WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INFORMATION SYSTEMS AND SERVICES

MEETING OF EXPERT TEAM ON DATA REPRESENTATION AND CODES

FINAL REPORT

EUMETSAT, DARMSTADT, 23-27 APRIL 2007

EXECUTIVE SUMMARY

The Meeting of the Expert Team on Data Representation and Codes was held, at the kind invitation of EUMETSAT in Darmstadt, from 23 to 27 April 2007.

The Team agreed to some additions of parameters in GRIB 2 Code Tables, mainly for TIGGE products, Earth model representation and precipitation rates. The Team also agreed for the need to revise the Guide for GRIB 2, and some amendments were already proposed for the Guide. ECMWF reported on the software for conversion GRIB 1 - GRIB 2. NCEP reported on their production in GRIB 2 format. NCEP conversion software GRIB 1 – GRIB 2 is also available. EUMETSAT produces also GRIB 2 products with NCEP software.

The representative of JCOMM, Hester Viola, reported to the Team that at the JCOMM Data Management Coordination Group, in October 2006, it was decided that a JCOMM task team on Table Driven codes should be formed. This team will collect and compile requirements for BUFR updates, submit them to the CBS/ET-DRC and ensure that BUFR Master Table 10 (MT10) for oceanographic data is compliant with WMO rules.

The Team examined various requirements, which had been expressed for additions to BUFR/CREX Tables. Templates for transmission of Sea Level data in CREX formats have been developed; but the Team agreed to postpone the finalization of these templates, which will be tested during following months. Validated atmospheric chemistry descriptors have been declared pre-operational. After lengthy discussion, the Team agreed that there was a need to introduce urgently a new operator for IEEE representation due to precision requirements and bit length of descriptors. It would, however, require the adaptation of existing decoders and make an Edition 5 of BUFR, for approval by CBS in 2008 for operational implementation in November 2009. Meanwhile, experimental bilateral exchanges could be performed to validate this proposal. The Team believed the added flexibility could have benefits in other areas that demand the depiction of extremely large value ranges.

The Team approved for pre-operational status descriptors for GHRSST data and for SBUV/2 ozone data. New descriptors were accepted but needed further validation like those for GFA (Graphical Forecast AIRMET) data, radar 3-D volume data, JASON 2 data and passive remote sensing by star occultation.

Thanks to the great work of Dr Eva Cervena, the Team reviewed various proposed templates for representation of SYNOP data and surface observations from one-hour period, the AWS templates with national numbering system, the EUCOS template for radiosonde data and agreed they all needed more validation. The preoperational status was recommended to the following templates: for SYNOP data manually encoded in CREX and for METAR/SPECI and TAF.

The Meeting was informed that It has now been agreed at CGMS (Coordination Group for Meteorological Satellites) that a Task Force on Codes for satellite data will be created. This Task Force should meet for the first time during 2007. The Task Force will coordinate requests for additions to BUFR Codes, related to satellite data and will also consider more the creation of a Master Table specifically for Satellite data. Its recommendations will be considered in 2008 by ET/DR&C.

The Team agreed that a revision of the BUFR Guide would be required and that the Secretariat, possibly with the help of a consultant should urgently undertake this revision.

Concerning Traditional Alphanumeric Character Codes, the Team considered the saturation of Common Code Table C-2 for attribution of radiosonde numbers, and agreed to solve the problem in recording the assignment date of new sondes in the Common Code Table, which are then given the same 2 digits number of sondes no longer in use at the date of assignment. It was also agreed to add a clarifying note for the specification of mean monthly temperature in CLIMAT TEMP and CLIMAT TEMP SHIP.

Concerning the migration to TDCF and recognizing there was an impact on Member states resources, the Team felt that insisting on a mandatory completion date was not practicable. The team nonetheless felt there was a need to provide a stronger emphasis upon completion of migration by the planed dates. It felt this should be reflected in a Migration Guidance Document to be sent to all WMO Members (together with a questionnaire) and that it should contain a strong recommendation that WMO Members meet these dates. In past guidance, the focus was placed on stressing the positive aspects of migration. The Team felt it was appropriate to also tactfully address the negative aspects and risks of not migrating.

The team reviewed reports from the Regional Rapporteurs, the Secretariat and other members regarding progress and issues related to migration. The Team was appreciative that there were representatives present from all WMO regions who could contribute and felt the continuance of this practice was necessary at all meetings related to Codes matter. It appeared that for the migration, there were only few countries in each Region active in a migration process. RA VI seemed however to start a serious move as 33 participants attended a recent training workshop at their own expense.

The Team reviewed the progress made on BUFR/CREX data verification services. It noted with great appreciation that Mr Milan Dragosava ECMWF had developed a web based verification service for BUFR/CREX data. The Team also reviewed the work done by Mr Waldenio Gambi of INPE in Brazil in this regard and expressed its appreciation of it.

The Team recommended the Secretariat convert the Tables of the Manual on Codes to a Microsoft Access format. From this format, it is relatively simple to publish the tables as a text document or export a database file. Centers and organizations that may have expertise in the conversion of the tables to a database format were encouraged to lend assistance to the Secretariat.

The Team expressed its gratitude for this very important contribution of Mr Waldenio Gambi of INPE,Brazil that fills the often-expressed gap, which previously existed for Windows based BUFR encoder/decoder systems. Mr Waldenio Gambi also reported they are developing a JAVA based graphical interface for the BUFR package and an alpha version will be bundled with the complete package and available for download from the same web site in May of 2007.

Concerning aviation data, the Team still believes the best long-term solution is BUFR. However, it also recognizes there was a need for XML encoding of some forms of data. Therefore, based on the results of the coordination to be completed within the aviation community and between CAeM, CBS and ICAO the appropriate and agreed on XML encoding standards should be developed by an XML expert team.

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REPORT OF MEETING OF THE EXPERT TEAM ON DATA REPRESENTATION AND CODES
(EUMETSAT, Darmstadt, 23-27 April 2007)

1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1.1.1 At the kind invitation of the EUMETSAT, the Meeting of the Expert Team on Data Representation and Codes (ET/DR&C) took place in its Headquarters in Darmstadt from 23 to 27 April 2007 (the participants' list can be found in the Annex to this paragraph). The Meeting was opened on Monday 23 April 2007 at 9.30 a.m. by the chairman of the Team, Mr Milan Dragosavac, who welcomed the experts. He then led the Meeting with diplomacy and efficiency.

1.1.2 The Director of Operations at EUMETSAT, Mr Mikael Rattenborg, welcomed the participants and stressed the importance of formats of satellite data for all its users. He stressed that the contact with the users was important for designing the best format. The representative of the WMO Secretariat thanked EUMETSAT for the excellent hospitality. He also thanked the local organizer, especially Dr Simon Elliott who worked hard, with his staff for the local arrangements. He stressed that 90 % of the volume of data exchanged between meteorological services was satellite data, and that it was important to work jointly with EUMESAT and satellite operators to develop the optimum data representation. He wished that the cooperation with EUMETSAT be always positive and efficient.

1.2 APPROVAL OF THE AGENDA

The Meeting agreed to the content of the agenda as proposed (see Table of Contents in front).

2. GRIB 2 CODE FORM

2.1 ADDITIONS OR MODIFICATIONS TO GRIB 2

2.1.1 New parameters for TIGGE

ECMWF has quite a large TIGGE archiving data set. It has been spotted that it is inconvenient to have different units for soil moisture and the auxiliary fields. ECMWF proposed to use soil moisture and its auxiliary fields consistently in its volumetric form (with unit proportion or m^3 m^{-3}) and non-volumetric forms (like unit kg m^{-3}). ECMWF proposed new parameters for that purpose. The Meeting agreed to declare pre-operational these new parameters and add a note to recommend not using the old parameters but the new ones, as described in Annex to this paragraph.

2.1.2 New Entry in Code Table 3.2 and new parameter number within GRIB2 Code Table 4.2

The U.S. NOAA National Weather Service maintains a National Digital Forecast Database (NDFD) containing the official 7-day forecasts for weather elements across the U.S. and its territories. Within NDFD, data are created on grids based upon points projected from a sphere of radius 6371.2 Km. However, the NDFD also uses the WGS84 ellipsoid as the horizontal datum of the resulting latitude/longitude field. When NDFD products are disseminated using GRIB2, it is important for users to know both of these pieces of information in order to properly geo-locate the data. This is especially important for GIS applications, so a new entry is proposed for GRIB2 code table 3.2 (Shape of the Earth) in order to adequately convey this information. (See Annex to this paragraph)

A division within U.S. NESDIS has been tasked to develop a sea ice product for distribution in GRIB2. One of the parameters to be reported is “Seconds prior to initial reference time”, which currently exists within Code Table 4.2 as parameter category 191, entry number 0 under product discipline 0 (meteorological products). It is then also required in product discipline 10. These additions are needed and considered operational. (See Annex to this paragraph)

2.1.3 Atmospheric divergence

At the request of its users, EUMETSAT has introduced an atmospheric divergence product. This product is derived from the atmospheric motion vector fields produced from the 6.2 micron channel on METEOSATs 8 and 9. These data are currently being disseminated via the EUMETCast DVB multicast service. In order to standardize the GRIB encoding of the data, an addition to Code table 4.2 as listed in Annex to this paragraph has been approved by the Team.

2.1.4 New entries in Table 4.2 for the Representation of Precipitation Rates and Accumulations for specific precipitation types

The Meteorological Service of Canada has a requirement to exchange forecasts of precipitation accumulation, categorized by precipitation type. In order to achieve representation of this data in GRIB 2, it is necessary to introduce some new parameters in Table 4.2. In order to avoid creating precipitation type parameters for both precipitation accumulation and precipitation rate, and in accordance with new regulation 92.6.2 (which aims to maintain the orthogonal structure of GRIB Edition2), the Team agreed to create only precipitation rate parameters (see Annex to this paragraph). Accumulation may be represented as a statistical process.

2.2 POSSIBLE REVISIONS TO GRIB 2 GUIDE

The existing version of WMO's Guide to GRIB Edition 2 was issued on 1 January 2003. Since this time it has become clear that there are a number of errors and inaccuracies in the Guide. Some of these have become apparent during the preparation of training material on GRIB Edition 2. The Meeting agreed to propose some modifications to the Guide as listed in Annex to this paragraph for immediate insertion. Nevertheless, the Meeting agreed that a more comprehensive work would have to be undertaken to review the Guide for GRIB 2 as well as the Guide for .BUFR. Consultants might be used for this task.

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

2.3.1 ECMWF software

ECMWF reported that the new GRIB API software for encoding and decoding of WMO FM-92 GRIB edition 1 and edition 2 messages has been released. It consists of a program interface (grib api) accessible from C and Fortran programs including a useful set of command line tools performing quick data manipulation in GRIB format. The library is designed to access and modify messages in both editions with the same function calls using a set of alphanumeric keys to access the coded information. The tools are designed to help users in doing interactively and in batch mode the most common operations on GRIB files. With them it is very easy to inspect the content of a GRIB file or to copy some selected GRIB messages from a file or to modify the GRIB message.

The software can be downloaded from:

http://www.ecmwf.int/products/data/software/grib_api.html

2.3.2 Report on the use of GRIB2 within the U.S.A.

Since 2004, NCEP has provided half-degree output from its global model to the U.S. Air Force Weather Agency (AFWA) using GRIB2. NCEP also provides output from both its global and mesoscale models to the U.S. National Weather Service (NWS) on the NOAAPORT satellite system. These GRIB2 products are at the highest spatial resolutions available from these models and will be utilized in the near future as a replacement for the older, lower resolution GRIB1 products within NWS.

NCEP has also begun providing all of its currently available numerical model guidance products in GRIB2 format on its public FTP servers. These data augment the GRIB1 products already available on these servers. In June 2007, NCEP is planning to begin a six- month transition to GRIB2 for all of its GRIB1 content on the NCEP and NWS public ftp servers. Please see http://www.nco.ncep.noaa.gov/pmb/docs/GRIB1_to_GRIB2.shtml for more details. During this time users will be encouraged to migrate to the GRIB2 products. After the six-month transition period, all GRIB1 format products will be removed from the public servers. To help facilitate users' migrations, NCEP has made available its GRIB2 software and libraries (including a routine to easily convert between the GRIB1 and GRIB2 formats) on its public web server at http://www.nco.ncep.noaa.gov/pmb/codes/GRIB2/ .

The EUMETSAT expert mentioned that the Agency was using the NCEP software, which is recommended for its users.

At last check, neither AFWA nor the U.S. Navy, each of whom is also involved in numerical weather prediction within the U.S.A. as well as the issuance of certain forecast products, had yet begun to issue any such products using GRIB2. However, members of these agencies have been briefed at several interagency meetings on the benefits of GRIB2 vs. GRIB1 and have therefore begun to consider GRIB2 within certain aspects of their long-range planning. In addition, the

Federal Aviation Administration, which represents the U.S. to ICAO, has also begun planning for a transition to GRIB2.

The meeting noted that NCEP provides good conversion utilities GRIB 1-GRIB2 in both ways.

The ICAO representative indicated that they plan a migration to GRIB2 completed by 2010.

2.3.3 Production of fields in GRIB 2 in Brazil

The Expert from Brazil reported to the Team that within the TIGGE project, the ensemble ouputs of the CPTEC/INPE global model need to be converted to GRIB2 format. A conversion from GRIB 1 to GRIB 2 will be performed with NCEP conversion programs.

3. BUFR AND CREX

3.1 REVIEW OF ENTRIES AWAITING VALIDATION FOR BECOMING PRE-OPERATIONAL

The Team considered the present list of Table entries awaiting validation. Several but not all can now considered pre-operational as listed below.

3.1.1 VOS SHIP and Buoy and waves Templates

These templates are still considered for finalization by JCOMM. The representative of JCOMM, Hester Viola, reported to the Team that JCOMM had made some progress in its work relating to Table Driven Code Forms since the last meeting of the ET/DR&C. JCOMM was addressing the issues associated with adopting Table Driven Code Forms seriously and was carefully taking all the requirements into account. At the JCOMM Data Management Coordination Group, in October 2006, it was decided that a task team on Table Driven codes should be formed. Initial terms of reference for the group have been proposed as follows:

1. *to collect and compile requirements from JCOMM panels and expert teams and submit them to the CBS Expert Team on Data Representation and Codes (ET-DRC) (one Member of the Group to attend ET-DRC meetings)*
2. *to make BUFR Master Table 10 (MT10) for oceanographic data compliant with WMO rules*
3. *to define a mechanism for updating and maintaining MT10 on behalf of JCOMM in compliance with rules defined by the CBS ET/DR&C. Coastal variables, bio-chemical data will have to be included.*
4. *to look at templates and make content mapping.*

The Team appreciated the commitment of JCOMM to use of BUFR and expected then that at its next meeting in 2008, templates for all the oceanographic and marine data will be finalized.

3.1.2 CREX Templates for tide elevation

The Secretariat presented the last proposals for transmission of Sea Level data in CREX formats, which may be used in the generation of Tsunami Warnings. This development had been done by Dr Eva Cervena, Atsuhi Shimazaki and Weiqing Qu. Australia was also planning to translate DART data in other new templates (see Annex to this paragraph). There was a consensus to postpone the finalization of these templates, which will be tested during following months.

3.1.3 Air Chemistry.

Following proposals for atmospheric chemistry descriptors at the previous ET-DR&C meetings Canada validated them with exchanges with NCEP. The team commended Jeff Ator, Yves Pelletier and Michael Schaffer for this work. Following this, the validation project sought other real-world examples in atmospheric chemistry research datasets made freely available on the Internet.

BUFR validation messages constructed from these datasets were made available on a public web site. In addition to being a repository for the BUFR samples, the web site has two goals: to facilitate participation, and to keep track of progress. As of April 2007, validation has been achieved for seven descriptors. A BUFR validation message using four additional descriptors is available on the web site for decoding by a collaborating party. It was also necessary to identify a descriptor for the diameter of particulate matter. The project web site is located at:
http://collaboration.cmc.ec.gc.ca/cmc/CMOI/ET-DRC/atmospheric-chemicals/

The Team after lengthy discussion agreed that there was a need to introduce urgently a new operator for IEEE representation due to precision requirements and bit length of descriptors. The absolute values and precision required for some measurement types (i.e. concentration) span across at least 16 decimal orders of magnitude. Individual chemical species may have narrower requirements, but to accommodate a whole catalogue of species with a single concentration descriptor, a concentration descriptor meant for general use for any chemical would need to be at least 54 bits wide. For individual species, the required width could in some cases exceed 32 bits. As a means of providing additional flexibility, it is proposed to create a new Data Description Operator that would make it possible to express values in IEEE floating-point format. In many cases this would allow data representation with the fewest possible intermediate steps while maintaining sufficient precision. It would, however, require the adaptation of existing decoders and make an Edition 5 of BUFR, for approval by CBS in 2008 for operational implementation in November 2009. Meanwhile, experimental bilateral exchanges could be performed to validate this proposal. The Team believed this would be worth the work, since the added flexibility could have benefits in other areas that demand the depiction of extremely large value ranges. (see Annex to this paragraph).

The Team agreed for haste in validation. Offers of collaboration (by NCEP, ECMWF) made verbally during the Meeting should be pursued.

3.1.4 New descriptors for GHRSST data

The Global Ocean Data Assimilation Experiment (GODAE) high-resolution sea surface temperature pilot project (GHRSST-PP) provides a new generation of global high-resolution (<10km) SST data products to the operational oceanographic, meteorological, climate and general scientific community, in near real time and delayed mode. The project involves a wide range of international participants who have invested a great deal in delivering high quality SST products. There is a requirement to exchange GHRSST data between operational centers in a WMO standard format. Although the GHRSST standard product is delivered in NetCDF, and is being converted to BUFR at the Met Office for operational use. This necessitates the use of suitable descriptors for the exchange of this data. These descriptors are now being used operationally at the UK Met Office. The Meeting agreed to declare these descriptors (see Annex to this paragraph) pre-operational.

3.1.5 BUFR template for representation of SYNOP data and surface observations from one-hour period

The combined AWS-SYNOP template (see Annex to this paragraph) is suitable in particular for transmission of data from the observing stations to the National Meteorological Centre (NMC), because one BUFR message can contain both SYNOP data and the surface observations from one-hour period. These single-subset messages will have to be decoded in the NMC prior to producing the multi-subset BUFR messages for the international exchange.

Two approaches may be used in the NMC:

a) The expanded data may be encoded into two BUFR messages, one of them containing the SYNOP data using the template TM 307080 (or any of the regional templates TM 307081 to TM 307086), the other containing the surface observations from one-hour period using the existing AWS template or template TM 307091 (after its validation). No further action is needed in this case.

b) If the expanded data are to be encoded using this combined AWS-SYNOP template for the international exchange, a new data sub-categories will have to be defined for this type of data and, consequently also new telecommunication headers for the BUFR messages. It might be also useful to appoint a common sequence descriptor for this template to ease the data handling. In this case, however, some additional modifications may be needed, e.g. to replace the "Extreme temperature" part that is marked yellow in the Annex, by 3 02 077 (the one-hour extreme temperatures) and 3 02 041 (SYNOP extreme temperatures), as suggested in the attached comments.

The Team recommended that more contacts were needed with Meteo-France to finalize this template, and the template remained for validation.

3.1.6 AWS templates with national and WMO station identification

The existing international system of station numbers is not sufficient for automatic weather stations. Some WMO Member States are using national station numbers to identify their AWSs. To allow representation of these national station numbers, the introduction of a new numbering system is proposed. This system, represented by 0 01 101 (State identifier) and 0 01 102 (National station number), will allow each WMO Member State to accommodate up to 999999 stations. This system shall be fully independent and completely separated from the WMO international numbering system represented by 0 01 001 (WMO block number) and 0 01 002 (WMO station number). It is proposed to introduce the national identification for all stations, including the stations that are identified by the WMO international numbers.

The submitted proposal for experimental exchange for full validation (see Annex to this paragraph) has been developed by Dr Eva Cervena following requirement expressed by CBS and taking into consideration the outcome of the discussion with members of ET- AWS, ET- DR&C and CT-MTDCF, in particular Messrs M. Dragosavac (ECMWF), S. Kellett (UK), M. Leroy (France), J. W. Noteboom (Netherlands), J. M. Rezende (Brazil), M. Weis (IBL Software Engineering) and I. Zahumenský (Slovakia).

It is also proposed to modify the existing AWS BUFR template for observations from n-minute period as follows: to add 3 01 089 (National station identification) at the beginning of it and to introduce the usage of short delayed replications in a similar way as it has been done in TM 3 07 091. After being validated, the AWS template for surface observations from n-minute period is proposed to be represented by the descriptor 3 07 092.

If reporting nominal values is required, the template TM 307091 or TM 307092 shall be supplemented with the sequence 307093 as listed in Annex to this paragraph (for validation).

3.1.7 Common sequence descriptors for representation of SYNOP data manually encoded in CREX

Significant work has been done by some RA I National Meteorological Services, in particular by Tanzania Meteorological Agency (TMA), to achieve progress in implementation of Migration to TDCF as reported by Mr. William Amos Chillambo, the Rapporteur on Codes for RA I.

The template TM D07089 proposed (see Annex to this paragraph) nearly corresponded to the template used by TMA in their CREX messages. The Team agreed to declare this template pre-operational.

3.1.8 EUCOS template for representation of radiosonde data

The Joint meeting of ET DR&C and CT MTDCF (Montreal, 8 – 12 May 2006) reviewed a proposal for “HIGH RESOLUTION RADIOSONDE BUFR (LAND, SHIP OR MOBILE)” template which introduction had been coordinated by EUCOS, and suggested several changes to it. One of the most important finding of the Meeting in Montreal was: Sequence 3 09 052 has the same capability to handle high-resolution data as the proposed template. To avoid any confusion, the proposed template is referred to as “EUCOS BUFR template for representation of radiosonde data” in this document or as “EUCOS template”. A new version of the EUCOS template is shown in the Annex to this paragraph and is still for validation. The Team recommended:

a) To contact the current EUCOS Operations Manager and the authors of the original EUCOS template and to learn their opinion on the submitted new version of the EUCOS template (suitable for representation of high resolution radiosonde data with geopotential height as the vertical coordinate, the vertical resolution being limited by the length of BUFR message).

b) If radiosonde data of very high resolution with pressure as the vertical coordinate is to be accomplished, usage of sequence descriptors 3 09 060 to 3 09 066 might be recommended.

c) Producing TEMP, TEMP SHIP and TEMP MOBIL data in BUFR for the international exchange should use the template TM 309052 that covers the complete extend of the TAC data. This is the main condition that has to be met during the migration process. Therefore, the alternatives in a) and b) could not be used for Migration to TDCF.

3.1.9 Review of new METAR/SPECI/TAF templates and related BUFR/CREX B and D descriptors

The Team examined a proposal for modifications/corrections of B and D descriptors in the new METAR/SPECI/TAF templates developed by Dr Eva Cervena and clarification of usage of descriptors for wind speed and maximum wind speed (gusts) taking into account the required unambiguous conversion from TDCF data to TAC data. The templates had been validated by some external users (see Annex to this paragraph) and the Team agreed to declare them pre-operational.

3.1.10 New Table B descriptors for passive remote sensing by star occultation

The expert from Canada presented a request for descriptor for report on atmospheric sensing by star occultation. The information is used by data assimilation group in Canada. The Team accept these new descriptors for validation as listed in Annex to this paragraph.

3.2 CLEARING BY CGMS FOR NEW SATELLITE DESCRIPTORS IN MASTER TABLE 0 OR IN A NEW SATELLITE MASTER TABLE

The Secretariat recalled the issues for making a new Master Table for satellite data. Three main problems were identified: the management of the new Master Table, the respect of BUFR regulations, especially for additions, and the implementation of the process. Starting new Master Table would require some coordination and commitment from the parties concerned.

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

It has now been agreed at CGMS (Coordination Group for Meteorological Satellites) that a Task Force on Codes for satellite data will be created. The task force, in accordance to its term of reference, will nominate a rapporteur to link between this Task Force and the CBS ET/DR&C.

This Task Force should meet for the first time during 2007. The Task Force will coordinate requests for additions to BUFR Codes, related to satellite data and will also consider more the creation of a Master Table specifically for Satellite data. Its recommendations will be considered in 2008 by ET/DR&C.

3.3 OTHER NEEDED ADDITIONS OR CORRECTIONS

3.3.1 Proposal for a Note to Flag Tables and for deprecation of the flag table 0 25 009

In the Guide to WMO Table Driven Code Forms: FM 94 BUFR and FM 95 CREX], Layer 3, the significance of bits within the bit string is specified: "In all flag tables within the BUFR specification, bits are numbered from 1 to N from the most significant to least significant within a data width of N bits, i.e. from left (bit 1) to right (bit N). In the Manual on Codes, however, there is no guidance referring to the significance of bits within the bit string of a flag table data width (N).

It is proposed to add a note under BUFR/CREX Table B and deprecate flag table 0 25 009:((to be replaced) as described in Annex to this paragraph.

3.3.2 New BUFR descriptors for SBUV/2 ozone data

The U.S. NESDIS was previously tasked to distribute ozone data from its SBUV/2 (Solar Backscatter Ultraviolet) instrument in BUFR. Several new Table B and Table D entries were developed during this effort, and several atmospheric chemistry descriptors previously proposed to the ET/DR+C in Montreal (May 2005) were utilized as well. Sample data resulting from this work was submitted to the ET/DR+C and others for validation in November 2006. Since that time, NESDIS has begun real-time distribution of such data within the U.S. as well as to numerous external customers including Canada, India, UKMO and ECMWF. Therefore, the Team agreed for the descriptors described in Annex to this paragraph to be approved for preoperational implementation.

3.3.3 New Common Table entries for Sub-Centres

The Team agreed to add entries and to correct one entry in Common Table C-12 as listed in Annex to this paragraph.

