIB 2 encoder/decoder software. EUMETSAT had started production with specific encoders for each data type. DWD had a software, still to be experimented. The target was for a universal encoder/decoder. Distribution would be made through a commercial partner, as for BUFR. ECMWF had a software that would be universal, with C and Fortran interfaces, and covering also GRIB1 decoding. It was expected to be available for the end of 2004. NCEP had a package available “as is”, currently running under UNIX in operational context, written in FORTRAN 90 and C. Most of templates were covered. JMA had an encoder and sample decoders, but they were not universal. UKMO had a package, not universal as far as packing methods were concerned. It had currently no operational use and only limited testing had been performed.

The Team examined various requirements which had been expressed for corrections and additions to BUFR regulations and Tables. A regulation was amended to define clearly displacement descriptors and increment descriptors. New descriptors were recommended following validation of templates for TEMP and SYNOP data. Additions were recommended for reporting both nominal and instrument values for Surface Observation Data, for satellites data, for representation of Satellite Radio Occultation data, for instantaneous radiation and for SIGWX messages. The Team discussed a general frame designed by Meteo-France for encoding any kind of meteorological features and recommended it for validation and asked for more coordination with ICAO. Entries proposed previously by USA for ozone concentrations and radiosondes were recommended to be declared pre-operational. More validation will have to be performed on entries for SIGMET message. The Team agreed to add new entries in Common Code Tables C-2 for radiosondes. The Team noted that this table was nearly saturated and recommended that BUFR should be used for radiosonde data, as soon as possible. Entries for NMC of all countries were added in Tables C-1 and C-11. Additional sub-centres were put in table C-12. The Team considered the definition of Master Tables for satellite and oceanographic data and attempted to define some rules and principles, which would have to be re-examined and clarified.

Additions for a new BUFR edition had been validated and were recommended: representation of probabilities, other forecast values, new operators, international sub-categories and local sub-categories and full date format. For compatibility with BUFR additions for a new edition, a new edition of CREX was also proposed. It was then recommended to make a new edition for November 2005 for BUFR and CREX, with the understanding that both edition could be used in parallel up to 2012, when the migration process will be fully completed, BUFR edition

4 and CREX edition 2 being the only ones accepted after that date. Decoder software providers were urged by the team to adjust their software as soon as possible to be able to decode BUFR edition 4 and CREX edition 2. Encoders should also be adapted to encode data in the new editions formats.

Following requirements expressed by ICAO and comments by Meteo-France, KNMI and PROMET, modifications to METAR/SPECI and TAF codes were recommended for implementation in 2 November 2005. The Team and the ICAO representative also recommended that ICAO should seriously consider the harmonization of implementation dates for code changes and Annex 3 amendments, in consultation with WMO.

In the context of the migration , the meeting reasserted the need to separate reporting practices from the TAC and rewrite those which need to remain in the Manual on Codes. The BUFR templates contain a different order of parameters. Additional work would need to consider what would be the best order both from a migration standpoint and a coding standpoint. The work should also determine the best way to present the information. The meeting recommended that a consultant be hired by WMO to perform this task. The Team agreed to add new common sequences in BUFR for translation of SYNOP, SHIP, PILOT and TEMP observations and AMDAR profiles and to modify the CLIMAT template. With regards to regional/national practices, the meeting agreed that when it was necessary to place regional/national practices in the middle of a template rather than at the end a specific note would be added to the template indicating where this should be done. It was also agreed that guidelines on this subject should be documented in each standard template as well as in the BUFR guide and other BUFR/CREX documentation. The meeting examined a proposal for a TAF BUFR template and it was proposed that Charles Sanders (Australia) and N. Halsey (ICAO) work to improve the TAF and METAR/SPECI templates.

The Team reviewed the status of the migration to TDCF. Already some data were produced in BUFR. Soon, USA will put into the GTS radiosonde data in BUFR. Newer Canadian automated observation systems generate observation in BUFR format at the source. Fiji had indicated they are pursuing making observations available in CREX. Service ARGOS was providing buoy and float observations in both TAC and BUFR. Japan Meteorological Agency will disseminate in 2005 SHIP data in BUFR. Japan is disseminating wind profiler data in BUFR. Japan was exchanging BUFR data with the Republic of Korea. Hong-Kong was transmitting wind profiler data in BUFR. Météo-France will disseminate AWS data in BUFR later 2005 or in 2006. CHMI (Czech Republic), DWD (Germany), KNMI (Netherlands) and SHMI (Slovakia) were disseminating AWS observations in BUFR. The Czech Republic was producing RS data in BUFR format. ASDAR and AMDAR data are produced in BUFR by Germany, UK and USA.

Promotion of TDCF had been undertaken by Fred Branski, chairman of the ET on TDCF in several meetings: the North American Europe Data Exchange (NEDEX) meeting, the Asia Pacific Satellite Data Exchange and Utilization (APSDEU) meeting, the United States Antarctic Program (USAP) meeting, the Hydrometeorology Equipment Industry (HMEI) group, the WMO CIMO Expert Team on an Upgraded Radiosonde Network and the Subgroup on Data Utilization (SGDU) of the international multi-lateral Group on Earth Observations (GEO). The idea of using BUFR with all its advantages was well received by these groups who would make plans for that goal.

The secretariat provided a synthesis of the results of the Questionnaire on WMO Codes Processing. There were 51 responses from 49 states and also from ECMWF and EUMETSAT. Still 5 centres out of 51 were not automated. Eleven centres were notably receiving CREX, but only 3 were automatically decoding it. Thirty centres were receiving BUFR data, but only 24 were decoding it. Ability to receive data through Internet was noted for TAC: 22, for CREX: 1, for GRIB: 21 and for BUFR: 13. Eight centres used BUFR as internal Data Base Format for observations received in TAC. The operating systems used were for almost 60% UNIX or LINUX systems and for about 30% WINDOWS systems. FORTRAN was the language used in 80 % of the cases. About 16% (only 5% in 1998) of countries encode some data types in CREX (10% at platform site, 3.5% in 1998) and about 40 % (only 21% in 1998) of countries encode some data types in BUFR (12% at platform site, same in 1998). Progress in the encoding of CREX and especially BUFR was thus observed, however one could notice it concerned mostly Region VI which represented 44% of the answers. The encoding software was mostly run on UNIX and LINUX operating systems. WINDOWS and MS_DOS were found only in two cases each. FORTRAN and C were the most languages used. One could note that CREX was definitely <u>not</u> a "non-starter" in the migration process and that some countries used it for SYNOP, AWS, BATHY, BUOY, TESAC and WAVEOB encoding even at the observing platform level.

Concerning national migration plan, only 8% of the countries (a very small number) had developed a migration plan, but 20% were currently developing one. Every other country were planning to develop a plan within the next five years. BUFR was already used for national/local/domestic data exchange by 30% of the countries for various data types. Only 24% of the countries had already secured a BUFR/CREX decoder. UNIX-LINUX 60% and WINDOWS 20% seemed to remain the foreseen used operating systems in the future for decoding. For future encoding, still 16% of the countries envisaged CREX encoding at observing platforms, and 22% at concentration site. For BUFR it is respectively 30% and 60%. Dates given for the operational readiness spanned from 2004 to 2008.

ECMWF indicated that BUFR, CREX and GRIB1 encoder/decoder software (under UNIX and LINUX) were available in the Centre web site. DWD had contracted the development of a BUFR encoder/decoder under Windows; this software was to be purchased by interested countries.

The Team agreed that more information should be sent to the PRs and the focal points on code matters about the migration and that international training should still be undertaken. Coordination of the migration at all levels: national, regional and international should be expanded. Countries should seriously create a National Migration to TDCF Steering Group and develop a national migration plan. A "Migration News" could also be included in the WWW newsletter to push a bit more countries to act.

Finally, after consideration of request for more metadata in Section 1 of BUFR, to be used for feeding XML metadata file, the Team agreed to consider the requirements at a later stage when more clear need would be expressed. It would have to be done during the next few months to be approved by CBS XIII for inclusion in the next edition of BUFR.

CONTENTS

REPORT OF THE MEETING OF EXPERT TEAM ON DATA REPRESENTATION AND CODES
(Kuala Lumpur, 21-26 June 2004)

1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1.1.1 At the kind invitation of Malaysia, the Meeting of the Expert Team on Data Representation and Codes (ET/DR&C) took place in the premises of the Malaysian Meteorological Service in Petaling Jaya, Kuala Lumpur from, 21-26 June 2004 (the participants' list can be found in the Annex to this paragraph). The Meeting was opened on Monday 21 June at 9.30 a.m. by Dr Chow Kok Kee, Director of Malaysian Meteorological Service and Permanent Representative of Malaysia with WMO. Dr Chow Kok Kee welcomed the Experts and recalled the importance of the work of the Team.

1.1.2 The representative of the WMO Secretariat thanked Malaysia for hosting the meeting. He thanked the Malaysia Meteorological Service for providing excellent hospitality and facilities and having work hard for the organization and logistic of the meeting. He thanked especially the local organizers from MMS, Mr Tan Kok Mee and all the other staff involved, for their good work. The Team had several challenging tasks on the agenda; in additions to the usual examination of the set of requests for additions to the GRIB 2 and BUFR Codes Tables, the Team had to consider the need for a new edition of BUFR and CREX, the updates to aviation codes and the status and necessary actions for the migration to TDCF.

1.1.3 Mr Jean Clochard, Chairman of the Team, after having thanked Malaysia, welcomed the participants. He then led the Team with diplomacy and efficiency in all items, except for items related to the migration to TDCF where Mr Fred Branski, chairman of the ET on MTDCF led the discussions.

1.2 APPROVAL OF THE AGENDA

The Team agreed to the content of the agenda as proposed with the addition of item 7 on the use of XML for the representation of meteorological metadata (see Table of Contents in front).

2. GRIB 2 CODE FORM

2.1 STATUS AND COORDINATION OF VALIDATION TESTS FOR GRIB2 ENCODING/DECODING

2.1.1 At its last meeting, the ET/DR&C pointed out that PDT (Product Definition Templates) 4.10 and 4.14 still needed validation, with a view for submission to the next CBS session and subsequent update of the Manual of Codes. The NCEP representative mentioned that a note pointing out that PDT 4.14 was not validated, was missing from the Manual and that should be reintroduced into the on-line version. NCEP confirmed its willingness to validate these templates. ECMWF did also, but did not foresee to be in such a position before completeness of its GRIB2 software for public delivery, by November 2004. It was also noted that some centres with GRIB2 capacities were not represented in the ET, and should be contacted by e-mail. This will be done by the Chairman, with the help of US representatives.

2.1.2 It was noted that, probably as a side effect to reflect GRIB1 features, PDT 4.7 was identical to PDT 4.0, and that the difference due to data type was also reflected in Code Table 4.3. To avoid future use of a duplicate template, appropriate remarks will be added to the Manual of Codes (see ANNEX to this paragraph).

2.2 VALIDATION OF SPECIAL TEMPLATES FOR THE TRANSMISSION IN GRIB2 OF CROSS-SECTIONS AND HOVMÖLLER TYPE DIAGRAMS

No work was reported to date. The invitation to all potential validating centres mentioned at previous item will be extended to these templates.

2.3 VALIDATION OF NEW COMPRESSION SCHEMES (JPEG2000, PNG, WH)

2.3.1 JPEG2000 and PNG were already proposed for validation at the previous meeting. At that time, NCEP had already made internal validation of encoding/decoding. Since that, further validation was performed by decoding of NCEP data by EUMETSAT. As no other producing centre represented did envisage to use such packing methods, the clause of single source of production applies, leading to give a pre-operational status to associated templates, with numbers referred to in the ANNEX to this paragraph.

2.3.2 Weather-Huffman (WH) compression method was considered by ICAO as an extra compression scheme. The underlying requirement was linked to future use of data sent directly to the cockpit, where the size and compactness of data was of extreme importance. In this context, a study conducted in 2002, comparing the use of BUFR, current GRIB2 and using directly PNG and Weather-Huffman methods showed an advantage of the latter method. The ET did receive this suggestion with interest, and pointed out that given the results of NCEP, the extension of the test to JPEG2000 encoding in GRIB2 would be highly valuable. The representative of ICAO will arrange appropriate contacts for such tests.

2.3.3 The question was raised on what kind of compression schemes might be envisaged for inclusion in GRIB. The ET stated the following mandatory criteria for further compression schemes:

- have a demonstrated need, not covered by existing GRIB2 packing methods
- not be subject to software licences or patents
- either be maintained by a standards organisation (ISO, IEEE…) or be sufficiently simple for inclusion in the WMO Codes Manual
- be adapted for universal implementation (offer portability)

2.4 OTHER ADDITIONS OR MODIFICATIONS TO GRIB2

2.4.1 At the request of EUMETSAT, additions to code tables were accepted to support delivery of GRIB2-encoded image-like products, for pre-operational status. An additional note to Data Representation Templates was accepted to enforce proper encoding of scale factors (see ANNEX to this paragraph).

2.4.2 For the purpose of describing a latitude-longitude grid with variable spacing in the latitude direction, the NCEP representative proposed an addition to code table 3.11. This was accepted for validation. It was pointed out that this would imply a revision of the code table name, as well as associated adaptations to Section 3 description in the Manual (see ANNEX to this paragraph), and potentially in the Guide.

2.4.3 JMA pointed out a discrepancy between the Manual and the Guide about the unit of earth radius/axes that may be used in some Grid Definition Templates, when using entry 3 in Code Table 3.2. Due to effective use of data reported by participants, the proposal retained was to specify km for entry 3 (as already in use by one centre), and recommend the addition of a new entry 7 for using m. Meters would also have to be specified when using entry 1, which was the current usage by data producing centres using this entry. (see ANNEX to this paragraph)

2.4.4 NCEP submitted a large list of parameter descriptors for consideration for addition to Code Table 4.1. Given the size and contents, it was decided that this list would be revised by correspondence between major producing centres to consolidate a list of parameters of common interest and use, for pre-operational status (see ANNEX to this paragraph).

2.5 REPORT ON PRODUCTION AND EXPERIMENTAL OR OPERATIONAL EXCHANGES OF FIELDS IN GRIB2

2.5.1 EUMETSAT used GRIB2 to disseminate over its satellite broadcast (and archive) a cloud mask product from MSG, which had been looked at by several receiving centres. GRIB2 will soon be used for a cloud analysis image product in the same context, and later this year for a cloud top height and a clear sky reflectance map. It had been decided to use GRIB2 for all future image-like products.

2.5.2 NCEP made available half-degree global output of its global model to AFWA (US Air Force Weather Agency), and should shortly send high-resolution output from Eta model to national forecast offices. Such products might be made available through RTH Washington/ftp server. An existing ozone product will be moved from GRIB1 to GRIB2, but there were currently no other plans to convert existing GRIB1 products to GRIB2.

2.5.3 JMA had started using GRIB2 for radar data, analysis/nowcast/very short-range forecast for precipitations, 3-month forecast, warm/cold season forecast. The last two mentioned forecasts were made available through Internet for international exchange. There was a plan to migrate GRIB1 data for external use to GRIB2 in 2006.

2.5.4 ECMWF aimed to provide GRIB2-coded probabilistic products for GTS in 2004. Work was also performed to build a strategy towards migration of current archive to GRIB2. In this context, potential problems were mentioned related to granularity of parameter concept and to describe specific products. A note will be added to Code table 4.0 to assist for disciplines use (see Annex to this paragraph). In the context of production for GMES, the ECMWF representative was invited to propose a new discipline such as aerosol chemistry, any required PDTs and associated code tables, as well as new table entries (coordinated by e-mail before next meeting).

2.6 REPORT ON AVAILABLE GRIB2 DECODER/ENCODER SOFTWARE

EUMETSAT had started production with specific encoders for each data type. Ad-hoc decoding software was made available at least as a sample for users of associated products.

DWD had a software, still to be experimented. The target was for a universal encoder/decoder. Distribution would be made through a commercial partner, as for BUFR.

ECMWF had a software that would be universal, with C and Fortran interfaces, and covering also GRIB1 decoding. It was expected to be available for the end of 2004, and would be freely available to NHMSs through its web server, as for (already existing) BUFR and CREX packages. It would support a variety of UNIX and LINUX environments, and WINDOWS through a LINUX-type environment (Cygwin).

NCEP had a package available “as is”, currently running under UNIX in operational context, written in FORTRAN 90 and C. Most of templates were covered.

JMA had an encoder and sample decoders, but they were not universal.

UKMO had a package, not universal as far as packing methods were concerned. It had currently no operational use. There had been limited testing on different computer platforms.

3. BUFR AND CREX

3.1 VARIOUS NEEDED ADDITIONS OR CORRECTIONS

The Team examined the various requirements which had been expressed for corrections and additions to BUFR regulations and Tables.

3.1.1 Displacement descriptors vs. increment descriptors

While there is a clear regulation 94.5.3.8 which describes the proper use of increments, there was no corresponding regulation which described the proper use of displacements nor how they differed from increments. Following several email-based discussions, a consensus amongst the members was reached that displacements apply independently and in a non-cumulative fashion to the corresponding defined location, whereas increments always apply in a cumulative fashion. It was agreed to simply amend the existing 94.5.3.8 so that it describes displacements as well as increments. The amendment is described in annex to this paragraph and should be considered as an editorial clarification.

3.1.2 Reporting both nominal and instrument values in BUFR Templates for Surface Observation Data, especially Data from Automatic Weather Stations (AWS)

The Commission for Basic Systems (CBS), following the recommendation of ET on AWS considered that BUFR/CREX template should allow for reporting of both instrument and nominal values. Various WMO manuals and guides define Level I data (primary data or instrument readings) as well as Level II data (meteorological parameters, i.e. nominal values) and provide the appropriate recommendations concerning requirements for data reporting:

Level I data: Primary data. In general these are instrument readings expressed in appropriate physical units and referred to Earth coordinates. Level I data still require conversion to the meteorological parameters specified in the data requirements.

Level II data: Meteorological parameters. These are obtained directly from many kinds of simple instruments, or derived from the Level I data.

BUFR Templates for AWS data should be capable of reporting both Level I and Level II type data if required. Therefore the specific task was identified by the CBS to investigate the possibility of reporting both nominal and instrument values in BUFR/CREX. If Level I data met requirements for data reporting defined in WMO manuals and guides, no adjustment was needed and both Level I data and Level II data have identical values. It was noted however that insertion of nominal values would increase volume of the data substantially.

For this purpose a set of new descriptors as defined in Annex to this paragraph was proposed. They should be exhaustively validated. The Team recommended also to check with Service Argos existing descriptors 0 07 064 and descriptor 0 08 082, of which the use, function and names might be re-considered.

3.1.3 The Team agreed to the inclusion of new entries requested by Japan related to Japan satellite ADEOS II in Common Tables C-5 and C-8 as listed in Annex to this paragraph. Japan indicated also that “NASDA” was to be replaced by “JAXA” in Common Table C-8

3.1.4 Additional descriptors for METEOSAT 8 Data:

METEOSAT 8 had a higher spatial and temporal resolution than the earlier METEOSATs. In addition it had 12 spectral channels rather than the three of the original design. These improvements meant that it was now possible to extract more meteorological products from the image data, and to improve on the quality of the existing products. Additional BUFR descriptors were hereby proposed in order to exchange all the necessary parameters within these products internationally. These are found in Annex to this paragraph. Being already exchanged operationally, these data were pre-operational and were recommended for approval by CBS.

3.1.5 The height assignment method code table in BUFR had 13 methods defined. It was proposed to define an additional entry, 14, to mean “composite height assignment”. This would allow the correct identification of the height assignment of the vector performed in the EUMETSAT processing chain. These entries listed in the Annex to this paragraph are recommended for operational status.

3.1.6 Proposal for new BUFR /CREX descriptors resulting from validation of templates for TEMP and SYNOP data

In order to finalize the templates for TEMP and SYNOP data, the additions to Code Tables listed in Annex to this paragraph were recommended by the Team. Additionally, as a result of the clarification of the regulation for increment and displacement usage, new sequences for ozone sounding data and tide gauge data were proposed as listed in the Annex to this paragraph. Corresponding modifications of examples in Manual on Codes and in Guide on BUFR and CREX were needed. The descriptors (in bullet 2 of Annex) for upper-air data had been validated and would be pre-operational.

3.1.7 The meeting examined a proposal for adding entries for satellite in Table C-5 as listed in Annex to this paragraph. It was also requested to add an EOS class in Code Table 0 02 020.

3.1.8 A proposal was presented by UKMO for the representation of Satellite Radio Occultation data in BUFR. The group appreciated the work done and suggested some enhancements to the proposed sequence descriptor, which UKMO agreed to consider further subsequent to the meeting. In the meantime, the entries as listed in Annex to this paragraph were approved for validation:

3.1.9 Descriptors for instantaneous radiation

The existing descriptors for instantaneous radiation did not have appropriate scale and bits for the range of observed values and reporting instruments. It is therefore requested two new descriptors recommended for validation as defined in Annex to this paragraph.

3.1.10 Reporting degree of turbulence in WAFS SIGWX messages

It had been noticed that in WAFS SIGWX messages the use of code figure 12 in table 011031 "Degree of turbulence", was inconsistent with the Manual on Codes. It had been used (presumably from a time when only figures 0-11 were defined) to indicate the turbulence forecast MOD OCNL SEV.

In view of this, a new extended table 011030 was proposed which incorporates all the entries in 011031 with the same code figures and includes new entries designed mainly for turbulence forecasts. The proposed new descriptor is found in Annex to this paragraph.

3.1.11 Some proposed other additions for transmitting SIGWX data were made and recommended as operational by the Team. The additions are listed in Annex to this paragraph.

3.1.12 General frame for encoding any kind of meteorological features

3.1.12.1 The Team considered a proposal by METEO-FRANCE for a general frame for encoding any kind of meteorological features, also called objects, into BUFR. This came after numerous discussions held between World Area Forecast Centres and Météo-France. Several releases of this proposal had been edited and discussed during last years within the meteorological community. Météo-France considered that the exchange of meteorological expertise through BUFR will be generalised in the nearest future. In the light of its experience with BUFR decoding/encoding Météo-France therefore proposed a convenient and general frame for encoding any kind of meteorological feature that could be automatically or manually generated by a weather centre.

3.1.12.2 The BUFR code is such auto-documented that its descriptors could be used without any ordering. Decoded meteorological objects were usable only if a graphical process was performed to plot them. More and more applications in the world needed graphical interaction or building graphical products by using such objects and this was an increasing requirement. The main reason in support of

a general frame for encoding consisted in the need of optimisation. Routines used for BUFR-decoding and creating drawable features could not be optimised and easily maintained if the BUFR sequences were not consistent with a common frame Hence the necessity of drawing up a frame suitable for any meteorological object.

3.1.12.3 Meteorological features are or will be used for 2D-plotting. For that reason, location coordinates must be clearly distinguished from any other element describing the object. Therefore, the following structure made of three parts and ending with a cancellation part was proposed by Meteo-France:

- (i) significance : significance feature, dimensional significance, statistics if necessary
- (ii) location features (coordinates, including vertical coordinates)
- (iii) meteorological and any other data to describe the meteorological feature

3.1.12.4 This proposal aimed at a general and consistent frame for the expertise exchange between meteorological centres. Nevertheless it intended to minimise changes to BUFR sequences already produced by World Area Forecast Centres and used by several applications. On the other end, the proposed solution should offer wider opportunities to encode additional meteorological objects in any field of meteorology (nowcasting, marine, medias, hydrology,...) and facilitate their exchange. It was typically a template-oriented approach, but this would not prevent to allocate new sequence descriptors. The general frame proposed is listed in Annex to this paragraph. Meteo-France proposed also new templates to describe various features like the ash cloud of a volcano. These templates would need to be more validated before making a common sequence. Meteo-France proposed also, in order to respond to a requirement concerning details about the numerical model on which the analysis/forecast was based, that the header be completed with a new descriptor for model identifier. This descriptor is defined in the Annex to this paragraph.

3.1.12.5 The Team appreciated the work made by Meteo-France and considered it to be very useful and it should be used for any new meteorological object definition. The coordination with ICAO should be pursued to arrive at some stage to perform the changes in the existing SIGWX templates and common sequences, however this may be achieved not immediately given the existing developments achieved or current. The Team recommended for validation the new descriptors for model identifier.

3.2 REVIEW OF ENTRIES AWAITING VALIDATION FOR BECOMING PRE-OPERATIONAL

3.2.1 Reporting ozone concentrations:

During the previous year, U.S./NCEP undertook an effort with the U.S. Environmental Protection Agency to develop a BUFR/CREX methodology for the reporting of ozone concentrations. The resulting proposal was "allocated" last year and subsequently validated in early 2004 when several sample test messages generated by U.S./NCEP were successfully decoded at ECMWF and EUMETSAT. . As a result, the Team requested that the corresponding descriptors and addition in Code Table be approved for "pre-operational" status as listed in Annex to this paragraph.

3.2.2 US/NWS radiosondes

During the previous year, U.S./NCEP obtained sample BUFR high-resolution radiosonde messages generated from the U.S./NWS Radiosonde Replacement System (RRS) and made them available to other members of the ET/DR+C. These messages made use of new Table D sequences that had only been listed as "allocated" at the time. However ECMWF and UKMO were able to subsequently decode these sample messages and thereby validate these new Table D sequences, so the Team requested that the descriptors as listed in Annex to this paragraph be approved for "pre-operational" status.

3.2.3 ENVISAT, satellite zenith angle, oceanographic and wave spectra data

The Team agreed that since all the descriptors for ENVISAT, satellite zenith angle, oceanographic and wave spectra data were used operationally, they had to be declared pre-operational.

3.3 SIGMET IN BUFR

3.3.1 Following an original joint proposal presented to ET/DR+C (Prague, April 2002) by the representatives from Australia and ICAO for the encoding of volcanic ash SIGMET messages into BUFR, the U.S. National Weather Service's Aviation Weather Center (NWS/AWC) proceeded during the subsequent year to expand the proposal to include a methodology for the encoding of all types of SIGMET messages into BUFR. The Team examined again the corresponding proposed additions to BUFR and recommended some changes as listed in Annex to this paragraph. This proposal will be validated during the coming year by Australia, Meteo-France, UKMO and NCEP (USA). The points-of-contact for the planned validation in the USA are Mike.Campbell@noaa.gov, Steven.Danz@noaa.gov, in UK richard.orrell@metoffice.com, in Meteo-France Jean.clochard@meteo.fr and in Australia C.Sanders@BoM.GOV.AU

3.3.2 The Representative of ICAO indicated that Graphical SIGMET should be operational in 2007 and that there would be the requirement to indicate the boundaries of the flight information region (FIR) in the vizualization of the SIGMET. The Team agreed that this should be taken care at the vizualisation stage and that only the identification of the FIR shall be included in the BUFR SIGMET message itself.

3.4 NEW COMMON TABLES

3.4.1 Additional entries requested by France, Russian Federation and USA have been included in Code Table C-2 and this table was very near saturation. The existing capability for new radiosondes to be described in TEMP code was limited to a few without deleting existing entries in the code table. This could only be if there were some entries, which have never been used. The same existing table in BUFR has over 150 new possibilities available. Additional BUFR tables could be added to accomodate as many additional entries as needed. With BUFR there would be up to 254 entries. And if that is not sufficient a new descriptor could be defined. The CIMO Expert Team on Upgrading the Global Radiosonde Network (ET-UGRN) who met in November 2003 reviewed the information presented and endorsed the need to migrate as soon as feasible to BUFR but not later than the dates provided for in the migration plan. After discussion, the meeting agreed to allocate BUFR/CREX entries and not change at whatever cost the alphanumeric codes. A metadata file outside the code form was the best solution. A catalogue of Radiosondes maintained by the secretariat would be the procedure. Focal point on code matters should report radiosonde changes to the WMO secretariat. Maintenance of the catalogue should not be too difficult. New BUFR entries would be attributed as required. (see Annex to this paragraph)

3.4.2 Sooner or later all Countries should have the potential to produce BUFR messages. Every national producing centre should have an originating centre code. Entries could be given in Code Table C-1 for all the Countries of all the Regions (at least one per Country) except for RA I. Supplementary entries for RA I would be for edition 2 of GRIB and for the future edition of BUFR since they could be allocated only in Code Table C-11. Additional entries for sub-centres as requested by UK and EUMETSAT were also included in Table C-12. The Team agreed to the new Common Tables as listed in Annex to this paragraph with the reserved entries not for specifically defined Regions.

3.5 MASTER TABLE FOR SATELLITE DATA

A proposal was submitted by EUMETSAT suggesting conditions by which a separate BUFR master table could be created and managed for satellite data. This arose out of a concern for the increasing number of Table B and D entries in Master Table 0 that were directly related to satellite data. The team noted that CGMS had tentatively agreed to be the organization which would supply and manage the information in such a new master table and that a rapporteur could be designated which would facilitate the exchange of information between CGMS and the ET/DR+C. The team further noted that a previous request had already been made by the IOC for their own BUFR master table (number 10) related to oceanographic data and this requirement was recognized by CBS. The Team agreed that

general guidelines for the establishment and maintenance of such tables needed to be clarified. Following much discussion, the team agreed on draft set of conditions by which separate Master Tables other than Master Tables 0 and 10 could be created for use with BUFR.:

- Table C may not be changed, nor may Classes 00 and 31 of Table B. These would remain identical for any of the master tables.
- For Classes 01 through 09 (coordinate classes) and Class 33 of Table B, and for Categories 00 and 01 of Table D, these Classes and Categories must have the same name and be used for the same types of descriptors as in Master Table 0; however, individual descriptors within these Classes and Categories would be left to the discretion of the organization defining the particular master table in question.
- For Table A and all remaining Classes of Table B and Categories of Table D, these would be left to the discretion of the organization defining the particular Master Table in question.

These guidelines need to be re-examined and refined in order to possibly become regulations in the future. In the meantime, the team agreed to allocate Classes and Categories 40, 41 and 42 of BUFR Tables B and D within Master Tables 0 for use in reporting satellite data. CGMS would submit consolidated request for names of and entries within these classes to the ET/DR&C via its rapporteur.

3.6 MASTER TABLE FOR OCEANOGRAPHIC DATA

The Team was informed that oceanographers, through Bob Keeley from MEDS (Canada) had developed the master table for oceanography, as the requirement had been recognized by the CBS. However the status of that table was not known and the Team recommended that the Secretariat contact further Bob Kelley to coordinate future actions for possibly including this table in the WMO Manual after re-examination by the Team.

3.7 IMPLICATIONS AND NEED FOR A NEW EDITION OF BUFR AND CREX

3.7.1 Additions relative to a new edition

3.7.1.1 Representation of probabilities, other forecast values and introduction of new operators

The Team considered that the requirements expressed in the previous Meeting of the Expert Team in 2002 in Prague and Arusha for new operators and for representation of probabilities and other forecast values were still valid and remained part of a set of additions necessary in a new edition of BUFR. However these additions should remain for validation for the time being. ECMWF offered to help for the validation**.** However few changes were required as listed in Annex to this paragraph.

3.7.1.2 Data category and sub-category definitions

The team agreed in general to designate subcategories based upon data types (e.g. synoptic vs. aviation) as well as platform type (land vs sea). Sub-categories would help switching BUFR/CREX messages during transmission as well as metadata identification within the FWIS context. It was further agreed that, for the subcategories corresponding to a particular traditional alphanumeric code form, the name of that code form would be included parenthetically as an intuitive aid but could be removed at a later date once migration was complete for that particular data type. The initial list of defined subcategories is listed in Annex to this paragraph.

3.7.1.3 Full date in BUFR and modified regulation 94.1.3 for length of section in octets

Following the problems encountered during the Y2K crisis, it had been proposed before to modify the system of reporting dates in BUFR, using the opportunity of the creation of a new edition. The proposed format for the new BUFR Edition 4 is to follow the system adopted for GRIB Edition 2, but without the reference time significance. The Team agreed that with a new edition, Section 1 should be as listed in Annex to this paragraph. The Team also agreed to modify regulation 94.1.3 for the new edition indicating that each section shall contain an integer multiple of octets as listed in Annex to this paragraph.

3.7.2 Need for a new edition of CREX

In Annex to this paragraph an excellent table originally made by Atsushi Shimazaki (JMA) is listed. It shows the existing difference between BUFR and CREX. To ease the conversion between BUFR and CREX it might be appropriate to add features to CREX but this would require making a new edition. The new edition for CREX could include features, which would be useful and may be requested also in processing CREX messages. The Team agreed to include the following features in a new edition of CREX:

Version number of local table
Typical date/time
Originating centre
Originating sub-centre international
Update sequence No.
Data category
Data sub-category international
Number of data subsets

3.7.3 Implications of new edition of BUFR and CREX

The implementation of a new edition of BUFR and CREX at a time of the migration to TDCF would not be so simple for the countries that would switch to TDCF. All the decoding software would have to be changed to accept new edition data. Encoding systems would have to be progressively adjusted to produce data in the new edition format. It would be a migration within the migration and the migration to TDCF process might be substantially more complicated. If advanced centres had not too much difficulty for changing their software, it would be more difficult to be understood and implemented by developing countries. When one tries to promote the migration because it would simplify code changes, it would be difficult to explain that one has to change everything again. That pessimistic opinion would call for a later implementation of the new edition, when the migration process of basic data should be completed. Japan expressed concern because of national users of BUFR. It was however noted that WMO had lived with simultaneous editions of GRIB for a long time. The problem was remote users who would not have the last decoder to decode the new edition. However that user would be most likely to use decoder from main software house like ECMWF software who would make the change in the decoder quickly to be able to decode BUFR new edition. It was then recommended to make a new edition for November 2005 for BUFR and CREX, with the understanding that both edition could be used in parallel up to 2012, when the migration process will be fully completed, BUFR edition 4 and CREX edition 2 being the only ones accepted after that date. Decoder software providers were urged by the team to adjust their software as soon as possible to be able to decode BUFR edition 4 and CREX edition 2. Encoders should also be adapted to encode data in the new editions formats.

4. MODIFICATIONS TO TRADITIONAL ALPHANUMERIC AERONAUTICAL CODES

ICAO presented the modifications that will be necessary to aeronautical meteorological codes as a result of Amendment 73 to Annex 3. It was recalled that all the proposed amendments were consequential to new or amended operational requirements included in Amendment 73 to Annex 3, which had been subject to the standard consultation process, a final review by the ICAO Air Navigation Commission (ANC) and adoption by the ICAO Council. The team confirmed that it was not possible to envisage identical applicability dates for the amendment to Annex 3/Technical Regulations (C.3.1) and to the *Manual on Codes* (WMO — No. 306), since the latter was still subject to the adoption by the Commission for Basic Systems (CBS). It was recommended that the applicability date for this amendment be as soon as practically possible after the 13th Session of the CBS to be held in February 2005 and 2 November 2005 was recommended. However, the Team would have understood the ICT on ISS or CBS might propose another date because of implementation delay. Comments received on this amendment by various group or countries (Meteo-France, KNMI and PROMET) were considered. And ICAO and the Team agreed to change regulation 15.8.8, add a new sentence to regulations 15.13.2.1 and to regulation 15.4, to recall that ICAO required all the parameters to be reported, although automatic systems could not be 100 % reliable. The proposed changes are listed in Annex to this paragraph. The Team and the ICAO representative also recommended that ICAO should seriously consider the harmonization of implementation dates for code changes and Annex 3 amendments, in consultation with WMO.

5. MANUAL ON CODES

5.1 OBSERVATION REPORTING PRACTICES

5.1.1 The meeting recalled that the Manual on Codes Volume I.1, which defines the TAC, contains more regulations related to reporting practices than formatting rules and that the Manual links reporting practices to the alphanumeric coding format. Volume I.2, which defines the TDCF, contains formatting rules, and practically no reporting regulations. The meeting reasserted the need to separate reporting practices from the TAC and rewrite those which need to remain in the Manual on Codes in a way in which they are not linked to any specific format.

5.1.2 Dr Cliff Dey as a consultant to WMO had made a start on this work. Additional work was needed to define more appropriate common sequences that should be in a new Volume I.3 of the Manual on Codes, where standard templates would be defined. It would be kept online in the WMO server. Dr Dey had developed a set of regulations for observations disconnecting the reporting practices from the coding in traditional format for some traditional code forms (FM 12, 13, 14, 18, 20, 22, 32, 33), however the sections and the order of the traditional code form were kept. The BUFR templates contain a different order of parameters. The additional work would need to consider what would be the best order both from a migration standpoint and a coding standpoint. The work should also determine the best way to present the information. The meeting recommended that a consultant be hired by WMO to perform this task. The result should be validated possibly by use.

5.2 REVIEW OF AVIATION TEMPLATES

The meeting noted there were discrepancies between ICAO requirements defined in the templates as listed in Annex to this paragraph and aviation code documentation. It was agreed to work over the next year with ICAO to review these discrepancies and to provide the needed updates.

5.3 EDITORIAL CORRECTIONS

Editorial corrections to the Manual on Codes were pointed by USA, as defined in Annex to this paragraph and should be implemented.

6. MIGRATION TO TABLE DRIVEN CODE FORMS

As requested by CBS, the ET/MTDCF completed a plan for migration to TDCF. The era of implementation and coordination had now started. The Plan called for the start of operational exchange by November of 2005 of data from category 1, Common codes. This category includes SYNOP, TEMP, PILOT and CLIMAT. The Annex to this paragraph contains the full Code Migration Schedule from the Migration Plan that defines categories of codes and critical dates applicable to migration. RADREP, CODAR, ARFOR and WINTEM were moved to category 6.

6.1 REVIEW AND DEFINE NEEDED TEMPLATES AND COMMON SEQUENCES

The meeting reviewed templates and common sequences for representing the TAC in Category 1, common codes. It noted and thanked Dr Eva Cervena of CHMI for her work over several years to develop and refine applicable templates.

6.1.1 Dr Cervena with input from particular Messrs J. Ator of the U.S. NOAA/NCEP, M. Dragosavac of ECMWF and C. Long of UK Met. Office updated templates and common sequences developed to encode PILOT and TEMP observations. The Team agreed to recommend these sequences as pre-operational. The meeting noted with satisfaction the templates could be applied to vertical profile data in general and not just PILOT and TEMP. The meeting agreed to rename the template as a vertical profile template that (should) be used for PILOT and TEMP observations (See Annex to this paragraph).

6.1.2 The meeting reviewed and approved BUFR and CREX templates for AMDAR profiles that were updated to add latitude and longitude at each reporting level (See Annex to this paragraph). This template had application for any aircraft ascent/descent profiling and was renamed as an aircraft ascent/descent profile that (should) be used for AMDAR data. There was a previous suggestion to convert aircraft profiles into TEMP code. This is contrary to the intent of migration and use for this data which had never been done before. If there is a need for aircraft profile in an alphanumeric format then CREX should be used. This is consistent with migration. CREX and BUFR can be easily transformed back and forth. CREX offers all the advantages of BUFR (it can evolve, is flexible and expandable, etc), and is an alphanumeric code like TEMP.

6.1.3 The meeting reviewed the current version of BUFR templates and proposed sequence descriptors, still to be validated, for SYNOP, SYNOP MOBIL and SHIP observations developed by E. Cervena. Consistent with other decisions for template naming conventions, the names of these templates were changed to synoptic reports from land and sea stations that (should) be used for SYNOP, SYNOP MOBIL and SHIP data. It was also agreed to change references to elevation within the template to “elevation angle” to be consistent with the wording in SYNOP coding and to clarify the meaning. A minor change in the template for AWS n-minute data was also agreed. See Annex to this paragraph.

6.1.4 The meeting examined a BUFR template for SYNOP observations supplemented by additional information developed by Madeleine Ceron and modified by Jean Clochard both of Meteo France. There were a number of national practices included in this template. The meeting suggested Meteo France consider whether this template could be made to fit within the standard synoptic observations template along with utilizing the approach for regional and national practices which the ET/DRC developed.

6.1.5 The meeting agreed to change the template to be used for CLIMAT data as proposed by DWD and listed in Annex to this paragraph.

6.1.6 The meeting considered how regional and national practices should be incorporated into templates. The Standard templates were developed to meet internationally agreed global coding requirements. One approach was to modify the standard template for each intended use effectively creating six or more additional templates for regional use and many more for national use. Another approach was to keep the standard templates as unchanged as possible with the regional and/or national practices added to the standard templates either at the end or within it, but in a consistent, well documented manner. Several key guidelines were recognized as important to the solution and critical to the support of migration. These were compatibility between BUFR and CREX, simplicity of approach and keeping the approach as conceptually close to existing practices used for TAC. These guidelines would help users and producers of data understand the relationship between TAC and TDCF. The meeting agreed that when it was necessary to place regional/national practices in the middle of a template rather than at the end a specific note would be added to the template indicating where this should be done. It was also agreed the guidelines listed above should be documented in each standard template as well as in the BUFR guide and other BUFR/CREX documentation. The meeting further considered the need for consistency in the use of standard templates for reporting certain data types such as TAC data. This should also be included in BUFR/CREX documentation.

6.2 TAF TEMPLATE

Charles Sanders, Australia developed a BUFR template for TAF data. The proposed template shares features with the existing METAR/SPECI template. It was suggested the two templates could be linked via common sequences or even be coalesced into one template. Additionally, some errors were identified in the existing METAR/SPECI template. The meeting echoed the feeling of Neil Halsey, the ICAO representative that it was important to keep the TAF and METAR/SPECI templates separate. It was felt this was also a better approach that simplifies these templates for users as well as better supports migration strategy. The meeting agreed the METAR/SPECI templates should be reviewed and coordinated with ICAO. It should have consistency with ICAO requirements templates for

METAR/SPECI. The same applies for the TAF template. Charles Sanders will work with N. Halsey and the ET/DRC to update the TAF and METAR/SPECI templates. (see Annex to this paragraph).

6.3 VOLUME OF TRANSMISSION OF OBSERVATIONS IN TDCF

M. Dragosavac of ECMWF did some work to estimate the volume of 24 hour TAC data converted into BUFR and CREX from data stored in ECMWF data files on a representative day. Comparison of sizes was provided between BUFR and CREX formats for collectives of different sizes as well as with and without QC data. It was estimated the ratio of BUFR and CREX data volumes for the same data was about 1:6. The daily volume of TDCF data if current data were fully migrated was less than 20MB. The meeting after reviewing the study felt this number might be too high. The data studied included ACARS and other data that were not exchanged in TAC format today. The meeting expressed the need for additional study to have a better definition of daily data volumes of both TAC and TDCF for the equivalent data. The meeting also felt it would be good to know the typical daily total volume of GTS data. M. Dragosavac kindly offered to do some additional work to clarify these issues.

6.4 REVIEW STATUS OF MIGRATION

As requested by CBS, the ET/MTDCF completed a plan for migration to TDCF. The times were now the era of implementation and coordination. The Plan calls for operational exchange by November of 2005 of data from Category 1, Common codes. This category includes SYNOP, TEMP, PILOT and CLIMAT. Some recent ongoing activities of significance to migration are summarized below.

6.4.1 Reported uses of TDCFs:

There is considerable data already being operationally exchanged. It is not intended here to list every example of exchange activities especially those already commonly known. Here are some recent specific activities.

6.4.1.1 The U.S. NWS has developed and is currently testing a replacement for its existing radiosonde system. The RRS has the capability to provide upper air observations in both traditional alphanumeric codes (TAC) and in BUFR. Initially, transmission is planned for both formats. The initial BUFR data will have at least the resolution of the TAC data. The U.S. will consider provision of higher resolution data depending on communication capability. At some point the TAC format will be discontinued. U.S. NWS Forecast Offices' workstations were designed to receive and use BUFR for upper air data. To feed them RTH Washington developed software to translate TAC upper air data into BUFR. This translation is done for all stations that are needed by the Forecast Offices. Many reports from non-U.S. stations are being translated. These data are made openly available. This capability may need to be continued after implementation of RRS as long as needed stations are still reported only in TAC. The U.S. is considering further expanding the stations that are translated. The U.S. contracted the production of replacement workstations for existing ISCS workstations it sponsors or uses. These stations have BUFR and GRIB 1 and 2 decoders to be prepared for code migration.

6.4.1.2 Newer Canadian automated observation systems generate observation in BUFR format at the source. They are then translated to whatever format is required for delivery such as METAR. Fiji had indicated they are pursuing making observations available in CREX. Service ARGOS is providing buoy and float observations in both TAC and BUFR. They will continue to provide dual transmission to facilitate users' transition to processing BUFR data. Most of the BUFR observations are being produced via centralized processing. Gradually fielded systems will provide direct BUFR output.

6.4.1.3 A trial was held to validate the New BUFR Template for AMDAR proposed and approved by the CBS ET on Data Representation and Codes at its meeting in Prague 2002 in preparation for approval by the CBS. DWD as one of the AMDAR BUFR data providers was asked by the WMO AMDAR Panel on behalf of the CBS ET/DR&C to implement the New BUFR Template and to test it in an operational environment in collaboration with another NWS as a test partner and receiver of the test messages. KNMI and CMC declared their willingness to participate in the WMO BUFR trial and to act as test partners. The trial was performed by all participants as a contribution in kind to the work of WMO and the AMDAR Panel in particular. The WMO BUFR Trial was performed in the period from 25th July to 24th October 2003 with the aim to validate the New BUFR Template for AMDAR. The AMDAR BUFR

data were encoded by the LH company Lido with its independently developed coding program. The trial partners KNMI, CMC and DWD were able to decode the transmitted operational test data faultlessly. CMC and DWD used independently developed decoders. KNMI used the same decoder as DWD, but in a different hardware and software environment. The decoded test values met the reference values exactly. This was also valid for the BUFR elements Latitude, Longitude and Temperature.

6.4.1.4 Satellite data producers are already exchanging data in BUFR and this will expand significantly in the future. Their needs continue to expand. There was still some production and use of SATOB, SARAD and SATEM data. Work needs to be done to facilitate final migration away from these code types for satellite data.

6.4.1.5 The Secretariat had compiled a list of known experimental exchanges of observations in BUFR and CREX which are listed in ANNEX to this paragraph.

RTH roles:

6.4.1.6 Through both multilateral/bilateral agreements between RTHs and WMO agreed initiatives, expanded routing and exchange of BUFR and CREX data is taking place with additional exchange coordination ongoing. The Chairman of ET/MTDCF will be working with the RTH Focal Points to extend this exchange further.

GRIB issues:

6.4.1.7 The key issue here is the transition of GRID data to GRIB. There are very few producers of GRID data today and requirements for GRID data are limited and shrinking. The Migration Plan calls for GRID to be transitioned by the end of 2008. The meeting agreed transition from GRID is not a major issue for migration, it is likely to move forward on it's own. However the situation still needs to be monitored and progress encouraged.

6.4.2 Promotion of TDCFs

6.4.2.1 The Chairman of ET/MTDCF made a presentation on code migration to this year's North American Europe Data Exchange (NEDEX) meeting after which migration was discussed. It was agreed the NEDEX group needed to focus on migration issues pertinent to it. Several actions were identified related to data exchange as well as data production. Migration will remain as a focus of the NEDEX group and it will work to support it via multi-lateral agreements and activities. The Chairman made also a presentation on code migration to this year's Asia Pacific Satellite Data Exchange and Utilization (APSDEU) meeting after which migration was discussed. It was agreed the APSDEU group needed to focus on migration issues pertinent to it. Several actions were identified related to data exchange as well as data production. Migration will remain as a focus of the APSDEU group and it will work to support it via multi-lateral agreements and activities. The Chairman attended the WMO Implementation Coordination Meeting on GTS and ISS in RA-V (ICM/RA V) held in December 2003 and code migration issues were discussed there. There was good support for migration but this was a region that was dependent on hardware and software systems to be able to fully implement code migration. Significant work needs to be done to develop and coordinate plans in this region. The Chairman presented information on migration to the United States Antarctic Program (USAP) during a recent meeting in May 2004. Representatives from other nations' Antarctic programs also attended this meeting. Discussions were held and a number of initiatives agreed to begin planning and implementation of several migration initiatives. The Chairman will be working with several organizations to make Antarctic observations available in BUFR and CREX.

6.4.2.2 The Hydrometeorology Equipment Industry (HMEI) group met this year during the U.S. American Meteorological Society (AMS) annual meeting. The Chairman of ET/MTDCF attended this meeting, provided a briefing and led a discussion on code migration. The manufacturers are very interested in migration and warmly received the presentation. They seem eager to provide systems to meet migrations goals and most either already have or are working to provide systems that provide output directly in BUFR.

6.4.2.3 The Chairman of ET/MTDCF attended the WMO CIMO Expert Team on an Upgraded Radiosonde Network (ET/UGRN) held in October/November 2003. There were observers from HMEI and several manufacturers at the meeting. The Chairman provided a presentation on and there was considerable discussion of migration. Much work has been done to provide BUFR reporting radiosonde systems on a global basis. This group is continuing to work to facilitate code migration as part of an upgraded radiosonde network.

6.4.2.4 The international multi-lateral Group on Earth Observations (GEO) is developing a 10 year plan to provide an integrated Earth Observation System spanning multiple disciplines and focused on addressing key issues resulting in societal benefits. The Chairman of ET/MTDCF is involved in the Subgroup on Data Utilization (SGDU) which is tasked with working on data policy, data sharing, data formats, transformation into information and other issues within the full range of data utilization. Members of SGDU have discussed WMO code migration and agree this should be fully supported within the overall structure of GEO data utilization. At this time, the GEO focus is on strategic issues for the 10-year plan however a technical document will be developed which should embrace objectives consistent with migration objectives. The Chairman of ET/MTDCF co-chairs the U.S. Office of the Federal Coordinator for Meteorology (OFCM) Committee for Environmental Information Systems And Communications (CEISC). CEISC has discussed code migration and it's impacts. A CEISC sub-group is the Working Group on Meteorological Codes (WGMC) that is chaired by J Ator who is also a member of ET/DRC. At the last WGMC meeting code migration was also discussed and the TOR of the WGMC has been amended to have the task of developing a coordinated U.S. implementation plan for code migration. CEISC will be meeting again in July 2004 where code migration will be discussed again.

6.4.3 Review results of questionnaire

The secretariat provided a synthesis of the results of the Questionnaire on WMO Codes Processing (see Annex to this paragraph). There were 51 responses from 49 states and also from ECMWF and EUMETSAT. By regions, there were answers from RA I: 4, RA II: 9, RA III: 4, RA IV: 6, RA V: 3 and RA VI: 22.

6.4.3.1 Data reception:

- Among the 51 answers, only one centre stated not to be able to receive TAC data through GTS, Internet or works-station dedicated to satellite reception. And still 5 centres out of 51 were not automated. Eleven centres were notably receiving CREX, but only 3 were automatically decoding it. Thirty six centres were notably receiving GRIB with 31 processing it. Thirty centres were receiving BUFR data, but only 24 were decoding it. Ability to receive data through Internet was noted for TAC: 22, for CREX: 1, for GRIB: 21 and for BUFR: 13.
- Eight centres used BUFR as internal Data Base Format for observations received in TAC.
- The operating systems used were for almost 60% UNIX or LINUX systems and for about 30% WINDOWS systems. FORTRAN was the language used in 80 % of the cases, with about 1/3rd in version 77 and 2/3rd in version 90.

6.4.3.2 Encoding (see extract of questionnaire below):

- About 16% (only 5% in 1998).of countries encode some data types in CREX (10% at platform site, 3.5% in 1998)

- About 40 % (only 21% in 1998) of countries encode some data types in BUFR (12% at platform site, same in 1998).

Progress in the encoding of CREX and especially BUFR was thus observed, however one could notice it concerned mostly Region VI which represented 44% of the answers.

The encoding software was mostly run on UNIX and LINUX operating systems. WINDOWS and MS_DOS were found only in two cases each. FORTRAN and C were the most languages used.

BASIC was found only 3 times and PASCAL once.

Questions		*Alphanumeric code* FM 95 CREX	*Binary code* FM 94 BUFR
a)	**Encoding at observing site or platform ?**	YES **5** NO **40** blank **6** manual **1** automatic **5**	YES **6** NO **36** blank **15**
	if YES, for which data types?	AWS **2,** BATHY **1**, BUOY **1**, Ozone **3**, SYNOP **1**, Sun radiation **1**, TESAC **1**, WAVEOB **1**, Miscellaneous **1**	AWS **2**, CLIMAT **1,** RADAR **4**, SYNOP **1,** TRACKOB **1,** Wind profiler **2**
b)	**Encoding at processing, concentration or telecommunication centre ?**	YES **3** NO **36** blank **12**	YES **15** NO **22** blank **14**
	if YES, for which data types?	DCP data **1**, Soil Temperatures **1,** Tropical Cyclone data **1**	AMDAR **2**, AWS **1**, BUOY **1**, GPS **1**, METAR **1**, PILOT **1**, RADAR **8**, Satellite data **2**, Soil Temperatures **1**, SYNOP **3**, TEMP **3**, TEMPSHIP **1**, Tropical Cyclone data **1**, Wind profiler **2**

One could note that CREX was definitely <u>not</u> a "non-starter" in the migration process and that some countries used it for SYNOP, AWS, BATHY, BUOY, TESAC and WAVEOB encoding even at the observing platform level.

6.4.3.3 Migration plan: Unfortunately only 8% of the countries had developed a migration plan, but 20% were currently developing one. Every other country were planning to develop a plan within the next five years. Three important comments were given concerning difficulties for the migration:

- *Cooperation between departments within the Meteorological Service will be necessary.*
- *The migration has to be coordinated internationally in a better way, especially for marine data (VOS-SHIP).*
- *International technical assistance is required.*

BUFR was already used for national/local/domestic data exchange by 30% of the countries for various data types. Only 24% of the countries had already secured a BUFR/CREX decoder. Unfortunately 9 countries did not plan to have a decoder for the migration. This answers might indicate a misunderstanding or lack of information. UNIX-LINUX 60% and WINDOWS 20% seemed to remain the foreseen used operating systems in the future for decoding.

6.4.3.4 Future encoding:

Still 16% of the countries envisaged CREX encoding at observing platforms, and 22% at concentration site. For BUFR it is respectively 30% and 60%. All data types are concerned. Dates given for the operational readiness spanned from 2004 to 2008.

6.4.4 Review status of universal BUFR decoder software for UNIX and WINDOWS

6.4.4.1 ECMWF responded to a request from WMO to specify, develop and distribute universal BUFR, CREX and GRIB decoding/encoding software on various platforms to the whole meteorological community. ECMWF is now providing BUFR software via free download. The software is distributed under rules agreed by the ECMWF's Council. The software can be downloaded from: http::/www.ecmwf.int/products/data/software. Both a compiled binary and the source code are available for various platforms. A BUFR User's Guide and a BUFR reference Manual in PDF form are also available. The compiled versions can be installed on the Linux, Windows (with CYGWIN), Decalpha, Sgimips, Macintosh OSX 10.1 and higher. More detailed information is listed in Annex to this paragraph.

6.4.4.2 The German Meteorological Service "Deutscher Wetterdienst" (DWD) developed a BUFR edition 3 library called BUFR3 which can encode or decode BUFR data. The distribution of the code and organisational matters has been handed over from DWD to the International Meteorological Systems (IMS) consortium. BUFR3 is available via a lump sum licence including support and possible updates for the first year as follows:

- Developing country: 100,00 Euro (net)
- Threshold country: 1.000,00 Euro (net)
- Developed country: 2.500,00 Euro (net)
- Company: 5.000,00 Euro (net)

After the first year updates are available for 20% of the lump sum licence. Developing countries shall receive updates exempt from charges. BUFR3 is distributed by the company Ernst Basler + Partner (www.ebp.de).

Extended functionality of the BUFR3 library as well as interpretation of BUFR reports is included in the GloBUS decoding system. The decoding can be done in a batch process or via a graphical user interface. BUFR is generated following the new templates developed by WMO. GloBUS can be used universally, on notebooks as well as in a client/server environment on supercomputers. GloBUS was developed for the German Meteorological Service Deutscher Wetterdienst (DWD) and is distributed by the company Ernst Basler + Partner (www.ebp.de). The BUFR3 library developed by the German Meteorological Service "Deutscher Wetterdienst" (DWD) gives full support to reading and writing meteorological data in BUFR. More detailed information is listed in Annex to this paragraph.

6.4.5 Review status of universal CREX decoder/encoder software for UNIX and WINDOWS

The ECMWF is also providing CREX software via free download. The software is distributed under rules agreed by the ECMWF's Council. The software can be downloaded from: http::/www.ecmwf.int/products/data/software. More detailed information is listed in Annex to this paragraph.

6.4.6 Implementation of the Migration Plan

The Secretariat provided a review of the status of implementation actions from the Migration Plan. These are included in ANNEX to this paragraph.

6.5 REVIEW ACTIONS TO BE PERFORMED AND DEFINE NECESSARY NEW ACTIONS

The meeting reviewed actions identified through previous activities, considered new actions and urged the following activities for continuing and future work.

6.5.1 The Secretariat should perform the following actions:

- Send information for Members through PR and Focal points including status updates. This should include a reminder to develop a national plan.
- A migration guidance document should be developed in coordination with the ET/DRC and ET/MTDCF which would identify the activities and issues members need to consider or address in the planning, coordination and implementation.
- Send questionnaire every two years to Focal Points (if possible limited to one page and focusing) - Inform Regional Rapporteurs - Results on Web
- Send METNO for migration warning (new bulletins) and Newsletter (advance warning and TAC stop warning)

- Maintain WMO Web site on migration *(separate templates for different observation types)*
- Aggressively continue the WMO training programme on MTDCF for trainers and software users
- Organise pilot projects and corresponding capacity building workshop
- Explore ways of working with manufacturers through existing activities and dedicated workshops/meetings
- Continue to provide Level 1 training in other WMO seminars.

6.5.2 Recommendations for co-ordination and review mechanisms

Information coordination and reporting of Migration Activities

6.5.2.1 Effort must continue to ensure all migration activities are integrated, impacts are minimized, problems are identified and progress monitored:

- Information coordination will be done via a tree structure with national and organizational focal points at the bottom. The next level would be regional focal points and rapporteurs or focal points in other teams or groups. The high level will be the ET/MTDCF or a successor team .
- Each level has responsibility for collecting information on migration activities and progress, consolidating it and making it available to levels above and below them.
- Regional and other appropriate focal points need migration responsibilities outlined in their terms of reference.
- These persons will provide central coordination of activities including experimental exchange and testing.
- ET/MTDCF would provide reports to OPAG/ISS, CBS or other bodies as needed and coordinate with them.
- It is recommended that the chairman of ET/MTDCF would sit as a member on ET/DRC and other groups as needed.

Catalogue of data available in a table driven format

6.5.2.2 A catalogue of all data exchanged in real-time (Bulletins) and possibly files in table driven format (either BUFR or CREX) should be built and made available on the web:

- It will help to spread the capability to handle table driven code forms.
- There is already a mechanism in WMO for cataloguing this information. It is Pub. 9, Vol. C. However, it is very generic, under-utilized and provides no focus to migration.
- The purpose of this cataloguing is to help increase data exchange by making Members aware of what is available, to assist in tracking migration and as a tool to help coordinate migration and data exchange.
- This activity would be started with information from national focal points that WMO has already requested from each member, regional Rapporteurs who would be given migration responsibilities. It is also would be coordinated with each respective RTH focal point.
- The cataloguing would include a complete review of existing bulletin definition to ensure the current catalogue is correct. It is important that obsolete bulletins are removed and that the de-cataloguing of bulletins is continued through the migration process.
- Information for all the Members would then be possible by the Secretariat with this information.

6.5.2.3 Co-ordination and review mechanisms at WMO level

Inter-Commissions

Other WMO Commissions should be informed of development and progress of the migration, by correspondence or participation with representative in the ET/MTDCF meetings.

With other Organisations, Agencies

Coordination at the international level in the marine and oceanographic communities of WMO and IOC will primarily be done through the JCOMM Data Management Programme Area (data distribution and archive, data users) and through the JCOMM Observations Programme Area where panels such as the DBCP, SOOP, ASAPP, and VOS actively participate and make observations (data producers). A representative of IOC should always participate in the meetings of the ET/MTDCF and DR&C. Coordination with ICAO is done through the representative of ICAO who should always participate in the meetings of the ET/MTDCF and DR&C.

6.5.2.4 Co-ordination and review mechanisms at Regional and National Levels

Role of regional rapporteurs

The successful implementation of the migration to table driven codes in developing countries largely depends on capacity building. Therefore an analysis of needs for further development of the WWW including GTS should be carried out at national and regional levels, and then regional strategic plans should be formulated to enhance basic facilities in the NMCs of developing countries. The regional rapporteurs should follow and coordinate the migration in their region and contribute to the establishment of the regional plan if necessary. They should provide guidance and assistance to NMCs and RTHs that are using national and regional coding practices that differ from international coding procedures. There is a need of coordination with the ET/DR&C to develop BUFR and CREX descriptors to address the optional sections of existing code structures within the current alphanumeric code forms as a replacement for these structures in BUFR.

Role of national focal-points

The national focal points should follow and coordinate the migration in their country and contribute to the establishment of the national plan. The focal point should ensure that the country notify the WMO Secretariat when planning to transmit data in BUFR or CREX, and send warning when TAC transmission are planned to be interrupted. National Focal points on Code matters should be reminded of these recommendations and should have access to documentation (WMO server, CD-ROM).

Establishment of a National Migration to TDCF Steering Group (NMTSG)

A National Migration to TDCF Steering Group (NMTSG) composed of national experts and including the national focal point should be established in every country to plan and optimize the transfer to Table Driven Code Forms. Russia and USA and some other members have already taken this initiative. Concerning the Actions by countries themselves, in view of the very small number of Countries who have a national migration plan, action, like a message to Code Focal Points and even a letter, may be considered to be sent to the Permanent Representatives to remind that they have to develop and implement a national plan for the migration to TDCF. A “Migration News” could also be included in the WWW newsletter to push a bit more countries to act.

7. USE OF XML FOR THE REPRESENTATION OF METEOROLOGICAL METADATA

7.1 The Meeting was informed that the Centres of Exeter, Offenbach and Toulouse were working in association with ECMWF and EUMETSAT on the development of a Virtual Global Information System Center (VGISC). The project of implementation of a VGISC in Region VI was considered as a central pilot project for the Future WMO Information System. The development of the VGISC was based on the use of:

- The ISO 19100 series of geographic information standards, in particular the ISO standard 19115 – Geographic information - Metadata for the definition of the metadata;

- And XML for the presentation of metadata and data.

7.2 The Expert Team on Integrated Data Management (ET-IDM) was working on the development of a WMO metadata standard. The ET-IDM was refining WMO metadata standard and considering the next step of the development of the WMO metadata standard required for the request/reply mechanism. Mr Gil Ross from UK, active member of the team on integrated data management raised questions related to the presentation of “cut-down” metadata and data for current WMO bulletins, in particular he found it was difficult to extract metadata from a BUFR message without decoding completely the message, especially when it was a multi-reports message.

7.3 The Team recommended that before defining additional standard parameters, as metadata, in Section 1 of BUFR, a precise list of the requirements should be given. The requirement so far has been for the applications, like data assimilation for NWP, where precisely the instrument metadata are attached immediately to the value observed, and a limited set of metadata is listed in Section 1. The Team agreed to consider the requirements at a later stage when more clear need would be expressed. It would have to be done during the next few months to be approved by CBS XIII for inclusion in the next edition of BUFR.

8. ACTIONS PLAN

8.1 NEXT MEETING:
It was suggested to have the next meeting in a place situated in West RA II or East RA VI to be able organize a follow-up training event in the same manner as it was done in Arusha and Kuala Lumpur.

8.2 TASKS:

- 2.1.1: Note pointing PDT 4.14 not validated to be added – Secretariat
- 2.1.1: Validation templates 4.10 to 4.14 - NCEP, ECMWF
- 2.1.1: Contact centres not represented at ET - Chairman, with the help of US representatives
- 2.2: Validation of templates for cross-sections and Hovmöller type diagrams – All concerned
- 2.3.2: More tests JPEG2000 and WH compression – NCEP, ICAO
- 2.4.4: Revise list of new parameters by email - All concerned
- 2.5.4: Define new discipline and parameters (GMES) – ECMWF
- 3.1.2: Validation of new descriptors for nominal and instrument values – All concerned
- 3.1.2: Check with Service ARGOS use of 0 07 064 and 0 08 082 – Eva Cervena
- 3.1.12.5: More validation of meteorological features templates- Meteo-France and ICAO
- 3.3.1: Validation of BUFR SIGMET – Australia, Meteo-France, UKMO and NCEP.
- 3.5: Refine Master Tables definition to make regulations – All concerned
- 3.5: To refine proposal for the satellite Master Table content- Simon Elliott through CGMS
- 3.6: Contact Bob Keeley for status of Master Table for oceanography – Secretariat
- 3.7.1.1: Validation of representation of probabilities, forecast values and new operators – NCEP, ECMWF
- 4.: Seriously consider the harmonization of implementation dates for code changes and Annex 3 amendments - ICAO and WMO Secretariats to make proposals
- 5.1.2: Consultant to finalize the reporting practices for BUFR/CREX – Secretariat
- 5.2: Review aviation templates – ICAO and all those concerned
- 6.1.3: Validation of new element and sequence descriptors for representation SYNOP and SHIP data – All concerned.
- 6.1.4: Standardize SYNOP template with national and regional practices – Meteo-France
- 6.1.6: Guidelines to place regional/national practices in the middle of a template rather than at the end should be documented in each standard template as well as in the BUFR guide and other BUFR/CREX documentation – All concerned
- 6.2: METAR/SPECI; TAF templates to be reviewed – Charles Sanders and ICAO
- 6.3: Volume of observations in BUFR, CREX versus TAC; more estimates needed – Milan

Dragosavac

- 6.4.1.4: Work needs to be done to facilitate final migration away from SATOB, SARAD and SATEM – Simon Elliott and all concerned
- 6.4.1.6: Extend exchange of BUFR and CREX data through both multilateral/bilateral agreements between RTHs and WMO agreed initiatives - Chairman of ET/MTDCF will be working with the RTH Focal Points
- 6.4.1.7: Encourage and monitor transition from GRID to GRIB – Chairman ET/MTDCF
- 6.4.2.1: Working with several organizations to make Antarctic observations available in BUFR and
- CREX - Chairman ET/MTDCF
- 6.5.1: The Secretariat should perform the following actions:
    - Send information for Members through PR and Focal points including status updates. This should include a reminder to develop a national plan.
    - A migration guidance document should be developed in coordination with the ET/DRC and ET/MTDCF which would identify the activities and issues members need to consider or address in the planning, coordination and implementation.
    - Send questionnaire every two years to Focal Points (if possible limited to one page and focusing) - Inform Regional Rapporteurs - Results on Web
    - Send METNO for migration warning (new bulletins) and Newsletter (advance warning and TAC stop warning)
    - Maintain WMO Web site on migration *(separate templates for different observation types)*
    - Aggressively continue the WMO training programme on MTDCF for trainers and software users
    - Organise pilot projects and corresponding capacity building workshop
    - Explore ways of working with manufacturers through existing activities and dedicated workshops/meetings
    - Continue to provide Level 1 training in other WMO seminars.
- 6.5.2.2: Build a catalogue of all TDCF data exchanged in real-time (bulletins) – Secretariat?
- 6.5.2.3: Invite other commission representatives in ET/MTDCF meetings (CAeM, CCL, JCOMM) – Secretariat
- 6.5.2.4: Develop regional and national descriptors and common sequence for templates – ET/DR&C as a whole.
- 6.5.2.4: Remind focal points their role – Secretariat
- 6.5.2.4: Migration News in the Newsletter- Secretariat with contribution of ETs/MTDCF and DR&C.
- 7.3: Requirements for metadata better expressed - UKMO

9. CLOSURE OF THE MEETING

The Meeting was closed by the Chairman of the ET/DR&C at 15.30 on Saturday 26 June 2004.