3.3.4 New descriptors for GFA (Graphical Forecast AIRMET) data

The U.S. NCEP Aviation Weather Center (AWC) has been working to develop a graphical forecast application for the generation of AIRMET messages. The resulting graphical output contains more detailed information than can be represented within the official ICAO AIRMET text format, and this information is of great interest to certain elements of the U.S. aviation community as well as other potential customers in Canada and elsewhere. In order to easily disseminate such detailed information to these customers, new BUFR sequences were developed and tested. During this process, an effort was made to utilize many of the same BUFR descriptors and sequences that were recently approved for use in the reporting of SIGMET messages. Nevertheless, a few additional descriptors and sequences were also required. The new application will allow the AWC to provide the necessary level of detail to those customers who are able to receive and process BUFR messages, while at the same time continuing to provide backward-capable generation of the ICAO AIRMET text format for others.

The Team agreed to declare the corresponding entries (see Annex to this paragraph) for validation. The representative of ICAO stated nevertheless that it was not an ICAO requirement and wished a note to be added accordingly.

The representative from ECMWF agreed to perform validation and UKMO and Canada will seek resources to help for the validation.

3.3.5 Correction of units for K index

The Team agreed to correct the units of K index entry to Degree Celsius instead of Kelvin, since the users are well known, the Team agreed to consider this correction as editorial (see Annex to this paragraph).

3.3.6 Proposal for new entries in BUFR Table B for radar volume data

DWD intended to encode radar volume data in FM94-BUFR. The volume (3-D) data are needed within a project for visualisation (NinJo). The exchange of the BUFR will be international. Several new table B entries have been developed for this purpose. Some descriptors are required for encoding metadata needed for the processing of the data (see Annex to this paragraph). The Team considered that this proposal needed validation and that some explanation of the abbreviations should be provided.

3.3.7 Entries for encoding of JASON2 data

EUMETSAT intends to encode the OGDR (Operational Geophysical Data Record) data from JASON2 in BUFR in order to exchange the data on the GTS and via satellite dissemination on EUMETCast. New entries are proposed for validation as listed in Annex to this paragraph.

3.4 REVISION OF THE BUFR GUIDE

The Team agreed that a revision of the BUFR Guide would be required and that the Secretariat, possibly with the help of a consultant should urgently undertake this revision.

4. MODIFICATIONS TO TRADITIONAL ALPHANUMERIC CODES

4.1 PROBLEM OF RADIOSONDE NUMBERS

The Common Code Table C-2 is saturated. Before all the radiosondes systems switched to BUFR, an interim solution imagined by Dr Steve Schroeder from USA (Texas A&M University) could solve the problem. One needs to record the assignment date in the Common Code Table of new sondes, which are then given the same 2 digits number of sondes no longer in use at the date of assignment. An example of a new look Common Code Table C-2 is shown in the Annex to this paragraph. The encoding/decoding software will have to take this into account, especially if one converts to or from BUFR. The Team agreed that it was the only solution (for operational implementation on 7 November 2007), but that migration to generation of TEMP in BUFR was in any case the best solution for the long term. The WMO Secretariat will make available the Table as soon as possible with the effective content of 7 November 2007.

4.2 CLARIFICATION OF NOTE (1) TO THE SPECIFICATION OF MEAN MONTHLY TEMPERATURE IN CLIMAT TEMP AND CLIMAT TEMP SHIP

The Meeting agreed to supplement the existing Note (1) to specification of mean monthly temperature (FM 75, FM 76) to read:

> For negative temperatures, 500 shall be added to the absolute value of the mean temperature, omitting the thousands digit for temperatures equal to or less than – 50.0 ˚C.

5. IN RELATION TO MIGRATION TO TABLE DRIVEN CODE FORMS

5.1 MIGRATION GUIDANCE DOCUMENT – INFORMATION TO PERMANENT REPRESENTATIVES

The Team reviewed the Migration Guidance Document provided by the Secretariat and expressed its gratitude for the initial compilation. Following discussion of proposed amendments, a sub group was established to begin reviewing the document. The team realized that migration issues would also be discussed at the WMO Congress meeting in May. Recognising this and the need to coordinate with the entire CT-MTDCF, it decided to target having a final version available in July for the secretariat to distribute to the Permanent Representatives.

5.1.1 The Team discussed the timeline in the Migration Matrix as currently approved by CBS which targets completion of migration of category 1, common codes by November of 2009, category 4, maritime codes by November of 2011 and category 3, aviation codes by November of 2016. It noted that although operational exchange of data for each of these categories had already started, there still were concerns about progress toward completion.

5.1.2 It also reflected on the language sometimes used to describe the progress of migration that it will occur as requirements drive the need and capabilities allow, noting that the Migration Matrix defines the migration completion dates this way:

- *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.*

5.1.3 Recognizing there was an impact on Member states resources, the Team felt that insisting on a mandatory completion date was not practicable. The team nonetheless felt there was a need to provide a stronger emphasis upon completion of migration by the planed dates. It felt this should be reflected in the Migration Guidance Document and that it should contain a strong recommendation that WMO Members meet these dates. In past guidance, the focus was placed on stressing the positive aspects of migration. The Team felt it was appropriate to also tactfully address the negative aspects and risks of not migrating.

5.1.4 The initial revision of the Migration Guidance Document is attached as an Annex to this paragraph.

5.2 QUESTIONNAIRE ON MIGRATION

The Team reviewed the updated Questionnaire on Migration developed by the Secretariat and expressed its appreciation. It decided to update the table representing the timeline with appropriate language regarding the importance of meeting the target migration dates as discussed in item 5.1. The team will coordinate the Questionnaire with the entire CT-MTDCF and ET/DRC to finalize for the same target date in July as the Migration Guidance Document so it can also be distributed. The updated Questionnaire is included in the Annex to this paragraph.

5.3 INVOLVEMENT OF REGIONAL RAPPORTEURS

The team reviewed reports from the Regional Rapporteurs, the Secretariat and other members regarding progress and issues related to migration. The Team was appreciative that there were representatives present from all WMO regions who could contribute and felt the continuance of this practice was necessary at all meetings related to Codes matter.

5.3.1 RA I

Mr William Chillambo, the Regional Rapporteur from RA I, reported that the fifth session of the Working Group (WG) on Planning and Implementation of WWW in RA I, held in Nairobi from 25 to 29th September, 2006, noted that in the period 2001 to 2006, technology had substantially evolved and as a result, RA I faced many new challenges including the need to migrate to the use of Table Driven Code Forms for data exchange and storage.

5.3.1.1 RAI Member countries were having difficulty beginning the migration process, even developing national migration plans. Approximately 25% had done so. Approximately another 25% were currently developing one. It was felt that developing countries needed to benefit more from the experience of advanced countries

5.3.1.2 Tanzania has undertaken developing the ability to use CREX as an interim solution before an automated solution can be achieved for migration to BUFR. Other Members have started experimental activities in coding and exchanging information in CREX. Mr. Mamadou Watt, Chief of Meteorological Services of ASECNA in Dakar, Senegal developed a method for reporting on squall lines in CREX.

5.3.1.3 Level 1 and 2 training was previously provided, but as the Region advances in its migration plans there is a need for additional training. The Regional Rapporteur, Mr. Chillambo is working with the NMHSs to provide additional training. Botswana Meteorological Services requested Tanzania Meteorological Services to conduct Level 2 training for personnel who have already completed Level 1. The training is planned to be held in mid-May, 2007. It is hoped that the training will also benefit the Kenya Meteorological Department.

5.3.1.4 Mr. Mamadou Watt of Senegal has indicated that ASECNA plans to organize a meeting in September, 2007 with the goal of explaining the philosophy of CREX and BUFR Codes.

5.3.2 RA II

The Japan Meteorological Agency (JMA) reported TAC codes SAREP (Category 2, satellite observations) and RADOB (Category 5, miscellaneous), are widely used by the Members of the ESCAP/WMO Typhoon Committee (TC). According to the WMO Migration Plan, these codes have completion of migration dates of November 2006 and 2008 respectively. The RSMC Tokyo Typhoon Center has been providing GTS dissemination of this data in BUFR along with parallel dissemination of the TAC data.

5.3.2.1 RSMC Tokyo in coordination with its TC Members distributed a questionnaire whose results are included in the Annex to this paragraph. These results will be used to finalize the TC's migration plan in late 2007. The RSMC plans to continue dissemination of SAREP and RADOB in TAC until the completion dates for SAREP and RADOB migration, which will be agreed by the Members of TC.

5.3.2.2 The CT-MTDCF was asked to add a note to the Code Migration Schedule indicating SAREP and RADOB require coordination by the ESCAP/WMO Typhoon Committee. The Team endorsed this action based on the result determined by the TC's completed Migration time. Any update would be made to the Plan for submission to the next CBS.

5.3.2.3 In other RA II developments, China has said it will produce SYNOP in BUFR in 2007. Hong-Kong reports it can decode BUFR data today and plans for a complete encoding capability in 2007. Iran, Mongolia and Oman have reported they are intently working on migration. Nepal and Laos have both indicated an interest in staring work on migration.

5.3.3 In RA III, Brazil plans to start sending AWS data and Satellite winds in BUFR operationally in June or July of 2007 using WMO headings ISAI01 SBBR and ISAI02 SBBR.

5.3.4 In RA IV, a Caribbean RADAR Mosaic is under development in BUFR. It is planned to be operational with 3 or 4 RADARs in November 2007 with 9 total RADARs included by the end of 2009. It is using software developed by Meteo-France based on the OPERA system.

5.3.5 In RA V, Australia produces tropical cyclone data in BUFR and in CREX and will produce soon SYNOP in BUFR for Australia and Papua New Guinea and works for other data types - Fiji produces tropical cyclone data in CREX.

5.3.6 RA VI

The RA VI Regional Rapporteur, Dr. Eva Cervena reported on migration status and activities in RA VI. The following Members are producing BUFR encoded observations as indicated: Czech Republic – TEMP, SYNOP and AWS data; Israel – TEMP, SYNOP and CLIMAT data; Jordan - SYNOP data; Germany – SYNOP and AWS data; Netherlands – AWS and TEMP data. *Note that TEMP data above includes time and position of the radiosonde at each level.*

5.3.6.1 The following Members have developed National Migration Plans: Belgium, Czech Republic, France, Germany, Hungary, Netherlands, Norway, Romania, Sweden, Switzerland and Turkey. The National Plans of these Members indicate the start of operational exchange of Category 1, common codes (SYNOP, TEMP, CLIMAT, CLIMAT TEMP) in 2007 (2008 in the National Plan of Turkey).

5.3.6.2 The following Members have progressed significantly in implementation of Migration to TDCF but have not yet provided a time schedule: Denmark, Ireland, Italy, Portugal, Serbia, and United Kingdom.

5.3.6.3 The following Members have indicated some progress in Migration to TDCF or their intention to provide more precise information later: Bulgaria, Iceland, Kazakhstan, Macedonia, Russian Federation and Slovakia.

5.3.6.4 In November 2006, Vaisala distributed a new version of DigiCORA sounding software (v. 3.52) to their Service Contract costumers that allows producing TEMP, PILOT and CLIMAT TEMP data in BUFR.

5.3.6.5 It was encouraging to note that 33 participants attended (at their own expense) a Training Workshop on BUFR and Migration to TDCF (Langen, Germany, 17-20 April 2007). Additional information for RA VI is reported in the Annex to this paragraph.

5.3.6.6 Dr. Eva Cervena of the Czech Republic reported on the development of a BUFR template for cross-border exchange of Road Weather Information as a part of the Regional TDCF Migration Plan. The template and local descriptors were developed by Eva Červená (CHMI) and Sibylle Krebber (DWD) in cooperation with Thomas Endrulat (DWD) and Jan Sulan (CHMI) and included in the Annex to this Paragraph.

5.4 WEB SITE FOR VERIFICATION SERVICE

The Team reviewed the progress made on BUFR/CREX data verification services proposed at the May 2006 joint meeting of the ET/DRC and CT-MTDCF. It noted with great appreciation that Milan Dragosavac of ECMWF developed a web based verification service for BUFR/CREX data. This service will handle a data file with a maximum size of 500 K bytes, which, as 7 November 2007, will become the limit for transmission on the GTS. The data file is uploaded to ECMWF's server and expanded, the content of the BUFR section 1 is checked and errors, if any, are reported. The web site is:

http://www.ecmwf.int/products/data/software/bufr.html
and go to : BUFR data validation

5.4.1 The Team also reviewed the work done by Mr Waldenio Gambi of INPE in Brazil in this regard and expressed its appreciation of it.

5.4.2 The Team considered other steps, which should be taken to further support these verification services. It considered the difference between validation and verification and agreed these services would be limited to verification that BUFR/CREX data are in compliance with the agreed BUFR/CREX standards and regulations, but do not validate the data values themselves.

5.4.3 The Team determined that both web based verification services and stand-alone BUFR/CREX verification software were desirable since the latter could be imbedded into a center system and testing service. The Team recommended Members having or developing such verification services or software make them openly available and that any software be added to the WMO Software Registry.

5.4.4 The Team determined the development of basic requirements for such services would be beneficial and agreed to develop a guide for these services. The team reviewed the initial requirements suggested by Mr Jan Willem Noteboom of KNMI and thanked him for his input. From this, the Team increased the verification requirements to be included in the guide. An initial draft is in the Annex to this paragraph

5.4.5 The Team considered the status of regional and national practices in these verification services. It recognized that some developers of these services may find inclusion of regional and national practices advantageous for their own purposes. The Team recommended that verification services, which include regional and national practices be designed in such a way, that they separate suitably reporting, alarming on and displaying of information pertaining to regional and national practices, from information on international reporting requirements. The Team also recommended that verification services including regional and national practices do not fail when not finding these practices encoded as expected. The Team suggested the designing verification services including regional and national practices be such, that these capabilities could be turned on or off or bypassed.

5.4.6 ECMWF BUFR creator under UNIX
The prototype ECMWF BUFR viewer tool was demonstrated to the members of the Team and at the RA VI Training Workshop in Langen (17-20 April 2007). The tool provides a Graphical User Interface to the BUFR software, allowing users to decode and view the contents of a BUFR message and to encode data in BUFR and CREX format. A message may be filtered to display only the requested descriptors, area or time and a data coverage map is shown. Messages can be sent via ftp to a remote server. The tool is written in java (version 1.4.2), C and links to the Fortran BUFR software (version 320).

5.5 FORMAT OF CODE TABLES IN WMO WEB SITE

The Team considered the format of the WMO Manual No. 306 Code Tables maintained by the Secretariat and available through its web site. The tables currently are maintained in Microsoft Word format and available in either Microsoft Word or PDF formats. The Team noted that all NMHSs running automated processing systems such as encoders, decoders and translators require the tables in an electronic format suitable for these systems and that all these users currently have to translate these tables today. This effort can be problematic for smaller centers whose resources are limited; it is an immense duplication of effort and is an impediment to migration. Additionally, the team noted these tables are also required in a format suitable for easy maintenance, reference and use by humans.

5.5.1 The team recognized the limited resources of the secretariat and any solution chosen should not be too resource intensive. After considering alternatives, the Team recommended the Secretariat convert these tables to a Microsoft Access format. From this format, it is relatively simple to publish the tables as a text document, a Microsoft Word document or export a database file. The Team also recommended the Secretariat make both the Microsoft Access and text format available via its web site.

5.5.2 Additionally the Team was aware that some centers and organizations may have expertise in the conversion of the tables to a database format and encourages those who may lend assistance to the secretariat.

5.6 DECODERS/ENCODERS UNDER WINDOWS

Mr Waldenio Gambi of INPE in Brazil reported on the development at his center of Windows and UNIX based decoder and encoder software. He also reported this software was available for free distribution from their web site at:

http://tempo.cptec.inpe.br:9080/publicacoes

5.6.1 The Team expressed its gratitude for this very important contribution that fills the often-expressed gap, which previously existed for Windows based systems. Mr Waldenio Gambi reported additional development of the software is underway and the project team is adding another full-time programmer in April of 2007 for one-year. This will greatly assist with BUFR migration.

5.6.2 Mr Waldenio Gambi also reported they are developing a JAVA based graphical interface for the BUFR package and an alpha version will be bundled with the complete package and available for download from the same web site in May of 2007.

5.7 MIGRATION MATRIX

The Team reviewed the Migration Matrix and found no additional update was needed at this time. However this status should be reviewed with all codes focal points and updated by November of this year, which is the next scheduled target date, start of experimental exchange for category 3, aviation codes. Also, migration completion is scheduled for category 5, miscellaneous codes by November of 2008 and progress on these needs to be evaluated.

5.7.1 The Team greatly appreciated the participation of Dr Olli Turpeinen, the Chief of the Meteorological Section of ICAO. It considered the status of migration for category 3, aviation codes and noted the aviation community was still evaluating other options besides BUFR for the OPMET codes METAR, SPECI and TAF though there had not been a formal determination by ICAO regarding a change to something other than BUFR.

5.7.2 The team recognized that migration of AMDAR to BUFR format had been a tremendous success and that it is the second largest volume of exchanged observations after satellite data. The Team also recognized the aviation community was using BUFR for a number of purposes including presenting pictorial information although this isn't a code migration issues.

5.7.3 The Team stands ready to continue to support BUFR encoding of METAR, SPECI and TAF, has prepared all required descriptors and templates and met all of ICAO's requirements.

5.7.4 Whatever solution ICAO decides on for OPMET data exchange, the capability to encode this information in BUFR for exchange within or between NMHSs or storage by NMHSs will be available.

5.8 THE TEAM CONSIDERED THE FOLLOWING ADDITIONAL MATTERS RELATED TO MIGRATION:

5.8.1 Dr Olli Turpeinen, the Director of Meteorological Services for IACO provided to the Team a summary of issues being considered by the aviation community and that should be taken into account when considering the migration to table-driven codes for aeronautical meteorological information (METAR/SPECI and TAF). The issues identified are intended to facilitate discussions in view of minimizing any negative impact on aeronautical users associated with the introduction of a future digital code form to be used for the dissemination and exchange of aeronautical MET information. These issues and concerns have been made known to ICAO by a number of ICAO planning and implementation regional groups (PIRG).

5.8.1.1 They identified several issues including those related to service providers:

Multiple service providers for aeronautical MET information

Continued requirement to display OPMET data to aviation users

Standardization of codes used for all aeronautical information

Benefits of using industry-standard software for QM

Difficulties in decoding non-standard OPMET messages

5.8.1.2 The aviation community identified another concern related to communication networks. The Aeronautical Fixed Telecommunication Network (AFTN) component of the Aeronautical Fixed Service (AFS) is still widely used and is not capable of carrying digital information. Many States are concerned about the costs of upgrading the AFS on a global basis as the business case for upgrading solely to carry the OPMET information may not be sufficient to justify the upgrade. There is a lack of confidence that a sufficient number of States would be in a position to upgrade the network in order to successfully utilize binary table-driven codes using the planned schedule provided by WMO in coordination with ICAO.

5.8.1.3 The aviation community is also concerned about the costs of doing format conversions and would like to explore the possibility of using other codes such as XML.

5.8.1.4 The Team reviewed the information provided. It considered The Working Arrangements between the International Civil Aviation Organization and the World Meteorological Organization (Doc 7475) specifies that the codes used for the ground-to-ground dissemination and exchange of OPMET information lies with WMO. It is therefore not possible for ICAO, or for the aviation industry to choose the code by itself.

5.8.1.5 The Team noted the first stage of the migration plan has been adopted by the ICAO Council and it will become applicable in November 2007. It allows States to exchange METAR/SPECI and TAF using BUFR on bilateral basis. Further code migration however will have a more substantive impact and it is therefore essential that any uncertainty is removed by a clear decision regarding the way forward without delay.

5.8.1.6 The Team discussed the information presented. It noted that a separate expert team was being designated to developed guidance for the use of XML. It felt the use of XML was certainly one possibility. It also noted that although XML is not a binary code it is very verbose and OPMET data converted to XML would be significantly larger than the original data. This may still cause significant problems for the aviation community.

5.8.1.7 The Team also noted that another Team was designated to begin coordination between CAeM, CBS and ICAO. The Team recognized that only the aviation community could evaluate the capability of its information technology infrastructure and its own ability to support changes to it.

5.8.1.8 The Team still believes the best long-term solution for aviation data is BUFR. However, it also recognizes there is a need for XML encoding of some forms of data. Therefore, based on the results of the coordination to be completed within the aviation community and between CAeM, CBS and ICAO the appropriate and agreed on XML encoding standards should be developed by the new XML expert team.

6. REVIEW OF ACTIONS TO BE PERFORMED

The Team reviewed the actions identified at the joint Meeting of the Expert Team on Data Representation and Codes (ET/DR&C) and Coordination Team of Migration to Table Driven Code Forms in Montreal from 8 to 12 May 2006. The standing actions and new actions are listed in the Annex to this chapter.

7. CLOSURE OF THE MEETING

The Meeting was closed by the Chairman of the ET/DR&C at 15.00 on Friday 27 April 2007.

ANNEX TO PARAGRAPH 1.1

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ANNEX TO PARAGRAPH 2.1.1
OPERATIONAL

To add a note not to use the following parameters

Product Discipline 2: Land surface products
Parameter Category 0: Vegetation/Biomass

9 Volumetric soil moisture content (Proportion)
17 Wilting point (Proportion)

Product Discipline 2: Land surface products
Parameter Category 3: Soil Products

5 Liquid volumetric soil moisture (non-frozen) (Proportion)
7 Transpiration stress-onset (soil moisture) (Proportion)
8 Direct evaporation cease (soil moisture) (Proportion)
9 Soil porosity (Proportion)

Rational behind:
The unit "Proportion" for the above parameters is not very descriptive and leads to confusion while converting to a different unit. Assume a GRIB2 file contains the value 0.5 (Proportion) at one grid point. If one tries for example to calculate a new value in the unit kg m^{-3} one has to know what the unit proportion stands for:

- *if Proportion stands for $m^3 m^{-3}$*
  0.5 $m^3 m^{-3}$ corresponds to 0.5 ρ_H2O m3/m3 = 500 kg m^{-3}

- *if Proportion stands for kg kg^{-1}*
  0.5 kg kg^{-1} corresponds to 0.5 rho_soil kg kg^{-1} = X kg m^{-3},
  where X depends on the density of the soil at the grid point

As we see from the example the procedure of converting the unit does depend on the way how proportion is actually defined.

And use instead the new parameters:

We propose below to add a Note to recommend no to use the 6 parameters above, but to use others with a more descriptive unit.

Product Discipline 2: Land surface products
Parameter Category 0: Vegetation/Biomass

25 Volumetric soil moisture ($m^3 m^{-3}$)
26 Wilting point (kg m^{-3})
27 Volumetric wilting point ($m^3 m^{-3}$)

Product Discipline 2: Land surface products
Parameter Category 3: Soil Products

10 Liquid volumetric soil moisture (non-frozen) ($m^3 m^{-3}$)
11 Volumetric transpiration stress-onset (soil moisture) ($m^3 m^{-3}$)
12 Transpiration stress-onset (soil moisture) (kg m^{-3})
13 Volumetric direct evaporation cease (soil moisture) ($m^3 m^{-3}$)

14 Direct evaporation cease (soil moisture) (kg m^{-3})
15 Soil porosity (m^3 m^{-3})
16 Volumetric saturation of soil moisture (m^3 m^{-3})
17 Saturation of soil moisture (kg m^{-3})

Rational behind:

- *We have added all the deprecated parameters plus some new but now with a descriptive SI unit, which does not cause confusion.*
- *Furthermore we have renamed parameters having the unit m^3 m^{-3} by adding the word "volumetric" in order to distinct them from the similar parameter with the unit kg m^{-3}.*

ANNEX TO PARAGRAPH 2.1.2

OPERATIONAL

Add the following new entry to GRIB2 Code Table 3.2:

8 Earth model assumed spherical with radius 6371200 m, but the horizontal datum of the resulting latitude/longitude field is the WGS84 reference frame

and change the range of “Reserved” entries to become 9-191.

Add the following new entry to “Product Discipline 10 – Oceanographic Products” in Code Table 4.1:

191 Miscellaneous

Add the following new entry to Code Table 4.2:

Product Discipline 10 – Oceanographic products, parameter category 191: miscellaneous

Number	**Parameter**	**Units**
0	Seconds prior to initial reference time (defined in Section 1)	s
1-191	Reserved	
192-254	Reserved for local use	
255	Missing	

ANNEX TO PARAGRAPH 2.1.3

OPERATIONAL

Addition:

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

Add:	Number 13, Parameter = Atmospheric divergence, Units = s^{-1}
Change:	Number 13 – 191, Parameter = Reserved
to:	Number 14 – 191, Parameter = Reserved

ANNEX TO PARAGRAPH 2.1.4

OPERATIONAL

Proposed new parameters

Table 4.2
Product Discipline 0 – Meteorological Products, parameter category 1: moisture

Discipline	Category	Parameter Number	Parameter	Units
0	1	65	Rain precipitation rate	kg m^{-2} s^{-1}
0	1	66	Snow precipitation rate	kg m^{-2} s^{-1}
0	1	67	Freezing rain precipitation rate	kg m^{-2} s^{-1}
0	1	68	Ice pellets precipitation rate	kg m^{-2} s^{-1}

ANNEX TO PARAGRAPH 2.2

Proposed modifications

The following changes are proposed with respect to the 1 January 2003 Issue of WMO's Guide to GRIB Edition 2 (Guide to the WMO Table Driven Code Form Used for the Representation and Exchange of Regularly Spaced Data In Binary Form: FM 92 GRIB Edition 2)

Top of page 8,

Product discipline 1: Meteorological products

should be

Product discipline 0: Meteorological products

Middle of page 8

29-189 Reserved

should be

20-189 Reserved

Top of page 9,

16-191 Reserved

should be

16 Snow phase change heat flux Wm^-2

17-191 Reserved

Page 9, bis

Section 1.3 reflects older scheme with "fast track" process. Needs update by Secretariat to reflect revised process.

Page 14, Section 2.1.1

... Thus, Code Table 3.4 would be the fourth code table referred to in Section 3...

This is wrong because we have Table 3.0, and so Code Table 3.4 is the fifth code table referred to in Section 3. Remove the sentence.