ANNEX TO PARAGRAPH 1.1.1

ET/DR&C, Kuala Lumpur, 21-26 June 2004

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ANNEX TO PARAGRAPH 2.1.2

<u>Additional note at end of PDT 4.7:</u>

This template should not be used. Production Definition Template 4.0 should be used instead.

ANNEX TO PARAGRAPH 2.3.1

<u>Entries for DRT/DT numbers</u>: 40 for JPEG2000, and 41 for PNG

ANNEX TO PARAGRAPH 2.4.1

Cloud analysis image:

Cloud analysis products from the earlier METEOSAT satellites have been and continue to be exchanged on the GTS in SATOB. With the advent of METEOSAT 8, a cloud analysis image product has been developed and is disseminated via the spacecraft in LRIT format. In order to encode these data in GRIB 2, the following changes to Code table 4.2 are proposed:

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

Add: Number 8, Parameter = Pixel scene type, Units = Code table (4.218)

Change: Number 8 – 191, Parameter = Reserved

to

Number 9 – 191, Parameter = Reserved

In order to define parameter 8 from the modified Code Table 4.2 above, it is also proposed to add a new Code Table, 4.218 as follows:

Code Table 4.218 - Pixel scene type

0 = Nominal cloud top height quality
1 = Green needle leafed forest
2 = Green broad leafed forest
3 = Deciduous needle leafed forest
4 = Deciduous broad leafed forest
5 = Deciduous mixed forest
6 = Closed shrub-land
7 = Open shrub-land
8 = Woody savanna
9 = Savannah
10 = Grassland
11 = Permanent wetland
12 = Cropland
13 = Urban
14 = Vegetation / crops
15 = Permanent snow / ice
16 = Barren desert
17 = Water bodies
18 = Tundra
19-96 = reserved
97 = Snow / ice on land
98 = Snow / ice on water
99 = Sun-glint

100 = General cloud
101 = Low cloud / fog / Stratus
102 = Low cloud / Stratocumulus
103 = Low cloud / unknown type
104 = Medium cloud / Nimbostratus
105 = Medium cloud / Altostratus
106 = Medium cloud / unknown type
107 = High cloud / Cumulus
108 = High cloud / Cirrus
109 = High cloud / unknown
110 = Unknown cloud type
111-191 = Reserved
192-254 = Reserved for local use
255 = Missing

Multi-sensor precipitation estimate:

A convective rain rate product is derived at EUMETSAT using METEOSAT image data and SSM/I level 1b radiances. This multi-sensor precipitation estimate (MPE) will be provided to users in quasi-real time via the Internet. The data will be presented as a picture (in JPEG). It is also intended to offer a GRIB version of the data, and in order to support this, the following changes to Code table 4.2 are proposed:

Code Table 4.2, Product Discipline 3 – Space products, Parameter category 1: quantitative products
Add: Number 1, Parameter = Instantaneous rain rate, Units = kgm^2s^{-1}
Change: Number 1 – 191, Parameter = Reserved
to
Number 2 – 191, Parameter = Reserved

Cloud top height:

Cloud top height products from the earlier METEOSAT satellites are encoded in a limited number of gray shades and disseminated via the spacecraft's analogue WEFAX dissemination. With the advent of METEOSAT 8, the cloud top height data are disseminated via the spacecraft in LRIT format. In order to encode these data in GRIB, the following changes to Code table 4.2 are proposed:

Code Table 4.2, Product Discipline 3 – Space products, Parameter category 1: quantitative products
Add: Number 2, Parameter = Cloud top height, Units = m
Add: Number 3, Parameter = Cloud top height quality indicator,
Units = Code table (4.219)
Change: Number 1 – 191, Parameter = Reserved
to
Number 4 – 191, Parameter = Reserved

In order to define parameter 3 from the modified Code Table 4.2 above, it is also proposed to add a new Code Table, 4.219 as follows:
Code Table 4.219 - Cloud top height quality indicator
0 = No scene identified
1 = Fog in segment
2 = Poor quality height estimation
3 = Fog in segment and poor quality height estimation
4-191 = Reserved
192-254 = Reserved for local use
255 = Missing

- Add the following note at end of DRTs 5.0 and 5.50:

Note: negative values of E or D shall be represented according to Regulation 92.1.5

ANNEX TO PARAGRAPH 2.4.2

Changes implied by additional entry in Code Table 3.11

- contents definition of octets 11 and 12 of Section 3 specification: cancel "defining number of points"
- Notes (2) to (4) of Section 3 specification to read as follows:

1. *(unchanged)*

2. An optional list of numbers **may be used** to document a quasi-regular grid In such a case, octet 11 is non zero, and gives the number of octets **used per item in the list**. For all other cases, such as regular grids, octets 11 and 12 are zero and no list is appended to the Grid Definition Template.

3. If a list of numbers is present, it is appended at the end of Grid Definition Template (or directly after Grid Definition Template Number if template is missing), the length of the list is given by the grid definition. When the Grid Definition Template is present, the length is given according to bit 3 of scanning mode flag octet (length is Nj or Ny for flag value 0). List ordering is implied by data scanning.

4. Depending on code value given in octet 12, the list of numbers either**:**
   - **corresponds to the coordinate lines as given in the grid definition, or**
   - **corresponds to a full circle, or**
   - **does not apply**

- Notes (2) and (3) of GDT 3.0 to read as follows:

(2) For data on a quasi-regular grid **where** all the rows or columns do not necessarily have the same number of grid points, either Ni (Octets 31-34) or Nj (Octets 35-38) and the corresponding Di (Octets 64-67) or Dj (Octets 68-71) shall be coded with all bits set to 1 (missing). The actual number of points along each parallel or meridian shall be coded in the octets immediately following the Grid Definition Template (Octets [xx+1] – nn), as described in the description of the Grid Definition Section.

(3) A quasi-regular grid is only defined for appropriate grid scanning modes. Either rows or columns, but not both simultaneously, may have variable numbers of points **or variable spacing**. The first point in each row (column) shall be positioned at the meridian (parallel) indicated by Octets 47-54. The grid points shall be evenly spaced in latitude (longitude).

- Code Table 3.11 title, contents and additional Note as follows:

Code table 3.11 **Interpretation of list of numbers at end of section 3**

Code figure	Meaning
0	There is no appended list
1	Numbers define number of points corresponding to full coordinate circles (i.e. parallels), coordinate values on each circle are multiple of the circle mesh, and extreme coordinate values given in grid definition (i.e. extreme longitudes) may not be reached in all rows
2	Numbers define number of points corresponding to coordinate lines delimited by extreme coordinate values given in grid definition (i.e. extreme longitudes) which are present in each row
3	**Numbers define the actual latitudes for each row in the grid. The list of numbers are integer values of the valid latitudes in microdegrees (scaled by 10^6) for each row, in the same order as specified in the "scanning mode flag" (bit no. 2). (see Note 1)**
4-254	Reserved

255 Missing

Note:
(1) The value for the constant direction increment Di (or Dx) in the accompanying Grid Definition Template should be set to all ones (missing).

ANNEX TO PARAGRAPH 2.4.3

Amendment to the Manual:

To avoid problems which may be caused by undefined unit of the Earth radius in the Manual and to clarify the unit for the Earth radius as metres of SI unit, add the following note to the relevant GDTs * as the last one .

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

* GDTs 3.0, 3.10, 3.20, 3.30, 3.31, 3.40, 3.90, 3.110, 3.1000 and 3.1100
** X depends on the number of Notes to the corresponding GDT.

Code Table 3.2 – *Shape of the Earth*

0	(unchanged)
1	Earth assumed spherical with radius (in m) specified by data producer
2	(unchanged)
3	Earth assumed oblate spheroid with major and minor axes specified (in km) by data producer
4	(unchanged)
5	(unchanged)
6	(unchanged)
7	Earth assumed oblate spheroid with major and minor axes specified (in m) by data producer
8-191	Reserved
192-254	Reserved for local use
255	Missing

Amendment to the Guide:

To eliminate the inconsistency between the Manual and the Guide on the unit of the Earth radius, modify the current Guide as follows.

In page 27,
(1) In the first paragraph and the Code Table 3.2, all values in km are multiplied by 1000 and expressed in meters.

In pages 50, 54, 68, 70, 87, 89, 94 and 96,
(2) The value and the meaning to the Octet 16 of Section 3 is changed to "0" (zero) and "The scale factor for the radius of the spherical earth is 0",respectively.

(3) The meaning to the Octets 17-20 of Section 3 is changed to "The scaled value of the radius of the spherical earth is 6350000 m".

ANNEX TO PARAGRAPH 2.4.4

Product Discipline	Parameter Category	Parameter Number	Parameter Name	Units
0	0	16	Snow phase change heat flux	W m^{-2}
0	1	33	Categorical rain	(Code table 4.222)
0	1	34	Categorical freezing rain	(Code table 4.222)
0	1	35	Categorical ice pellets	(Code table 4.222)
0	1	36	Categorical snow	(Code table 4.222)
0	1	37	Convective precipitation rate	kg m^{-2} s^{-1}
0	1	38	Horizontal moisture divergence	kg kg^{-1} s^{-1}
0	1	39	Percent frozen precipitation	%
0	1	40	Potential evaporation	kg m^{-2}
0	1	41	Potential evaporation rate	W m^{-2}
0	1	42	Snow cover	%
0	1	43	Rain fraction of total cloud water	Proportion
0	1	44	Rime factor	Numeric
0	1	45	Total column integrated rain	kg m^{-2}
0	1	46	Total column integrated snow	kg m^{-2}
0	2	25	Vertical speed shear	s^{-1}
0	2	26	Horizontal momentum flux	N m^{-2}
0	2	27	U-component storm motion	m s^{-1}
0	2	28	V-component storm motion	m s^{-1}
0	2	29	Drag coefficient	Numeric
0	2	30	Frictional velocity	m s^{-1}
0	3	15	5-wave geopotential height	gpm
0	3	16	Zonal flux of gravity wave stress	N m^{-2}
0	3	17	Meridional flux of gravity wave stress	N m^{-2}
0	3	18	Planetary boundary layer height	m
0	3	19	5-wave geopotential height anomaly	gpm
0	4	7	Downward short-wave radiation flux	W m^{-2}
0	4	8	Upward short-wave radiation flux	W m^{-2}
0	5	3	Downward long-wave radiation flux	W m^{-2}
0	5	4	Upward long-wave radiation flux	W m^{-2}
0	6	14	Non-convective cloud cover	%
0	6	15	Cloud work function	J kg^{-1}
0	6	16	Convective cloud efficiency	Proportion
0	6	17	Total condensate	kg kg^{-1}
0	6	18	Total column-integrated cloud water	kg m^{-2}
0	6	19	Total column-integrated cloud ice	kg m^{-2}
0	6	20	Total column-integrated condensate	kg m^{-2}
0	6	21	Ice fraction of total condensate	Proportion
0	7	10	Surface lifted index	K
0	7	11	Best (4-layer) lifted index	K
0	7	12	Richardson number	Numeric
0	14	1	Ozone mixing ratio	kg kg^{-1}
0	19	17	Maximum snow albedo	%
0	19	18	Snow-free albedo	%
0	191	0	Seconds prior to initial reference time (defined in Section 1)	s
1	0	5	Baseflow-groundwater runoff	kg m^{-2}

1	0	6	Storm surface runoff	kg m^{-2}
2	0	9	Volumetric soil moisture content	Proportion
2	0	10	Ground heat flux	W m^{-2}
2	0	11	Moisture availability	%
2	0	12	Exchange coefficient	kg m^{-2} s^{-1}
2	0	13	Plant canopy surface water	kg m^{-2}
2	0	14	Blackadar's mixing length scale	m
2	0	15	Canopy conductance	m s^{-1}
2	0	16	Minimal stomatal resistance	s m^{-1}
2	0	17	Wilting point	Proportion
2	0	18	Solar parameter in canopy conductance	Proportion
2	0	19	Temperature parameter in canopy conductance	Proportion
2	0	20	Humidity parameter in canopy conductance	Proportion
2	0	21	Soil moisture parameter in canopy conductance	Proportion
2	3	5	Liquid volumetric soil moisture (non-frozen)	Proportion
2	3	6	Number of soil layers in root zone	Numeric
2	3	7	Transpiration stress-onset (soil moisture)	Proportion
2	3	8	Direct evaporation cease (soil moisture)	Proportion
2	3	19	Soil porosity	Proportion
3	1	4	Estimated U wind	m s^{-1}
3	1	5	Estimated V wind	m s^{-1}

Code table 4.222 – Categorical result

Code figure	Meaning
0	No
1	Yes
2-191	Reserved
192-254	Reserved for local use
255	Missing

ANNEX TO PARAGRAPH 2.5.4

Code table 0.0:

Add the following note:

In the context of addition of a new parameter entry for Code Table 4.1, when more than one discipline applies, the choice of discipline should be made based on the intended use of the product.

ANNEX TO PARAGRAPH 3.1.1

Amend existing BUFR/CREX regulation 94.5.3.8 as follows:

94.5.3.8 Increments:

Any occurrence of an element descriptor from classes 04 to 07 which defines an increment shall indicate that the location corresponding to that class be incremented by the corresponding data value. In the case of successive increments from the same class, this means that each increment applies in a cumulative manner, with all preceding increments remaining in effect.

Displacements:

In contrast, any displacement descriptor from classes 04 to 07 does not redefine the location corresponding to that class. In the case of successive displacements from the same class, this means that each displacement applies independently and in a non-cumulative manner to the location corresponding to that class.

ANNEX TO PARAGRAPH 3.1.2

A new descriptor in the Class 8 is proposed as a nominal value indicator (for Level II data):

0 08 083 Nominal value indicator, Flag table, 0, 0, 15

Bit No.	
1	Adjusted with respect to representative height of sensor above local ground (or deck of marine platform)
2	Adjusted with respect to representative height of sensor above water surface
3	Adjusted with respect to standard surface roughness
4	Adjusted with respect to wind speed
5	Adjusted with respect to temperature
6	Adjusted with respect to pressure
7	Adjusted with respect to humidity
8	Adjusted with respect to evaporation
9	Adjusted with respect to wetting losses
10 -14	Reserved
All 15	Missing value

Two new descriptors in Class 7 are proposed

F X Y	Element name	BUFR				CREX		
0 07 065	Representative height of sensor above local ground (or deck of marine platform)	m	2	0	16	m	2	5

Note: Representative height of sensor above local ground (or deck of marine platform) is the standard height of a sensor required by WMO documentation. Value of the following meteorological element should be adjusted using a formula (or a recommended procedure for obtaining nominal values). For example, standard height recommended in WMO documentation for surface wind sensors is 10 m. If the sensor is placed at different height, the wind speed should be adjusted using a formula.

F X Y	Element name	BUFR				CREX		
0 07 066	Representative height of sensor above water surface	m	1	0	12	m	1	4

Note: Representative height of sensor above water surface is the standard height of a sensor required by WMO documentation. Value of the following meteorological element should be adjusted using a formula (or a recommended procedure for obtaining nominal values).

ANNEX TO PARAGRAPH 3.1.3:

Add new entries to the Common Code Tables C-5 and C-8 as follows.

(1) A new entry to the Common Code Table C-5: *Satellite Identifier*

Code figure for $I_6I_6I_6$	Code figure for BUFR
121	ADEOS II

(2) New entries to the Common Code Table C-8: *Satellite instruments*

Code	Agency	Type	Instrument short name	Instrument long name
481	JAXA	Radiometer	AMSR	Advanced Microwave Scanning Radiometer
484	JAXA	Imager	GLI	Global Imager

ANNEX TO PARAGRAPH 3.1.4

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
Number of observations	Numeric	0 – 99	± 1	0-08-049	0	0	8
Cloud index	Code table	0 – 99	± 1	0-20-050	0	0	8
Cloud phase	Code table	0 - 3	± 1	0-20-056	0	0	3

The cloud index code table (0-20-050) would be as follows:

0 = reserved
1 = 1st low cloud
2 = 2nd low cloud
3 = 3rd low cloud
4 = 1st medium cloud
5 = 2nd medium cloud
6 = 3rd medium cloud
7 = 1st high cloud
8 = 2nd high cloud

9 – 254 = reserved
255 = missing

The cloud phase code table (0-20-056) would be as follows:

0 = unknown
1 = water
2 = ice
3 = mixed
4 – 6 = reserved
7 = missing

Climate data set

Climate data set products from the earlier METEOSAT satellites have been and continue to be produced, and are archived at EUMETSAT, both in an internal format and in BUFR. In order to encode all of the required parameters, the following addition descriptors are proposed:

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
Amount of segment covered by scene	%	0 – 100	± 1	0-20-083	0	0	7
Sun-glint indicator	Code table	0 – 1	± 1	0-08-065	0	0	2
Semi-transparency indicator	Code table	0 - 1	± 1	0-08-066	0	0	2
Sun to satellite azimuth difference	Degrees	-180 – 180	± 0.1	0-05-023	-1800	1	12

The sun-glint indicator code table (0-08-065) would be as follows:

0 = no sun-glint
1 = sun-glint
2 = reserved
3 = missing

The semi-transparency indicator code table (0-08-066) would be as follows:

0 = opaque
1 = semi-transparent
2 = reserved
3 = missing

Global instability index

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
K Index	Kelvin	-20 – 50	± 1	0-13-044	-30	0	8
KO Index	Kelvin	-20 – 20	± 1	0-13-045	-30	0	8
Maximum buoyancy	Kelvin	-20 – 40	± 1	0-13-046	-30	0	8

Clear sky radiance

The additional features of the classification scheme used for METEOSAT 8 mean that it is possible to derive a new type of confidence measure for the clear sky radiance data. Additionally, a quality control mechanism based on the "Gaussian-ness" of the distribution of the clear sky radiance values is also being finalized. In order to encode confidence values from both of these schemes, two additional code table entries, 3 and 4, are proposed.

The "method of derivation of percentage confidence" code table (0-08-033) would be as follows:

0 = reserved
1 = percentage confidence calculated using cloud fraction
2 = percentage confidence calculated using standard deviation of temperature
3 = percentage confidence calculated using probability of cloud contamination
4 = percentage confidence calculated using normality of distribution
5 – 126 = reserved
127 = missing

ANNEX TO PARAGRAPH 3.1.5:

The height assignment method code table (0-02-163) would be as follows:

0 = Auto editor
1 = IRW height assignment
2 = WV height assignment
3 = H2O intercept height assignment
4 = CO2 slicing height assignment
5 = Low pixel max gradient
6 = Higher pixel max gradient
7 = Primary height assignment
8 = Layer thickness assignment
9 = Cumulative contribution function -10 percent height
10 = Cumulative contribution function - 50 percent height
11 = Cumulative contribution function - 90 percent height
12 = Cumulative contribution function - height of maximum gradient
13 = Reserved
14 = Composite height assignment
15 = Missing value

ANNEX TO PARAGRAPH 3.1.6

(1) modify bit number 5 of flag table 008001 to read:
5 Significant level, temperature and/or relative humidity

(2) new descriptors (pre-operational):

F X Y	Element name	BUFR				CREX		
0 08 042	Extended vertical sounding significance	Flag table	0	0	18	Flag table	0	6

0 08 042 Extended vertical sounding significance

Bit No.

1	Surface
2	Standard level
3	Tropopause level
4	Maximum wind level
5	Significant temperature level
6	Significant humidity level
7	Significant wind level
8	Beginning of missing temperature data
9	End of missing temperature data
10	Beginning of missing humidity data
11	End of missing humidity data
12	Beginning of missing wind data
13	End of missing wind data
14-17	Reserved
All 18	Missing value

F X Y	Element name	BUFR				CREX		
0 04 086	Long time period or displacement	Second	0	-8192	15	Second	0	5
0 05 015	Latitude displacement (high accuracy)	Degree	5	-9000000	25	Degree	5	7
0 05 016	Latitude displacement (coarse accuracy)	Degree	2	-9000	15	Degree	2	4
0 06 015	Longitude displacement (high accuracy)	Degree	5	-18000000	26	Degree	5	8
0 06 016	Longitude displacement (coarse accuracy)	Degree	2	-18000	16	Degree	2	5

(3) **delete** the descriptor **0 04 018** (Long time increment) from the list of “preoperational entries” as it is not needed anymore.

(4) **New sequence descriptor 3 09 031 (and D 09 031)**

To be able to oblige the current practice of reporting the time offset from the launch time in the ozone sounding messages, a new sequence descriptor 3 09 031 (and D 09 031) is needed:

						(Ozone sonde flight data)
3	**09**	**031**	0	15	004	Ozone sounding correction factor
			0	15	005	Ozone p
			1	04	000	Delayed replication of 4 descriptors
			0	31	001	Replication factor
			0	**04**	**025**	**Time displacement (since launch time) in minutes**
			0	08	006	Ozone vertical sounding significance
			0	07	004	Pressure
			0	15	003	Measured ozone partial pressure

And add footnote (1) to sequence descriptor 3 09 030 (D 09 030) in BUFR (CREX) Table D:

“This sequence is deprecated because of incorrect usage of descriptor 0 04 015 (B 04 015); sequence 3 09 031 (D 09 031) should be used instead”

(5) **New CREX sequence descriptors D 09 045 ... D 09 049**

To report the time offset from the launch time in the ozone vertical sounding messages, a new set of descriptors **D 09 045, D 09 046, D 09 047, D 09 048 and D 09 049** is proposed in which D 09 031 would be included instead of D 09 030; otherwise these descriptors would be identical with D 09 040, D 09 041, D 09 042, D 09 043 and D 09 044, respectively, and footnotes should be added to Class 9 of CREX Table D for each of the sequences D 09 040,41,42,43,44 stating:

"This sequence is deprecated because it includes deprecated sequence D 09 030; sequence D 09 045(46,47,48,49) should be used instead.

(6) B 04 075 (short time period or displacement) is currently used in sequence descriptors D 06 020 and D 06 024 to redefine the initial time of observation, which is inconsistent with the recent interpretation of the BUFR/CREX regulations. B 04 065 (short time increment) should be used for this purpose. As corresponding modification is not acceptable, it is proposed to **deprecate D 06 020 and D 06 024** and to introduce two new sequence descriptors (e.g. **D 06 019 and D 06 025**) which would be identical with D 06 020 and D 06 024**,** only B 04 075 would be replaced by B 04 065. In addition, footnotes would be added to each of these sequences D 06 020 (and 24) :

"This sequence is deprecated because of incorrect usage of descriptor B 04 075; sequence D 06 019 (25) should be used instead."

(7) **New descriptors needed for data representation of SYNOP data**

The current version of the template for SYNOP data does not provide facilities for reporting all groups of SYNOP Section 3 described in the international part of Manual on Codes (groups $54g_0s_nd_T$, $56D_LD_MD_H$, $57CD_ae_C$, $58p_{24}p_{24}p_{24}$ and $59p_{24}p_{24}p_{24}$). BUFR/CREX descriptors are available only for some of these elements. Therefore, the following entries are proposed (0 12 049 for data representation of s_nd_T, 0 20 054 for D_L, D_M and D_H):

F X Y	Element name	BUFR				CREX		
0 12 049	Temperature change over period specified	K	0	-30	6	^oC	0	2
0 20 054	True direction from which clouds are moving	Degree true	0	0	9	Degree true	0	3

ANNEX TO PARAGRAPH 3.1.7

EOS class to be added in Code Table 0 02 020 as Entry 10.

Proposed additions to Table C-5

The proposed new entries to Common Code Table C-5 are:

$I_6I_6I_6$	Code figure for BUFR (Code table 0 01 007)	
060	060	ENVISAT
249	249	DMSP 16
285	285	DMSP 17
282	282	TRMM

784 784 AQUA

ANNEX TO PARAGRAPH 3.1.8

New Table B descriptors

F X Y	Element name	BUFR				CREX		
0 07 040	Impact parameter	m	1	62000000	22	m	1	8
0 10 035	Earth's local radius of curvature	m	1	62000000	22	m	1	8
0 10 036	Geoid undulation	m	2	-15000	15	m	2	6
0 15 036	Atmospheric refractivity	N-units	3	0	19	N-units	3	6
0 15 037	Bending angle	Radians	8	-100000	23	Radians	8	7
0 33 039	Quality flags for Radio Occultation data	Flag table	0	0	16	Flag table	0	6

Additional notes to Table B

Class 07.

(8) For an atmospheric limb sounder, the "impact parameter" is the distance between the ray asymptote and the centre of curvature of the Earth's surface at the tangent point.

Class 10

(4) The "geoid undulation" is the difference between the reference ellipsoid (WGS-84) and the geoid height (EGM96) at the geographic location of the observation, both referenced to the centre of mass of the Earth.

Class 15

(5) The refractivity, *N*, is related to the refractive index, *n* by the formula $N = 10^6 (n - 1)$. *N* is therefore dimensionless but values computed by the formula are by convention described as being in 'N-units'.

Additions to Common Code Table C-5 (Satellite Identifier)

Descriptor	***Value***	***Meaning***
001007	40	Oersted
	41	Champ
	722	GRACE A
	723	GRACE B
	740	COSMIC-1
	741	COSMIC-2
	742	COSMIC-3
	743	COSMIC-4
	744	COSMIC-5
	745	COSMIC-6
	800	Sunsat
	820	SAC-C

And add the range headings:

800 – 849 ***Allocated to other satellite operators***

and:

850 – 998 Reserved

New Flag Table

Descriptor	***Bit***	
033039	1	Non-nominal quality
	2	Offline product
	3	Ascending occultation flag
	4	Excess Phase processing non-nominal
	5	Bending Angle processing non-nominal
	6	Refractivity processing non-nominal
	7	Meteorological processing non-nominal
	8-13	Reserved
	14	Background profile non-nominal
	15	Background (i.e. not retrieved) profile present
	All 16	Missing value

ANNEX TO PARAGRAPH 3.1.9

Table reference	*Element name*	*Unit*	*Scale*	*Reference value*	*Data width*
0 14 061	Instantaneous long-wave radiation	$W\ m^{-2}$	0	-512	10
0 14 062	Instantaneous short-wave radiation	$W\ m^{-2}$	0	-2048	12

The Class 14 element descriptors 0 14 017 and 0 14 018 should be deprecated by a note.

ANNEX TO PARAGRAPH 3.1.10

0 11 030
Extended degree of turbulence

Code figure		
0	Nil	in cloud
1	Light	in cloud
2	Moderate	in cloud
3	Severe	in cloud
4	Nil	in clear air
5	Light	in clear air
6	Moderate	in clear air
7	Severe	in clear air
8	Nil	cloud/clear air not specified
9	Light	cloud/clear air not specified
10	Moderate (MOD)	cloud/clear air not specified
11	Severe (SEV)	cloud/clear air not specified
12	Extreme, in clear air	
13	Extreme, in cloud	
14	Extreme, cloud/clear air not specified (EXTREME)	
15	Light, isolated moderate (ISOL MOD)	

16	Light, occasional moderate (OCNL MOD)
17	Light, frequently moderate (FRQ MOD)
18	Moderate, isolated severe (MOD ISOL SEV)
19	Moderate, occasional severe (MOD OCNL SEV)
20	Moderate, frequently severe (MOD FRQ SEV)
21	Severe, isolated extreme (SEV ISOL EXTREME)
22	Severe, occasional extreme (SEV OCNL EXTREME)
23	Severe, frequently extreme (SEV FRQ EXTREME)
24-62	Reserved
63	Missing value

F X Y	Element name	BUFR				CREX		
0 11 030	Extended degree of turbulence	Code table	0	0	6	Code table	0	2

ANNEX TO PARAGRAPH 3.1.11

(1) Add the following new entries to the code table for descriptor 0-08-040/B-08-040 “Flight level significance”:

43	Begin missing wind data
44	End missing wind data
60	Level of 80-knot isotach above jet
61	Level of 80-knot isotach below jet

(2) Add the following new note (3) to Class 19 of BUFR/CREX Table B:

“Descriptor 0-19-005: the direction given in this entry is the direction towards which the feature is moving.”

ANNEX TO PARAGRAPH 3.1.12.4

Add the following Table B entry for numerical model identifier :

0 01 030 Numerical model identifier, CCITTIA5, Scale=0, Reference=0,Data bit width=128

Note: The value of this feature could be a string of characters which contains the name of the model and other useful elements such as the model mesh.

GENERAL FRAME FOR METEOROLOGICAL FEATURES

description :	descriptor :	unit :	comment :
(*part i*)			
significance feature (*1)	**0 08 011, or 0 08 005,**	**code table**	**meteorological feature, or**
meteor. feature significance,			
	or 0 08 001	**flag table**	**or vertical significance**
dimensional significance volume	**0 08 007**	**code table**	**value for point, line, area,**
first order statistics, necessary if necessary	*0 08 023*	*code table*	*value for min, max ... if*
(*part ii*)			
delayed replication of descriptors (*2)	**1 yy 000**	**none**	**delayed replication : number**
replication	**0 31 001**	**numeric**	**number of points to follow**
--- latitude	**0 05 002**	**deg N**	**--- negative for deg S**
--- longitude	**0 06 002**	**deg E**	**--- negative for deg W**
--- first feature point, if necessary (*3)	*...*	*...*	*--- first feature of each*
	... etc ...		
--- last feature point, if necessary	*...*	*...*	*--- last feature of each*
altitude	*0 07 002*	*m*	*altitude, if necessary*
altitude	*0 07 002*	*m*	*altitude, if necessary*
(*part iii*) (*4)			
--- one feature	*...*	*...*	*one feature, if necessary*
--- ... etc ...			
--- last feature	*...*	*...*	*last feature, if necessary*
(cancellation part) (*5)			
first order statistics, if necessary	*0 08 023*	*code table*	*cancel, if necessary*
dimensional significance	**0 08 007**	**code table**	**cancel**
significance feature	**0 08 011, or 0 08 005,**	**code table**	**cancel**
	or 0 08 001	**flag table**	**cancel**

Notes

(*1) First descriptors from class 08 are given to show the nature of new objects that are described. These features remain in force until the cancellation descriptors.

(*2) This number of descriptors must be equal or greater than 2 because of latitude and longitude descriptors.

(*3) Descriptors of data related to the geographical points of the object follow latitude and longitude descriptors within the replication loop.

Part ii also contains a pair of descriptors for altitude, if necessary. Horizontal coordinates are essential for 2D-plotting. On the other hand, the encoding of any object does not systematically use vertical coordinates descriptors. For these two reasons and with the aim of encoding/decoding routine optimisation, horizontal coordinates remain in first position as they are essential.

(*4) All descriptors of data related to features of the whole object are in *part iii .*

(*5) Use of cancellation descriptors is a possibility given by the Guide to WMO Binary Code Forms.

The points-of-contact for this proposal are :

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ANNEX TO PARAGRAPH 3.2.1

New descriptors 0 15 025 and 0 15 026 together with an addition in Code table 0 33 020 : 6 = estimated, are declared preoperational after validation.

ANNEX TO PARAGRAPH 3.2.2

TABLE REFERENCE F	X	Y	TABLE REFERENCES			ELEMENT NAME
						(Radiosonde abbreviated header and launch information)
3	01	120	3	01	001	WMO block and station number
			0	01	094	WBAN number
			0	02	011	Radiosonde type
			3	01	121	Radiosonde launch point location
						(Radiosonde launch point location)
3	01	121	0	08	041	Data significance (3 = “balloon launch point”)
			3	01	122	Date/time (to hundredths of second)
			3	01	021	Latitude and longitude (high accuracy)
			0	07	031	Height of barometer above MSL
			0	07	007	Height (of radiosonde release above MSL)
						(Date/time (to hundredths of second))
3	01	122	3	01	011	Date
			3	01	012	Time
			2	01	135	Change data width

			2	02	130	Change scale
			0	04	006	Second
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
						(Radiosonde full header information)
3	01	123	1	02	002	Replicate 2 descriptors 2 times
			0	08	041	Data significance (0 = “parent site”, 1 = “observation site”)
			0	01	062	Short ICAO location identifier
			3	01	001	WMO block and station number
			0	01	094	WBAN number
			0	02	011	Radiosonde type
			0	01	018	Short station or site name
			0	01	095	Observer identification
			0	25	061	Software identification
			0	25	068	Number of archive recomputes
			0	01	082	Radiosonde ascension number
			0	01	083	Radiosonde release number
			0	01	081	Radiosonde serial number
			0	02	067	Radiosonde operating frequency
			0	02	066	Radiosonde ground receiving system
			0	02	014	Tracking technique/status of system used
			0	25	067	Release point pressure correction
			0	25	065	Orientation correction (azimuth)
			0	25	066	Orientation correction (elevation)
			0	02	095	Type of pressure sensor
			0	02	096	Type of temperature sensor
			0	02	097	Type of humidity sensor
			0	02	016	Radiosonde configuration
			0	02	083	Type of balloon shelter
			0	02	080	Balloon manufacturer
			0	02	081	Type of balloon
			0	01	093	Balloon lot number
			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	082	Weight of balloon
			0	08	041	Data significance (2 = “balloon manufacture date”)
			3	01	011	Date

						(Radiosonde surface observation)
3	02	050	0	08	041	Data significance (5 = “sfc ob displacement from launch pt)
			0	05	021	Bearing or azimuth
			0	07	005	Height increment
			2	02	130	Change scale
			0	06	021	Distance
			2	02	000	Cancel change scale
			0	08	041	Data significance (4 = “surface observation”)
			2	01	131	Change data width
			2	02	129	Change scale
			0	02	115	Type of surface observing equipment
			0	10	004	Pressure
			0	02	115	Type of surface observing equipment
			0	13	003	Relative humidity
			2	02	000	Cancel change scale

			2	01	000	Cancel change data width
			0	02	115	Type of surface observing equipment
			0	11	001	Wind direction
			0	11	002	Wind speed
			0	02	115	Type of surface observing equipment
			1	02	002	Replicate 2 descriptors 2 times
			0	12	101	Temperature/dry bulb temperature
			0	04	024	Time displacement (hour)
			0	02	115	Type of surface observing equipment
			0	12	103	Dew-point temperature
			0	12	102	Wet bulb temperature
			1	01	003	Replicate 1 descriptor 3 times
			0	20	012	Cloud type
			0	20	011	Cloud amount
			0	20	013	Height of base of cloud
			1	01	002	Replicate 1 descriptor 2 times
			0	20	003	Present weather
						(Radiosonde duration of flight and termination information)
3	03	040	0	08	041	Data significance (7 = “flight level termination point”)
			0	04	025	Time displacement (minute)
			0	04	026	Time displacement (second)
			3	01	021	Latitude and longitude (high accuracy)
			3	01	122	Date/time (to hundredths of second)
			2	01	131	Change data width
			2	02	129	Change scale
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			0	13	003	Relative humidity
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	10	009	Geopotential height
			1	02	002	Replicate 2 descriptors 2 times
			0	08	040	Flight level significance
			0	35	035	Reason for termination
						(Radiosonde complete registration and surface observation)
3	09	060	3	01	123	Radiosonde full header information
			3	01	121	Radiosonde launch point location
			3	02	050	Radiosonde surface observation
			3	03	040	Radiosonde duration of flight and termination information
						(Raw PTU)
3	09	061	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			2	01	131	Change data width
			2	02	129	Change scale
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width

	0 33 007	Percent confidence (for Pressure)
	0 33 035	Manual/automatic quality control (for Pressure)
	0 33 015	Data quality-check indicator (for Pressure)
	0 13 009	Relative humidity
	0 33 007	Percent confidence (for Relative humidity)
	0 33 035	Manual/automatic quality control (for Relative humidity)
	0 33 015	Data quality-check indicator (for Relative humidity)
	0 02 013	Solar and infrared radiation correction
	0 12 101	Temperature/dry bulb temperature
	0 33 007	Percent confidence (for Temperature)
	0 33 035	Manual/automatic quality control (for Temperature)
	0 33 015	Data quality-check indicator (for Temperature)
		(Raw GPS unsmoothed wind)
3 09 062	3 01 120	Radiosonde abbreviated header and launch information
	0 08 041	Data significance (6 = “flight level observation”)
	3 01 122	Date/time (to hundredths of second)
	0 05 001	Latitude (high accuracy)
	0 33 035	Manual/automatic quality control (for Latitude)
	0 33 015	Data quality-check indicator (for Latitude)
	0 06 001	Longitude (high accuracy)
	0 33 035	Manual/automatic quality control (for Longitude)
	0 33 015	Data quality-check indicator (for Longitude)
	0 07 007	Height
	0 33 035	Manual/automatic quality control (for Height)
	0 33 015	Data quality-check indicator (for Height)
	0 11 003	U-component
	0 33 035	Manual/automatic quality control (for U-component)
	0 33 015	Data quality-check indicator (for U-component)
	0 11 004	V-component
	0 33 035	Manual/automatic quality control (for V-component)
	0 33 015	Data quality-check indicator (for V-component)
	0 33 007	Percent confidence (for Raw GPS unsmoothed wind)

		(Raw GPS smoothed wind)
3 09 063	3 01 120	Radiosonde abbreviated header and launch information
	0 08 041	Data significance (6 = “flight level observation”)
	3 01 122	Date/time (to hundredths of second) sequence
	0 05 001	Latitude (high accuracy)
	0 33 035	Manual/automatic quality control (for Latitude)
	0 33 015	Data quality-check indicator (for Latitude)
	0 06 001	Longitude (high accuracy)
	0 33 035	Manual/automatic quality control (for Longitude)
	0 33 015	Data quality-check indicator (for Longitude)
	0 07 007	Height
	0 33 035	Manual/automatic quality control (for Height)
	0 33 015	Data quality-check indicator (for Height)
	0 11 003	U-component
	0 33 035	Manual/automatic quality control (for U-component)
	0 33 015	Data quality-check indicator (for U-component)
	0 11 004	V-component
	0 33 035	Manual/automatic quality control (for V-component)
	0 33 015	Data quality-check indicator (for V-component)
	0 33 007	Percent confidence (for Raw GPS smoothed wind)

						(Processed PTU)
3	09	064	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			2	01	131	Change data width
			2	02	129	Change scale
			1	04	002	Replicate 4 descriptors 2 times
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			0	33	035	Manual/automatic quality control (for Pressure)
			0	33	015	Data quality-check indicator (for Pressure)
			0	13	003	Relative humidity
			0	33	035	Manual/automatic quality control (for Relative humidity)
			0	33	015	Data quality-check indicator (for Relative humidity)
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
			1	04	002	Replicate 4 descriptors 2 times
			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	33	035	Manual/automatic quality control (for Temperature)
			0	33	015	Data quality-check indicator (for Temperature)
			0	12	103	Dew-point temperature
			0	33	035	Manual/automatic quality control (for Dew-point temperature)
			0	33	015	Data quality-check indicator (for Dew-point temperature)
			0	10	009	Geopotential height
			0	33	035	Manual/automatic quality control (for Geopotential height)
			0	33	015	Data quality-check indicator (for Geopotential height)

						(Processed GPS)
3	09	065	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			0	05	001	Latitude (high accuracy)
			0	33	035	Manual/automatic quality control (for Latitude)
			0	33	015	Data quality-check indicator (for Latitude)
			0	06	001	Longitude (high accuracy)
			0	33	035	Manual/automatic quality control (for Longitude)
			0	33	015	Data quality-check indicator (for Longitude)
			0	07	007	Height
			0	33	035	Manual/automatic quality control (for Height)
			0	33	015	Data quality-check indicator (for Height)
			0	11	003	U-component
			0	33	035	Manual/automatic quality control (for U-component)
			0	33	015	Data quality-check indicator (for U-component)
			0	11	004	V-component
			0	33	035	Manual/automatic quality control (for V-component)
			0	33	015	Data quality-check indicator (for V-component)
						(Standard and significant levels)
3	09	066	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			0	08	040	Flight level significance
			2	01	131	Change data width

	2	02	129	Change scale
	0	25	069	Flight level pressure correction
	0	07	004	Pressure
	0	13	003	Relative humidity
	2	02	000	Cancel change scale
	2	01	000	Cancel change data width
	0	02	013	Solar and infrared radiation correction
	0	12	101	Temperature/dry bulb temperature
	0	12	103	Dew-point temperature
	0	10	009	Geopotential height
	0	10	007	Height
	0	11	002	Wind speed
	0	11	001	Wind direction

ANNEX TO PARAGRAPH 3.3.1

Proposed Table B entries

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 01 037	SIGMET sequence identifier	CCITT IA5	0	0	24	Character	0	3
0 01 065	ICAO region identifier	CCITT IA5	0	0	256	Character	0	32
0 08 019	Qualifier for following centre identifier	Code table	0	0	4	Code table	0	2
0 08 079	Change in status of following product	Code table	0	0	3	Code table	0	1
0 10 064	SIGMET cruising level	Code table	0	0	3	Code table	0	1
0 20 028	Expected change in intensity	Code table	0	0	3	Code table	0	1
0 27 035	Length of phenomenon	m	-3	0	13	m	-3	4
0 28 035	Width of phenomenon	m	-3	0	13	m	-3	4

Add the following new categories to Table A within BUFR and CREX:

13 Forecasts
14 Warnings

Add the following new code table values for the descriptors to Table B within BUFR:

0 08 011
21 Thunderstorm
22 Tropical Cyclone
23 Mountain Wave
24 Duststorm

25 Sandstorm

0 20 008

15 Obscured (OBSC)
16 Embedded (EMBD)

0 20 024

5 Severe

Code tables for proposed new Table B descriptors:

Code figure	**0 08 019** **Qualifier for following centre identifier**
0	Reserved
1	ATS (Air Traffic Service) unit serving FIR (Flight Information Region)
2	FIR (Flight Information Region)
3	UIR (Upper Information Region)
4	CTA (Control Area)
5	VAAC (Volcanic Ash Advisory Centre)
6	MWO (Meteorological Watch Office) issuing SIGMET
7-14	Reserved
15	Missing value

Code figure	**0 08 079** **Change in status of following product**
0	Cancelled
1-6	Reserved
7	Missing value

Code figure	**0 10 064** **SIGMET cruising level**
0	Subsonic
1	Transonic
2	Supersonic
3-6	Reserved
7	Missing value

Code figure	**0 20 028** **Expected change in intensity**
0	No change (NC)
1	Forecast to weaken (WKN)
2	Forecast to intensify (INTSF)
3-6	Reserved
7	Missing value

New Table D descriptors:

		(Description of a feature in 3-D or in 2-D, in the last case replication = 1)
3 01 027	1 01 000	Replicate one descriptor
	0 31 001	Replication count
	3 01 028	Description of horizontal section [1]
		(Horizontal section of a feature described as a polygon or a line or a point; in the last case replication = 1)
3 01 028	0 07 010	Flight Level
	1 02 000	Replicate two descriptors [2]
	0 31 001	Replication count
	0 05 002	Latitude (coarse accuracy)
	0 06 002	Longitude (coarse accuracy)
		(SIGMET header)
3 16 030	1 02 002	Replication of 2 descriptors two times (Define validity period)
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 01 037	SIGMET sequence identifier
	0 10 064	SIGMET cruising level
	0 08 019	Qualifier for location identifier, 1=ATS unit serving FIR
	0 01 062	Short ICAO location identifier
	1 02 000	Replicate two descriptors
	0 31 001	Replication count
	0 08 019	Qualifier for location identifier, 2=FIR, 3=UIR, 4=CTA
	0 01 065	ICAO region identifier
	0 08 019	Qualifier for location identifier, 6=MWO
	0 01 062	Short ICAO location identifier
	0 08 019	Qualifier for location identifier, Missing=Cancel
		(SIGMET, Obs or Fcst location and motion)
3 16 031	0 08 021	Time Significance, 16=Analysis, 4=Forecast
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 07 010	Flight level (base)
	0 07 010	Flight level (top)
	0 27 035	Length of phenomenon
	0 28 035	Width of phenomenon
	0 08 007	Dimensional significance, 1=point, 2=area, 3=volume
	3 01 027	Description of feature
	0-08-007	Dimensional significance (Missing=cancel)
	0 19 005	Direction of motion
	0 19 006	Speed of motion
	0 19 007	Radius of feature
	0 20 028	Expected change in intensity
	0 08 021	Time significance, Missing=cancel
		(SIGMET, Fcst position)
3 16 032	0 08 021	Time Significance, 4=Forecast

1 3-D features should be described by a set of horizontal sections in successive ascending flight levels.

2 Polygon should be described by a sequence of contiguous points.

	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 08 007	Dimensional significance, 1=point, 2=area
	1 01 000	Replicate one descriptor
	0 31 001	Replication count
	3 01 023	Latitude, longitude
	0 08 007	Dimensional significance, Missing=cancel
	0 08 021	Time significance, Missing=cancel
		(SIGMET, Outlook)
3 16 033	0 08 021	Time Significance, 4=Forecast
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	1 05 000	Replicate 5 descriptors
	0 31 001	Replication count
	0 07 010	Flight level (base)
	0 07 010	Flight level (top)
	0 08 007	Dimensional significance, 1=point, 2=area, 3=volume
	3 01 027	Description of feature
	0 08 007	Dimensional significance, Missing=cancel
	0 08 021	Time significance, Missing=cancel
		(Volcanic Ash SIGMET)
3 16 034	3 16 030	SIGMET Header
	0 08 011	Meteorological feature, 17=Volcano
	0 01 022	Name of feature
	0 08 007	Dimensional significance, 0=Point
	3 01 023	Location
	0 08 007	Dimensional significance, Missing=Cancel
	0 20 090	Special Clouds, 5=Clouds from volcanic eruptions
	3 16 031	SIGMET Obs or Fcst location and motion
	1 01 000	Delayed replication
	0 31 000	Short replication factor
	3 16 032	SIGMET Fcst position
	1 01 000	Delayed replication
	0 31 001	Delayed replication factor
	3 16 033	SIGMET Outlook
	0 08 011	Meteorological feature, Missing=Cancel
		(Thunderstorm SIGMET)
3 16 035	3 16 030	SIGMET Header
	0 08 011	Meteorological feature, 21=Thunderstorm
	0 20 023	Other weather phenomenon, bit 2=Squalls or all 18 bits = Missing
	0 20 021	Type of precipitation, bit 14=Hail or all 30 bits=Missing
	0 20 008	Cloud distribution 15=OBSC, 16=EMBD, 12=FRQ, 31=Missing
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel

		(Tropical Cyclone SIGMET)
3 16 036	3 16 030	SIGMET Header
	0 08 011	Meteorological feature, 22=Tropical Cyclone
	0 01 027	WMO storm name
	3 16 031	SIGMET Obs or Fcst location and motion

	1 01 000	Delayed replication
	0 31 000	Short replication factor
	3 16 032	SIGMET Fcst position
	1 01 000	Delayed replication
	0 31 001	Delayed replication factor
	3 16 033	SIGMET Outlook
	0 08 011	Meteorological feature, Missing=Cancel
		(Turbulence SIGMET)
3 16 037	3 16 030	SIGMET header
	0 08 011	Meteorological feature, 13=Turbulence
	0 11 031	Degree of turbulence, 10=Mod, 11=Severe
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel
		(Icing SIGMET)
3 16 038	3 16 030	SIGMET header
	0 08 011	Meteorological feature, 15=Airframe Icing
	0 20 041	Airframe icing, 7=Severe
	0 20 021	Type of precip, bit 3=Liquid freezing precip or all 30 bits = Missing
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel
		(Mountain Wave SIGMET)
3 16 039	3 16 030	SIGMET header
	0 08 011	Meteorological feature, 23=Mountain Wave
	0 20 024	Intensity of phenomena, 5=Severe
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel
		(Duststorm SIGMET)
3 16 040	3 16 030	SIGMET header
	0 08 011	Meteorological feature, 24=Duststorm
	0 20 024	Intensity of phenomena, 3=Heavy
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel

		(Sandstorm SIGMET)
3 16 041	3 16 030	SIGMET header
	0 08 011	Meteorological feature, 25=Sandstorm
	0 20 024	Intensity of phenomena, 3=Heavy
	3 16 031	SIGMET Obs or Fcst location and motion
	0 08 011	Meteorological feature, Missing=Cancel

		(Cancellation of SIGMET)
3 16 042	3 16 030	SIGMET header
	0 08 079	Change in status of following product, 0 = Cancelled
	1 02 002	Replication of 2 descriptors two times (Define validity period)
	3 01 011	Year, Month, Day of the SIGMET to be cancelled
	3 01 012	Hour, Minute of the SIGMET to be cancelled
	0 01 037	SIGMET sequence identifier of the SIGMET to be cancelled
	0 10 064	SIGMET cruising level of the SIGMET to be cancelled

	0 08 079	Change in status of following product, Missing = Cancel

ANNEX TO PARAGRAPH 3.4.1

COMMON CODE TABLE C-2: RADIOSONDE/ SOUNDING SYSTEM USED

Common Code Table: (Code table 3685 -r_ar_a (Radiosonde/sounding system used) – for alphanumeric codes
(Code table 0 02 011 (Radiosonde type) in BUFR

Code figure for r_ar_a (Code table 3685)	**Code figure for BUFR (Code table 0 02 011)**	
00–01	0–1	Reserved
02	2	No radiosonde – passive target (e.g. reflector)
03	3	No radiosonde – active target (e.g. transponder)
04	4	No radiosonde – passive temperature-humidity profiler
05	5	No radiosonde – active temperature-humidity profiler
06	6	No radiosonde – radio-acoustic sounder
07–08	7–8	No radiosonde – . . . (reserved)
09	9	No radiosonde – system unknown or not specified
10	10	VIZ type A pressure-commutated (USA)
11	11	VIZ type B time-commutated (USA)
12	12	RS SDC (Space Data Corporation – USA)
13	13	Astor (no longer made — Australia)
14	14	VIZ Mark I MICROSONDE (USA)
15	15	EEC Company type 23 (USA)
16	16	Elin (Austria)
17	17	Graw G. (Germany)
18	18	Reserved for allocation of radiosonde
19	19	Graw M60 (Germany)
20	20	Indian Meteorological Service MK3 (India)
21	21	VIZ/Jin Yang Mark I MICROSONDE (South Korea)
22	22	Meisei RS2-80 (Japan)
23	23	Mesural FMO 1950A (France)
24	24	Mesural FMO 1945A (France)
25	25	Mesural MH73A (France)
26	26	Meteolabor Basora (Switzerland)
27	27	AVK-MRZ (Russian Federation)
28	28	Meteorit Marz2-1 (Russian Federation)
29	29	Meteorit Marz2-2 (Russian Federation)
30	30	Oki RS2-80 (Japan)
31	31	VIZ/Valcom type A pressure-commutated (Canada)
32	32	Shanghai Radio (China)
33	33	UK Met Office MK3 (UK)
34	34	Vinohrady (Czechoslovakia)
35	35	Vaisala RS18 (Finland)
36	36	Vaisala RS21 (Finland)
37	37	Vaisala RS80 (Finland)
38	38	VIZ LOCATE Loran-C (USA)
39	39	Sprenger E076 (Germany)
40	40	Sprenger E084 (Germany)
41	41	Sprenger E085 (Germany)
42	42	Sprenger E086 (Germany)
43	43	AIR IS - 4A - 1680 (USA)
44	44	AIR IS - 4A - 1680 X (USA)
45	45	RS MSS (USA)
46	46	Air IS - 4A - 403 (USA)
47	47	Meisei RS2-91 (Japan)
48	48	VALCOM (Canada)
49	49	VIZ MARK II (USA)
50	50	GRAW DFM-90 (Germany)
51	51	VIZ-B2 (USA)
52	52	Vaisala RS80-57H
53	53	AVK-RF95 (Russian Federation)
54	54	GRAW DFM-97 (Germany)
55	55	Meisei RS-01G (Japan)
56	56	Modem M2K2 GPSonde with derived pressure from GPS

Code figure for r_ar_a (Code table 3685)	Code figure for BUFR (Code table 0 02 011)	
		height (France)
57	57	Modem M2K2-P GPSonde with pressure sensor chip (France)
58	58	AVK-BAR(Russian Federation)
59	59	Modem M2K2-R 1680 MHz RDF radiosonde with pressure sensor chip (France)
60	60	Vaisala RS80/MicroCora (Finland)
61	61	Vaisala RS80/Loran/Digicora I,II or Marwin (Finland)
62	62	Vaisala RS80/PCCora (Finland)
63	63	Vaisala RS80/Star (Finland)
64	64	Orbital Sciences Corporation, Space Data Division, transponder radiosonde, type 909-11-XX, where XX correspond to the model of the instrument (USA)
65	65	VIZ transponder radiosonde, model number 1499–520 (USA)
66	66	Vaisala RS80 /Autosonde (Finland)
67	67	Vaisala RS80/Digicora III (Finland)
68	68	AVK-MRZ-UAP(Russian Federation)
69	69	AVK-BAR-UAP(Russian Federation)
70	70	Reserved for additional automated sounding systems
71	71	Vaisala RS90/Digicora I,II or Marwin (Finland)
72	72	Vaisala RS90/PC-Cora (Finland)
73	73	Vaisala RS90/Autosonde (Finland)
74	74	Vaisala RS90/Star (Finland)
75	75	AVK-MRZ-ARMA (Russian Federation)
76	76	AVK-RF95-ARMA (Russian Federation)
77	77	Modem GL98 GPSonde with derived pressure from GPS height (France)
78	78	Vaisala RS90/Digicora III (Finland)
79	79	Vaisala RS92/Digicora I,II or Marwin (Finland)
80	80	Vaisala RS92/Digicora III (Finland)
81	81	Vaisala RS92/Autosonde (Finland)
82	82	Sippican MK2 GPS/STAR (USA) with rod thermistor, carbon element, and derived pressure
83	83	Sippican MK2 GPS/W9000 (USA) with rod thermistor, carbon element, and derived pressure
84	84	Sippican MARK II with chip thermistor, carbon element, and derived pressure from GPS height
85	85	Sippican MARK IIA with chip thermistor, carbon element, and derived pressure from GPS height
86	86	Sippican MARK II with chip thermistor, pressure, and carbon element
87	87	Sippican MARK IIA with chip thermistor, pressure, and carbon element
88	88	MARL-A-MRZ (Russian Federation)
89	89	MARL-A-BAR (Russian Federation)
90	90	Radiosonde not specified or unknown
91	91	Pressure-only radiosonde
92	92	Pressure-only radiosonde plus transponder
93	93	Pressure-only radiosonde plus radar-reflector
94	94	No-pressure radiosonde plus transponder
95	95	No-pressure radiosonde plus radar-reflector
96	96	Descending radiosonde
97–99	97–99	Reserved for allocation of sounding systems with incomplete sondes
	100–254 Reserved	
	255 Missing value	

NOTES:

(1) References to countries in brackets indicate the manufacturing location rather than the country using the instrument.

(2) Some of the radiosondes listed are no longer in use but are retained for archiving purposes.

ANNEX TO PARAGRAPH 3.4.2

COMMON CODE TABLE C-1: Identification of originating/generating centre

Common Code Table:

(F_1F_2 for alphanumeric codes
($F_3F_3F_3$ for alphanumeric codes
(Code Table 0 in GRIB Edition 1/Code Table 0 01 033 in BUFR

Code figure for F_1F_2	Code figure for $F_3F_3F_3$	Octet 5 in GRIB Edition 1, Sect. 1/ Octet 6 in BUFR Edition 3, Sect. 1	
00	000	0	WMO Secretariat
			01-09: WMCs
01	001	1	Melbourne
02	002	2	Melbourne
03	003	3	)
04	004	4	Moscow
05	005	5	Moscow
06	006	6	)
07	007	7	US National Weather Service, National Centres for Environmental Prediction(NCEP)
08	008	8	US National Weather Service TelecommunicationsGateway (NWSTG)
09	009	9	US National Weather Service - Other
			10-25: Centres in Region I
10	010	10	Cairo (RSMC/RAFC)
11	011	11	)
12	012	12	Dakar (RSMC/RAFC)
13	013	13	)
14	014	14	Nairobi (RSMC/RAFC)
15	015	15	)
16	016	16	Casablanca (RSMC)
17	017	17	Tunis (RSMC)
18	018	18	Tunis Casablanca (RSMC)
19	019	19	)
20	020	20	Las Palmas (RAFC)
21	021	21	Algiers (RSMC)
22	022	22	ACMAD
23	023	23	Mozambique (NMC)
24	024	24	Pretoria (RSMC)
25	025	25	La Réunion (RSMC)
			26-40: Centres in Region II
26	026	26	Khabarovsk (RSMC)
27	027	27	)
28	028	28	New Delhi (RSMC/RAFC)
29	029	29	)
30	030	30	Novosibirsk (RSMC)
31	031	31	)
32	032	32	Tashkent (RSMC)
33	033	33	Jeddah (RSMC)
34	034	34	Tokyo (RSMC), Japan Meteorological Agency
35	035	35	)
36	036	36	Bangkok
37	037	37	Ulan Bator
38	038	38	Beijing (RSMC)
39	039	39	)
40	040	40	Seoul
			41-50: Centres in Region III
41	041	41	Buenos Aires (RSMC/RAFC)
42	042	42	)

Code figure for F_1F_2	Code figure for $F_3F_3F_3$	Octet 5 in GRIB Edition 1, Sect. 1/ Octet 6 in BUFR Edition 3, Sect. 1	
43	043	43	Brasilia (RSMC/RAFC)
44	044	44	)
45	045	45	Santiago
46	046	46	Brazilian Space Agency - INPE
47	047	47	Colombia NMC
48	048	48	Ecuador NMC
49	049	49	Peru NMC
50	050	50	Venezuela NMC
			51-63: Centres in Region IV
51	051	51	Miami (RSMC/RAFC)
52	052	52	Miami RSMC, National Hurricane Center
53	053	53	Montreal (RSMC)
54	054	54	)
55	055	55	San Francisco
56	056	56	Reserved
57	057	57	U.S. Air Force Air Force Global Weather Central
58	058	58	Fleet Numerical Meteorology and Oceanography Center, Monterey, CA
59	059	59	The NOAA Forecast Systems Laboratory, Boulder, CO, USA
60	060	60	United States National Centre for Atmospheric Research (NCAR)
61	061	61	Service ARGOS - Landover
62	062	62	U.S. Naval Oceanographic Office
63	063	63	Reserved for another centre in Region IV
			64-73: Centres in Region V
64	064	64	Honolulu (RSMC)
65	065	65	Darwin (RSMC)
66	066	66	)
67	067	67	Melbourne (RSMC)
68	068	68	Reserved
69	069	69	Wellington (RSMC/RAFC)
70	070	70	)
71	071	71	Nadi (RSMC)
72	072	72	Singapore
73	073	73	Malaysia NMC
			74-99: Centres in Region VI
74	074	74	UK Meteorological Office - Exeter (RSMC)
75	075	75	)
76	076	76	Moscow (RSMC/RAFC)
77	077	77	Reserved
78	078	78	Offenbach (RSMC)
79	079	79	)
80	080	80	Rome (RSMC)
81	081	81	)
82	082	82	Norrköping
83	083	83	)
84	084	84	Toulouse (RSMC)
85	085	85	Toulouse (RSMC)
86	086	86	Helsinki
87	087	87	Belgrade
88	088	88	Oslo
89	089	89	Prague
90	090	90	Episkopi
91	091	91	Ankara
92	092	92	Frankfurt/Main (RAFC)
93	093	93	London (WAFC)
94	094	94	Copenhagen
95	095	95	Rota
96	096	96	Athens
97	097	97	European Space Agency (ESA)

Code figure for F_1F_2	Code figure for $F_3F_3F_3$	Octet 5 in GRIB Edition 1, Sect. 1/ Octet 6 in BUFR Edition 3, Sect. 1	
98	098	98	ECMWF, RSMC
99	099	99	De Bilt
			Additional Centres
n.a.	100	100	Brazzaville
n.a.	101	101	Abidjan
n.a.	102	102	Libyan Arab Jamahiriya NMC
n.a.	103	103	Madagascar NMC
n.a.	104	104	Mauritius NMC
n.a.	105	105	Niger NMC
n.a.	106	106	Seychelles NMC
n.a.	107	107	Uganda NMC
n.a.	108	108	Tanzania NMC
n.a.	109	109	Zimbabwe NMC
n.a.	110	110	Hong-Kong, China
n.a.	111	111	Afghanistan NMC
n.a.	112	112	Bahrain NMC
n.a.	113	113	Bangladesh NMC
n.a.	114	114	Bhutan NMC
n.a.	115	115	Cambodia NMC
n.a.	116	116	Democratic People's Republic of Korea NMC
n.a.	117	117	Islamic Republic of Iran NMC
n.a.	118	118	Iraq NMC
n.a.	119	119	Kazakhstan NMC
n.a.	120	120	Kuwait NMC
n.a.	121	121	Kyrgyz Republic NMC
n.a.	122	122	Lao People's Democratic Republic NMC
n.a.	123	123	Macao, China
n.a.	124	124	Maldives NMC
n.a.	125	125	Myanmar NMC
n.a.	126	126	Nepal NMC
n.a.	127	127	Oman NMC
n.a.	128	128	Pakistan NMC
n.a.	129	129	Qatar NMC
n.a.	130	130	Republic of Yemen NMC
	131	131	Sri Lanka, NMC
n.a.	132	132	Tajikistan NMC
n.a.	133	133	Turkmenistan NMC
n.a.	134	134	United Arab Emirates NMC
	135	135	Uzbekistan, NMC
n.a.	136	136	Socialist Republic of Viet Nam NMC
n.a.	137 to 139	137 to 139	Reserved for other centres
n.a.	140	140	Bolivia NMC
n.a.	141	141	Guyana NMC
n.a.	142	142	Paraguay NMC
n.a.	143	143	Suriname NMC
n.a.	144	144	Uruguay NMC
n.a.	145	145	French Guyana
n.a.	146 to 149	146 to 149	Reserved for other centres
n.a.	150	150	Antigua and Barbuda NMC
n.a.	151	151	Bahamas NMC
n.a.	152	152	Barbados NMC
n.a.	153	153	Belize NMC
n.a.	154	154	British Caribbean Territories Centre
n.a.	155	155	San Jose
n.a.	156	156	Cuba NMC
n.a.	157	157	Dominica NMC
n.a.	158	158	Dominican Republic NMC
n.a.	159	159	El Salvador NMC
n.a.	160	160	US NOAA/NESDIS
n.a.	161	161	US NOAA Office of Oceanic and Atmospheric Research

n.a.	162	162	Guatemala NMC
n.a.	163	163	Haiti NMC
n.a.	164	164	Honduras NMC
n.a.	165	165	Jamaica NMC
n.a.	166	166	Mexico
n.a.	167	167	Netherlands Antilles and Aruba NMC
n.a.	168	168	Nicaragua NMC
n.a.	169	169	Panama NMC
n.a.	170	170	Saint Lucia NMC
n.a.	171	171	Trinidad and Tobago NMC
n.a.	172	172	French Departments
n.a.	173 to 189	173 to 189	Reserved for other centres
n.a.	190	190	Cook Islands NMC
n.a.	191	191	French Polynesia NMC
n.a.	192	192	Tonga NMC
n.a.	193	193	Vanuatu NMC
n.a.	194	194	Brunei NMC
n.a.	195	195	Indonesia NMC
n.a.	196	196	Kiribati NMC
n.a.	197	197	Federated States of Micronesia NMC
n.a.	198	198	New Caledonia NMC
n.a.	199	199	Niue
n.a.	200	200	Papua New Guinea NMC
n.a.	201	201	Philippines NMC
n.a.	202	202	Samoa NMC
n.a.	203	203	Solomon Islands NMC
n.a.	204 to 209	204 to 209	Reserved for other centres
n.a.	210	210	Frascati (ESA/ESRIN)
n.a.	211	211	Lanion
n.a.	212	212	Lisboa
n.a.	213	213	Reykjavik
n.a.	214	214	Madrid
n.a.	215	215	Zürich
n.a.	216	216	Service ARGOS Toulouse
n.a.	217	217	Bratislava
n.a.	218	218	Budapest
n.a.	219	219	Ljubljana
n.a.	220	220	Warsaw
n.a.	221	221	Zagreb
n.a.	222	222	Albania NMC
n.a.	223	223	Armenia NMC
n.a.	224	224	Austria NMC
n.a.	225	225	Azerbaijan NMC
n.a.	226	226	Belarus NMC
n.a.	227	227	Belgium NMC
n.a.	228	228	Bosnia and Herzegovina NMC
n.a.	229	229	Bulgaria NMC
n.a.	230	230	Cyprus NMC
n.a.	231	231	Estonia NMC
n.a.	232	232	Georgia NMC
n.a.	233	233	Dublin
n.a.	234	234	Israel NMC
n.a.	235	235	Jordan NMC
n.a.	236	236	Latvia NMC
n.a.	237	237	Lebanon NMC
n.a.	238	238	Lithuania NMC
n.a.	239	239	Luxembourg
n.a.	240	240	Malta NMC
n.a.	241	241	Monaco
n.a.	242	242	Romania NMC
n.a.	243	243	Syrian Arab Republic NMC
n.a.	244	244	The former Yugoslav Republic of Macedonia NMC
n.a.	245	245	Ukraine NMC
n.a.	246	246	Republic of Moldova
n.a.	247 to 253	247 to 253	Reserved for other centres
n.a.	254	254	EUMETSAT Operation Centre
n.a.	255	255	Missing value

n.a.	256 to 999	n.a.	Not used

NOTES:

(1) The closed bracket sign) indicates that the corresponding code figure is reserved for the previously named centre.

(2) n.a. means not available.

(3) With GRIB or BUFR, to indicate whether the originating/generating centre is a sub-centre or not, the following procedure should be applied:

Use in GRIB Edition 1of Octet 26, Section 1, or use in BUFR Edition 3 of Octet 5, Section 1 with the following meaning:

Code figure	
0	Not a sub-centre, the originating/generating centre is the centre defined by Octet 5, Section 1 of GRIB Edition 1 or Octet 6, Section 1 of BUFR edition 3.
1 to 254	Identifier of the sub-centre which is the originating/generating centre. The identifier of the sub-centre is allocated by the associated centre, which is defined by octet 5, Section 1 of GRIB Edition 1or octet 6, Section 1 of BUFR Edition 3. The sub-centre(s) identifiers should be supplied to the WMO Secretariat by the associated centre(s) for publication.

(4) For Sub-centres definition provided to the WMO Secretariat, see Common table C-12.