Page 14, Section 2.1.1

Maximum length for GRIB2 message is 2^64 - 2. A value of 2^64 - 1 in Section 0 would give a missing length, according to Regulation 92.1.4.

Page 14, Section 2.1.2

... originating centre or sub-centre ...

should be

... originating centre and sub-centre ...

Page 14, Section 2.1.2

Octet 10 is defined as GRIB Master Tables Version Number (see Code Table 1.0) (currently 1)

should be GRIB Master Tables Version Number (see Code Table 1.0)

Page 15, Section 2.1.2

... It is an aid to finding one's way through ...

should say

... It is required in order to identify Sections in ...

Page 15

Explanation of Section 1, Octets 6 - 7 and 8 - 9. These are defined by Common Code Tables C-11 and C-12 respectively, not C-1. Secretariat should update text accordingly.

Page 16

Code Table 1.0 is out of date and should be updated. The description of the use Code Tables 1.0 and 1.1 in the subsequent text should be updated by the Secretariat.

General

Data are plural. Secretariat to perform general search and replace of "data is" with "data are".

Page 20

... Template 3.20 requires use of octets 14 – 65 ...

should be

... Template 3.20 requires use of octets 15 – 65 ...

Page 22

11 – 19	Reserved

should be

11	Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
12	Derived forecasts based in all ensemble members at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
13	Derived forecasts based on a cluster of ensemble members over a rectangular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
14	Derived forecasts based on a cluster of ensemble members over a circular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
15-19	Reserved

1001	Gross section of averaged or otherwise statistically processed analysis or forecast over a range of time

should be

1001	Cross section of averaged or otherwise statistically processed analysis or forecast over a range of time

Page 23

... those data points whose value is zero do not have that zero value appear in the Data Section ...

This is incorrect. Zero is a valid data value which can be reported. Delete this phrase to give

... However, when a bit map is used (this is discussed in Section 2.1.7), the number of data point values to be found in the data Section (given by octets 6 - 9 of the Data Representation Section) may be smaller than the number ...

Page 23

4 – 49	Reserved

should be

4-39	Reserved
40	Grid point data – JPEG 2000 Code Stream Format
41	Grid point data – Portable Network Graphics (PNG)
42-49	Reserved

Page 24, Section 2.1.7

7-nn	Bit-map

should be

7-nn	Bit-map - Contiguous bits with a bit to data point correspondence, ordered as defined in Section 3. A bit set equal to 1 implies the presence of a data value at the corresponding data point, whereas a value of 0 implies the absence of such a value.

Page 25, first paragraph

At this point, suffice it to say that there are three basic approaches to data compression used in GRIB2; simple packing, complex packing, and spatial differencing.

should be

At this point, suffice it to say that there are several approaches to data compression used in GRIB2, including simple packing, complex packing, spatial differencing, JPEG2000 and PNG.

Page 27
Note 5 to GDT 3.20 should be included.

Page 27
Code table 3.2 is out of date. Correct entries 1 and 3. Add entry 7. Correct range of Reserved values.

ANNEX TO PARAGRAPH 3.1.2

FOR FINALIZATION AND VALIDATION

<u>CREX Template for tide elevation - full version *(in validation)*</u>

D	**06**	**026**					*(CREX Template for tide elevation - full version)*		
							(Station identification)	Chrs	Remarks
B	01	075					Tide station identification	5	
B	01	015					Station or site name	20	
D	01	021	B	05	001		Latitude	7	
			B	06	001		Longitude	8	
							(Reference date and time)		
D	01	011	B	04	001		Year	4	
			B	04	002		Month	2	
			B	04	003		Day	2	
D	01	013	B	04	004		Hour	2	
			B	04	005		Minute	2	
			B	04	006		Second	2	
							(Data for each sensor)		
R	15	000					Delayed replication of 15 descriptors	-	
							(Offset from reference date and time)		
B	04	016					Time increment (offset) - in seconds	4	
							(Identification of sensor)		
B	08	015					Identification of primary or secondary sensor	1	new descriptor
B	02	007					Type of sensor	2	new descriptor
							(Identification of quality check)		
B	22	120					Tide station automated water level check	2	
B	22	121					Tide station manual water level check	2	
							(Instantaneous data)		
B	04	016					Time increment - in seconds	4	
R	08	000					Delayed replication of 8 descriptors	4	
B	10	051					Pressure reduced to mean sea level	5	
B	22	038					Tidal elevation with respect to local chart datum	5	
B	22	040					Meteorological residual tidal elevation (surge or offset)	5	
							(Statistical data)		
B	04	026					Time period or displacement (averaging period) - in seconds	4	
R	03	004					Replicate 3 descriptors 4 times	-	for 4 types of statistical obs.
B	08	023					First-order statistics (mean, max., min., standard dev.)	2	

B	22	038					Tidal elevation with respect to local chart datum	5	
B	22	040					Meteorological residual tidal elevation (surge or offset)	5	

CREX Template for tide elevation - reduced version

(Station identification)								Chrs	Remarks
B	01	075					Tide station identification	5	
B	01	015					Station or site name	20	
D	01	021	B	05	001		Latitude	7	
			B	06	001		Longitude	8	
(Reference date and time)									
D	01	011	B	04	001		Year	4	
			B	04	002		Month	2	
			B	04	003		Day	2	
D	01	013	B	04	004		Hour	2	
			B	04	005		Minute	2	
			B	04	006		Second	2	
(Offset from reference time)									
B	04	016					Time increment (offset) - in seconds	4	
(Identification of sensor)									
B	08	015					Identification of primary or secondary sensor for tide elevation	1	new descriptor
B	02	007					Type of sensor	2	new descriptor
(Identification of quality check)									
B	22	120					Tide station automated water level check	2	
B	22	121					Tide station manual water level check	2	
(Instantaneous data)									
B	04	016					Time increment - in seconds	4	
R	03	000					Delayed replication of 3 descriptors	4	
B	10	051					Mean sea level pressure	5	instantaneous value
B	22	038					Tidal elevation with respect to local chart datum	5	
B	22	040					Meteorological residual tidal elevation (surge or offset)	5	

Code tables for sea level data

0 08 015 - Significance qualifier for sensor

0	Single sensor
1	Primary sensor
2	Secondary sensor (Backup sensor)
3-6	Reserved
7	Missing value
(7-9	*Not used in CREX)*

0 02 007 – Type of sensor for sea level

0	Reserved
1	Floating
2	Ultrasonic
3	Radar
4	Pressure
5-14	Reserved
15	Missing value
(15-99	*Not used in CREX*)

AN ENTIRELY DIFFERENT SEQUENCE FOR DART BUOY IS REQUIRED.

Australia submitted the following proposal:

The tide elevation new sequence (D06026) proposed may not be flexible enough because not all stations will be reporting MSL pressure, residual tide elevation and statistical data. Sea level stations for tsunami warning purposes normally report at higher frequencies, e.g. 1-minute intervals, but MSL pressure or sea surface temperatures do not change rapidly and they may not be required to be reported as frequent as the sea level elevations.

Perhaps a few different table D sequences may be needed. It might be better to create sequence descriptors for some major parts of the data rather than trying to create sequence descriptors for everything, e.g.

- Tide gauge identification + date and time
- Meteorological data
- Oceanographic data
- Sequence of tide elevation without residuals
- Sequence of tide elevation with residuals
- Sequence of tide elevation and statistics without residuals
- Sequence of tide elevation and statistics with residuals

A typical report could contain 3 or 4 table D descriptors in section 1 instead of one. Possible sequences could be (aaa, bbb etc. represent numbers to be assigned)

D 01 aaa Identification + date/time
B 01 075 Tide gauge identifier (5 chars)
D 01 023 Latitude, longitude (coarse accuracy),
D 01 011 Year, month, day
D 01 012 Hour, minute

D 01 bbb Identification + date/time
B 01 075 Tide gauge identifier (5 chars)
D 01 021 Latitude, longitude (high accuracy),
D 01 011 Year, month, day
D 01 012 Hour, minute

D 02 ccc Tide gauge meteorological data
B 10 051 MSL pressure
B 11 011 10m wind direction
B 11 012 10m Wind speed
B 12 004 2m Temperature
B 12 006 2m Dew point

D 06 ddd Tide gauge oceanographic data
B 22 042 Sea temperature
B 22 062 Salinity

D 06 eee Tide elevation without residuals
B 04 016 Time increment (offset) - in seconds from obs time to before start of sequence
B 08 015 Significance qualifier for sensor (primary, secondary, etc.)
B 02 007 Type of sensor for sea level (Radar, Acoustic, etc.)
B 22 120 Tide station automated water level check
B 22 121 Tide station manual water level check
B 04 016 Time increment in seconds (between items in sequence)
R 01 000 Repeat next descriptor an indefinite number of times
B 22 038 Tide elevation with respect to local datum

D 06 fff Tide elevation with residuals
B 04 016 Time increment (offset) - in seconds from obs time to before start of sequence
B 08 015 Significance qualifier for sensor (primary, secondary, etc.)
B 02 007 Type of sensor for sea level (Radar, Acoustic, etc.)
B 22 120 Tide station automated water level check
B 22 121 Tide station manual water level check
B 04 016 Time increment in seconds (between items in sequence)
R 02 000 Repeat next two descriptors an indefinite number of times
B 22 038 Tide elevation with respect to local datum
B 22 040 Meteorological residual tide elevation

D 06 ggg Tide elevation and statistics without residuals
B 04 016 Time increment (offset) - in seconds from obs time to before start of sequence
B 08 015 Significance qualifier for sensor (primary, secondary, etc.)
B 02 007 Type of sensor for sea level (Radar, Acoustic, etc.)
B 22 120 Tide station automated water level check
B 22 121 Tide station manual water level check
B 04 016 Time increment in seconds (between items in sequence)
R 01 000 Repeat next descriptor an indefinite number of times
B 22 038 Tide elevation with respect to local datum
B 04 026 Time period of averaging in seconds
R 02 004 Repeat two descriptors 4 times
B 08 023 Type of statistic (Mean, Min, Max, Std dev)
B 22 038 Tide elevation with respect to local datum

D 06 hhh Tide elevation and statistics with residual
B 04 016 Time increment (offset) - in seconds from obs time to before start of sequence
B 08 015 Significance qualifier for sensor (primary, secondary, etc.)
B 02 007 Type of sensor for sea level (Radar, Acoustic, etc.)
B 22 120 Tide station automated water level check
B 22 121 Tide station manual water level check
B 04 016 Time increment in seconds (between items in sequence)
R 01 000 Repeat next descriptor an indefinite number of times
B 22 038 Tide elevation with respect to local datum
B 04 026 Time period of averaging in seconds
R 02 004 Repeat three descriptors 4 times
B 08 023 Type of statistic (Mean, Min, Max, Std dev)
B 22 038 Tide elevation with respect to local datum
B 22 040 Meteorological residual tide elevation

These sequences can be combined to cover most of the examples seen so far from the various tide gauge formats currently reporting on GTS. .

This approach may be more reasonable.   A single table D sequence that meets all requirements is unlikely to suit everyone.   A number of smaller sequences that can be combined as needed may be more appropriate.

ANNEX TO PARAGRAPH 3.1.3

PREOPERATIONAL OR FOR VALIDATION

DESCRIPTORS FOR CHEMISTRY

Table 1 - Preoperational Descriptors

Element Descriptor	Element name	Unit	Scale	Reference Value	Data Width
0-02-071	SPECTROGRAPHIC WAVELENGTH	m	13	0	30
0-08-026	MATRIX SIGNIFICANCE	CODE TABLE	0	0	6
0-08-043	ATMOSPHERIC CHEMICAL OR PHYSICAL CONSTITUENT TYPE	CODE TABLE	0	0	8
0-08-090	DECIMAL SCALE OF FOLLOWING SIGNIFICANDS	NUMERIC	0	-127	8
0-15-008	SIGNIFICAND OF VOLUMETRIC MIXING RATIO	NUMERIC	0	0	10
0-15-024	OPTICAL DEPTH	NUMERIC	4	0	24
0-25-143	LINEAR COEFFICIENT	NUMERIC	6	-5000000	24

Table 2 - Validation in progress

Element Descriptor	Element name	Unit	Scale	Reference Value	Data Width
0-07-011	PRESSURE (HIGH PRECISION)	Pa	0	0	30
0-08-044	CAS REGISTY NUMBER	CCITT IA5	0	0	88
0-15-010	PARTIAL PRESSURE	PA	0	0	10
0-15-029	EXTINCTION COEFFICIENT	m^{-1}	0	0	10

Table 3 - Awaiting validation

Element Descriptor	Element name	Unit	Scale	Reference Value	Data Width
0-02-072	SPECTROGRAPHIC WIDTH	m	13	0	30
0-08-027	MATRIX GEOMETRY	CODE TABLE	0	0	6
0-08-045	PARTICULATE MATTER CHARACTERIZATION	CODE TABLE	0	0	8
0-15-007	MOLECULAR MASS	u	2	0	15
0-15-009	INTEGRATED NUMBER DENSITY	m^{-2}	0	0	10
0-15-021	INTEGRATED MASS DENSITY	kg m^{-2}	0	0	10
0-15-022	INTEGRATED NUMBER DENSITY	m^{-3}	0	0	10
0-15-023	MASS DENSITY	kg m^{-3}	0	0	10
0-15-028	PHOTO DISSOCIATION RATE	s^{-1}	0	0	10
New proposal for Validation 0-15-040	PARTICULATE MATTER DIAMETER	m	8	0	9
0-15-042	REFLECTANCE	NUMERIC	6	0	20
0-15-043	NUMBER OF AVERAGING KERNAL LAYERS	NUMERIC	0	0	10
0-15-044	AVERAGING KERNEL VALUE	NUMERIC	6	-5000000	24
0-20-079	SNOW/ICE CRYSTALS INDICATOR	CODE TABLE	0	0	2
0-20-080	CLOUD AMOUNT PRECENTAGE INTERVAL	CODE TABLE	0	0	3
0-25-144	MATRIX DIMENSION (I AXIS)	NUMERIC	0	0	9

0-25-145	MATRIX DIMENSION (J AXIS)	NUMERIC	0	0	9

IEEE DATA DESCRIPTION OPERATOR

Table Reference	Operator name	Operation Description
F X Operand		
2 09 YYY	IEEE floating point representation	"For elements in Table B other than CCITT IA5, Code Tables, Flag Tables and delayed descriptor replication factors, this operator shall indicate that values are represented in YYY bits IEEE floating point, where YYY can be set to 032 (single precision) or 064 (double precision). This operator shall override the scaling, reference value and data width from Table B. An operand of YYY=000 shall reinstate the Table B scaling, reference value and data width. (See note 21)

Note (21):

IEEE single or double precision floating point representation is specified in the standard ISO/IEC 559-1985 and ANSI/IEE 754-1985, which should be consulted for more details.

The sub group suggested that adding examples of the IEEE representation templates at 32 and 64 bits to note 21 would be convenient for the users but added that this should not be construed as an authoritative reference on IEEE representation, which only the IEEE documentation itself can provide. Text will be provided to Joël Martellet in coming days.

Additions to Regulations relatively to IEEE for BUFR Edition 5:

Insert a third sentence to regulation 94.1.5:

…deemed to be necessary. Missing values for IEEE data (when use of operator 209YYY) shall be the largest IEEE floating-point number for YYY bits taken from the 209YYY operator. This regulation….

In 94.6.3 change note (2) as:

(2) Where more than one data subset is included in a single BUFR message, data compression may be used as follows:

(i) Values for each data element are grouped into sets, and the sets shall be in the order defined by the data description; the first value in each set shall represent a minimum value for the set; for character data the first value in the set shall be set to all bits zero; however, if the character data values in all subsets are identical, the first value shall represent the character string; for IEEE floating point data the first value in the set shall be set all bits to zero; however, if all IEEE data values are identical the first value shall represent the IEEE value; this value is termed a "local reference value", R^0, with respect to the subsequent set of data.

(ii) Local reference value shall be coded according to Regulation 94.6.2.

(iii) If all values of an element are missing, R^0 shall be coded with all bits set to 1s. In the case of IEEE data the local reference value shall be coded using YYY bits from the 209YYY operator and the value shall be the largest positive IEEE floating point number for YYY bits.

(iv) The local reference value shall be followed by 6-bit quantity specifying the number of bits for each increment or for character data, specifying the number of octets representing the character string. For IEEE data element it shall be the number of octets corresponding to YYY bits from the 209YYY operator. However, if the character or IEEE data values in all subsets are identical, sub-note (vii) shall apply.

(v) Actual values, V, for non IEEE data and non-character string, will then be obtained as:
………………………………………………………… *no change*

(vi) Missing values will be denoted by setting all bits of the corresponding I to 1s. Missing values for IEEE data shall be the largest IEEE floating point number for YYY bits taken from the 209YYY operator.

(vii) ………………….. *no change*

…………………………

In the:

Section 4 - Data section

(2) The binary data in compressed form may be described as follows:

…………
Add:
If operator 209YYY is used, R_1^0 local reference value shall be set to largest IEEE floating-point number for YYY bits (32 bits: hexadecimal: 7f7fffff) (64 bits: hexadecimal: 7fefffffffffffff). The NBINC shall contain the number of octets corresponding to YYY bits and increments shall contain the IEEE values of YYY bits. If the IEEE values in all subsets are identical, NBINC=0 and R_1^0 shall contain the IEEE value. The IEEE values shall be represented as big endian IEEE floating point numbers.

ANNEX TO PARAGRAPH 3.1.4

PREOPERATIONAL

The proposal is for the group to agree on descriptors for the following to be used when exchanging GHRSST data:

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

Table 1. Proposed BUFR and CREX codes.

0 25 022 - GHRSST Rejection Flag

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

0 25 023 - GHRSST Confidence Flag

Bit No.	
1	Default confidence value has been used.
2	Default bias and standard deviation has been used.
3	Sun glint suspected
4	Sea ice retrieval for microwave data
5	High wind speed retrieval

6	Inaccurate SST due to low SST (< 285K). (Only applies to the TMI instrument).
7	Relaxed rain contamination suspected
8	Potential side lobe contamination
All 9	Missing value

0 25 024 – GHRSST proximity confidence.

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

0 01 028 - Aerosol optical Depth (AOD) source

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

0 01 024 - Wind Speed source

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

0 01 029 - SSI Source

Code figure	

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

0 01 038 - Source of Sea Ice Fraction

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

Table of Acronyms

Acronym	***Expansion***
AATSR	Advanced Along-Track Scanning Radiometer.
AMSR-E	Advanced Microwave Scanning Radiometer.
AOD	Aerosol optical depth.
BUFR	Binary Universal Form for the Representation of meteorological data.
CMS	Centre de Meteorologie Spatiale (Lannion, France).
CREX	Character form for the Representation and Exchange of meteorological and other data.
ECMWF	European Centre for Medium-range Weather Forecasts.
ERS	European Remote-sensing Satellite.
EUMETSAT	European organization for the exploitation of meteorological satellites.
GHRSST-PP	GODAE High Resolution Sea Surface Temperature Pilot Project.
GODAE	Global Ocean Data Assimilation Experiment.
GOES	Geostationary Operational Environment Satellite.
IR	Infra-red.
MERIS	Medium Resolution Imaging Spectrometer.
MSG	Meteosat Second Generation.
MW	Microwave.
NAAPS	Navy Aerosol Analysis and Prediction System.
NAVOCEANO	Naval Oceanographic Office (United States of America).
NCEP	National Centers for Environmental Prediction.
NESDIS	National Environmental Satellite, Data, and Information Service. (United States of America).
NWP	Numerical weather prediction.
OSI-SAF	Ocean and Sea Ice Satellite Applications Facility.
RF	Radio frequency.
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SSI	Surface Solar Irradiance.
TMI	Tropical Rainfall Measuring Mission (TRMM) Microwave Imager.

ANNEX TO PARAGRAPH 3.1.5
IN VALIDATION

"MERGED" BUFR TEMPLATE FOR SURFACE OBSERVATIONS FROM ONE-HOUR PERIOD AND FOR REPORTING SYNOP DATA IN BUFR (REVISED, JUNE 2006)

This template is proposed to be used for representation of surface observation data from both automatic stations and manned stations. This template is also suitable for SYNOP observation data, by including parameters covering periods longer than one hour.
Descriptors used by both templates are not marked.
Descriptors used from the SYNOP BUFR template TM 307080 are indicated by an asterisk *.
Descriptors used from the AWS BUFR template are indicated by an asterisk *.

3 01 090			**3 07 080**	**AWS**	**Surface station identification; time, horizontal and vertical co-ordinates**	
	3 01 004				**Surface station identification**	
		0 01 001			WMO block number	Numeric
		0 01 002			WMO station number	Numeric
		0 01 015			Station or site name	CCITT IA5
		0 02 001			Type of station	Code table
	3 01 011	0 04 001			Year	Year
		0 04 002			Month	Month
		0 04 003			Day	Day
	3 01 012	0 04 004			Hour	Hour
		0 04 005			Minute	Minute
	3 01 021	0 05 001			Latitude (high accuracy)	Degree, scale 5
		0 06 001			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 08 010					Surface qualifier (for temperature data)	Code table, 0
3 01 091				*	***Surface station instrumentation***	
	0 02 180			*	*Main present weather detecting system*	*Code table, 0*
	0 02 181			*	*Supplementary present weather sensor*	*Flag table, 0*
	0 02 182			*	*Visibility measurement system*	*Code table, 0*
	0 02 183			*	*Cloud detection system*	*Code table, 0*
	0 02 184			*	*Type of lightning detection sensor*	*Code table, 0*
	0 02 179			*	*Type of sky condition algorithm*	*Code table, 0*
	0 02 186			*	*Capability to detect precipitation phenomena*	*Flag table, 0*
	0 02 187			*	*Capability to detect other weather phenomena*	*Flag table, 0*
	0 02 188			*	*Capability to detect obscuration*	*Flag table, 0*
	0 02 189			*	*Capability to discriminate lightning strikes*	*Flag table, 0*
3 02 031					**Pressure data**	
	3 02 001	0 10 004			Pressure	Pa, scale –1
		0 10 051			Pressure reduced to mean sea level	Pa, scale –1
		0 10 061			3-hour pressure change	Pa, scale –1
		0 10 063			Characteristic of pressure tendency	Code table, 0
	0 10 062		*		*24-hour pressure change*	*Pa, –1*

					$p_{24}p_{24}p_{24}$	
	0 07 004				Pressure (standard level)	Pa, scale –1
	0 10 009				Geopotential height of the standard level	gpm, 0
3 02 072					**Temperature and humidity data**	
	0 07 032				Height of sensor above local ground	m, scale 2
	0 07 033			*	*Height of sensor above water surface*	*m, scale 1*
	0 12 101				Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 12 103				Dew-point temperature (scale 2)	K, scale 2
	0 13 003				Relative humidity	%, 0
1 01 005				*	*Replicate one descriptor five times*	
3 07 063	*0 07 061*			*	*Depth below land surface*	*m, scale 2*
	0 12 130			*	*Soil temperature (scale 2)*	*K, scale 2*
3 02 069					**Visibility data**	
	0 07 032				Height of sensor above local ground	m, scale 2
	0 07 033			*	*Height of sensor above water surface*	*m, scale 1*
	0 33 041			*	*Attribute of following value*	*Code table*
	0 20 001				Horizontal visibility	m, scale –1
0 07 032					Height of sensor above local ground *(set to missing to cancel the previous value)*	*m, scale 2*
0 07 033				*	*Height of sensor above water surface (set to missing to cancel the previous value)*	*m, scale 1*
0 20 031				*	*Ice deposit (thickness)*	*m, scale 2*
0 20 032				*	*Rate of ice accretion*	*Code table, 0*
0 02 038				*	*Method of sea surface temperature measurement*	*Code table*, 0
0 22 043				*	*Sea/water temperature (scale 2)*	*K, scale 2*
3 02 021	*0 22 001*			*	*Direction of waves*	*Degree true*
	0 22 011			*	*Period of waves*	*s, scale 0*
	0 22 021			*	*Height of waves*	*m, scale 1*
3 02 078					**State of ground and snow depth measurement**	
	0 02 176			*	*Method of state of ground measurement*	*Code table, 0*
	0 20 062				State of ground (with or without snow)	Code table, 0
	0 02 177			*	Method of snow depth measurement	Code table, 0
	0 13 013				Total snow depth	m, scale 2
0 12 113			*		*Ground minimum temperature (scale2), past 12 hours* ***$s_nT_gT_g$***	*K, scale2*
					Cloud data	
3 02 004	0 20 010				Cloud cover (total)	%, scale 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)*	*Code table, 0*

					C_H	
1 05 004				*	Replicate 5 descriptors four times	
0 08 002					Vertical significance	Code table, 0
0 20 011					Cloud amount	Code table, 0
0 20 012					Cloud type	Code table, 0
0 33 041				*	Attribute of following value	Code table, 0
0 20 013					Height of base of cloud	m, scale -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** $6D_LD_MD_H$	
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)	Code table, 0
	0 20 054		*		True direction from which clouds are moving $D_LD_MD_H$	Degree true, 0
0 08 002			*		Vertical significance (set to missing to cancel the previous value)	Code table, 0
			*		**Direction and elevation of cloud** $57CD_ae_C$	
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
					Present and past weather	
0 20 003					Present weather (See Note 3)	Code table, 0
1 03 002					Replicate 3 descriptors 2 times	
0 04 025					Time period (= - 60 minutes in the first replication, -x minutes in the second replication, corresponding to the duration of the period W1W2 in the SYNOP report)	Minute, 0
0 20 004					Past weather (1)	Code table, 0

0 20 005					Past weather (2)	Code table, 0
3 02 075				*	**Intensity of precipitation, size of precipitation element**	
	0 08 021			*	Time significance (= 2 (time averaged))	Code table, 0
	0 04 025			*	Time period (= - 10 minutes)	Minute, 0
	0 13 055			*	Intensity of precipitation	kg $m^{-2}s^{-1}$,scale 4
	0 13 058			*	Size of precipitation element	m, scale 4
	0 08 021			*	Time significance (= missing value)	Code table, 0
0 04 025				*	Time period (= - 10 minutes)	Minute, 0
3 02 076				*	Precipitation, obscuration and other phenomena	
	0 20 021			*	Type of precipitation	Flag table, 0
	0 20 022			*	Character of precipitation	Code table, 0
	0 26 020			*	Duration of precipitation (See Note 4)	Minute, 0
	0 20 023			*	Other weather phenomena	Flag table, 0
	0 20 024			*	Intensity of phenomena	Code table, 0
	0 20 025			*	Obscuration	Flag table, 0
	0 20 026			*	Character of obscuration	Code table, 0
0 04 025				*	Time period (= - 10 minutes)	Minute, 0
0 13 059				*	Number of flashes	Numeric, 0
					Wind data	
0 07 032					Height of sensor above local ground	m, scale 2
0 07 033					Height of sensor above water surface	m, scale 1
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, if any)	Minute, 0
0 11 001					Wind direction	Degree true, 0
0 11 002					Wind speed	m s^{-1}, scale 1
0 08 021					Time significance (= missing value)	Code table, 0
1 03 003					Replicate next 3 descriptors 3 times	
0 04 025			*		Time period (= - 10 minutes in the first replication, = - 60 minutes in the second replication = - 60*3 or 60*6 minutes in the third replication)	Minute, 0
0 11 043					Maximum wind gust direction	Degree true, 0
0 11 041					Maximum wind gust speed	m s^{-1}, scale 1
0 04 025				*	Time period (= - 10 minutes)	Minute, 0
0 11 016				*	Extreme counterclockwise wind direction of a variable wind	Degree true, 0
0 11 017				*	Extreme clockwise wind direction of a variable wind	Degree true, 0
					Extreme temperature data	
0 07 032					Height of sensor above local ground	m, scale 2
0 07 033				*	Height of sensor above water surface	m, scale 1
1 06 002					Replicate 6 descriptors 2 times	
0 04 024			*		Time period or displacement (= - 1 hour in the first replication, = - 12 or - 24 or – x hours in the	Hour, 0

					second replication)	
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	K, scale 2
0 04 024			*		Time period or displacement (= - 1 hour in the first replication, = - 12 or - 24 or – x hours in the second replication)	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	K, scale 2
0 07 032				*	Height of sensor above local ground (for ground temperature)	m, scale 2
0 04 025				*	Time period (= - 60 minutes)	Minute, 0
0 12 112				*	Minimum temperature (scale 2) at height and over period specified (for ground temperature)	K, scale 2
0 07 033				*	Height of sensor above water surface (set to missing to cancel the previous value)	m, scale 1
					Precipitation measurement	
0 07 032					Height of sensor above local ground	m, scale 2
0 02 175				*	Method of precipitation measurement	Code table, 0
0 02 178				*	Method of liquid water content measurement of precipitation	Code table, 0
1 02 004					Replicate 2 descriptors 4 times	
0 04 024					Time period in hours ***t_R*** (= - 1 hour in the first replication, = - 3, -6, -12 or - 24 hours in the next replications)	Hour, 0
0 13 011					Total precipitation / total water equivalent of snow	kg m^{-2}, scale 1
0 07 032					Height of sensor above local ground (set to missing to cancel the previous value)	m, scale 2
					Evaporation measurement	
0 02 185				*	Method of evaporation measurement	Code table, 0
1 01 002					Replicate 1 descriptor 2 times	
3 02 044	0 04 024		*		Time period in hours (= -1 hour in the first replication, = -24 hours in the second replication)	Hour, 0
	0 02 004		*		Type of instrument for evaporation measurement or type of crop	Code table, 0
	0 13 033				Evaporation /evapotranspiration	kg m^{-2}, scale 1
					Total sunshine data	
1 01 002			*		Replicate 1 descriptor 2 times	
3 02 039	0 04 024		*		Time period in hours (= -1 hour in the first replication, = -x hours in the second replication)	Hour, 0
	0 14 031				Total sunshine	Minute, 0

					Radiation data	
1 01 002			*		*Replicate 1 descriptor 2 times*	
3 02 045	*0 04 024*		*		*Time period in hours* *(= -1 hour in the first replication,* *= -24 hours in the second replication)*	Hour, 0
	0 14 002				*Long-wave radiation, integrated over period specified*	J m-2, scale -3
	0 14 004				*Short-wave radiation, integrated over period specified*	J m-2, scale -3
	0 14 016				*Net radiation, integrated over period specified*	J m-2, scale -4
	0 14 028				*Global solar radiation (high accuracy), integrated over period specified*	J m-2, scale -2
	0 14 029				*Diffuse solar radiation (high accuracy), integrated over period specified*	J m-2, scale -2
	0 14 030				*Direct solar radiation (high accuracy), integrated over period specified*	J m-2, scale -2
3 02 046			*		***Temperature change*** *gr.* $\mathbf{54g_0s_nd_T}$	
	0 04 024		*		*Time period or displacement*	Hour, 0
	0 04 024		*		*Time period or displacement (see Note 5)*	Hour, 0
	0 12 049		*		*Temperature change over period specified* s_nd_T	K, 0
3 02 083				*	*First order statistics of P, W, T, U data*	
	0 04 025			*	*Time period (= -10 minutes)*	Minute, 0
	0 08 023			*	*First order statistics* *(= 9 (best estimate of standard deviation)) (see Note 6)*	Code table, 0
	0 10 004			*	*Pressure*	Pa, scale –1
	0 11 001			*	*Wind direction*	Degree true, 0
	0 11 002			*	*Wind speed*	*m* s^{-1}*, scale 1*
	0 12 101			*	*Temperature/dry-bulb temperature (scale 2)*	K, scale 2
	0 13 003			*	*Relative humidity*	%, 0
	0 08 023			*	*First order statistics (= missing value)*	Code table, 0
0 33 005				*	*Quality information (AWS data)*	Flag table, 0
0 33 006				*	*Internal measurement status information (AWS)*	Code table, 0

Notes:

1) 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) Present weather shall be always represented by 0 20 003. When encoding present weather reported from an automatic weather station, the sequence of descriptors (proposed under 3 02 076) should be used, when applicable.

4) Duration of precipitation represents number of minutes in which precipitation was registered.

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

6) Best estimate of standard deviation is counted out of a set of samples (signal measurements) recorded within the period specified; it should be reported as a missing value, if the measurements of the relevant element are not available from a part of the period specified by 0 04 025.

Comments (written in June 2006 and the template modified accordingly):

1) Reporting of SYNOP Section 3 cloud data is mandatory if the data are available. The meaning of the question “Useful considering the following Cloud layers?” is not quite clear.
2) Present weather in the combined AWS-SYNOP template has to be always represented using code table 0 20 003.
3) Past weather data in the combined AWS-SYNOP template have to be able to represent not only past weather from the previous 1 hour, but also past weather from period required by Regulations 12.2.6.6.1 and 12.2.6.7.1 (B/C 1.10.1.7.1 and B/C 1.10.1.8.1). Using time period in hour would be preferable.
4) The time period for maximum and for minimum temperatures may differ, therefore the each of them has to be preceded by its own <0 04 024, 0 04 024>. Consequently, the proposed replication 1 04 002 should be 1 06 002.
5) The part of the template, marked in yellow, might be better replaced by 3 02 077 (the one-hour extreme temperatures) and 3 02 041 (SYNOP extreme temperatures).
6) Number of different required time periods, from which amount of precipitation is reported, shall never exceed 4, corresponding to t_R in the group 6 in Section 1, t_R in the group 6 in Section 3, 24 hours (group 7 in Section 3) and one hour from the AWS template. Therefore, *1 02 004* is sufficient.
7) Type of instrument for evaporation measurement or type of crop 0 02 004 is required for reporting SYNOP data in BUFR.
8) Radiation data are described by 1 descriptor 3 02 045. These data are required from one hour and 24 hour period. Therefore, 3 02 045 is to be replicated twice (not three times).
9) Cloud bases below station level, ice deposit, sea/water temperature and waves are parameters of instantaneous character and they cannot be placed at the end of the template. Additional parameters required by regional or national reporting practices shall be accommodated as described in B/C1 - Regulations for reporting SYNOP data in TDCF.
10) If this template is used only for transmission from the stations to the NMC, certain reduction is possible, e.g. 3 02 047 or 3 02 048 may be omitted from the template in not needed.
11) It is to be considered that nominal values are required for some variables from the AWS template.

ANNEX TO PARAGRAPH 3.1.6

FOR VALIDATION

Proposed new descriptors

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 01 101	State identifier	Code table	0	0	10	Code table	0	3
0 01 102	National station number	Numeric	0	0	20	Numeric	0	6

Table reference	Table reference	Element name
3 01 089		*National station identification*
	0 01 101	State identifier
	0 01 102	National station number

Table reference	Table reference	Element name
3 07 091	*See below*	*AWS BUFR template for surface observations from one-hour period with national and WMO station identification*
3 07 092		*AWS BUFR template for surface observations from n-minute period with national and WMO station identification*
3 07 093	*See below*	*Nominal values*

AWS BUFR template for surface observations from one-hour period

Sequence descriptor 3 07 091 is proposed to be used for representation of AWS BUFR template for surface observations from one-hour period with national and WMO station identification.

This template shall be used for representation of surface observation data from automatic and manned stations using the national numbering system. The WMO international identification 0 01 001 (WMO block nu mber) and 0 01 002 (WMO station number) shall be reported if available for the particular station. The text written in blue corresponds to the proposal for the representation of national station numbers.

If the national numbering system has not yet been introduced by the WMO Member State, the existing AWS template for surface observations from one-hour period, available at:
http://www.wmo.int/web/www/WMOCodes/MigrationTDCF/ExamplesotherTemplates.htm
may be used until the national identification system is implemented.

Extensive usage of short delayed replications has been introduced to allow reduction of the message volume. The entries written in red would allow to reduce the volume of the BUFR message, especially in case of stations with limited instrumentation.

TM 307091

			Unit, scale
3 01 089		National station identification	
	0 01 101	State identifier [(1)]	Code table, 0
	0 01 102	National stationnumber [(1)]	Numeric, 0
3 01 090		Fixed surface station identification; time, horizontal and vertical co-ordinates	
	3 01 004	Surface station identification	
		WMO block number[(1)]	Numeric, 0
		WMO station number[(1)]	Numeric, 0
		Station or site name	CCITT IA5, 0
		Type of station	Code table, 0
	3 01 011	Year[(2)]	Year, 0
		Month[(2)]	Month, 0
		Day[(2)]	Day, 0
	3 01 012	Hour[(2)]	Hour, 0
		Minute[(2)]	Minute, 0
	3 01 021	Latitude (high accuracy)	Degree, 5
		Longitude (high accuracy)	Degree, 5
	0 07 030	Height of station ground above mean sea level	m, 1
	0 07 031	Height of barometer above mean sea level	m, 1
0 08 010		Surface qualifier (for temperature data)	Code table, 0
3 01 091		Surface station instrumentation	
	0 02 180	Main present weather detecting system	Code table, 0
	0 02 181	Supplementary present weather sensor	Flag table, 0
	0 02 182	Visibility measurement system	Code table, 0
	0 02 183	Cloud detection system	Code table, 0
	0 02 184	Type of lightning detection sensor	Code table, 0
	0 02 179	Type of sky condition algorithm	Code table, 0
	0 02 186	Capability to detect precipitation phenomena	Flag table, 0
	0 02 187	Capability to detect other weather phenomena	Flag table, 0
	0 02 188	Capability to detect obscuration	Flag table, 0
	0 02 189	Capability to discriminate lightning strikes	Flag table, 0
3 02 001	0 10 004	Pressure	Pa, –1
	0 10 051	Pressure reduced to mean sea level	Pa, –1
	0 10 061	3-hour pressure change[(3)]	Pa, –1
	0 10 063	Characteristic of pressure tendency[(3)]	Code table, 0
0 07 004		Pressure (standard level)	Pa, –1
0 10 009		Geopotential height of the standard level	gpm, 0
3 02 072		Temperature and humidity data	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, 2
	0 12 103	Dew-point temperature (scale 2)	K, 2
	0 13 003	Relative humidity	%, 0
1 02 000		Delayed replication of 2 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
1 01 005		Replicate one descriptor five times	
3 07 063	0 07 061	Depth below land surface	m, 2
	0 12 130	Soil temperature (scale 2)	K, 2
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0

3 02 069		Visibility data	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 33 041	Attribute of following value	Code table, 0
	0 20 001	Horizontal visibility	m, –1
0 07 032		***Height of sensor above local ground*** (set to missing to cancel the previous value)	m, 2
0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
1 05 000		Delayed replication of 5 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 20 031		Ice deposit (thickness)	m, 2
0 20 032		Rate of ice accretion	Code table, 0
0 02 038		Method of sea surface temperature measurement	Code table, 0
0 22 043		Sea/water temperature (scale 2)	K, 2
3 02 021	0 22 001	Direction of waves	Degree true, 0
	0 22 011	Period of waves	s, 0
	0 22 021	Height of waves	m, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 078		State of ground and snow depth measurement	
	0 02 176	Method of state of ground measurement	Code table, 0
	0 20 062	State of ground (with or without snow)	Code table, 0
	0 02 177	Method of snow depth measurement	Code table, 0
	0 13 013	Total snow depth	m, 2
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 073		Cloud data	
	0 20 010	Cloud cover (total)	%, 0
	1 05 004	Replicate 5 descriptors four times	
	0 08 002	Vertical significance	Code table, 0
	0 20 011	Cloud amount	Code table, 0
	0 20 012	Cloud type	Code table, 0
	0 33 041	Attribute of following value	Code table, 0
	0 20 013	Height of base of cloud	m, -1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 074		Present and past weather	
	0 20 003	Present weather(4)	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 20 004	Past weather (1) (4)	Code table, 0
	0 20 005	Past weather (2) (4)	Code table, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 075		Intensity of precipitation, size of precipitation element	
	0 08 021	Time significance (= 2 (time averaged))	Code table, 0
	0 04 025	Time period (= - 10 minutes)	Minute, 0
	0 13 055	Intensity of precipitation	Kg $m^{-2} s^{-1}$, 4
	0 13 058	Size of precipitation element	m, 4
	0 08 021	Time significance (= missing value)	Code table, 0
1 02 000		Delayed replication of 2 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 04 025		Time period (= - 10 minutes)	Minute, 0

3 02 076		Precipitation, obscuration and other phenomena	
	0 20 021	Type of precipitation	Flag table, 0
	0 20 022	Character of precipitation	**Code table, 0**
	0 26 020	Duration of precipitation (5)	Minute, 0
	0 20 023	Other weather phenomena	Flag table, 0
	0 20 024	Intensity of phenomena	Code table, 0
	0 20 025	Obscuration	Flag table, 0
	0 20 026	Character of obscuration	Code table, 0
3 02 071		Wind data from one-hour period	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	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, if any)	Minute, 0
	0 11 001	Wind direction	Degree true, 0
	0 11 002	Wind speed	$m\ s^{-1}$, 1
	0 08 021	Time significance (= missing value)	Code table, 0
	1 03 002	Replicate next 3 descriptors 2 times	
	0 04 025	Time period (= - 10 minutes in the first replication, = - 60 minutes in the second replication)	Minute, 0
	0 11 043	Maximum wind gust direction	Degree true, 0
	0 11 041	Maximum wind gust speed	$m\ s^{-1}$, 1
	0 04 025	Time period (= - 10 minutes)	Minute, 0
	0 11 016	Extreme counterclockwise wind direction of a variable wind	Degree true, 0
	0 11 017	Extreme clockwise wind direction of a variable wind	Degree true, 0
3 02 077		Extreme temperature data	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 12 111	Maximum temperature (scale 2) at height and over period specified	K, 2
	0 12 112	Minimum temperature (scale 2) at height and over period specified	K, 2
	0 07 032	Height of sensor above local ground (for ground temperature)	m, 2
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 12 112	Minimum temperature (scale 2) at height and over period specified (for ground temperature)	K, 2
0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 079		Precipitation measurement	
	0 07 032	Height of sensor above local ground	m, 2
	0 02 175	Method of precipitation measurement	Code table, 0
	0 02 178	Method of liquid water content measurement of precipitation	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 13 011	Total precipitation / total water equivalent of snow	$kg\ m^{-2}$, 1
0 07 032		***Height of sensor above local ground*** (set to missing to cancel the previous value)	m, 2
1 01 000		Delayed replication of 1 descriptor	

0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 080		Evaporation measurement	
	0 02 185	Method of evaporation measurement	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 13 033	Evaporation /evapotranspiration	kg m^{-2}, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 081		Total sunshine data	
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 14 031	Total sunshine	Minute, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 082		Radiation data	
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 14 002	Long-wave radiation, integrated over period specified	J m^{-2}, -3
	0 14 004	Short-wave radiation, integrated over period specified	J m^{-2}, -3
	0 14 016	Net radiation, integrated over period specified	J m^{-2}, -4
	0 14 028	Global solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
	0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
	0 14 030	Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
1 02 000		Delayed replication of 2 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 04 025		Time period (= - 10 minutes)	Minute, 0
0 13 059		Number of flashes	Numeric, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 083		First order statistics of P, W, T, U data	
	0 04 025	Time period (= -10 minutes)	Minute, 0
	0 08 023	First order statistics (= 9 (best estimate of standard deviation)) (6)	Code table, 0
	0 10 004	Pressure	Pa, –1
	0 11 001	Wind direction	Degree true, 0
	0 11 002	Wind speed	m s^{-1}, 1
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 13 003	Relative humidity	%, 0
	0 08 023	First order statistics (= missing value)	Code table, 0
0 33 005		Quality information (AWS data)	Flag table, 0
0 33 006		Internal measurement status information (AWS)	Code table, 0

Notes:

(1) 0 01 101 (State identifier) and 0 01 102 (National station number) shall be used to identify a station within the national numbering system that is completely independent of the WMO international numbering system. The WMO international identification 0 01 001 (WMO block number) and 0 01 002 (WMO station number) shall be reported if available for the particular station.

(2) The time identification refers to the end of the one-hour period.

(3) 0 10 061 (3-hour pressure change) and 0 10 063 (Characteristic of pressure tendency) are included in this template, although they refer to 3-hour period preceding the time of observation.

(4) Present weather may be represented only by 0 20 003, especially if reported from a manned non-automated station. When encoding present weather reported from an automatic weather station, the sequence of descriptors (proposed under 3 02 076) should be used, if applicable.

(5) Duration of precipitation (in minutes) represents number of minutes in which any precipitation was registered.

(6) Best estimate of standard deviation is counted out of a set of samples (signal measurements) recorded within the period specified; it should be reported as a missing value, if the measurements of the relevant element are not available from a part of the period specified by 0 04 025.

(7) If reporting nominal values is required, the template shall be supplemented with 3 07 093.

If reporting nominal values is required, the template TM 307091 or TM 307092 shall be supplemented with the following sequence:

3 07 093		**Nominal values**	
	2 23 000	Substituted values operator	
	2 36 000	Backward reference bit map	
	1 01 000	Delayed replication of 1 descriptor	
	0 31 001	Delayed descriptor replication factor = number of element descriptors	Numeric, 0
	0 31 031	Data present indicator	Numeric, 0
	0 01 033	Indication of originating/generating center	Code table, 0
	0 01 032	Generating application	Code table, 0
	0 08 083	Nominal value indicator	Flag table, 0
	1 01 000	Delayed replication of 1 descriptor	
	0 31 001	Delayed descriptor replication factor	Numeric, 0
	2 23 255	Substituted values	
	1 08 000	Delayed replication of 1 descriptor	
	0 31 001	Delayed descriptor replication factor	Numeric, 0
	2 23 000	Substituted values operator	
	2 37 000	Use previously defined bit map	
	0 01 033	Indication of originating/generating center	Code table, 0
	0 01 032	Generating application	Code table, 0
	0 08 083	Nominal value indicator	Flag table, 0
	1 01 000	Delayed replication of 1 descriptor	
	0 31 001	Delayed descriptor replication factor	Numeric, 0
	2 23 255	Substituted values	

ANNEX

Code Table 0 01 101

State identifier

Code figure	
0-99	Reserved
100	Algeria
101	Angola
102	Benin
103	Botswana
104	Burkina Faso
105	Burundi
106	Cameroon
107	Cape Verde
108	Central African Republic
109	Chad
110	Comoros
111	Congo
112	Cote d'Ivoire
113	Democratic Republic of the Congo
114	Djibouti
115	Egypt
116	Eritrea
117	Ethiopia
118	France (RA I)
119	Gabon
120	Gambia
121	Ghana
122	Guinea
123	Guinea-Bissau
124	Kenya
125	Lesotho
126	Liberia
127	Libyan Arab Jamahiriya
128	Madagascar
129	Malawi
130	Mali
131	Mauritania
132	Mauritius
133	Morocco
134	Mozambique
135	Namibia
136	Niger
137	Nigeria
138	Portugal (RA I)
139	Rwanda
140	Sao Tom and Prince
141	Senegal
142	Seychelles
143	Sierra Leone

144	Somalia
145	South Africa
146	Spain
147	Sudan
148	Swaziland
149	Togo
150	Tunisia
151	Uganda
152	United Kingdom of Great Britain and Northern Ireland (RA I)
153	United Republic of Tanzania
154	Zambia
155	Zimbabwe
156 -199	Reserved for Region I (Africa)
200	Afghanistan
201	Bahrain
202	Bangladesh
203	Bhutan
204	Cambodia
205	China
206	Democratic People's Republic of Korea
207	Hong Kong, China
208	India
209	Iran, Islamic Republic of
210	Iraq
211	Japan
212	Kazakhstan
213	Kuwait
214	Kyrgyz Republic
215	Lao People's Democratic Republic
216	Macao, China
217	Maldives
218	Mongolia
219	Myanmar
220	Nepal
221	Oman
222	Pakistan
223	Qatar
224	Republic of Korea
225	Republic of Yemen
226	Russian Federation (RA II)
227	Saudi Arabia
228	Sri Lanka
229	Tajikistan
230	Thailand
231	Turkmenistan
232	United Arab Emirates
233	Uzbekistan
234	Viet Nam, Socialist Republic of
235 -299	Reserved for Region II (Asia)
300	Argentina
301	Bolivia
302	Brazil

303	Chile
304	Colombia
305	Ecuador
306	France
307	Guyana
308	Paraguay
309	Peru
310	Suriname
311	Uruguay
312	Venezuela
313 -399	Reserved for Region III (South America)
400	Antigua and Barbuda
401	Bahamas
402	Barbados
403	Belize
404	British Caribbean Territories
405	Canada
406	Colombia
407	Costa Rica
408	Cuba
409	Dominica
410	Dominican Republic
411	El Salvador
412	France (RA IV)
413	Guatemala
414	Haiti
415	Honduras
416	Jamaica
417	Mexico
418	Netherlands Antilles and Aruba
419	Nicaragua
420	Panama
421	Saint Lucia
422	Trinidad and Tobago
423	United Kingdom of Great Britain and Northern Ireland (RA IV)
424	United States of America (RA IV)
425	Venezuela
426 - 499	Reserved for Region IV (North America, Central America and the Caribbean)
500	Australia
501	Brunei Darussalam
502	Cook Islands
503	Fiji
504	French Polynesia
505	Indonesia
506	Kiribati
507	Malaysia
508	Micronesia, Federated States of
509	New Caledonia
510	New Zealand
511	Niue
512	Papua New Guinea

513	Philippines
514	Samoa
515	Singapore
516	Solomon Islands
517	Tonga
518	United Kingdom of Great Britain and Northern Ireland (RA V)
519	United States of America (RA V)
520	Vanuatu
521 – 599	Reserved for Region V (South-West Pacific)
600	Albania
601	Armenia
602	Austria
603	Azerbaijan
604	Belarus
605	Belgium
606	Bosnia and Herzegovina
607	Bulgaria
608	Croatia
609	Cyprus
610	Czech Republic
611	Denmark
612	Estonia
613	Finland
614	France (RA VI)
615	Georgia
616	Germany
617	Greece
618	Hungary
619	Iceland
620	Ireland
621	Israel
622	Italy
623	Jordan
624	Kazakhstan
625	Latvia
626	Lebanon
627	Lithuania
628	Luxembourg
629	Malta
630	Monaco
631	Montenegro
632	Netherlands
633	Norway
634	Poland
635	Portugal (RA VI)
636	Republic of Moldova
637	Romania
638	Russian Federation (RA VI)
639	Serbia
640	Slovakia
641	Slovenia
642	Spain
643	Sweden

644	Switzerland
645	Syrian Arab Republic
646	The Former Yugoslav Republic of Macedonia
647	Turkey
648	Ukraine
649	United Kingdom of Great Britain and Northern Ireland (RA VI)
650 - 699	Reserved for Region VI (Europe)
700 – 799	Reserved for Nations in Antartica
800 - 999	Reserved
1000 – 1022	Not used
1023	Missing value

ANNEX TO PARAGRAPH 3.1.7
PREOPERATIONAL

TM D07089 - Template for synoptic reports from fixed land stations suitable for SYNOP data manually encoded in CREX

D 07 089		**Sequence for representation of synoptic reports from a fixed land station suitable for SYNOP data manually encoded in CREX**
	D 07 087	“Instantaneous” parameters of sequence D07089
	D 07 088	“Period” parameters of sequence D07089

Notes:

(1) “Instantaneous” parameter is a parameter that is not coupled to a time period descriptor, e.g. B04024.

(2) “Period” parameter is a parameter that is coupled to a time period descriptor, e.g. B04024.