COMMON CODE TABLE C-11: Originating/generating centre

CREX B 01 035 (5 characters)	Section 1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits) Section 1/ Octets 5-6 in Edition 4	
00000	00000	WMO Secretariat
		00001-00009: WMCs
00001	00001	Melbourne
00002	00002	Melbourne
00003	00003	)
00004	00004	Moscow
00005	00005	Moscow
00006	00006	)
00007	00007	US National Weather Service, National Centres for Environmental Prediction(NCEP)
00008	00008	US National Weather Service TelecommunicationsGateway (NWSTG)
00009	00009	US National Weather Service - Other
		00010-00025: Centres in Region I
00010	00010	Cairo (RSMC)
00011	00011	)
00012	00012	Dakar (RSMC)
00013	00013	)
00014	00014	Nairobi (RSMC)
00015	00015	)
00016	00016	Casablanca (RSMC)
00017	00017	Tunis (RSMC)
00018	00018	Tunis Casablanca (RSMC)
00019	00019	)
00020	00020	Las Palmas
00021	00021	Algiers (RSMC)
00022	00022	ACMAD
00023	00023	Mozambique (NMC)
00024	00024	Pretoria (RSMC)
00025	00025	La Réunion (RSMC)
		00026-00040: Centres in Region II
00026	00026	Khabarovsk (RSMC)
00027	00027	)
00028	00028	New Delhi (RSMC)
00029	00029	)
00030	00030	Novosibirsk (RSMC)
00031	00031	)
00032	00032	Tashkent (RSMC)
00033	00033	Jeddah (RSMC)
00034	00034	Tokyo (RSMC), Japan Meteorological Agency
00035	00035	)
00036	00036	Bangkok
00037	00037	Ulan Bator
00038	00038	Beijing (RSMC)
00039	00039	)
00040	00040	Seoul
		00041-00050: Centres in Region III
00041	00041	Buenos Aires (RSMC)
00042	00042	)
00043	00043	Brasilia (RSMC)
00044	00044	)
00045	00045	Santiago
00046	00046	Brazilian Space Agency - INPE
00047	00047	Colombia NMC
00048	00048	Ecuador NMC
00049	00049	Peru NMC
00050	00050	Venezuela NMC
		00051-00063: Centres in Region IV

CREX B 01 035 (5 characters)	Section 1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits) Section 1/ Octets 5-6 in Edition 4	
00051	00051	Miami (RSMC)
00052	00052	Miami RSMC, National Hurricane Center
00053	00053	Montreal (RSMC)
00054	00054	)
00055	00055	San Francisco
00056	00056	Reserved
00057	00057	U.S. Air Force Air Force Global Weather Central
00058	00058	Fleet Numerical Meteorology and Oceanography Center, Monterey, CA
00059	00059	The NOAA Forecast Systems Laboratory, Boulder, CO, USA
00060	00060	United States National Centre for Atmospheric Research (NCAR)
00061	00061	Service ARGOS - Landover
00062	00062	U.S. Naval Oceanographic Office
00063	00063	Reserved for another centre in Region IV
		00064-00073: Centres in Region V
00064	00064	Honolulu (RSMC)
00065	00065	Darwin (RSMC)
00066	00066	)
00067	00067	Melbourne (RSMC)
00068	00068	Reserved
00069	00069	Wellington (RSMC)
00070	00070	)
00071	00071	Nadi (RSMC)
00072	00072	Singapore
00073	00073	Malaysia (NMC)
		00074-00099: Centres in Region VI
00074	00074	UK Meteorological Office - Exeter (RSMC)
00075	00075	)
00076	00076	Moscow (RSMC)
00077	00077	Reserved
00078	00078	Offenbach (RSMC)
00079	00079	)
00080	00080	Rome (RSMC)
00081	00081	)
00082	00082	Norrköping
00083	00083	)
00084	00084	Toulouse (RSMC)
00085	00085	Toulouse (RSMC)
00086	00086	Helsinki
00087	00087	Belgrade
00088	00088	Oslo
00089	00089	Prague
00090	00090	Episkopi
00091	00091	Ankara
00092	00092	Frankfurt/Main
00093	00093	London (WAFC)
00094	00094	Copenhagen
00095	00095	Rota
00096	00096	Athens
00097	00097	European Space Agency (ESA)
00098	00098	ECMWF, RSMC
00099	00099	De Bilt
00100	00100	Brazzaville
00101	00101	Abidjan
00102	00102	Libyan Arab Jamahiriya NMC
00103	00103	Madagascar NMC
00104	00104	Mauritius NMC
00105	00105	Niger NMC
00106	00106	Seychelles NMC

CREX B 01 035 (5 characters)	Section 1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits) Section 1/ Octets 5-6 in Edition 4	
00107	00107	Uganda NMC
00108	00108	Tanzania NMC
00109	00109	Zimbabwe NMC
00110	00110	Hong-Kong, China
00111	00111	Afghanistan NMC
00112	00112	Bahrain NMC
00113	00113	Bangladesh NMC
00114	00114	Bhutan NMC
00115	00115	Cambodia NMC
00116	00116	Democratic People's Republic of Korea NMC
00117	00117	Islamic Republic of Iran NMC
00118	00118	Iraq NMC
00119	00119	Kazakhstan NMC
00120	00120	Kuwait NMC
00121	00121	Kyrgyz Republic NMC
00122	00122	Lao People's Democratic Republic NMC
00123	00123	Macao, China
00124	00124	Maldives NMC
00125	00125	Myanmar NMC
00126	00126	Nepal NMC
00127	00127	Oman NMC
00128	00128	Pakistan NMC
00129	00129	Qatar NMC
00130	00130	Republic of Yemen NMC
131	131	Sri Lanka, NMC
132	132	Tajikistan NMC
133	133	Turkmenistan NMC
134	134	United Arab Emirates NMC
135	135	Uzbekistan, NMC
136	136	Socialist Republic of Viet Nam NMC
137 to 139	137 to 139	Reserved for other centres
00140	00140	Bolivia NMC
00141	00141	Guyana NMC
00142	00142	Paraguay NMC
00143	00143	Suriname NMC
00144	00144	Uruguay NMC
00145	00145	French Guyana
00146-00149	00146-00149	Reserved for other centres
00150	00150	Antigua and Barbuda NMC
00151	00151	Bahamas NMC
00152	00152	Barbados NMC
00153	00153	Belize NMC
00154	00154	British Caribbean Territories Centre
00155	00155	San Jose
00156	00156	Cuba NMC
00157	00157	Dominica NMC
00158	00158	Dominican Republic NMC
00159	00159	El Salvador NMC
00160	00160	US NOAA/NESDIS
00161	00161	US NOAA Office of Oceanic and Atmospheric Research
00162	00162	Guatemala NMC
00163	00163	Haiti NMC
00164	00164	Honduras NMC
00165	00165	Jamaica NMC
00166	00166	Mexico
00167	00167	Netherlands Antilles and Aruba NMC
00168	00168	Nicaragua NMC
00169	00169	Panama NMC

CREX B 01 035 (5 characters)	Section 1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits) Section 1/ Octets 5-6 in Edition 4	
00170	00170	Saint Lucia NMC
00171	00171	Trinidad and Tobago NMC
00172	00172	French Departments
00173-00189	00173-00189	Reserved for other centres
00190	00190	Cook Islands NMC
00191	00191	French Polynesia NMC
00192	00192	Tonga NMC
00193	00193	Vanuatu NMC
00194	00194	Brunei NMC
00195	00195	Indonesia NMC
00196	00196	Kiribati NMC
00197	00197	Federated States of Micronesia NMC
00198	00198	New Caledonia NMC
00199	00199	Niue
00200	00200	Papua New Guinea NMC
00201	00201	Philippines NMC
00202	00202	Samoa NMC
00203	00203	Solomon Islands NMC
00204-00209	00204-00209	Reserved for other centres
00210	00210	Frascati (ESA/ESRIN)
00211	00211	Lanion
00212	00212	Lisboa
00213	00213	Reykiavik
00214	00214	Madrid
00215	00215	Zürich
00216	00216	Service ARGOS Toulouse
00217	00217	Bratislava
00218	00218	Budapest
00219	00219	Ljubljana
00220	00220	Warsaw
00221	00221	Zagreb
00222	00222	Albania NMC
00223	00223	Armenia NMC
00224	00224	Austria NMC
00225	00225	Azerbaijan NMC
00226	00226	Belarus NMC
00227	00227	Belgium NMC
00228	00228	Bosnia and Herzegovina NMC
00229	00229	Bulgaria NMC
00230	00230	Cyprus NMC
00231	00231	Estonia NMC
00232	00232	Georgia NMC
00233	00233	Dublin
00234	00234	Israel NMC
00235	00235	Jordan NMC
00236	00236	Latvia NMC
00237	00237	Lebanon NMC
00238	00238	Lithuania NMC
00239	00239	Luxembourg
00240	00240	Malta NMC
00241	00241	Monaco
00242	00242	Romania NMC
00243	00243	Syrian Arab Republic NMC
00244	00244	The former Yugoslav Republic of Macedonia NMC
00245	00245	Ukraine NMC
00246	00246	Republic of Moldova
00247 to 00253	00247 to 00253	Reserved for other centres
00254	00254	EUMETSAT Operation Centre
00255	00255	*Not to be used*

CREX B 01 035 (5 characters)	Section 1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits) Section 1/ Octets 5-6 in Edition 4	
00256	00256	Angola NMC
00257	00257	Benin NMC
00258	00258	Botswana NMC
00259	00259	Burkina Faso NMC
00260	00260	Burundi NMC
00261	00261	Cameroon NMC
00262	00262	Cape Verde NMC
00263	00263	Central African republic NMC
00264	00264	Chad NMC
00265	00265	Comoros NMC
00266	00266	Democratic Republic of the Congo NMC
00267	00267	Djibouti NMC
00268	00268	Eritrea NMC
00269	00269	Ethiopia NMC
00270	00270	Gabon NMC
00271	00271	Gambia NMC
00272	00272	Ghana NMC
00273	00273	Guinea NMC
00274	00274	Guinea Bissau NMC
00275	00275	Lesotho NMC
00276	00276	Liberia NMC
00277	00277	Malawi NMC
00278	00278	Mali NMC
00279	00279	Mauritania NMC
00280	00280	Namibia NMC
00281	00281	Nigeria NMC
00282	00282	Rwanda NMC
00283	00283	Sao Tome and Principe NMC
00284	00284	Sierra Leone NMC
00285	00285	Somalia NMC
00286	00286	Sudan NMC
00287	00287	Swaziland NMC
00288	00288	Togo NMC
00289	00289	Zambia NMC
00290 to 65534	00290 to 65534	Reserved for other centres
65535	65535	Missing value
65536 to 99999	n.a.	Not used

NOTES:

(1) The closed bracket sign ")" indicates that the corresponding code figure is reserved for the previously named centre.

(2) n.a. means not available.

(3) With GRIB or BUFR, to indicate whether the originating/generating centre is a sub-centre or not, the following procedure should be applied:

Use in GRIB of Octets 8-9, Section 1, or use in BUFR Edition 4 of Octets 7-8, Section 1 with the following meaning:

Code figure	
0	Not a sub-centre, the originating/generating centre is the centre defined by Octets 6-7, Section 1 of GRIB Edition 2 or Octets 5-6, Section 1 of BUFR Edition 4.
1 to 254	Identifier of the sub-centre which is the originating/generating centre. The identifier of the sub-centre is allocated by the associated centre, which is defined by octets 6-7, Section 1 of GRIB Edition 2 or octets 5-6, Section 1 of BUFR Edition 4. The sub-centre(s) identifiers should be supplied to the WMO Secretariat by the associated centre(s) for publication.

(4) For Sub-centres definition provided to the WMO Secretariat, see Common table C-12.

COMMON CODE TABLE C-12: Sub-Centres of Originating Centres defined by *entries in Common Tables C-1 or C-11*

ORIGINATING CENTRES		**SUB-CENTRES**	
C-1 or C-11		*BUFR 0 01 034 and Octets 7-8 in Section1 (Edition4)* *Octet 5, Section 1 of BUFR (Edition 3)* *Octet 26, Section 1 of GRIB Edition 1* *Octets 8-9, Section 1 of GRIB Edition 2*	
Code figure	**Name**	**Code figure**	**Name**
		0	No Sub-Centre
Region IV			
00007	US National Weather Service, NCEP	1	NCEP Reanalysis Project
		2	NCEP Ensemble Products
		3	NCEP Central Operations
		4	Environmental Modeling Center
		5	Hydrometeorological Prediction Center
		6	Marine Prediction Center
		7	Climate Prediction Center
		8	Aviation Weather Center
		9	Storm Prediction Center
		10	Tropical Prediction Center
		11	NWS Techniques Development Laboratory
		12	NESDIS Office of Research and Applications
		13	Federal Aviation Administration
		14	NWS Meteorological Development Laboratory
00161	U.S. NOAA Office of Oceanic and Atmospheric Research	1	Great Lakes Environmental Research Laboratory
		2	Forecast Systems Laboratory
Region VI			
00074	UK M.O., Exeter (RSMC)	1	Shanwick Oceanic Area Control Centre
		2	Fucino
		3	Gatineau
		4	Maspalomas
		5	ESA ERS Central Facility
		6	Prince Albert
		7	West Freugh
		13	Tromso
		21	Agenzia Spaziale Italiana (Italy)
		22	Centre National de la Recherche Scientifique (France)
		23	GeoForschungsZentrum (Germany)
		24	Geodetic Observatory Pecny (Czech Republic)
		25	Institut d'Estudis Espacials de Catalunya (Spain)
		26	Swiss Federal Office of Topography
		27	Nordic Commission of Geodesy (Norway)
		28	Nordic Commission of Geodesy (Sweden)
		29	Institute de Geodesie National (France)
		30	Bundesamt für Kartographie und Geodäsie (Germany)
		31	Institute of Engineering Satellite Surveying and Geodesy (U.K.)
00254	EUMETSAT Operation Centre	10	Tromso (Norway)
		20	Maspalomas (Spain)

		30	Kangerlussuaq (Greenland)
		40	Edmonton (Canada)
		50	Bedford (Canada)
		60	Gander (Canada)
		70	Monterey (USA)
		80	Wallops Island (USA)
		90	Gilmor Creek (USA)
		100	Athens (Greece

ANNEX TO PARAGRAPH 3.7.1.1

Changes to definition of operators descriptors for representation of probabilities and other forecast values:

- In operator 2 07 Y definition: change note (3) to: " Calculate ((10xY) +2)/3, disregard any fractional remainder and add the result to the existing bit width.
- In operator 2 08 Y definition: change Operator name to: "Change width of CCITT IA5 field.

ANNEX TO PARAGRAPH 3.7.1.2

COMMON CODE TABLE C-13: Data sub categories *of categories defined by entries in BUFR Table A*

Data categories		International data sub-categories	
BUFR octet 11 CREX nnn in group Annnmmm		BUFR octet 12 CREX mmm in group Annnmmm	
Code figure	**Name**	**Code figure**	**Name *(corresponding traditional alphanumeric codes are in backets)***
000	Surface data — land	000	Hourly synoptic observations from fixed-land stations (SYNOP)
		001	Intermediate synoptic observations from fixed-land stations (SYNOP)
		002	Main synoptic observations from fixed-land stations (SYNOP)
		003	Hourly synoptic observations from mobile-land stations (SYNOP MOBIL)
		004	Intermediate synoptic observations from mobile-land stations (SYNOP MOBIL)
		005	Main synoptic observations from mobile land stations (SYNOP MOBIL)
		006	One-hour observations from automated stations
		007	n-minute observations from AWS stations
		010	Routine aeronautical observations (METAR)
		011	Special aeronautical observations (SPECI)
		020	Climatological observations (CLIMAT)
		030	Spherics locations (SFLOC)
		040	Hydrologic reports
001	Surface data — sea	000	Synoptic observations (SHIP)
		006	One-hour observations from automated stations
		007	n-minute observations from AWS stations
		020	Climatological observations (CLIMAT SHIP)
		025	Buoy observation (BUOY)
		030	Tide gauge
		031	Observed water level time series
002	Vertical soundings (other than satellite)	001	Upper-wind reports from fixed-land stations (PILOT)
		002	Upper-wind reports from ships (PILOT SHIP)
		003	Upper-wind reports from mobile-land stations (PILOT MOBIL)
		004	Upper-level temperature/humidity/wind reports from fixed-land stations (TEMP)
		005	Upper-level temperature/humidity/wind reports from ships (TEMP SHIP)
		006	Upper-level temperature/humidity/wind report from mobile-land stations (TEMPMOBIL)
		007	Upper-level temperature/humidity/wind reports from dropwinsondes (TEMP DROP)
		010	Wind profiler reports
		011	RASS temperature profiles

		020	ASDAR/ACARS profiles (AMDAR)
		025	Climatological observations from fixed-land stations (CLIMAT TEMP)
		026	Climatological observations from ships (CLIMAT TEMP SHIP)
003	Vertical soundings (satellite)	000	Temperature (SATEM)
		001	TIROS (TOVS)
004	Single level upper-air data (other than satellite)	000	ASDAR/ACARS (AMDAR)
		001	Manual (AIREP, PIREP)
005	Single level upper-air data (satellite)	000	Cloud wind data (SATOB)
006	Radar data	000	Reflectivity data
		001	Doppler wind profiles
		002	Derived products
		003	Ground radar weather (RADOB)
007	Synoptic features	000	Forecast Tropical cyclone tracks from EPS
008	Physical/chemical constituents	000	Ozone measurement at surface
		001	Ozone vertical sounding
009	Dispersal and transport	000	Trajectories, analysis or forecast
010	Radiological data	001	Observation (RADREP)
		002	Forecast (RADOF)
012	Surface data (satellite)	000	ERS-uwa
		001	ERS-uwi
		002	ERS-ura
		003	ERS-uat
		004	SSM/I radiometer
		005	Quickscat
		006	Surface temp./radiation (SATOB)
031	Oceanographic data	000	Surface observation
		001	Surface observation along track (TRACKOB)
		002	Spectral wave observation (WAVEOB)
		003	Bathythermal observation (BATHY)
		004	Sub surface floats (profile)
		005	XBT/XCTD profiles (TESAC)
		006	Waves reports

ANNEX TO PARAGRAPH 3.7.1.3:

Proposed modified Section 1 for BUFR Edition 4:

1-3 Length of section
4 BUFR master table
5-6 Identification of originating/generating centre (see Common Code Table C-11)
7-8 Identification of originating/generating sub-centre (allocated by originating/generating Centre- see Common Code Table C-12)
9 Update sequence number (zero for original BUFR messages; incremented for updates)
10 Bit 1 =0 No optional section
=1 Optional section follows
Bit 2-8 Set to zero (reserved)
11 Data Category (Table A)
12 International data sub-category (See Common Table C-13 – see Note (4))
13 Local data sub-category (defined locally by automatic data processing (ADP) centres –see Note (4))
14 Version number of master table (currently 12 for WMO FM 94 BUFR tables – see Note (2))
15 Version number of local tables used to augment master table in use – see Note (2)
16-17 Year (4 digits) |
18 Month |
19 Day | Most typical for the BUFR message content
20 Hour |
21 Minute |
22 Second |
23 Reserved for local use by ADP centres

And add a new Note:

(4) The local data sub-category is maintained for backwards-compatibility with editions 0-3 of BUFR, since many ADP centers have made extensive use of such values in the past. The international data sub-category, introduced beginning with edition 4 of BUFR, is intended to provide a mechanism for better understanding of the overall nature and intent of messages exchanged between ADP centers. These two values (i.e. local sub-category vs. international sub-category) are intended to be supplementary to one another, so both may be used within a particular BUFR message.

Modify regulation 94.1.3 to say:

94.1.3 Each section included in the code form shall always contain an integer multiple of 8 bits (octet). This rule shall be applied by appending bits set to zero to the section where necessary.

ANNEX TO PARAGRAPH 3.7.2

Differences in representing the data/products in BUFR and CREX

Items for definition	BUFR new ed.	existing CREX	**CREX new ed.**	Remarks
OCTETS OF SECTIONS				
Beginning with code name	yes	yes	yes	
Length of section	yes	no	no	Same function for delimiting sections
Section terminator	no	yes	yes	
Master table used	yes	yes	yes	
Edition number	yes	yes	yes	
Version number of master table	yes	yes	yes	
Version number of local table	yes	no	**yes**	
Originating centre	yes	no	**yes**	
Originating sub-centre international	yes	no	**yes**	
Originating sub-centre local	yes	no	no	
Update sequence No.	yes	no	**yes**	

Data category	yes	yes	**yes**	
Data sub-category international	yes	no	**yes**	
Data sub-category local	yes	no	no	
Typical date/time	yes	no	**yes**	
Total length of message	yes	no	no	
Number of data subset	yes	no	**yes**	Same function for delimiting message
Subset terminator	no	yes	yes	
Data compression	yes	no	no	
Check digit	no	yes	yes	
Space characters as separator	no	yes	yes	
End with 7777	yes	yes	yes	
DESCRIPTORS				
Table B	yes	yes	yes	F=B in CREX, Non-SI Units used in CREX, No *data description operator qualifier (class 31)* in CREX
Table C	yes	yes	yes	F=C in CREX, Limited number of descriptors, but additional *unit replacement descriptor* in CREX
Table D	yes	yes	yes	F=D in CREX, No satellite, image and radar data related categories in CREX
(Delayed) replication	yes	yes	yes	F=R in CREX, Without a replication factor (descriptor) in CREX
Code table	yes	yes	yes	
Flag table	yes	yes	yes	Octal representation in CREX
Additional field	yes	no	no	

New edition for CREX Section 1 - Data description section

Group No.	Contents	Meanings	
1	Ttteevvbbww	T :	Indicator for CREX Tables
		tt :	CREX Master table used (00 for WMO standard FM 95 CREX tables)
		ee :	CREX edition number (currently 02)
		vv :	CREX table version number (currently 03)
		bb:	BUFR master table version number used (currently 12)
		ww :	Version number of local table
2	Yyyyymmdd	yyyy:	Typical year
		mm:	Typical month
		dd:	Typical day
3	Hhhnn	hh:	Typical hour
		nn:	Typical minute
4	Annnmmm	A :	Indicator for CREX Table A entry
		nnn :	Data category from CREX Table A
		mmm :	International data sub-category from Common table C-13
5	Poooooppp	ooooo	Originating Centre from Common table C-11
		ppp	Originating sub-centre from Common table C-12
6	Uuu	uu	Update sequence number (00 for original message, uu for updated version)
7	Ssss	sss	Number of subsets included in the report
8 to n	Bxxyyy,	B, C, D:	Indicators for CREX Tables B,C,D entries
	Cxxyyy,	xxyyy:	5 digits each which indicates references from CREX Tables B, C and/or D
	Dxxyyy,		
and/or	Rxxyyy:	R:	Indicator for replication:
		xx:	number of replicated descriptors
		yyy:	number of replications (delayed replication if yyy= 0)

ANNEX TO PARAGRAPH 4

FM 15-X Ext. METAR
FM 16-X Ext. SPECI

a) Code form. *Add* “COR” after “METAR or SPECI”; *add* “NIL” before “(AUTO)”;

b) Code form. *Delete* brackets around “AUTO”;

c) Code form. *Amend* “VVVVD_V or CAVOK” to read “VVVV or VVVV**NDV** or CAVOK”;

d) Code form. *Amend* “**NSC**” to read “**NSC** or **NCD**”;

e) Code form. *Add* at the end of NOTE (2) the following text: “The code words “COR” and “NIL” shall be used, as appropriate, for corrected and missing reports, respectively”;

f) Regulation 15.4. *Amend* the first two sentences to read: “The optional code word AUTO shall be inserted before the wind group when a report contains fully automated observations without human intervention. The ICAO requirement is that all of the specified elements shall be reported. However, if any element….“

g) Regulation 15.5.1 *Delete in NOTE (2)* “— subject to a decision which is currently under review by ICAO”

h) Regulation 15.5.2. *Amend* in the first sentence “3 knots (2 m/s or 6 km/h) or less” to read “less than 3 knots (2 m/s or 6 km/h)”;

i) Regulation 15.5.3. *Amend* in the first sentence “greater than 3 knots (2 m/s or 6 km/h)” to read “3 knots (2 m/s or 6 km/h) or more”;

j) Regulation 15.6. *Amend* “VVVVD_V” to read “VVVV**NDV**”;

k) Regulation 15.6.1. *Amend* the paragraph to read as follows: “The group VVVV shall be used to report prevailing visibility. When the horizontal visibility is not the same in different directions and when the visibility is fluctuating rapidly and the prevailing visibility cannot be determined, the group VVVV shall be used to report the lowest visibility. When visibility sensors are used and they are sited in such a manner that no directional variations can be given, the abbreviation **NDV** shall be appended to visibility reported.”;

l) Note following Regulation 15.6.1. *Delete* the note.

m) Regulation 15.6.2. *Delete* the regulation

n) Regulation 15.6.3(renumbered to 15.6.2 and other regulations appropriately):. *Amend* the paragraph to read as follows: “When the horizontal visibility is not the same in different directions and when the minimum visibility is different from the prevailing visibility; and less than 1500 metres or less than 50 % of the prevailing visibility, the group V_X V_X V_X $V_X D_V$ shall also be used to report the minimum visibility and its general direction in relation to the aerodrome indicated by reference to one of the eight points of compass. If the minimum visibility is observed in more than one direction, the D_V shall represent the most operationally significant direction.”

o) Regulation 15.7.6. *Amend* the last sentence in (a) to read “When the RVR is assessed to be more than 2 000 metres, it shall be reported as P2000”.

p) Regulation 15.8.4 *Amend* the first sentence to read as follows: “Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm.”;

q) Regulation 15.8.8 *Change* to read: “The qualifier **TS** shall be used whenever thunder is heard or lightning is detected at the aerodrome within the 10-minute period preceding the time of observation. When appropriate, **TS** shall be followed immediately, without a space, by relevant letter abbreviations to indicate any precipitation observed. The letter abbreviation **TS** on its own shall be used when thunder is heard or lightning detected at the aerodrome but no precipitation observed.”

r) Regulation 15.8.10 *Amend* “BLSA and BLSN” to read “BLSA, BLSN and VA”;

s) Regulation 15.9. *Add* “or **NCD**” after “**NSC**”;

t) Regulation 15.9.1.1. *Add* the following as the last sentence: “When an automatic observing system is used and no clouds are detected by that system, the abbreviation **NCD** shall be used”;

u) Regulation 15.9.1.7. *Add* the following as the last sentence: “When an automatic observing system is used and the cloud type cannot be observed by that system, the cloud type in each cloud group shall be replaced by ///.” ;

v) Regulation 15.13.2.1. *Amend* “moderate or heavy blowing snow (including snowstorm)” to read “blowing snow”; and add the following as the last sentence: "When an automatic observing system is used and when the type of the precipitation cannot be identified by this system, the abbreviation **REUP** shall be used for recent precipitation"

w) Regulation 15.14.12. *Delete* “(including snowstorm)”.

FM 51-X Ext. TAF

a) Code form. *Add* “COR” after “TAF”; add “NIL” after YYGGggZ and “CNL” after “$Y_1Y_1G_1G_1G_2G_2$”;

b) Code form. *Add* at the end of NOTE (3) the following text: “The code words “CNL”, “COR” and “NIL” shall be included, as appropriate, for cancelled, corrected and missing forecasts, respectively;

c) Regulation 51.3.3 *Amend* in the first sentence “3 knots (2 m/s or 6 km/h) or less” to read “less than 3 knots (2 m/s or 6 km/h)”;

d) Regulation 51.4.1. *Amend* the word “minimum” to read “prevailing”; *add* the following sentence: “When the prevailing visibility cannot be forecast, the group VVVV shall be used to forecast the minimum visibility”; and

e) Regulation 51.5.1. *Delete* the words “(including snowstorm)”;

FM 50-VIII Ext. WINTEM

Add Note (5) to read as follows: “No aeronautical requirement for this code form is stated by ICAO for international air navigation in ICAO Annex 3/WMO Technical Regulations (C.3.1). *Reason: change in aeronautical requirements (Amendment 73 to Annex 3)*.

SYMBOLIC LETTERS AND REMARKS AS TO THE METHODS OF CODING

GgggZ **Time of observation or forecast, in hours and minutes UTC, followed by the letter Z as an abbreviated indicator of UTC (FM 15, FM 16, FM 51, FM 53, FM 54)**

(1) FM 15: ~~official~~ actual time of observation ~~laid down by the meteorological office concerned, in accordance with regional air navigation agreement.~~

. . .

Editorial Note.— Amend part (1) of the definition of “Actual time of observation” to encompass also METARs (FM 15).

. . .

$V_R V_R V_R V_R$ *Amend* (1) to read as follows: “Runway visual range shall be reported in steps of 25 metres when the runway visual range is less than 400 metres; in steps of 50 metres when it is between 400 metres and 800 metres; and in steps of 100 metres when the runway visual range is more than 800 metres. Any observed value which does not fit the reporting scale in use shall be rounded down to the nearest lower step in the scale”.

. . .

~~$V_X V_X V_X V_X$~~ $V_N V_N V_N V_N$ *Amend* “maximum” to read “minimum”.

The team agreed to rename this group as $V_N V_N V_N V_N$. and amend the FM 15-XII METAR and FM 16-XII SPECI code and regulations 15.6 and 15.6.3 accordingly.

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w’w’

a) *Amend* Note (5), the first sentence to read as follows: “Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm.”; *Delete* the second sentence;

b) *Amend* Note (9), the second sentence to read: “When due to blowing snow the observer cannot determine whether or not snow is also falling from cloud, then only BLSN shall be reported”;

c) Note (13). *Amend* in Note (13) “BLSA and BLSN” to read “BLSA, BLSN and VA;

d) *Add* under PRECIPITATION: **UP** Unknown precipitation; and

e) *Add* Note (14): UP is to be used only in reports from fully automated stations unable to distinguish precipitation type.

5. Review of aviation TAC for next year

The meeting noted there were discrepancies between ICAO requirements and aviation code documentation. It was agreed to work over the next year with ICAO to review these discrepancies and to provide the needed updates.

ANNEX TO PARAGRAPH 5.2

Template for METAR and SPECI

Key:

M	=	inclusion mandatory, part of every message
C	=	inclusion conditional, dependent on meteorological conditions or method of observation
O	=	inclusion optional

Note 1. — The ranges and resolutions for the numerical elements included in METAR and SPECI are shown in Table A3-5 of this appendix.

Note 2.— The explanations for the abbreviations used can be found in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes *(PANS-ABC, Doc 8400)*.

Element as specified in Chapter 4	*Detailed content*	*Template(s)*		*Examples*
Identification of the type of report (M)	Type of report (M)	METAR, METAR COR, SPECI *or* SPECI COR		METAR METAR COR SPECI
Location indicator (M)	ICAO location indicator (M)	nnnn		YUDO[1]
Time of the observation (M)	Date and actual time of the observation in UTC (M)	nnnnnnZ		221630Z
Identification of an automated or missing report (C)[2]	Automated or missing report identifier (C)	AUTO *or* NIL		AUTO NIL
END OF METAR IF THE REPORT IS MISSING				
Surface wind (M)	Wind direction (M)	nnn	VRB	24015KMH VRB4KMH (24008KT) (VRB2KT) 19022KMH (19011KT) 00000KMH (00000KT) 140P199KMH (140P99KT)
	Wind speed (M)	[P]nn[n]		
	Significant speed variations (C)[3]	G[P]nn[n]		12012G35KMH (12006G18KT) 24032G54KMH (24016G27KT)
	Units of measurement (M)	KMH (*or* KT)		
	Significant direction al variation s (C)[4]	nnnVnnn	—	02020KMH 350V070 (02010KT 350V070)
Visibility (M)	Prevailing or minimum[5] visibility (M)	nnnn	C A V O K	0350 CAVOK 7000NDV 9999
	Unidirectional visibility (C)[6]	NDV		0800
	Minimum visibility (C)[7]	nnnn		2000 1200NW 6000 2800E
	Direction of the minimum visibility (C)[7]	N *or* NE *or* E *or* SE *or* S *or* SW *or* W *or* NW		

RVR (C)[8]	Name of the element (M)	R			R32/0400
	Runway (M)	nn[n]/			R10/M0050 R14L/P2000
	RVR (M)	[P *or* M]nnnn			R16L/0650 R16C/0500 R16R/0450 R17L/0450
	RVR variations (C)[9]	V[P *or* M]nnnn			R20/0700V1200 R19/0350VP1200
	RVR past tendency (C)[10]	U, D *or* N			R12/1100U R26/0550N R20/0800D R09/0375V0600U R10/M0150V0500D
Present weather (C)[2,11]	Intensity or proximity of present weather (C)[12]	*–or +*	—	*VC*	
	Characteristics and type of present weather (M)[13]	DZ *or* RA *or* SN *or* SG *or* PL *or* DS *or* SS *or* TSRA *or* TSSN *or* TSPL *or* TSGR *or* TSGS *or* SHRA *or* SHSN *or* SHPL *or* SHGR *or* SHGS *or* FZRA *or* FZDZ *or* UP[6] *or* FZUP	IC *or* FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* FZFG *or* BLSN *or* BLSA *or* BLDU *or* DRSN *or* DRSA *or* DRDU *or* MIFG *or* BCFG *or* PRFG	FG *or* PO *or* FC *or* DS *or* SS *or* TS *or* SH *or* BLSN *or* BLSA *or* BLDU *or* VA	RA HZ VCFG +TSRA FG VCSH +DZ VA VCTS -SN MIFG VCBLSA +TSRASN -SNRA DZ FG +SHSN BLSN UP FZUP
Cloud (M)[14]	Cloud amount and height of cloud base or vertical visibility (M)	FEWnnn *or* SCTnnn *or* BKNnnn *or* OVCnnn	VVnnn *or* VV///	SKC *or* NSC *or* NCD[6]	FEW015 VV005 SKC OVC030 VV/// NSC
	Cloud type (C)[2]	CB *or* TCU *or* ///	—		SCT010 OVC020 BKN025/// BKN009TCU NCD SCT008 BKN025CB
Air and dew-point temperature (M)	Air and dew-point temperatures (M)	[M]nn/[M]nn			17/10 02/M08 M01/M10
Pressure values (M)	Name of the element (M)	Q			Q0995 Q1009 Q1022 Q0987
	QNH (M)	nnnn			
Supplementary information (C)	Recent weather (C)[2 11]	REFZDZ *or* REFZRA *or* REDZ *or* RE[SH]RA *or* RE[SH]SN *or* RESG *or* RE[SH]PL *or* RESHGR *or* RESHGS *or* REBLSN *or* RESS *or* REDS *or* RETSRA, RETSSN *or* RETSPL *or* RETSGR *or* RETSGS *or* REFC *or* REVA *or* REUP			REFZRA RETSRA
	Wind shear (C)[2]	WS RWYnn[n] *or* WS ALL RWY			WS RWY03 WS ALL RWY
	Sea-surface temperature and state of the sea (C)[15]	W[M]nn/Sn			W15/S2
	State of the runway (C)[16] — Runway designator (M)	nn		SNOCLO	99421594 SNOCLO 14CLRD//
	State of the runway — Runway deposits (M)	n *or* /	CLRD//		
	State of the runway — Extent of runway contamination (M)	n *or* /			
	State of the runway — Depth of deposit (M)	nn *or* //			
	State of the runway — Friction coefficient or braking action (M)	nn *or* //			
Trend forecast (O)[17]	Change indicator (M)[18]	NOSIG	BECMG *or* TEMPO		NOSIG BECMG FEW020
	Period of change (C)[2]		FMnnnn *and/or* TLnnnn *or* ATnnnn		
	Wind (C)[2]		nnn[P]nn[n][G [P]nn[n]]KMH		TEMPO 25070G100KMH

			(*or* nnn[P]nn[G[P] nn]KT*)*				(TEMPO 25035G50KT)
	Prevailing visibility (C)[2]		nnnn			CAVOK	BECMG FM1030 TL1130 CAVOK BECMG TL1700 0800 FG BECMG AT1800 9000 NSW BECMG FM1900 0500 +SNRA BECMG FM1100 SN TEMPO FM1130 BLSN TEMPO FM0330 TL0430 FZRA
	Weather phenomenon: intensity (C)[12]		–*or* +	—	NSW		
	Weather phenomenon: characteristics and type (C)[2,11,13]		DZ *or* RA *or* SN *or* SG *or* PL*or* DS *or* SS *or* TSRA *or* TSSN *or* TSPL *or* TSGR *or* TSGS *or* SHRA *or* SHSN *or* SHPL *or* SHGR *or* SHGS *or* FZRA *or* FZDZ	IC *or* FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* FZFG *or* BLSN *or* BLSA *or* BLDU *or* DRSN *or* DRSA *or* DRDU *or* MIFG *or* BCFG *or* PRFG			
	Cloud amount and height of cloud base or vertical visibility (C)[2]		FEWnnn *or* SCTnnn or BKNnnn *or* OVCnnn	VVnnn *or* VV///	SKC *or* NSC		TEMPO TL1200 0600 BECMG AT1200 8000 NSW NSC BECMG AT1130 OVC010
	Cloud type (C)[2]		CB *or* TCU	—			TEMPO TL1530 +SHRA BKN012CB

Notes.—

1. Fictitious location.
2. To be included whenever applicable.
.3. To be included in accordance with 4.1.4.2 c).
4. To be included in accordance with 4.1.4.2 b) 1).;
5. To be included in accordance with 4.2.4.4 b).
6. For automated reports only, in accordance with Section 4.9.
7. To be included in accordance with 4.2.4.4 a).
8. To be included if visibility or RVR < 1500 m; for up to a maximum of four runways in accordance with 4.3.6.5 b).
9. To be included in accordance with 4.3.6.6 b).
10. To be included in accordance with 4.3.6.6 a).
11. One or more, up to a maximum of three, groups in accordance with 4.4.2.6, 4.8.1.1 and Appendix 5, 2.2.4.1.
12. To be included whenever applicable; no qualifier for *moderate* intensity in accordance with 4.4.2.5;
13. Precipitation types listed under 4.4.2.3 a) may be combined in accordance with 4.4.2.6 and Appendix 5, 2.2.4.1. Only moderate or heavy precipitation to be indicated in trend forecasts in accordance with Appendix 5, 2.2.4.
14. Up to four cloud layers in accordance with 4.5.4.1 g).
15. To be included; in accordance with 4.8.1.4 a).
16. To be included in accordance with 4.8.1.4.b).
17. To be included in accordance with Chapter 6, 6.3.2.
18. Number of change indicators to be kept to a minimum in accordance with Appendix 5, 2.2.1.1; normally not exceeding three groups

— — — — — — — —

Ranges and resolutions for the numerical elements included in METAR and SPECI

Element as specified in Chapter 4			*Range*	*Resolution*
Runway:		(no units)	01 - 36	1
Wind direction:		° true	000 - 360	10
Wind speed:		KMH KT	00 - 399* 00 - 199*	1 1
Visibility:		M M M M	0000 - 0800 0800 - 5 000 5 000 - 9 000 9 000 - 9 999	50 100 1 000 999
RVR:		M M M	0000 - 0400 0400 - 0800 0800 - 2 000	25 50 100
Vertical visibility:		30's M (100's FT)	000 - 020	1
Clouds: height of cloud base:		30's M (100's FT)	000-050	1
Air temperature; Dew-point temperature:		°C	-80 - +60	1
QNH:		hPa	0850 - 1 100	1
Sea-surface temperature:		°C	-10 - +40	1
State of the sea:		(no units)	0 - 9	1
State of the runway	Runway designator:	(no units)	01 - 36; 51 - 86; 88; 99	1
	Runway deposits:	(no units)	0 - 9	1
	Extent of runway contamination:	(no units)	1; 2; 5; 9	—
	Depth of deposit:	(no units)	00 - 90; 92 - 99	1
	Friction coefficient/ braking action:	(no units)	00 - 95; 99	1

* There is no aeronautical requirement to report surface wind speeds of 200 km/h (100 kt) or more; however, provision has been made for reporting wind speeds up to 399 km/h (199 kt) for non-aeronautical purposes, as necessary.