This CREX template for synoptic reports from fixed land stations further expands as follows:

D 07 087			**“Instantaneous” parameters of sequence D07089**		
			Surface station identification, time, horizontal and vertical coordinates		**in CREX**
	D 01 001	B 01 001	WMO block number	**II**	Numeric, 0, 2
		B 01 002	WMO station number	**iii**	Numeric, 0, 3
	B 02 001		Type of station	**(i_x)**	Code table, 0, 1
	D 01 011	B 04 001	Year		Year, 0, 4
		B 04 002	Month		Month, 0, 2
		B 04 003	Day	**YY**	Day, 0, 2
	D 01 012	B 04 004	Hour	**GG**	Hour, 0, 2
		B 04 005	Minute	**gg**	Minute, 0, 2
	D 01 023	B 05 002	Latitude (course accuracy)		Degree, 2, 4
		B 06 002	Longitude (course accuracy)		Degree, 2, 5
	B 07 030		Height of station ground above msl		m, 1, 5
	B 07 031		Height of barometer above msl		m, 1, 5
			Pressure data		
	D 02 001	B 10 004	Pressure	**$P_oP_oP_oP_o$**	Pa, –1, 5
		B 10 051	Pressure reduced to mean sea level	**PPPP**	Pa, –1, 5
		B 10 061	3-hour pressure change	**ppp**	Pa, –1, 4
		B 10 063	Characteristic of pressure tendency	**a**	Code table, 0, 2
	B 10 062		24-hour pressure change	**$p_{24}p_{24}p_{24}$**	Pa, –1, 4
	B 07 004		Pressure (standard level) = 925, 850, 700, ..hPa = missing for lowland stations	**a_3**	Pa, –1, 5
	B 10 009		Geopotential height of the standard level = missing for lowland stations	**hhh**	gpm, 0, 5
			Temperature and humidity		
	B 07 032		Height of sensor above local ground (for temperature measurement)		m, 2, 5
	B 12 101		Temperature/dry-bulb temperature (sc. 2)	**s_nTTT**	°C, 2, 4
	B 12 103		Dew-point temperature (sc. 2)	**$s_nT_dT_dT_d$**	°C, 2, 4
	B 13 003		Relative humidity		%, 0, 3
	B 07 032		Height of sensor above local ground (set to missing to cancel the previous value)		m, 2, 5
			Visibility		

	B 20 001		Horizontal visibility **VV**	m, –1, 4
			Cloud data	
	D 02 004	B 20 010	Cloud cover (total) **N** If N = 9, then B 20 010 = 113 %, if N = /, then B 20 010 = missing.	%, 0, 3
		B 08 002	Vertical significance if C_L are observed, then B 08 002 = 7 (low cloud), if C_L are not observed and C_M are observed, then B 08 002 = 8 (middle cloud), if only C_H are observed, B 08 002 = 0, if N = 9, then B 08 002 = 5, if N = 0, then B 08 002 = 62, if N = /, then B 08 002 = missing.	Code table, 0, 2
		B 20 011	Cloud amount (of low or middle clouds) **N_h** If N = 0, then B 20 011 = 0, if N = 9, then B 20 011 = 9, if N = /, then B 20 011 = missing.	Code table, 0, 2
		B 20 013	Height of base of cloud **h** If N = 0 or /, then B 20 013 = missing.	m, –1, 4
		B 20 012	Cloud type (low clouds) **C_L** B 20 012 = C_L + 30, if N = 0, then B 20 012 = 30, if N = 9 or /, then B 20 012 = 62.	Code table, 0, 2
		B 20 012	Cloud type (middle clouds) **C_M** B 20 012 = C_M + 20, if N = 0, then B 20 012 = 20, if N = 9 or / or C_M = /, then B 20 012 = 61.	Code table, 0, 2
		B 20 012	Cloud type (high clouds) **C_H** 0 20 012 = C_H + 10, if N = 0, then B 20 012 = 10, if N = 9 or / or C_H = /, then B 20 012 = 60.	Code table, 0, 2
	R 01 000		Delayed replication of the next 1 descriptor	
	D 02 005	B 08 002	Vertical significance In any Cb layer, B 08 002 = 4 , else: in the first replication: if N = 9, then B 08 002 = 5, if N = /, then B 08 002 = missing, else B 08 002 = 1; in the other replications B 08 002 = 2, 3, 4**.**	Code table, 0, 2
		B 20 011	Cloud amount **N_s** In the first replication: If N = /, then B 20 011 = missing, else B 20 011 = **N_s**; in the other replications B 20 011 = **N_s**.	Code table, 0, 2
		B 20 012	Cloud type **C** if N = 9 or /, then B 20 012 = missing, else B 20 012 = **C**.	Code table, 0, 2
		B 20 013	Height of base of cloud **h_sh_s**	m, -1, 4
D 07 088			**“Period” parameters of sequence D 07 089**	
			Present and past weather	
	B 20 003		Present weather **ww**	Code table, 0, 3
	B 04 024		Time period At 00, 06, 12, 18 UTC **= - 6.** At 03, 09,15, 21 UTC **= - 3.**	Hour, 0, 4

	B 20 004		Past weather (1) **W_1**	Code table, 0, 2
	B 20 005		Past weather (2) **W_2**	Code table, 0, 2
			Evaporation	
	B 04 024		Time period in hours **= - 24**	Hour, 0, 4
	B 02 004		Type of instrument for evaporation or crop type for evapotranspiration **i_E**	Code table, 0, 2
	B 13 033		Evaporation /evapotranspiration **EEE**	kg m^{-2}, 1, 4
			Sunshine	
	R 02 002		Replicate next 2 descriptors 2 times	
	B 04 024		Time period in hours In the first replication **= - 24,** in the second replication **= - 1.**	Hour, 0, 4
	B 14 031		Total sunshine in minutes In the first replication **SSS** in the second replication **SS**	Minute, 0, 4
			Precipitation	
	R 02 002		Replicate next 2 descriptors 2 times	
	B 04 024		Time period in hours **t_R**	Hour, 0, 4
	B 13 011		Total precipitation **RRR** no precipitation = 0 trace = - 0.1	kg m^{-2}, 1, 5 Encoded as: -00001
			Extreme temperatures	
	B 07 032		Height of sensor above local ground (for temperature measurement)	m, 2, 5
	B 04 024		Time period in hours **= - 12**	Hour, 0, 4
	B 12 111		Maximum temperature at height and over period specified **$s_nT_xT_xT_x$**	°C, 2, 4
	B 04 024		Time period in hours **= - 12**	Hour, 0, 4
	B 12 112		Minimum temperature at height and over period specified **$s_nT_nT_nT_n$**	°C, 2, 4
			Wind data	
	B 07 032		Height of sensor above local ground (for wind measurement)	m, 2, 5
	B 02 002		Type for instrumentation for wind measurement **i_w**	Flag table, 0, 2
	B 08 021		Time significance **= 2** (time averaged)	Code table, 0, 2
	B 04 025		Time period **= - 10** (or number of minutes after a significant change of wind, if any)	Minute, 0, 4
	B 11 001		Wind direction **dd** If dd = 00 (calm) or dd = 99 (variable), B 11 001 = 0.	Degree true, 0, 3
	B 11 002		Wind speed **ff**	m s^{-1}, 1, 4
	B 08 021		Time significance (set to **missing** to cancel the previous value)	Code table, 0, 2

Notes:

(1) CREX Edition 1 is recommended for manual encoding of data.

(2) If the addition of another "instantaneous" parameter is required, the sequence descriptor D07089 shall be replaced by D07087 D07088, and the B-descriptor for this parameter shall be placed between D07087 and D07088.

(3) If the addition of another "period" parameter is required, the sequence D 07 089 shall be supplemented by the relevant B-descriptor provided no additional "instantaneous" parameter is needed.

Example

CREX++

T000103 A000 D07089++

63 894 1 2006 02 22 06 00 -0687 03920 00552 00564 10062 10122 //// // 0000 ///// ///// 00125 2900 2320 071 ///// 2500 038 07 03 0073 31 20 10 0001 01 03 08 0073 005 -0006 00 00 -0024 01 0085 -0024 0690 -0001 0060 -0024 00000 //// ///// 00125 //// //// -0012 2210 01000 14 02 -0010 060 0025 //++
7777

Example with optional check digits:

CREX++

T000103 A000 D07089 E++

063 1894 21 32006 402 522 606 700 8-0687 903920 000552 100564 210062 310122 4//// 5// 60000 7///// 8///// 900125 02900 12320 2071 3///// 42500 5038 607 703 80073 931 020 110 20001 301 403 508 60073 7005 8-0006 900 000 1-0024 201 30085 4-0024 50690 6-0001 70060 8-0024 900000 0//// 1///// 200125 3//// 4//// 5-0012 62210 701000 814 902 0-0010 1060 20025 3//++
7777

ANNEX TO PARAGRAPH 3.1.8
FOR VALIDATION

Proposal for a new Code table

Among the required instrumentation entries in the original proposal, there was a request for a new code table for "Geopotential height calculation". If this parameter is validated and becomes preoperational, it should be included also in the ANNEX II to B/C25 Regulations for reporting TEMP, TEMP SHIP and TEMP MOBIL data in TDCF.

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 02 191	Geopotential height calculation	Code table	0	0	4	Code table	0	2

Code table 0 02 191
Geopotential height calculation

Code figure	
0	Reserved
1	Geopotential height calculated from pressure
2	Geopotential height calculated from GPS Height
3 - 14	Reserved
15	Missing value

EUCOS template for representation of radiosonde data with geopotential height as the vertical coordinate (to be validated)

This template is suitable for representation of high resolution radiosonde data with geopotential height as the vertical coordinate, the vertical resolution being limited by the length of BUFR message.

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
0 25 061		Software identification and version number	CCITT IA5
0 01 081		Radiosonde serial number	CCITT IA5
0 01 082		Radiosonde ascension number	Numeric
0 02 067		Radiosonde operating frequency	Hz, scale -5
0 02 095		Type of pressure sensor	Code table
0 02 096		Type of temperature sensor	Code table
0 02 097		Type of humidity sensor	Code table
0 02 081		Type of balloon	Code table
0 02 082		Weight of balloon	kg, scale 3
0 02 084		Type of gas used in balloon	Code table
0 02 191		**Geopotential height calculation**	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
		Surface station measurements	
0 10 004		Pressure	Pa, scale –1
3 02 032	0 07 032	Height of sensor above local ground (for temperature measurement)	m, scale 2
	0 12 101	Temperature/dry-bulb temperature(scale 2)	K, scale 2
	0 12 103	Dew-point temperature (scale 2)	K, scale 2
	0 13 003	Relative humidity	%
0 07 032		Height of sensor above local ground (for wind measurement)	m, scale 2
0 02 002		Type of instrumentation for wind measurement	Flag table
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}, scale 1
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, scale 2
0 20 003		Present weather	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, relative humidity and wind data at height levels	
1 01 000		Delayed replication of 1 descriptor	
0 31 002		Extended delayed descriptor replication factor	Numeric
3 03 055		**Temperature, dew-point, relative humidity and wind data at a height level with radiosonde position**	
	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 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 13 009	**Relative humidity (see Note 4)**	%, scale 1
	0 12 103	Dew-point temperature (scale 2) (see Note 4)	K, scale 2
	0 11 001	Wind direction	Degree true

	0 11 002	Wind speed	m s^{-1}, scale 1

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

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

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

(4) If the radiosonde is equipped with a relative humidity sensor, 0 13 009 shall be reported as mandatory and dew-point temperature may be included as a derived value. If the radiosonde is equipped with a dew-point temperature sensor, 0 12 103 shall be reported and 0 13 009 shall be set to a missing value.

ANNEX TO PARAGRAPH 3.1.9
PREOPERATIONAL

Proposal for modification of B-descriptors for representation of visibility

Newly proposed B-descriptors for prevailing and minimum horizontal visibility with a Note to be added under Class 20:

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 20 060	Prevailing horizontal visibility (5)	m	-1	0	10	m	-1	4
0 20 059	Minimum horizontal visibility	m	-1	0	9	m	-1	3

(5) A prevailing visibility value of 10000 m before scaling (after scaling 1000) shall be used to report prevailing visibility 10 km or more.

Unambiguous conversion from TDCF data to TAC data

Unambiguous conversion from TDCF data to TAC data is requested by ICAO as well as by many end users, it is proposed to add two notes under the BUFR Table D, Category 7:

Notes:

(x) Within 3 07 045, 3 07 048 and 3 07 053, wind speed shall be reported in the same units as in the original TAC data and:
0 11 083 shall be set to missing, if wind speed is reported in knots or m s^{-1} in TAC data,
0 11 084 shall be set to missing, if wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

(y) Within 3 07 045, 3 07 048 and 3 07 053, maximum wind speed (gusts) shall be reported in the same units as in the original TAC data and:
0 11 085 shall be set to missing, if maximum wind speed is reported in knots or m s^{-1} in TAC data,
0 11 086 shall be set to missing, if maximum wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

Following the Notes (x) an (y), the wind speed (and the maximum wind speed) will be reported only in meters per second in the BUFR message if these parameters are reported in meters per second in the original TAC data.

Below are the METAR/SPECI/TAF templates and BUFR/CREX B and D descriptors with the proposed modifications, corrections and additions written in blue. It should replace the current file in the WMO Server.

NEW PROPOSED METAR/SPECI AND TAF TEMPLATES

Proposed additions to BUFR Table D

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
		(Main part of METAR/SPECI), replacing 3 07 011	
3 07 045	0 01 063	ICAO location indicator	CCCC
	0 08 079	Aviation product status (routine, special)	**METAR SPECI COR**
	0 02 001	Type of station	(**AUTO**)
	3 01 011	Year, month, day	YY
	3 01 012	Hour, minute	GGgg
	3 01 024	Latitude-longitude (coarse accuracy), height of station	
	0 07 032	Height of sensor above local ground = 10m	
	0 11 001	Wind direction	ddd
	0 11 016	Extreme counterclockwise wind direction of a variable wind	$d_nd_nd_n$
	0 11 017	Extreme clockwise wind direction of a variable wind	$d_xd_xd_x$
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 002	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = 2m	
	0 12 023	Temperature (Celsius)	T´T´
	0 12 024	Dew point (Celsius)	$T'_dT'_d$
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
	0 10 052	Altimeter setting (QNH)	**Q**$P_HP_HP_HP_H$
	0 20 009	General Weather Indicator TAF/METAR	**CAVOK**
		(METAR/SPECI visibility)	
3 07 046	0 20 060	Prevailing visibility	VVVV or VVVV**NDV**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replication (up to 2)	
	0 05 021	Bearing or azimuth (direction of minimum visibility observed)	D_v
	0 20 059	Minimum visibility	$V_NV_NV_NV_N$
		(METAR/SPECI/TAF clouds), replacing 3 07 015	
3 07 047	1 05 000	Delayed replication of 5 descriptor	
	0 31 001	Number of replications	
	0 08 002	Vertical significance	
	0 20 011	Cloud amount	$N_sN_sN_s$
	0 20 012	Cloud type	CC
	0 20 013	Height of base of cloud (m)	$h_sh_sh_s$
	0 20 092	Height of base of cloud (feet)	$h_sh_sh_s$
	0 20 002	Vertical visibility (m)	**VV**$h_sh_sh_s$
	0 20 091	Vertical visibility (feet)	**VV**$h_sh_sh_s$

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
		(Trend type forecast), replacing 3 07 018	
3 07 048	0 08 016	Change qualifier for trend type forecast	TTTTT **NOSIG**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replications (0, 1 or 2)	
	0 08 017	Qualifier for time of forecast change	TT
	3 01 012	Time of change	GGgg
	1 12 000	Delayed replication of twelve descriptors	
	0 31 000	Short delayed replication count (0 or 1)	
	0 07 032	Height of sensor above local ground = 10m	
	0 11 001	Wind direction	ddd
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 002	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
	0 20 009	General weather indicator	**CAVOK NSW NSC SKC**
	1 01 000	Delayed replication of one descriptor	
	0 31 000	Short delayed replication count (0 or 1)	
	0 20 060	Prevailing visibility	VVVV
	3 07 014	Weather intensity and phenomena	w'w'
	3 07 047	METAR/SPECI/TAF clouds	$N_sN_sN_sh_sh_sh_s$
		(Sea conditions WT_sT_s/SS')	
3 07 049	1 02 000	Delayed replication of 2 descriptors	
	0 31 000	Short delayed replication factor (0 or 1)	
	0 22 043	Sea/water temperature	T_sT_s
	0 22 021	Height of waves	S'
		(Runway state $R_RR_RE_RE_RC_Re_Re_RB_RB_R$)	
3 07 050	1 01 000	Delayed replication of one descriptor	
	0 31 000	Short delayed replication factor (0 or 1)	
	0 20 085	General condition of runway	**SNOCLO**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replications	
	0 01 064	Runway designator	R_RR_R
	0 20 085	General condition of runway	**CLRD//**
	1 05 000	Delayed replication of 5 descriptors	
	0 31 001	Number of replications	
	0 01 064	Runway designator	R_RR_R
	0 20 086	Runway deposits	E_R
	0 20 087	Runway contamination	C_R
	0 20 088	Depth of runway deposits	e_Re_R
	0 20 089	Runway friction coefficient	B_RB_R
		(Full METAR/SPECI), replacing 3 07 021	
3 07 051	3 07 045	Main part of METAR/SPECI data	

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
	3 07 046	Visibility	VVVV or VVVV**NDV** $V_NV_NV_NV_ND_v$
	3 07 013	Runway visual range	**R**$D_RD_RV_RV_RV_RV_R$
	3 07 014	Weather intensity and phenomena	w'w'
	3 07 047	Clouds	$N_sN_sN_sh_sh_sh_s$
	3 07 016	Recent weather phenomena	**RE**w'w'
	3 07 017	Runway shear	**WS RWY**D_RD_R
	3 07 049	Sea conditions	**W**T_sT_s/SS'
	3 07 050	Runway state	$R_RR_RE_RC_Re_Re_RB_RB_R$
	1 01 000	Delayed replication of one descriptor	
	0 31 001	Replication count (0 to 3 normally)	
	3 07 048	Trend type forecast	
		(Aerodrome forecast identification and time interval)	
3 07 052	0 01 063	ICAO location identifier	CCCC
	0 08 039	Time significance = 0 (Issue time of forecast)	
	3 01 011	Year, Month, Day	YY
	3 01 012	Hour, Minute	GGgg
	0 08 079	Aviation product status	**COR CNL AMD NIL**
	0 08 039	Time significance = 1 (Time of commencement of period of the forecast)	
	3 01 011	Year, Month, Day	Y_1Y_1
	3 01 012	Hour, Minute	G_1G_1
	0 08 039	Time significance = 2 (Time of ending of period of the forecast)	
	3 01 011	Year, Month, Day	Y_2Y2
	3 01 012	Hour, Minute	G_2G_2
	3 01 024	Latitude, Longitude, Height of station	
		(Forecast weather at an aerodrome)	
3 07 053	0 07 032	Height of sensor above local ground = 10m	
	0 11 001	Wind direction	ddd
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 002	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
	0 20 009	General weather indicator	**CAVOK NSW NSC SKC**
	0 20 060	Prevailing visibility	VVVV
	3 07 014	Weather	w'w'
	3 07 047	Cloud layer(s)	$N_sN_sN_sh_sh_sh_s$
		(Forecast of extreme temperatures)	
3 07 054	0 07 032	Height of sensor above local ground = 2m	
	0 08 039	Time significance = 3 (Forecast time of maximum	

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
		temperature)	
	0 04 003	Day	
	0 04 004	Hour	G_FG_F
	0 08 023	First order statistics = 3 (Minimum)	
	0 12 023	Temperature (Celsius)	T_FT_F
	0 08 039	Time significance = 4 (Forecast time of minimum temperature)	
	0 04 003	Day	
	0 04 004	Hour	G_FG_F
	0 08 023	First order statistics = 2 (Maximum)	
	0 12 023	Temperature (Celsius)	T_FT_F
	0 08 023	First order statistics = missing (to cancel the previous value)	
	~~0 08 039~~	~~Time significance = missing (to cancel the previous value)~~	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
		(Change indicator and forecast changes)	
3 07 055	0 33 045	Probability of following event	C_2C_2
	0 08 016	Change qualifier for an aerodrome forecast	TTTTTT
	0 08 039	Time significance = 5 (Time of beginning of the forecast change)	
	0 04 003	Day	
	3 01 012	Hour, Minute	GGgg
	0 08 039	Time significance = 6 (Time of beginning of the forecast change)	
	0 04 003	Day	
	3 01 012	Hour, Minute	G_eG_e
	3 07 053	Forecast conditions during or after change	
		(Aerodrome forecast – full TAF)	
3 07 056	3 07 052	Identification and time interval	
	3 07 053	Forecast	
	3 07 054	Extreme temperatures forecast	
	1 01 000	Delayed replication of one descriptor	
	0 31 001	Replication factor	
	3 07 055	Forecast change	

The following notes are proposed to be included under BUFR Table D, Category 7.

Notes:

(x) Within 3 07 045, 3 07 048 and 3 07 053, wind speed shall be reported in the same units as in the original TAC data and:
0 11 083 shall be set to missing, if wind speed is reported in knots or m s^{-1} in TAC data,
0 11 084 shall be set to missing, if wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

(y) Within 3 07 045, 3 07 048 and 3 07 053, maximum wind speed (gusts) shall be reported in the same units as in the original TAC data and:
0 11 085 shall be set to missing, if maximum wind speed is reported in knots or m s^{-1} in TAC data,
0 11 086 shall be set to missing, if maximum wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

Proposed additions to BUFR/CREX table B.

Table reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Reference	Width	Unit	Scale	Width
0 08 039	Time significance (Aviation forecast)	Code table	0	0	6	Code table	0	2
0 08 054	Qualifier for wind speed or wind gusts	Code table	0	0	3	Code table	0	1
0 11 083	Wind speed	km h^{-1}	0	0	9	km h^{-1}	0	3
0 11 084	Wind speed	knot	0	0	8	knot	0	3
0 11 085	Maximum wind gust speed	km h^{-1}	0	0	9	km h^{-1}	0	3
0 11 086	Maximum wind gust speed	knot	0	0	8	knot	0	3
0 12 023	Temperature	Celsius	0	-99	8	Celsius	0	2
0 12 024	Dew point temperature	Celsius	0	-99	8	Celsius	0	2
0 20 059	Minimum horizontal visibility	m	-1	0	9	m	-1	3
0 20 060	Prevailing horizontal visibility (5)	m	-1	0	10	m	-1	4
0 20 085	General condition of runway	Code table	0	0	4	Code table	0	1
0 20 086	Runway deposits	Code table	0	0	4	Code table	0	1
0 20 087	Runway contamination	Code table	0	0	4	Code table	0	1
0 20 088	Depth of runway deposits	m	3	0	12	m	0	4
0 20 089	Runway friction coefficient	Code table	0	0	7	Code table	0	2
0 20 092	Height of base of cloud	Feet	-2	0	10	Feet	-2	3
0 20 091	Vertical visibility	Feet	-2	0	10	Feet	-2	3

The following Note (5) is proposed to be included under Class 20:

(5) A prevailing visibility value of 10000 m before scaling (after scaling 1000) shall be used to report prevailing visibility 10 km or more.

Proposed additions to BUFR Code/Flag tables

0 08 039	
Time significance (Aviation forecast)	
Code figure	
0	Issue time of forecast
1	Time of commencement of period of the forecast
2	Time of ending of period of the forecast
3	Forecast time of maximum temperature
4	Forecast time of minimum temperature
5	Time of beginning of the forecast change
6	Time of ending of the forecast change
7…62	Reserved
63	Missing
0 08 054	
Qualification of wind speed or wind gusts	
0	Wind speed or gust is as reported
1	Wind speed is greater than that reported (**P** in **METAR/TAF/SPECI**)
2…6	Reserved
7	Missing
0 20 086	
Runway deposits	
Code figure	
0	Clear and dry
1	Damp
5	Wet snow
6	Slush
7	Ice
8	Compacted or rolled snow
9	Frozen ruts or ridges
10-14	Reserved
15	Missing or not reported

Proposed additions to BUFR Code table 0 08 079

0 08 079	
Product status	
Code figure	
6	Special report (**SPECI**)
7	Corrected special report (**SPECI COR**)
8…14	Reserved
15	Missing or not applicable

ANNEX TO PARAGRAPH 3.1.10
FOR VALIDATION

Proposed descriptors

Element Descriptor	Element name	Unit	Scale	Reference Value	Data Width
0-01-097	Star catalog number	Numeric	0	0	13
0-25-151	Star relative magnitude	Numeric	3	-20000	14
0-25-152	Star brightness temperature	K	0	0	17
0-25-153	Limb	Code Table	0	0	2

Code Table 0-25-153

Limb	
Code Figure	
0	*Reserved*
1	*Bright Limb*
2	*Dark Limb*
3	*Missing value*

ANNEX TO PARAGRAPH 3.3.1
OPERATIONAL

New Note to be added under BUFR/CREX Table B

It is proposed to add a note under BUFR/CREX Table B :

(9) In all flag tables within the BUFR specification, bits are numbered from 1 to N from the most significant to least significant within a data width of N bits, i.e. bit No.1 is the leftmost and bit No. N is the rightmost bit within the data width. The bit No. N (the least significant bit) is set to 1 only if all the bits are set to 1 within the data width of the flag table to represent a missing value.