— — — — — — — —

Template for TAF

Key: M = inclusion mandatory, part of every message
C = inclusion conditional, dependent on meteorological conditions or method of observation
O = inclusion optional

Note 1.— The ranges and resolutions for the numerical elements included in TAF are shown in Table A5-3 of this appendix.

Note 2.— The explanations for the abbreviations used can be found in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes *(PANS-ABC, Doc 8400)*.

Element as specified in Chapter 6	*Detailed content*	*Template(s)*	*Examples*
Identification of the type of forecast (M)	Type of forecast (M)	TAF or TAF AMD or TAF COR	TAF TAF AMD
Location indicator (M)	ICAO location indicator (M)	nnnn	YUDO[1]
Date and time of issue of forecast (M)	Date and time of issue of the forecast in UTC (M)	nnnnnnZ	160000Z
Identification of a missing forecast (C)	Missing forecast identifier (C)	NIL	NIL
END OF TAF IF THE FORECAST IS MISSING			
Date and period of validity of forecast (M)	Date and period of the validity of the forecast in UTC (M)	nnnnnn	160624 080918
Identification of a cancelled forecast (C)	Cancelled forecast identifier(C)	CNL	CNL
END OF TAF IF THE FORECAST IS CANCELLED			
Surface wind (M)	Wind direction (M)	nnn *or* VRB[3]	24015KMH; VRB04KMH (24008KT); (VRB02KT) 19022KMH (19011KT) 00000KMH (00000KT) 140P199KMH (140P99KT) 12012G35KMH (12006G18KT) 24032G54KMH (24016G27KT)
	Wind speed (M)	[P]nn[n]	
	Significant speed variations (C)[2]	G[P]nn[n]	
	Units of measurement (M)	KMH (*or* KT)	
Visibility (M)	Prevailing visibility (M)	nnnn CAVOK	0350 CAVOK 7000 9000 9999
Weather (C)[4, 5]	Intensity of weather phenomena (C)[6]	*– or +*	—	
	Characteristics and type of weather phenomena)(C)[7].	DZ *or* RA *or* SN *or* SG *or* PL *or* DS *or* SS *or* TSRA *or* TSSN *or* TSPL *or* TSGR *or* TSGS *or* SHRA *or* SHSN *or* SHPL *or* SHGR *or* SHGS *or* FZRA *or* FZDZ	IC *or* FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* FZFG *or* BLSN *or* BLSA *or* BLDU *or* DRSN *or*	RA HZ +TSRA FG – FZDZ PRFG +TSRASN SNRA FG

				DRSA *or* DRDU *or* MIFG *or* BCFG *or* PRFG		
Cloud (M)[8]	Cloud amount and height of base or vertical visibility (M)	FEWnnn *or* SCTnnn *or* BKNnnn *or* OVCnnn	VVnnn *or* VV ///	SKC *or* NSC		FEW010 VV005 SKC OVC020 VV/// NSC SCT005 BKN012 SCT008 BKN025CB
	Cloud type (C)[4]	CB	—			
Temperature (O)[9]	Name of the element (M)	TX				TX25/13Z TN09/05Z TX05/12Z TNM02/03Z
	Maximum temperature (M)	[M]nn/				
	Time of occurrence of the maximum temperature (M)	nnZ				
	Name of the element (M)	TN				
	Minimum temperature (M)	[M]nn/				
	Time of occurrence of the minimum temperature (M)	nnZ				
Expected significant changes to one or more of the above elements during the period of validity (C)[4,10]	Change or probability indicator (M)	PROB30 [TEMPO] *or* PROB40 [TEMPO] *or* BECMG *or* TEMPO *or* FM				
	Period of occurrence or change (M)	nnnn				
	Wind (C)[4]	nnn[P]nn[n][G[P] nn[n]]KMH *or* VRBnnKMH (*or* nnn[P]nn[G[P]nn]KT *or* VRBnnKT)				TEMPO 1518 25070G100KMH (TEMPO 1518 25035G50KT) TEMPO 1214 17025G50KMH 1000 TSRA SCT010CB BKN020 (TEMPO 1214 17012G25KT 1000 TSRA SCT010CB BKN020)
	Prevailing visibility (C)[4]	nnnn			C A V O K	BECMG 1011 00000KMH 2400 OVC010 (BECMG 1011 00000KT 2400 OVC010) PROB30 1214 0800 FG
	Weather phenomenon: intensity (C)[6]	- *or* +	—	NSW		BECMG 1214 RA TEMPO 0304 FZRA TEMPO 1215 BLSN PROB40 TEMPO 0608 0500 FG
	Weather phenomenon: characteristics and type (C)[4, 7,]	DZ *or* RA *or* SN *or* SG *or* PL *or* DS *or* SS *or* TSRA *or* TSSN *or* TSPL *or* TSGR *or* TSGS *or* SHRA *or* SHSN *or* SHPL *or* SHGR *or* SHGS *or* FZRA *or* FZDZ	IC *or* FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* FZFG *or* BLSN *or* BLSA *or* BLDU *or* DRSN *or* DRSA *or* DRDU *or* MIFG *or* BCFG *or* PRFG			
	Cloud amount and height of base or vertical visibility (C)[4]	FEWnnn *or* SCTnnn *or* BKNnnn *or* OVCnnn	VVnnn *or* VV///	SKC *or* NSC		FM1230 15015KMH 9999 BKN020 (FM1230 15008KT 9999 BKN020 BECMG 1820 8000 NSW NSC

	Cloud type (C)[4]	CB	—			BECMG 0608 SCT015CB BKN020

Notes.—

1. Fictitious location.
2. To be included in accordance with 1.2.1.
3. To be used in accordance with.1.2.1.
4. To be included whenever applicable.
5. One or more, up to a maximum of three, groups in accordance with 1.2.3.;
6. To be included whenever applicable in accordance with 1.2.3. No qualifier for *moderate* intensity;
7. Weather phenomena to be included in accordance with 1.2.3.
8. Up to four cloud layers in accordance with 1.2.4.
9. To be included in accordance with 1.2.5.
10. To be included in accordance with.1.3, 1.4 and 1.5.

— — — — — — — —

Ranges and resolutions for the numerical elements included in TAF

Element as specified in Chapter 6		*Range*	*Resolution*
Wind direction:	° true	000 - 360	10
Wind speed:	KMH	00 - 399*	1
	KT	00 - 199*	1
Visibility:	M	0000 - 0800	50
	M	0800 - 5 000	100
	M	5 000 - 9 000	1 000
	M	9 000 - 9 999	999
Vertical visibility:	30’s M (100’s FT)	000 - 020	1
Cloud: height of base:	30’s M (100’s FT)	000 - 050	1
Air temperature (maximum and minimum):	°C	-80 - +60	1

*There is no aeronautical requirement to report surface wind speeds of 200 km/h (100 kt) or more; however, provision has been made for reporting wind speeds up to 399 km/h (199 kt) for non-aeronautical purposes, as necessary.

ANNEX TO PARAGRAPH 5.3

The following inconsistencies and/or typographical errors have been noted in WMO Manual 306 and are proposed to be remedied as editorial corrections:

(1) on p. I.2 - BUFR/CREX Table B/14-2, the element name for 0-14-051 should have a comma between "radiation" and "integrated" (to be consistent with other element names)

(2) on p. I.2 - BUFR/CREX Table B/02-4, the units for elements 0-02-082/B-02-082 and 0-02-085/B-02-085 should be "kg", not "Kg"

(3) on p. I.2 - BUFR/CREX Table B/20-2, the units for elements 0-20-043/B-20-043 and 0-20-044/B-20-044 should be "kg m^{-3}", not "Kg m^{-3}"

(4) on p. I.2 - BUFR/CREX Table B/13-2, the units for 0-13-083/B-13-083 should be "kg m^{-3}", not "Kg m^{-3}"

(5) on p. I.2 - BUFR/CREX Table B/13-2, the units for 0-13-090/B-13-090 and 0-13-091/B-13-091 should be "kg m^{-2}", not "Kg m^{-2}"

(6) on p. I.2 - BUFR/CREX Table B/13-2, the units for 0-13-081/B-13-081 should be "S m^{-1}" not "Siemens m^{-1}" (to be consistent with Common Code table C-6 as well as descriptor 0-22-066/B-22-066)

(7) on p. I.2 - BUFR/CREX Table B/01-2, the units for 0-01-031/B-01-031 should be “Common Code table C-11” instead of “Code table” because, even though this descriptor has been deprecated by Note (10) to Class 01, it is clearly inconsistent to use an 8-bit code table for a 16-bit element. A similar change should be made on p. I.2 – CODE/FLAG Tables/01–1 under 0-01-031 by modifying the text “(See Common Code table C-1 in Part C/c)” to read “(See Common Code table C-11 in Part C/c)”

(8) on p. I.2 – CODE/FLAG Tables/04-1, the descriptions for bits 2, 3 and 4 under flag table 0-04-059/B-04-059 should be “0600 UTC”, “1200 UTC” and “1800 UTC” respectively, not “0006 UTC”, “0012 UTC” and “0018 UTC”

(9) on p. I.2 – CREX Table D/01-1, under the description for sequence D-01-029, the second descriptor should be B-02-001 for “Type of station”, not D-02-001

(10) on p. I.2 – CREX Table C-1, the column heading “OPERATING DEFINITION” should be changed to “OPERATION DEFINITION” for consistency with BUFR Table C, and the text within the definition for operator C-01-YYY should be changed from “characters (from 000 to 999)” to “characters (from 001 to 999)”

(11) on p. I.2 – GRIB CF3 – 1, delete the word “Equatorial” from the meaning of code figure 110 in Code table 3.1, so that the meaning now reads “Azimuthal equidistant projection”

ANNEX TO PARAGRAPH 6

Code Migration Schedule

Category →	**Cat.1: common**	**Cat.2: satellite observations**	**Cat.3: aviation[(1)]**	**Cat. 4: maritime**	**Cat. 5[(2)]: miscellaneous**	**Cat. 6[(2)]: almost obsolete**
Lists of → Traditional code forms ***Schedule ↓***	SYNOP SYNOP MOBIL PILOT PILOT MOBIL TEMP TEMP MOBIL TEMP DROP CLIMAT CLIMAT TEMP	SAREP SATEM SARAD SATOB	METAR SPECI TAF AMDAR ROFOR	BUOY TRACKOB BATHY TESAC WAVEOB SHIP CLIMAT SHIP PILOT SHIP TEMP SHIP CLIMAT TEMP SHIP	RADOB IAC IAC FLEET GRID*(to GRIB)* MAFOR HYDRA HYFOR RADOF	CODAR ICEAN GRAF NACLI etc. SFAZI SFLOC SFAZU RADREP ROCOB ROCOB SHIP ARFOR WINTEM
Start experimental Exchange[(3)]	**Nov. 2002** for some data (AWS SYNOP, TEMP USA)	Current at some Centres	**2006** **2002** at some Centres for AMDAR	**2005** **2003** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2004**	Not applicable
Start operational exchange[(3)]	**Nov. 2005**	Current at some Centres	**2008** **2003** for AMDAR	**2007** **2003** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2006**	Not applicable
Migration complete	**Nov. 2010**	**Nov. 2006**	**2015** **2005** for AMDAR	**2012** **2008** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2008**	Not applicable

Notes:

(1) Aviation Codes require ICAO coordination and approval.

(2) For category 5 consider that codes need to be reviewed in order to decide whether or not they should be migrated to BUFR/CREX. Codes in category 6 are not to be migrated.

(3) All dates above are meant as "not later than". However, Members and Organizations are encouraged to start experimental exchange, and, if all relevant conditions (see below) are satisfied, to start operational exchange as soon as possible.

- Start of experimental exchange: data will be made available in BUFR (CREX) but not operationally, i.e. in addition to the current alphanumeric codes, which are still operational.

- Start of operational exchange: data will be made available in BUFR (CREX) whereby some (but not all) Members rely on them operationally. Still the current alphanumeric codes will be distributed (parallel distribution).

- Migration complete: at this date the BUFR (CREX) exchange becomes the standard WMO practice. Parallel distribution is terminated. For archiving purposes and at places where BUFR (CREX) exchange still causes problems the alphanumeric codes may be used on a local basis only.

Relevant conditions to be satisfied before experimental exchange may start:

- Corresponding BUFR/CREX-tables and templates are available;
- Training of concerned testing parties has been completed;
- Required software of testing parties (encoding, decoding, viewing) is implemented;

Relevant conditions to be satisfied before operational exchange may start:

- Corresponding BUFR/CREX-tables and templates are fully validated;
- Training of all concerned parties has been completed;
- All required software (encoding, decoding, viewing) is operational.

ANNEX TO PARAGRAPH 6.1.1

Proposals for sequence descriptors for PILOT and TEMP observation type data

Following sequence descriptors are proposed:

		(Identification of launch site and instrumentation for wind measurements)
3 01 110	3 01 001	WMO block number, WMO station number
	0 01 011	Ship or mobile land station identifier
	0 02 011	Radiosonde type
	0 02 014	Tracking technique/status of system used
	0 02 003	Type of measuring equipment used

		(Identification of launch site and instrumentation for P, T, U and wind measurements)
3 01 111	3 01 001	WMO block number, WMO station number
	0 01 011	Ship or mobile land station identifier
	0 02 011	Radiosonde type
	0 02 013	Solar and infrared radiation correction
	0 02 014	Tracking technique/status of system used
	0 02 003	Type of measuring equipment used

		(Identification of launch point and instrumentation of dropsonde)
3 01 112	0 01 006	Aircraft identifier
	0 02 011	Radiosonde type
	0 02 013	Solar and infrared radiation correction
	0 02 014	Tracking technique/status of system used
	0 02 003	Type of measuring equipment used

		(Date/time of launch)
3 01 113	0 08 021	Time significance (= 18 (launch time))
	3 01 011	Year, month, day of launch
	3 01 013	Hour, minute, second of launch

Note: Time of launch 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.

		(Horizontal and vertical coordinates of launch site)
3 01 114	3 01 021	Latitude (high accuracy)
		Longitude (high accuracy)
	0 07 030	Height of station ground above mean sea level
	0 07 031	Height of barometer above mean sea level
	0 07 007	Height of release of sonde above mean sea level
	0 33 024	Station elevation quality mark (for mobile stations)

						(Cloud information reported with vertical soundings)
3	02	049	0	08	002	Vertical significance
			0	20	011	Cloud amount (of low or middle clouds N_h)
			0	20	013	Height of base of cloud (h)
			0	20	012	Cloud type (low clouds C_L)
			0	20	012	Cloud type (middle clouds C_M)
			0	20	012	Cloud type (high clouds C_H)
			0	08	002	Vertical significance (= missing value)

						(Wind data at a pressure level with radiosonde position)
3	03	050	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	004	Pressure
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	001	Wind direction
			0	11	002	Wind speed

Notes: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds)

(2) 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.

						(Wind shear data at a pressure level with radiosonde position)
3	03	051	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	004	Pressure
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	061	Absolute wind shear in 1 km layer below
			0	11	062	Absolute wind shear in 1 km layer above

Note: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

						(Wind data at a height level with radiosonde position)
3	03	052	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	009	Geopotential height
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	001	Wind direction
			0	11	002	Wind speed

Note: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

						(Wind shear data at a height level with radiosonde position)
3	03	053	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	009	Geopotential height
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	061	Absolute wind shear in 1 km layer below
			0	11	062	Absolute wind shear in 1 km layer above

Note: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

		(Temperature, dew-point and wind data at a pressure level with radiosonde position)
3 03 054	0 04 086	Long time period or displacement (since launch time)
	0 08 042	Extended vertical sounding significance
	0 07 004	Pressure
	0 10 009	Geopotential height
	0 05 015	Latitude displacement since launch site (high accuracy)
	0 06 015	Longitude displacement since launch site (high accuracy)
	0 12 101	Temperature/dry-bulb temperature (scale 2)
	0 12 103	Dew-point temperature (scale 2)
	0 11 001	Wind direction
	0 11 002	Wind speed

Note: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

Common Sequences for representation of PILOT code and TEMP observation type data

		(Sequence for representation of PILOT, PILOT SHIP and PILOT MOBIL observation type data with pressure as the vertical coordinate)
3 09 050	3 01 110	Identification of launch site and instrumentation for wind measurements
	3 01 113	Date/time of launch
	3 01 114	Horizontal and vertical coordinates of launch site
	1 01 000	Delayed replication of 1 descriptor
	0 31 002	Extended delayed descriptor replication factor
	3 03 050	Wind data at a pressure level
	1 01 000	Delayed replication of 1 descriptor
	0 31 001	Delayed descriptor replication factor
	3 03 051	Wind shear data at a pressure level

		(Sequence for representation of PILOT,PILOT SHIP and PILOT MOBIL observation type data with height as the vertical coordinate)
3 09 051	3 01 110	Identification of launch site and instrumentation for wind measurements
	3 01 113	Date/time of launch
	3 01 114	Horizontal and vertical coordinates of launch site
	1 01 000	Delayed replication of 1 descriptor
	0 31 002	Extended delayed descriptor replication factor
	3 03 052	Wind data at a height level
	1 01 000	Delayed replication of 1 descriptor
	0 31 001	Delayed descriptor replication factor
	3 03 053	Wind shear data at a height level
		(Sequence for representation of TEMP, TEMP SHIP and TEMP MOBIL observation type data)
3 09 052	3 01 111	Identification of launch site and instrumentation for P, T, U and wind measurements
	3 01 113	Date/time of launch
	3 01 114	Horizontal and vertical coordinates of launch site
	3 02 049	Cloud information reported with vertical soundings
	0 22 043	Sea water temperature
	1 01 000	Delayed replication of 1 descriptor

	0	31	002	Extended delayed descriptor replication factor
	3	03	054	Temperature, dew-point and wind data at a pressure level
	1	01	000	Delayed replication of 1 descriptor
	0	31	001	Delayed descriptor replication factor
	3	03	051	Wind shear data at a pressure level

						(Sequence for representation of TEMP DROP observation type data)
3 09 053			3	01	112	Identification of launch point and instrumentation of dropsonde
			3	01	113	Date/time of launch
			3	01	114	Horizontal and vertical coordinates of launch site
			1	01	000	Delayed replication of 1 descriptor
			0	31	002	Extended delayed descriptor replication factor
			3	03	054	Temperature, dew-point and wind data at a pressure level
			1	01	000	Delayed replication of 1 descriptor
			0	31	001	Delayed descriptor replication factor
			3	03	051	Wind shear data at a pressure level

BUFR VERTICAL PROFILE TEMPLATES FOR WIND SOUNDING *(SUITABLE FOR PILOT, PILOT SHIP AND PILOT MOBIL OSERVATION TYPE DATA)*

a) with pressure as the vertical coordinate – 3 09 050

3 01 110		**Identification of launch site and instrumentation for wind measurements**	
	3 01 001	WMO block number	Numeric
		WMO station number	Numeric
	0 01 011	Ship or mobile land station identifier	CCITT IA5
	0 02 011	Radiosonde type	Code table
	0 02 014	Tracking technique/status of system used	Code table
	0 02 003	Type of measuring equipment used	Code table
3 01 113		**Date/time of launch**	
	0 08 021	Time significance (= 18 (launch time))	Code table
	3 01 011	Year	Year
		Month	Month
		Day	Day
	3 01 013	Hour	Hour
		Minute	Minute
		Second	Second
3 01 114		**Horizontal and vertical coordinates of launch site**	
	3 01 021	Latitude (high accuracy)	Degree, scale 5
		Longitude (high accuracy)	Degree, scale 5
	0 07 030	Height of station ground above mean sea level	m, scale 1
	0 07 031	Height of barometer above mean sea level	m, scale 1
	0 07 007	Height of release of sonde above mean sea level	m
	0 33 024	Station elevation quality mark (for mobile stations)	Code table
		Wind data at pressure levels	
1 01 000		Delayed replication of 1 descriptor	
0 31 002		Extended delayed descriptor replication factor	Numeric
3 03 050		**Wind data at a pressure level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5

	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}, scale 1
		Wind shear data at pressure levels	
1 01 000		Delayed replication of 1 descriptor	
0 31 001		Delayed descriptor replication factor	Numeric
3 03 051		**Wind shear data at a pressure level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 061	Absolute wind shear in 1 km layer below	m s^{-1}, scale 1
	0 11 062	Absolute wind shear in 1 km layer above	m s^{-1}, scale 1

Notes: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds)

(2) 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.

b) with height as the vertical coordinate – 3 09 051

3 01 110		**Identification of launch site and instrumentation for wind measurements**	
	3 01 001	WMO block number	Numeric
		WMO station number	Numeric
	0 01 011	Ship or mobile land station identifier	CCITT IA5
	0 02 011	Radiosonde type	Code table
	0 02 014	Tracking technique/status of system used	Code table
	0 02 003	Type of measuring equipment used	Code table
3 01 113		**Date/time of launch**	
	0 08 021	Time significance (= 18 (launch time))	Code table
	3 01 011	Year	Year
		Month	Month
		Day	Day
	3 01 013	Hour	Hour
		Minute	Minute
		Second	Second
3 01 114		**Horizontal and vertical coordinates of launch site**	
	3 01 021	Latitude (high accuracy)	Degree, scale 5
		Longitude (high accuracy)	Degree, scale 5
	0 07 030	Height of station ground above mean sea level	m, scale 1
	0 07 031	Height of barometer above mean sea level	m, scale 1
	0 07 007	Height of release of sonde above mean sea level	m
	0 33 024	Station elevation quality mark (for mobile stations)	Code table
		Wind data at heights	
1 01 000		Delayed replication of 1 descriptor	
0 31 002		Extended delayed descriptor replication factor	Numeric
3 03 052		**Wind data at a height level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 009	Geopotential height	gpm
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}, scale 1

		Wind shear data at heights	
1 01 000		Delayed replication of 1 descriptor	
0 31 001		Delayed descriptor replication factor	Numeric
3 03 053		**Wind shear data at a height level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 009	Geopotential height	gpm
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 061	Absolute wind shear in 1 km layer below	m s^{-1}, scale 1
	0 11 062	Absolute wind shear in 1 km layer above	m s^{-1}, scale 1

Notes: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds)

(2) 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.

BUFR VERTICAL PROFILE TEMPLATE FOR UPPER-AIR SOUNDING *(SUITABLE FOR TEMP, TEMP SHIP AND TEMP MOBIL OSERVATION TYPE DATA)*

3 09 052

3 01 111		**Identification of launch site and instrumentation**	
	3 01 001	WMO block number	Numeric
		WMO station number	Numeric
	0 01 011	Ship or mobile land station identifier	CCITT IA5
	0 02 011	Radiosonde type	Code table
	0 02 013	Solar and infrared radiation correction	Code table
	0 02 014	Tracking technique/status of system used	Code table
	0 02 003	Type of measuring equipment used	Code table
3 01 113		**Date/time of launch**	
	0 08 021	Time significance (= 18 (launch time))	Code table
	3 01 011	Year	Year
		Month	Month
		Day	Day
	3 01 013	Hour	Hour
		Minute	Minute
		Second	Second
3 01 114		**Horizontal and vertical coordinates of launch site**	
	3 01 021	Latitude (high accuracy)	Degree, scale 5
		Longitude (high accuracy)	Degree, scale 5
	0 07 030	Height of station ground above mean sea level	m, scale 1
	0 07 031	Height of barometer above mean sea level	m, scale 1
	0 07 007	Height of release of sonde above mean sea level	m
	0 33 024	Station elevation quality mark (for mobile stations)	Code table
3 02 049		**Cloud information reported with vertical soundings**	
	0 08 002	Vertical significance	Code table
	0 20 011	Cloud amount (of low or middle clouds N_h)	Code table
	0 20 013	Height of base of cloud (h)	m, scale –1
	0 20 012	Cloud type (low clouds C_L)	Code table
	0 20 012	Cloud type (middle clouds C_M)	Code table
	0 20 012	Cloud type (high clouds C_H)	Code table
	0 08 002	Vertical significance (= missing value)	Code table
0 22 043		Sea/water temperature (for ship stations)	K, scale 2
		Temperature, dew-point, wind at pressure levels	
1 01 000		Delayed replication of 1 descriptor	
0 31 002		Extended delayed descriptor replication factor	Numeric

3 03 054		**Temperature, dew-point, wind at a pressure level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 10 009	Geopotential height	gpm
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 12 103	Dew-point temperature (scale 2)	K, scale 2
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}, scale 1
		Wind shear data at pressure levels	
1 01 000		Delayed replication of 1 descriptor	1 01 000
0 31 001		Delayed descriptor replication factor	0 31 001
3 03 051		**Wind shear data at a pressure level**	**3 03 051**
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 061	Absolute wind shear in 1 km layer below	m s^{-1}, scale 1
	0 11 062	Absolute wind shear in 1 km layer above	m s^{-1}, scale 1

Notes: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds)

(2) 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.

BUFR VERTICAL PROFILE TEMPLATE FOR DROP SOUNDING *(SUITABLE FOR TEMP DROP OSERVATION TYPE DATA)*

3 09 053

3 01 112		**Identification of launch point and instrumentation of dropsonde**	
	0 01 006	Aircraft identifier	CCITT IA5
	0 02 011	Radiosonde type	Code table
	0 02 013	Solar and infrared radiation correction	Code table
	0 02 014	Tracking technique/status of system used	Code table
	0 02 003	Type of measuring equipment used	Code table
3 01 113		**Date/time of launch**	
	0 08 021	Time significance (= 18 (launch time))	Code table
	3 01 011	Year	Year
		Month	Month
		Day	Day
	3 01 013	Hour	Hour
		Minute	Minute
		Second	Second
3 01 114		**Horizontal and vertical coordinates of launch site**	
	3 01 021	Latitude (high accuracy)	Degree, scale 5
		Longitude (high accuracy)	Degree, scale 5
	0 07 030	Height of station ground above mean sea level	m, scale 1
	0 07 031	Height of barometer above mean sea level	m, scale 1
	0 07 007	Height of release of sonde above mean sea level	m
	0 33 024	Station elevation quality mark	Code table
		Temperature, dew-point, wind at pressure levels	
1 01 000		Delayed replication of 1 descriptor	

0 31 002		Extended delayed descriptor replication factor	Numeric
3 03 054		**Temperature, dew-point, wind at a pressure level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 10 009	Geopotential height	gpm
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 12 103	Dew-point temperature (scale 2)	K, scale 2
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}, scale 1
		Wind shear data at pressure levels	
1 01 000		Delayed replication of 1 descriptor	
0 31 001		Delayed descriptor replication factor	Numeric
3 03 051		**Wind shear data at a pressure level**	
	0 04 086	Long time period or displacement (since launch time)	Second
	0 08 042	Extended vertical sounding significance	Flag table
	0 07 004	Pressure	Pa, scale –1
	0 05 015	Latitude displacement since launch site (high accuracy)	Degree, scale 5
	0 06 015	Longitude displacement since launch site (high accuracy)	Degree, scale 5
	0 11 061	Absolute wind shear in 1 km layer below	m s^{-1}, scale 1
	0 11 062	Absolute wind shear in 1 km layer above	m s^{-1}, scale 1

Notes: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds)

(2) 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.

ANNEX TO PARAGRAPH 6.1.2

BUFR/CREX TEMPLATE FOR AIRCRAFT ASCENT/DESCENT PROFILE *(SUITABLE FOR AMDAR PROFILE DATA)*

Element	**FM 94 BUFR descriptor/ sequence descriptor (BUFR Table B/D)**	**Notes**	**CREX descriptor**
Suggested single new descriptor defining aircraft ascent/descent profile	3 11 008		D 11 008
Aircraft identification	0 01 008		B 01 008
Year, month, day	3 01 011	Date/Time and position of first level in profile	D 01 011
Hour, Min, second	3 01 013		D 01 013
Latitude, Longitude	3 01 021		D 01 021
Phase of flight	0 08 004	Ascent or descent profile	B 08 004
Delayed replication of one descriptor	1 01 000		R 01 000
Delayed descriptor replication factor	0 31 001	Number of levels following	
Aircraft ascent/descent profile data for one level (as below)	***3 11 006***		***D 11 006***
Flight level	0 07 010		B 07 010
Wind direction	0 11 001		B 11 001
Wind speed	0 11 002		B 11 002
Roll angle quality	0 02 064		B 02 064
Temperature/dry-bulb temperature	0 12 101		B 12 101
Dew-point temperature	0 12 103		B 12 103
Suggested single new descriptor defining aircraft ascent/descent profile *with lat. long given for each level*	3 11 009		D 11 009
Aircraft identification	0 01 008		B 01 008
Year, month, day	3 01 011	Date/Time and position of first level in profile	D 01 011
Hour, Min, second	3 01 013		D 01 013
Latitude, Longitude	3 01 021		D 01 021
Phase of flight	0 08 004	Ascent or descent profile	B 08 004
Delayed replication of one descriptor	1 01 000		R 01 000
Delayed descriptor replication factor	0 31 001	Number of levels following	
Aircraft ascent/descent profile data for one level with lat. long. indicated	***3 11 007***		***D 11 007***
Flight level	0 07 010		B 07 010
Latitude, Longitude	3 01 021		D 01 021
Wind direction	0 11 001		B 11 001
Wind speed	0 11 002		B 11 002
Roll angle quality	0 02 064		B 02 064
Temperature/dry-bulb temperature	0 12 101		B 12 101
Dew-point temperature	0 12 103		B 12 103

ANNEX TO PARAGRAPH 6.1.3

1. Minor changes in the template for AWS data from n-minute period

It is proposed to replace 0 04 025 Time displacement (= - n minutes) by 0 04 015 Time increment (= - n minutes). Thus the template would read:

BUFR TEMPLATE FOR AWS DATA FROM N-MINUTE PERIOD

3 01 090		Surface station identification; time, horizontal and vertical co-ordinates	
0 08 010		Surface qualifier (for temperature data)	Code table
3 01 091		Surface station instrumentation	
0 04 015		Time increment (= - n minutes)	Minute
0 04 065		Short time increment (= 1 minute)	Minute
1 14 n		Replicate 14 descriptors n- times	
		E.g.: 1 14 006 in case of 6-minute period, *1 14 010 in case of 10-minute period*	
0 10 004		Pressure	Pa, scale –1
etc.			