Deprecation of flag table 0 25 009 to be replaced by a new fag table 0 25 029:

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 25 029	Calibration method	Flag table	0	0	6	Flag table	0	2

0 25 029

Calibration method

Bit No.	
1	Reserved
2	Calibration target or signal
3	Against raingauges
4	Against other instruments (distrometer – atenuation)
5	Reserved
All 6	Missing value

ANNEX TO PARAGRAPH 3.3.2

PREOPERATIONAL

FOR SBUV/2 OZONE DATA

New Table D sequence

		(Ozone data)
3 10 019	0 01 007	Satellite identifier
	0 02 019	Satellite instruments (“624” = SBUV/2)
	3 01 011	Date
	3 01 013	Time
	3 01 023	Lat/Long
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“28” = Start of scan)
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“29” = End of scan)
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“Missing” = Cancel)
	0 08 029	Remotely-sensed surface type
	0 05 040	Orbit number
	0 08 075	Ascending/descending orbit qualifier
	0 08 003	Vertical significance (“0” = Surface)
	0 10 004	Pressure (terrain)
	0 08 003	Vertical significance (“Missing” = Cancel)
	2 07 002	Increase scale, reference value and data width
	0 15 001	Total ozone
	2 07 000	Cancel increase scale, reference value and data width
	0 33 070	Total ozone quality
	0 15 030	Aerosol contamination index
	2 07 002	Increase scale, reference value and data width
	0 20 081	Cloud amount in segment (cloud fraction)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 003	Vertical significance (“2” = Cloud top)
	0 33 042	Type of limit represented by following value (“0” = Exclusive lower limit)
	0 07 004	Pressure
	2 07 002	Increase scale, reference value and data width
	0 15 001	Total ozone (below cloud top pressure)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 003	Vertical significance (“Missing” = Cancel)
	1 13 021	Repeat next 13 descriptors 21 times
	0 07 004	Pressure (at bottom of layer)
	0 07 004	Pressure (at top of layer)
	2 07 002	Increase scale, reference value and data width
	0 08 021	Time significance (“27” = First guess)
	0 15 005	Ozone p
	0 08 021	Time significance (“Missing” = Cancel)
	0 15 005	Ozone p
	0 33 007	% confidence
	2 07 000	Cancel increase scale, reference value and data width
	0 08 026	Matrix significance (“4” = Row of averaging kernel matrix)
	1 01 020	Repeat next descriptor 20 times
	0 25 143	Linear coefficient

	0 08 026	Matrix significance (“Missing” = Cancel)
	0 08 043	Atmospheric chemical type (“0” = Ozone)
	1 09 015	Repeat next 9 descriptors 15 times
	0 07 004	Pressure
	0 08 090	Decimal scale of following Table B values
	2 07 006	Increase scale, reference value and data width
	0 15 008	Scaled mixing ratio (volumetric)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 090	Decimal scale of following Table B values (“Missing” = Cancel)
	2 07 002	Increase scale, reference value and data width
	0 33 007	% confidence
	2 07 000	Cancel increase scale, reference value and data width
	0 08 043	Atmospheric chemical type (“Missing” = Cancel)
	0 33 071	Profile ozone quality
	1 08 008	Repeat next 8 descriptors 8 times
	2 02 124	Change scale
	2 01 107	Change data width
	0 02 071	Spectrographic wavelength
	2 01 000	Cancel change data width
	2 02 000	Cancel change scale
	2 07 002	Increase scale, reference value and data width
	0 20 081	Cloud amount in segment (cloud fraction)
	2 07 000	Cancel increase scale, reference value and data width

New Table B descriptors

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 15 030	Aerosol contamination index (see Note 6)	Numeric	2	-1000	12	Numeric	2	4
0 33 070	Total ozone quality	Code table	0	0	4	Code table	0	2
0 33 071	Profile ozone quality	Code table	0	0	4	Code table	0	2

0-33-070 Total ozone quality

0	Low path length, good scan
1	High path length, good scan
2	Very high path, good scan
3	Reserved
4	Inconsistency between best ozone and the largest weighted ozone pair
5	Difference between best ozone and total zone for profile greater than three sigma
6	Reserved
7	Photometer reflectivity and monochrometer reflectivity differ by more than 0.15
8	Best reflectivity out of range (less than 0.05 or greater than 1.05)
9	A-pair, B-pair or C-pair ozone exceeds the dynamic range of the tables. (See Note)
10-14	Reserved
15	Missing

Note: The dynamic ranges are:

* Latitude < 15 deg - 180-350 DU
* Latitude 15-45 deg - 180-600 DU
* Latitude > 45 deg - 180-650 DU

0-33-071 Profile ozone quality

0	No error
1	Lower level anomaly
2	Inconsistency between best ozone and profile total ozone
3	Final residue greater than 3 sigma
4	Measured Q-value calculated with a priori profile and multiple-scattering/reflectivity correction
5	C greater than 3.0 DU or less than 0.5 DU
6	Sigma greater than 0.8 or less than 0.3
7	Reflectivity is less than -0.05, greater than 1.05, or changes by more than 0.05 from wavelength to wavelength
8	Total ozone not available
9	Bad radiance or eclipse contamination
10-14	Reserved
15	Missing

Add the following note to BUFR/CREX Class 15:

(6) For this descriptor, numbers less than -1 indicate a predominance of scattering aerosols, increasing in concentration as the number becomes more negative. Numbers greater than +1 indicate a predominance of absorptive aerosols, increasing in concentration as the number becomes more positive. Numbers between -1 and +1 indicate clouds or noise.

Add the following entries to the existing code table for
0-08-029 Remotely-sensed surface type

4	Low inland (below sea level)
5	Mix of land and water
6	Mix of land and low inland
7-254	Reserved

ANNEX TO PARAGRAPH 3.3.3

OPERATIONAL

Additions to Common Code Table C-12:

Under REGION IV

00160	U.S. NOAA/NESDIS	10 = Tromso (Norway)
		11 = McMurdo (Antarctica)

Modifications to Common Code Table C-12:

Under REGION IV

00161	U.S. NOAA/OAR	change: 2 = Forecast Systems Laboratory
		to: 2 = Earth System Research Laboratory

ANNEX TO PARAGRAPH 3.3.4

FOR VALIDATION

New descriptors for GFA (Graphical Forecast AIRMET) data

New Table B descriptors

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 01 039	Graphical Forecast AIRMET (GFA) sequence identifier	CCITT IA5	0	0	40	Character	0	5
0 20 006	Flight Rules	Code Table	0	0	3	Code Table	0	1

Code Figure	**0 20 006 Flight Rules**
0	Low Instrument Flight Rules - Ceiling < 500 feet and/or Visibility < 1 mile
1	Instrument Flight Rules - Ceiling < 1000 feet and/or Visibility < 3 miles
2	Marginal Visual Flight Rules – 1000 feet <= Ceiling < 3000 feet and/or 3 miles <= Visibility < 5 miles
3	Visual Flight Rules - Ceiling >= 3000 feet and/or Visibility >= 5 miles
4-6	Reserved
7	Missing value

Add new values to the existing code/flag tables for the following BUFR/CREX Table B descriptors:

0 08 040

34 Freezing level

0 08 041

8 IFR Ceiling and Visibility
9 Mountain obscuration
10 Strong surface wind
11 Freezing level

0 20 023

12 Wind shear

0 20 025

14 Cloud
15 Precipitation

New Table D descriptors:

		(Graphical AIRMET Sierra)
3 16 051	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 055	GFA IFR Ceiling and Visibility
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 056	GFA Mountain Obscuration
		(Graphical AIRMET Tango)
3 16 052	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 057	GFA Turbulence
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 058	GFA Strong Surface Wind
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 059	GFA Low-Level Wind Shear
		(Graphical AIRMET Zulu)
3 16 053	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 060	GFA Icing
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 061	GFA Freezing Level

		(GFA Identifier and Observed/Forecast Location)
3 16 054	0 01 039	GFA sequence identifier
	0 08 021	Time significance, 4=Forecast, 16=Analysis
	3 01 014	Time period (for which hazard is being observed/forecast)
	3 01 027	Description of Feature
	0 08 021	Time Significance, Missing=Cancel

		(GFA IFR Ceiling and Visibility)
3 16 055	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 041	Data significance, 8=IFR Ceiling and Visibility
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 20 006	Flight rules, 1=IFR
	2 02 129	Increase scale by 1
	2 01 130	Increase bit width by 2
	0 33 042	Type of limit represented by following (cloud base) value, 2=Exclusive upper limit, 7=Missing
	0 20 013	Height of base of cloud
	0 33 042	Type of limit represented by following (visibility) value, 2=Exclusive upper limit, 7=Missing
	0 20 001	Horizontal visibility
	2 01 000	Cancel increase bit width
	2 02 000	Cancel increase scale
	0 20 025	Obscuration
	0 20 026	Character of obscuration, 6=Blowing, 15=Missing
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

		(GFA Mountain Obscuration)
3 16 056	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 041	Data significance, 9=Mountain obscuration
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 20 006	Flight rules, 1=IFR
	0 20 025	Obscuration
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Turbulence)
3 16 057	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 011	Meteorological feature, 13=Turbulence
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 11 031	Degree of turbulence, 6=Moderate
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Strong Surface Wind)
3 16 058	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 041	Data significance, 10=Strong surface wind
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 33 042	Type of limit represented by following (wind speed) value, 0=Exclusive lower limit
	0 11 012	Wind speed at 10 m
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Low-Level Wind Shear)
3 16 059	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 011	Meteorological feature, 16=Phenomenon
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 20 023	Other weather phenomena, bit 12=Wind shear
	0 20 024	Intensity of phenomena
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

		(GFA Icing)
3 16 060	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 011	Meteorological feature, 15=Airframe Icing
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 20 041	Airframe icing, 4=Moderate Icing
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Freezing Level)
3 16 061	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD
	0 08 041	Data significance, 11=Freezing level
	3 16 054	GFA Identifier and Observed/Forecast Location
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

Note: 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].

ANNEX TO PARAGRAPH 3.3.5

OPERATIONAL - EDITORIAL

In Table B, entry 0-13-044 has been added for the K index, a measure of atmospheric instability. This has been given the SI units for temperature, Kelvin.

Actual units for K index

The K index is defined as follows:

K index = (Tobs(850) - Tobs(500)) + TDobs(850) - (Tobs(700) - TDobs(700)),

where Tobs is the observed temperature, TDobs is the observed dew point temperature, all at the indicated pressure level (in hPa).

Since the observed dew point temperature is generally measure in degrees Celcius, the K index is also derived in degrees Celcius. Interpretation of the K index always assumes a value in degrees Celcius .
The K index distributed by EUMETSAT using 0-13-044 is, in fact, already in degrees Celcius rather than Kelvin.

As degree Celcius are included in common code table C-6, it is proposed to amend the units of 0-13-044 from Kelvin to Degree Celcius.

ANNEX TO PARAGRAPH 3.3.6

FOR VALIDATION

Entries for Volume (3-D) Radar data

Proposal for a new BUFR/CREX Table B entries

It is proposed to add the new BUFR/CREX Table B entries :

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 01 097	Unique product definition	CCITTIA5	0	0	2048	CCITTIA5	0	256
0 01 098	Type of product	Code table	0	0	12	Code table	0	4
0 02 137	Radar DualPRF ratio	Code table	0	0	4	Code table	0	2
0 02 138	Antenna rotation direction	Code table	0	0	2	Code table	0	1
0 05 035	Maximum size of X-dimension	Numeric	0	0	12	Numeric	0	4
0 06 035	Maximum size of Y-dimension	Numeric	0	0	12	Numeric	0	4
0 07 035	Maximum size of Z-dimension	Numeric	0	0	12	Numeric	0	4
0 07 036	Level index of Z	Numeric	0	0	12	Numeric	0	4
0 21 018	extended NYQUIST velocity	$m\ s^{-1}$	0	0	8	$m\ s^{-1}$	0	3
0 21 019	high NYQUIST velocity	$m\ s^{-1}$	0	0	8	$m\ s^{-1}$	0	3
0 21 022	Range bin offset	m	1	0	14	m	1	5
0 21 023	Range bin size	m	0	0	14	m	0	5
0 21 024	Azimuth offset	Degree	1	0	12	Degree	1	4
0 21 025	Azimuthal resolution	Degree	1	0	8	Degree	1	3
0 30 033	Number of bins along the radial	Numeric	0	0	12	Numeric	0	4
0 30 034	Number of azimuths	Numeric	0	0	12	Numeric	0	4

Proposal for code tables

Code table 0 01 098 (Type of product) should have the following entries

0 01 098

Type of product

Code figure	
1	Total power, 1 byte (DB_DBT)
2	Reflectivity corrected for ground clutter, 1 byte (DB_DBZ)
3	Velocity, 1 byte (DB_VEL)
4	Width, 1 byte (DB_WIDTH)
5	Differential reflectivity, 1 byte (DB_ZDR)
6	Corrected reflectivity, 1 byte (DB_DBZC)
7	Total power, 2 byte (DB_DBT2)
8	Reflectivity, 2 byte (DB_DBZ2)
9	Velocity, 2 byte (DB_VEL2)
10	Width, 2 byte (DB_WIDTH2)
11	Differential reflectivity, 2 byte (DB_ZDR2)
12	Rainfall rate, 2 byte (DB_RAINRATE2)
13	KDP (Differential phase), 1 byte (DB_KDP)
14	KDP (Differential phase), 2 byte (DB_KDP2)
15	PhiDP(Differential phase), 1 byte (DB_PHIDP)
16	Corrected velocity, 1 byte (DB_VELC)
17	SQI, 1 byte (DB_SQI)
18	RhoHV, 1 byte (DB_RHOHV)
19	RhoHV, 2 byte (DB_RHOHV2)
20	Corrected Reflectivity, 2 byte (DB_DBZC2)
21	Corrected velocity, 2 byte (DB_VELC2)
22	SQI, 2 byte (DB_SQI2)
23-4094	Reserved
4095	Missing value

0 02 137

Radar DualPRF ratio

Code figure	
1	3:2
2	4:3
3	5:4
4-14	Reserved
15	Missing value

0 02 138

Antenna rotation direction

Code figure	
1	clockwise rotation
2	counterclockwise rotation
3	Missing value

Proposal for an additional entry in Code Table 0 29 001:

If Projection type is required as a meta data but there is no projection of the data, it should be possible to encode this properly. Therefore the entry "no projection" is proposed as an entry in Code Table 0 29 001 (projection type)

0 29 001

Projection type

Code figure	
0	Gnomonic projection
1	Polar stereographic projection
2	Lambert's conformal conic projection
3	Mercator's projection
4	Scanning Cone (radar)*
5	no projection
6	Reserved
7	Missing value

ANNEX TO PARAGRAPH 3.3.7

FOR VALIDATION

It is proposed to use the following sequence of entries for the encoding of the JASON2 OGDR data (new entries are in *italicised and underlined*):

BUFR	Description	*Min*	*Max*	Unit	Scale	Reference	Width
F X Y	**Satellite**						
0 01 007	SATELLITE IDENTIFIER						
0 02 019	SATELLITE INSTRUMENTS						
0 01 096	ACQUISITION STATION IDENTIFIER						
0 25 061	SOFTWARE IDENTIFICATION						
0 05 044	SATELLITE CYCLE NUMBER						
0 05 040	ORBIT NUMBER						
0 01 030	NUMERICAL MODEL IDENTIFIER						
	Datation						
0 04 001	YEAR						
0 04 002	MONTH						
0 04 003	DAY						
0 04 004	HOUR						
0 04 005	MINUTE						
0 04 007	SECONDS WITHIN A MINUTE						
	Location and Surface Type						
0 05 001	LATITUDE (HIGH ACCURACY)	-70	70				
0 06 001	LONGITUDE (HIGH ACCURACY)	0	360				
0 08 029	REMOTELY SENSED SURFACE TYPE						
0 08 074	ALTIMETER ECHO TYPE						
<u>0 08 077</u>	*<u>RADIOMETER SENSED SURFACE TYPE</u>*	-	-	*<u>CODE TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>7</u>*
	Flags						
<u>0 40 011</u>	*<u>INTERPOLATION FLAG</u>*	-	-	*<u>FLAG TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>8</u>*
<u>0 25 090</u>	*<u>ORBIT STATE FLAG</u>*	-	-	*<u>CODE TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>4</u>*
0 25 095	ALTIMETER STATE FLAG			CODE TABLE			
<u>0 25 098</u>	*<u>ALTIMETER DATA QUALITY FLAG</u>*	-	-	*<u>FLAG TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>9</u>*
<u>0 25 099</u>	*<u>ALTIMETER CORRECTION QUALITY FLAG</u>*	-	-	*<u>FLAG TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>9</u>*
0 21 144	ALTIMETER RAIN FLAG						
0 25 096	RADIOMETER STATE FLAG						
<u>0 40 012</u>	*<u>RADIOMETER DATA QUALITY FLAG</u>*	-	-	*<u>FLAG TABLE</u>*	*<u>0</u>*	*<u>0</u>*	*<u>8</u>*

0 40 013	RADIOMETER BRIGHTNESS TEMPERATURE INTERPRETATION FLAG	-	-	CODE TABLE	0	0	3
0 21 169	ICE PRESENCE INDICATOR	-	-	CODE TABLE	0	0	2
	Altimeter: Ku Band						
0 22 151	KU BAND OCEAN RANGE						
0 22 162	RMS OF 20 Hz KU BAND OCEAN RANGE	-	-	M	3	0	16
0 22 163	NUMBER OF 20Hz VALID POINTS FOR KU BAND	-	-	NUMERIC	0	0	10
0 25 160	KU BAND NET INSTRUMENTAL CORRECTION	-120000	120000	M	4	-120000	18
0 25 133	SEA STATE BIAS CORRECTION ON KU BAND						
0 22 156	KU BAND SIGNIFICANT WAVE HEIGHT						
0 22 164	RMS 20 HZ KU BAND SIGNIFICANT WAVE HEIGHT	-	-	M	3	0	16
0 22 165	NUMBER OF 20HZ VALID POINTS FOR KU BAND SIGNIFICANT WAVE HEIGHT	-	-	NUMERIC	0	0	10
0 22 166	KU BAND NET INSTRUMENTAL CORRECTION FOR SIGNIFICANT WAVE HEIGHT	-1000	1000	M	3	-1000	11
0 21 137	KU BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT						
0 21 138	STD KU BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT						
0 22 167	NUMBER OF VALID POINTS FOR KU BAND BACKSCATTER	-	-	NUMERIC	0	0	10
0 21 139	KU BAND NET INSTRUMENTAL CORRECTION FOR AGC						
0 21 118	ATTENUATION CORRECTION ON SIGMA-0						
0 21 145	KU BAND AUTOMATIC GAIN CONTROL	-	-	DB	2	0	13
0 21 146	RMS KU BAND AUTOMATIC GAIN CONTROL	-	-	DB	2	0	8
0 21 147	NUMBER OF VALID POINTS FOR KU BAND AUTOMATIC GAIN CONTROL	-	-	NUMERIC	0	0	5
	Altimeter: C band						
0 22 168	C BAND OCEAN RANGE	-	-	M	3	0	31
0 22 169	RMS OF C BAND OCEAN RANGE	-	-	M	3	0	16
0 22 170	NUMBER OF 20Hz VALID POINTS FOR C BAND	-	-	NUMERIC	0	0	10
0 25 161	C BAND NET INSTRUMENTAL CORRECTION	-120000	120000	M	4	-120000	18
0 25 162	SEA STATE BIAS CORRECTION ON C BAND	-6000	0	M	4	-6000	13
0 22 171	C BAND SIGNIFICANT WAVE HEIGHT	-	-	M	3	0	16

0 22 172	RMS 20HZ C BAND SIGNIFICANT WAVE HEIGHT	-	-	M	3	0	16
0 22 173	NUMBER OF 20HZ VALID POINTS FOR C BAND SIGNIFICANT WAVE HEIGHT	-	-	NUMERIC	0	0	10
0 22 174	C BAND NET INSTRUMENTAL CORRECTION FOR SIGNIFICANT WAVE HEIGHT	-1000	1000	M	3	-1000	11
0 21 170	C BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT	-	-	DB	2	-32768	16
0 21 171	RMS C BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT	-	-	DB	2	-32768	16
0 22 175	NUMBER OF VALID POINTS FOR C BAND BACKSCATTER	-	-	NUMERIC	0	0	10
0 21 172	C BAND NET INSTRUMENTAL CORRECTION FOR AGC	-	-	DB	2	-2048	12
0 21 118	ATTENUATION CORRECTION ON SIGMA-0						
0 21 173	C BAND AUTOMATIC GAIN CONTROL	-	-	DB	2	0	13
0 21 174	RMS C BAND AUTOMATIC GAIN CONTROL	-	-	DB	2	0	9
0 21 175	NUMBER OF VALID POINTS FOR C BAND AUTOMATIC GAIN CONTROL	-	-	NUMERIC	0	0	10
	Radiometer						
0 12 063	BRIGHTNESS TEMPERATURE						
0 12 063	BRIGHTNESS TEMPERATURE						
0 12 063	BRIGHTNESS TEMPERATURE						
0 13 090	RADIOMETER WATER VAPOR CONTENT						
0 13 091	RADIOMETER LIQUID CONTENT						
	Wind						
0 11 097	WIND SPEED FROM ALTIMETER	-	-	M/S	2	0	12
0 11 098	WIND SPEED FROM RADIOMETER	-	-	M/S	2	0	12
0 11 095	U COMPONENT OF THE MODEL WIND VECTOR						
0 11 096	V COMPONENT OF THE MODEL WIND VECTOR						
	Dynamic Topography						
0 10 096	MEAN DYNAMIC TOPOGRAPHY	-	-	M	3	-131072	18
0 07 002	HEIGHT OR ALTITUDE						
0 10 082	INSTANTANEOUS ALTITUDE RATE						
0 10 083	OFF NADIR ANGLE OF THE SATELLITE FROM PLATFORM DATA						
0 10 084	OFF NADIR ANGLE OF THE SATELLITE FROM WAVEFORM DATA						
0 25 132	IONOSPHERIC CORRECTION FROM MODEL ON KU BAND						
0 25 163	ALTIMETER IONOSPHERIC CORRECTION ON KU BAND	-	-	M	3	-32768	16
025 126	MODEL DRY TROPOSPHERIC CORRECTION						

0 25 128	MODEL WET TROPOSPHERIC CORRECTION						
0 25 164	*RADIOMETER WET TROPOSPHERIC CORRECTION*	*-5000*	*0*	*M*	*4*	*-5000*	*13*
0 10 085	MEAN SEA SURFACE HEIGHT						
0 10 097	*MEAN SEA SURFACE HEIGHT FROM ALTIMETER ONLY*	-	-	*M*	*3*	*-131072*	*18*
0 10 086	GEOID'S HEIGHT						
0 10 087	OCEAN DEPTH/LAND ELEVATION						
0 10 092	SOLID EARTH TIDE HEIGHT						
0 10 088	GEOCENTRIC OCEAN TIDE HEIGHT SOLUTION 1						
0 10 089	GEOCENTRIC OCEAN TIDE HEIGHT SOLUTION 2						
0 10 098	*LOADING TIDE HEIGHT GEOCENTRIC OCEAN TIDE SOLUTION 1*	*-2000*	*2000*	*M*	*4*	*-2000*	*12*
0 10 099	*LOADING TIDE HEIGHT GEOCENTRIC OCEAN TIDE SOLUTION 2*	*-2000*	*2000*	*M*	*4*	*-2000*	*12*
0 10 090	LONG PERIOD TIDE HEIGHT						
0 10 100	*N0N-EQUILIBRIUM LONG PERIOD TIDE HEIGHT*	*-2000*	*2000*	*M*	*4*	*-2000*	*12*
0 10 093	GEOCENTRIC POLE TIDE HEIGHT						
0 25 127	SEA SURFACE HEIGHT CORRECTION DUE TO PRESSURE LOADING						
0 40 013	*HIGH FREQUENCY FLUCTUATIONS OF THE SEA SURFACE TOPOGRAPHY CORRECTION*	-	-	*M*	*4*	*-3000*	*13*

It is proposed to allocate the Table D entry ***3 40 005*** for the above sequence.

Proposal for code and flag tables

Code Table 0 08 077 (Radiometer sensed surface type) should be based on existing entries 0 08 012 (Land/sea qualifier) and 0 08 029 (Remotely sensed surface type).

0 08 077

Radiometer sensed surface type

Code figure	
0	Land
1	Sea
2	Coastal
3	Open ocean or semi-enclosed sea
4	Enclosed sea or lake
5	Continental ice
6-126	Reserved
127	Missing value

0 40 011

Interpolation flag

Bit number	
1	Mean sea surface (MSS) interpolation flag
2	Ocean tide solution 1 interpolation flag (0=4 points over ocean, 1=less than 4 points)
3	Ocean tide solution 2 interpolation flag (0=4 points over ocean, 1=less than 4 points)
4	Meteorological data interpolation flag (0=4 points over ocean, 1=less than 4 points)
5	Spare
6	Spare
7	Spare
All 8 bits	Missing

0 25 090

Orbit state flag

Code figure	
1	Orbit computed during a manoeuvre
2	Adjusted mission operations orbit
3	Extrapolated mission operations orbit
4	Adjusted (preliminary/precise) orbit
5	(preliminary/precise) orbit is estimated during a manoeuvre period
6	(preliminary/precise) orbit is interpolated over a tracking data gap
7	(preliminary/precise) orbit is extrapolated for a duration less than 1 day
8	(preliminary/precise) orbit is extrapolated for a duration that ranges from 1 day to 2 days
9	(preliminary/precise) orbit is extrapolated for a duration larger than 2 days, or that the orbit is extrapolated just after a manoeuvre
10	DORIS† DIODE‡ navigator orbit
11 - 14	Reserved
15	Missing value

† DORIS stands for "Doppler Orbitography and Radio-positioning Integrated by Satellite".
‡ DIODE means "Détermination Immédiate d'Orbite par Doris Embarqué" or immediate onboard orbit determination by DORIS. It is part of the DORIS instrument, which calculates the satellite's position and velocity.