2. Sequence descriptors for synoptic reports from land and sea stations (suitable for SYNOP, SYNOP MOBIL, SHIP and SHIP from VOS stations observation data)

2.1 List of sequence descriptors displayed in the templates

Following sequence descriptors for synoptic reports from land and ship (suitable for SYNOP, SYNOP MOBIL, SHIP and SHIP from VOS stations observations data) are listed in Chapter 3 of this Annex:

3 01 092, 3 01 093, 3 02 031, 3 02 032, 3 02 033, 3 02 034, 3 02 035, 3 02 036, 3 02 037, 3 02 038, 3 02 039, 3 02 040, 3 02 041, 3 02 042, 3 02 043, 3 02 044, 3 02 045, 3 02 046, 3 02 047, 3 02 048, 3 02 052, 3 02 053, 3 02 054, 3 02 055, 3 02 056, 3 02 057, 3 02 058, 3 02 059, 3 02 060, 3 02 062, 3 02 063 and 3 07 070.

2.2 Sequence descriptors 3 02 046, 3 02 047 and 3 02 048

3 02 046 is proposed to express the data of the SYNOP group $54g_0s_nd_T$, where

g_0 is “Period of time, in hours, between the time of observation and the temperature change”,
s_n is “Sign of the temperature change” – Code table 3845,
d_T is “ Amount of temperature change, the sign of the change given by s_n “– Code table 0822.

		(Temperature change)
3 02 046	0 04 024	Time period or displacement
	0 04 024	Time period or displacement
	0 12 049	Temperature change over period specified

3 02 047 is proposed to express data of SYNOP group $56D_LD_MD_H$, where

D_L is “True direction from which C_L clouds are moving” – Code table 0700,
D_M is “True direction from which C_M clouds are moving” – Code table 0700,
D_H is “True direction from which C_H clouds are moving” – Code table 0700.

		(Direction of cloud drift)
3 02 047	1 02 003	Replicate 2 descriptors 3 times
	0 08 002	Vertical significance
	0 20 054	True direction from which clouds are moving

3 02 048 is proposed to express data of SYNOP group $57CD_ae_C$, where

C is "Genus of cloud" – Code table 0500,

D_a is "True direction in which the phenomenon indicated is observed" – Code table 0700,

e_C is "Elevation angle of the top of the cloud indicated by C" – Code table 1004.

						(Direction and elevation of cloud)
3	02	048	0	05	021	Bearing or azimuth
			0	07	021	Elevation angle
			0	20	012	Cloud type
			0	05	021	Bearing or azimuth (= missing to cancel the previous value)
			0	07	021	Elevation angle (= missing to cancel the previous value)

3. Review of BUFR templates for synoptic reports from land and sea stations (suitable for SYNOP, SYNOP MOBIL, SHIP and SHIP from VOS stations observation data)

BUFR TEMPLATE FOR SYNOPTIC REPORTS FROM LAND STATIONS SUITABLE FOR SYNOP OBSERVATION DATA

3 01 090			**Fixed surface station identification, time, horizontal and vertical coordinates**		Unit, scale
	3 01 004	0 01 001	WMO block number	**II**	Numeric, 0
		0 01 002	WMO station number	**iii**	Numeric, 0
		0 01 015	Station or site name		CCITT IA5, 0
		0 02 001	Type of station	(i_x)	Code table, 0
	3 01 011	0 04 001	Year		Year, 0
		0 04 002	Month		Month, 0
		0 04 003	Day	**YY**	Day, 0
	3 01 012	0 04 004	Hour	**GG**	Hour, 0
		0 04 005	Minute	**gg**	Minute, 0
	3 01 021	0 05 001	Latitude (high accuracy)		Degree, 5
		0 06 001	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
			Pressure data		
3 02 031	3 02 001	0 10 004	Pressure	$\mathbf{P_0P_0P_0P_0}$	Pa, –1
		0 10 051	Pressure reduced to mean sea level	**PPPP**	Pa, –1
		0 10 061	3-hour pressure change	**ppp**	Pa, –1
		0 10 063	Characteristic of pressure tendency	**a**	Code table, 0
	0 10 062		24-hour pressure change	$\mathbf{p_{24}p_{24}p_{24}}$	Pa, –1
	0 07 004		Pressure (standard level)	$\mathbf{a_3}$	Pa, –1
	0 10 009		Geopotential height of the standard level	**hhh**	gpm, 0
3 02 035			**Basic synoptic "instantaneous" data**		
			Temperature and humidity data		
	3 02 032	0 07 032	Height of sensor above local ground (for temperature measurement)		m, 2
		0 12 101	Temperature/dry-bulb temperature(sc.2)	$\mathbf{s_nTTT}$	K, 2
		0 12 103	Dew-point temperature (scale 2)	$\mathbf{s_nT_dT_dT_d}$	K, 2
		0 13 003	Relative humidity		%, 0
			Visibility data		
	3 02 033	0 07 032	Height of sensor above local ground (for visibility measurement)		m, 2
		0 20 001	Horizontal visibility	**VV**	m, –1

			Precipitation past 24 hours	
	3 02 034	0 07 032	Height of sensor above local ground (for precipitation measurement)	m, 2
		0 13 023	Total precipitation past 24 hours **$R_{24}R_{24}R_{24}R_{24}$**	kg m^{-2}, 1
	0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
			Cloud data	
	3 02 004	0 20 010	Cloud cover (total) **N**	%, 0
		0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (of low or middle clouds) **N_h**	Code table, 0
		0 20 013	Height of base of cloud **h**	m, –1
		0 20 012	Cloud type (low clouds C_L) **C_L**	Code table, 0
		0 20 012	Cloud type (middle clouds C_M) **C_M**	Code table, 0
		0 20 012	Cloud type (high clouds C_H) **C_H**	Code table, 0
	1 01 000		Delayed replication of 1 descriptor	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	3 02 005	0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (N_s) **N_s**	Code table, 0
		0 20 012	Cloud type (C) **C**	Code table, 0
		0 20 013	Height of base of cloud (h_sh_s) **h_sh_s**	m, -1
			Clouds with bases below station level	
3 02 036	1 05 000		Delayed replication of 5 descriptors	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	0 08 002		Vertical significance	Code table, 0
	0 20 011		Cloud amount **N'**	Code table, 0
	0 20 012		Cloud type **C'**	Code table, 0
	0 20 014		Height of top of cloud **H'H'**	m, -1
	0 20 017		Cloud top description **C_t**	Code table, 0
			Direction of cloud drift gr. **$56D_LD_MD_H$**	
3 02 047	1 02 003		Replicate 2 descriptors 3 times	
	0 08 002		Vertical significance = 7 (low cloud) = 8 (middle cloud) = 9 (high cloud)	Degree true, 0
	0 20 054		True direction from which clouds are moving **D_L, D_M, D_H**	Degree true, 0
0 08 002			Vertical significance (set to missing to cancel the previous value)	Code table, 0
			Direction and elevation of cloud gr. **$57CD_ae_C$**	
3 02 048	0 05 021		Bearing or azimuth **D_a**	Degree true, 2
	0 07 021		Elevation angle **e_C**	Degree, 2
	0 20 012		Cloud type **C**	Code table, 0
	0 05 021		Bearing or azimuth (set to missing to cancel the previous value)	Degree true, 2
	0 07 021		Elevation angle (set to missing to cancel the previous value)	Degree, 2
			State of ground, snow depth, ground minimum temperature	
3 02 037	0 20 062		State of ground (with or without snow) **E** or **E'**	Code table, 0
	0 13 013		Total snow depth **sss**	m, 2
	0 12 113		Ground minimum temperature (scale2), past 12 hours **$s_nT_gT_g$**	K, 2
3 02 043			**Basic synoptic "period" data**	
			Present and past weather	
	3 02 038	0 20 003	Present weather **ww**	Code table, 0

		0 04 024	Time period in hours	Hour, 0
		0 20 004	Past weather (1) **W_1**	Code table, 0
		0 20 005	Past weather (2) **W_2**	Code table, 0
			Sunshine data	
	1 02 002		Replicate 2 descriptors 2 times	
	3 02 039	0 04 024	Time period in hours	Hour, 0
		0 14 031	Total sunshine **SS** and **SSS**	Minute, 0
			Precipitation measurement	
	3 02 040	0 07 032	Height of sensor above local ground (for precipitation measurement)	m, 2
		1 02 002	Replicate next 2 descriptors 2 times	
		0 04 024	Time period in hours **t_R**	Hour, 0
		0 13 011	Total precipitation / total water equivalent of snow **RRR**	kg m^{-2}, 1
			Extreme temperature data	
	3 02 041	0 07 032	Height of sensor above local ground (for temperature measurement)	m, 2
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Notes 1 and 2)	Hour, 0
		0 12 111	Maximum temperature (scale 2) at height and over period specified **$s_nT_xT_xT_x$**	K, 2
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Note 2)	Hour, 0
		0 12 112	Minimum temperature (scale 2) at height and over period specified **$s_nT_nT_nT_n$**	K, 2
			Wind data	
	3 02 042	0 07 032	Height of sensor above local ground (for wind measurement)	m, 2
		0 02 002	Type of instrumentation for wind measurement **i_w**	Flag table, 0
		0 08 021	Time significance (= 2 (time averaged))	Code table, 0
		0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind)	Minute, 0
		0 11 001	Wind direction **dd**	Degree true, 0
		0 11 002	Wind speed **ff**	m s^{-1}, 0
		0 08 021	Time significance (= missing value)	Code table, 0
		1 03 002	Replicate next 3 descriptors 2 times	
		0 04 025	Time period in minutes	Minute, 0
		0 11 043	Maximum wind gust direction	Degree true, 0
		0 11 041	Maximum wind gust speed 910**f_mf_m**, 911**f_xf_x**	m s^{-1}, 0
	0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
			Evaporation data	
3 02 044	0 04 024		Time period in hours	Hour, 0
	0 02 004		Type of instrument for evaporation or crop type for evapotranspiration **i_E**	Code table, 0
	0 13 033		Evaporation /evapotranspiration **EEE**	kg m^{-2}, 1
			Radiation data (from 1 hour and 24 hour period)	
1 01 002			Replicate next descriptor 2 times	
3 02 045	0 04 024		Time period in hours	Hour, 0
	0 14 002		Long-wave radiation, integrated over period specified 553SS 4**FFFF** or 553SS 5**FFFF,** 55SSS 4**$F_{24}F_{24}F_{24}F_{24}$** or 55SSS 5**$F_{24}F_{24}F_{24}F_{24}$**	J m^{-2}, -3

	0 14 004		Short-wave radiation, integrated over period specified 553SS 6**FFFF,** 55SSS 6$F_{24}F_{24}F_{24}F_{24}$	J m^{-2}, -3
	0 14 016		Net radiation, integrated over period specified 553SS 0**FFFF** or 553SS 1**FFFF,** 55SSS 0$F_{24}F_{24}F_{24}F_{24}$ or 55SSS 1$F_{24}F_{24}F_{24}F_{24}$	J m^{-2}, -4
	0 14 028		Global solar radiation (high accuracy), integrated over period specified 553SS 2**FFFF,** 55SSS 2$F_{24}F_{24}F_{24}F_{24}$	J m^{-2}, -4
	0 14 029		Diffuse solar radiation (high accuracy), integrated over period specified 553SS 3**FFFF,** 55SSS 3$F_{24}F_{24}F_{24}F_{24}$	J m^{-2}, -4
	0 14 030		Direct solar radiation (high accuracy), integrated over period specified 55408 4**FFFF,** 55508 5$F_{24}F_{24}F_{24}F_{24}$	J m^{-2}, -4
3 02 046			**Temperature change** group **54**$g_0 s_n d_T$	
	0 04 024		Time period or displacement	Hour, 0
	0 04 024		Time period or displacement (see Note 3)	Hour, 0
	0 12 049		Temperature change over period specified $s_n d_T$	K, 0

Notes:

1) Within RA-IV, the maximum temperature at 1200 UTC is reported for the previous calendar day (i.e. the ending time of the period is not equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

2) Within RA-III, the maximum day-time temperature and the minimum night-time temperature is reported (i.e. the ending time of the period may not be equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

3) To construct the required time range, descriptor 004024 has to be included two times.

BUFR TEMPLATE FOR SYNOPTIC REPORTS FROM LAND STATIONS SUITABLE FOR SYNOP MOBIL OBSERVATION DATA

BUFR template for SYNOP MOBIL is similar to the BUFR template for SYNOP. The only difference between them is in the very first sequence descriptor; in case of representation of SYNOP MOBIL data, the station identification, time, horizontal and vertical coordinates is provided by a newly proposed sequence descriptor **3 01 092**:

3 01 092			**Mobile surface station identification, time, horizontal and vertical coordinates**	Unit, scale
	0 01 011		Mobile land station identifier **D….D**	CCITT IA5, 0
	0 01 003		WMO Region number A_1	Code table, 0
	0 02 001		Type of station (i_x)	Code table, 0
	3 01 011	0 04 001	Year	Year, 0
		0 04 002	Month	Month, 0
		0 04 003	Day **YY**	Day, 0
	3 01 012	0 04 004	Hour **GG**	Hour, 0
		0 04 005	Minute **gg**	Minute, 0
	3 01 021	0 05 001	Latitude (high accuracy) $L_aL_aL_a$	Degree, 5
		0 06 001	Longitude (high accuracy) $L_oL_oL_o$	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 33 024		Station elevation quality mark **i_m**	Code table, 0

The rest of the template is identical with the BUFR template for SYNOP data, including the Notes below the template for SYNOP data.

BUFR TEMPLATE FOR SYNOPTIC REPORTS FROM SEA STATIONS SUITABLE FOR SHIP OBSERVATION DATA

3 01 093			**Ship identification, movement, type, date/time, horizontal and vertical coordinates**	Unit, scale
	3 01 036	0 01 011	Ship or mobile land station identifier **D….D**	CCITT IA5, 0
		0 01 012	Direction of motion of moving observing platform(3) **D_s**	Degree true, 0
		0 01 013	Speed of motion of moving observing platform(4) **v_s**	m s^{-1}, 0
		0 02 001	Type of station (**i_x**)	Code table, 0
		0 04 001	Year	Year, 0
		0 04 002	Month	Month, 0
		0 04 003	Day **YY**	Day, 0
		0 04 004	Hour **GG**	Hour, 0
		0 04 005	Minute **gg**	Minute, 0
		0 05 002	Latitude (coarse accuracy) **$L_aL_aL_a$**	Degree, 2
		0 06 002	Longitude (coarse accuracy) **$L_oL_oL_oL_o$**	Degree, 2
	0 07 030		Height of station platform above mean sea level	m, 1
	0 07 031		Height of barometer above mean sea level	m, 1
			Pressure data	
3 02 001	0 10 004		Pressure **$P_0P_0P_0P_0$**	Pa, –1
	0 10 051		Pressure reduced to mean sea level **PPPP**	Pa, –1
	0 10 061		3-hour pressure change **ppp**	Pa, –1
	0 10 063		Characteristic of pressure tendency **a**	Code table, 0
3 02 054			**SHIP "instantaneous" data**	
			Temperature and humidity data	
	3 02 052	0 07 032	Height of sensor above marine deck platform (for temperature measurement)	m, 2
		0 07 033	Height of sensor above water surface (for temperature measurement)	m, 1
		0 12 101	Temperature/dry-bulb temperature(sc.2) **s_nTTT**	K, 2
		0 12 103	Dew-point temperature (scale 2) **$s_nT_dT_dT_d$**	K, 2
		0 13 003	Relative humidity	%, 0
			Visibility data	
	3 02 053	0 07 032	Height of sensor above marine deck platform (for visibility measurement)	m, 2
		0 07 033	Height of sensor above water surface (for visibility measurement)	m, 1
		0 20 001	Horizontal visibility **VV**	m, –1
	0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1

			Precipitation past 24 hours	
	3 02 034	0 07 032	Height of sensor above marine deck platform (for precipitation measurement)	m, 2
		0 13 023	Total precipitation past 24 hours **$R_{24}R_{24}R_{24}$**	kg m^{-2}, 1
	0 07 032		Height of sensor above marine deck platform (set to missing to cancel the previous value)	m, 2
			Cloud data	
	3 02 004	0 20 010	Cloud cover (total) **N**	%, 0
		0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (of low or middle clouds) **N_h**	Code table, 0
		0 20 013	Height of base of cloud **h**	m, –1
		0 20 012	Cloud type (low clouds C_L) **C_L**	Code table, 0
		0 20 012	Cloud type (middle clouds C_M) **C_M**	Code table, 0
		0 20 012	Cloud type (high clouds C_H) **C_H**	Code table, 0
	1 01 000		Delayed replication of 1 descriptor	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	3 02 005	0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (N_s) **N_s**	Code table, 0
		0 20 012	Cloud type (C) **C**	Code table, 0
		0 20 013	Height of base of cloud (h_sh_s) **h_sh_s**	m, -1
0 08 002			Vertical significance (set to missing to cancel the previous value)	Code table, 0
			Icing and ice	
3 02 055	0 20 031		Ice deposit (thickness) **E_sE_s**	m, 2
	0 20 032		Rate of ice accretion **R_s**	Code table, 0
	0 20 033		Cause of ice accretion **I_s**	Flag table, 0
	0 20 034		Sea ice concentration **c_i**	Code table, 0
	0 20 035		Amount and type of ice **b_i**	Code table, 0
	0 20 036		Ice situation **z_i**	Code table, 0
	0 20 037		Ice development **S_i**	Code table, 0
	0 20 038		Bearing of ice edge **D_i**	Degree true, 0
3 02 057			**SHIP marine data**	
			Sea/water temperature	
	3 02 056	0 02 038	Method of sea surface temperature measurement	Code table, 0
		0 22 043	Sea/water temperature **$s_sT_wT_wT_w$**	K, 2
			Waves	
	3 02 021	0 22 001	Direction of waves	Degree true
		0 22 011	Period of waves **$P_{wa}P_{wa}$**	s, 0
		0 22 021	Height of waves **$H_{wa}H_{wa}$**	m, 1
	3 02 024	0 22 002	Direction of wind waves	Degree true, 0
		0 22 012	Period of wind waves **P_wP_w**	s, 0
		0 22 022	Height of wind waves **H_wH_w**	m, 1
		1 01 002	Replicate 1 descriptor 2 times	

		3 02 023	Swell waves (2 systems of swell) **$d_{w1}d_{w1}$, $P_{w1}P_{w1}$, $H_{w1}H_{w1}$** **$d_{w2}d_{w2}$, $P_{w2}P_{w2}$, $H_{w2}H_{w2}$**	
3 02 060			**SHIP"period" data**	
			Present and past weather	
	3 02 038	0 20 003	Present weather **ww**	Code table, 0
		0 04 024	Time period in hours	Hour, 0
		0 20 004	Past weather (1) **W_1**	Code table, 0
		0 20 005	Past weather (2) **W_2**	Code table, 0
			Precipitation measurement	
	3 02 040	0 07 032	Height of sensor above marine deck platform (for precipitation measurement)	m, 2
		1 02 002	Replicate next 2 descriptors 2 times	
		0 04 024	Time period in hours **t_R**	Hour, 0
		0 13 011	Total precipitation / total water equivalent of snow **RRR**	kg m^{-2}, 1
			Extreme temperature data	
	3 02 058	0 07 032	Height of sensor above marine deck platform (for temperature measurement)	m, 2
		0 07 033	Height of sensor above water surface (for temperature measurement)	m, 1
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Notes 1 and 2)	Hour, 0
		0 12 111	Maximum temperature (scale 2) at height and over period specified **$s_nT_xT_xT_x$**	K, 2
		0 04 024	Time period or displacement	Hour, 0
			Time period or displacement (see Note 2)	Hour, 0
		0 12 112	Minimum temperature (scale 2) at height and over period specified **$s_nT_nT_nT_n$**	K, 2
			Wind data	
	3 02 059	0 07 032	Height of sensor above marine deck platform (for wind measurement)	m, 2
		0 07 033	Height of sensor above water surface (for wind measurement)	m, 1
		0 02 002	Type of instrumentation for wind measurement **i_w**	Flag table, 0
		0 08 021	Time significance (= 2 (time averaged))	Code table, 0
		0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind)	Minute, 0
		0 11 001	Wind direction **dd**	Degree true, 0
		0 11 002	Wind speed **ff**	m s^{-1}, 0
		0 08 021	Time significance (= missing value)	Code table, 0
		1 03 002	Replicate next 3 descriptors 2 times	
		0 04 025	Time period in minutes	Minute, 0
		0 11 043	Maximum wind gust direction	Degree true, 0
		0 11 041	Maximum wind gust speed 910**f_mf_m**, 911**f_xf_x**	m s^{-1}, 0

Notes:

1) Within RA-IV, the maximum temperature at 1200 UTC is reported for the previous calendar day (i.e. the ending time of the period is not equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

2) Within RA-III, the maximum day-time temperature and the minimum night-time temperature is reported (i.e. the ending time of the period may not be equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

3) 0 01 012: Means course made good (average course over the ground) during the three hours preceding the time of observation.

4) 0 01 013: Means speed made good (average speed over the ground) during the three hours preceding the time of observation.

5) If "plain language" text is reported within Section 2, this information can be conveyed in BUFR via the use of an appropriate 205YYY field as an extra descriptor following the above basic template.

BUFR TEMPLATE FOR SYNOPTIC REPORTS FROM SEA STATIONS SUITABLE FOR SHIP OBSERVATION DATA FROM VOS STATIONS

3 07 070

3 07 070 = 3 01 093 + 3 02 062 + 3 02 063

3 01 093			**Ship identification, movement, type, date/time, horizontal and vertical coordinates**	Unit, scale
	3 01 036	0 01 011	Ship or mobile land station identifier **D….D**	CCITT IA5, 0
		0 01 012	Direction of motion of moving observing platform(3) **D_s**	Degree true, 0
		0 01 013	Speed of motion of moving observing platform(4) **v_s**	m s^{-1}, 0
		0 02 001	Type of station **(i_x)**	Code table, 0
		0 04 001	Year	Year, 0
		0 04 002	Month	Month, 0
		0 04 003	Day **YY**	Day, 0
		0 04 004	Hour **GG**	Hour, 0
		0 04 005	Minute **gg**	Minute, 0
		0 05 002	Latitude (coarse accuracy) **$L_aL_aL_a$**	Degree, 2
		0 06 002	Longitude (coarse accuracy) **$L_oL_oL_oL_o$**	Degree, 2
	0 07 030		Height of station platform above mean sea level	m, 1
	0 07 031		Height of barometer above mean sea level	m, 1
3 02 062			**SHIP "instantaneous" data from VOS**	
			Pressure data	
	3 02 001	0 10 004	Pressure **$P_0P_0P_0P_0$**	Pa, –1
		0 10 051	Pressure reduced to mean sea level **PPPP**	Pa, –1
		0 10 061	3-hour pressure change **ppp**	Pa, –1
		0 10 063	Characteristic of pressure tendency **a**	Code table, 0
			Temperature and humidity data	
	3 02 052	0 07 032	Height of sensor above marine deck platform (for temperature measurement)	m, 2
		0 07 033	Height of sensor above water surface (for temperature measurement)	m, 1
		0 12 101	Temperature/dry-bulb temperature(sc.2) **s_nTTT**	K, 2
		0 02 039	Method of wet-bulb temperature measurement	Code table, 0
		0 12 102	Wet-bulb temperature (scale 2) **$s_wT_bT_bT_b$**	K, 2
		0 12 103	Dew-point temperature (scale 2) **$s_nT_dT_dT_d$**	K, 2
		0 13 003	Relative humidity	%, 0
			Visibility data	
	3 02 053	0 07 032	Height of sensor above marine deck platform (for visibility measurement)	m, 2
		0 07 033	Height of sensor above water surface	m, 1

			(for visibility measurement)	
		0 20 001	Horizontal visibility **VV**	m, –1
	0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
			Precipitation past 24 hours	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 034	0 07 032	Height of sensor above marine deck platform (for precipitation measurement)	m, 2
		0 13 023	Total precipitation past 24 hours **$R_{24}R_{24}R_{24}R_{24}$**	kg m^{-2}, 1
	0 07 032		Height of sensor above marine deck platform (set to missing to cancel the previous value)	m, 2
			Cloud data	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 004	0 20 010	Cloud cover (total) **N**	%, 0
		0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (of low or middle clouds) **N_h**	Code table, 0
		0 20 013	Height of base of cloud **h**	m, –1
		0 20 012	Cloud type (low clouds C_L) **C_L**	Code table, 0
		0 20 012	Cloud type (middle clouds C_M) **C_M**	Code table, 0
		0 20 012	Cloud type (high clouds C_H) **C_H**	Code table, 0
	1 01 000		Delayed replication of 1 descriptor	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	3 02 005	0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (N_s) **N_s**	Code table, 0
		0 20 012	Cloud type (C) **C**	Code table, 0
		0 20 013	Height of base of cloud (h_sh_s) **h_sh_s**	m, -1
	0 08 002		Vertical significance (set to missing to cancel the previous value)	Code table, 0
			Icing and ice	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 055	0 20 031	Ice deposit (thickness) **E_sE_s**	m, 2
		0 20 032	Rate of ice accretion **R_s**	Code table, 0
		0 20 033	Cause of ice accretion **I_s**	Flag table, 0
		0 20 034	Sea ice concentration **c_i**	Code table, 0
		0 20 035	Amount and type of ice **b_i**	Code table, 0
		0 20 036	Ice situation **z_i**	Code table, 0
		0 20 037	Ice development **S_i**	Code table, 0
		0 20 038	Bearing of ice edge **D_i**	Degree true, 0
			Sea/water temperature	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 056	0 02 038	Method of sea surface temperature measurement	Code table, 0
		0 22 043	Sea/water temperature **$s_sT_wT_wT_w$**	K, 2
			Waves	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 021	0 22 001	Direction of waves	Degree true, 0
		0 22 011	Period of waves **$P_{wa}P_{wa}$**	s, 0
		0 22 021	Height of waves **$H_{wa}H_{wa}$**	m, 1
	1 01 000		Delayed replication of 1 descriptor	

	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 024	0 22 002	Direction of wind waves	Degree true, 0
		0 22 012	Period of wind waves **P_wP_w**	s, 0
		0 22 022	Height of wind waves **H_wH_w**	m, 1
		1 01 002	Replicate 1 descriptor 2 times	
		3 02 023	Swell waves (2 systems of swell) **$d_{w1}d_{w1}$, $P_{w1}P_{w1}$, $H_{w1}H_{w1}$** **$d_{w2}d_{w2}$, $P_{w2}P_{w2}$, $H_{w2}H_{w2}$**	
3 02 063			**SHIP"period" data from VOS**	
			Present and past weather	
	3 02 038	0 20 003	Present weather **ww**	Code table, 0
		0 04 024	Time period in hours	Hour, 0
		0 20 004	Past weather (1) **W_1**	Code table, 0
		0 20 005	Past weather (2) **W_2**	Code table, 0
			Precipitation measurement	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 040	0 07 032	Height of sensor above marine deck platform (for precipitation measurement)	m, 2
		1 02 002	Replicate next 2 descriptors 2 times	
		0 04 024	Time period in hours **t_R**	Hour, 0
		0 13 011	Total precipitation / total water equivalent of snow **RRR**	kg m^{-2}, 1
			Extreme temperature data	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 000		Short delayed descriptor replication factor	Numeric, 0
	3 02 058	0 07 032	Height of sensor above marine deck platform (for temperature measurement)	m, 2
		0 07 033	Height of sensor above water surface (for temperature measurement)	m, 1
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Notes 1 and 2)	Hour, 0
		0 12 111	Maximum temperature (scale 2) at height and over period specified **$s_nT_xT_xT_x$**	K, 2
		0 04 024	Time period or displacement	Hour, 0
			Time period or displacement (see Note 2)	Hour, 0
		0 12 112	Minimum temperature (scale 2) at height and over period specified **$s_nT_nT_nT_n$**	K, 2
			Wind data	
	3 02 059	0 07 032	Height of sensor above marine deck platform (for wind measurement)	m, 2
		0 07 033	Height of sensor above water surface (for wind measurement)	m, 1
		0 02 002	Type of instrumentation for wind measurement **i_w**	Flag table, 0
		0 08 021	Time significance (= 2 (time averaged))	Code table, 0
		0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind)	Minute, 0
		0 11 001	Wind direction **dd**	Degree true, 0
		0 11 002	Wind speed **ff**	m s^{-1}, 0
		0 08 021	Time significance (= missing value)	Code table, 0
		1 03 000	Delayed replication of 3 descriptors	
		0 31 001	Delayed descriptor replication factor	Numeric, 0
		0 04 025	Time period in minutes	Minute, 0
		0 11 043	Maximum wind gust direction	Degree true, 0

		0 11 041	Maximum wind gust speed 910**f**$_m$**f**$_m$, 911**f**$_x$**f**$_x$	m s^{-1}, 0

Notes:

1) Within RA-IV, the maximum temperature at 1200 UTC is reported for the previous calendar day (i.e. the ending time of the period is not equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

2) Within RA-III, the maximum day-time temperature and the minimum night-time temperature is reported (i.e. the ending time of the period may not be equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

3) 0 01 012: Means course made good (average course over the ground) during the three hours preceding the time of observation.

4) 0 01 013: Means speed made good (average speed over the ground) during the three hours preceding the time of observation.

5) If "plain language" text is reported within Section 2, this information can be conveyed in BUFR via the use of an appropriate 205YYY field as an extra descriptor following the above basic template.

ANNEX TO PARAGRAPH 6.1.5

Proposed change of the CLIMAT Template

1 02 008		Replicate 2 descriptors **8 times**	
0 08 050		Qualifier for number of missing values in calculation of statistic = **1** (pressure), = **2** (temperature), = **3** (extreme temperatures),(4) = **4** (vapour pressure), = **5** (precipitation), = **6** (sunshine duration) = **7 (maximum temperature),** (4) = **8 (minimum temperature),** (4)	Code table
0 08 020		Total number of missing entities (years) = **y**$_p$**y**$_p$ **- s.2, gr. 8** (pressure) = **y**$_T$**y**$_T$ **- s.2, gr. 8** (temperature) = **y**$_{Tx}$**y**$_{Tx}$ **- s.2, gr. 8** (extreme temperatures)(4) = **y**$_e$**y**$_e$ **- s.2, gr. 9** (vapour pressure) = **y**$_R$**y**$_R$ **- s.2, gr. 9** (precipitation) = **y**$_S$**y**$_S$ **- s.2, gr. 9** (sunshine duration) = **maximum temperature** (4) = **minimum temperature** (4)	Numeric

Add Note:

(4) The number of missing years within the reference period from the calculation of normal for mean extreme air temperature should be given, if available, for both the calculation of normal maximum temperature and for the calculation of normal minimum temperature in addition to the number of missing years for the extreme air temperatures reported under 0 08 020 preceded by 0 08 050 in which Figure 3 is used.

ANNEX TO PARAGRAPH 6.2

DRAFT TEMPLATE FOR TAF IN BUFR/CREX

This possible sequence would require new Table D descriptors:

F X Y	Reference	Element/Sequence name	
		(Aerodrome forecast identification and time interval)	
3 07 aaa	0 01 063	ICAO location identifier	CCCC
	0 08 ddd	Time significance – issue time	
	3 01 011	Year, month, day	YY
	3 01 012	Hour, minute	GGgg
	0 08 ddd	Time significance – Cancel; Forecast ?	
	3 01 011	Year, month, day (start of forecast)	Y_1Y_1
	0 04 004	Hour (start of forecast)	G_1G_1
	3 01 011	Year, month, day (end of forecast)	
	0 04 004	Hour (end of forecast)	G_2G_2
	3 01 024	Latitude, longitude, height of station	
		(Forecast weather for aerodrome forecast)	
3 07 bbb	0 07 006	Height above station (10m)	
	0 11 001	Wind direction	ddd
	0 11 002	Wind speed	ff
	0 11 041	Maximum wind speed (gusts)	f_mf_m
	0 20 009	General weather indicator (CAVOK, NSW, NSC)	
	0 20 001	Horizontal visibility	VVVV
	3 07 014	Weather	w'w'
	3 07 015	Cloud layer(s)	
3 07 ccc	3 07 aaa	Identification and time interval	
	3 07 bbb	Forecast	
	0 05 000	Delayed replication of five descriptors	
	0 31 001	Replication factor	
	0 xx ggg	Probability of following event occurring	C_2C_2
	0 08 016	Change qualifier of an aerodrome forecast	TTTTT
	3 01 012	Start of time of change	GG or GGgg
	3 01 012	End of time of change	G_eG_e
	3 07 bbb	Forecast conditions during or after change	
	0 07 006	Height above station (2m)	
	0 08 ddd	Time significance (Time of maximum temperature)	
	0 04 004	Hour	G_FG_F
	0 12 111	Maximum temperature	T_FT_F
	0 08 ddd	Time significance (Time of minimum temperature)	
	0 04 004	Hour	G_FG_F
	0 12 111	Minimum temperature	T_FT_F
	0 08 ddd	Time significance (Cancel)	

ANNEX TO PARAGRAPH 6.4.1.5

1. Japan Meteorological Agency will disseminate in 2005 SHIP data, which are converted at RTH Tokyo, in BUFR. Japan is disseminating wind profiler data in BUFR. Japan is exchanging AWS data in BUFR with the Republic of Korea.

2. Hong-Kong is transmitting wind profiler data in BUFR.

3. Météo-France disseminate JASON 1 satellite data in BUFR. It will disseminate AWS data in BUFR later 2005 or in 2006.

3. CHMI (Czech Republic), DWD (Germany), KNMI (Netherlands) and SHMI (Slovakia) are disseminating AWS observations in BUFR.

4. The Czech Republic is producing upper-air sounding data in BUFR format.

5. USA is actively planning to produce radiosonde data in BUFR.

6. Experimental transmission of Buoy data by Service Argos in BUFR started during 2003. A limited number of ships are transmitting their XBT data via Argos (less than 20 ships). As Service Argos has developed BUFR encoding capability for buoy data, such capability might be used for GTS distribution of XBT data from those ships as well. In that case, as for the buoy data, and for an undefined period, data should be distributed in both BUFR and BATHY code forms. Most of the profiling floats are presently reporting via Argos. As Service Argos is developing BUFR encoding capability for buoy data, such capability might be used for GTS distribution of profiling float data as well. In that case, as for the buoy data, and for an undefined period, data should be distributed in both BUFR and TESAC code forms. Before a coordinated approach can be proposed, decision to go to BUFR will be made by individual float operators.

7.1 The technical coordinator of the DBCP reported on the development and implementation of the BUFR encoding capability within the Argos GTS sub-system. Following DBCP-XVII recommendations, developments started in January 2002 and progress was reported at the 18th DBCP session. Developments continued during the last intersessional period and work was completed in April 2003. Extensive tests had been conducted between April and June 2003 with active participation from the Czech Hydrometeorological Institute (CHMI), ECMWF, Deutscher Wetterdienst (DWD), Météo France, Service Argos, JCRI, and the Technical Coordinator. Test BUFR reports and their decoded content can be downloaded from the JCOMMOPS ftp site at ftp://ftp/jcommops.org/gts/test/bufr/.

7.2 After validation, operational implementation of the new software at Service Argos was achieved on 1 July 2003 at the French Argos Global Processing Centre (FRGPC, Toulouse), and on 3 July 2003 at the US Argos Global Processing Center (USGPC, Largo). All buoys which reported on the GTS from Service Argos in BUOY format are now reporting in both formats, i.e. BUOY and BUFR. Buoy data will continue to be distributed in BUOY format for an undefined period, probably several years.

7.3 GTS bulletin headers used for BUFR reports have the following form:

- "**IOZX*ii* LFVW**" for the bulletins issued from the FRGPC, Toulouse, France
- "**IOZX*ii* KARS**" for the bulletins issued from the USGPC, Largo, USA

Values for ***ii*** will remain the same as for the BUFR bulletin headers used for GTS distribution of the data in BUOY format. So for example data normally distributed in BUOY code under "SSVX02 KARS" will also be distributed in BUFR under "IOZX02 KARS". The current list of GTS bulletin headers used for distribution in BUOY format is available at: http://www.dbcp.noaa.gov/dbcp/1gbh.html.

ANNEX TO PARAGRAPH 6.4.3

Questionnaire on WMO Codes Processing
(January 2004)

(A) PRESENT PROCESSING - *DECODING*

1.	**Is your Agency/Service able to receive traditional alphanumeric codes (TAC) from other countries?** (*any Code from FM 12 to FM 88)*		yes **50**	no **1**	blank **0**
	How is the TAC data reaching your Agency/Service ?				
	a)	through GTS	yes **43**	no **0**	Blank **8**
	b)	through Internet	yes **22**	no **14**	blank **15**
	c)	through workstation(s) dedicated to satellite reception (SADIS **9**, ISCS **5**, MDD **6**, RETIM **7**, DWDSAT 3) *Blank: **28***	yes **28**	no **14**	Blank **9**
	d)	through other means AFTN **6**	yes **8**	no **27**	blank **16**

2.	**Is the processing of traditional alphanumeric codes (TAC) automated?**			yes **44**	no **5**	blank **2**
	*>>> if YES to question 2,**What does the automated processing include?***					
	a)	Decoding		yes **42**	no **4**	blank **5**
	b)	Plotting		yes **41**	no **4**	blank **6**
	c)	Database		yes **40**	no **3**	blank **8**
		>>> if YES to 2.c) **is the data stored in WMO FM format ? ; or**		yes **21**	no **14**	blank **16**
		-is the data first decoded and then stored in a different format ? BUFR **8,** ORACLE **3,** NetCDF **1,** INTERNAL **10**		yes **27**	no **5**	Blank**9**
	d)	***Hardware and software***				
		On what computer platform(s) is the *TAC decoding* software presently running?	DEC **1**, HP **17**, IBM **7**, NEC **1**, PC **11**, SGI **7**, SUN **7**			
		- with which operating system?	ACOS 4 **1**, AIX **3**, ALPH OPEN VM **1**, HP-UX **4,** IRIX **1**, LINUX **7**, SOLARIS **4**, VMS **3**, UNIX **23**, WINDOWS **16**, z/OS **1**			
		- language used by the decoder?	C **25**, COBOL **1**, DELPHI **3**, FORTRAN 77 **16**, FORTRAN 90 **14**, JAVA **2**, LEX **1**, mixture yacc **1**, PERL **3**, VISUAL BASIC **4**			

3.	**Is your Agency/Service receiving alphanumeric table driven code FM 95 CREX data?**			yes **11**	no **37**	blank **3**
	*>>> if YES to question 3, **How is the CREX data received?***					
	a)	through GTS		yes **9**	no **2**	blank **40**
	b)	through Internet		yes **1**	no **11**	Blank **39**
	c)	through other means, *please specify:* DCP **1**, EMWIN **1**, FTP **1**		yes **2**	no **8**	blank **41**
	d)	Does your Agency/Service automatically process CREX? *list for what types of data:* Ozone **3**, Tide gauge **1**, Tropical Cyclone **1**		yes **3**	no **10**	Blank **38**
	e)	***Hardware and software***				
		On what computer platform(s) is the *CREX* processing software presently running?	HP **1**, IBM **2**, NEC **1,** PC **1**, SGI **1**			
		- with which operating system? *(UNIX, MS-DOS, Windows, etc.)*	ACOS **2**, HP **2**, J40 **1**, UNIX **3**, WINDOWS **1**			
		- language used by the decoder? *(FORTRAN 90, C++, etc.)*	C **1**, COBOL **1**, FORTRAN **3**			

4.	**Is your Agency/Service able to receive FM 92 GRIB binary code?**		yes **36**	no **12**	Blank**3**
	*>>> if YES to question 4, **How is the GRIB data reaching your Agency/Service ?***				
	a)	through GTS	yes **33**	no **3**	blank **15**
	b)	through Internet	yes **21**	no **11**	blank **19**
	c)	through workstation(s) dedicated to satellite reception (DWDSAT **3**, ISCS **4**, MDD **2**, RETIM **6,** SADIS **6**) *blank **34***	yes **21**	no **12**	Blank**18**
	d)	through other means: ECMWF **3**, FTP **2**, Leased line **2**, RMDCN **3**	yes **10**	no **17**	blank **24**
	e)	Does your Agency/Service visualize or process GRIB products?	yes **31**	no **2**	blank **18**

	f)	**Hardware and software**	
		On what computer platform(s) is the decoding software *for GRIB* running? *(mainframe, PC, etc.)*	DEC **1**, HP **11**, IBM **8,** NEC **1**, PC **12**, SGI **7**, SUN **6**
		- with which operating system? *(UNIX, MS-DOS, etc.)*	ACOS 4 **1**, AIX **3,** HP-UX **3,** IRIX **6**, LINUX **13,** SOLARIS **3,** T64 **1,** UNIX **20**, VMS **1**, WINDOWS **11**
		- language used by the decoder? *(FORTRAN 90, C++, etc.)*	C **20**, COBOL **1**, DELPHI **2,** FORTRAN 77 **15**, FORTRAN 90 **20,** GRADS **1**, VISUAL BASIC **2**

5.	**Is your Agency/Service able to receive FM 94 BUFR binary code?**		yes **30**	no **18**	Blank **3**
	*>>> if YES to question 5, **How is the BUFR data reaching your Agency/Service ?***				
	a)	through GTS	yes **25**	no **2**	Blank **24**
	b)	through Internet	yes **13**	no **15**	blank **23**
	c)	through workstation(s) dedicated to satellite reception (DWSAT **2**, ISCS **3,** MDD **2**, RETIM **5,** SADIS **2**) *Blank **39***	yes **14**	no **14**	blank **23**
	d)	through other means: **ECMWF 1, FTP 2, LEASED LINE 1**	yes **3**	no **19**	blank **29**
	e)	**Is your Agency/Service able to decode FM 94 BUFR binary code?** *>>> list for what types of data*	yes **24**	no **6**	blank **21**
		ALL **5**, AIREP **3**, AMDAR **8**, BATHY **2**, BUOY **3**, GPS **1**, PILOT **4,** RADAR **6**, SATELLITE **14**, SFLOC **2**, SHIP **4**, SIGWX **2**, SYNOP **11,** TEMP **6,** TIDE **2**, TROPICAL CYCLONE **2,** WAVEOB **1**, WIND PROFILER **6**			

	f)	***Hardware and software***	
		On what computer platform(s) is the decoding software *for BUFR* running?	DEC **1,** HITACHI **1**, HP **15**, IBM **7,** NEC **1**, PC **9**, SGI **6,** SUN 5
		- with which operating system? *(UNIX, MS-DOS, Windows, etc.)*	ACOS 4 **1,** AIX **3,** HP-UX **4,** IRIX **4**, LINUX **7**, SOLARIS **1,** T64 **2,** UNICOS **1**, UNIX **18,** VMS **2**, WINDOWS **6**
		- which language is used by the decoder? *(FORTRAN 90, C++, etc.)*	C **27**, COBOL **1**, FORTRAN 77 **9**, FORTRAN 90 **20**, JAVA **2,** VISUAL BASIC **1**

(A) PRESENT PROCESSING - ENCODING

6. Existing Encoding for Table Driven Codes

Questions		*Alphanumeric code* FM 95 CREX	*Binary code* FM 94 BUFR	*GRIB codes* FM 92 GRIB Edition 1	FM 92 GRIB Edition 2 (GRIB 2)
a)	Encoding at observing site or platform ?	yes **5** no **40 blank 6** *if yes:* manual **1** automatic **5**	yes **6** no **36 blank 15**	***not applicable***	***not applicable***
	if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type:* AWS **2,** BATHY **1**, BUOY **1**, Ozone **3**, SYNOP **1**, Sun radiation **1**, TESAC **1**, WAVEOB **1**, Miscellaneous **1**	*data type*: AWS **2**, CLIMAT **1,** RADAR **4**, SYNOP **1,** TRACKOB **1,** Wind profiler **2**	***not applicable***	***not applicable***
b)	Encoding at processing, concentration or telecommunication centre ?	yes **3** no **36** **blank 12**	yes **15** no **22 blank 14**	yes **15** no **19 blank 17**	yes **2** no **29 blank 20**
	if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type:* DCP data **1**, Soil Temperatures **1,** Tropical Cyclone data **1**	*data type:* AMDAR **2**, AWS **1**, BUOY **1**, GPS **1**, METAR **1**, PILOT **1**, RADAR **8**, Satellite data **2**, Soil Temperatures **1**, SYNOP **3**, TEMP **3**, TEMPSHIP **1**, Tropical Cyclone data **1**, Wind profiler **2**	*data type:* NWP model fields **15,** Satellite data **2**	*data type:* NWP model fields **1,** Satellite data **1**
c)	With which computer?	COMPAQ **1,** IBM **1**, PC **3**, SUN **1**	DIGITAL **3**, , HP **6**, , IBM **3**, PC **5**, SGI **2**, SUN **1**,	ALPHA **3**, CRAY **2**, FUJITSU **1**, HP **3**, IBM **3**, NEC **2**, PC **2**, SGI **5**, SUN **1**	DIGITAL **1**, HP **1**, IBM **1**, SGI **1**
	operating system? *(LINUX, etc.)*	LINUX **1**, MS-DOS **1**, UNIX **2**, VMS **1**, WINDOWS **2**	HP **3**, LINUX **2**, MS-DOS **1**, T64 **2**, UNIX **13**	LINUX **3**, UNICOS **1**, UNIX **13**	UNIX **4**
	encoder language? *(FORTRAN 90, etc)*	BASIC **3**, C **2**, FORTRAN 90 **1**, PASCAL **1**	C **12**, FORTRAN 77 **2**, FORTRAN 90 **7**	C **3**, FORTRAN 77 **5**, FORTRAN 90 **12**	C **2**, FORTRAN 77 **1**, FORTRAN 90 **3**

(B) MIGRATION TO TABLE DRIVEN CODE FORMS : BUFR, CREX and GRIB, and FUTURE PROCESSING *(within the next five years)*

1.		**Has your Agency/Service/NMHS already developed a National Migration Plan?**	yes **4**	no **39**	blank **18**
	a)	Is there a National Migration Plan currently being developed ?	yes **11**	no **29**	blank **11**
	b)	Will a National Migration Plan be developed within the next five years ?	yes **34**	no **3**	blank **24**
	c)	Are there any difficulties to define a National Migration Plan?	yes **12**	no **24**	blank **15**
		*if yes to **1.c)** please elaborate:* - *Cooperation between departments within the Meteorological Service will be necessary.* - *The migration has to be coordinated internationally in a better way, especially for marine data (VOS-SHIP)* - *International technical assistance is required.*			
2.	**a)**	**Does your Agency/Service use BUFR for national/local/domestic data exchange ?**	yes **15**	no **25**	blank **11**
		*if YES to **2.a)**, list for what types of data:* All types **1**, AIREP **1**, AMDAR **1**, ATOVS – Satellite data **5,** BATHY **1**, BUOY **1**, CLIMAT-TEMP **1**, PILOT **2**, RADAR **4**, Road Observations **1**, SFLOC **1,** SHIP **2**, SYNOP **5**, TEMP **3**, WAVEOB **1**, Wind profilers **2**			

DECODING

Please note, if your Agency/Service is automated or the automation is planned for the reception of data, to complete the migration successfully, a ***universal decoder software*** for BUFR/CREX is indispensable. Access to binary data is required, although as an intermediate solution CREX can be received since it is an alphanumeric code. *The universal decoder software works for all data types using the complete set of WMO BUFR/CREX Code Tables.*

3.	**Has your Agency/Service already secured the BUFR/CREX decoder software for the migration?; *or***			yes **12**	no **20**	blank **19**
	Will your Agency/Service secure the BUFR/CREX decoder software for the migration?			yes **32**	no **9**	blank **10**
	>>> if YES to the one or the other above questions under 3, ***Please describe who has developed (or will develop) the decoder software for the migration.***					
a)	staff at our Agency/Service	Yes**14**	No**14**	already completed **4**	date to be completed : (month/year)	
b)	a private company/ industrial sector	Yes**6**	No**14**	already completed **1**	date to be completed : (month/year)	
c)	another Agency/Service	Yes**10**	No**13**	already completed **4**	date to be completed : (month/year)	
d)	other *>>> if other, please specify:* ECMWF **3**, OPERA **1**	Yes**9**	No**11**	already completed **3**	date to be completed : (month/year)	
e)	*>>> if planned, when will the operational decoding be ready?* *(month/year)*					

3.	**f)**	***Hardware and software***		
		On what likely computer platform(s) *will* your decoder software *for the migration* run in the future?	*make/model* COMPAQ **2**, HITACHI **1**, HP **5**, IBM **3**, NEC **2**, PC **13**, SUN **5**, T64 **1**	blank
		- with which operating system? (UNIX, MS-DOS, Windows, etc.)	LINUX **19**, UNIX **19**, VMS **1**, WINDOWS **17**	blank
		- with which language for the decoder?	C **22,** BASIC **1**, FORTRAN 77 **4**, FORTRAN 90 **19**, JAVA **2**	blank

4.	a)	Does your Agency/Service use a GRIB decoder software, now?	yes **27**	no **15**	blank **9**
	b)	Does your Agency/Service plan to use a GRIB decoder software in the future?	yes **22**	no **9**	Blank **20**
	>>> ***If planned, when will the operational decoding be ready?*** *(month/year)*				
	c)	***Hardware and software***			
		On what likely computer platform(s) *will your GRIB* decoder software run in the future?	*make/model* COMPAQ **1**, CRAY **1**, DEC **1**, DELL **1**, HITACHI **1**, HP **7**, IBM **4**, PC **16**, SGI **4,** SUN **5**		blank
		- with which operating system? (UNIX, MS-DOS, Windows, etc.*)*	LINUX **14**, UNICOS **1**, UNIX **12**, WINDOWS **9**		blank
		- with which language for the decoder?	C **30**, DELPHI **1**, FORTRAN 77 **4**, FORTRAN 90 **29**, JAVA **1,** PERL **2**		blank

(B) MIGRATION TO TABLE DRIVEN CODE FORMS : BUFR, CREX and GRIB, and FUTURE PROCESSING *(within the next five years)*

ENCODING

5.	Planned Encoding for Table Driven Codes – Future Processing *(within the next five years)*				
Questions		***Alphanumeric code***	***Binary code***	***GRIB codes***	
		FM 95 CREX	**FM 94 BUFR**	**FM 92 GRIB Edition 1**	**FM 92 GRIB Edition 2 (GRIB 2)**
a)	Encoding at observing site or platform ?	yes **8** no **20** **blank 23** **if yes :** manual **4** automatic **7**	yes **15** no **25** **blank 11**	***not applicable***	***not applicable***
	if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type* *when* RS 2005 **1** Soil temp. 06/2004 **1** TEMP 2005 **1**	*data type* *when* ALL **3** AWS Done **1**, 2005 **1** CLIMAT 2005 **1** CLIMAT-TEMP 2005 **1** METAR 2005 **1** RADAR **1** SYNOP Done 1, 11/2004 **1**, 2005 **3**, 2008 **2** TEMP 2004 **1,** 2005 **1,** 2008 **4**	***not applicable***	***not applicable***
b)	Encoding at processing, concentration or telecommunication centre ?	yes **11** no **22** **blank 18**	yes **29** no **5** **blank 17**	yes **16** no **11** **blank 24**	yes **12** no **13** **blank 26**

	if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type when* ALL **2** METAR 2006 **1** Soil temp. Done **1** SPECI 2005 **1** SYNOP 2004 **1**, mid 2005 **3**, 2007 **1** TAF 2006 **1** TEMP mid 2005 **1**, 2007 **1**	*data type when* ALL **8**, 2005 **2** AMDAR **1** CLIMAT 2006 **2**, 2007 **1** CLIMAT-TEMP 2007 **1** METAR **1**, 2006 **1**, 2007 **1** PILOT 2006 **1**, 2008 **1** SHIP 2006 **2**, 2008 **1** SPECI 2005 **1** SYNOP **3**, 2005 **4**, 2006 **2**, 2007 **1** TAF 2006 **1**, 2007 **1** TEMP 2005 **1**, 2006 **2**, 2007 **1**, 2008 **2**	*data type when* All NWP model output Operational now **14**	*data type when* ALL **4** Satellite data now **1** 2007 **1** NWP products 2007 **2** SATOB 2005 **1**
c)	With which computer?	COMPAQ **1** PC **6** SGI **1** SUN **2**	COMPAQ **2** HP **5** IBM **2** PC **11** SGI **1** SUN **3** X86 **1**	COMPAQ **1** HP **1** IBM **1** NEC **1** PC **4** SGI **1** SUN **1** X86 **1**	HP **2** IBM **1** PC **4** SUN **1** X86 **1**
	operating system? *(LINUX, etc.)*	LINUX **4** MS-DOS **1** UNIX **5** VMS **1** WINDOWS **3**	LINUX **10** UNIX **13** WINDOWS **5**	LINUX **3** UNIX **10**	LINUX **3** UNIX **6**
	encoder language? *(FORTRAN 90, etc)*	C **3** BASIC **2** FORTRAN 90 **3** JAVA **1**	C **15** BASIC **1** DELPHI **2** FORTRAN 77 **2** FORTRAN 90 **12** JAVA **1**	C **5** FORTRAN 77 **1** FORTRAN 90 **9** PERL **1**	C **5** FORTRAN 90 **5** PERL **1**

6.	**Note:** During the migration process, NMHSs' encoding observations in BUFR may perform the so-called *double transmission* or *dual dissemination*, upon request, for users who are not able to process BUFR. In those cases, the observations transmitted in BUFR will have to be transmitted also in TAC (SYNOP, TEMP, etc.).			
	Does your Agency/Service plan to be able to perform a *dual dissemination* at the beginning of the migration process?	yes **18**	no **2**	Blank **31**

ANNEX TO PARAGRAPH 6.4.4.1

ECMWF BUFR software

BUFR library has been tested for these different machine architectures existing at ECMWF:

Dec Alpha - Compaq Fortran90, C++
HP - HP Fortran and C
Linux -pgf90, pgcc, Gnu g77 and gcc
RS6000 - XL, C
Sgimips - MIPSpro f77, MIPS C
SUN4 - Forte developer 7 Fortran 95, Sun OS/BSD compatibility package C compiler

The BUFR software can be installed on Windows systems only if a CYGWIN LINUX compatible environment and Gnu compilers are available. There are additional programs available including one to convert BUFR formatted data into CREX format.

ANNEX TO PARAGRAPH 6.4.4.2

Features of the DWD BUFR3 library are:

- Conformity to FM 94 BUFR (edition 3),
- Support of associated fields like quality and monitoring information,
- Support of data compression,
- Support of recursive structures (any depth),
- Support of ASCII fields (strings),
- Interfaces to ANSI-C and Fortran 90,
- Dynamic memory allocation,
- Use of tables in the “well known OPERA” format,
- Support of additional local tables,
- High performance (ANSI-C implementation),
- Portable (up to now the library has been tested on: MS/Windows (32bit), SGI/IRIX (32/64bit), IBM/AIX (32/64bit), GNU/Linux (x86), Fujitsu/VPP).

The Read/Write interface offers the following functionalities:

- Identifying BUFR records in a file,
- Reading individual sections of BUFR (including decoding Section 1),
- Decoding Section 3,
- Decoding Section 4.

Additional to the library there is a package containing:

- A program for printing BUFR content (descriptors as well as data) as human readable ASCII (not CREX!),
- Example programs demonstrating the ANSI-C and Fortran 90 interfaces,
- Detailed descriptions of the programming interfaces in ASCII and HTML.

Future developments planned for include:

- Support of the ASCII format FM 95 CREX (edition 1)
- Interfaces to JAVA and ANSI-C++
- Support of additional platforms (HP-UX, COMPAQ/True64, Sun/Solaris,...)

Special features of GloBUS include:

- OS-independent client/server or stand-alone application (implemented in Java)
- Parallel read, decode and output modes
- Designed to include new codes and output formats
- Several input/output media (file system, database, Internet, etc.)

Basically, all WMO table codes can be used as input formats for GloBUS. Currently 21 WMO and 10 NATO codes have been implemented. Among these are FM 12, FM 13, FM 14, FM 15, FM 16, FM 18, FM 32, FM 33, FM 34, FM 35, FM 36, FM 37, FM 38, FM 41, FM 42, FM 51, FM 71, FM 72, FM 86, FM 92, FM 94 as well as GAFOR, MREP, PHAEN, WISPO and WEHI. The modular architecture allows the implementation of defined codes for specific tasks.

Output is available as BUFR and GRIB as well as CORBA objects. Future updates will include application-specific formats (e.g. XML).

ANNEX TO PARAGRAPH 6.4.5

ECMWF CREX software

Both a compiled binary and the source code are available for various platforms. A CREX User's Guide is available in PDF format. The compiled versions can be installed on the Linux, Windows (cygwin) Decalpha, Sgimips, Macintosh OSX 10.1 and higher. The BUFR library has been tested for these different machine architectures existing at ECMWF.

Decalpha - Compaq Fortran90, C++
HP - HP Fortran and C
Linux -pgf90, pgcc, Gnu g77 and gcc
RS6000 - XL, C
Sgimips - MIPSpro f77, MIPS C
SUN4 - Forte developer 7 Fortran 95, Sun OS/BSD compatibility package C compiler

The CREX software can be installed on Windows systems only if a CYGWIN LINUX compatible environment and Gnu compilers are available. There are additional programs available including one to convert BUFR formatted data into CREX format.

ANNEX TO PARAGRAPH 6.4.6

- Focal points to receive all information concerning the migration (2.1.1 Secretariat - ASAP) *Done*
- The WMO Commission for Climatology (CCl) to be contacted for comment on Templates translating CLIMAT messages in BUFR (2.1.2 Secretariat - ASAP) *Done but no answer*
- More information on the Migration to TDCF to be disseminated also to all concerned organisations or international bodies (2.1.3 All - Systematic) *Done (IOC, ICAO)*
- Send a questionnaire to Focal points (2.2.2 Secretariat - ASAP and every two years) *Done*
- Questionnaire answers from a Region to be sent to the Regional Rapporteur on Data Management (2.2.2 Secretariat) *(to be done)*
- To make BUFR encoded rawindsonde data available on the GTS and give list of stations (2.3.1 USA - ASAP) *Done soon*
- To notify the WMO Secretariat when planning to transmit data in BUFR or CREX (2.3.2 WMO Members) and METNO to be sent to inform all WMO Members (2.3.2 Secretariat)*To be done when occurring*
- Identification as sub-types within the TDCF message for the application processing to be addressed, perhaps within the frame of a new edition for BUFR/CREX (2.3.2 ET/DR&C) *Currently done*.
- Produce Guide on GRIB 2 (2.4.2 Secretariat - ASAP) *Done*
- Produce Manual on Reporting Practices (2.4.3 Secretariat - ASAP) *To be done*
- Start National training on TDCF (2.5 WMO Members - ASAP) *To be done*
- To develop BUFR/CREX descriptors to address the Optional Section of the code structures that would replace the current alphanumeric code forms (4.1.5 ET/DR&C) *To be done*.
- Size limit for all binary messages be raised to 250,000 octets (5.2 Secretariat and ET on GTS - ASAP) *Done*
- Bulletin headers definition scheme to be revised and document submitted to CBS (5.3 Chairman, Secretariat and ET on GTS - ASAP, **URGENT**) *Partially done*
- Letter to ECMWF, which would be submitted at their Council asking for free support to WMO Members for a software house (6.4 Secretariat - ASAP) *Done, very positive, software-house*
- Approach EUMETNET (6.4 Secretariat - ASAP) *Done, negative results*
- Organise workshop on implications of the migration to TDCF for developing Countries and defining pilot project(s) (6.7 Secretariat - ASAP) *To be done, no pilot projects yet*
- BUFR templates for CLIMAT, CLIMAT SHIP, CLIMAT TEMP and CLIMAT TEMP SHIP validated via experimental exchange (7.4.2 members of ET/DR&C - ASAP) *To be done*
- To define more common sequences (7.4.5.3 members of ET/DR&C - ASAP) *To be done*
- Catalogue data already available in a table driven format other than direct model output and actively coordinate its global exchange (7.5 National focal points, RTH focal points, DM Regional Rapporteur, Secretariat - ASAP) *To be done*
- Establish a periodic regular review of code descriptor and template requirements for representation of all data possibilities in traditional code forms, coordinate needs with ET/DR&C and provide central coordination of testing (7.5 ET/DR&C and ET/MTDCF - as needed, at least every year) *Partially done*
- Information coordination and reporting of Migration Activities (7.5 National focal points, RTH focal points, DM Regional Rapporteur, ET/MTDCF, Secretariat - ASAP) *To be done*
- Updating Migration Matrix (8. ET/MTDCF, Secretariat - ASAP) *To be done*
- Organize WMO training programme on MTDCF for trainers and software users (9.2.1, 9.2.2 Secretariat - ASAP) *Done: RA I; III/IV; II east/V west, to be done for: RA II west, RA VI east*
- Organize Seminar with manufacturers (9.4 Secretariat - ASAP) *not done*
- Provide Level 1 training in WMO seminar (9.5 Secretariat - ASAP) *Done*
- Detailed migration plan for CBS (10.1 Chairman, Secretariat - before End of June 2002) *Done*

ANNEX LIST OF ACRONYMS

ACARS	AirCraft Addressing and Reporting System
ADS	Astrophysics Data System (USA)
AFWA	Air Force Weather Agency
AIRS	Advanced Infra-Red Sounder
AMDAR	Aircraft Meteorological Data Relay
AMS	American Meteorological Society
AMSU	Advanced Microwave Sounding Unit
ANC	Air Navigation Commission (ICAO)
ANSI	American National Standards Institute
API	Application Program Interface
APSDEU	Asia Pacific Satellite Data Exchange and Utilization
AWIPS	Advanced Weather Interactive Processing System
AWC	Aviation Weather Center
AWS	Automatic Weather Station
ATSR	Along Tack Scanning Radiometer
BUFR	Binary Universal Form for data Representation
CBS	Commission for Basic Systems
CBS-Ext.(98)	Extraordinary session of CBS held in 1998
CCl	Commission for Climatology (WMO)
CGMS	Coordination Group for Meteorological Satellite
CIMO	Commission for Instruments and Methods of Observations
COST	European Co-Operation in the field of Scientific and Technical research
CREX	Character Representation form for data EXchange
DBCP	Drifting Buoy Cooperation Panel
DBMS	Data Base Management System
DCP	Data Collection Platform
DIF	Directory Interchange Format
DPFS	Data Processing and Forecasting Systems
DRT	Data Representation Template
DT	Data Template
DWD	Deutscher Wetter Dienst
EANPG	European Air Navigation Planning Group
EARS	EUMETSAT ATOVS Retransmission Service
EC	Executive Council of the WMO
ECMWF	European Centre for Medium-range Weather Forecast
EGOWS	European Group on Operational Worskstation Systems
EOS	Earth Observation Science
EPS	Ensemble Prediction System
ESA	European Space Agency
ET	Expert Team
ET/EDF	Expert Team on Evolution of Data Formats
ET/DR&C	Expert Team on Data Representation and Codes
EUMETNET	European Meteorological Networks
EUMETSAT	EUropean organisation for the exploitation of METeorological SATellites
FIR	Flight Information Region
FNMOC	Fleet Numerical Meteorology and Oceanography Centre
FORTRAN	FORmula TRANslation
FTP	File Transfer Protocol
FWIS	Future WMO Information System
GDPS	Global Data Processing System
GDT	Grid Definition Template
GEO	Group on Earth Observation
GIF	Graphic Interchange Format
GIS	Geographic Information System

GMES	Global Monitoring for the Environment and Security
GOS	Global Observing System
GRIB 1	Processed data in the form of GRId-point values expressed in Binary form - GRIB Edition 1
GRIB 2	General Regularly distributed Information in Binary form - GRIB Edition 2
GTS	Global Telecommunications System
HMEI	HydroMeteorology Equipment Industry
HTML	Hyper Text Markup Language
ICAO	International Civil Aviation Organisation
ICT	Implementation/Coordination Team (of CBS)
ICT/DRC	Implementation/Coordination Team on Data Representation and Codes
ID	Identifier
IEC	International Electrotechnical Commission
IEEE	Institution of Electrical and Electronics Engineers
IOC	International Oceanographic Commission
ISO	International Standards Organization
ISS	Information Systems and Services (OPAG of CBS)
JAXA	Japan Aerospace eXploration Agency
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
JPEG	Joint Photographic Experts Group format
LINUX	*Not an acronym – name of an operating system*
MEDS	Marine Environment Data Service
MS/DOS	/Disk Operating System
MSG	METEOSAT Second Generation
MSS	Message Switching System
MTDCF	Migration to Table Driven Code Forms
MTN	Main Telecommunications Network (of the GTS)
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Centre (USA)
NCEP	National Centre for Environment Prediction (USA)
NEDEX	North American Europe Data Exchange
NESDIS	National Environmental Satellite Data and Information Service
NMC	National Meteorological Centre
NMHS	National Meteorological or Hydrological Service
NMS	National Meteorological Service
NMTSG	National Migration to TDCF Steering Group
NWP	Numerical Weather Prediction
NWS	National Weather Service
OMF	weather Observation Markup Format
OPAG	Open Programme Area Group (of CBS)
OPAG-ISS	Open Programme Area Group on Information Systems and Services
PDT	Product Definition Template
PNG	Portable Network Graphic
RA	Regional Association (WMO)
RASS	Radio Acoustic Sounding System
RDBC	Regional Data Bank Centre
RSS	Radiosonde Replacement System
RSMC	Regional Specialised Meteorological Centre
RTH	Regional Telecommunication Hub
SGDR&C	Sub-Group on Data Representation and Codes (CBS)
SGML	Standard Generalized Markup Language
SI	System International
SOOP	Ship Of Opportunity Programme
SST	Sea Surface Temperature

TAC	Traditional Alphanumeric Codes
TCP	Tropical Cyclone Programme
TCP/IP	Transport Control Protocol/Internet Protocol
TDL	Techniques Development Laboratory
TIFF	Tagged Image File Format
UGRN	Upgrading the Global Radiosonde Network
UKMO	United Kingdom Meteorological Office
UNIX	*Not an acronym – name of an operating system*
USAP	United States Antarctic Programme
UTC	Universal Time Coordinate
VGISC	Virtual Global Information System Centre
VOS	Voluntary Observing Ship
WAFC	World Area Forecasting Centre (ICAO)
WAFS	World Area Forecasting System
WGDM	Working Group on Data Management (CBS)
WGMC	Working Group on Meteorological Codes (USA)
WGS	Working Group on Standards
WMO	World Meteorological Organization
WH	Weather-Huffman compression
WWW	World Weather Watch
W3C	World Wide Web Consortium
XBT	eXpendable Bathy Thermograph
XCTD	eXpendable Conductivity Temperature Depth sensor
XML	eXtensible Markup Language