0 25 098

Altimeter data quality flag

Bit number	(0 is good, 1 is bad)
1	Ku band range
2	C band range
3	Ku band SWH*
4	C band SWH*
5	Ku band backscatter coefficient
6	C band backscatter coefficient
7	Off nadir angle from Ku band waveform parameters
8	Off nadir angle from platform
All 9 bits	Missing

* SWH stands for "Significant wave height"

0 25 099

Altimeter correction quality flag

Bit number	(0 is good, 1 is bad)
1	Ku band range instrumental correction
2	C band range instrumental correction
3	Ku band SWH* instrumental correction
4	C band SWH* instrumental correction

5	Ku band backscatter coefficient instrumental correction
6	C band backscatter coefficient instrumental correction
7	Spare
8	Spare
All 9 bits	Missing

* SWH stands for “Significant wave height”

0 40 012

Radiometer data quality flag

Bit number	(0 is good, 1 is bad)
1	18.7 GHz brightness temperature
2	23.8 GHz brightness temperature
3	34 GHz brightness temperature
4	Spare
5	Spare
6	Spare
7	Spare
All 8 bits	Missing

0 40 013

Radiometer brightness temperature interpretation flag

Code figure	
0	Interpolation with no gap between JMR§ data
1	Interpolation with gaps between JMR§ data
2	Extrapolation of JMR§ data
3	Failure of extrapolation and interpolation
4 - 6	Reserved
7	Missing

§ JMR stands for “JASON-1 Microwave Radiometer”

0 21 169

Ice presence indicator

Code figure	
0	No ice present
1	Ice present
2	Reserved
3	Missing

ANNEX TO PARAGRAPH 4.1
OPERATIONAL

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

Date of Assignment of number (if after 30/04/2007)	Code figure for r_ar_a (Code table 3685)	Code figure for BUFR (Code table 0 02 011)	
	00–01	000–001	Reserved
	02	002	No radiosonde – passive target (e.g. reflector)
	03	003	No radiosonde – active target (e.g. transponder)
	04	004	No radiosonde – passive temperature-humidity profiler
	05	005	No radiosonde – active temperature-humidity profiler
	06	006	No radiosonde – radio-acoustic sounder
	07–08	007–008	No radiosonde – . . . (reserved)
	09	009	No radiosonde – system unknown or not specified
	10	010	VIZ type A pressure-commutated (USA)
	11	011	VIZ type B time-commutated (USA)
	12	012	RS SDC (Space Data Corporation – USA)
	13	013	Astor (no longer made — Australia)
	14	014	VIZ Mark I MICROSONDE (USA)
	15	015	EEC Company type 23 (USA)
	16	016	Elin (Austria)
	17	017	Graw G. (Germany)
	18	018	Reserved for allocation of radiosonde
	19	019	Graw M60 (Germany)
	20	020	Indian Meteorological Service MK3 (India)
	21	021	VIZ/Jin Yang Mark I MICROSONDE (South Korea)
	22	022	Meisei RS2-80 (Japan)
	23	023	Mesural FMO 1950A (France)
	24	024	Mesural FMO 1945A (France)
	25	025	Mesural MH73A (France)
	26	026	Meteolabor Basora (Switzerland)
	27	027	AVK-MRZ (Russian Federation)
	28	028	Meteorit Marz2-1 (Russian Federation)
	29	029	Meteorit Marz2-2 (Russian Federation)
	30	030	Oki RS2-80 (Japan)
	31	031	VIZ/Valcom type A pressure-commutated (Canada)
	32	032	Shanghai Radio (China)
	33	033	UK Met Office MK3 (UK)
	34	034	Vinohrady (Czechoslovakia)
	35	035	Vaisala RS18 (Finland)
	36	036	Vaisala RS21 (Finland)
	37	037	Vaisala RS80 (Finland)
	38	038	VIZ LOCATE Loran-C (USA)
	39	039	Sprenger E076 (Germany)
	40	040	Sprenger E084 (Germany)
	41	041	Sprenger E085 (Germany)
	42	042	Sprenger E086 (Germany)
	43	043	AIR IS - 4A - 1680 (USA)
	44	044	AIR IS - 4A - 1680 X (USA)
	45	045	RS MSS (USA)
	46	046	Air IS - 4A - 403 (USA)

Date of Assignment of number (if after 30/04/2007)	Code figure for r_ar_a (Code table 3685)	Code figure for BUFR (Code table 0 02 011)	
	47	047	Meisei RS2-91 (Japan)
	48	048	VALCOM (Canada)
	49	049	VIZ MARK II (USA)
	50	050	GRAW DFM-90 (Germany)
	51	051	VIZ-B2 (USA)
	52	052	Vaisala RS80-57H
	53	053	AVK-RF95 (Russian Federation)
	54	054	GRAW DFM-97 (Germany)
	55	055	Meisei RS-016 (Japan)
	56	056	M2K2 (France)
	57	057	M2K2-DC Modem (France)
	58	058	AVK-MRZ (Russian Federation)
	59	059	Modem M2K2-R 1680 MHz RDF radiosonde with pressure sensor chip (France)
	60	060	Vaisala RS80/MicroCora (Finland)
	61	061	Vaisala RS80/Loran/Digicora I,II or Marwin (Finland)
	62	062	Vaisala RS80/PCCora (Finland)
	63	063	Vaisala RS80/Star (Finland)
	64	064	Orbital Sciences Corporation, Space Data Division, transponder radiosonde, type 909-11-XX, where XX correspond to the model of the instrument (USA)
	65	065	VIZ transponder radiosonde, model number 1499–520 (USA)
	66	066	Vaisala RS80 /Autosonde (Finland)
	67	067	Vaisala RS80/Digicora III (Finland)
	68	068	AVK-RZM-2 (Russian Federation)
	69	069	MARL-A or Vektor-M-RZM-2 (Russian Federation)
	70	070	Vaisala RS92/Star (Finland)
	71	071	Vaisala RS90/Digicora I,II or Marwin (Finland)
	72	072	Vaisala RS90/PC-Cora (Finland)
	73	073	Vaisala RS90/Autosonde (Finland)
	74	074	Vaisala RS90/Star (Finland)
	75	075	AVK-MRZ-ARMA (Russian Federation)
	76	076	AVK-RF95-ARMA (Russian Federation)
	77	077	GEOLINK GPSonde GL98 (France)
	78	078	Vaisala RS90/Digicora III (Finland)
	79	079	Vaisala RS92/Digicora I,II or Marwin (Finland)
	80	080	Vaisala RS92/Digicora III (Finland)
	81	081	Vaisala RS92/Autosonde (Finland)
	82	082	Sippican MK2 GPS/STAR (USA) with rod thermistor, carbon element, and derived pressure
	83	083	Sippican MK2 GPS/W9000 (USA) with rod thermistor, carbon element, and derived pressure
	84	084	Sippican MARK II with chip thermistor, carbon element, and derived pressure from GPS height
	85	085	Sippican MARK IIA with chip thermistor, carbon element, and derived pressure from GPS height
	86	086	Sippican MARK II with chip thermistor, pressure, and carbon element
	87	087	Sippican MARK IIA with chip thermistor, pressure, and carbon element
	88	088	MARL-A or Vektor-M-MRZ (Russian Federation)
	89	089	MARL-A or Vektor-M-MRZ (Russian Federation)
	90	090	Radiosonde not specified or unknown
	91	091	Pressure-only radiosonde

Date of Assignment of number (if after 30/04/2007)	Code figure for $r_a r_a$ (Code table 3685)	Code figure for BUFR (Code table 0 02 011)	
	92	092	Pressure-only radiosonde plus transponder
	93	093	Pressure-only radiosonde plus radar-reflector
	94	094	No-pressure radiosonde plus transponder
	95	095	No-pressure radiosonde plus radar-reflector
	96	096	Descending radiosonde
	97–99	097–099	Reserved for allocation of sounding systems with incomplete sondes
	Not available	100-109	Reserved
1/05/2007	10	110	NNNNNNNNNN
		111–254	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.

(3) The alphanumeric code format reports only the last 2 digits, and the correct first digit is identified from the date (the first digit is 0 if the observation is before the expiration date of the "old" 2-digit code, or 1 otherwise).

ANNEX TO PARAGRAPH 5.1.4

MIGRATION GUIDANCE

MIGRATION: WHAT ARE THE KEYS TO SUCCESS?

Migration to TDCF will go with automation. It cannot be undertaken without:
–careful planning
–training
–some resources:
•competent staff
•financial
•international cooperation (grouping for projects)
•international assistance

ACTIONS EXPECTED FROM ALL WMO MEMBER STATES:

- DEFINE MIGRATION CONTACT POINTS (national focal point on Codes matters) (105 over 188 so far) *does your country have one?*
- NOMINATE A NATIONAL STEERING GROUP ON MIGRATION TO TDCF (TO INCLUDE THE NATIONAL FOCAL POINT)
- DEFINE A NATIONAL PLAN FOR MIGRATION TO TDCF FOLLOWING THE INTERNATIONAL PLAN - FOUND IN WMO WEB SITE:
http://www.wmo.int/web/www/WMOCodes.html

– ANALYZE AND IDENTIFY IMPACTS OF MIGRATION ON NATIONAL OPERATION
– IDENTIFY SOME NECESSARY (BUT USUALLY LIMITED) FINANCIAL AND STAFF RESOURCES
- DEFINE and RUN a NATIONAL TRAINING PROGRAMME ON TDCF
- DEFINE AND PERFORM *SOFTWARE ADJUSTMENTS (*preparatory corrective actions at GDPS Centres to avoid missing incoming data):
1) process BUFR/CREX bulletins in MSS
2) introduce BUFR/CREX processing with decoder in PROCESSING CHAIN:
– reception, decoding, display, archiving
3) introduce BUFR/CREX encoder for the concerned data type at: CONCENTRATION site or/and (if feasible)OBSERVATION PLATFORM *(test and check format)*
4) transmit BUFR/CREX Bulletins (with proper headers after notification to WMO Secretariat)

ISSUES:

Because the migration affects the whole meteorological observation data flow, it requires a lot of attention and commitment by NMHS.

1) The migration is not a drastic brutal change (as previously for TAC codes), but slow and smooth with dual dissemination (TAC and BUFR in parallel).

2) The dates in the plan are TARGET DATES. WMO strongly recommend that member states migrate by the end of the transition period. Countries should plan migration targeting those dates.

3) There is a lack of understanding for te necessity of migration.

4) The initial purpose is for real-time operational international exchange only.

5) There may be confusion between visualization and transport format. The exchange process requires several steps: producing (encoding), transport, decoding, Data Base storage, visualizing, archiving (the format used to represent data could be different at each stage, if it is more efficient).

6) There may be confusion between physical representation (or format) and envelop (wrapper) *(e.g. XML and NetCDF are wrappers, BUT standards of physical representation within the general standard have to be defined).*

7) *XML and Net CDF are not alternative to BUFR and GRIB 2. Tthe physical meteorological standards within XML and Net CDF would have to be entirely defined. Many years of work would be needed (it would be again other migration processes!).*

8) Issues 1 to 7 are likely to slow the process for migration.

9) Explain the process and steps to be followed when producers are ready. They have to go through some verification tests. It is fundamental to verify the data, especially if there is no dual transmission for these data. For the checking of encoded data, it is recommended to perform fully nationally the decoding first and then when it is satisfying perform experimental bilateral exchange(s). (*The bi-lateral exchange for testing could be organized in each region, or some Centres could also volunteer to check other NMCs, what ever their location*.)

10) NMCs can convert into BUFR after the national concentration, automation is not needed at station level from the start.

11) If there is a real immediate need to transmit additional parameters, new data types or necessary metadata, then manual coding in CREX can also be a intermediate solution.

12) It was written in the CBS report in ANNEX III, paragraph 3.2, G3 that
"In the interest of timely data delivery, the first BUFR (or CREX) message should be sent when level 100 hPa is reached and the second message should be sent when the whole sounding is completed (containing all observation points). The delivery of the profile data in several stages may be necessary to accommodate the interests of other application areas, such as nowcasting and aeronautical meteorology. Collaboration with CIMO and various code groups should be established."

This requirement has already been met in regulations BC25-TEMP and BC20-PILOT.

13) Of immediate importance was providing to WMO members the procedures, which should be followed to begin exchange of their migrated data. The procedures to start the dissemination of new BUFR bulletins should be clearly explained in the guidance. These procedures are not new. They are already defined and are the standard procedures for implementation of new bulletins on the GTS. It is not understood by all members that there are no new or unique procedures (see Appendix)

14) Noting that some WWW centres had not followed the allocations of abbreviated headings for BUFR bulletins available in Attachment II- of the Manual on Global Telecommunication System, one should stress the need for these centres to implement Attachment II-5. In some cases, in particular for satellite data, abbreviated headings were selected for the insertion of new bulletins into the GTS at a time when appropriate allocations were not available in Attachment II-5. The CT agreed to take these specific cases into consideration in order to avoid imposing major changes in the abbreviated headings of bulletins already exchanged on the GTS.

ANNEX TO PARAGRAPH 5.2

QUESTIONNAIRE ON WMO CODES PROCESSING

(May 2007)

The Fourteenth WMO Congress supported the conclusions of CBS that table-driven code forms (TDCF), with their self-description, flexibility and expandability, were the solution to satisfy the demands of the rapidly evolving science and technology. The table-driven code forms FM 94 BUFR and FM 95 CREX offered great advantages in comparison with the traditional alphanumeric codes (TAC) like FM 12 SYNOP and FM 35 TEMP. The reliability of binary data transmission provides for an increase in data quality and quantity received at meteorological centres, which would lead to the generation of better products.

Congress noted with satisfaction that CBS had developed a thorough plan for a WMO-wide migration to table-driven code forms. See details in the WMO/WWW website: http://www.wmo.int/web/www/WMOCodes.html.

The goal of the migration plan is the replacement of TAC for observational data exchange by the binary code BUFR. Congress noted that the plan is ensuring a smooth transition without negative impacts on the World Weather Watch operations. The basic principles of the plan are:

a) The migration process is flexible. Within the target dates defined in the plan (spanning from 2005 to 2015, depending on the data type), WMO Members can choose their own timetable for the migration; it is the data producer, not the user, who is the initiator of the migration process;

b) The use of CREX is an interim step in the migration to BUFR;

c) Data users must have access to new data produced in BUFR or CREX and be able to receive data exchanged in BUFR or CREX; data users should have first priority for training; data users should implement BUFR and CREX decoders as soon as possible; dual transmission (initially in BUFR and TAC, later in BUFR and CREX) should be provided, where data users are unable to receive or process BUFR or CREX.

Congress stressed that the successful migration in developing countries would depend on capacity building. Assistance to developing countries in the form of pilot and specific projects would be necessary for implementation of new coding procedures, new software and possibly hardware for automation. Congress was pleased that ECMWF would make software for encoding/decoding BUFR, CREX and GRIB 1 & 2, available free of charge for WMO Members with limited remote assistance. That software will run on UNIX, LINUX operating system; it is coded in FORTRAN language. It also noted that some WMO Members would make their encoding/decoding software available at request. Congress recognized that the costs involved in the implementation of the migration plan should be compensated by the benefits to be gained, noting that the migration plan allowed sufficient time and flexibility for implementation. It stressed that training was a fundamental prerequisite of the migration process.

Congress endorsed the migration plan developed by CBS and urged every Member country to develop as soon as possible a national migration plan, derived from the international plan, with analysis of impacts, costs, solutions, sources of funding (as necessary), national training, technical planning and schedule. Congress highlighted the complexity of the migration process and requested CBS to put in place an effective implementation/coordination mechanism for guiding, assisting and monitoring the migration to TDCF. The questionnaire that follows has been designed to meet this request.

CATEGORY OF TRADITIONAL ALPHANUMERIC CODES (TAC)	Nov. 2005	Nov. 2006	Nov. 2007	Nov. 2008	Nov. 2009	Nov. 2010	Nov. 2011	Nov. 2012	Nov. 2013	Nov. 2014	Nov. 2015	Nov. 2016
1. Common: SYNOP; TEMP PILOT; CLIMAT	*Start operational* exchange					Migration Complete						
2. Satellite Observations: SARAD, SAREP SATEM, SATOB	*Operational exchange*	Migration Complete										
3. Aviation: METAR, SPECI, TAF			*Start experimental exchange*	*Start operational exchange*								Migration Complete
AMDAR	*Operational exchange*	Migration Complete										
4. Maritime: BUOY, TRACKOB BATHY, TESAC WAVEOB, SHIP CLIMAT SHIP PILOT SHIP TEMP SHIP CLIMAT TEMP SHIP	*Start experimental exchange*		*Start operational exchange*					Migration Complete				
5. Miscellaneous: RADOB, IAC IAC FLEET GRID, RADOF	*Experimental exchange*	*Start operational exchange*		Migration Complete								
6. Obsolete: ICEAN, GRAF, NACLI etc, SFAZI, SFLOC, SFAZU, ROCOB, ROCOB SHIP, CODAR, WINTEM, ARFOR, ROFOR, RADREP, MAFOR, HYDRA, HYFOR *NOT APPLICABLE*												

Notes:

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.

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

(b) **Start of operational exchange:** data will be made available in BUFR (CREX if needed) whereby some (but not all) Members rely on them operationally. Some distribution of the current alphanumeric codes will still be done;

(c) **Migration complete:** at this date the BUFR (CREX if needed) exchange becomes the standard WMO practice. Distribution of the current alphanumeric codes is terminated. For archiving purposes and where BUFR or CREX exchange still causes problems, the alphanumeric codes may be used on a local or national.

Relevant conditions to be satisfied before experimental exchange may start			***Relevant conditions to be satisfied before operational exchange may start***	
a)	corresponding BUFR/CREX-tables and templates are available;		**a)**	Corresponding BUFR/CREX-tables and templates are fully validated;
b)	training of exchanging parties has been completed;		**b)**	Training of all concerned parties has been completed;
c)	Required software of exchanging parties (encoding, decoding, viewing) is implemented.		**c)**	ll required software (encoding, decoding, viewing) is operational.

The questionnaire that follows has been prepared so as to facilitate the submission of replies and the compilation of data. For ease of reference, a copy will be placed on the World Weather Watch website *(notice change to www.wmo.int)* at :

Please, take the time to answer the questionnaire in full and carefully for contributing to the development of the migration process, and please return it to WMO by 31 August 2007to the attention of Mr Joël Martellet. It would also be appreciated if in addition you could send an electronic copy as an e-mail attachment, to Mr Martellet's e-mail address : jmartellet@wmo.int .

The questionnaire (pages) has been designed with check boxes for questions requiring a *"yes"* or a *"no"* to minimize the time required for its completion.

- If using a computer, just click on the *"yes"* or *"no"* boxes and the marking will appear (to remove the marking, click on the box again); and for all other questions, type your answer in the *"shaded areas"* provided for. (these shaded areas will stretch out as necessary to fit the required information.

- If you complete the questionnaire by hand, kindly write clearly, in print characters.

Questionnaire on WMO Codes Processing

(May 2007)

1.	Are you aware of the advantage of Table Driven Code Forms (BUFR and CREX) versus Traditional Alphanumeric Codes (e.g. SYNOP, TEMP, etc..)? ***If, Yes, Please, elaborate:***	yes ☐	no ☐

(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 ☐	no ☐
		>>> if YES to question 1, ***How is the TAC data reaching your Agency/Service ?***		
	a)	through GTS	yes ☐	no ☐
	b)	through Internet	yes ☐	no ☐
	c)	through workstation(s) dedicated to satellite reception (e.g. SADIS, ISCS, MDD, RETIM, MSG, etc.) *>>> list the workstation(s)*	yes ☐	no ☐
	d)	through other means *>>> please specify*	yes ☐	no ☐

2.		**Is the processing of traditional alphanumeric codes (TAC) automated?**			yes ☐	no ☐
		>>> if YES to question 2, ***What does the automated processing include?***				
	a)	Decoding			yes ☐	no ☐
	b)	Plotting			yes ☐	no ☐
	c)	Database			yes ☐	no ☐
		>>> if YES to 2.c) **-is the data stored in WMO FM format ? ; or**			yes ☐	no ☐
		-is the data first decoded and then stored in a different format ? *>>> in which format?*			yes ☐	no ☐
	d)	***Hardware and software***				
		On what computer platform(s) is the *TAC decoding* software presently running?	*make/model*	*make/model*	*make/model*	
		- with which operating system? *(UNIX, MS-DOS, Windows, etc.)*				
		- language used by the decoder? *(FORTRAN 90, C++, etc.)*				

3.	**Is your Agency/Service able to receive FM 94 BUFR binary code?**		yes ☐	no ☐
	>>> if YES to question 5, ***How is the BUFR data reaching your Agency/Service ?***			
	a)	through GTS	yes ☐	no ☐
	b)	through Internet	yes ☐	no ☐
	c)	through workstation(s) dedicated to satellite reception (e.g. SADIS, ISCS, MDD, RETIM, etc.) *>>> list the workstation(s)*	yes ☐	no ☐
	d)	through other means *>>> please specify*	yes ☐	no ☐
	e)	**Is your Agency/Service able to decode FM 94 BUFR binary code?** *>>> list for what types of data*	yes ☐	no ☐

	f)	***Hardware and software***			
		On what computer platform(s) is the decoding software *for BUFR* running?	*make/model*	*make/model*	*make/model*
		- with which operating system? *(UNIX, MS-DOS, Windows, etc.)*			
		- which language is used by the decoder? *(FORTRAN 90, C++, etc.)*			

4.	**Is your Agency/Service receiving alphanumeric table driven code FM 95 CREX data?**		yes ☐	no ☐
	>>> if YES to question 3, ***How is the CREX data received?***			
	a)	through GTS	yes ☐	no ☐
	b)	through Internet	yes ☐	no ☐
	c)	through other means *>>> please specify*	yes ☐	no ☐
	d)	Does your Agency/Service automatically process CREX? >>> ***list for what types of data:***	yes ☐	no ☐

ENCODING

Questions			*Alphanumeric code* **FM 95 CREX**	*Binary code* **FM 94 BUFR**
5.	**a)**	Encoding at national concentration or telecommunication centre ?	yes ☐ no ☐	yes ☐ no ☐
		if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type*	*data type*
	b)	Encoding at observing site or platform ?	yes ☐ no ☐ *if yes:* manual ☐ automatic ☐	yes ☐ no ☐
		if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type*	*data type*
	c)	With which computer?		
		operating system? *(LINUX, etc.)*		
		encoder language? *(FORTRAN 90, etc)*		

6.	**a)**	**Does your Agency/Service use BUFR for national/local/domestic data exchange ?**		yes ☐	no ☐
		>>> if YES to ***2.a)****, list for what types of data*			

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

1.	**Has your Agency/Service/NMHS already developed a National Migration Plan?**		yes ☐	no ☐
	a)	Did you nominate a national focal point on Codes matters and migration?	yes ☐	no ☐
	b)	Do you have a national committee on migration to TDCF?	yes ☐	no ☐
	c)	Is there a National Migration Plan currently being developed ?	yes ☐	no ☐
	d)	Will a National Migration Plan be developed within the next five years ?	yes ☐	no ☐
	e)	Are there any difficulties to define a National Migration Plan?	yes ☐	no ☐
		*>>> if yes to **1.e)** please elaborate :*		
	f)	In your opinion, what are the international actions expected to address the problems identified in (e)?		
		Please elaborate:		

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.*

2.	**Has your Agency/Service already secured the BUFR/CREX decoder software for the migration?; *or***				yes ☐	no ☐
	Will your Agency/Service secure the BUFR/CREX decoder software for the migration?				yes ☐	no ☐
	>>> 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)	Another Agency/Service (e.g ECMWF)	yes ☐	no ☐	already completed ☐	date to be completed : **(month/year)**
	b)	a private company/ industrial sector	yes ☐	no ☐	already completed ☐	date to be completed : **(month/year)**
	c)	staff at our Agency/Service	yes ☐	no ☐	already completed ☐	date to be completed : **(month/year)**

	d)	other *>>> if other, please specify*	yes ☐	no ☐	already completed ☐	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*	*make/model*	*make/model*
		- with which operating system? (UNIX, MS-DOS, Windows, etc.*)*			
		- with which language for the decoder? *(FORTRAN 90, C++, etc.)*			

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

ENCODING

2.1.1.1.1.1 Questions			***Alphanumeric code***	***Binary code***
			FM 95 **CREX**	**FM 94** **BUFR**
4.	**a)**	Encoding at national concentration or telecommunication centre ?	yes ☐ no ☐	yes ☐ no ☐
		if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type* *when*	*data type* *when*
		With which computer?		
		operating system? *(LINUX, etc.)*		
		encoder language? *(FORTRAN 90, etc)*		
		When validation exchange tests are planned?	*data type* *when*	*data type* *when*
	b)	Encoding at observing site or platform ?	yes ☐ no ☐ **if yes :** manual ☐	yes ☐ no ☐

			automatic ☐	
		if YES, for which data types *(Auto Synop, Radiosonde, soil, temperature, ozone, satellite data, etc.)*	*data type when*	*data type when*
		With which computer?		
		operating system? *(LINUX, etc.)*		
		encoder language? *(FORTRAN 90, etc*		
		When validation exchange tests are planned (for which data type)?	*data type when*	*data type when*

5.	**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? Not yet decided ☐ Any comments ?	yes ☐	no ☐

(C) NAME AND FULL ADDRESS OF AGENCY/SERVICE

NAME OF AGENCY/ SERVICE	
Address	
City	
COUNTRY	
Telephone	
Fax	
E-mail	
Website	
Name of designated Focal Point for Migration to TDCF	
(Remarks, if necessary)	

ANNEX TO PARAGRAPH 5.3.2.1

ESCAP/WMO Typhoon Committee Questionnaire

(0-1) Are you receiving and using SAREP in TAC distributed by JMA?

Yes: 3 **No: 5**

(0-2) Are you receiving and using RADOB in TAC distributed by JMA and/or other NMHSs?

Yes: 4 **No: 4**

(1-1) Are you receiving and using SAREP in TDCF distributed by JMA?

Yes: 2 **No: 6**

If yes, when did you start?**December 2005**

November 2006 (for receiving & NO for using)

If no, why? and when do you think you can use it?

- decoding software
- telecommunication means
- others. Please specify the difficulties

We are requesting them from JMA now

We are not yet ready for the software although it is now available. We are still working for it.

Because we do not have a decoder for BUFR format. And also not yet decided to receive the SAREP in this moment.

No requirement currently

Actually, we do not receive SAREP distributed by JMA. Normally, we receive all the meteorological data through GTS. We do not know the reason.

(1-2) Are you receiving and using RADOB in TDCF distributed by JMA and/or other NMHSs?

Yes: 2 **No: 6**

If yes, when did you start? **October 2006 (JMA's RADOB)**

In 2006

If no, why? and when do you think you can use it?

- decoding software
- telecommunication means
- others. Please specify the difficulties

Until we finished installing relevant software for TDCF

Because we do not have a decoder for BUFR format. And also not yet decided to receive the RADOB in this moment.

We don't make any decision related to RADOB in TDCF. But, we'd like to get sample data and decoding programme.

No requirement currently

(2-1) Are you producing RADOB in TAC by yourself?

Yes: 4 **No: 4**

(2-2) Are you producing RADOB in TDCF by yourself?

Yes: 0 No: 8

If yes, when did you start?

If no, why? and when do you think you can produce it?

- encoding software
- telecommunication means
- others. Please specify the difficulties

Not yet, but it is planned for delivery via GTS around mid 2007.

We are not ready to produce now. We will produce it in very near future.

We are not producing RADOB in TDCF.

Until we finished installing relevant software for TDCF

We do not have to do it.

We don't make any decision related to RADOB in TDCF.

The radar network is not working stable. We need some more time to be able to produce RADOB.

ANNEX TO PARAGRAPH 5.3.6.5

List of activities of the Rapporteur related to Migration to TDCF in RA VI in 2005-2006

- Participation in RA II – RA VI Training Seminar on TDCF as a lecturer (Muscat, Oman, 10-14 December 2005).
- A letter (of 16 January 2006) was sent to the RA VI Focal Points on Migration to TDCF, containing the information on the outcome of meetings related to the Migration to Table-Driven Code Forms (MTDCF) that had been held in November and December 2005. The invitation to provide the rapporteur with information on National plans for MTDCF or on the problems encountered was also included.
- Development of Regulations for reporting traditional observation data in TDCF for SYNOP, SYNOP MOBIL, SHIP, PILOT, PILOT SHIP, PILOT MOBIL, TEMP, TEMP SHIP, TEMP MOBIL, TEMP DROP, CLIMAT, CLIMAT SHIP, CLIMAT TEMP and CLIMAT TEMP SHIP data (CBS Ext.(06)/Doc. 6.2(2)ADD.2).
- Participation in Joint meeting of the CT on MTDCF and the ET on DR&C, Montreal, 8 to 12 May 2006 (10 documents submitted).
- Revision of the combined SYNOP-AWS template required by the representative of EUMETNET.
- Testing of Vaisala's BUFR sample messages containing PILOT, TEMP and CLIMAT TEMP data, so that the new version of the DigiCORA software is capable to support the production of the upper-air data in BUFR.
- A letter to the RA VI Focal Points on MTDCF (of 3 October 2006), containing the information on some items discussed at the Joint CT/MTDCF and ET on DR&C meeting in Montreal and an offer to provide testing of BUFR (CREX) messages. It was stressed again that the countries creating new BUFR or CREX bulletins should inform WMO Secretariat on their new bulletins available on the GTS.
- Organizing a meeting of representatives of RA VI countries on 13 November 2006 at the Extraordinary CBS Session in Seoul. A letter to the RA VI Focal Points on MTDCF (of 6 December 2006), containing the information on the main issues discussed at this meeting.
- Providing BUFR samples containing SYNOP and TEMP data (November 2006) in compliance with the request of participants of the meeting in Seoul.
- Preliminary work on Draft Regional TDCF Migration Plan.

Meeting of representatives of RA VI countries on Migration to Table-Driven Code Forms, 13 November 2006 in Seoul, South Korea

At the Extraordinary CBS Session in Seoul, representatives of RA VI countries were invited to participate in a meeting on Migration to Table-Driven Code Forms (MTDCF) in RA VI that was held on 13 November 2006 after the regular CBS plenary session.

Main issues discussed during the Meeting of representatives of RA VI countries:

- The Meeting was informed about the activities of the Rapporteur on MTDCF in RA VI. To support this information, all participants received a copy of the previous letters to the Focal Points on MTDCF.
- The need for updating the list of Focal Points on MTDCF was expressed. The existing list was supplemented by several entries either right at the meeting or later.
- The participants were advised to use the currently valid version of the templates for MTDCF, available in CBS Ext.(06)/Doc. 6.2(2)ADD.2. Mr. Joël Martellet (WMO Secretariat) assured the Meeting that updating templates in the WMO server would be taken care of with the highest priority.
- Development of National Migration Plan was recommended as the first important step that might significantly help the following implementation of MTDCF.

- The ability of NMSs to decode and process the incoming data in TDCF was emphasized. Writing the interface between the BUFR decoder and a database is estimated at one or two months for one data type.
- Problem of data formats to be used for data collecting at the national level was discussed. The choice is entirely in the competence of the NMS. Data may be collected in traditional codes, TDCF or an internal format, provided that the required metadata as well as the data values are included in the BUFR messages for the international exchange.
- Some participants expressed their wish to obtain BUFR samples for test decoding.
- Requirement for organizing a Workshop on MTDCF for RA VI countries in 2007 was expressed by several participants of the meeting.
- The Meeting was informed on the prepared Report of the Rapporteur on Migration to TDCF in RA VI where the current status of MTDCF in RA VI should be reflected.

Meeting of coordinators/rapporteurs of the WG on Planning and Implementation of the WWW, 23 to 25 January 2007 in Langen, Germany)

At the Meeting of coordinators/rapporteurs of the WG on Planning and Implementation of the WWW in RA VI that was held from 23 to 25 January in Langen, Germany, Status report of the Rapporteur on Regional TDCF Migration Plan (Doc. 3(7) Rev.1 was presented as well as Draft Work Plan for Rapporteur on Regional TDCF Migration Plan (Doc. 5(6)). Both documents are available at http://www.wmo.int/web/www/BAS/CBS-meetings.html.

There is a Table below from the Work Plan for the RA VI WG on PIW for the Intercessional period till 2009, relevant to Migration to TDCF.

List of activities of the RAVI Rapporteur following the Meeting of coordinators/rapporteurs of the WG on PIW in Langen

- A letter (of 14 February 2007) was sent to the RA VI Focal Points on Migration to TDCF, containing the information on the outcome of the meeting in Langen.
- BUFR samples containing CLIMAT, SYNOP and TEMP data were distributed to all RA VI Focal Points on Migration to TDCF together with their TAC counterparts (on 6 March 2007).
- Correspondence with RA VI member countries (providing them with advice, comments, explanations, tables, etc. and testing of available BUFR messages).
- Participation in RA VI Training Workshop on BUFR and Migration to TDCF as a lecturer (Langen, Germany, 17-20 April 2007)

Item No.	ToR/ Requirements from XIV RA-VI	Requirements from Strategic Plan Version 0.3	Work Plan / specific action	Owner	Deadline	Action tracking
1	4.3.20 Attachment to Res. 1 (XIV-RA VI), f)	none	To monitor the migration process in RA VI and to advise members of the Region on all aspects related to migration strategy.	Rapporteur		Ongoing
2	none	none	To update the list of Focal Points on Migration to TDCF in the WMO web server.	WMO Secretariat	April 2007	Open
3	4.3.20 Attachment to Res. 1 (XIV-RA VI), f)	none	To produce a set of BUFR samples for several types of traditional data.	Rapporteur	April 2007	Ongoing
4	4.3.20 Attachment to Res. 1 (XIV-RA VI), f)	none	To perform testing of BUFR messages upon request from RA VI members or some manufacturers.	Rapporteur	For the whole period	Upon request
5	none	none	To participate in further development of the website offering "data verification service".	Rapporteur, CT MTDCF		Ongoing
6	none	none	To implement RA VI SYNOP template TM 307086.	RA VI members of ET DR&C	By the end of 2007	Open
7	4.3.20 Attachment to Res. 1 (XIV-RA VI), f)	none	To organize a Workshop on Migration to TDCF for RA VI countries.	WMO Secretariat	June 2007	Ongoing
8	4.3.20 Attachment to Res. 1 (XIV-RA VI), f)	none	To develop Draft Regional TDCF Migration Plan.	Rapporteur	June 2007	Ongoing

ANNEX TO PARAGRAPH 5.3.6.6

BUFR Template Road Weather Information

This template is proposed to be used for representation of road weather data corresponding to the data encoded in SH70 code.

		Identification	
0 01 018		Short station or site name (for identification of the road weather monitoring site) **Dddd**	CCITT IA5 (up to 5 characters)
0 01 015		Station or site name	CCITT IA5 (up to 20 characters)
0 01 241		State / federal state identifier	CCITT IA5 (up to 4 characters)
0 01 242		Highway designator	CCITT IA5 (up to 5 characters)
0 01 243		Routes kilometer of highway	m, scale -2
0 02 243		Extended type of station	Flag table
0 02 244		Type of road	Code table
0 02 245		Type of construction	Code table
3 01 011	0 04 001	Year	Year
	0 04 002	Month	Month
	0 04 003	Day **DD**	Day
3 01 012	0 04 004	Hour **hh**	Hour
	0 04 005	Minute **mm**	Minute
3 01 021	0 05 001	Latitude (high accuracy)	Degree, scale 5
	0 06 001	Longitude (high accuracy)	Degree, scale 5
0 07 030		Height of station ground above mean sea level	m, scale 1
		Temperature, humidity and visibility data	
0 07 032		Height of sensor above local ground	m, scale 2
0 12 101		Temperature/dry-bulb temperature **s_nTTT**	K, scale 2
0 12 103		Dew-point temperature **$s_nT_dT_dT_d$**	K, scale 2
0 13 003		Relative humidity	%
0 07 032		Height of sensor above local ground (= missing value)	m, scale 2
0 20 001		Horizontal visibility **VVVV**	m, scale –1
		Road temperature and other data	
1 09 000		Replicate nine descriptors	
0 31 001		Delayed descriptor replication factor	numeric
0 02 242		Position of road sensors	Code table
0 12 241		Road surface temperature **$s_nT_sT_sT_s$**	K, scale 2
1 02 000		Replicate two descriptors	
0 31 001		Delayed descriptor replication factor	numeric
0 07 061		Depth below land surface = 0.30 m in the first replication, = e.g. 0.15 or 0.07 m in the second replication	m, scale 2
0 12 242		Road sub-surface temperature **$s_nT_uT_uT_u$**	K, scale 2

0 07 061		Depth below land surface (= missing value)	m, scale 2
0 13 241		Water film thickness **h_wh_w**	m, scale 3
0 20 241		Road surface condition **S_z**	Code table
		Precipitation data	
0 04 025		Time period (= - 15 minutes)	Minute
0 20 024		Intensity of phenomena (for intensity of precipitation) **K_R**	Code table
0 13 055		Intensity of precipitation	kg m^{-2} s^{-1} , scale 4
0 20 021		Type of precipitation **W**	Flag table
0 13 011		Total precipitation / total water equivalent of snow **RR**	kg m^{-2}, scale 1
		Wind data	
0 07 032		Height of sensor above local ground	m, scale 2
0 08 021		Time significance (= 2 (time averaged))	Code table
0 04 025		Time period (= - 10 minutes)	Minute
0 11 001		Wind direction **dd**	Degree true
0 11 002		Wind speed **ff**	m s^{-1}, scale 1
0 08 021		Time significance (= missing value)	Code table
		Maximum wind gust	
0 04 025		Time period in minutes	Minute
0 11 043		maximum wind gust direction	Degree true
0 11 041		maximum wind gust speed	m s^{-1}, scale 1
		State of functionality	
0 33 005		Quality information (AWS data) **F**	Flag table

Notes:

1. Telecommunication header – ISXD70 CCCC YYGGgg.
2. To represent Intensity of precipitation K_R, Type of precipitation **W** and State of functionality **F**, 0 20 024 (Code table), 0 20 021(Flag table) and 0 33 005 (Flag table) are used, respectively. The conversion between the code figures for **W** and **F** in the SH70 code and the flag table entries of the corresponding BUFR descriptors is not straightforward.
3. To reduce the workload with respect to the station database, some more descriptors are required for e.g. identification of the federal state, identification of the highway and so on.
4. Method or name of road sensor manufacturer (**m** in the SH70 code)) is not represented in the BUFR template. The corresponding descriptor **0 02 241** is included, however, in ANNEX for potential use in the future if the data from a particular sensor were significantly influenced by its origin or for selective visualization of data measured with sensors of chosen producers only.
5. Class of water film thickness (**K_w** in the SH70 code) is not represented in the BUFR template. It has been considered not to be very useful as there is no standard definition of the classes.
6. Majority of stations has only one position on the road and one sub-surface temperature sensor. Delayed replications have been introduced to increase flexibility and volume efficiency.
7. Each position of road sensors includes the measurements of

- road surface temperature
- road sub-surface temperatures
- water film thickness
- road surface condition

8. Some type of stations do not have the ability to identify the accurate surface condition. They could only report conditions like "not dry" or "glazed". The code table for road surface conditions has been adjusted accordingly.

ANNEX

Proposal for local descriptors:

F X Y	Element name	BUFR				CREX		
0 01 241	State / federal state identifier	CCITT IA5	0	0	32	CCITT IA5	0	4
0 01 242	Highway designator	CCITT IA5	0	0	40	CCITT IA5	0	5
0 01 243	Routes kilometer of highway	m	-2	0	14	m	-2	5
0 02 241	Name of road sensor manufacturer	Code table	0	0	4	Code table	0	2
0 02 242	Position of road sensors	Code table	0	0	4	Code table	0	2
0 02 243	Extended type of station	Flag table	0	0	6	Flag table	0	2
0 02 244	Type of road	Code table	0	0	5	Code table	0	2
0 02 245	Type of construction	Code table	0	0	4	Code table	0	2
0 12 241	Road surface temperature	K	2	0	16	C	2	4
0 12 242	Road sub-surface temperature	K	2	0	16	C	2	4
0 13 241	Water film thickness	m	3	0	7	m	3	2
0 20 241	Road surface condition	Code table	0	0	4	Code table	0	2

Note:

0 02 241 (Name of road sensor manufacturer) does not appear in the current template, but it is left for potential use in the future in case that data from a particular sensor would be significantly influenced by its manufacturer.

Code tables:

0 02 241 Name of road sensor manufacturer

Code figure	
0	Reserved
1	ANT/Bosch
2	Boschung
3	SSI/Scan (MicKS)
4	Vaisala
5	Vibrometer
6	Malling
7 -14	Reserved
15	Missing value

0 02 242 Position of road sensors

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

0 02 243 Extended type of station

Bit No.	
1	Automatic
2	Manned
3	Event triggered
4-5	Reserved
all 6	Missing value

0 02 244 Type of road

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

0 02 245 Type of construction

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

0 20 241 Road surface condition

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

ANNEX TO PARAGRAPH 5.4.4

Guide for BUFR/CREX verification practices

This document is to provide guidance in developing a system for the verification of BUFR and/or CREX messages against regulations and/or co-provided reference data. The guidance consists of practices organized in two levels:

- level 1 practices to verify BUFR/CREX messages against regulations;
- level 2 practices to verify BUFR/CREX messages against co-provides reference data.

The level 1 practices have been further structured into minimal, standard and advanced requirements using general practices that address general capabilities and specific practices that address verification abilities.

Referenced regulations:
[1] WMO
[2] B/C
[3] Website
[4] GTS….

LEVEL 1 PRACTICES

Practices to verify BUFR/CREX messages against regulations

Minimal requirements:

General practices (general capabilities)

a) Free downloadable software or a web-based service should be provided.
b) The software/service should be able to verify BUFR/CREX data with results presented instantly.
c) The software/service should provide descriptive messages in case of non-compliances and errors.
d) The software/service should include at least a brief introduction as well as version and status information.
e) The software/service should provide the ability to save the verification results.
f) The software/service should provide the ability to comment on the software/service (e.g. e-mail address included).
g) …

Specific practices (verification capabilities)

a) The structure of BUFR/CREX messages should be checked against FM94/FM95 regulations.
b) BUFR identification data (section 1) should be checked against FM94 regulations.
c) BUFR/CREX descriptors should be checked against operational BUFR/CREX table B and D.
d) The BUFR/CREX data description and data should be consistent.
e) …

Standard requirements:

General practices (general capabilities)

a) The software/service should summarize the verification results (e.g. verification record).
b) The software should provide a command-line user interface (or a graphical user interface).
c) The software/service should include user documentation.

d) The software/service should be able to handle multiple BUFR/CREX messages.
e) …

Specific practices (verification capabilities)

a) Applied BUFR/CREX template sequences should be checked against sequences included in B/C regulations .
b) BUFR/CREX descriptors should be checked against both operational and pre-operational BUFR/CREX table B and D (pre-operational descriptors should be indicated).
c) BUFR category/subcategory data and the reporting date/hour should be consistent.
d) BUFR category/subcategory data and applied template sequences should be consistent.
e) …

Advanced requirements:

General practices (general capabilities)

a) The software/service should provide the ability to select sets or subsets of regulations to be verified.
b) The software/service should include an on-line help system including news, release notes and frequently ask questions.
c) The software/service should provide both a command-line and graphical user interface
d) The software/service should be able to verify GTS bulletins containing BUFR/CREX messages
e) ...

Specific practices (verification checks)

a) BUFR/CREX data should be checked for valid code and flag table entries
b) BUFR/CREX data should be checked for valid time periods given B/C regulations.
c) BUFR/CREX messages can be checked against regional practices/regulations.
d) The GTS bulletin header and structure should be checked against 286 manual on GTS
e) The BUFR category/subcategory and GTS header data should be consistent.
f) …

LEVEL 2 PRACTICES

Practices to verify BUFR/CREX messages against co-provided reference data

a) The ability to verify BUFR/CREX messages against co-provided identification data
b) The ability to verify BUFR/CREX messages against co-provided observation data
c) The ability to verify BUFR/CREX messages against co-provided description data
d) The ability to verify BUFR/CREX messages against co-provided TAC data
e) The ability to select both regulations and co-provided data to verify.
f) …

ANNEX TO CHAPTER 6

LIST OF RECOMMENDED ACTIONS:

2,2 Check the GRIB2 Guide and list any other possible needed amendments **(Action: Team**).

3.1.2 CREX template for exchange of sea level data for tsunami warning – Aim to finalize template(s) for validation. **Action: Dr Weiqing Qu, Dr Kelvin Wong, Dr Eva Červená and Mr Atsushi Shimazaki** to contact representatives of the ICG/PTWS and ICG/IOTWS to obtain the required additional information.

3.1.3 Validation of some atmospheric chemistry descriptors to be completed rapidly (**Action: CMC, NCEP; UKMO; ECMWF**)

3.1.5 More contacts with Meteo-France to finalize template (combines SYNOP and 1hour obs.).**Action: Team**

3.1.6 TM 307092 (AWS BUFR template for surface observations from n-minute period with national and WMO station identification) to be developed. **Action: Dr Eva Cervena**.

3.1.8 Contact EUCOS Operations Manager for radiosonde Template. **Action: Team**

3.4 Revision of the BUFR Guide to be undertaken (**Action: Secretariat with consultant – if budget**)

1. Note be added in the BUFR regulations, which limit the use of non-standard units in BUFR to aviation usage (**Action: Secretariat**).Will be included in Manual this year

2. Examples of coded CREX messages be put into the WMO web site (**Action: to be provided to Secretariat for insertion**).—Not done, who provides?

3. Migration Guidance Document be finalized--- **To be done. Secretariat**

5,1 - 5.2 Passing more Information about the Migration to all WMO PRs. A circular letter with appropriate documentation should be sent. Another questionnaire should be dispatched (**Action: Secretariat)**. Not done yet More consideration of the subject in constituent body meetings (JCOMM; CCl, AeM, CBS; EC and Congress) would be necessary (**Action: Secretariat**).Including negative aspects if migration is not done.

4. Assistance required helping countries to implement the migration. New training programme for RA I, with different means and content (to focus more on the implementation rather that the detailed code knowledge). Training the “code trainers” should be the priority. Advanced Centres to assist in promoting the capability of personnel involved for delivering the knowledge in RAI.---Financial support lacking in WMO-(Budget decreases!) (**Action: Secretariat**)

5. Code Tables, Templates, Guides and Migration information always up-to-date in the WMO web server and WMO Secretariat to provide sufficient manpower to perform this task, when change occurs without any delay. A special Migration News page could be inserted, as well as in the WWW Newsletter (**Action: Secretariat**)---

6. Code Tables in machine-readable form (for example BUFR itself, CSV or XML) (**Action: a member to make available these Tables in such a format and Secretariat to try Microsoft Access format**) and made available in the WMO web server (**Action: secretariat**).

5.4.5 The Team recommended that verification services, which include regional and national practices be designed in such a way, that they separate suitably reporting, alarming on and displaying of information pertaining to regional and national practices, from information on international reporting requirements. The Team also recommended that verification services including regional and national practices do not fail when not finding these practices encoded as expected. The Team suggested the designing verification services including regional and national practices be such, that these capabilities could be turned on or off or bypassed. (**Action: Team)**

7. Place copies of the training materials developed for the seminars on the improved WMO migration web site. Guidance distributed to the focal points on Code Matters and Migration to strongly encouraged them to read and use these presentations (in PowerPoint). (**Action: Secretariat**)---To be done

The Team determined that both web based verification services and stand-alone BUFR/CREX verification software were desirable since the latter could be imbedded into a center system and testing service. The **Team recommended Members** having or developing such verification services or software make them openly available and that any software be added to the WMO Software Registry.

ANNEX LIST OF ACRONYMS

ACARS	AirCraft Addressing and Reporting System
ADS	Astrophysics Data System (USA)
AFWA	Air Force Weather Agency (USA)
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
ASCAT	Advanced SCATterometer
ATOVS	Advanced TIROS Operational Vertical Sounder
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
CAeM	Commission for Aeronautical Meteorology
CBS	Commission for Basic Systems
CBS-Ext.(98)	Extraordinary session of CBS held in 1998
CCI	Commission for Climatology (WMO)
CGMS	Coordination Group for Meteorological Satellites
CIMO	Commission for Instruments and Methods of Observations
CLM	CLoud Mask (EUMETSAT)
CLAI	CLoud Analysis Image (EUMETSAT)
CMA	China Meteorological Administration
COST	European Co-Operation in the field of Scientific and Technical research
CREX	Character Representation form for data EXchange
CRM	Clear sky Reflectance Map (EUMETSAT)
CSV	Comma-Separated Value (format)
CT	Coordination Team
CTH	Cloud Top Height (EUMETSAT)
DBCP	Drifting Buoy Cooperation Panel
DBMS	Data Base Management System
DCP	Data Collection Platform
DIF	Directory Interchange Format
DOD	Department Of Defence (USA)
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
EP	Ensemble Prediction
EPA	Environmental Protection Agency (USA)
EPS	Ensemble Prediction System
ESA	European Space Agency
ESCAP	*United Nations* Economic and Social Commission for Asia and the Pacific
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
FAA	Federal Aviation Administration (USA)
FIR	FIRe Detection Product (EUMETSAT)
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
GEMS	Global and regional Earth-system Monitoring using Satellite and in situ data
GEO	Group on Earth Observation
GHRSST	GODAE High Resolution SST (Pilot Project)
GIF	Graphic Interchange Format
GIS	Geographic Information System
GMES	Global Monitoring for the Environment and Security
GODAE	Global Ocean Data Assimilation Experiment
GOS	Global Observing System
GRAS	Global RAdio occultation Sounder
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
HIRS	HIgh Resolution infrared Sounder
HMEI	HydroMeteorology Equipment Industry
HTML	Hyper Text Markup Language
IASI	Infrared Atmospheric Sounding Interferometer
ICAO	International Civil Aviation Organisation
ICNIRP	International Commission on Non-Ionizing Radiation Protection
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
IGACO	Integrated Global Atmospheric Chemistry Observation (System)
IJPS	Initial Joint Polar System
IOC	Intergovernmental Oceanographic Commission of UNESCO
ISO	International Standards Organization
ISS	Information Systems and Services (OPAG of CBS)
IUT	Indicator of Unit of Time
JAXA	Japan Aerospace eXploration Agency
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
JMBL	Joint Meteorological and Oceanographic (METOC) Broker Language (XML)
JPEG	Joint Photographic Experts Group format
LINUX	*Not an acronym – name of an operating system*
LZW	Lempel-Ziv-Welch compression
MEDS	Marine Environment Data Service
MHS	Microwave Humidity Sounder
MIP	Migration Implementation Programme
MPE	Multi sensor Precipitation Estimate (EUMETSAT)
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)
NetCDF	Network Common Data Form
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
NOAA	National Oceanographic and Atmospheric Administration (USA)
NWP	Numerical Weather Prediction
NWS	National Weather Service (USA)
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
PM	Particulate Matter
PNG	Portable Network Graphic
RA	Regional Association (WMO)
RASS	Radio Acoustic Sounding System
RDBC	Regional Data Bank Centre
RSS	Radiosonde Replacement System (program) (USA)
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
SOT	Ship Observation Team
SST	Sea Surface Temperature
TAC	Traditional Alphanumeric Codes
TCP	Tropical Cyclone Programme
TCP/IP	Transport Control Protocol/Internet Protocol
TDCF	Table Driven Code Form
TDL	Techniques Development Laboratory
THORPEX	The Observing system Research and Predictability EXperiment
TIFF	Tagged Image File Format
TIGGE	Thorpex Interactive Grand Global Ensemble
TIROS	Television InfraRed Observation Satellite
TMA	Tanzania Meteorological Agency
TOVS	TIROS Operational Vertical Sounder
TWS	Tsunami Warning System
UGRN	Upgrading the Global Radiosonde Network
UKMO	United Kingdom Meteorological Office
UML	Unified Modeling Language
UNEP	United Nations Environment Programme
UNIX	*Not an acronym – name of an operating system*
URL	Uniform Resource Locator
USAP	United States Antarctic Programme
UTC	Universal Time Coordinate
UVI	Ultra Violet Index
VCP	Voluntary Cooperation Programme
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
WH	Weather-Huffman compression
WHO	World Health Organization
WIS	WMO Information System
WMO	World Meteorological Organization
WWW	World Weather Watch
W3C	World Wide Web Consortium
XBT	eXpendable Bathy Thermograph
XCTD	eXpendable Conductivity Temperature Depth sensor
XML	eXtensible Markup Language
4-DVAR	Four Dimensional VARiational Analysis